GEFRAN

نماینده رسمی جفران ایتالیا در ایران

DC DRIVES TPD32 Series

GEFRAN
BIYOND TECHNOLOGY

فروش و پشتیبانی

۰۹۱۲ ۹۵۳ ۲۸ ۷۱

Industrial Application

DC drives

TPD32-EV

.... Instruction manual

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BEYOND TECHNOLOGY

Thank you for choosing this Gefran product.

We will be glad to receive any possible information which could help us improve this manual. The e-mail address is the following: techdoc@gefran.com.

Before using the product, read the safety instruction section carefully.

Keep the manual in a safe place and available to engineering and installation personnel during the product functioning period.

The manufacturer has the right to modify products, data and dimensions without notice.

The data can only be used for the product description and they can not be understood as legally stated properties.

This manual is updated according the software version:

TPD32-EV Standard: V. 11.02A (*)

TPD32-EV-CU: V. 11.02A (*)

TPD32-EV FC: V. 11.26X/11.27X

(*) Starting from firmware version V. 10.08 it is possible the use of the SOFTSCOPE Tool (Gefran Digital Scope).
Refer to 1S9SFTEN Softscope manual for detailed informations.

The identification number of the software version can be read on the converter nameplate or on the label on the EPROM memories mounted on the regulation card.

Table of Contents

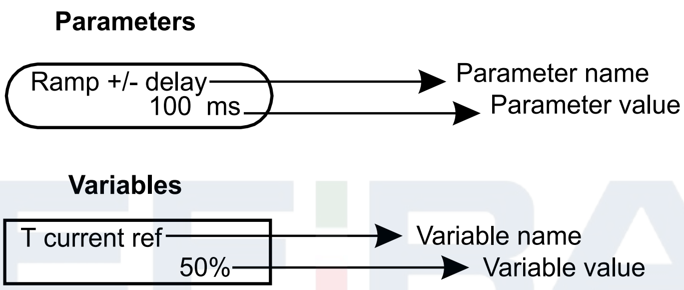
SAFETY SYMBOL LEGEND

WARNING: Commands attention to an operating procedure, practice, condition, or statement which, if not strictly observed, could result in personai injury or death.

CAUTION: Commands attention to an operating procedure, practice, condition, or statement which, if not strictly observed, could result in damage or destruction of equipment.

NOTE: Commands attention to an operating procedure, practice, condition, or statement that must be highlighted.

BLOCK DIAGRAM LEGEND



1 - SAFETY PRECAUTIONS - PRECAUTIONS DE SECURITÉ

ATTENTION!

According to the EU standards the TPD32-EV and accessories must be used only after checking that the machine has been produced using those safety devices required by the 2006/42/EC set of rules, as far as the machine industry is concerned.

Drive systems cause mechanical motion. It is the responsibility of the user to insure that any such motion does not result in an unsafe condition. Factory provided interlocks and operating limits should not be bypassed or modified.

Selon les normes EEC, les drives TPD32 et leurs accessoires doivent être employés seulement après avoir verifié que la machine ait été produit avec les même dispositifs de sécurité demandés par la réglementation 2006/421/EEC concernant le secteur de l'industrie.

Les systèmes provoquent des mouvements mécaniques. L'utilisateur est responsable de la sécurité concernant les mouvements mécaniques. Les dispositifs de sécurité prévues par l'usine et les limitations operationelles ne doivent être dépassés ou modifiés.

WARNING - ELECTRICAL SHOCK AND BURN HAZARD / ATTENTION – DÉCHARGE ÉLECTRIQUE ET RISQUE DE BRÚLURE :

When using instruments such as oscilloscopes to work on live equipment, the oscilloscope's chassis should be grounded and a differential amplifier input should be used. Care should be used in the selection of probes and leads and in the adjustment of the oscilloscope so that accurate readings may be made. See instrument manufacturer's instruction book for proper operation and adjustments to the instrument.

Lors de l'utilisation d'instruments (par example oscilloscope) sur des systémes en marche, le chassis de l'oscilloscope doit être relié à la terre et un amplificateur différentiel devrait être utilisé en entrée.

Les sondes et conducteurs doivent être choissis avec soin pour effectuer les meilleures mesures à l'aide d'un oscilloscope.

Voir le manuel d'instruction pour une utilisation correcte des instruments.

WARNING - FIRE AND EXPLOSION HAZARD / ATTENTION – RISQUE D'INCENDIES ET D'EXPLOSIONS:

Fires or explosions might result from mounting Drives in hazardous areas such as locations where flammable or combustible vapors or dusts are present. Drives should be installed away from hazardous areas, even if used with motors suitable for use in these locations.

L'utilisation des drives dans des zônes à risques (présence de vapeurs ou de poussières inflammables), peut provoquer des incendies ou des explosions. Les drives doivent être installés loin des zônes dangeureuses, et équipés de moteurs appropriés.

WARNING - STRAIN HAZARD / ATTENTION À L'ÉLÉVATION:

Improper lifting practices can cause serious or fatal injury. Lift only with adequate equipment and trained personnel.

Une élévation inappropriée peut causer des dommages sérieux ou fatals. Il doit être élevé seulement avec des moyens appropriés et par du personnel qualifié.

WARNING - DANGER OF ELECTRIC SHOCK / ATTENTION – CAS DE DECHARGE ELECTRIQUE:

Drives and motors must be ground connected according to the NEC (national electric rules).

Tous les moteurs et les drives doivent être mis à la terre selon le Code Electrique National ou équivalent.

WARNING / ATTENTION:

Replace all covers before applying power to the Drive. Failure to do so may result in death or serious injury.

Remettre tous les capots avant de mettre sous tension le drive. Des erreurs peuvent provoquer de sérieux accidents ou même la mort.

WARNING / ATTENTION:

Converters are electrical appliances for use in heavy current installations. Parts of the converter are energized during operation. The electrical installation and the opening of the device should therefore only be carried out by qualified personnel. Improper installation of motors or converters may therefore cause the failure of the device as well as serious injury to people or material damage. Follow the instructions given in this manual and observe the local and national safety regulations applicable.

Les convertisseur sont des dispositifs électriques utilisés dans des installations industriels. Une partie des drive sont sous tension pendant l'operation. L'installation électrique et l'ouverture des drive devrait être executé uniquement par du personel qualifié. De mauvaises installations de moteurs ou de drive peuvent provoquer des dommages materiels ou blesser des personnes On doit suivir les instructions donneés dans ce manuel et observer les régles nationales de sécurité.

WARNING! - POWER SUPPLY AND GROUNDING / ATTENTION ! ALIMENTATION PUISSANCE ET MISE À LA TERRE

Power supply networks

Based on the grounding method, the IEC 60634-1 describes three main types of grounding for power supply networks: TN, TT and IT systems. In particular, the IT system has all the active parts insulated from earth or a point connected to ground through an impedance. The earths of the system are connected separately or collectively to the system ground.

The following figures show these different systems.

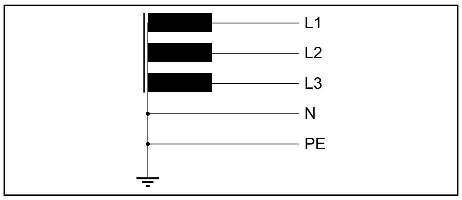
Réseaux d'alimentation

En fonction de la modalité de mise à la terre, la norme IEC 60364-1 décrit trois types principaux de mise à la terre des réseaux d'alimentation : système TN, système TT et système IT.

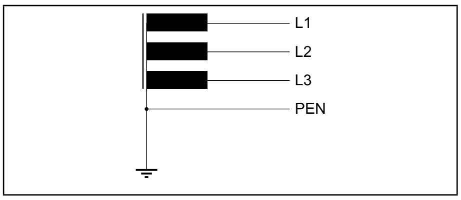
En particulier, dans le système IT, toutes les parties actives sont isolées de laterre ou un point est relié à la terre au travers d'une impédance. Les masses de l'installation sont raccordées séparément ou collectivement au système de mise à la terre.

Les figures suivantes illustrent les différents systèmes mentionnés.

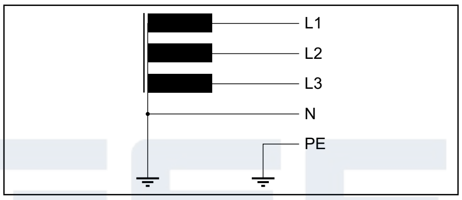
TN-S supply lines / Lignes d'alimentation TN-S



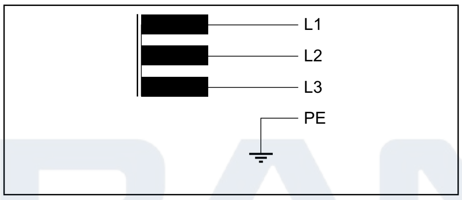
TN-C supply lines / Lignes d'alimentation TN-C



TT supply lines / Lignes d'alimentation TT



Linee di alimentazione IT / Lignes d'alimentation IT



In case of a three phase supply not symmetrical to ground, an insulation loss of one of the devices connected to the same network can cause functional problem to the drive, if the use of a delta/wye transformer is avoided.

1- The drives are designed to be powered from standard three phase lines that are electrically symmetrical with respect to ground (TN or TT network).

2- In case of supply with IT network, the use of delta/star transformer is mandatory, with a secondary three phase wiring referred to ground or, it is mandatory to request a series of drives specifically for IT networks.

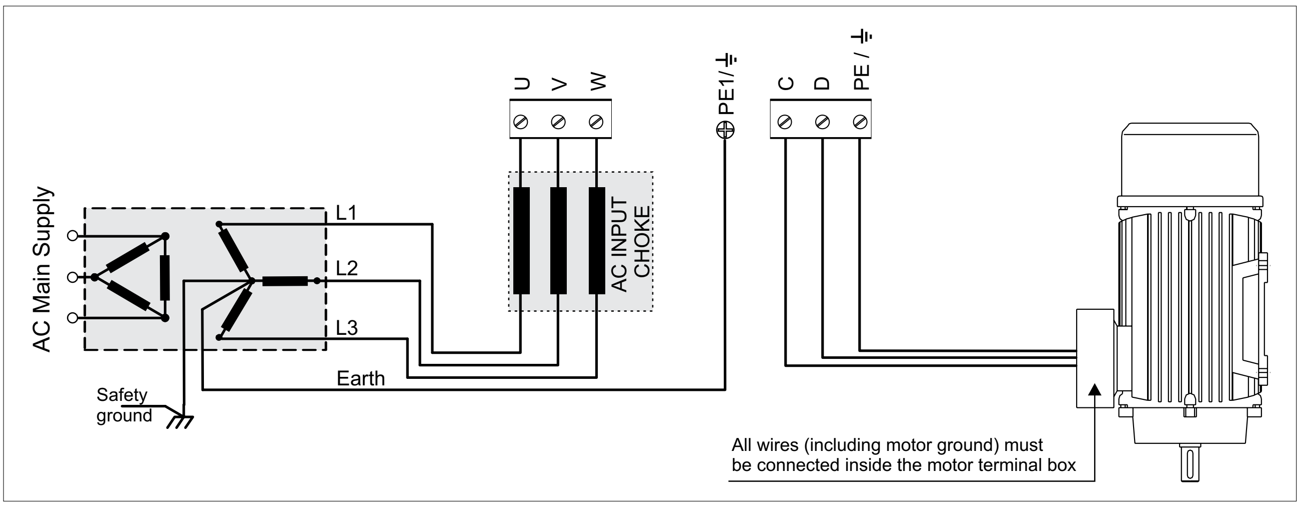
Please refer to the following connection sample.

Si le réseau n'est pas équilibré par rapport à la terre et qu'il n'y a pas de transformateur raingle/étoile, une mauvaise isolation d'un appareil électrique connecté au même réseau que le variateur peut lui causer des troubles de fonctionnement.

1- Les variateurs sont prévus pour être alimentés par un réseau triphasé équilibré avec un régime de neutre standard (TN ou TT).

2- Si le régime de neutre est IT, nous vous recommendons d'utiliser un tranformateur triangle/étoile avec point milieu ramené à la terre ; le cas échéant, il sera nécessaire de commander une série d'entraînements spécifiques pour l'utilisation avec un réseau IT.

Vous pouvez trouver ci-après des exemples de câblage.



CAUTION / PRECAUTION:

DO NOT install an EMI filter external to the TPD32-EV drive when it is used on IT networks. The capacitors in the standard EMI filter could become damaged and/or cause safety problems.

The required supply voltage to the control circuits themselves, and connected to the terminals U2 - V2 **is excluded** from the above considerations and must come from a separate source (secondary of a transformer 115VAC/230VAC) having normally one extreme, or the central point, connected to earth (PE).

Ne pas installer un filtre EMI extérieur à l'entraînement TPD32-EV, si utilisé sur les réseaux IT. Les condensateurs à l'intérieur du filtre standard EMI pourraient se détériorer et/ou entraîner des problèmes de sécurité

La tension d'alimentation nécessaire aux circuits de commande, branchée sur les bornes U2 – V2, n'est pas concernée par les considérations relatives aux réseaux IT. Elle devra provenir d'une source autonome (secondaire d'un transformateur de 115Vca/230Vca) ayant normalement une extrémité ou un point milieu raccordés à la terre (PE).

CAUTION / PRECAUTION:

Do not connect power supply voltage that exceeds the standard specification voltage fluctuation permissible. If excessive voltage is applied to the Drive, damage to the internal components will result.

Ne pas raccorder de tension d'alimentation dépassant la fluctuation de tension permise par les normes. Dans le cas d' une alimentation en tension excessive, des composants internes peuvent être endommagés.

CAUTION / PRECAUTION:

Do not operate the Drive without the ground wire connected. The motor chassis should be grounded to earth through a ground lead separate from all other equipment ground leads to prevent noise coupling.

The grounding cable shall be sized in accordance with the national electric rules and it is to be fixed using the crimp tool specified by the cable manufacturer.

Ne pas faire fonctionner le drive sans prise de terre. Le chassis du moteur doit être mis à la terre à l'aide d'un connecteur de terre separé des autres pour éviter le couplage des perturbations.

Le cable de terre devrait être dimensionné selon la norme electique national et doit être fixé a l'aide d'un instrument de serrage specifié par le producteur du cable.

CAUTION / PRECAUTION:

Do not perform a megger test between the Drive terminals or on the control circuit terminals.

Ne pas exécuter un test megger entre les bornes du drive ou entre les bornes du circuit de contrôle.

CAUTION / PRECAUTION:

Because the ambient temperature greatly affects Drive life and reliability, do not install the Drive in any location that exceeds the allowable temperature. Leave the ventilation cover attached for temperatures of 104° F (40° C) or below.

Étant donné que la température ambiante influe sur la vie et la fiabilité du drive, on ne devrait pas installer le drive dans des places ou la temperature permise est dépassée. Laisser le capot de ventilation en place pour températures de 104°F (40°C) ou inférieures.

CAUTION / PRECAUTION:

If the Drive's Fault Alarm is activated, consult the TROUBLESHOOTING section of this instruction book, and after correcting the problem, resume operation. Do not reset the alarm automatically by external sequence, etc.

Si la Fault Alarm du drive est activée, consulter la section du manuel concernant les défauts et après avoir corrigé l'erreur, reprendre l'opération. Ne pas réiniliatiser l'alarme automatiquement par une séquence externe, etc....

CAUTION / PRECAUTION:

Be sure to remove the desicant dryer packet(s) when unpacking the Drive. (If not removed these packets may become lodged in the fan or air passages and cause the Drive to overheat).

Lors du déballage du drive, retirer le sachet déshydraté. (Si celui-ci n'est pas retiré, il empêche la ventilation et provoque une surchauffe du drive).

CAUTION / PRECAUTION:

The Drive must be mounted on a wall that is constructed of heat resistant material. While the Drive is operating, the temperature of the Drive's cooling fins can rise to a temperature of 194° F (90°C).

Le drive doit être monté sur un mur construit avec des matériaux résistants à la chaleur. Pendant le fonctionnement du drive, la température des ailettes du dissipateur thermique peut arriver à 194°F (90°).

NOTE: The terms “Converters”, “Controller” and “Drive” are sometimes used interchangably throughout the industry. We will use the term “Drive” in this document

Les mots “Convertisseur”, “Controller” et “Drive” sont interchangeables dans le domaine industriel. Nous utiliserons dans ce manuel seulement le mot “Drive”.

1. Never open the device or covers while the AC Input power supply is switched on. Wait for at least one minute befor working on the terminals or inside the device.

   Ne jamais ouvrir l’appareil lorsqu’il est suns tension. Le temps minimum d’attente avant de pouvoir travailler sur les bornes ou bien à l’intérieur de l’drive est de 1 minute.

2. Do not touch or damage any components when handling the device. The changing of the isolation gaps or the removing of the isolation and covers is not permissible. If the front plate has to be removed because of a room temperature higher than 40 degrees, the user has to ensure that no occasional contact with live parts may occur.

   Manipuler l’appareil de façon à ne pas toucher ou endommager des parties. Il n’est pas permis de changer les distances d’isolement ou bien d’enlever des matériaux isolants ou des capots. Si la plaque frontale doit être enlevée pour un fonctionnement avec la température de l’environnement plus haute que 40°C, l’utilisateur doit s’assurer, par des moyens opportuns, qu’aucun contact occasionnel ne puisse arriver avec les parties sous tension.

3. Protect the device from impermissible environmental conditions (temperature, humidity, shock etc.)

   Protéger l’appareil contre des effets extérieurs non permis (température, humidité, chocs etc.).

4. No voltage should be connected to the output of the converter (terminals C and D). The parallel connection of several motors on a converter output is not permissible.

   Aucune tension à la sortie du convertisseur ne peut être appliquée (bornes C et D). Il n’est pas permis d’insérer plus de convertisseurs en parallèle à la sortie ni d’effectuer une connexion directe de l’entrée avec une sortie du convertisseur.

5. When engaging a running motor, the Auto capture function (Auto capture in the ADD SPEED FUNCT menu) must be activated.

   Pour reprendre des moteurs en rotation, la fonction suivante doit être activée : “Auto capture” dans le menu ADD SPEED FUNCT.

6. A capacitative load (e.g. phase compensation capacitors) should not be connected to the output of the frequency inverter (terminals C and D).

   Aucune charge capacitive ne doit être connectée à la sortie du convertisseur (bornes C et D) (par exemple des condensateurs de mise en phase).

7. Always connect the converter to the protective ground (PE) via the marked connection terminals and the housing. The discharge current to earth ground is greater then 3.5 mA. EN 61800-5-1 specifies that with discharge currents greater than 3.5 mA the protective conductor ground connection must be fixed type and doubled for redundancy.

   Effectuer toujours des connexions de terre (PE) par le biais des bornes et du chassis. Le courant de dispersion vers la terre est supérieur à 3,5 mA. Selon EN 50178 il faut prévoir dans ces cas une double connexion à terre.

8. The electrical commissioning should only be carried out by qualified personnel, who are also responsible for the provision of a suitable ground connection and a protected power supply feeder in accordance with the local and national regulations. The motor must be protected against overloads.

   La mise en service électrique doit être effectuée par un personnel qualifié. Ce dernier est responsable de l’existence d’une connexion de terre adéquate et d’une protection des câbles d’alimentation selon les prescriptions locales et nationales. Le moteur doit être protégé contre la surcharge

9. No dielectric tests should be carried out on parts of the frequency inverter. A suitable measuring instrument (internal resistance of at least 10 kΩ/V) should be used for measuring the signal voltages.

   Il ne faut pas éxécuter de tests de rigidité diélectrique sur des parties du convertisseurs. Pour mesurer les tensions, des signaux, il faut utiliser des instruments de mesure appropriés (résistance interne minimale 10 kΩ/V).

10. When the drive is stopped, but it has not been disconnected from the main via the main contactor, it is not possible to exclude the accidental movement of the motor shaft when a failure occurs.

    Quand l’actionnement est arrêté, mais non débranché du réseau par le contacteur de réseau, il n’est pas possible d’exclure le mouvement accidentel de l’arbre moteur en cas de panne.

11. The user must provide overload protection for the motor, as indicated in chapter 2.6.1 and Fig. 4.8.2.

    L’utilisateur dout effectuer la protection de sour-charge du moteur, comme indiqué dans le chapitre 2.6.1 et figure 4.8.2.

WARNING / ATTENTION:

The UL listed equipments is suitable for use on a circuit capable of delivering not more than the rms symmetrical amperes, 600 volts maximum, shown in the table below, when protected by special purpose fuses JFHR2, Gould or Bussman, Model n. as in table 4.9.1.1 and 4.9.2.1. Fuses are internally mounted on sizes 770...1050A.

Cet appareil est apte pour l'utilisation sur un cicuit à même de délivrer un courant rms symmetrique de court-circuit, à un max. de 500 volt, pas supérieur aux valeurs ci-dessus.

.

Converter size	Short circuit current
17 … 2350 A (American sizes)	100 kA
20 ... 3300 A (Standard sizes)	100 kA

1.1 INSTRUCTIONS FOR COMPLIANCE WITH THE UL MARK (UL REQUIREMENTS), ELECTRICAL STANDARDS IN THE USA AND CANADA

Short-circuit ratings

TPD32-EV converters must be connected to a grid capable of supplying a symmetrical short-circuit current of less than or equal to 100 "kArms.

Note: The converter will be protected by semi-conductor fuses, as specified in the instruction manual.

Branch circuit protection

Use the fuses specified in paragraph "4.9 Circuit Protection" on page 86 to protect the drive against overcurrent.

Environmental conditions

The drive is supplied as "open type" equipment. Maximum ambient temperature: 40°C. Pollution degree: 2.

Wiring of input and output terminals

Use UL-listed cables rated at 75°C and crimp-type terminals. Use the tool recommended by the terminal manufacturer to crimp the terminals.

Tighten the terminals to the torque specified in paragraph "4.3 Power Section" on page 64 .

Overspeed; current limit/overload; motor overload

The drive incorporates overspeed, current limit/overload and motor overload protection. The degree of protection and details about installation are specified in the instruction manual.

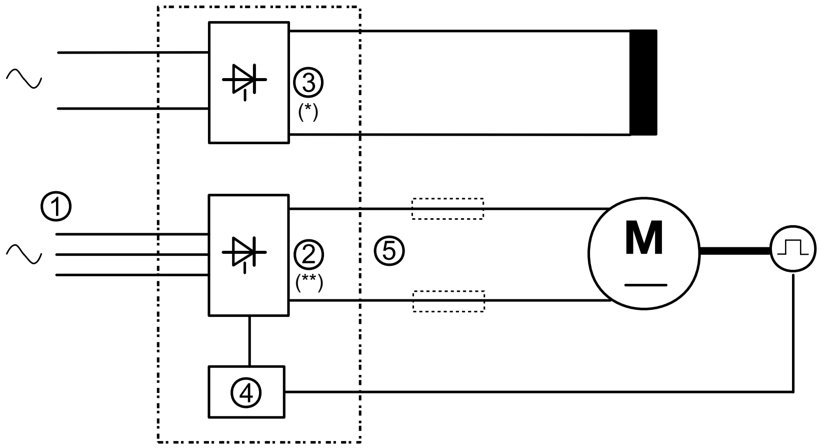
Overload protection for solid state motor.

The drive is provided with motor overload protection. This protection is implemented as a software function. The degree of protection and details about installation are specified in the instruction manual..

2 - DESCRIPTION, COMPONENT IDENTIFICATION AND SPECIFICATIONS

2.1 GENERAL

A converter transforms the constant voltage of an existing three-phase power supply into a direct voltage, in order to regulate the speed and/or the torque of a direct current motor with a separate excitation.



(*) not included in the TPD32-EV-FC-...
(**) not included in the TPD32-EV-CU-...

Figure 2.1: Base diagram of a converter

① AC input supply voltage (U_{LN}):	3 x 230 V, 50/60 Hz,	3 x 400 V, 50/60 Hz
	3 x 460 V, 50/60 Hz,	3 x 500 V, 50/60 Hz
	3 x 575 V, 50/60 Hz,	3 x 690 V, 50/60 Hz

② Armature converter:	Totally controlled three-phase bridge. Double bridge for TPD32-EV-...-4B..)
③ Field converter:	Semi-controlled single-phase bridge
④ Programmable control section:	Control and regulation cards of the power section. Commands, references and feedbacks are connected to them.
⑤ Output voltage (U_{dN}):	Direct voltage changing from 0... U_{dN}
Output rated current (I_{dN}):	20.... 3300 A [for a max. ambient temperature of 104°F (40°C)]

The default version of a converter includes the presence of a power supply circuit for the adjustable field; in this way the motors can operate with a mixed armature or field regulation, without adding other devices.
The basic technical data of a converter are stated in the type code and on the identification nameplate.

- **TPD32-EV**

The available TPD32-EV converters are of two types:

TPD32-EV-...-2B...	for a two quadrant functioning
TPD32-EV-...-4B...	for a four quadrant functioning

Each type includes three series of devices, which differ the one from the other because of the max. power supply voltage:

TPD32-EV-500/...	AC input supply voltage up to 3 x 500 V
TPD32-EV-575/...	AC input supply voltage up to 3 x 575 V
TPD32-EV-690/...	AC input supply voltage up to 3 x 690 V

Type E TPD32-EV converters are not compact units but consist of a power section and a regulation section joined by a specific cable with connectors..

TPD32-EV -XXX / XXX -XX -XB -X -NA

- UL standard compliant
- Construction type: A, B, C, D, E
- Operating quadrants: 2B = two quadrants; 4B = four quadrants
- Output rated current [A]
- Rated DC voltage output [VDC]
- Rated AC voltage input [VAC]
- Type of converter

- **TPD32-EV-FC-...**

Series of converters designed to supply highly inductive loads such as electromagnets, chokes, synchronous motor excitation circuits, galvanic applications, etc.

Maximum supply voltage available:

TPD32-EV-FC-500/...	AC input supply voltage up to 3 x 500 V
TPD32-EV-FC-200.	AC input supply voltage up to 3 x 200 V

TPD32-EV -FC -XXX / XXX -XX -XB -X

- Construction type: A, B
- Operating quadrants: 2B = two quadrants; 4B = four quadrants
- Output rated current [A]
- Rated DC voltage output [VDC]
- Rated AC voltage input [VAC]
- Special converter for inductive loads

- **TPD32-EV-CU-...**

External bridge control unit.

Two series are available. These differ according to the maximum supply voltage:

TPD32-EV-CU-230/500	Mains supply voltage up to 3 x 500 V
TPD32-EV-CU-575/690	Mains supply voltage up to 3 x 690 V

TPD32-EV-CU -XXX / XXX -THYX -XX

- Output field current: 40A, 70A
- External bridge control: THY1 = single SCR per branch, THY2 = 2 SCRs in parallel
- Rated DC voltage output [VDC]
- Rated AC voltage input [VAC]
- External bridge control unit

The available size are listed in the following table:

Table 2.1.1: Converter size

TPD32 EV Standard sizes	TPD32 EV-...-NA American sizes	Two-quadrant: 2B	Four-quadrant: 4B	Construction type	ULN AC Mains voltage: TPD32 EV-500 (230 ... 500Vac ± 10%, 3ph)	TPD32 EV-575 (230 ... 575Vac ± 10%, 3ph)	TPD32 EV-690 (230 ... 690Vac ± 10%, 3ph)	Grid frequency	IDN, Rated output current (Standard)	IDN, Rated output current (American) (1)
					[VAC]	[VAC]	[VAC]	[Hz]	[A]	[A]
20	17	•	•	A1	•			50/60 Hz ±5%	20	17
40	35	•	•	A1	•				40	35
70	56	•	•	A2	•				70	56
110	88	•	•	A3	•				110	88
140	112	•	•	A3	•				140	112
185	148	•	•	A3	•				185	148
280	224	•	•	B1	•	•			280	224
350	280	•	•	B1	•	•			350	280
420	336	•	•	B1	•	•			420	336
500	400	•	•	B1	•	•			500	400
560	360	•	•	C			•		560	360
650	450	•	•	B2	•	•			650	450
700	490	•	•	C		•	•		700	490
770	560	•	•	C	•				770	560
900	650	•	•	C			•		900	650
1000	750	•		C		•			1000	750
1050	750		•	C		•			1050	750
1000	800	•		C	•				1000	800
1050	850		•	C	•				1050	850
1300	920		•	D			•		1300	920
1300	980		•	D		•	•		1300	980
1300	980	•		D		•			1300	980
1400	1000	•	•	D	•				1400	1000
1600	1200	•	•	D	•	•	•		1600	1200
1900	1450	•	•	D			•		1900	1450
2000	1500	•	•	D	•	•			2000	1500
2100	1650	•	•	D			•		2100	1650
2300	1800	•	•	D		•			2300	1800
2400	1850	•	•	D	•				2400	1850

TPD32 EV Standard sizes	TPD32 EV-...-NA American sizes	Two-quadrant: 2B	Four-quadrant: 4B	Construction type	ULN AC Mains voltage: TPD32 EV-500 (230 ... 500Vac ± 10%, 3ph)	TPD32 EV-690 (230 ... 690Vac ± 10%, 3ph)	Grid frequency	IDN, Rated output current (Standard)	IDN, Rated output current (American) (1)
					[VAC]	[VAC]	[Hz]	[A]	[A]
1200	1000	•		E	•		50/60 Hz ±5%	1200	1000
1500	1300	•	•	E	•			1500	1300
1700	1350		•	E	•			1700	1350
1800	1400	•		E	•			1800	1400
2000	1500	•	•	E	•			2000	1500
2400	1800	•	•	E	•			2400	1800
2700	2000	•	•	E	•			2700	2000
2900	2200	•		E	•			2900	2200
3300	2350	•	•	E	•			3300	2350
1010	900	•	•	E		•		1010	900
1400	1150	•	•	E		•		1400	1150
1700	1350	•	•	E		•		1700	1350
2000	1500	•	•	E		•		2000	1500
2400	1800	•	•	E		•		2400	1800
2700	2000	•	•	E		•		2700	2000
3300	2350	•	•	E		•		3300	2350

(1) Factory setting overload 150%.

The converter choice is made on the basis of the motor rated current and of the available AC input voltage. The output rated current must be higher or equal to the one required by the used motor.

Functions and features (Overview)

The devices of the TPD32-EV series are developed as converters with excellent regulation features and a wide function range.

Integrated field converter.

- Galvanic separation and high impedance between the power and the regulation section.
- Galvanic separation between the regulation section and the digital I/O terminals.
- Differential analog inputs.
- Diagnostic LED module (KC-TPD32-EV) supplied as a standard and mounted on the drive front cover
- Removable optional Keypad (KB-TPD32-EV)
- START UP menu which makes set-up easier.

Simple operation of the device

- via terminal strip
- via keypad with a back-lit keypad
- via a default set PC program and RS485 serial interface
- via a connection with a Field Bus (option), PROFIBUS DP CANopen and DeviceNet.

Stored messages concerning the last 10 faults and indication of the operation time.

Separate configuration of the drive behaviour for each message in an alarm situation.

Automatic change into an armature feedback because of the interruption of the speed feedback signal (only in constant torque mode).

Overload control

Three freely configurable analog inputs on the standard device.

Widening of digital inputs and of digital, analog outputs via a option card.

Reference assignation and display of the feedback values as a percentage or in a dimension which can be defined by the user.

Possibility of a speed and torque regulation

Adaptive of the speed regulator

Current predictive regulator with an automatic adaptation.

Motor potentiometer function (increase / decrease speed command).

Jog function.

8 internal speed references.

5 internal linear or S-shaped ramps.

Internal signal conditioning (gains, min/max limits, offset....).

Function widening available for specific applications (option).

2.2 UPON DELIVERY INSPECTION PROCEDURES

Storage, Transport

A high degree of care is taken in packing the converters of the TPD32-EV series and preparing them for delivery. They should only be transported with suitable transport equipment (see weight data). Observe the instructions printed on the packaging. This also applies when the device is unpacked up to when it is installed in the control cabinet.

On delivery check the following:
- the packaging for any external damage
- whether the delivery note matches your order.

Open the packaging with suitable tools. Check whether
- any parts were damaged during transport
- the device type corresponds to your order

In the event of any damage or of an incomplete or incorrect delivery please notify the sales offices responsible immediately.
The devices should only be stored in dry rooms within the temperature ranges specified.

NOTE! A certain degree of moisture condensation is permissible if this arises from changes in temperature (see section 3.1, "Permissible Ambient Conditions") This does not, however, apply when the devices are in operation. Ensure always that there is no moisture condensation in devices that are connected to the power supply!

2.2.1 Device setting

The converters of the TPD32-EV series can operate connected to an AC input three-phase voltage from 230V to 690V. Inside this voltage range the device setting is carried out on the basis of the motor rated current. Therefore the converter rated current must be higher or the same as the motor rated one.

If an overload is necessary, the setting is carried out according to the example mentioned in section 6.14.6, "Overload control", so that the overcurrent must not be supplied in a continuative way from the type of the chosen converter.

NOTE! A reduction factor should be considered if the converter is installed at altitudes of over 3,300 feet (1000 m) above sea level and at higher temperatures (see section 3.1, "Permissible ambient conditions").

Example for a 15kW motor

AC input voltage: 400 V, 3Ph

1. Two quadrant functioning

Nameplate data:	Power	15 kW
	Armature Voltage	470 V_{DC}
	Armature Current	37.6 Amps
	Field Voltage	310 V_{DC}
	Field Current	0.8 Amps
Choice criteria:	400 V, 3Ph	see section “AC Input”
	37.6A < 40 A	see section “AC Ouput”
	0.8 A < 10 A	see section “AC Ouput”
Chosen converter:	TPD32-EV-500/600-40-2B	

The converter can supply 1.06 of motor rated current continously. If higher overload values are required, see section 6.14.6, “Overload control”.

2. Four quadrant functioning

Nameplate data:	Power	15 kW
	Armature Voltage	420 V_{DC}
	Armature Current	42 Amps
	Field Voltage	310 V_{DC}
	Field Current	0.8 Amps
Choice criteria:	400 V, 3Ph	see section “AC Input”
	42 A < 70 A	see section “AC Output”
	0.8 A < 10 A	see section “AC Output”
Chosen converter:	TPD32-EV-500/520-70-4B	

The converter can supply 1.66 of motor rated current continously. If higher overload values are required, see section 6.14.6, “Overload control”.

2.3 SPECIFICATIONS

2.3.1 Standards

General: EN 61800-1, EN 60146-1-1.
Safety: EN 61800-5-1, EN 50178
Clearances and creepage distances:
Overvoltage category for circuits connected directly to the mains: III; pollution degree: 2. Double or reinforced insulation/safe separation from live parts of decisive voltage class C; see EN 61800-5 §4.2.3.
Oscillation test: EN 60721-3-3 class 3M1, EN 60068-2-6, test Fc.
Climatic conditions: EN 60721-3-3, class 3K3. EN 60068-2-2, test Bd.
EMC: EN 61800-3. See “Guide to the electromagnetic compatibility”.
Rated mains voltage: IEC 60038.
Protection degree: According to EN 60529,
IP20 for types A, B, C; IP00 for types D and E.
UL/cUL approval: For TPD32-EV, TPD32-EV-…-NA, TPD32-EV-CU and TPD32-EV-FC models (frame E, sizes TPD32-EV-690/... and TPD32-EV_12P/12S not included).

ATTENTION! The DC drive is suitable for use under the environmental service conditions (climate, mechanical, pollution, etc.) defined as usual service conditions according to EN61800-1.

2.3.2 AC Input

Table 2.3.2.1: AC input voltages

<table>
<tr><th>DC Drive series</th><th colspan="2">Power section
(U/V/W terminals)</th><th>Field circuit

(U1/V1 terminals)</th><th>Power supply regulation section
(U2/V2 terminals)</th></tr>
<tr><td>TPD32-EV-500/...</td><td>3 x 230 V ±10 %*
3 x 400 V ±10 %*
3 x 440 V ±10 %*
3 x 460 V ±10 %*
3 x 480 V ±10 %*
3 x 500 V ±10 %*</td><td>50/60 Hz ±5 %</td><td rowspan="5">1 x 230 V ±10 %*
1 x 400 V ±10 %*
1 x 460 V ±10 %*

50/60 Hz ±5 %</td><td rowspan="7">1 x 115 V ±15 % **
or
1 x 230 V ±15 % **

50 / 60 Hz ±5 %</td></tr>
<tr><td>TPD32-EV-575/...</td><td>3 x 230 V ±10 %*
3 x 400 V ±10 %*
3 x 440 V ±10 %*
3 x 460 V ±10 %*
3 x 480 V ±10 %*
3 x 500 V ±10 %*
3 x 575 V ±10 %*</td><td>50/60 Hz ±5 %</td></tr>
<tr><td>TPD32-EV-690/...</td><td>3 x 230 V ±10 %*
3 x 400 V ±10 %*
3 x 440 V ±10 %*
3 x 460 V ±10 %*
3 x 480 V ±10 %*
3 x 500 V ±10 %*
3 x 575 V ±10 %*
3 x 690 V ±10 %*</td><td>50/60 Hz ±5 %</td></tr>
<tr><td>TPD32-EV-CU-230/500-THY.-..</td><td>3 x 230...500V ±10 %</td><td>50/60 Hz ±5 %</td></tr>
<tr><td>TPD32-EV-CU-575/690-THY.-..</td><td>3 x 575...690V ±10 %</td><td>50/60 Hz ±5 %</td></tr>
<tr><td>TPD32-EV-FC-200/...</td><td>3 x 60...200V ±10 %</td><td>50/60 Hz ±5 %</td><td>-</td></tr>
<tr><td>TPD32-EV-FC-500/...</td><td>3 x 230...500V ±10 %</td><td>50/60 Hz ±5 %</td><td>-</td></tr>
</table>

* With the indicated tolerance values the output voltage complies the DIN 40030 standard.
With wider tolerances the max output voltage chenges accordingly.

** **For operation at 115 V, from sizes 280 A to 1050 A, insert a jumper between terminals SA – SB located at the top of the converters.**

During start-up the threshold for the undervoltage message has to be set via the **Undervolt thr** parameter (standard: 230 V).

NOTE! According the input voltage the switch S15.7/8 on the regulation board must be set as follows:

TPD32-EV-500/...	S15.7 = ON	S15.8 = OFF
TPD32-EV-575/...	S15.7 = OFF	S15.8 = ON
TPD32-EV-690/...	S15.7 = OFF	S15.8 = ON
TPD32-EV-FC-200/... (from fw 10.21)	S15.7 = ON	S15.8 = OFF
TPD32-EV-FC-500/... (from fw 10.20)	S15.7 = ON	S15.8 = OFF

NOTE! As for the operation of the TPD32-EV converters AC input reactors and interference suppression filters are required. See section 4.10, “Reactors/Filters”.

The converters above 770 A and the AC input reactors have a discharge currents to ground higher than 3.5 mA. EN 50178 states that beside the ground conductor another ground connection should be laid.

CAUTION! Due to the increased discharge current involved, a fixed ground connection (without connectors) for the EMI filters of the TPD32-EV converter is required.

Current /Power on AC input

Note! The values showed on table below are refered to a converter functioning at nominal current I_{DN} (armature) and I_{PN} (field).

Table 2.3.2.2: AC input curents

American	Current on the AC Input	Standard	Current on the AC Input	Current on the field AC Input
TPD32-EV-.../...-17-..-A	14.6 A	TPD32-EV-.../...-20-..-A	17.2 A	10 A
TPD32-EV-.../...-35-..-A	30.1 A	TPD32-EV-.../...-40-..-A	34.4 A	10 A
TPD32-EV-.../...-56-..-A	48.1 A	TPD32-EV-.../...-70-..-A	60.2 A	10 A
TPD32-EV-.../...-88-..-A	75.6 A	TPD32-EV-.../...-110-..-A	94.6 A	14 A
TPD32-EV-.../...-112-..-A	96.3 A	TPD32-EV-.../...-140-..-A	120.4 A	14 A
TPD32-EV-.../...-148-..-A	127.2 A	TPD32-EV-.../...-185-..-A	159.1 A	20 A
TPD32-EV-.../...-224-..-B	192.6 A	TPD32-EV-.../...-280-..-B	240.8 A	20 A
TPD32-EV-.../...-280-..-B	240.8 A	TPD32-EV-.../...-350-..-B	301 A	20 A
TPD32-EV-.../...-336-..-B	289 A	TPD32-EV-.../...-420-..-B	361.2 A	20 A
TPD32-EV-.../...-400-..-B	344 A	TPD32-EV-.../...-500-..-B	430 A	20 A
TPD32-EV-.../...-360-..-C	310 A	TPD32-EV-.../...-560-..-C	482.2 A	25 A
TPD32-EV-.../...-450-..-B	387 A	TPD32-EV-.../...-650-..-B	559 A	20 A
TPD32-EV-.../...-490-..-C	421.4 A	TPD32-EV-.../...-700-..-C	602.7 A	25 A
TPD32-EV-.../...-560-..-C	481.2 A	TPD32-EV-.../...-770-..-C	662.2 A	25 A
TPD32-EV-.../...-650-..-C	559 A	TPD32-EV-.../...-900-..-C	774.9 A	25 A
TPD32-EV-./...-750-2B-C	645 A	TPD32-EV-575/...-1000-2B-C	903 A	25 A
TPD32-EV-575...-750-4B-C	645 A	TPD32-EV-575/...-1050-4B-C	904 A	25 A
TPD32-EV-.../...-800-..-C	688 A	TPD32-EV-500/...-1000-..-C	860 A	25 A
TPD32-EV-.../...-850-4B-C	731 A	TPD32-EV-500/...-1050-4B-C	904 A	25 A
TPD32-EV-.../...-920-2B-D	791.2 A	TPD32-EV-690/...-1300-2B-D	1119 A	40 A
TPD32-EV-.../...-980-..-D	843 A	TPD32-EV-575/...-1300-..-D	1119 A	40 A
TPD32-EV-.../...-1000-..-D	860 A	TPD32-EV-.../...-1400-..-D	1205 A	40 A
TPD32-EV-.../...-1200-..-D	1032 A	TPD32-EV-.../...-1600-..-D	1378 A	40 A
TPD32-EV-.../...-1450-..-D	1247 A	TPD32-EV-.../...-1900-..-D	1636 A	40 A
TPD32-EV-.../...-1500-..-D	1290 A	TPD32-EV-.../...-2000-..-D	1722 A	40 A
TPD32-EV-.../...-1650-..-D	1419 A	TPD32-EV-.../...-2100-..-D	1808 A	70 A
TPD32-EV-.../...-1800-..-D	1548 A	TPD32-EV-.../...-2300-..-D	1980 A	70 A
TPD32-EV-.../...-1850-..-D	1591 A	TPD32-EV-.../...-2400-..-D	2066 A	70 A
TPD32-EV-.../...-900-..-E	774 A	TPD32-EV-.../...-1010-..-E	860 A	40 A
TPD32-EV-.../...-1000-2B-E	860 A	TPD32-EV-.../...-1200-2B-E	1032 A	40 A
TPD32-EV-.../...-1150-..-E	989 A	TPD32-EV-.../...-1400-..-E	1205 A	40 A
TPD32-EV-.../...-1300-2B-E	1118 A	TPD32-EV-.../...-1500-2B-E	1290 A	40 A
TPD32-EV-.../...-1350-..-E	1161 A	TPD32-EV-.../...-1700-..-E	1464 A	40 A
TPD32-EV-.../...-1400-2B-E	1204 A	TPD32-EV-.../...-1800-2B-E	1542 A	40 A
TPD32-EV-.../...-1500-..-E	1290 A	TPD32-EV-.../...-2000-..-E	1720 A	40 A
TPD32-EV-.../...-1800-..-E	1548 A	TPD32-EV-.../...-2400-..-E	2064	70 A
TPD32-EV-.../...-2000-..-E	1720 A	TPD32-EV-.../...-2700-..-E	2313 A	70 A
TPD32-EV-.../...-2200-2B-E	1892 A	TPD32-EV-.../...-2900-2B-E	2485 A	70 A
TPD32-EV-.../...-2350-..-E	2021 A	TPD32-EV-.../...-3300-..-E	2827 A	70 A

TPD32-EV-FC-.../...-20-..-A	17.2 A
TPD32-EV-FC-.../...-40-..-A	34.4 A
TPD32-EV-FC-.../...-70-..-A	60.2 A
TPD32-EV-FC-.../...-110-..-A	94.6 A
TPD32-EV-FC-.../...-140-..-A	120.4 A
TPD32-EV-FC-.../...-185-..-A	159.1 A
TPD32-EV-FC-.../...-280-..-B	240.8 A
TPD32-EV-FC-.../...-350-..-B	301 A
TPD32-EV-FC-.../...-420-..-B	361.2 A
TPD32-EV-FC-.../...-500-..-B	430 A
TPD32-EV-FC-.../...-650-..-B	559 A

2.3.3 Output

Note! It is not possible to connect an external voltage to the converter output terminals! It is not even possible to disconnect the motor from the device output while the drive is active.

In normal cases no leveling choke is necessary. It must be taken into account, anyway, that some motor producers prescribe such a choke according to the type of the motor used. In this case it must inserted on the motor cable.
The stated currents refer to the continuous operation with an ambient temperature of 104°F (40° C).

Output current

- **Armature circuit**

Table 2.3.3.1: TPD32-EV Output currents

American			Standard			Field converter
Type	Armature current (Terminals C/D)		Type	Armature current (Terminals C/D)		(Term. C1 / D1)
	Continuous curr. I_{dN} with Ta = 104°F *	Max. current (with over-load) **		Continuous curr. IdN with Ta = 104°F *	Max. current (with over-load) **	Continuous curr. I_{FN} with Ta = 40°C *
TPD32-EV-.../...-17-..-A	17 A	34 A	TPD32-EV-.../...-20-..-A	20 A	40 A	10 A
TPD32-EV-.../...-35-..-A	35 A	70 A	TPD32-EV-.../...-40-..-A	40 A	80 A	10 A
TPD32-EV-.../...-56-..-A	56 A	112 A	TPD32-EV-.../...-70-..-A	70 A	140 A	10 A
TPD32-EV-.../...-88-..-A	88 A	172 A	TPD32-EV-.../...-110-..-A	110 A	220 A	14 A
TPD32-EV-.../...-112-..-A	112 A	224 A	TPD32-EV-.../...-140-..-A	140 A	280 A	14 A
TPD32-EV-.../...-148-..-A	148 A	296 A	TPD32-EV-.../...-185-..-A	185 A	370 A	14 A
TPD32-EV-.../...-224-..-B	224 A	448 A	TPD32-EV-.../...-280-..-B	280 A	560 A	20 A
TPD32-EV-.../...-280-..-B	280 A	560 A	TPD32-EV-.../...-350-..-B	350 A	700 A	20 A
TPD32-EV-.../...-336-..-B	336 A	672 A	TPD32-EV-.../...-420-..-B	420 A	840 A	20 A
TPD32-EV-.../...-400-..-B	400 A	800 A	TPD32-EV-.../...-500-..-B	500 A	1000 A	20 A
TPD32-EV-.../...-360-..-C	360 A	720 A	TPD32-EV-.../...-560-..-C	560 A	1120 A	25 A
TPD32-EV-.../...-450-..-B	450 A	900 A	TPD32-EV-.../...-650-..-B	650 A	1300 A	20 A
TPD32-EV-.../...-490-..-C	490 A	980 A	TPD32-EV-.../...-700-..-C	700 A	1400 A	25 A
TPD32-EV-.../...-560-..-C	560 A	1120 A	TPD32-EV-.../...-770-..-C	770 A	1540 A	25 A
TPD32-EV-.../...-650-..-C	650 A	1300 A	TPD32-EV-.../...-900-..-C	900 A	1800 A	25 A
TPD32-EV-./...-750-2B-C	750 A	1500 A	TPD32-EV-575/...-1000-2B-C	1000 A	2000 A	25 A
TPD32-EV-575...-750-4B-C	750 A	1500 A	TPD32-EV-575/...-1050-4B-C	1050 A	2100 A	25 A
TPD32-EV-.../...-800-..-C	800 A	1600 A	TPD32-EV-500/...-1000-..-C	1000 A	2000 A	25 A
TPD32-EV-.../...-850-4B-C	850 A	1700A	TPD32-EV-500/...-1050-4B-C	1050 A	2100 A	25 A
TPD32-EV-.../...-920-2B-D	920 A	1840 A	TPD32-EV-690/...-1300-2B-D	1300 A	2600 A	40 A
TPD32-EV-.../...-980-..-D	980 A	1960 A	TPD32-EV-575/...-1300-..-D	1300 A	2600 A	40 A
TPD32-EV-.../...-1000-..-D	1000 A	2000 A	TPD32-EV-.../...-1400-..-D	1400 A	2800 A	40 A
TPD32-EV-.../...-1200-..-D	1200 A	2400 A	TPD32-EV-.../...-1600-..-D	1600 A	3200 A	40 A
TPD32-EV-.../...-1450-..-D	1450 A	2900 A	TPD32-EV-.../...-1900-..-D	1900 A	3800 A	40 A
TPD32-EV-.../...-1500-..-D	1500 A	3000 A	TPD32-EV-.../...-2000-..-D	2000 A	4000 A	40 A
TPD32-EV-.../...-1650-..-D	1650 A	3300 A	TPD32-EV-.../...-2100-..-D	2100 A	4200 A	70 A
TPD32-EV-.../...-1800-..-D	1800 A	3600 A	TPD32-EV-.../...-2300-..-D	2300 A	4600 A	70 A
TPD32-EV-.../...-1850-..-D	1850 A	3700 A	TPD32-EV-.../...-2400-..-D	2400 A	4800 A	70 A
TPD32-EV-.../...-900-..-E	900 A	1800 A	TPD32-EV-.../...-1010-..-E	1010 A	2020 A	40 A
TPD32-EV-.../...-1000-2B-E	1000 A	2000 A	TPD32-EV-.../...-1200-2B-E	1200 A	2400 A	40 A
TPD32-EV-.../...-1150-..-E	1150 A	2300 A	TPD32-EV-.../...-1400-..-E	1400 A	2800 A	40 A
TPD32-EV-.../...-1300-2B-E	1300 A	2600 A	TPD32-EV-.../...-1500-2B-E	1500 A	3000 A	40 A
TPD32-EV-.../...-1350-..-E	1350 A	2700 A	TPD32-EV-.../...-1700-..-E	1700 A	3400 A	40 A
TPD32-EV-.../...-1400-2B-E	1400 A	2800 A	TPD32-EV-.../...-1800-2B-E	1800 A	3600 A	40 A
TPD32-EV-.../...-1500-..-E	1500 A	3000 A	TPD32-EV-.../...-2000-..-E	2000 A	4000 A	40 A
TPD32-EV-.../...-1800-..-E	1800 A	3600 A	TPD32-EV-.../...-2400-..-E	2400 A	4800 A	70 A
TPD32-EV-.../...-2000-..-E	2000 A	4000 A	TPD32-EV-.../...-2700-..-E	2700 A	5400 A	70 A

TPD32-EV-.../...-2200-2B-E	2200 A	4400 A	**TPD32-EV-.../...-2900-2B-E**	2900 A	5800 A	70 A
TPD32-EV-.../...-2350-..-E	2350 A	4700 A	**TPD32-EV-.../...-3300-..-E**	3300 A	6600 A	70 A

* Current reduction for higher temperatures, see section 3.1, "Permissible ambient conditions".
** The overload size and duration depend on the overload cycle, see section 6.14.6, "Overload control".

Note! The field motor current can sometimes be very small compared with rated field current of the converter. In order to provide regulation during Voltage control of the motor, follow the described instructions to change the Flux current max of the converter. In this case the **Nom field scale** parameter must be set with the new rated field current value.

Table 2.3.3.2: TPD32-EV-FC Output currents

Type	**Field converter (Terminals C/D)** Continuous curr. IdN with Ta = 40°C (104°F) (*)	**Field converter (Terminals C/D)** Max. current (with overload) (**)
TPD32-EV-FC-.../...-20-..-A	20 A	40 A
TPD32-EV-FC-.../...-40-..-A	40 A	80 A
TPD32-EV-FC-.../...-70-..-A	70 A	140 A
TPD32-EV-FC-.../...-110-..-A	110 A	220 A
TPD32-EV-FC-.../...-140-..-A	140 A	280 A
TPD32-EV-FC-.../...-185-..-A	185 A	370 A
TPD32-EV-FC-.../...-280-..-B	280 A	560 A
TPD32-EV-FC-.../...-350-..-B	350 A	700 A
TPD32-EV-FC-.../...-420-..-B	420 A	840 A
TPD32-EV-FC-.../...-500-..-B	500 A	1000 A
TPD32-EV-FC-.../...-650-..-B	650 A	1300 A

Table 2.3.3.3: TPD32-EV-CU Output currents

Type	**Armature current (***) (Terminals C/D)**		**Field converter (Terminals C1 / D1)**
	Continuous current (***) (settable) I_{dN} with Ta = 40°C (104°F) (*)	**Max. current (with overload)** (**)	**Continuous curr. IFN with Ta = 40°C** *
TPD32-EV-CU-.../....-THY1-40	4 .... 20000 A (currents range managed by CU)	up to 200%	40 A
TPD32-EV-CU-.../....-THY2-40			40 A
TPD32-EV-CU-.../...-THY1-70			70 A
TPD32-EV-CU-.../...-THY2-70			70 A

* Current reduction for higher temperatures, see section 3.1, "Permissible ambient conditions".
** The overload size and duration depend on the overload cycle, see section 6.14.6, "Overload control".
*** External power bridge.

- ***Field circuit***

The TPD32-EV regulation card is shipped with the field current feedback resistor dipswitches S14 calibrated for the maximum rating of the field package capacity for each size TPD32-EV .

Compare the actual motor field data to the maximum rating of the field package of the TPD32-EV model supplied (see table 2.3.3.1), and to the field calibration dipswitch S14, as noted below.

- For fixed field current operation, if the actual motor (base) field current $\leq$ 10% of the maximum rating of the field package it is required to calibrate the field current feedback scaling using dipswitch S14.
- For weak field operation, also referred as “CEMF field control” or “crossover field control”, if the top base speed Motor nom flux $\leq$ 10% of the maximum rating of the field package it is required to calibrate the field current feedback scaling using dipswitch S14.

Calibration to the exact field current setting is not required, as long as the above conditions are met.

Calibration is not required if the field control is provided by a separate field converter.

In order to obtain a current setting value different from those stated in the table, use the following formulas to calculate the resistance to be used between the terminals LA and LB on the regulation card. In this case all the switches have to be set to zero (OFF).

1) For sizes TPD32-EV-.../...-20-..-A (17-NA-..-A) ... up to TPD32-EV-.../...-1050-..-C (850-NA-..-C) :

Resistance = 1667 / field current (A).

Table 2.3.3.4-A: Field current resistors (20A ...1050A / 17A ... 850A, types A/B/C)

Switch ohms	168.5 Ohm	333 Ohm	182 Ohm	36.4 Ohm	845 Ohm	1668 Ohm			Equivalent resistance
Nom flux curr	S14-1	S14-2	S14-3	S14-4	S14-5	S14-6	S14-7	S14-8	
1.0 A	OFF	OFF	OFF	OFF	OFF	ON	Not used		1668 Ohm
2.0 A	OFF	OFF	OFF	OFF	ON	OFF			845 Ohm
3.0 A	OFF	OFF	OFF	OFF	ON	ON			560.9 Ohm
5.0 A	OFF	ON	OFF	OFF	OFF	OFF			333.3 Ohm
9.9 A	ON	OFF	OFF	OFF	OFF	OFF			168.5 Ohm
12.9 A	ON	OFF	OFF	OFF	ON	ON			129.6 Ohm
14.2 A	OFF	ON	ON	OFF	OFF	OFF			117.7 Ohm
17.1 A	OFF	ON	ON	OFF	ON	ON			97.3 Ohm
20.0 A	ON	OFF	ON	OFF	OFF	ON			83.1 Ohm
24.1 A	ON	ON	ON	OFF	OFF	OFF			69.3 Ohm
25.1 A	ON	ON	ON	OFF	OFF	ON			66.5 Ohm

2) For sizes bigger than TPD32-EV-.../...-1050-..-C (850-NA-..-C) ... up to TPD32-EV-.../...-2000-..-D (1500-NA-..-D):

Resistance = 3332/field current (A).

Table 2.3.3.4-B: Field current resistors (>1050A ... 2000A / 850A ... 1500A, type D)

Switch ohms	**168.5 Ohm**	**333 Ohm**	**182 Ohm**	**36.4 Ohm**	**845 Ohm**	**1668 Ohm**			**Equivalent resistance**
Nom flux curr	**S14-1**	**S14-2**	**S14-3**	**S14-4**	**S14-5**	**S14-6**	**S14-7**	**S14-8**	
10.0 A	OFF	ON	OFF	OFF	OFF	OFF	Not used		333.3 Ohm
20.0 A	ON	OFF	OFF	OFF	OFF	OFF			168.5 Ohm
30.0 A	ON	ON	OFF	OFF	OFF	OFF			111.9 Ohm
40.0 A	ON	OFF	ON	OFF	OFF	ON			83.1 Ohm

3) **For sizes bigger than TPD32-EV-.../...-2000-..-D (1500-NA-..-D) ... up to TPD32-EV-.../...-2400-..-D (1850-NA-..-D) :**

Resistance = 1667 / field current (A).

Table 2.3.3.4-C: Field current resistors (>2000...2400A / 1500...1850A, type D)

Switch ohms	168.5 Ohm	333 Ohm	182 Ohm	36.4 Ohm	845 Ohm	1668 Ohm			Equivalent resistance
Nom flux curr	S14-1	S14-2	S14-3	S14-4	S14-5	S14-6	S14-7	S14-8	
10.0 A	ON	OFF	OFF	OFF	OFF	OFF	Not used		168.5 Ohm
20.0 A	ON	OFF	ON	OFF	OFF	ON			83.1 Ohm
50.0 A	OFF	ON	OFF	ON	OFF	OFF			32.8 Ohm
70.0 A	ON	ON	ON	ON	OFF	OFF			23.9 Ohm

4) **For sizes bigger than TPD32-EV-.../...-1200-..-E (1000-NA-..-E) ... up to TPD32-EV-.../...-2000-..-E (1500-NA-..-E):**

Resistance = 3332 / field current (A).

Table 2.3.3.4-D: Field current resistors (>1200...2000A / 1000...1500A, type E)

Switch ohms	168.5 Ohm	333 Ohm	182 Ohm	36.4 Ohm	845 Ohm	1668 Ohm			Equivalent resistance
Nom flux curr	S14-1	S14-2	S14-3	S14-4	S14-5	S14-6	S14-7	S14-8	
10.0 A	OFF	ON	OFF	OFF	OFF	OFF	Not used		332 Ohm
20.0 A	ON	OFF	OFF	OFF	OFF	OFF			168 Ohm
40.0 A	ON	OFF	ON	OFF	OFF	ON			83 Ohm

5) **For sizes bigger than TPD32-EV-.../...-2000-..-E (1500-NA-..-E) ... up to TPD32-EV-.../...-3300-..-E (2350-NA-..-E):**

Resistance = 1667 / field current (A).

Table 2.3.3.4-E: Field current resistors (>2000A / 1500A, type E)

Switch ohms	168.5 Ohm	333 Ohm	182 Ohm	36.4 Ohm	845 Ohm	1668 Ohm			Equivalent resistance
Nom flux curr	S14-1	S14-2	S14-3	S14-4	S14-5	S14-6	S14-7	S14-8	
14 A	OFF	ON	ON	OFF	OFF	OFF	Not used		117.6 Ohm
24 A	ON	ON	ON	OFF	OFF	OFF			69.2 Ohm
46 A	OFF	OFF	OFF	ON	OFF	OFF			36.4 Ohm
70 A	ON	ON	ON	ON	OFF	OFF			23.8 Ohm

6) **For sizes TPD32-EV-CU-...**

Table 2.3.3.4-F: Field current resistors Sizes TPD32-EV-CU-...

Type of field circuit	Full scale value	168.5 Ohm	333 Ohm	182 Ohm	36.4 Ohm	845 Ohm	1668 Ohm	3333.3 Ohm	
		S14-1	S14-2	S14-3	S14-4	S14-5	S14-6	S14-7	S14-8
40A (TPD32-EV-CU-XXX/ XXX-THYX-40)	2A	OFF	OFF	OFF	OFF	OFF	ON	OFF	
	4A	OFF	OFF	OFF	OFF	ON	OFF	OFF	
	6A	OFF	OFF	OFF	OFF	ON	ON	OFF	
	10A	OFF	ON	OFF	OFF	OFF	OFF	OFF	
	20A	ON	OFF	OFF	OFF	OFF	OFF	OFF	
	30A	ON	ON	OFF	OFF	OFF	OFF	OFF	
	40A	ON	OFF	ON	OFF	OFF	ON	OFF	
70A (TPD32-EV-CU-XXX/ XXX-THYX-70)	1A	OFF	OFF	OFF	OFF	OFF	ON	OFF	
	5A	OFF	ON	OFF	OFF	OFF	OFF	OFF	
	10A	ON	OFF	OFF	OFF	OFF	OFF	OFF	
	20A	ON	OFF	ON	OFF	OFF	ON	OFF	
	50A	OFF	ON	OFF	ON	OFF	OFF	OFF	
	70A	ON	ON	ON	ON	OFF	OFF	OFF	

Field current full scale values other than those shown in the table can be obtained by connecting a resistor of a suitable value between terminals LA and LB on the regulation card. This value is calculated as follows:

Type of field circuit	Resistance R_{LA-LB} [Ohm]	Dip-switch S14
40A	R_{LA-LB} = 3333.3 / field current f.s.v. [A]	All OFF
70A	R_{LA-LB} = 1666.6 / field current f.s.v. [A]	

Output voltage

The below mentioned output voltages take into account an AC input undervoltage within the stated tolerance limits and a voltage drop of 4% due to the inserted AC input reactors. It is the same as the rated armature voltage suggested for the connected motor.

• *Armature circuit*

Table 2.3.3.5: Armature circuit output voltages

AC input voltage (terminals U / V / W)	Max output voltage U_{dN} (terminals C/D)	
	Two quadrant converter	Four quadrant converter
3 x 230 V ±10 %	260 V	240 V
3 x 400 V ±10 %	470 V *	420 V *
3 x 440 V ±10 %	530 V	460 V
3 x 460 V ±10 %	560 V	480 V
3 x 480 V ±10 %	580 V	500 V
3 x 500 V ±10 %	600 V	520 V *
3 x 575 V ±10%	680 V	600 V
3 x 690 V ±10%	810 V	720 V

* Voltage measured as DIN 40 030 (09/93)

• *Field circuit*

Table 2.3.3.6: Field circuit output voltages

AC input voltage (terminals U1 / V1)	Output field voltage U_{FN} ** (terminals C1 / D1)	
	Fixed field	Adjustable field
1 x 230 V ±15 %	200 V *	200 V *
1 x 400 V ±15 %	310 V *	310 V *
1 x 460 V ±10%	360 V	360 V

* Voltage measured as DIN 40 030 (09/93)
** The max field voltage is equal to 0.85 x U_{LN}

• *Field circuit TPD32-EV-FC version*

Table 2.3.3.7: Field circuit output voltages TPD32-EV-FC

AC input voltage (terminals U / V /N)	Max Output field voltage U_{dN} ** (terminals C / D)	
	2B	4B
3 x 110 V	-	115 V
3 x 200 V	-	210 V
3 x 230 V	260 V	240 V
3 x 400 V	470 V	420 V
3 x 500 V	600 V	520 V

2.3.4 Control section

Enables		0 / 15...30 V	3.2...6.4 mA (approx. 5 mA at 24 V)
Analog inputs	option	0... ± 10 V	0.25mAmax
		0...20 mA	10 V max
		4...20 mA	10 V max
Analog outputs		0...± 10 V	5 mA max each output
Digital inputs		0 / 15...30 V	3.2...6.4 mA (approx. 5 mA at 24 V)
Digital outputs	supply	+ 15...35 V	
	signal	+ 15...35 V	20 mA max each output

Encoder inputs

Sinusoidal	voltage	1 V pp	
	current	8.3 mA pp each channel (input resistance = 124 ohm)	
	pulses per rev	min 600	max 9999
	max frequency	150 kHz	
	max cable length	screened, 150m (0.75 mm^2) / 125m (0.5 mm^2) / 55m (0.22 mm^2)	
Digital	voltage	5V TTL / 15...24V HTL (H logic)	
	current	4.5 mA / 6.8 ... 10.9 mA each channel with H logic	
	pulses per rev	min 600	max 9999
	max frequency	150 kHz	
	max cable length	screened, 150m (0.75 mm^2) / 125m (0.5 mm^2) / 55m (0.22 mm^2)	

Analog tachogenerator input

voltage	22.7 / 45.4 / 90.7 / 181.6 / 302.9 V max, depending on the switch S4 setting
current	8 mA full scale
max cable length	screened, the max length depends on the installation, typical 150m

Internal supply voltage

max load	+ 5 V	160 mA	encoder connector, PIN 7/9 (only for sinusoidal encoder)
	+ 10 V	10 mA	terminal 7
	- 10 V	10 mA	terminal 8
	+ 24 V	200 mA	terminal 19
			encoder connector, PIN 2/9 (only for digital encoder)
tolerance	+ 10 V	± 3 % [1)]	
	- 10 V	± 3 % [1)]	
	+ 24 V	+ 20 ... 30 V, not stabilized	

[1)] The values of the voltages + 10V and -10V are the same. The stated tolerance refers to the voltage width.

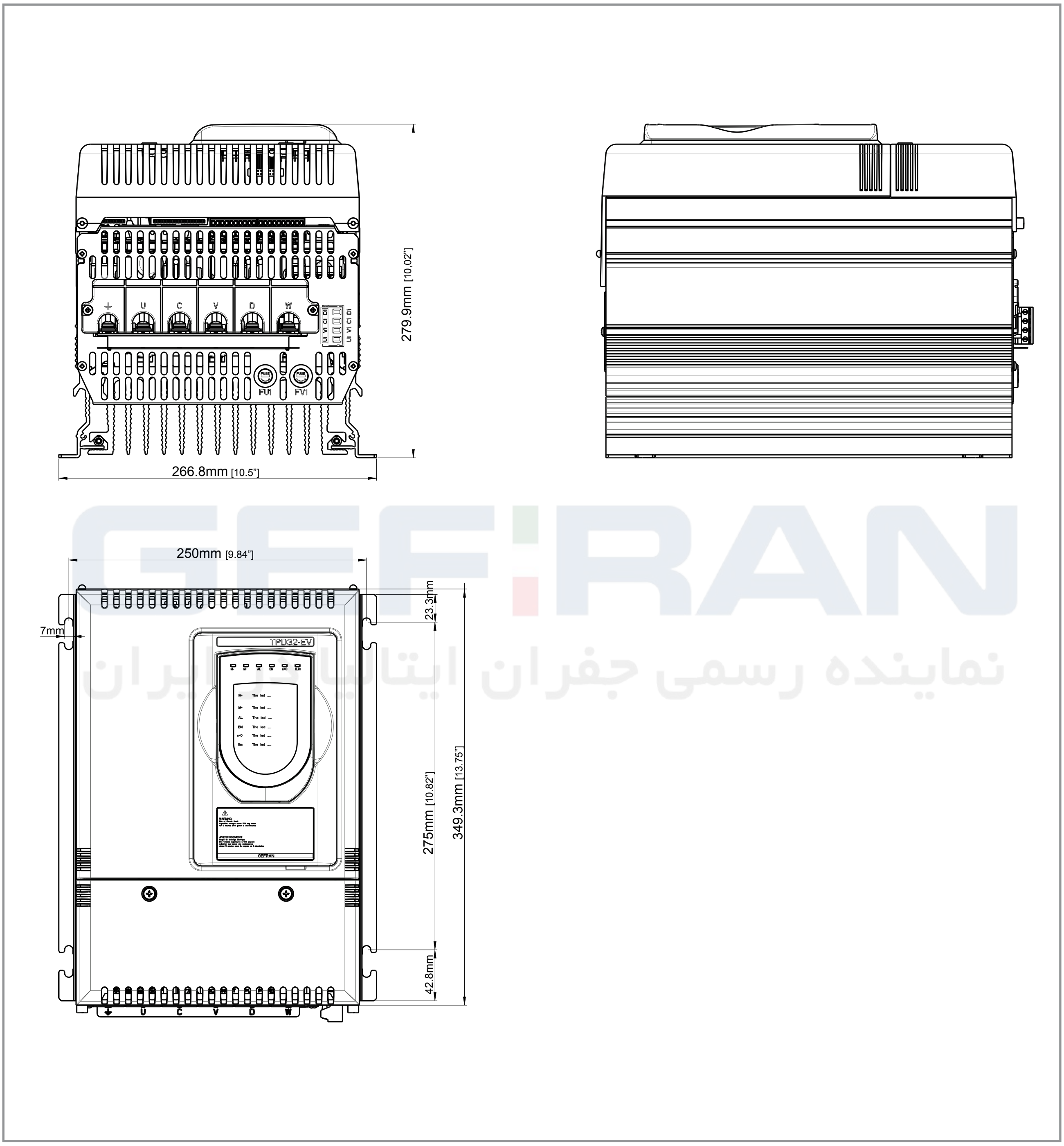
2.3.5 Accuracy

Internal reference voltage (± 10V, terminals 7 or 8):	
temperature dependent stability error	100 ppm/°C
References	
via keypad/serial line/Bus	
resolution:	16 Bit or 15 Bit + sign
via terminals (1/2, 3/4, 5/6)	
resolution:	11 Bit + sign
linearity	±0.1% of the full range value
Analog outputs (TBO only)	
resolution:	11 Bit + sign
linearity:	±0.5% of the full range value
Speed regulation	
for all the operation mode	
max speed	8000 rpm
digital reference resolution:	0.25 rpm
analog reference resolution:	≥0.25 rpm
with sinusoidal encoder	
speed feedback resolution:	0.25 rpm
accuracy	typical 0.01%
control range	better than 1:10000
with digital encoder	
speed feedback resolution	0.5 rpm
accuracy	typical 0.02%
control range	better than 1:1000
with tachogenerator	
speed feedback resolution	better than 1:2000
accuracy	typical 0.1%
control range	better than 1:1000
Torque regulation	
resolution	better than 1:2000
accuracy	typical 0.2%
control range	better than 1:500

2.4 DIMENSION AND WEIGHTS

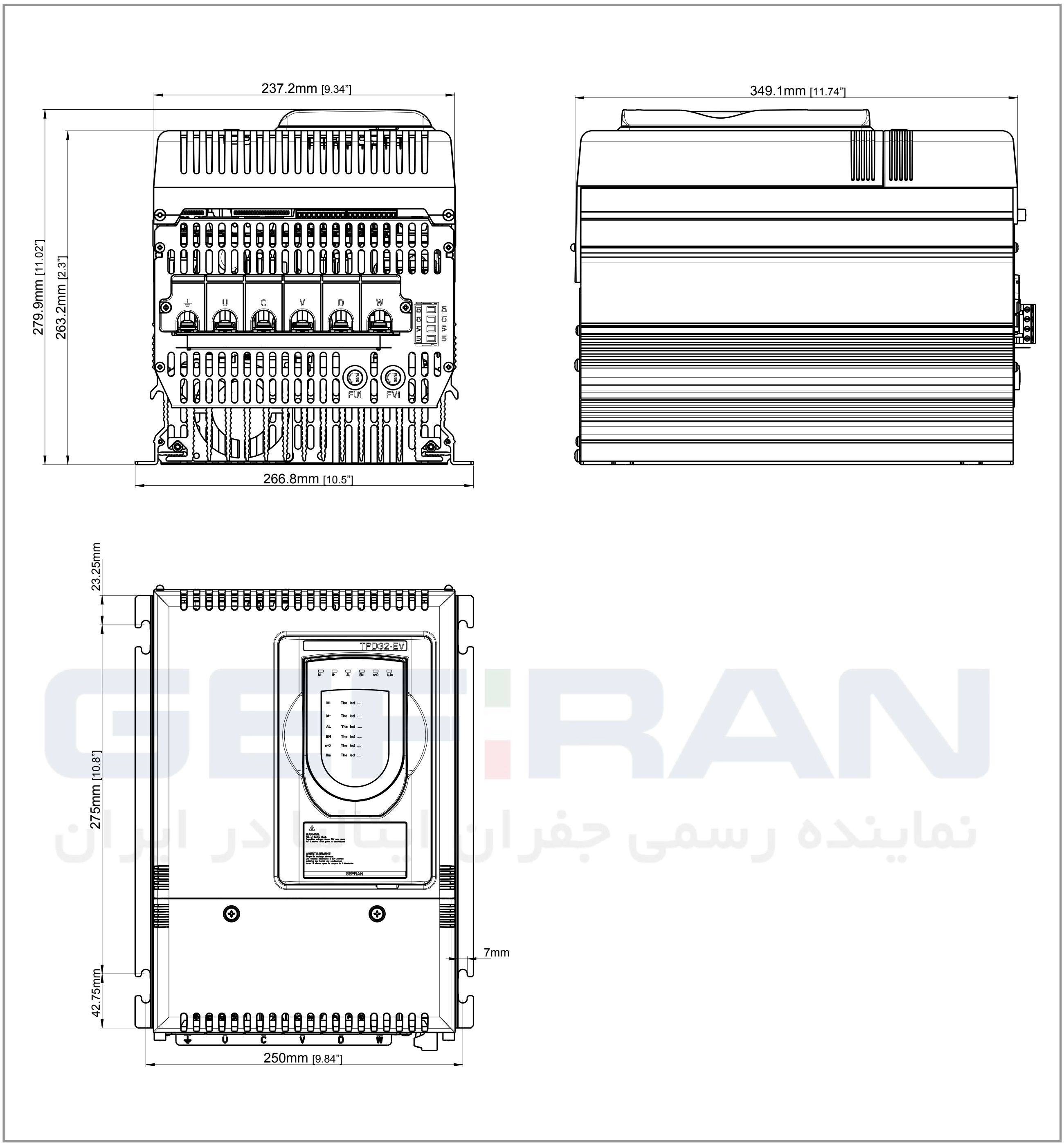
NOTE! TPD32-EV-FC-... : reference should be made to the corresponding TPD32-EV Standard sizes.

Figure 2.4.1: Type A1 dimensions



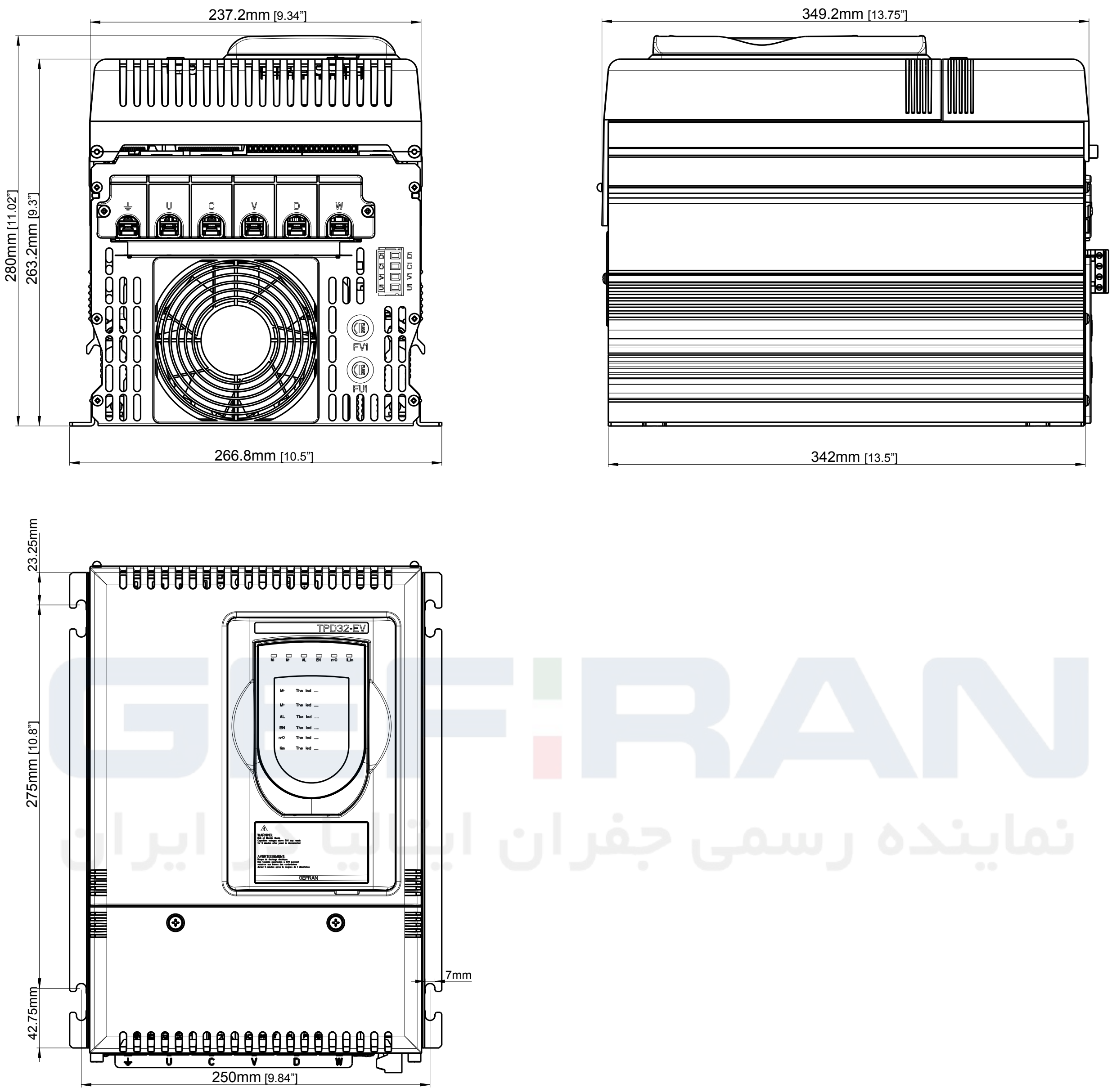
American	Standard	Weight kg [lbs]
TPD32-EV-.../...-17-..-A	TPD32-EV-.../...-20-..	11 [24.2]
TPD32-EV-.../...-35-..-A	TPD32-EV-.../...-40-..	11 [24.2]

Figure 2.4.2: Type A2 dimensions



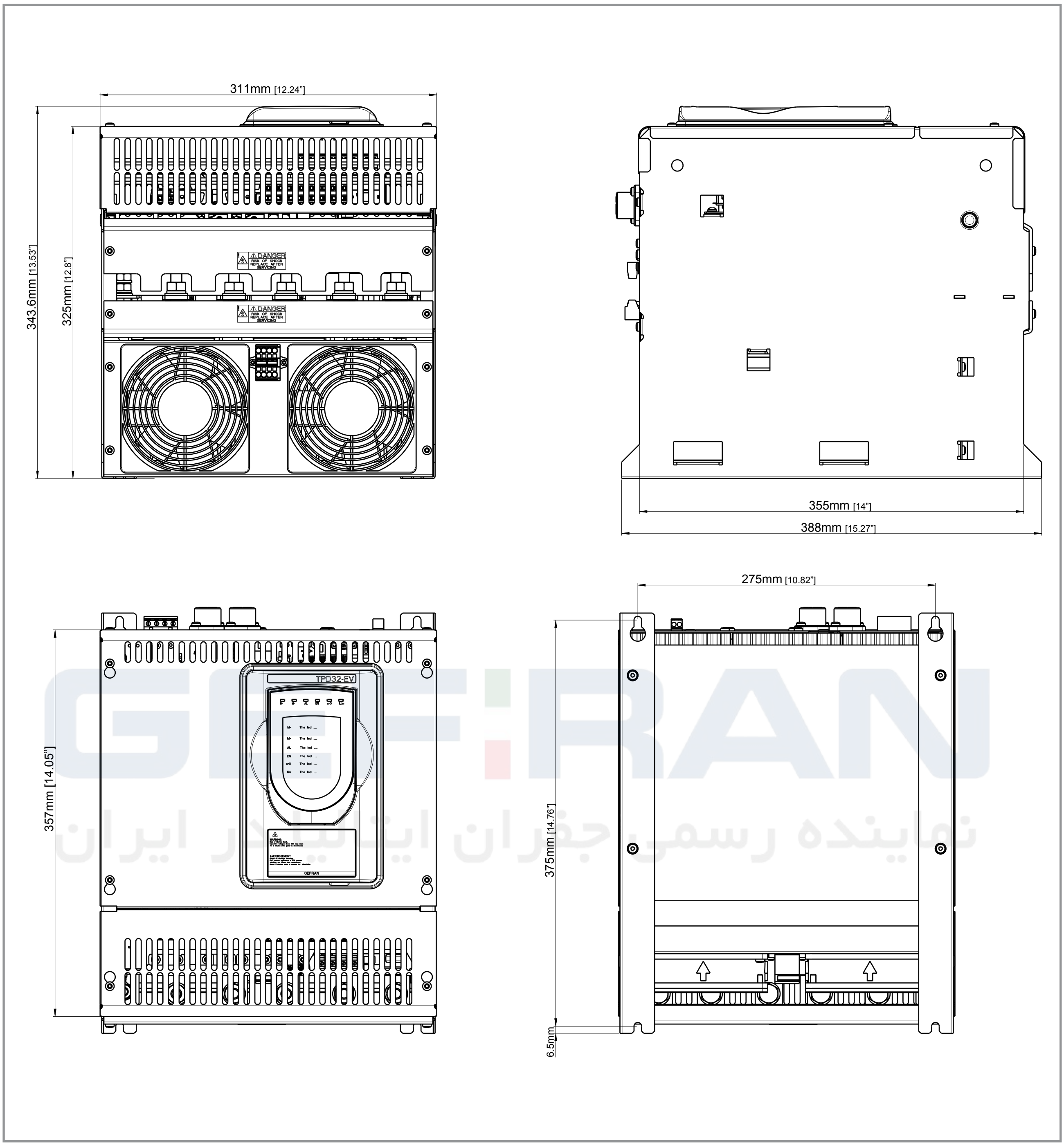
American	Standard	Weight kg [lbs]
TPD32-EV-.../...-56-..-A	**TPD32-EV-.../...-70-..-A**	11.5 [25.3]

Figure 2.4.3: Type A3 dimensions



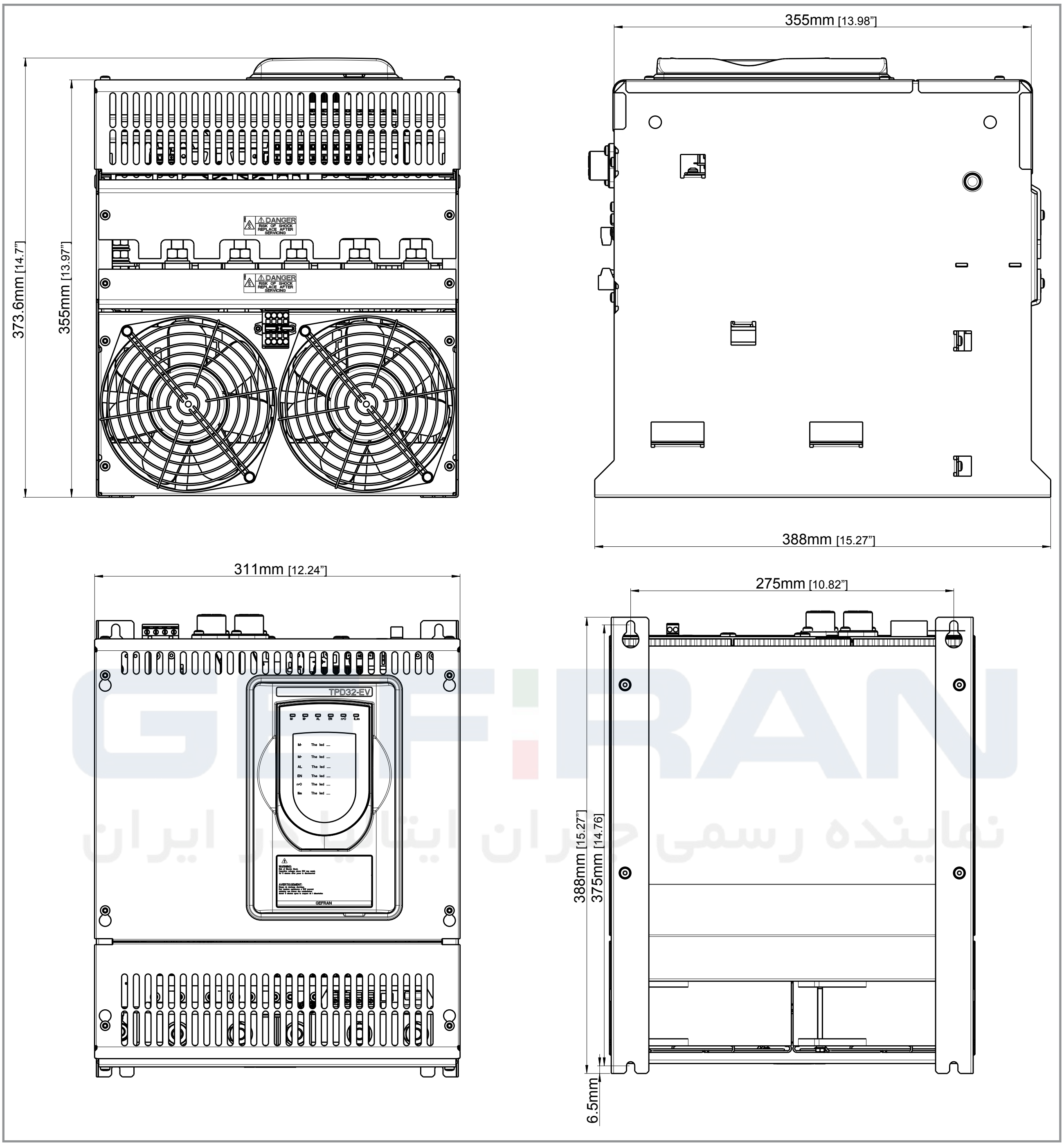
American	Standard	Weight kg [lbs]
TPD32-EV-.../...-88-..-A	TPD32-EV-.../...-110-..-A	12 [26.5]
TPD32-EV-.../...-112-..-A	TPD32-EV-.../...-140-..-A	12 [26.5]
TPD32-EV-.../...-148-..-A	TPD32-EV-.../...-185-..-A	12 [26.5]

Figure 2.4.4: Type B1 dimensions



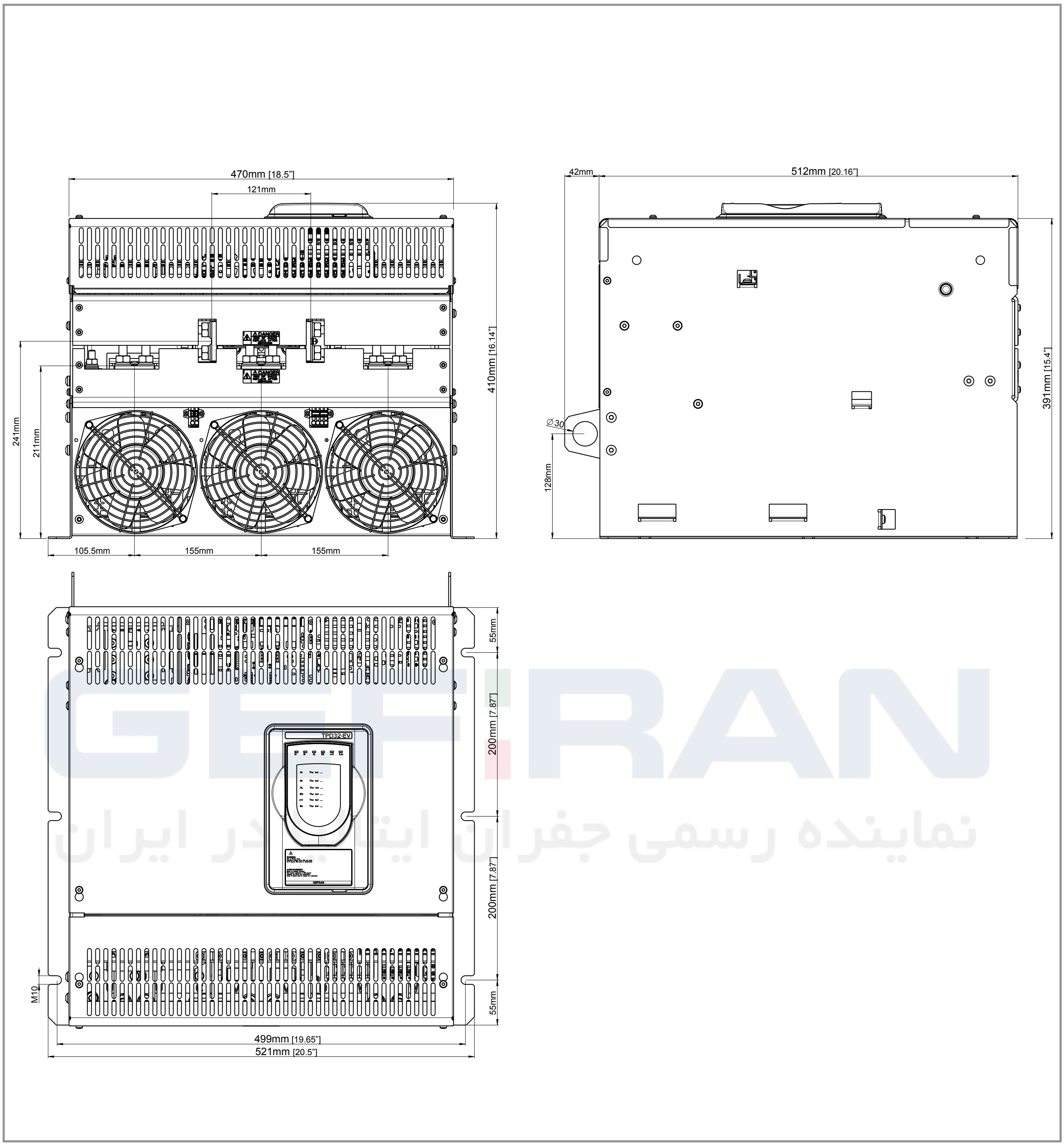
American	Standard	Weight kg [lbs]
TPD32-EV-.../...-224-..-B	TPD32-EV-.../...-280-..-B	26 [57.3]
TPD32-EV-.../...-280-..-B	TPD32-EV-.../...-350-..-B	26 [57.3]
TPD32-EV-.../...-336-..-B	TPD32-EV-.../...-420-..-B	26 [57.3]
TPD32-EV-.../...-400-..-B	TPD32-EV-.../...-500-..-B	26 [57.3]

Figure 2.4.5: Type B2 dimensions



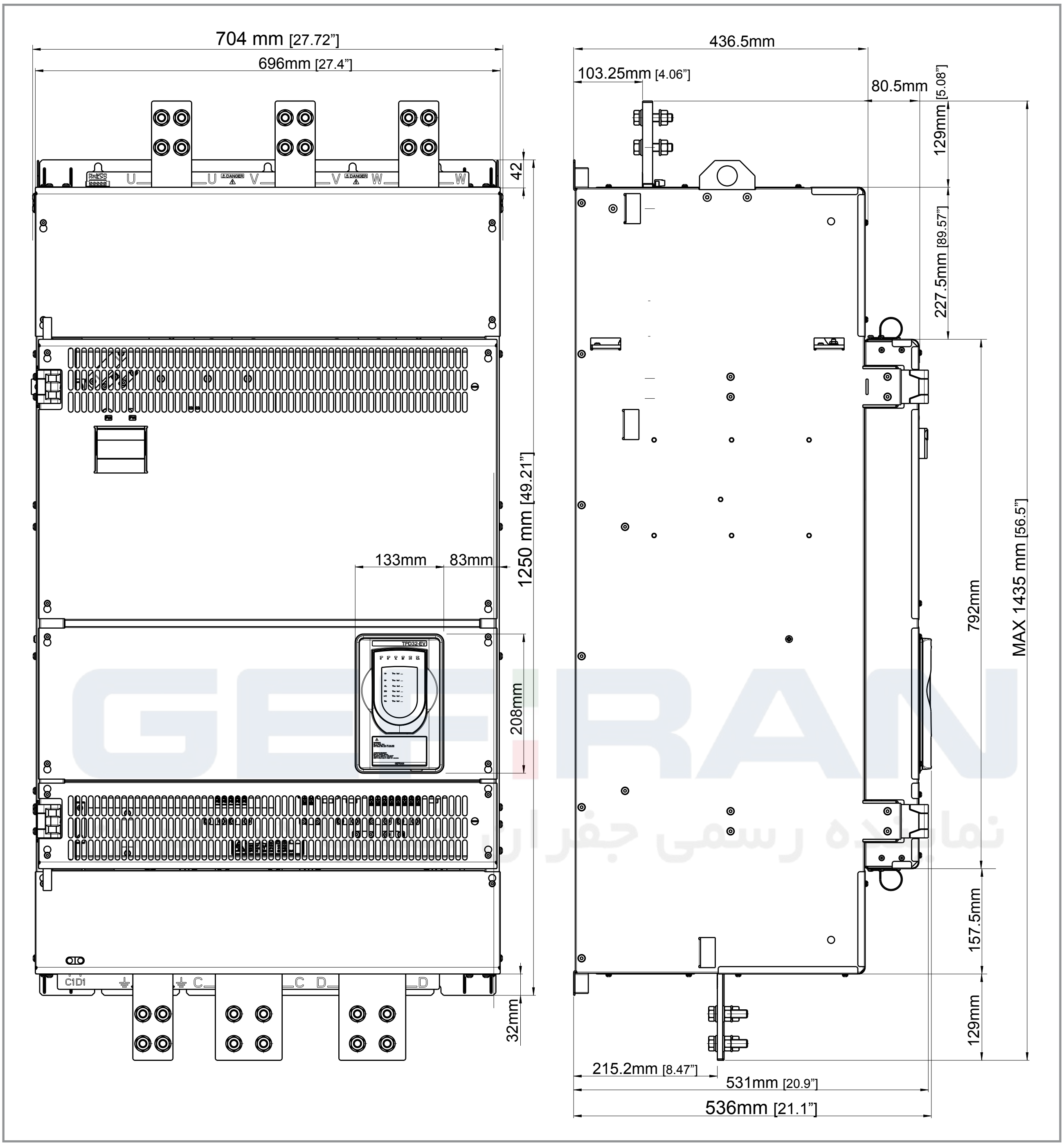
American	Standard	Weight kg [lbs]
TPD32-EV-.../...-450-..-B	**TPD32-EV-.../...-650-..-B**	32 [70.5]

Figure 2.4.6: Type C dimensions



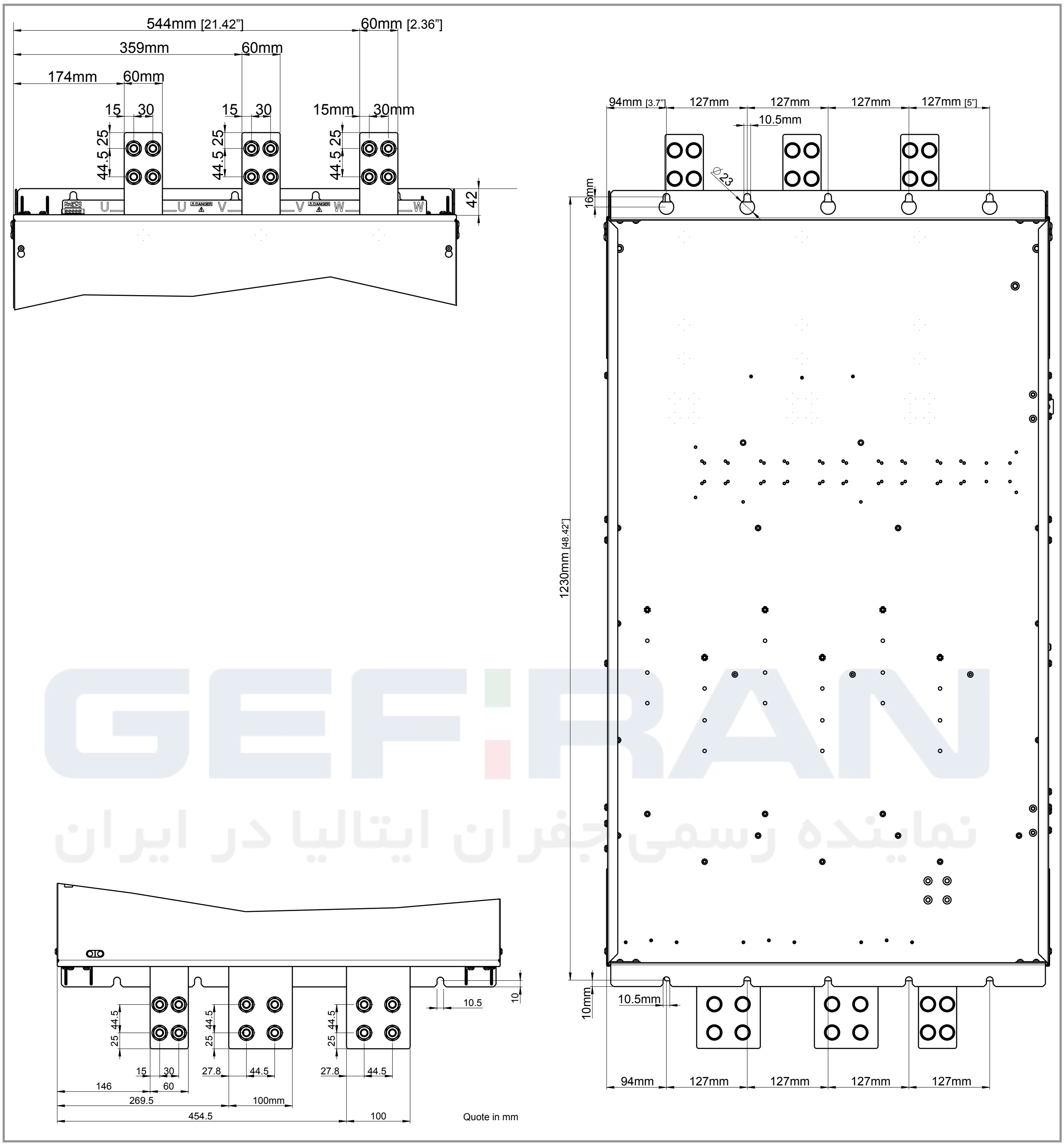
American	Standard	Weight kg [lbs]
TPD32-EV-.../...-360-..-C	TPD32-EV-.../...-560-..-C	61 [134.5]
TPD32-EV-.../...-490-..-C	TPD32-EV-.../...-700-..-C	61 [134.5]
TPD32-EV-.../...-560-..-C	TPD32-EV-.../...-770-..-C	61 [134.5]
TPD32-EV-.../...-650-..-C	TPD32-EV-.../...-900-..-C	65 [143.3]
TPD32-EV-.../...-750-..-C	TPD32-EV-575/...-1000-..-C	72 [158.7]
TPD32-EV-.../...-750-..-C	TPD32-EV-575/...-1050-..-C	72 [158.7]
TPD32-EV-.../...-800-..-C	TPD32-EV-500/...-1000-..-C	72 [158.7]
TPD32-EV-.../...-850-..-C	TPD32-EV-500/...-1050-..-C	72 [158.7]

Figure 2.4.7-A: Type D dimensions



American	Standard	Weight kg [lbs]	
		2B	4B
TPD32-EV-.../...-920-..-D	TPD32-EV-.../...-1300-..-D	152 [335.1]	203 [447.5]
TPD32-EV-.../...-980-..-D	TPD32-EV-575/...-1300-..-D	152 [335.1]	203 [447.5]
TPD32-EV-.../...-1000-..-D	TPD32-EV-.../...-1400-..-D	165 [363.8]	215 [474.0]
TPD32-EV-.../...-1200-..-D	TPD32-EV-.../...-1600-..-D	165 [363.8]	215 [474.0]
TPD32-EV-.../...-1450-..-D	TPD32-EV-.../...-1900-..-D	165 [363.8]	215 [474.0]
TPD32-EV-.../...-1500-..-D	TPD32-EV-.../...-2000-..-D	165 [363.8]	215 [474.0]
TPD32-EV-.../...-1650-..-D	TPD32-EV-.../...-2100-..-D	191 [421.1]	241 [531.3]
TPD32-EV-.../...-1800-..-D	TPD32-EV-.../...-2300-..-D	191 [421.1]	241 [531.3]
TPD32-EV-.../...-1850-..-D	TPD32-EV-.../...-2400-..-D	191 [421.1]	241 [531.3]

Figure 2.4.7-B: Centre-to-centre distance for mounting, type D



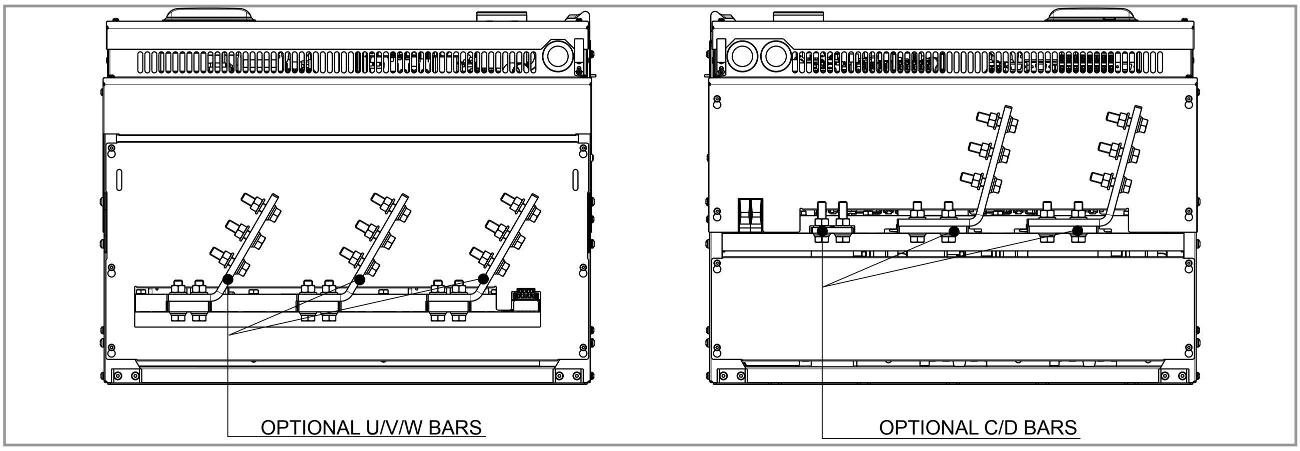
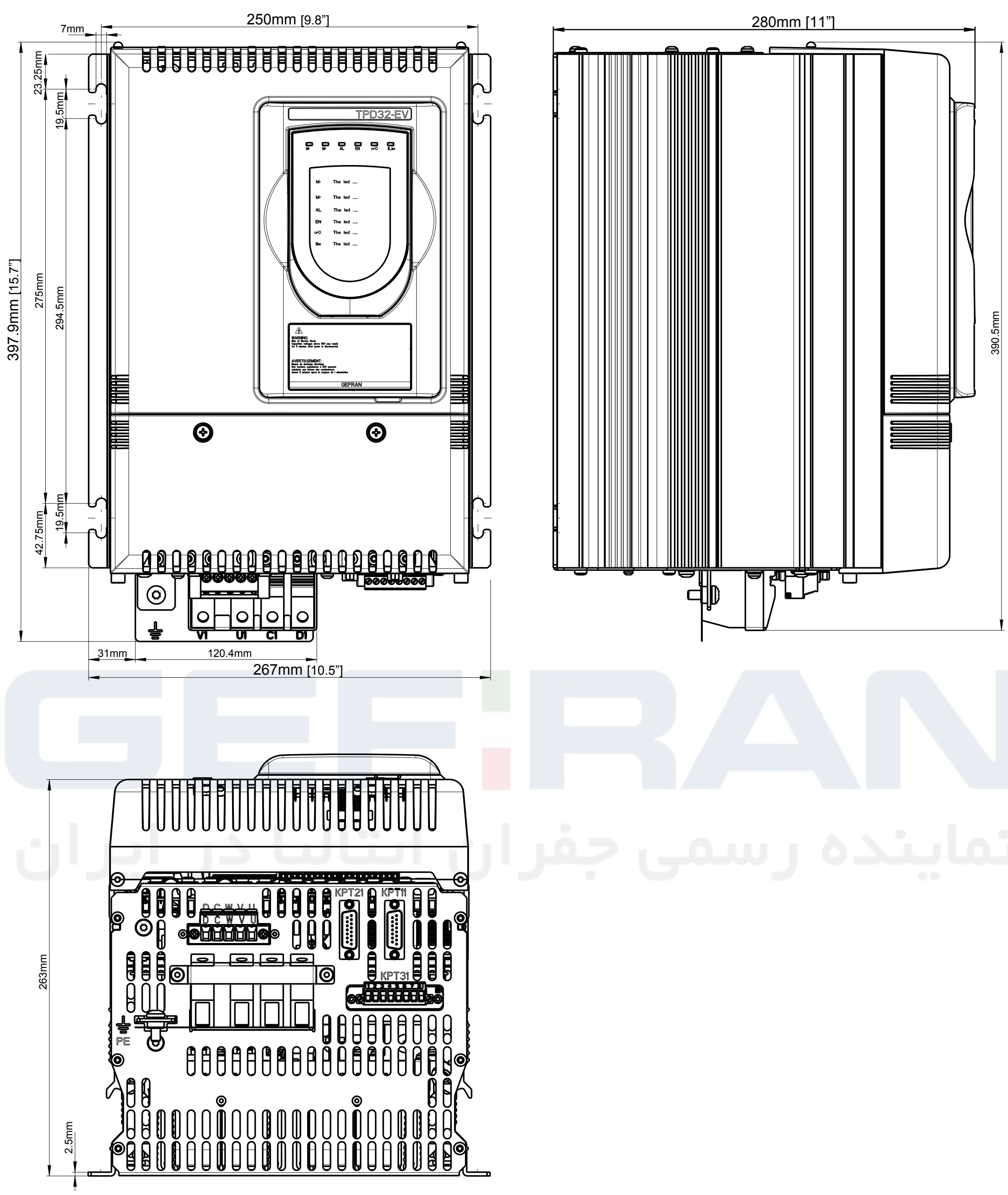
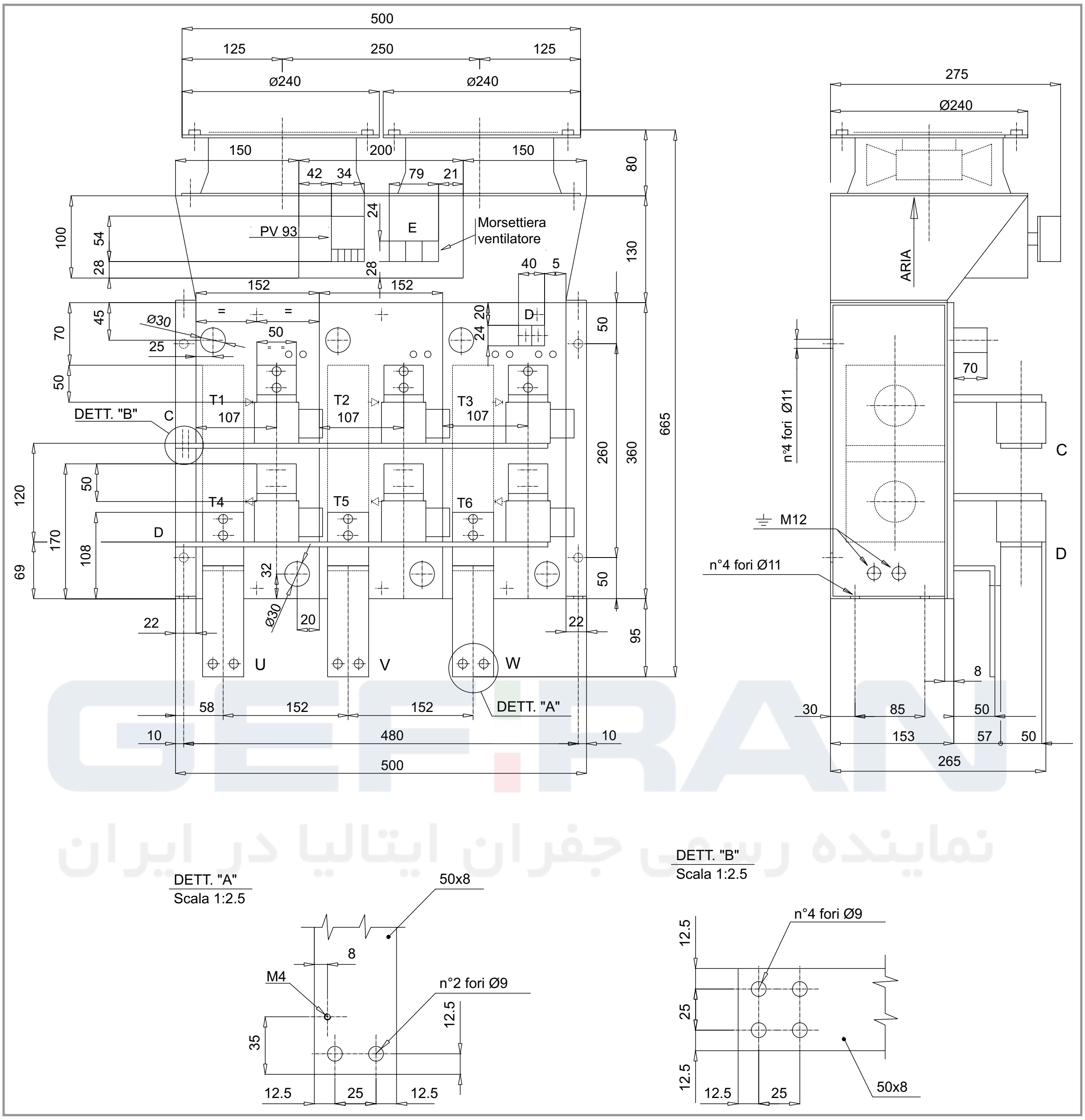


Figure 2.4.8: TPD32-EV-CU-... dimensions, External bridge control unit



Model	Type	Weight kg [lbs]
TPD32-EV-CU-.../...-THY1-40	A1	11 [24.2]
TPD32-EV-CU-.../...-THY2-40	A1	11 [24.2]
TPD32-EV-CU-.../...-THY1-70	A1	11 [24.2]
TPD32-EV-CU-.../...-THY2-70	A1	11 [24.2]

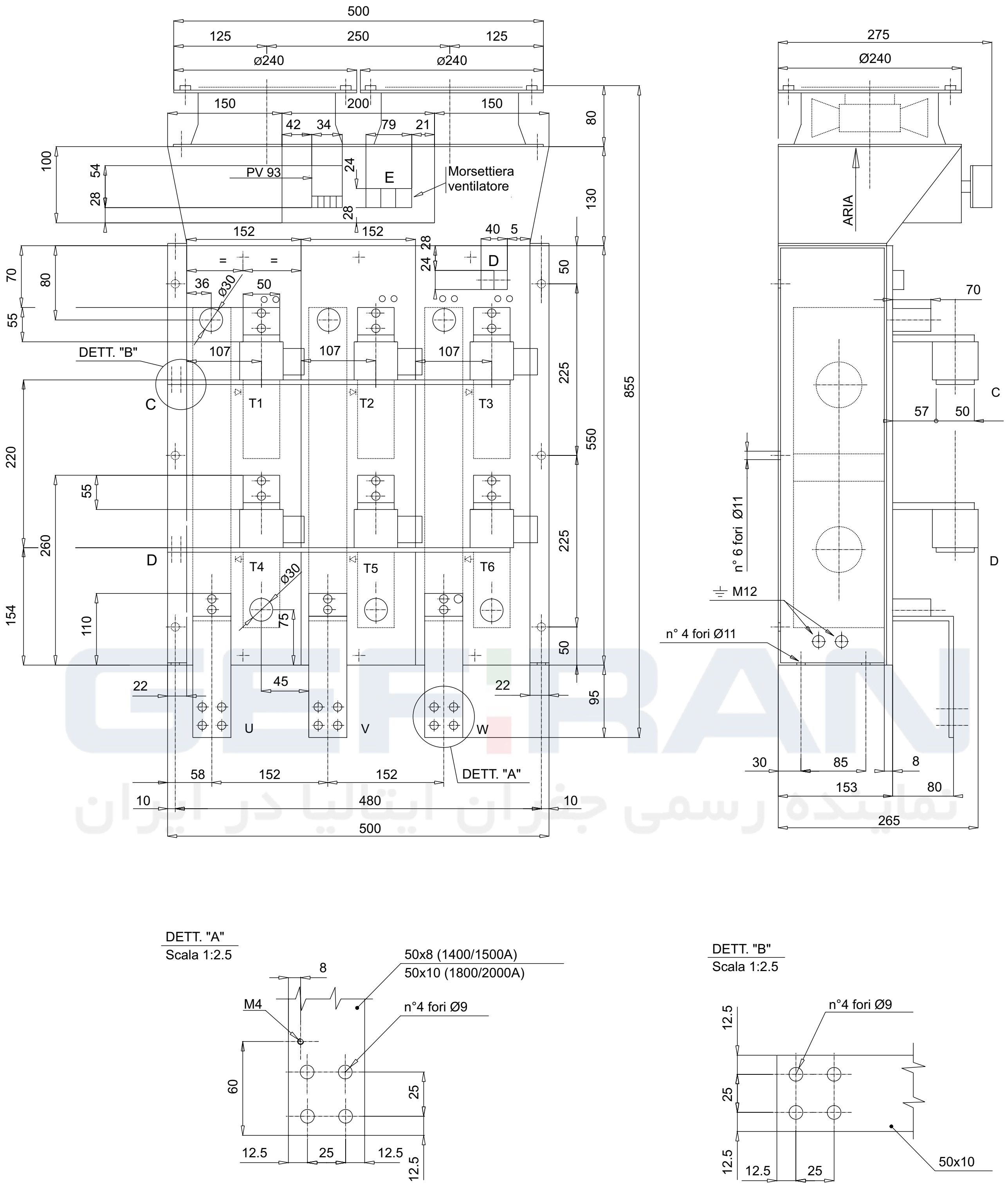
Figure 2.4.9: TPD32-EV-500/600-1200-2B-E dimensions



Values in mm.

Characteristics	
WEIGHT	65 kg
FAN UNIT	Tot. capacity 900 m³/h
	Single-phase motor 230 V 50/60 Hz, 0.4A 62÷65 dBA

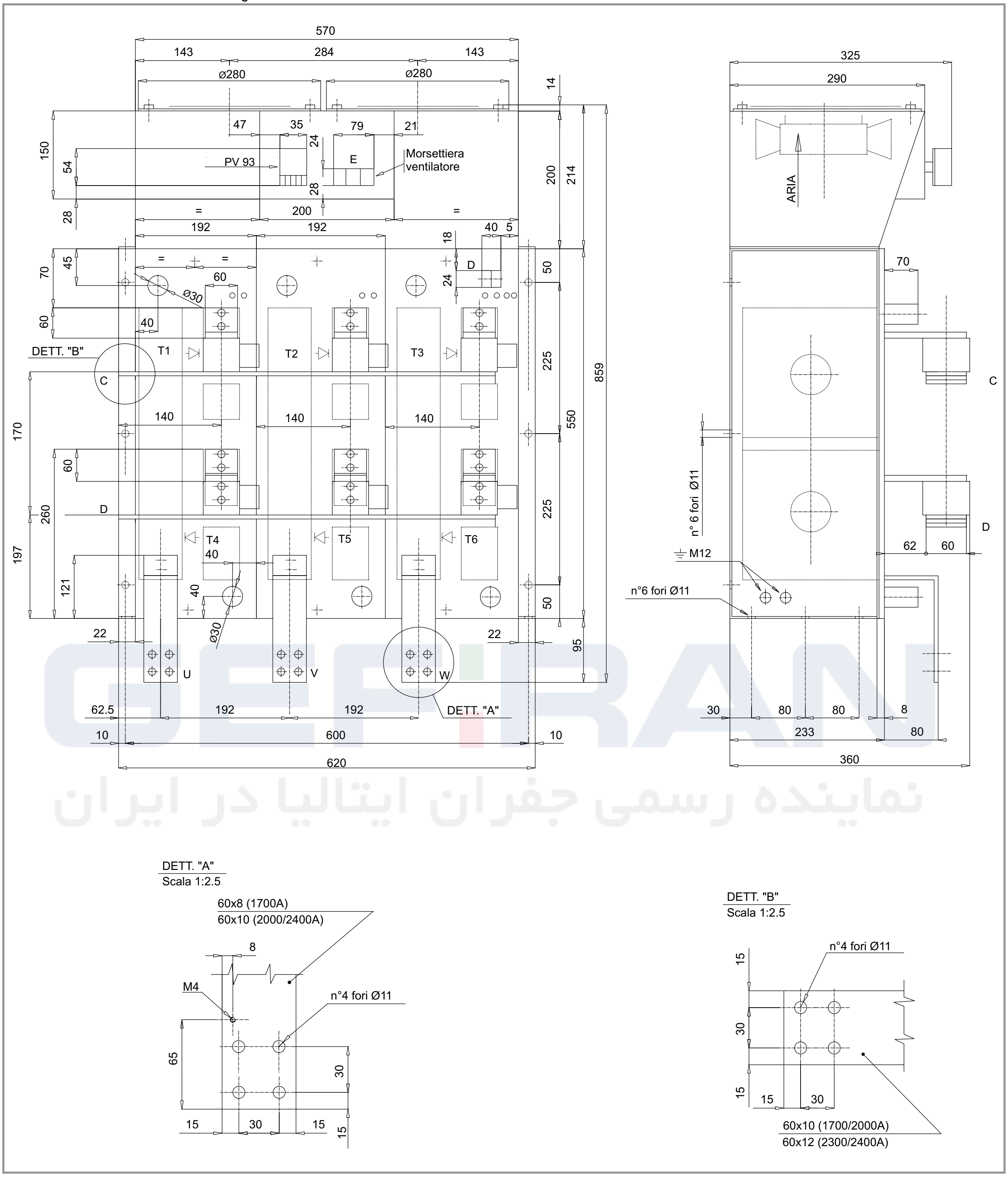
Figure 2.4.10: TPD32-EV-500/600-1500...2000-2B-E and TPD32-EV-690/810-1010...1400-2B-E dimensions



Values in mm.

Characteristics	
WEIGHT	75 kg
FAN UNIT	Tot. capacity 900 m³/h
	Single-phase motor 230 V 50/60 Hz, 0.4A 62÷65 dBA

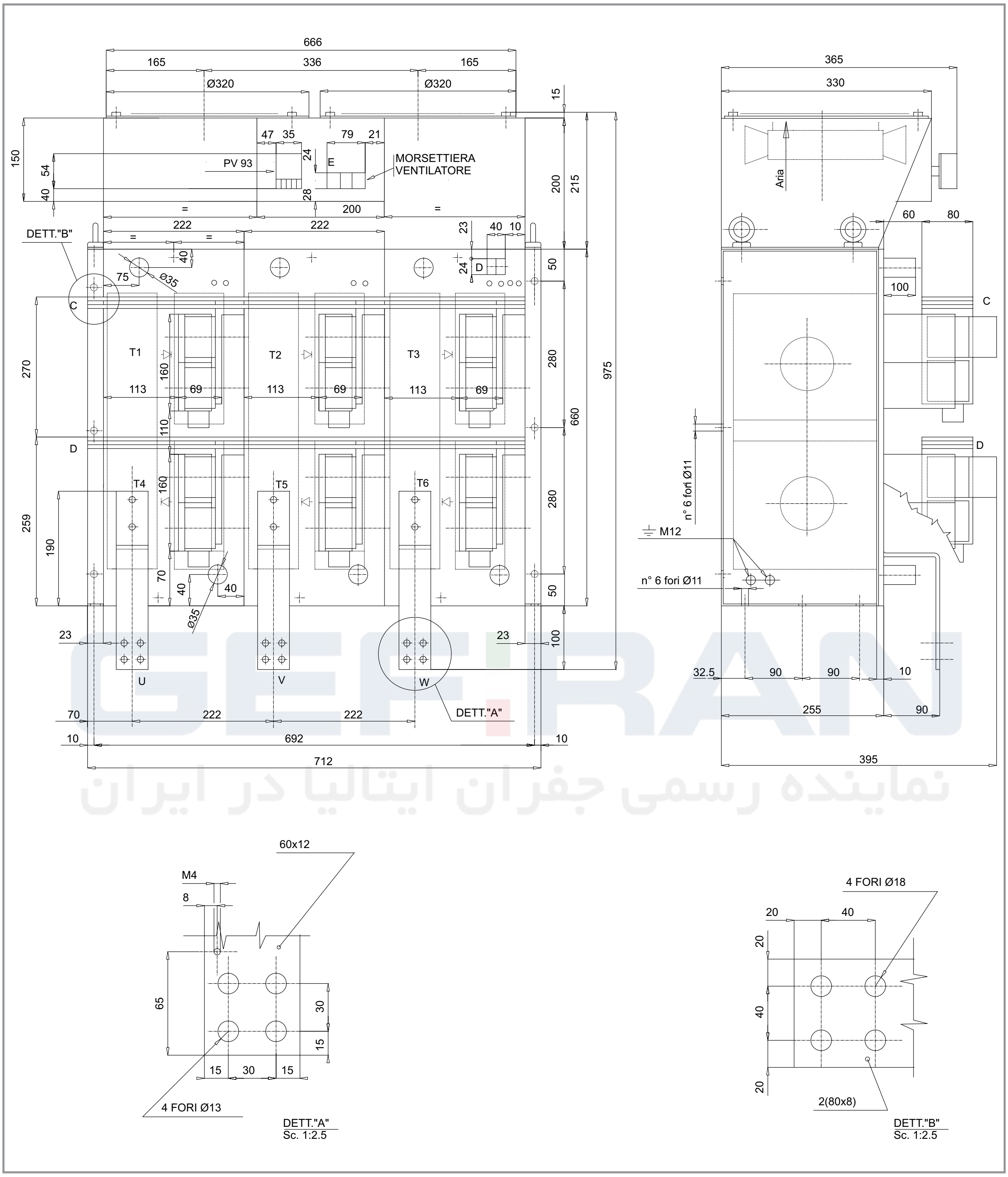
Figure 2.4.11: TPD32-EV-500/600-2400-2B-E and TPD32-EV-690/810-1700...2000-2B-E dimensions



Values in mm.

Characteristics	
WEIGHT	115 kg
FAN UNIT	Tot. capacity 1450 m³/h
	Single-phase motor 230 V 50/60 Hz, 0.5/0.6 A 65÷69 dBA

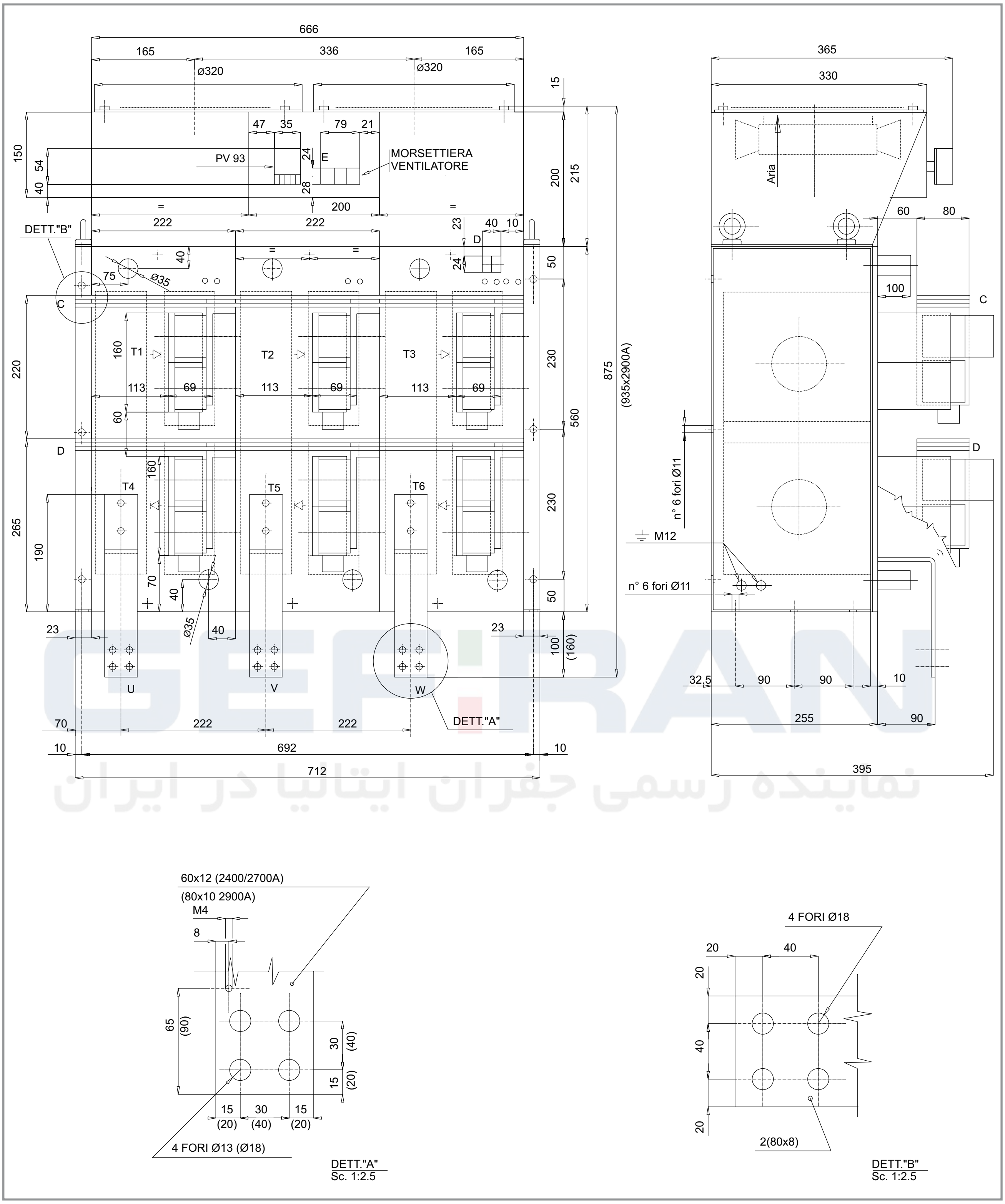
Figure 2.4.12: TPD32-EV-500/600-2700-2B-E dimensions



Values in mm.

Characteristics	
WEIGHT	155 kg
FAN UNIT	Tot. capacity 2600 m³/h
	Single-phase motor 230 V 50/60 Hz; 1/1.3A 72÷74dBA

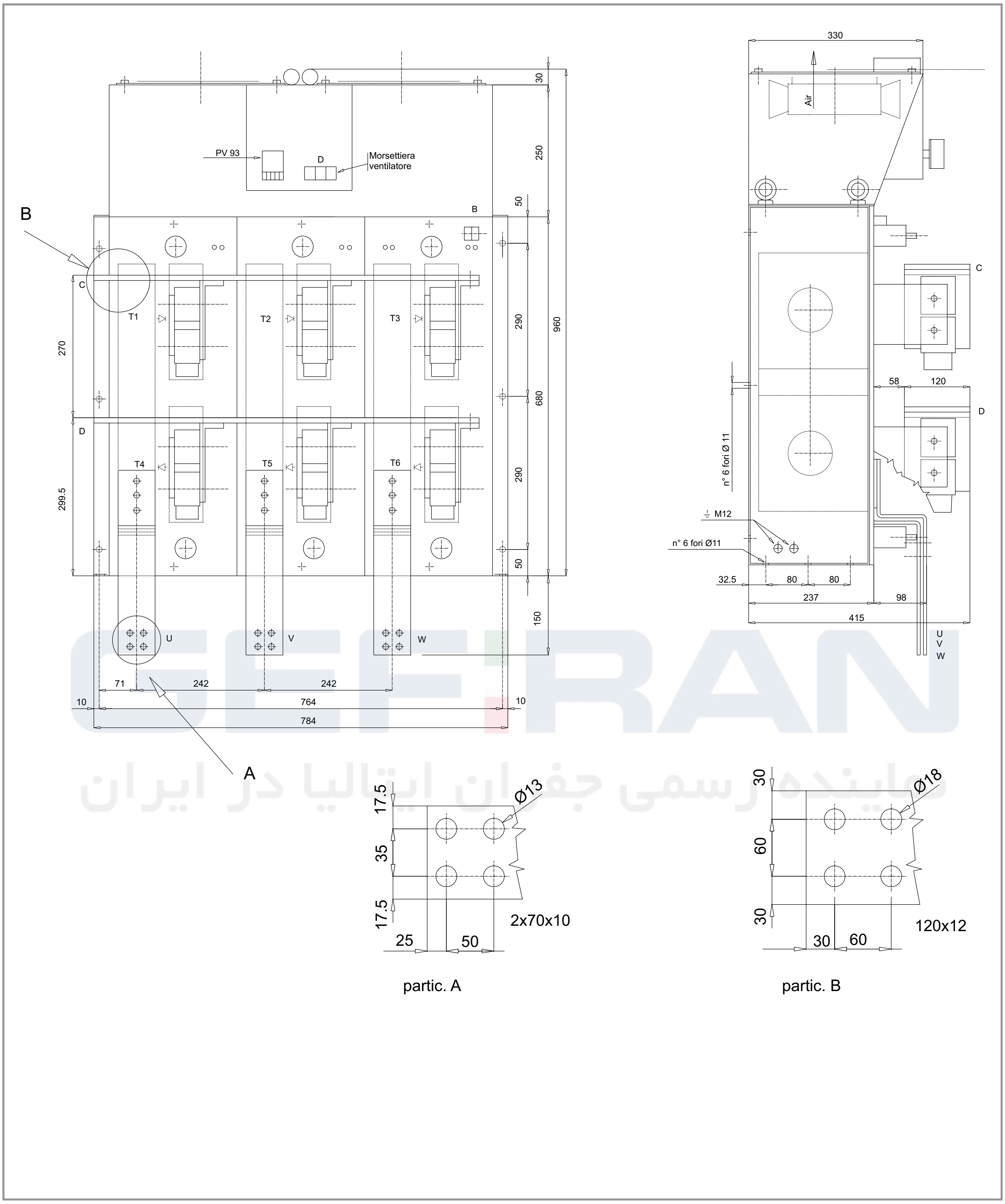
Figure 2.4.13: TPD32-EV-500/600-2900-2B-E and TPD32-EV-690/810-2400...2700-2B-E dimensions



Values in mm.

Characteristics	
WEIGHT	140 kg
FAN UNIT	Tot. capacity 2600 m³/h
	Single-phase motor 230 V 50/60 Hz; 1/1.3A 72÷74dBA

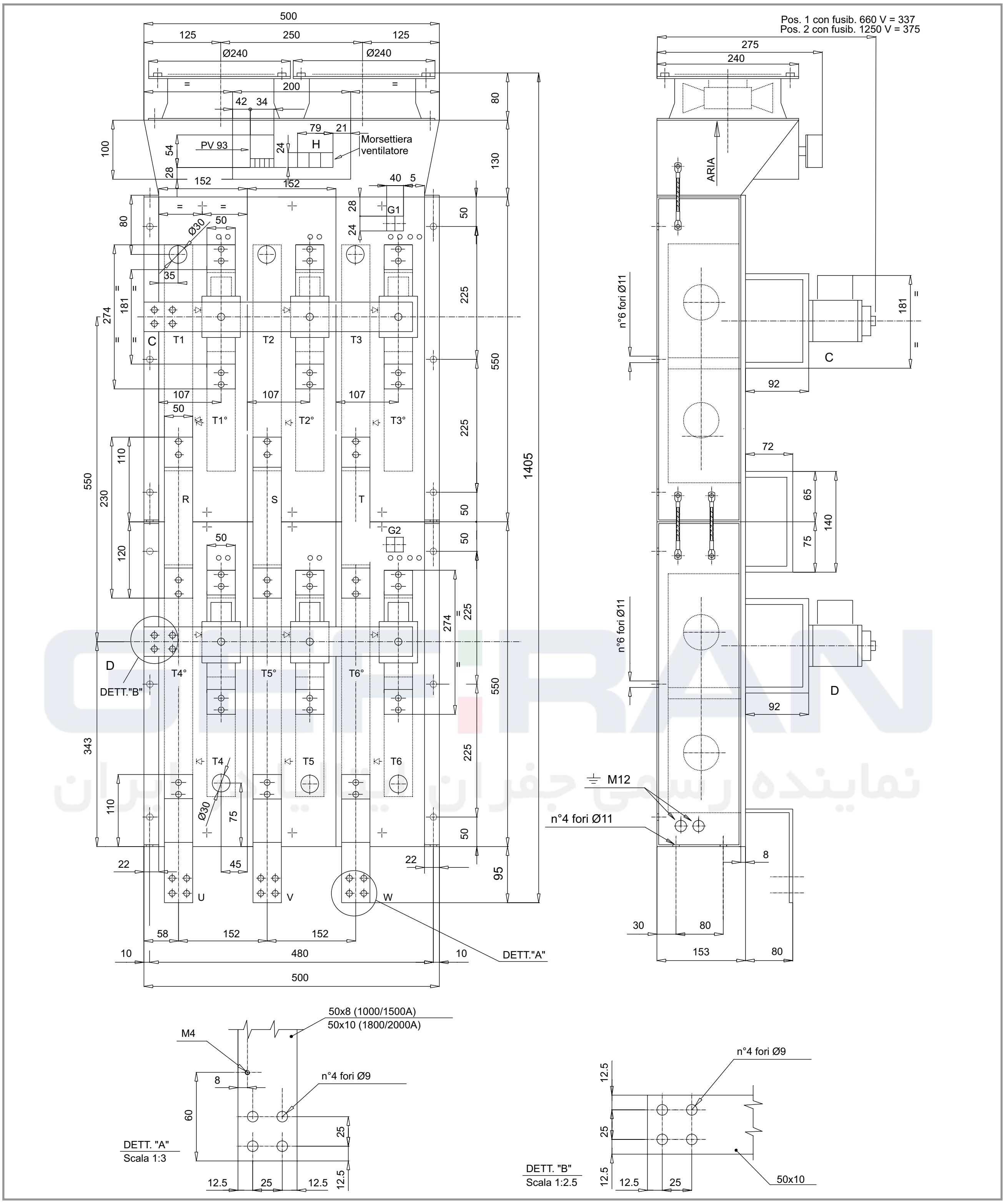
Figure 2.4.14: TPD32-EV-500/600-3300-2B-E and TPD32-EV-690/810-3300-2B-E dimensions



Values in mm.

Characteristics	
WEIGHT	197 kg
FAN UNIT	Tot. capacity 2600 m³/h
	Single-phase motor 230 V 50/60 Hz 1 A 72÷74 dBA

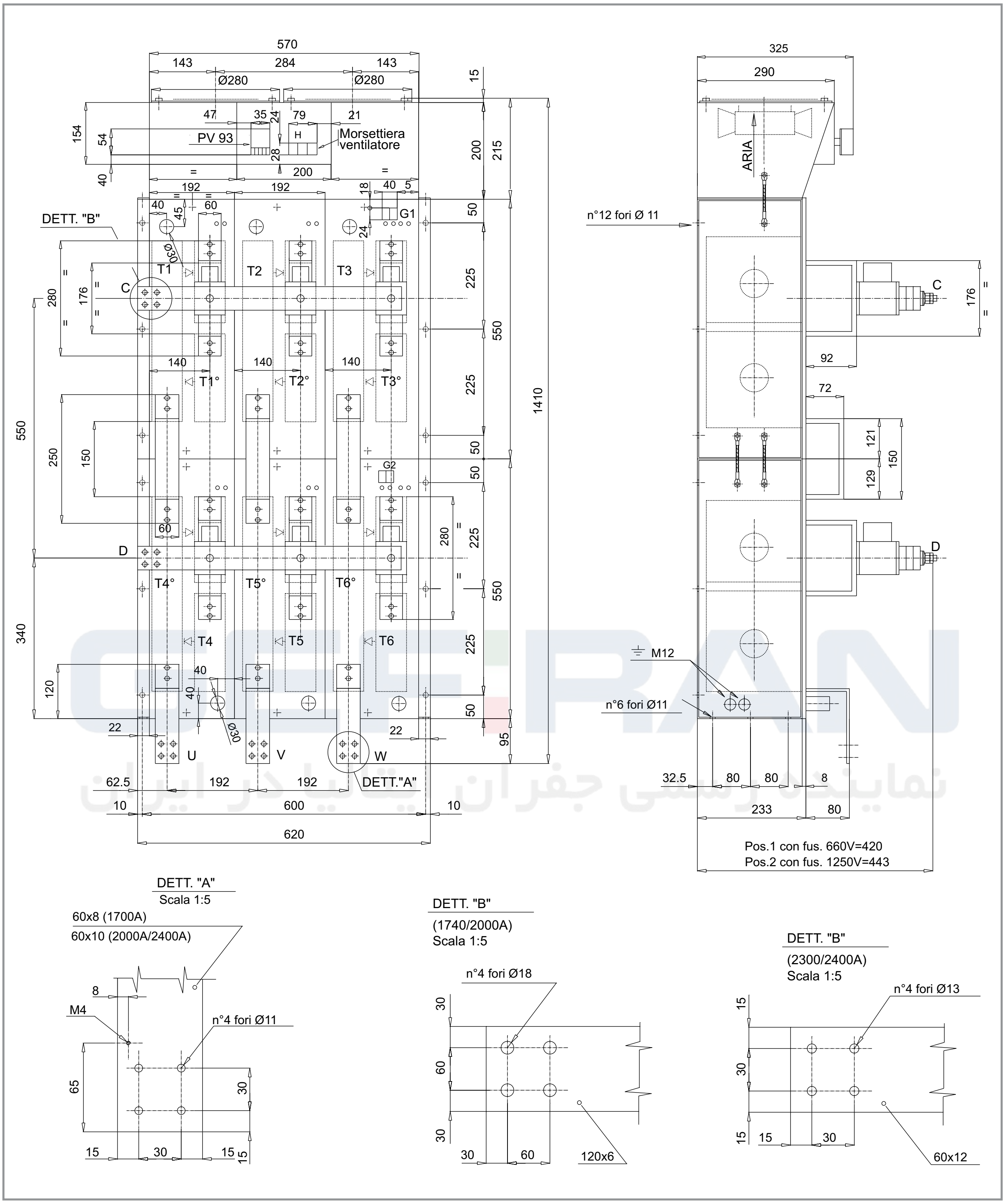
Figure 2.4.15: TPD32-EV-500/520-1500...2000-4B-E and TPD32-EV-690/720-1010...1400-4B-E dimensions



Values in mm.

Characteristics	
WEIGHT	130 kg
FAN UNIT	Tot. capacity 900 m³/h
	Single-phase motor 230 V 50/60 Hz, 0.4A 62÷65dBA

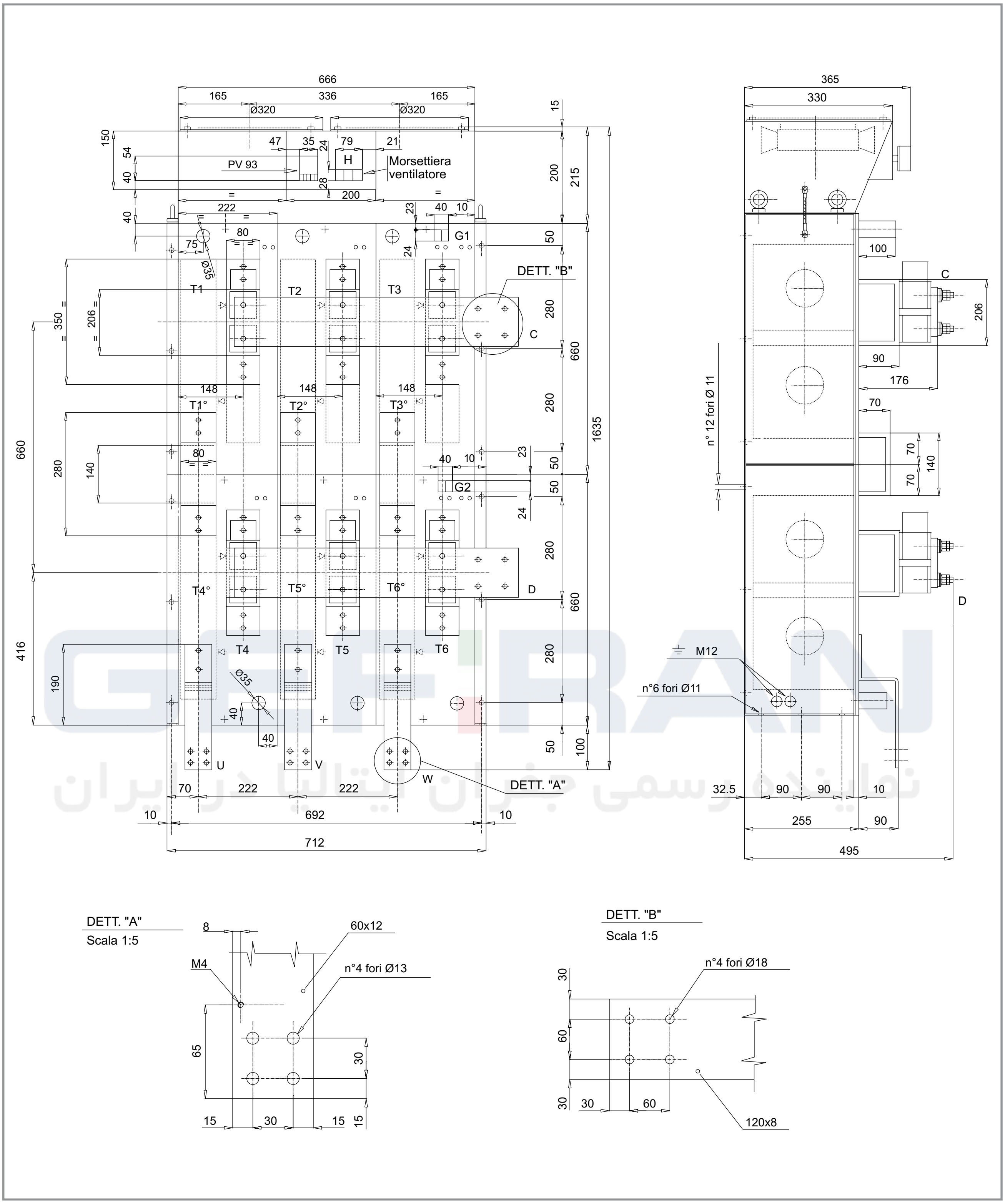
Figure 2.4.16: TPD32-EV-500/520-2400-4B-E and TPD32-EV-690/720-1700...2000-4B-E dimensions



Values in mm.

Characteristics	
WEIGHT	220 kg
FAN UNIT	Tot. capacity 1450 m³/h
	Single-phase motor 230 V 50/60 Hz 0.5/06 A tot. 65÷69dBA

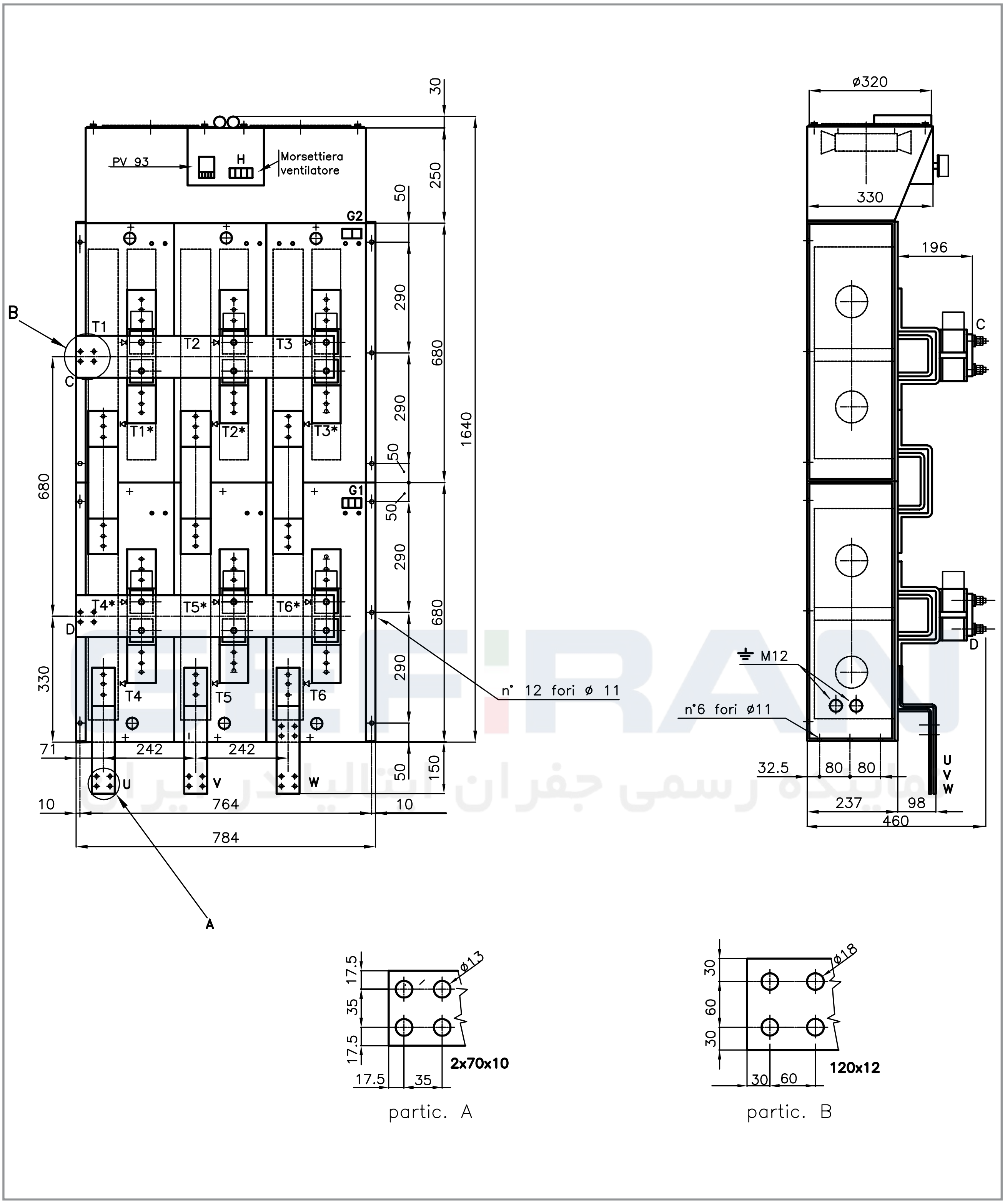
Figure 2.4.17: TPD32-EV-500/520-2700-4B-E dimensions



Values in mm.

Characteristics	
WEIGHT	280 kg
FAN UNIT	Tot. capacity 2600 m³/h
	Single-phase motor 230 V 50/60 Hz 1/1.3 A tot. 71÷74dBA

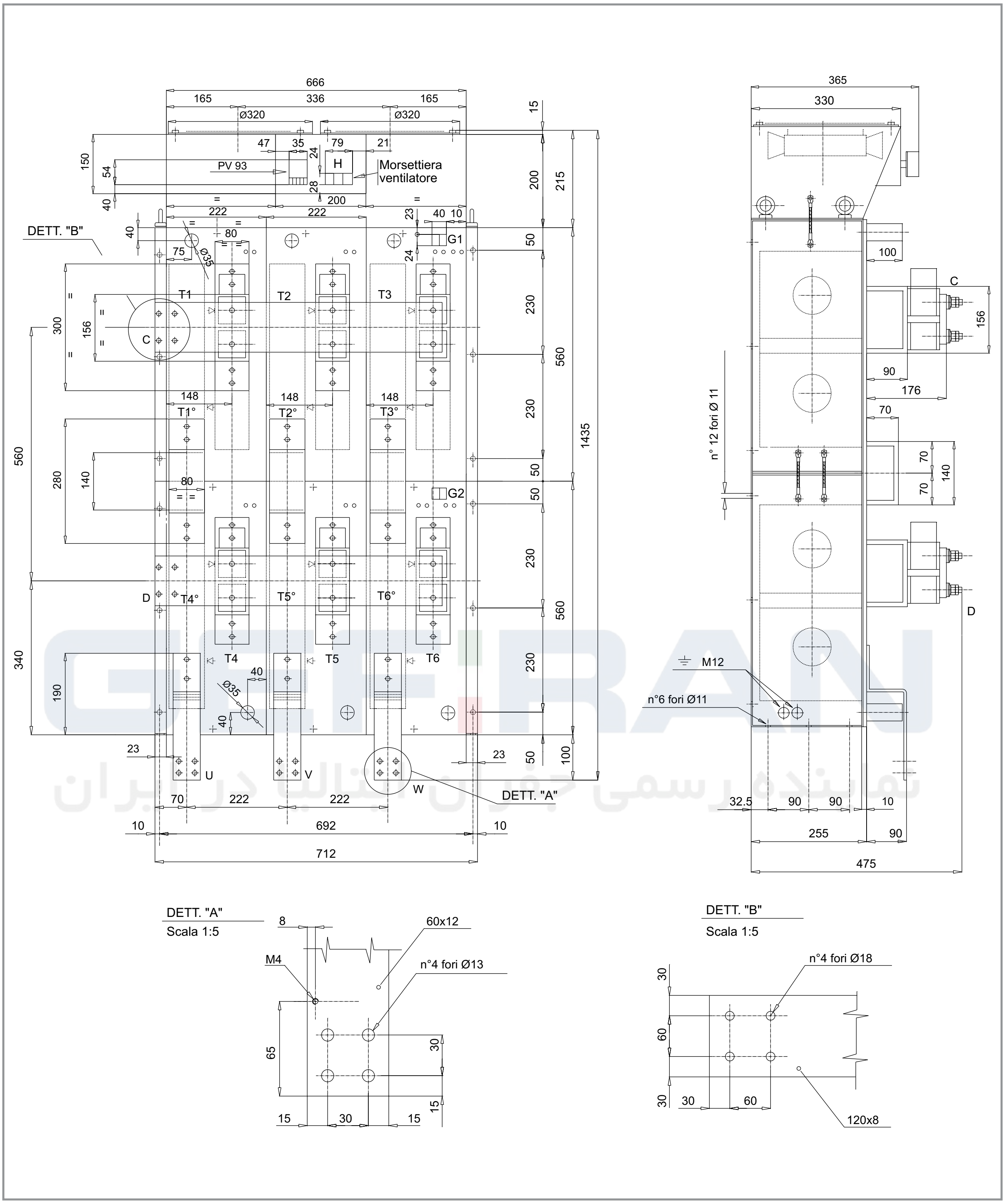
Figure 2.4.18: TPD32-EV-500/520-3300-4B-E and TPD32-EV-690/720-3300-4B-E dimensions



Values in mm.

Characteristics	
WEIGHT	322 kg
FAN UNIT	Tot. capacity 2600 m^3/h
	Single-phase motor 230 V 50/60 Hz 1 A tot. 71÷74dBA

Figure 2.4.19: TPD32-EV-690/720-2400...2700-4B-E dimensions



Values in mm.

Characteristics	
WEIGHT	280 kg
FAN UNIT	Tot. capacity 2600 m³/h
	Single-phase motor 230 V 50/60 Hz 1/1.3 A tot. 72÷74dBA

2.5 WATT LOSS

The power dissipation on the converter side depends on the AC input voltage. The values of the dissipated powers stated in the following table refer to the functioning with rated current.

NOTE! The mounting should take into consideration a free space above and below the device of at least 6 inches (150 mm). (Air circulation).

Externally-powered fan units must be connected to a 230 V 50/60 Hz single-phase voltage supply (terminals U3 and V3) and 400 V / 460 V 50/60 Hz three-phase voltage supply (terminals U3, V3 and W3).

Standard	American	Power loss P_v [W]	Fans		
			Voltage [V]	Rated current [A]	Air capacity [m^3/h]
TPD32-EV-.../...-20-..-A	TPD32-EV-.../...-17-..-A	131	-	-	-
TPD32-EV-.../...-40-..-A	TPD32-EV-.../...-35-..-A	186	-	-	-
TPD32-EV-.../...-70-..-A	TPD32-EV-.../...-56-..-A	254	Internal power supply	Internal power supply	80
TPD32-EV-.../...-110-..-A	TPD32-EV-.../...-88-..-A	408	Internal power supply	Internal power supply	160
TPD32-EV-.../...-140-..-A	TPD32-EV-.../...-112-..-A	476	Internal power supply	Internal power supply	160
TPD32-EV-.../...-185-..-A	TPD32-EV-.../...-148-..-A	553	Internal power supply	Internal power supply	160
TPD32-EV-.../...-280-..-B	TPD32-EV-.../...-224-..-B	781	Internal power supply	Internal power supply	320
TPD32-EV-.../...-350-..-B	TPD32-EV-.../...-280-..-B	939	Internal power supply	Internal power supply	320
TPD32-EV-.../...-420-..-B	TPD32-EV-.../...-336-..-B	1038	Internal power supply	Internal power supply	320
TPD32-EV-.../...-500-..-B	TPD32-EV-.../...-400-..-B	1248	Internal power supply	Internal power supply	320
TPD32-EV-.../...-650-..-B	TPD32-EV-.../...-450-..-B	1693	Internal power supply	Internal power supply	680
TPD32-EV-.../...-560-..-C	TPD32-EV-.../...-360-..-C	2372	1ph 230	1	1050
TPD32-EV-.../...-700-..-C	TPD32-EV-.../...-490-..-C	3085	1ph 230	1	1050
TPD32-EV-.../...-770-..-C	TPD32-EV-.../...-560-..-C	2143	1ph 230	1	1050
TPD32-EV-.../...-900-..-C	TPD32-EV-.../...-650-..-C	3384	1ph 230	1	1050
TPD32-EV-575/...-1000-2B-C	TPD32-EV-./...-750-2B-C	2986	1ph 230	1	1050
TPD32-EV-575/...-1050-4B-C	TPD32-EV-575...-750-4B-C	3103	1ph 230	1	1050
TPD32-EV-500/...-1000-..-C	TPD32-EV-.../...-800-..-C	2590	1ph 230	1	1050
TPD32-EV-500/...-1050-4B-C	TPD32-EV-.../...-850-4B-C	2590	1ph 230	1	1050
TPD32-EV-690/...-1300-2B-D	TPD32-EV-.../...-920-2B-D	6175	3 ph 400/460	1.25 (50Hz) / 1.55 (60Hz)	2900 (400V/50Hz) 3400 (460V/60Hz)
TPD32-EV-575/...-1300-..-D	TPD32-EV-.../...-980-..-D	4863	3 ph 400/460	1.25 (50Hz) / 1.55 (60Hz)	
TPD32-EV-.../...-1400-..-D	TPD32-EV-.../...-1000-..-D	5142	3 ph 400/460	1.25 (50Hz) / 1.55 (60Hz)	
TPD32-EV-.../...-1600-..-D	TPD32-EV-.../...-1200-..-D	6225	3 ph 400/460	1.25 (50Hz) / 1.55 (60Hz)	
TPD32-EV-.../...-1900-..-D	TPD32-EV-.../...-1450-..-D	7598	3 ph 400/460	1.25 (50Hz) / 1.55 (60Hz)	
TPD32-EV-.../...-2000-..-D	TPD32-EV-.../...-1500-..-D	7238	3 ph 400/460	1.25 (50Hz) / 1.55 (60Hz)	
TPD32-EV-.../...-2100-..-D	TPD32-EV-.../...-1650-..-D	8032	3 ph 400/460	1.25 (50Hz) / 1.55 (60Hz)	
TPD32-EV-.../...-2300-..-D	TPD32-EV-.../...-1800-..-D	7480	3 ph 400/460	1.25 (50Hz) / 1.55 (60Hz)	
TPD32-EV-.../...-2400-..-D	TPD32-EV-.../...-1850-..-D	7343	3 ph 400/460	1.25 (50Hz) / 1.55 (60Hz)	
TPD32 EV-.../...-1010-..-E	-	3500	1ph 230	0.4	900
TPD32 EV-.../...-1050-..-E	TPD32 EV-.../...-800-..-NA	2590	1ph 230	0.75	1050
TPD32 EV-.../...-1000-..-E	TPD32 EV-.../...-850-..-NA	2590	1ph 230	0.75	1050
TPD32 EV-.../...-1200-..-E		3500	1ph 230	0.4	900
TPD32 EV-.../...-1400-..-E		4900	1ph 230	0.4	900
TPD32 EV-.../...-1500-..-E		4900	1ph 230	0.4	900
TPD32 EV-500/520-1700-..-E		5200	1ph 230	0.4	900
TPD32 EV-690/810-1700-..-E		6700	1ph 230	0.6	1450
TPD32 EV-.../...-1800-..-E		5200	1ph 230	0.4	900
TPD32 EV-500/520-2000-..-E		5400	1ph 230	0.4	900
TPD32 EV-690/810-2000-..-E		6800	1ph 230	0.6	1450
TPD32 EV-500/220-2400-..-E		6800	1ph 230	0.6	1450
TPD32 EV-690/810-2400-..-E		8000	1ph 230	1.3	2600
TPD32 EV-.../...-2700-..-E		8700	1ph 230	1.3	2600
TPD32 EV-.../...-2900-..-E		8700	1ph 230	1.3	2600
TPD32 EV-.../...-3300-..-E		9500	1ph 230	1.3	2000

Table 2.5.1: Dissipated power TPD32-EV and TPD32-EV-FC series

Moidel	Dissipated power	
	Total for control unit [W]	External field fuses [W]
TPD32-EV-CU-230/500-THY1-40 TPD32-EV-CU-230/500-THY2-40	303	2 x 11
TPD32-EV-CU-230/500-THY1-70 TPD32-EV-CU-230/500-THY2-70	357	2 x 14
TPD32-EV-CU-575/690-THY1-40 TPD32-EV-CU-575/690-THY2-40	374	2 x 11
TPD32-EV-CU-575/690-THY1-70 TPD32-EV-CU-575/690-THY2-70	428	2 x 14

Table 2.5.2: Dissipated power TPD32-EV-CU series

Information on the power dissipated by recommended external field fuses is also provided.

2.6 MOTORS, ENCODER, TACHOMETER

The converters of the TPD32-EV series are provided for the regulation of DC motors with an independent excitation. As for speed feedback there is the use of a sinusoidal incremental encoder, a digital encoder or an analog tachometer generator. In case of limited precision needs it is possible to use as feedback the armature voltage without defluxing.

2.6.1 Motors

The electrical and mechanical data of the dc motors with an independent excitation refer to a particular functioning field. The following points have to be taken into consideration in order to operate these motors:

Motor data necessary to connect it to a converter

The data on the motor nameplate:
- Armature rated voltage
- Armature rated current
- Field rated current
- Motor rated speed

Motor protection

Thermo relay of the motor
- Placed above the converter: dimensioning I_{dN} • 0.82 • 1.05
- The relay contact can stop the drive through a control circuit or it can signal to the converter as an external failure (terminal 15).

NOTE! Remember that with a thermo relay it is possible only to control the heating of the motor due to an overload, but not the one due to an insufficient ventilation. For this purpose some PTC thermistors or thermal switches should be inserted in the motor windings.

Thermistors and thermal switches

On terminals 78 and 79 it is possible to connect a thermistor or thermal switch in order to detect motor overheating. When no temperature sensors are present an external resistor (R = 1 kohm) has to be connected to these terminals. The connection of the sensor has to be done according the following instructions.

Thermistors (PTC)

PTC thermistors according to DIN 44081 or 44082 fitted in the motor can be connected directly to the converter vie terminals 78 and 79. In this case the resistor (1 kohm) mounted between the terminals 78, 79 has to be removed.

Thermal switches (klixons) in the motor windings

Temperature-dependent contacts "klixon" type can disconnect the drive via the external control or can be reported as an external error on the converter (terminal 15). They can also be connected to the terminals 78 and 79 in order to have a specific error signal. In this case remove the 1 kohm resistor from these terminals and connect it in series to the wiring.

Limitation of the converter current

The current limitation can protect the motor from unwanted overloads. To this purpose it is necessary to set the current limitation and the control function of the converter overload (overload function), so that the current remains within the values allowed for the motor.

NOTE! Remember that with a current limitation it is possible to control only the motor heating due to an overload, but not the one due to an insufficient ventilation. For this purpose some PTC thermistors or thermal switches should be inserted in the motor windings.

2.6.2 Encoder / Tachometer

The encoders and the tachometers give the speed feedback to the regulation. They have to be mounted on the motor shaft with joints without gaps. The best regulation results are possible by using incremental sinusoidal encoders; it is also possible to use digital incremental encoders or tachogenerators, see section, "Accuracy".

Features:

Sinusoidal encoder

max frequency	150 kHz
number of pulses per revolution	min 600 max 9999
channel	two-channel
supply	+ 5V (internal supply)
load capacity	> 8.3 mA pp each channel

Digital encoder

max frequency	150 kHz
number of pulses per revolution	min 600 max 9999
channels	two-channel, with complementary outputs
supply	+ 5V / 15 ... 24V (external supply) + 24V (internal supply)
load capacity	> 4.5 mA / 6.8 ... 10.9 mA each channel

Analog tachometer

for TPD32-EV-...-2B	dynamo
for TPD32-EV-...-4B	dynamo (for the rotation direction inversion, the supplied voltage polarity shall invert)
max voltage at max speed	22.7 / 45.4 / 90.7 / 181.6 / 302.9 V, depending on the dip switch S4 setting
current	8 mA, full scale

Tacho voltage input (V)	S4-1 S4-8	S4-2 S4-7	S4-3 S4-6	S4-4 S4-5
22.7	ON	ON	ON	ON
45.4	ON	ON	ON	OFF
90.7	ON	ON	OFF	OFF
181.6	ON	OFF	OFF	OFF
302.9	OFF	OFF	OFF	OFF

3 - INSTALLATION GUIDELINES

3.1 PERMISSIBLE AMBIENT CONDITION

Protection degree:		IP 20 (Type A-B-C-D) at operating temperatures of 32-131° F (0 ... 55° C; IP00 (Type E). UL enclosure type 1. (American size) The converter must be installed in a pollution degree 2 environment.
Installation location		Pollution degree 2 or lower (free from direct sunligth, vibration, dust, corrosive or inflammable gases, fog, vapour oil and dripped water, avoid saline environment)
Altitude:		Up to 3300 feet (1000 m) above sea level; higher altitudes a current reduction of 1.2 % for every 330 feet (100 m) of additional altitude. Max 2000m (6562 feet) above sea level.
Temperature :	Operation	**TPD32-EV-....:** Ta = 32-131° F (0 ... 55° C), over 104° F (40 °C): current reduction of 1.25 % for every 1.8 ° F over 104° F (1 °C over 40 °C) better than the 3K3 class per EN 50178) **TPD32-EV-CU-....: Ta = 0... 55 °C** above 122° F (50 °C) reduce the current of 1.25 % for every K above 104° F (40 °C) (best in class 3K3 according to EN 50178).
	Storage	Ta = -13° F ... 131° F (-25 ... +55° C) (1K4 class as per EN 50178) Ta = -4° F ... 131° F (-20 ... +55° C) (for devices with LCD)
	Transport	Ta = -13° F ... 131° F (-25 ... +55° C) (2K3 class as per EN 50178) Ta = -4° F ... 140° F (-20 ... +60° C) (for devices with LCD)
Air humidity:		
	Operation	5% up to 85%, 1 g/m^3 up to 25 g/m^3 without moisture condensation or icing (3K3 class as per EN 50178)
	Storage	5% up to 95%, 1 g/m^3 up to 29 g/m^3 (1K3 class as per EN 50178)
	Transport	95% [1], 60 g/m [2] A light condensation of moisture may occur for a short time occasionally when the device is not in operation (2K3 class as per EN 50178).
Air pressure:	Operation	From 86 kPa up to 106 kPa (3K3 class per EN 50178)
	Storage	From 86 kPa up to 106 kPa (1K4 class per EN 50178)
	Transport	From 70 kPa up to 106 kPa (2K3 class per EN 50178)

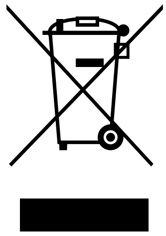
[1] Greatest relative air humidity occurs with the temperature 104° F (40° C) or if the temperature of the device is brought immediately from -13° F ... 86° F (-25° C to +30° C).

[2] Greatest absolute air humidity if the device is brought immediately from 158° F ... 59° F (70° C to +15° C).

3.2 DISPOSAL OF THE DEVICE

The converters of the TPD32-EV series can be disposed as electronic scraps in accordance with the currently valid national regulations for the disposal of electronic parts.

Pursuant to Article 26 of Italian Legislative Decree no. 49 of 14 March 2014 "Implementation of Directive 2012/19/EU on waste electrical and electronic equipment (WEEE)"



The symbol showing a crossed-out wheeled bin on equipment or its packaging indicates that the product must be collected separately from other waste at the end of its useful life.

The manufacturer is responsible for organising and managing the separate collection of this piece of equipment at the end of its useful life.

Users wishing to dispose of the equipment must therefore contact the manufacturer to obtain instructions from the same on how to have the equipment collected separately at the end of its useful life.

By collecting the disused equipment separately, it can be recycled, treated or disposed of in an environmentally friendly manner, thus helping to prevent the environment and public health from being affected negatively and enabling reuse and/or recycling of the materials forming the same equipment.

3.3 MOUNTING THE DEVICE

NOTE! The dimensions and weights specifed in this manual should be taken into consideration when the device is mounted. The technical equipment required (carriage or crane for large weights) should be used. Improper handling and the use of unsuitable tools may cause damage.

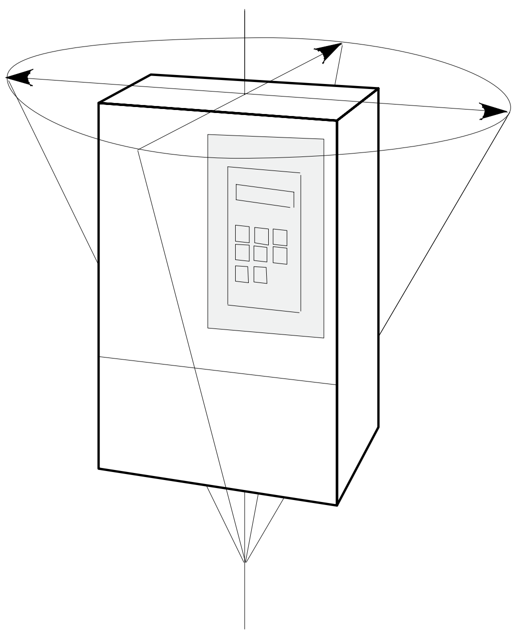


Figure 3.3.1: max Angle of Inclination

This equipment is designed for use in a clean, dry environment (see "3.1 Permissible Ambient Condition" on page 60). It must not be possible for air-borne contaminants such as oils, corrosive fumes or abrasive materials to penetrate installation cabinets.

The IP20 or IP00 protection rating does not protect the equipment against air-borne contaminants.

The maximum angle of inclination is 30°.

The converters must be mounted in such a way that the free flow of air is ensured.

The clearance to the device must be at least 6 inches (150 mm).

A space of at least 2 inches (50 mm) must be ensured at the front.

Devices that generate a large amount of heat must not be mounted in the direct vicinity of the frequency inverter.

NOTE! Mounting screws should be re-tightened after a few days of operation.

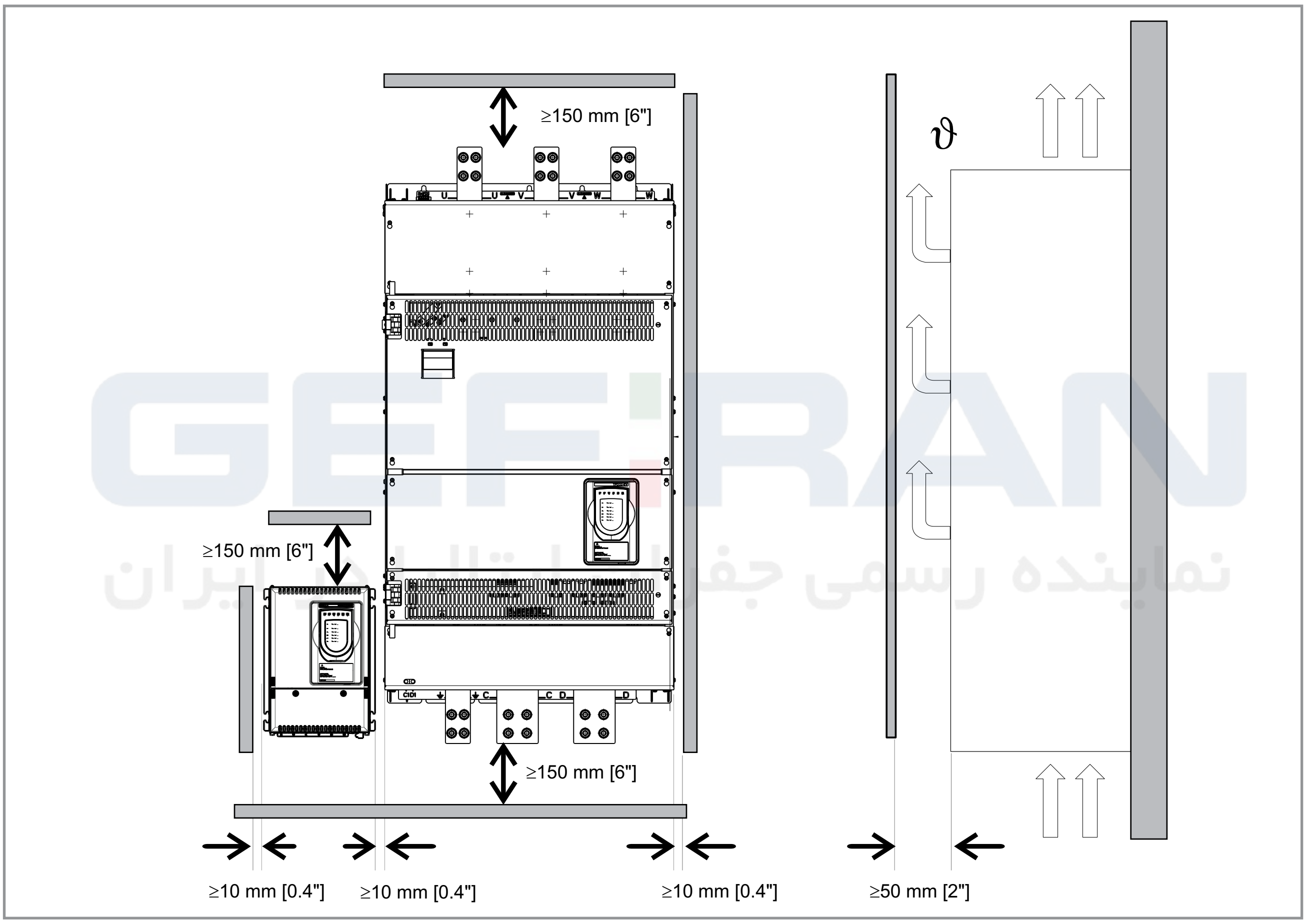


Figure 3.3.2: Mounting Clearance

4. WIRING PROCEDURE

4.1 REMOVING THE FRONT COVER

The front cover of the device must be removed to make the electrical connections and to mount the option card.

WARNING! Observe the safety instructions and warnings given in this manual. The devices can be opened without the use of force. Only use the tools specified.

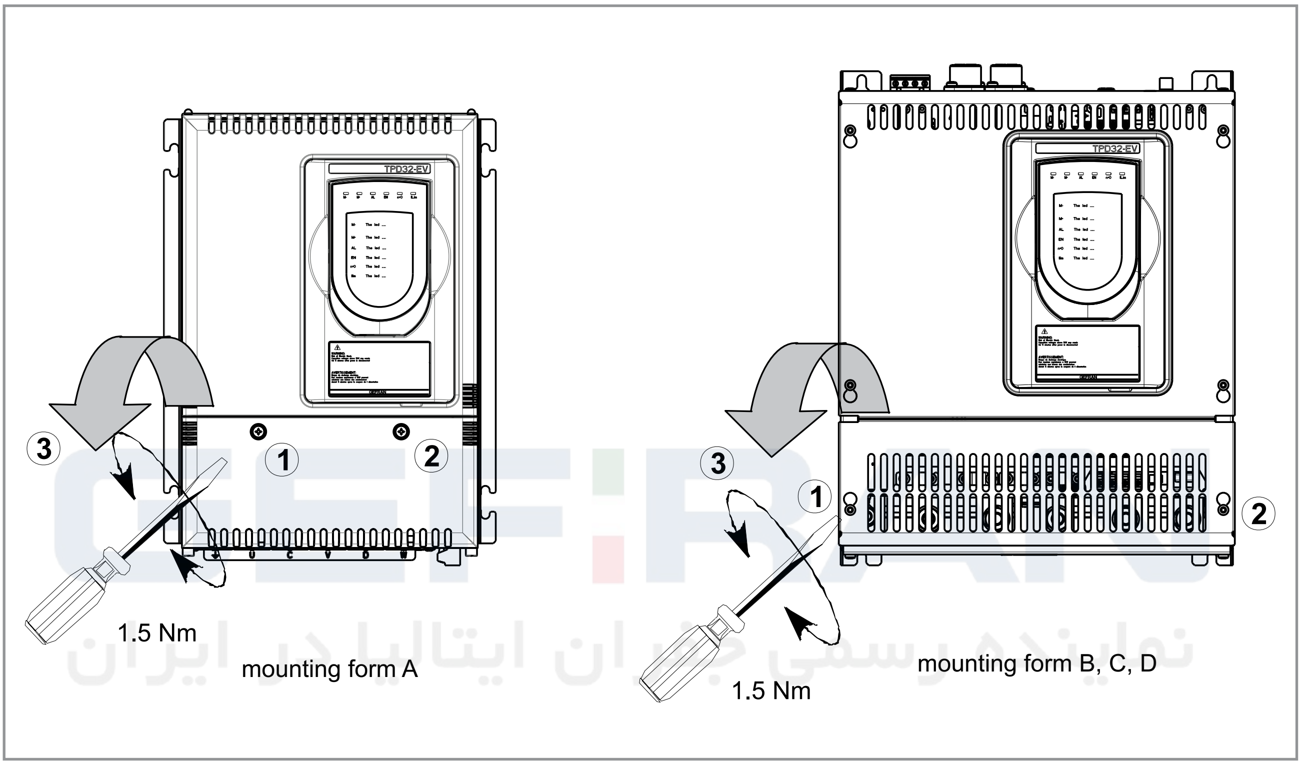


Figure 4.1.1: Removing the Front Panel

To remove the lower cover of devices, use a phillips screwdriver. Remove the screws (1) (2), lift cover (3), and open out to the front.

Tools required: 7x2 mm slotted-head screwdriver
Torx ® screwdriver: T10, T20, T25.
Cross-head screwdriver #1, 2, 3.

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Terminal Assignments/Cable Sections

The terminals of the devices are made accessible by removing the front cover.

4.2 WIRING THE DRIVE

Wire the drive in accordance with the standard connection diagrams, see chapter "4.8 Standard Connection Diagrams" on page 82

4.3 POWER SECTION

NOTE! Use copper conductors only.
For UL listed equipments use 75°C stranded copper conductors only.

Table 4.3.1: Terminals description

Designation	Function	I/O	max voltage	max current	min current
U, V, W	Connection to the AC mains of the armature circuit	I	3 x 690V AC ± 10%	see 2.3.2	—
C, D	Armature connection	O	see tab. 2.4.3.3	see 2.3.3	—
U1, V1 *	Connection to the AC mains of the field circuit	I	1 x 460V AC ± 10%	see 2.3.2	—
C1, D1 *	Field connection	O	0.87 U_{LN}	see 2.3.3	—
U2, V2	AC power supply regulation	I	1 x 115V ±15% 1 x 230V ±15%	see 2.3.2	—
U3, V3	AC mains power supply for internal fan (Construction type C-E converters only, see table 2.5.1)	I	1 x 230V AC	see 2.5	—
U3, V3, W3	AC mains power supply for internal fan (Construction type D converters only, see table 2.5.1)	I	3 x 400/460V AC (50Hz) / (60Hz)	see 2.5	—
31 / 32	Fan unit power supply relay potential-free NC contact (Type D-E converters only)	O	250 VAC	1 A AC11	100mA
35 / 36	Contact without potential of OK relay (closed = OK), function as per the OK relay func parameter in the CONFIGURATION / digital output menu	O	250 VAC	1 A AC11	100mA
75 / 76	Contact without potential of relay 2, function as per Relay 2 parameter in the I/O CONFIGURATION / digital outputs menu	O	250 VAC	1 A AC11	100mA
78 / 79	Thermistor connection	I	—	—	—
81 / 82	Internal fuses intervention signalling (For types C and D, see table 2.1.1)	O	250 VAC	1 A AC11	50mA

* not included in TPD32-EV-FC-... models

Table 4.3.2: Cable size for power terminals U, V, W, C, D, PE

Standard	max cable section [mm²]	AWG	Tightening torque [Nm]
TPD32-EV-.../...-20-..-A	**4**	**12**	**2...3**
TPD32-EV-.../...-40-..-A	**10**	**8**	**2.5...3**
TPD32-EV-.../...-70-..-A	**16**	**6**	
TPD32-EV-.../...-110-..-A	**6...50**	**10...1**	**12**
TPD32-EV-.../...-140-..-A	**16...95**	**6...000**	
TPD32-EV-.../...-185-..-A			
TPD32-EV-.../...-280-..-B	**Cu-Band 10 x 16 x 0.8**	**-**	**25 (PE: 12)**
TPD32-EV-.../...-350-..-B			
TPD32-EV-.../...-420-..-B			
TPD32-EV-.../...-500-..-B	**Cu-Band 11 x 21 x 1**	**-**	
TPD32-EV-.../...-650-..-C			
TPD32-EV-.../...-560-..-C	**Cu-Band 50 x 8 or Cu-Band 2 x 10 x 16 x 0.8**	**-**	
TPD32-EV-.../...-700-..-C ... TPD32-EV-500/...-1050-4B-C			
TPD 32-EV-690/...-1300-2B-D ... TPD32-EV-.../...-1900--D	**300**	**-**	**45**

Standard	max cable section [mm^2]	AWG	Tightening torque [Nm]
TPD32-EV-.../...-2000-..-D ... TPD32-EV-.../...-2400-..-D	300	-	45

Table 4.3.3: Cable section for UL approval

Device type	Terminals	Wire AWG / kcmils	Terminal bolt metric size [mm]	Tightening torque [Nm]
TPD32-EV-.../...-20-..-A	U, V, W, C, D PE	10	5	6
TPD32-EV-.../...-40-..-A	U, V, W, C, D PE	8	5	6
TPD32-EV-.../...-70-..-A	U, V, W, C, D PE	4	5	6
TPD32-EV-.../...-110-..-A	U, V, W C, D	1/0	terminal block	12
	PE	2	terminal block	12
TPD32-EV-.../...-140-..-A	U, V, W C, D	2/0	terminal block	12
	PE	2	terminal block	12
TPD32-EV-.../...-185-..-A	U, V, W	3/0	terminal block	12
	C, D	4/0; kit required	terminal block	12
	PE	2	terminal block	12
TPD32-EV-.../...-280-..-B	U, V, W C, D	2 x 2/0	10	50
	PE	2/0	8	25
TPD32-EV-.../...-350-..-B	U, V, W C, D	2 x 4/0	10	50
	PE	2/0	8	25
TPD32-EV-.../...-420-..-B	U, V, W	2 x 4/0	10	50
	C, D	2 x 300	10	50
	PE	2/0	8	25
TPD32-EV-.../...-500-..-B	U, V, W	2 x 300; kit required	10	50
	C, D	2 x 350; kit required	10	50
	PE	2/0	8	25
TPD32-EV-.../...-560-..-C TPD32-EV-.../...-700-..-C	U, V, W	4 x 4/0	10	50
	C, D	4 x 250	10	50
	PE	2/0	8	25
TPD32-EV-.../...-650-..-B	U, V, W	2 x 500; kit required	10	50
	C, D	2 x 600; kit required	10	50
	PE	2/0	8	25
TPD32-EV-.../...-770-..-C	U, V, W	4 x 1/0	10	50
	C, D	4 x 2/0	10	50
	PE	1	8	25
TPD32-EV-.../...-900-..-C	U, V, W	2 x 400; kit required	10	50
	C, D	2 x 600; kit required	10	50
	PE	1	8	25
TPD32-EV-.../...-1050-..-C	U, V, W	4 x 300; kit required	10	50
	C, D	4 x 400; kit required	10	50
	PE	2/0	8	25
TPD32-EV-.../...-1000-..-C TPD32-EV-.../...-1050-..-C	U, V, W	4 x 300; kit required	10	50
	C, D	4 x 4/0; kit required	10	50
	PE	2/0	8	25
TPD32-EV-.../...-1000-..-C	U, V, W	4 x 300; kit required	10	50
	C, D	4 x 350; kit required	10	50
	PE	2/0	8	25
TPD32-EV-.../...-1300-4B-D	U, V, W	4 x 300; kit required	12	45
	C, D	4 x 4/0; kit required	12	45
	PE	2/0	12	45
TPD32-EV-.../...-1300-2B-D	U, V, W	4 x 250; kit required	12	45
	C, D	4 x 400; kit required	12	45
	PE	2/0	12	45
TPD32-EV-.../...-1400-..-D	U, V, W	4 x 350	12	45
	C, D	4 x 500	12	45
	PE	5 x 60	12	45
TPD32-EV-.../...-1600-..-D	U, V, W	4 x 500; kit required	12	45
	C, D	5 x 500; kit required	12	45
	PE	5 x 60	12	45
TPD32-EV-.../...-1900-..-D TPD32-EV-.../...-2000-..-D	U, V, W	5 x 500; kit required	12	45
	C, D	6 x 500; kit required	12	45
	PE	8 x 60	12	45

Device type	Terminals	Wire AWG / kcmils	Terminal bolt metric size [mm]	Tightening torque [Nm]
TPD32-EV-.../...-2100-..-D	U, V, W	6 x 400; kit required	12	45
	C, D	Busbar or Flexibar	12	45
	PE	8 x 60	12	45
TPD32-EV-.../...-2300-..-D TPD32-EV-.../...-2400-..-D	U, V, W	6 x 500; kit required	12	45
	C, D	Busbar or Flexibar	12	45
	PE	8 x 60	12	45

Table 4.3.4: Wire adapter Kit and lugs suggested for UL approval

The following sizes are not provided with pressure connectors. Recommended compression lugs are in the following table. For sizes up to 56A any UL listed lug, sized for the indicated bolt and AWG or MCM cable, is suitable for this use, otherwise a compression lug type from ILSCO or BURNDY (YA...) or Grainger (3L...) manufacturer is specified.

Device type	Terminals	AWG o MCM	Lug type	Bolt diameter [mm]	Tightening torque [Nm]
TPD32-EV-.../...-17-....-A-NA	U-V-W-C-D-PE	12	any	5	2-3
TPD32-EV-.../...-35-....-A-NA	U-V-W-C-D-PE	8	any	5	2.5-3
TPD32-EV-.../...-56-....-A-NA	U-V-W-C-D-PE	4	any	5	2.5-3
TPD32-EV-.../...-88-....-A-NA	U-V-W-C-D-PE	See table below			
TPD32-EV-.../...-112-....-A-NA	U-V-W-C-D-PE				
TPD32-EV-.../...-148-....-A-NA	U-V-W-C-D-PE				
TPD32-EV-.../...-224-..-B-NA	U-V-W	2 x 1	YA1CL6-BOX	M10	25
	C-D	2 x 2/0	YA26L6-BOX	M10	25
	PE			M8	15
TPD32-EV-.../...-280-..-B-NA	U-V-W	2 x 2/0	YA26L6-BOX	M10	25
	C-D	2 x 3/0	YA27L-BOX	M10	25
	PE			M8	15
TPD32-EV-.../...-336-..-B-NA	U-V-W	2 x 250	YA27L-BOX	M10	25
	C-D	2 x 3/0	YA29L-BOX	M10	25
	PE			M8	15
TPD32-EV-.../...-400-..-B-NA	U-V-W	2 x 250	YA29L-BOX,	M10	25
	C-D	2 x 300; serve kit	YA30L	M10	25
	PE			M8	15
TPD32-EV-.../...-450-..-B-NA	U-V-W	2 x 300; serve kit	YA30L7	M10	25
	C-D	2 x 400; serve kit	YA32L	M10	25
	PE			M8	15
TPD32-EV-.../...-490-..-C-NA	U-V-W	3 x 3/0	YA27L-BOX	M10	25
	C-D	4 x 2/0	YA26L6-BOX	M10	25
	PE	1/0	YA25L6-BOX	M8	15
TPD32-EV-.../...-560-..-C-NA	U-V-W	3 x 3/0	YA27L-BOX	M10	25
	C-D	4 x 2/0	YA26L6-BOX	M10	25
	PE			M8	15
TPD32-EV-.../...-750-..-C-NA	U-V-W	4 x 4/0	YA28L-BOX	2 x M10	25
	C-D	4 x 300, serve kit	YA30L	2 x M10	25
	PE	2/0	YA26L6-BOX	M8	15
TPD32-EV-.../...-800-..-C-NA	U-V-W-C-D	4 x 250	CRA-250 o CRA-250L	M10	25
	PE			M8	15
TPD32-EV-.../...-850-..-C-NA	U-V-W-C-D	4 x 300, serve kit	CRA-300 o CRA-300L	M10	25
	PE			M8	15
TPD32-EV-.../...-980-..-D-NA	U-V-W	4 x 300	3LM58	4 x M12	45
	C-D	4 x 500	3LM61	4 x M12	45
	PE	2 x 300	3LM58	4 x M12	45
TPD32-EV-.../...-1000-..-D-NA	U-V-W	4 x 350	3LM59	4 x M12	45
	C-D	4 x 500	3LM61	4 x M12	45
	PE	4 x 350	3LM59	4 x M12	45
TPD32-EV-.../...-1200-..-D-NA	U-V-W	4 x 500 with EAM 2617_1 adapter	3LM61	4 x M12	45
	C-D	5 x 500 with EAM 2617_3 adapter	3LM61	4 x M12	45
	PE	2 x 500	3LM61	4 x M12	45
TPD32-EV-.../...-1500-..-D-NA	U-V-W	5 x 500 with EAM 2617_1 adapter	3LM61	4 x M12	45
	C-D	6 x 500 with EAM 2617_3 adapter	3LM61	4 x M12	45
	PE	3 x 350	3LM59	4 x M12	45

Device type	Terminals	AWG o MCM	Lug type	Bolt diameter [mm]	Tightening torque [Nm]
TPD32-EV-.../...-1800-..-D-NA	U-V-W	6 x 500 with EAM 2617_1 adapter	3LM61	4 x M12	45
	C-D	Use Cu-bar or Eriflex "Flexibar"	-	4 x M12	45
	PE	3 x 500	3LM61	4 x M12	45
TPD32-EV-.../...-1850-..-D-NA	U-V-W	6 x 500 with EAM 2617_1 adapter	3LM61	4 x M12	45
	C-D	Use Cu-bar or Eriflex "Flexibar"	-	4 x M12	45
	PE	3 x 500	3LM61	4 x M12	45

2x means that two compression lugs of the specified type have to be used on the opposite side of the busbar.
4x means that four compression lugs of the specified type have to be used on the same busbar, two for each side and one for each bolt hole.
Bolt, nuts and washers are factory mounted on output busbars. The required ILSCO compression tool is marked on each terminal plug.

For sizes above 112A the front terminal cover has to be removed when using the above listed lugs.
The following sizes are provided with terminal blocks:
U/V/W/C/D: AWG 5-3/0(16-95mm2), stranded Cu
PE: AWG 5-1(16-50mm2), stranded Cu

The following AWG and torque are required for field wiring:

Device type	AWG	Tightening torque [Nm]
TPD32-EV-.../...-88-..	2	12
TPD32-EV-.../...-112-..	1/0	12
TPD32-EV-.../...-148-..	3/0	12
Grounding	-	12

Note! When connecting the converter, a 9.5 mm (3/8 in.) spacing between uninsulated live parts of opposite polarity should be mantained.

Note! The TPD32-EV converters are UL listed only when used with the above mentioned terminal kits.

Table 4.3.5: Wire adapter Kit and lugs suggested for UL approval

Device type	Terminals	Wire adapter kit			Recommended lugs		
		type	Kit bolt size [mm]	Tightening torque [Nm]	ILSCO type	Burndy type	Grainger type
TPD32-EV-.../...-148-....-A-NA	U, V, W	-	-	-	-	-	-
	C, D	EAM 1578	M8	15	CCL-4/0-516	YA28-L3	-
	PE	-	-	-	-	-	-
TPD32-EV-.../...-224-..-B-NA	U, V, W	-	-	-	CCL-2/0-12	YA1CL6-BOX	-
	C, D	-	-	-	CCL-2/0-12	YA26L6-BOX	-
	PE	-	-	-	CRA-2/0, CCL-2/0-38	YA26-LBOX	-
TPD32-EV-.../...-280-..-B-NA	U, V, W	-	-	-	CCL-4/0-12	YA26L6-BOX	-
	C, D	-	-	-	CCL-4/0-12	YA27L-BOX	-
	PE	-	-	-	CRA-2/0, CCL-2/0-38	YA26-LBOX	-
TPD32-EV-.../...-336-..-B-NA	U, V, W	-	-	-	CCL-4/0-12	YA27L-BOX	-
	C, D	-	-	-	CRA-300, CRA-300L	YA29L-BOX	-
	PE	-	-	-	CRA-2/0, CCL-2/0-38	YA26-LBOX	-
TPD32-EV-.../...-400-..-B-NA	U, V, W	2 x 250	M10	25	-	YA29L-BOX,	-
	C, D	EAM1579	M10	25	-	YA30L	-
	PE	-	-	-	CRA-2/0, CCL-2/0-38	YA26-LBOX	-
TPD32-EV-.../...-450-..-B-NA	U, V, W	EAM1580	M14	45	-	YA30L7	-
	C, D	EAM1580	M14	45	-	YA32L	-
	PE	-	-	-	CRA-2/0, CCL-2/0-38	YA26-LBOX	-
TPD32-EV-.../...-490-..-C-NA	U, V, W	-	2 x M10	25	-	YA27L-BOX	-
	C, D	-	2 x M10	25	-	YA26L6-BOX	-
	PE	-	-	-	-	-	-
TPD32-EV-.../...-560-..-C-NA	U, V, W	-	-	-	CCL-4/0-12	YA27L-BOX	-
	C, D	-	-	-	CRA-250, CRA-250L	YA26L6-BOX	-
	PE	-	-	-	CRA-2/0, CCL-2/0-38	YA26-LBOX	-

Device type	Terminals	Wire adapter kit type	Kit bolt size [mm]	Tightening torque [Nm]	Recommended lugs ILSCO type	Burndy type	Grainger type
TPD32-EV-.../...-750-..-C-NA	U, V, W	4 x 4/0	2 x M10	25	-	YA28L-BOX	-
	C, D	EAM1581	M10	25	-	YA30L	-
	PE	2/0	-	-	CRA-2/0, CCL-2/0-38	YA26L6-BOX	-
TPD32-EV-.../...-800-..-C-NA	U, V, W	-	M10	25	CRA-250 o CRA-250L	-	-
	C, D	-	M10	25	CRA-250 o CRA-250L	-	-
	PE						-
TPD32-EV-.../...-850-..-C-NA	U, V, W	EAM 1581	M10	25	-	YA30-L	-
	C, D		M10	25	-	YA32-L1	-
	PE	-	-	-	CRA-2/0, CCL-2/0-38	YA26-LBOX	-
TPD32-EV-.../...-980-..-D-NA	U, V, W	EAM2617_2	4 x M12	45	-	-	3LM57
	C, D	-	4 x M12	45	-	-	3LM61
	PE	-	4 x M12	45	-	-	
TPD32-EV-.../...-1000-..-D-NA	U, V, W	EAM2617_2	4 x M12	45	-	-	3LM57
	C, D	-	4 x M12	45	-	-	3LM61
	PE	-	4 x M12	45	-	-	
TPD32-EV-.../...-1200-..-D-NA	U, V, W	EAM2617_1	4 x M12	45	-	-	3LM57
	C, D	EAM2617_3	4 x M12	45	-	-	3LM61
	PE	-	4 x M12	45	-	-	-
TPD32-EV-.../...-1500-..-D-NA	U, V, W	EAM2617_1	4 x M12	45	-	-	3LM57
	C, D	EAM2617_3	4 x M12	45	-	-	3LM61
	PE		4 x M12	45	-	-	
TPD32-EV-.../...-1800-..-D-NA	U, V, W	EAM2617_1	4 x M12	45	-	-	3LM57
	C, D	Use busbar	4 x M12	45	-	-	3LM61
	PE		4 x M12	45	-	-	
TPD32-EV-.../...-1850-..-D-NA	U, V, W	EAM2617_1	4 x M12	45	-	-	3LM57
	C, D	Use busbar	4 x M12	45	-	-	3LM61
	PE		4 x M12	45	-	-	

Note! The cable cross section to be connected must be dimensioned and determined by the designer that has to take into account the current, the temperature and the cable position. The values indicated on the table are referred to the maximum cross section accepted by its terminals; they are not the indication about the cable dimension to be connected!

Caution! The current in the protective conductor of the motor cable can be up to twice the value of the rated current I_{dN} if there is an earth fault at the output of the TPD32 converter.

Note! For further details about Kits see "A3.1 EAM Adapter Kit" on page 502, on these drawings it is possible to indicate alternative wire terminals to those in the table.

Table 4.3.6: Cable size for power field terminals U1, V1, C1, D1

American	Standard	max cable section [mm²]	AWG	Tightening torque [Nm]
TPD32-EV-.../...-17-..-A ... TPD32-EV-.../...-850-4B-C	TPD32-EV-.../...-20-..-A ... TPD32-EV-500/...-1050-4B-C	0.2...4	24...10	0.5...0.8
TPD32-EV-.../...-920-2B-D	TPD32-EV-690/...-1300-2B-D	10... 16	6 ... 3	4
TPD32-EV-.../...-980-..-D ... TPD32-EV-.../...-1850-..-D	TPD32-EV-575/...-1300-..-D ... TPD32-EV-.../...-2400-..-D			

Table 4.3.7: Cable size for fans, signals, thermistors and regulation supply

Terminals	Max connection cable section flexible [mm²]	multi-core [mm²]	AWG	Tightening torque [Nm]
PE	2.5...10	2.5...10	12...8	2
U2, U3, V2, V3, 31, 32, 35, 36, 75, 76, 78, 79	0.14...1.5	0.14...2.5	26...14	0.5

4.4 REGULATION SECTION

Regulation card is factory set according to the device type.

When the regulation card is supplied as a spare part, dispose the S15 switches for the corresponding size and S4 to adapt the tachogenerator feedback voltage!

4.4.1 R-TPD32-EV Regulation Card

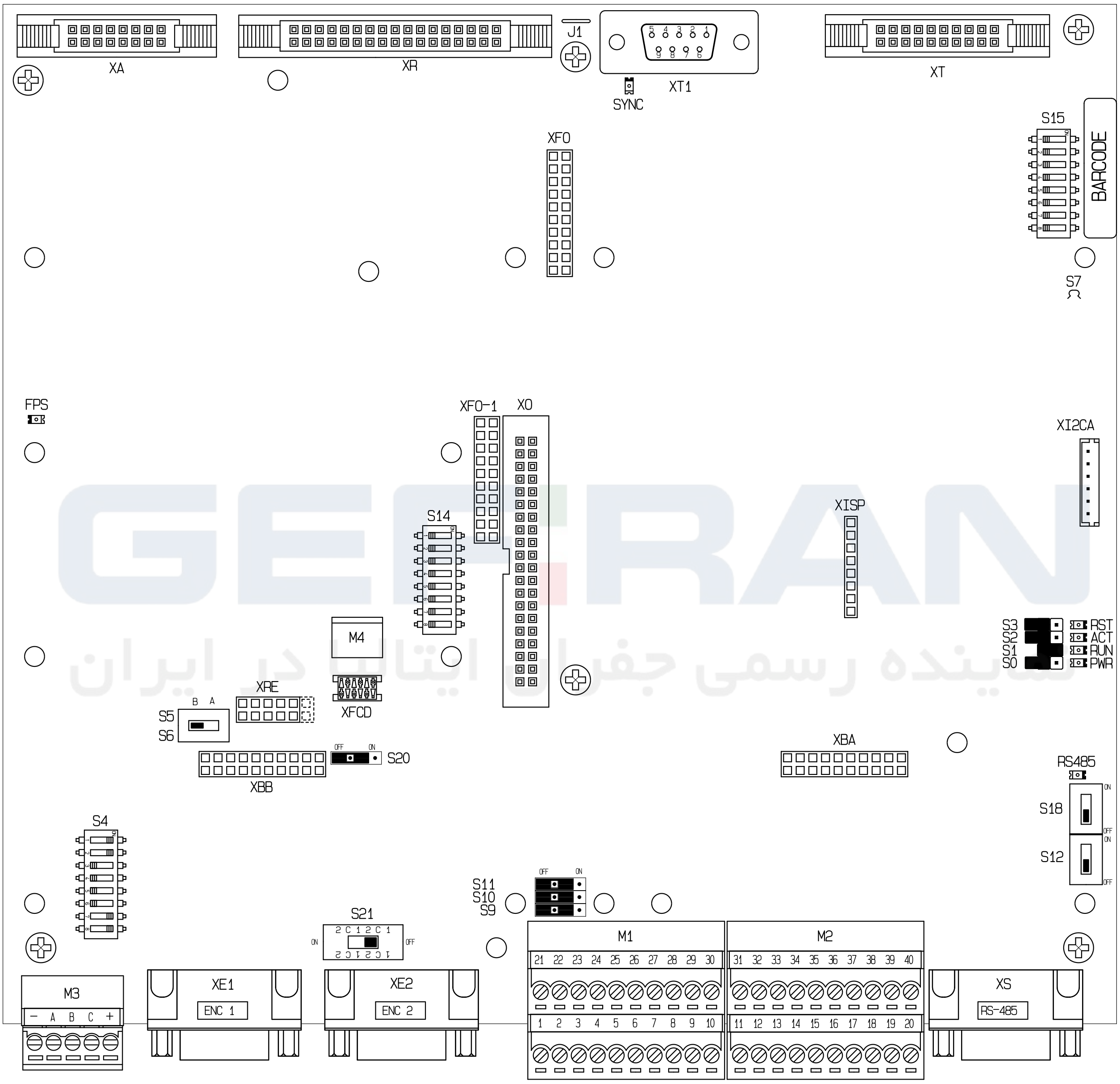


Figure 4.4.1: R-TPD32-EV regulation card (Rev. Q)

Table 4.4.1: LEDs on the R-TPD32-EV card

Designation	Function
PWR	ON when the +5 V voltage is present at the right value
RST	ON when the signal RST is active
RS485	ON when the RS485 interface is supplied
ACT	It is lit when the SCR driving system is active
RUN	The LED blinks during the regulation phase

Table 4.4.2-A: Dip-switch S15 adaptation of the regulation card to the device type

Standard	American	S15-8	S15-7	S15-6	S15-5	S15-4	S15-3	S15-2	S15-1
TPD32-EV-500/600-20-..-A TPD32-EV-FC-.../...-20-..-A	TPD32-EV-500/600-17-..-A-NA	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF
TPD32-EV-500/600-40-..-A TPD32-EV-FC-.../...-40-..-A	TPD32-EV-500/600-35-..-A-NA	OFF	ON	OFF	OFF	OFF	OFF	OFF	ON
TPD32-EV-500/600-70-..-A TPD32-EV-FC-.../...-70-..-A	TPD32-EV-500/600-56-..-A-NA	OFF	ON	OFF	OFF	OFF	OFF	ON	OFF
TPD32-EV-500/600-110-..-A TPD32-EV-FC-.../...-110-..-A	TPD32-EV-500/600-88-..-A-NA	OFF	ON	OFF	OFF	OFF	OFF	ON	ON
TPD32-EV-500/600-140-..-A TPD32-EV-FC-.../...-140-..-A	TPD32-EV-500/600-112-..-A-NA	OFF	ON	OFF	OFF	OFF	ON	OFF	OFF
TPD32-EV-500/600-185-..-A TPD32-EV-FC-.../...-185-..-A	TPD32-EV-500/600-148-..-A-NA	OFF	ON	OFF	OFF	OFF	ON	OFF	ON
TPD32-EV-500/600-280-..-B TPD32-EV-FC-.../...-280-..-B	TPD32-EV-500/600-224-..-B-NA	OFF	ON	OFF	OFF	OFF	ON	ON	OFF
TPD32-EV-500/600-350-..-B TPD32-EV-FC-.../...-350-..-B	TPD32-EV-500/600-280-..-B-NA	OFF	ON	OFF	OFF	OFF	ON	ON	ON
TPD32-EV-500/600-420-..-B TPD32-EV-FC-.../...-420-..-B	TPD32-EV-500/600-336-..-B-NA	OFF	ON	OFF	OFF	ON	OFF	OFF	OFF
TPD32-EV-500/600-500-..-B TPD32-EV-FC-.../...-500-..-B	TPD32-EV-500/600-400-..-B-NA	OFF	ON	OFF	OFF	ON	OFF	OFF	ON
TPD32-EV-500/600-650-..-B TPD32-EV-FC-.../...-650-..-B	TPD32-EV-500/600-450-..-B-NA	OFF	ON	OFF	OFF	ON	OFF	ON	OFF

Note! For sizes TPD32-EV-.../...-...-..-E, dip-switch S15 shown in the table (which is factory-set) is on the regulation card of the TPD32-EV-CU-... associated with the external bridge.

Standard	American	S15-8	S15-7	S15-6	S15-5	S15-4	S15-3	S15-2	S15-1
TPD32-EV-500/600-770-2B-C	TPD32-EV-500/600-560-2B-C-NA	OFF	ON	OFF	OFF	ON	OFF	ON	ON
TPD32-EV-500/600-1000-2B-C	TPD32-EV-500/600-800-2B-C-NA	OFF	ON	OFF	OFF	ON	ON	OFF	OFF
TPD32-EV-500/600-1400-2B-D	TPD32-EV-500/600-1000-2B-D-NA	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF
TPD32-EV-500/600-1600-2B-D	TPD32-EV-500/600-1200-2B-D-NA	OFF	ON	ON	OFF	OFF	OFF	OFF	ON
TPD32-EV-500/600-2000-2B-D	TPD32-EV-500/600-1500-2B-D-NA	OFF	ON	OFF	ON	OFF	ON	OFF	OFF
TPD32-EV-500/600-2400-2B-D	TPD32-EV-500/600-1850-2B-D-NA	OFF	ON	ON	OFF	OFF	ON	ON	OFF
TPD32-EV-500/600-1200-2B-E	TPD32-EV-500/600-1000-2B-E-NA	OFF	ON	OFF	OFF	ON	ON	OFF	ON
TPD32-EV-500/600-1500-2B-E	TPD32-EV-500/600-1300-2B-E-NA	OFF	ON	OFF	ON	OFF	OFF	OFF	ON
TPD32-EV-500/600-1800-2B-E	TPD32-EV-500/600-1400-2B-E-NA	OFF	ON	OFF	ON	OFF	OFF	ON	ON
TPD32-EV-500/600-2000-2B-E	TPD32-EV-500/600-1500-2B-E-NA	OFF	ON	OFF	ON	OFF	ON	OFF	OFF
TPD32-EV-500/600-2400-2B-E	TPD32-EV-500/600-1800-2B-E-NA	OFF	ON	OFF	ON	OFF	ON	OFF	ON
TPD32-EV-500/600-2700-2B-E	TPD32-EV-500/600-2000-2B-E-NA	OFF	ON	OFF	ON	OFF	ON	ON	OFF
TPD32-EV-500/600-2900-2B-E	TPD32-EV-500/600-2200-2B-E-NA	OFF	ON	OFF	ON	OFF	ON	ON	ON
TPD32-EV-500/600-3300-2B-E	TPD32-EV-500/600-2350-2B-E-NA	OFF	ON	OFF	ON	ON	OFF	OFF	OFF
TPD32-EV-575/680-280-2B-B	TPD32-EV-575/680-224-2B-B-NA	ON	OFF	OFF	OFF	OFF	ON	ON	OFF
TPD32-EV-575/680-350-2B-B	TPD32-EV-575/680-280-2B-B-NA	ON	OFF	OFF	OFF	OFF	ON	ON	ON
TPD32-EV-575/680-420-2B-B	TPD32-EV-575/680-336-2B-B-NA	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF
TPD32-EV-575/680-500-2B-B	TPD32-EV-575/680-400-2B-B-NA	ON	OFF	OFF	OFF	ON	OFF	OFF	ON
TPD32-EV-575/680-650-2B-B	TPD32-EV-575/680-450-2B-B-NA	ON	OFF	OFF	OFF	ON	OFF	ON	OFF
TPD32-EV-575/680-700-2B-C	TPD32-EV-575/680-490-2B-C-NA	ON	OFF	OFF	ON	ON	OFF	ON	ON
TPD32-EV-575/680-1000-2B-C	TPD32-EV-575/680-750-2B-C-NA	ON	OFF	OFF	ON	ON	ON	OFF	ON
TPD32-EV-575/680-1300-2B-D	TPD32-EV-575/680-980-2B-D-NA	ON	OFF	OFF	ON	ON	ON	ON	ON
TPD32-EV-575/680-1600-2B-D	TPD32-EV-575/680-1200-2B-D-NA	ON	OFF	ON	OFF	OFF	OFF	OFF	ON
TPD32-EV-575/680-2000-2B-D	TPD32-EV-575/680-1500-2B-D-NA	ON	OFF	OFF	ON	OFF	ON	OFF	OFF
TPD32-EV-575/680-2300-2B-D	TPD32-EV-575/680-1800-2B-D-NA	ON	OFF	ON	OFF	OFF	ON	OFF	ON
TPD32-EV-690/810-560-2B-C	TPD32-EV-690/810-360-2B-C-NA	ON	OFF	OFF	ON	ON	OFF	ON	OFF
TPD32-EV-690/810-700-2B-C	TPD32-EV-690/810-490-2B-C-NA	ON	OFF	OFF	ON	ON	OFF	ON	ON
TPD32-EV-690/810-900-2B-C	TPD32-EV-690/810-650-2B-C-NA	ON	OFF	OFF	ON	ON	ON	OFF	OFF
TPD32-EV-690/810-1300-2B-D	TPD32-EV-690/810-920-2B-D-NA	ON	OFF	OFF	ON	ON	ON	ON	OFF
TPD32-EV-690/810-1600-2B-D	TPD32-EV-690/810-1200-2B-D-NA	ON	OFF	ON	OFF	OFF	OFF	OFF	ON
TPD32-EV-690/810-1900-2B-D	TPD32-EV-690/810-1450-2B-D-NA	ON	OFF	ON	OFF	OFF	OFF	ON	ON
TPD32-EV-690/810-2100-2B-D	TPD32-EV-690/810-1650-2B-D-NA	ON	OFF	ON	OFF	OFF	ON	OFF	OFF
TPD32-EV-690/810-1010-2B-E	TPD32-EV-690/810-900-2B-E-NA	ON	OFF	OFF	OFF	ON	ON	ON	ON
TPD32-EV-690/810-1400-2B-E	TPD32-EV-690/810-1150-2B-E-NA	ON	OFF	OFF	ON	OFF	OFF	OFF	OFF
TPD32-EV-690/810-1700-2B-E	TPD32-EV-690/810-1350-2B-E-NA	ON	OFF	OFF	ON	OFF	OFF	ON	OFF

TPD32-EV-690/810-2000-2B-E	TPD32-EV-690/810-1500-2B-E-NA	ON	OFF	OFF	ON	OFF	ON	OFF	OFF
TPD32-EV-690/810-2400-2B-E	TPD32-EV-690/810-1800-2B-E-NA	ON	OFF	OFF	ON	OFF	ON	OFF	ON
TPD32-EV-690/810-2700-2B-E	TPD32-EV-690/810-2000-2B-E-NA	ON	OFF	OFF	ON	OFF	ON	ON	OFF
TPD32-EV-690/810-3300-2B-E	TPD32-EV-690/810-2350-2B-E-NA	ON	OFF	OFF	ON	ON	OFF	OFF	OFF

Standard	American	S15-8	S15-7	S15-6	S15-5	S15-4	S15-3	S15-2	S15-1
TPD32-EV-500/520-770-4B-C	TPD32-EV-500/520-560-4B-C-NA	OFF	ON	OFF	OFF	ON	OFF	ON	ON
TPD32-EV-500/520-1050-4B-C	TPD32-EV-500/520-850-4B-C-NA	OFF	ON	OFF	OFF	ON	ON	OFF	OFF
TPD32-EV-500/520-1400-4B-D	TPD32-EV-500/520-1000-4B-D-NA	OFF	ON	OFF	ON	ON	OFF	ON	ON
TPD32-EV-500/520-1600-4B-D	TPD32-EV-500/520-1200-4B-D-NA	OFF	ON	OFF	ON	ON	ON	OFF	OFF
TPD32-EV-500/520-2000-4B-D	TPD32-EV-500/520-1500-4B-D-NA	OFF	ON	OFF	ON	OFF	OFF	OFF	ON
TPD32-EV-500/520-2400-4B-D	TPD32-EV-500/520-1850-4B-D-NA	OFF	ON	ON	OFF	OFF	OFF	OFF	ON
TPD32-EV-500/520-1500-4B-E	TPD32-EV-500/520-1300-4B-E-NA	OFF	ON	OFF	OFF	ON	ON	ON	ON
TPD32-EV-500/520-1700-4B-E	TPD32-EV-500/520-1350-4B-E-NA	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF
TPD32-EV-500/520-2000-4B-E	TPD32-EV-500/520-1500-4B-E-NA	OFF	ON	OFF	ON	OFF	OFF	OFF	ON
TPD32-EV-500/520-2400-4B-E	TPD32-EV-500/520-1800-4B-E-NA	OFF	ON	OFF	ON	OFF	OFF	ON	OFF
TPD32-EV-500/520-2700-4B-E	TPD32-EV-500/520-2000-4B-E-NA	OFF	ON	OFF	ON	OFF	OFF	ON	ON
TPD32-EV-500/520-3300-4B-E	TPD32-EV-500/520-2350-4B-E-NA	OFF	ON	OFF	ON	OFF	ON	OFF	ON
TPD32-EV-575/600-280-4B-B	TPD32-EV-575/600-224-4B-B-NA	ON	OFF	OFF	OFF	OFF	ON	ON	OFF
TPD32-EV-575/600-350-4B-B	TPD32-EV-575/600-280-4B-B-NA	ON	OFF	OFF	OFF	OFF	ON	ON	ON
TPD32-EV-575/600-420-4B-B	TPD32-EV-575/600-336-4B-B-NA	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF
TPD32-EV-575/600-500-4B-B	TPD32-EV-575/600-400-4B-B-NA	ON	OFF	OFF	OFF	ON	OFF	OFF	ON
TPD32-EV-575/600-650-4B-B	TPD32-EV-575/600-450-4B-B-NA	ON	OFF	OFF	OFF	ON	OFF	ON	OFF
TPD32-EV-575/600-700-4B-C	TPD32-EV-575/600-490-4B-C-NA	ON	OFF	OFF	ON	OFF	ON	ON	ON
TPD32-EV-575/600-1050-4B-C	TPD32-EV-575/600-750-4B-C-NA	ON	OFF	OFF	ON	ON	OFF	OFF	ON
TPD32-EV-575/600-1300-4B-D	TPD32-EV-575/600-980-4B-D-NA	ON	OFF	OFF	ON	ON	OFF	ON	OFF
TPD32-EV-575/600-1600-4B-D	TPD32-EV-575/600-1200-4B-D-NA	ON	OFF	OFF	ON	ON	ON	OFF	OFF
TPD32-EV-575/600-2000-4B-D	TPD32-EV-575/600-1500-4B-D-NA	ON	OFF	OFF	ON	OFF	OFF	OFF	ON
TPD32-EV-575/600-2300-4B-D	TPD32-EV-575/600-1800-4B-D-NA	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF
TPD32-EV-690/720-560-4B-C	TPD32-EV-690/720-360-4B-C-NA	ON	OFF	OFF	ON	OFF	ON	ON	OFF
TPD32-EV-690/720-700-4B-C	TPD32-EV-690/720-490-4B-C-NA	ON	OFF	OFF	ON	OFF	ON	ON	ON
TPD32-EV-690/720-900-4B-C	TPD32-EV-690/720-650-4B-C-NA	ON	OFF	OFF	ON	ON	OFF	OFF	OFF
TPD32-EV-690/720-1300-4B-D	TPD32-EV-690/720-980-4B-D-NA	ON	OFF	OFF	ON	ON	OFF	ON	OFF
TPD32-EV-690/720-1600-4B-D	TPD32-EV-690/720-1200-4B-D-NA	ON	OFF	OFF	ON	ON	ON	OFF	OFF
TPD32-EV-690/720-1900-4B-D	TPD32-EV-690/720-1450-4B-D-NA	ON	OFF	OFF	ON	ON	ON	ON	OFF
TPD32-EV-690/720-2100-4B-D	TPD32-EV-690/720-1650-4B-D-NA	ON	OFF	OFF	ON	ON	ON	ON	ON
TPD32-EV-690/720-1010-4B-E	TPD32-EV-690/720-900-4B-E-NA	ON	OFF	OFF	OFF	ON	ON	OFF	ON
TPD32-EV-690/720-1400-4B-E	TPD32-EV-690/720-1150-4B-E-NA	ON	OFF	OFF	OFF	ON	ON	ON	OFF
TPD32-EV-690/720-1700-4B-E	TPD32-EV-690/720-1350-4B-E-NA	ON	OFF	OFF	ON	OFF	OFF	OFF	OFF
TPD32-EV-690/720-2000-4B-E	TPD32-EV-690/720-1500-4B-E-NA	ON	OFF	OFF	ON	OFF	OFF	OFF	ON
TPD32-EV-690/720-2400-4B-E	TPD32-EV-690/720-1800-4B-E-NA	ON	OFF	OFF	ON	OFF	OFF	ON	OFF
TPD32-EV-690/720-2700-4B-E	TPD32-EV-690/720-2000-4B-E-NA	ON	OFF	OFF	ON	OFF	OFF	ON	ON
TPD32-EV-690/720-3300-4B-E	TPD32-EV-690/720-2350-4B-E-NA	ON	OFF	OFF	ON	OFF	ON	OFF	ON

Table 4.4.2-B: Dip-switch S15 Adjustment of the TPD32-EV-CU-... series mains voltage regulation card

Standard	American	S15-8	S15-7	S15-6	S15-5	S15-4	S15-3	S15-2	S15-1
TPD32-EV-CU-230/500-THY1-FC40	TPD32-EV-CU-230/500-THY1-FC40	OFF	ON	ON	ON	ON	ON	ON	ON
TPD32-EV-CU-230/500-THY2-FC40	TPD32-EV-CU-230/500-THY2-FC40	OFF	ON	ON	ON	ON	ON	ON	ON
TPD32-EV-CU-230/500-THY1-FC70	TPD32-EV-CU-230/500-THY1-FC70	OFF	ON	ON	ON	ON	ON	ON	ON
TPD32-EV-CU-230/500-THY2-FC70	TPD32-EV-CU-230/500-THY2-FC70	OFF	ON	ON	ON	ON	ON	ON	ON
TPD32-EV-CU-575/690-THY1-FC40	TPD32-EV-CU-575/690-THY1-FC40	ON	OFF	ON	ON	ON	ON	ON	ON
TPD32-EV-CU-575/690-THY2-FC40	TPD32-EV-CU-575/690-THY2-FC40	ON	OFF	ON	ON	ON	ON	ON	ON
TPD32-EV-CU-575/690-THY1-FC70	TPD32-EV-CU-575/690-THY1-FC70	ON	OFF	ON	ON	ON	ON	ON	ON
TPD32-EV-CU-575/690-THY2-FC70	TPD32-EV-CU-575/690-THY2-FC70	ON	OFF	ON	ON	ON	ON	ON	ON

Note! The drive rated current value must be set in parameter 465 "Drive Size". Switches SW3 and SW4 on the “FIR” power card must also be configured. (see "11.1 Hardware configuration" on page 471).

Table 4.4.3: Dip-switch S4 adaptation of the tachometer feedback to the input voltage

Tacho voltage full scale (V)	S4-1 S4-8	S4-2 S4-7	S4-3 S4-6	S4-4 S4-5
22.7	ON	ON	ON	ON
45.4	ON	ON	ON	OFF
90.7	ON	ON	OFF	OFF
181.6	ON	OFF	OFF	OFF
302.9	OFF	OFF	OFF	OFF

Table 4.4.4: Jumpers on the Regulator card

Designation	Function	Factory
S4	Matching of the input voltage of the tachogenerator reaction, see table 4.4.3	
S5	Adaptation of the speed feedback type: Pos. A Sinusoidal encoder Pos. B Tachogenerator Any position: digital encoder, armature feedback	B
S9	Adaptation to the signal of the analog input Input 1 (terminals 1 and 2) ON 0 ... 20 mA / 4 ... 20 mA OFF 0 ... 10V / -10 ... +10V	OFF
S10	Adaptation to the signal of the analog input Input 2 (terminal 3 and 4) ON 0 ... 20 mA / 4 ... 20 mA OFF 0 ... 10V / -10 ... +10V	OFF
S11	Adaptation to the signal of the analog Input 3 (terminals 5 and 6) ON 0 ... 20 mA / 4 ... 20 mA OFF 0 ... 10V / -10 ... +10V	OFF
S12	Terminating resistor for the serial interface RS485 ON Interface terminated with resistor OFF Interface not terminated	OFF
S14	Field current resistors setting, see table 2.4.3.2	
S15	Adaptation of the regulation card to the device type, see table 4.4.2	
S18 / S19	Selection of the internal/external supply of the RS485 serial interface OFF Serial interface supplied from the outside (PIN 5 and 9) and galvanic divided form the regulation section. ON Serial interface supplied from the inside and connected to the potential reference point of the regulation. PIN 5 and 9 are used to supply the adaptor of the serial interface.	OFF
S20	Monitoring of the C channel of the digital encoder on connector XE2 ON C-channel monitored OFF C-channel not monitored	OFF
S21	Encoder supply voltage selection ON 5 V encoder supply voltage OFF 15...30 V encoder supply voltage	OFF

Table 4.4.5: Test points on Regulator card

Test point	Function	Test point	Function
XY20	Monitoring (± 10VDC) of the Select output parameters setting. (Using this test point set all the Select output 1,2,3,4 to the variable that has to be measured).	XY17	Output current signal (0.61 V =Nominal Drive output current)
XY10	Reference point	XY18	Reference point

21	22	23	24	25	26	27	28	29	30	31	32	33	34	37	38	39	40	41	42
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Figure 4.4.2: Disposition of terminals from 1 to 42

Table 4.4.6 - A: Terminal Assignment (terminals from 1 to 20)

Terminal designation	Function	I/O	Max voltage	Max current
1 +2 Analog input 1	Configurable analog differntial input Signal: Term. 1, Reference point Term. 2 Factory set for Ramp ref 1*	I	±10V	0.25mA (20mA at current ref. value)
3 +4 Analog input 2	Configurable analog differntial input Signal: Term. 3, Reference point Term. 4 Not factory set	I	±10V	0.25mA (20mA at current ref. value)
5 +6 Analog input 3	Configurable analog differntial input Signal: Term. 5, Reference point Term. 6 Not factory set	I	±10V	0.25mA (20mA at current ref. value)
7 +10V	Reference voltage +10V Reference point: Term. 9	0	+10V	10mA
8 -10V	Reference voltage -10V Reference point: Term. 9	0	-10V	10mA
9 0V 10	Reference point for the reference voltages on terminal 7 and 8	—	—	—
10	Screen connection (PE) (connected with housing)	—	—	—
11	Internal 0V	—	—	—
12 Enable drive	Converter enable 0V Disabled converter +15...30V Enabled converter	I	+30V	15V/3.2mA 24V/5mA 30V/6.4mA
13 Start	Start command 0V No start command +15...30V Start	I	+30V	15V/3.2mA 24V/5mA 30V/6.4mA
14 Fast stop	Fast stop 0V Fast stop +15...30V No Fast stop	I	+30V	15V/3.2mA 24V/5mA 30V/6.4mA
15 External fault	External fault 0V External fault present +15...30V No external fault present	I	+30V	15V/3.2mA 24V/5mA 30V/6.4mA
16 COM ID	Reference point of the digital inputs, terminals 12 to 15	—	—	—
18 0V 24	Reference point of the 24V voltage on terminal 19	—	—	—
19 +24 V	Voltage +24V Reference point Terminal 18	0	+20...30V	200 mA**
20	Screen connection (PE) (connected w/housing)	—	—	—

* The user can adapt the configuration to the requirements of the application concerned via the keypad, the serial interface or a bus connection.
** Total value including Terminal 19, Pin 2 of connector XE2 and the digital outputs on the TBO option card.

The R-TPD32-EV regulation card includes a TBO card (terminals 21 to 42). The integrated card is considered by the device as TBO "A".

Table 4.4.6 - B: Terminal Assignment (terminals from 21 to 42)

Designation	Function	I/O	Max voltage	Max current
21 Analog out 1	Analog output 1 Reference point: Terminal 22 Factory set for Actual speed	0	±10V	5mA
22 COM analog output 1	Reference point of analog output 1	—	—	—
23 Analog out 2	Analog output 2 Reference point: Terminal 24 Factory set for Motor current	0	±10V	5mA

24 COM analog output 2	Reference of analog output 2	—	—	—
25 COM digital outputs	COM digital outputs (Terminals 26…29)	—	—	—
26 Digital output 1	Digital output 1 COM: Terminal 25 Factory set for Ramp +	O	+30V	50mA
27 Digital output 2	Digital output 2 COM: Terminal 25 Factory set for Ramp -	O	+30V	50mA
28 Digital output 3	Digital output 3 COM: Terminal 25 Factory set for Spd threshold	O	+30V	50mA
29 Digital output 4	Digital output 4 COM: Terminal 25 Factory set for Overload available	O	+30V	50mA
30 Supply digital output	Supply voltage for digital outputs	I	+30V	depends on the load max 80mA
31 Digital input 1	Digital input 1 COM: Terminal 37 Not Factory set	I	+30V	15V/3.2mA 24V/5mA 30V/6.4mA
32 Digital input 2	Digital input 2 COM: Terminal 37 Not Factory set	I	+30V	15V/3.2mA 24V/5mA 30V/6.4mA
33 Digital input 3	Digital input 3 COM: Terminal 37 Not Factory set	I	+30V	15V/3.2mA 24V/5mA 30V/6.4mA
34 Digital input 4	Digital input 4 COM: Terminal 37 Not Factory set	I	+30V	15V/3.2mA 24V/5mA 30V/6.4mA
37 COM digital inputs	COM of the digital inputs (Terminals 31…34)	—	—	
38 … 42	Not used			

Table 4.4.7: Cable size for fans, signals, and thermistors

Terminals	Max connection cable section			Tightening torque [Nm]
	flexible [mm²]	multi-core [mm²]	AWG	
1...20, +, -	0.14...1.5	0.14...1.5	26...16	0.4

The use of a 3 x 0.1 x 0.02 inches (75 x 2.5 x 0.4 mm) flat screwdriver is recommended. Remove 0.26 inches (6.5mm) of the insulation at the cable ends. Only one unprepared wire (without ferrule) should be connected to each terminal.

Table 4.4.8: Terminal strip for the connection of an analog tachometer

Designation	Function	I/O	max volt.	max curr.
—	Negative tachometer input	I	—	—
+	Positive tachometer input Clockwise rotation: positive / counterclockwise: negative.	I	22.7 / 45.4 / 90.7 / 181.6 / 302.9 V *	8 mA

* It depends on the section set via the Dip switch S4 (see table 4.4.3).

Table 4.4.9: Assignment of an XE1 connector for a sinusoidal encoder

Designation*	Function	I/O	max volt.	max curr.
PIN 1	Channel B-	I	1 V pp	8.3mA pp
PIN 2	Not connected			
PIN 3	Channel C+ (zero pulse)	I	1 V pp	8.3mA pp
PIN 4	Channel C- (zero pulse)	I	1 V pp	8.3mA pp
PIN 5	Channel A+	I	1 V pp	8.3mA pp
PIN 6	Channel A-	I	1 V pp	8.3mA pp
PIN 7	Reference point for 5V	0		
PIN 8	Channel B+	I	1 V pp	8.3mA pp
PIN 9	Supply voltage + 5V for the encoder	0	+5 V	160mA

* 9-pole socket connector, fitted on device. A plug connector according DIN 41 652 is required for the connection.

Table 4.4.10: Assignment of the XE2 connector for a digital encoder

Designation*	Function	I/O	max volt.	max curr.
PIN 1	Channel B-	I	30 V pp**	17mA pp
PIN 2	Supply voltage +24V for the encoder	0	24 V	200mA***
PIN 3	Channel C+ (zero pulse)	I	30 V pp**	17mA pp
PIN 4	Channel C- (zero pulse)	I	30 V pp**	17mA pp
PIN 5	Channel A+	I	30 V pp**	17mA pp
PIN 6	Channel A-	I	30 V pp**	17mA pp
PIN 7	Reference point for 24V	0	—	—
PIN 8	Channel B+	I	30 V pp**	17mA pp
PIN 9	Not connected	—	—	—

* 9-pole socket connector, fitted on device. A plug connector acc. DIN 41 652 is required for the connection.

** The max voltage is 30V when switch S21 = OFF (default, Encoder 15...30V). If switch S21 = ON the max voltage at these Pins is 5V!

*** Total value including Terminal 19, Pin 2 of connector XE2 and the digital outputs on the TBO option card.

4.5 RS485 SERIAL INTERFACE

4.5.1 Description

The RS 485 serial interface enables data transfer via a loop made of two symmetrical, spiral conductors with a common shield. The maximum transmission distance is 3936 feet (1200 m) with a transfer rate of 38,400 KBaud.

The transmission is carried out via a differential signal.

RS 485 interfaces are bus-compatible in half-duplex mode, i.e. sending and receiving take place in succession. Up to 31 TPD32-EV devices (up to 128 address selectable) can be networked together via the RS 485 interface.

Address setting is carried out via the **Device address** parameter. Further information concerning the parameters to be transfered, their type and value range is given in the table contained in section 10, “Parameter List” (RS485 column).

The RS 485 on the TPD32-EV series devices is located on the Regulation card in the form of a 9-pole SUB-D socket connector (XS).The communication may be with or without galvanic isolation: by using galvanic isolation an external power supply is necessary for +5V. The differential signal is transferred via PIN 3 (TxA/RxA) and PIN 7 (TxB/RxB). Bus terminating resistors must be connected at the physical beginning and end of an RS 485 bus in order to prevent signal reflexion. The bus terminating resistors on TPD32-EV series devices are connected when S12 = ON. This enables a direct point-to-point connection with a PLC or PC.

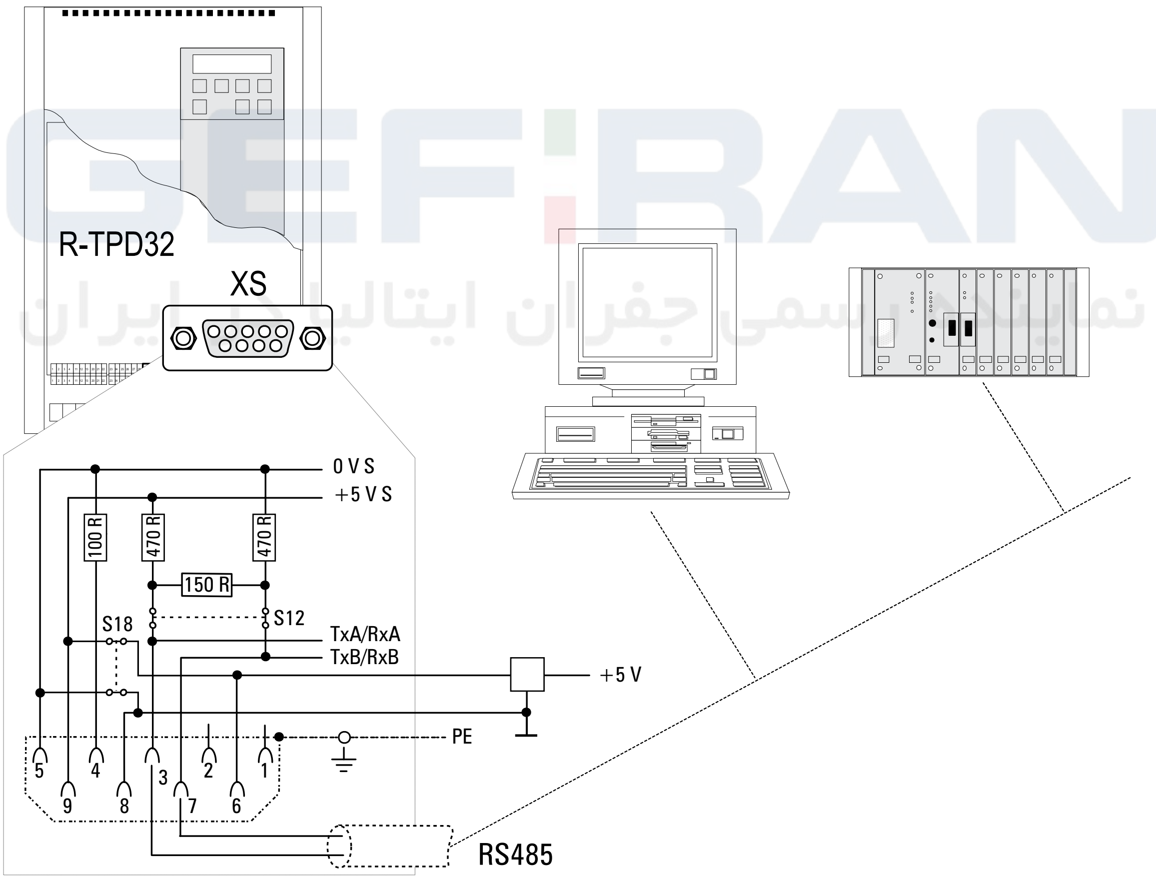


Figure 4.5.1.1: RS485 serial interface

NOTE! Ensure that only the first and last drop of an RS 485 bus have a bus terminating resistor mounted (S12=ON). In all other cases (within the line) jumpers S12=OFF.

With S18=ON the drive supply the serial line. This modality is allowed on point-to-point connection without galvanic isolation only.

NOTE! A connection point to point can be done using "PCI-485" option interface (S18=ON). For multidrop connection (two or more drive), an external power supply is necessary (pin 5 / 0V and pin 9 / +5V).

Pins 6 and 8 are reserved for use with the "PCI-485" interface card.

When connecting the serial interface ensure that:

- only shielded cables are used
- power cables and control cables for contactors/relays are routed separately.

4.5.2 RS485 serial interface connector description

Table 4.5.2.1: Description of the XS connector for the RS485 serial interface

Designation*	Function	I/O	Elec. Interface
PIN 1	Internal use		
PIN 2	Internal use		
PIN 3	RxA/TxA	I/O	RS485
PIN 4	Internal use		
PIN 5	0 V (reference point 5V)		Power supply
PIN 6	Internal use		
PIN 7	RxB/TxB	I/O	RS485
PIN 8	Internal use		
PIN 9	+5V		Power supply

* 9-pole socket connector, fitted on device. A plug connector acc. DIN 41 652 is required for the connection.

The pin 5 and 9 function depends on the position of the switch S18 which state if the serial line is divided or not from the converter reference potential.

S18 in position OFF — The serial interface is galvanic separated from the regulator section. The serial interface power supply is provided from the outside via the PIN 5 (0V) and PIN 9 (+5V) of the XS connector (default factory setting).

S18 in position ON — The serial interface has the same potential reference point as the regulator. The PIN 5 and 9 can be used to supply the adaptor of the RS 232 to RS 485 serial interface that can be purchased from the General Electric Company. They can not be used for any other purpose!

4.6 INPUT/OUTPUT EXPANSION CARD TBO

The input/output expansion card TBO can be fitted in a converter of the TPD32-EV Series. The card provides analog outputs and digital inputs/outputs.
This option card, which is inserted on the XBB connector, is considered by the device as TBO "B".

4.6.1 Assignment of the plug-in terminal strip (terminals 1...15) for Option Card TBO

Table 4.6.1.1: Terminal strip connections

Designation	Function	I/O	Max voltage	Max current
1 Analog output 3	Analog output 3 Reference point: Terminal 2 Factory set for T current (motor current)	0	±10V	5mA
2 COM analog output 3	Reference point of analog output 3 (Terminal 1)	—	—	—
3 Analog output 4	Analog output 4 Reference point: Terminal 4 Factory set for motor speed (Current U)	0	±10V	5mA
4 COM analog output 4	Reference of analog output 4 (Terminal 3)	—	—	—
5 COM digital outputs	COM digital outputs (Terminals 6...9)	—	—	—
6 Digital output 5	Digital output 5 COM: Terminal 5 Factory set for Ramp + (Curr limit state)	0	+30V	50mA
7 Digital output 6	Digital output 6 COM: Terminal 5 Factory set for Ramp - (Overvoltage)	0	+30V	50mA
8 Digital output 7	Digital output 7 COM: Terminal 5 Factory set for Spd threshold (Undervoltage)	0	+30V	50mA
9 Digital output 8	Digital output 8 COM: Terminal 5 Factory set for Overload available (Overcurrent)	0	+30V	50mA
10 Supply digital outputs	Supply voltage for digital outputs	I	+30V	depends on the load max 80mA
11 Digital input 5	Digital input 5 COM: Terminal 15 Not Factory set	I	+30V	15V/3.2mA 24V/5mA 30V/6.4mA
12 Digital input 6	Digital input 6 COM: Terminal 15 Not Factory set	I	+30V	15V/3.2mA 24V/5mA 30V/6.4mA
13 Digital input 7	Digital input 7 COM: Terminal 15 Not Factory set	I	+30V	15V/3.2mA 24V/5mA 30V/6.4mA
14 Digital input 8	Digital input 8 COM: Terminal 15 Not Factory set	I	+30V	15V/3.2mA 24V/5mA 30V/6.4mA
15 COM digital inputs	COM of the digital inputs (Terminals 11...14)	—	—	

Table 4.6.1.2: Cable size for terminals of the option card TBO

Terminals	Max cable connection section			Tightening torque (Nm)
	flexible (mm)	multi-core (mm)	AWG	
1...15	0.14...1.5	0.14...1.5	28...16	0.4

The use of a 3 x 0.1 x 0.02 inches (75 x 2.5 x 0.4 mm) flat screwdriver is recommended. Strip the ends of the cables to a length of 0.26 inch (6.5 mm). Only one unprepared wire (without ferrule) should be connected to each terminal.

4.6.2 Fitting the option card

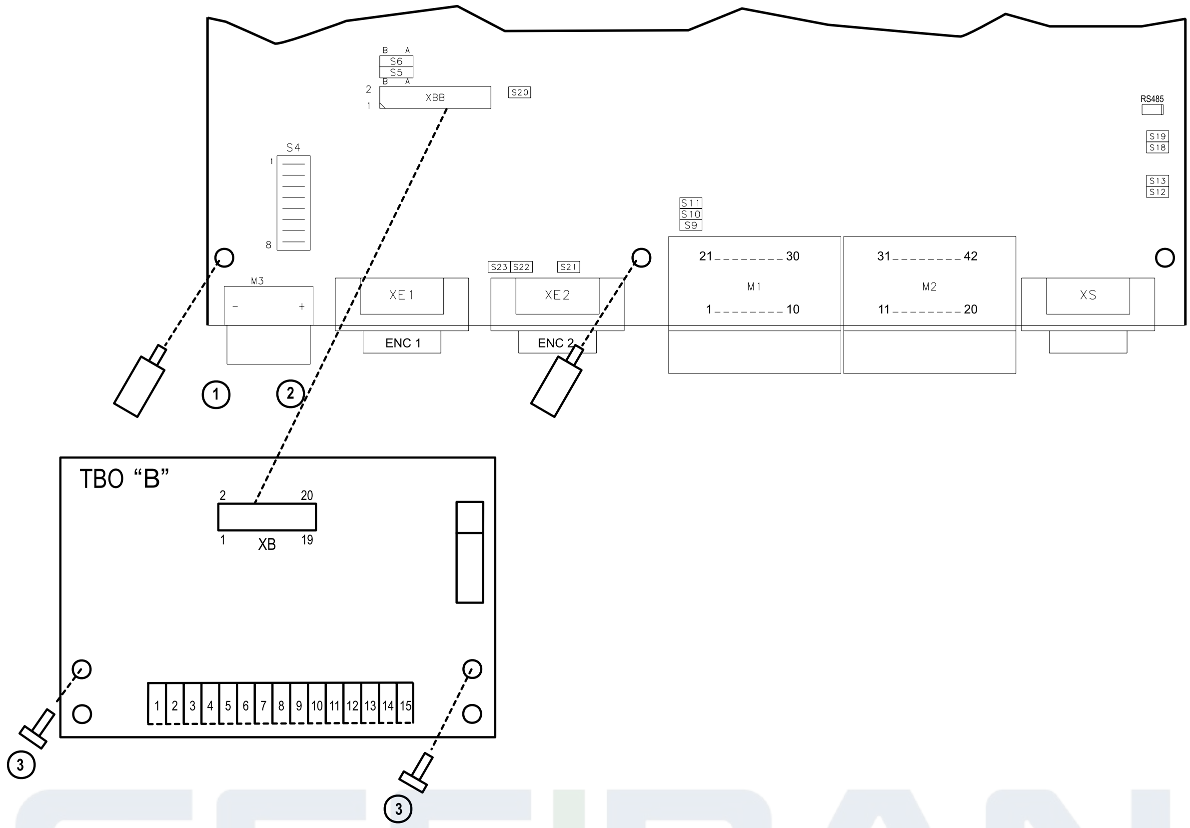


Figure 4.6.2.1: Installing the option card

1 Unscrew the existing fixing screws and screw the spacers in the threaded holes

2 Fix the option card (connector XB of the option in the connector XBB of the device).

3 Fix the option cards on the spacers with the screws.

4.7 DIGITAL ENCODER INTERFACE DEII

4.7.1 Description

The option card DEII has been projected to adapt, to separate galvanically and to connect a digital encoder to the input XE1 of the converters TPD32-EV regulations boards. As standard, this input is arranged for the connection of an analog encoder.

The card DEII will be fixed externally to the drive by the mounting rail DIN EN 50 022-35. The input female connector **XS1** must be connected to the digital encoder using a 9-pole male connector, through a shielded cable, Tasker c/186 (6 x 2 x 0.22) with a maximal length of 150 m.

Male output connector XS2 with 1.5 m shielded cable must be connected to the 9-pin connector fitted on the TPD32-EV control card. The input voltage can be 15V...24V (HTL) or 5V (TTL), depending on whether the encoder to be connected is type HTL or TTL. When the voltage connected to terminals +Venc and 0Venc is switched on, the HTL or TTL LED will light up. If the encoder has HTL outputs, switch S1-S2-S3 must be positioned on HTL side (default configuration); on the opposite side if the encoder has a TTL output. If switch S1-S2-S3 is positioned on TTL side, voltage +Venc is also connected to pin 9 of XS1, in addition to pin 2.

S4 jumper is used to cut out the channel C (no impulse) from the test of encoder loss. S4 closed = canal C included, S4 open = canal C cut out. The EL LED lights up to signal the absence of at least one encoder signal. The function that checks the absence of encoder signals works correctly only with encoders with complementary outputs. It does NOT work with single-ended encoder drivers.

The jumper SH is mounted on condition of standard delivery; it must be cut only in case of the shield side encoder is connected to the chassis of the motor, to avoid the forming a ground ring.

For converter operation with the DEII card it is necessary to set the switch S5, on the regulation board (R-TPD32-EV ≥ rev Q) in position A.

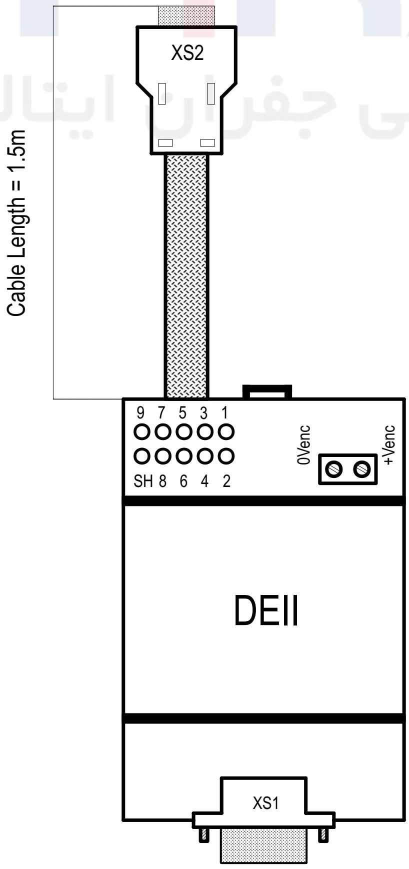


Figure 4.7.1.1: DEII card

4.7.2 DEII Terminal Assignment

Table 4.7.2.1: Terminal assignment (Terminals 0Venc and +Venc)

Designation	Function	I/O	max volt.	max curr.
0Venc	0 V supply to the encoder	I	-	-
+Venc	+15 ... 24 V supply to the encoder (S1, S2, S3 open) +5V supply to the encoder (S1, S2, S3 closed)	I	+24V	depending on encoder data

I = Input O = Output

Table 4.7.2.2: Permissible cable cross section on the terminals of option card DEII

Terminals	Max cable connection section			Tightening torque [Nm]
	[mm²]		AWG	
	flexible	multi-core		
0 Venc and +Venc	0.14 ... 1.5	0.14 ... 1.5	28 ... 14	0.5

The use of a 3 x 0.1 x 0.02 inches (75 x 2.5 x 0.4 mm) flat screwdriver is recommended. Strip the ends of the cables to a length of 0.26 inch (6.5 mm). Only one unprepared wire (without ferrite) should be connected to each terminal.

Table 4.7.2.3: XS1 9-pole connector

Designation	Function	I/O	max volt.	max curr.
PIN 1	Channel B-	I	+24V	10.9mA
PIN 2	Supply voltage for the encoder (the allowed level depends on the jumper position, see chapter 4.7.1	O	+24V	depending on ext. power supply unit
PIN 3	Channel C+ (zero pulse)	O	+24V	10.9mA
PIN 4	Channel C- (zero pulse)	I	+24V	10.9mA
PIN 5	Channel A+	I	+24V	10.9mA
PIN 6	Channel A-	I	+24V	10.9mA
PIN 7	Reference point for supply voltage	O	-	-
PIN 8	Channel B+	I	+24V	10.9mA
PIN 9	+ 5V (only if S1-S2-S3 = TTL)	O	+5V	depending on ext. power supply unit

I = Input O = Output

4.8 STANDARD CONNECTION DIAGRAMS

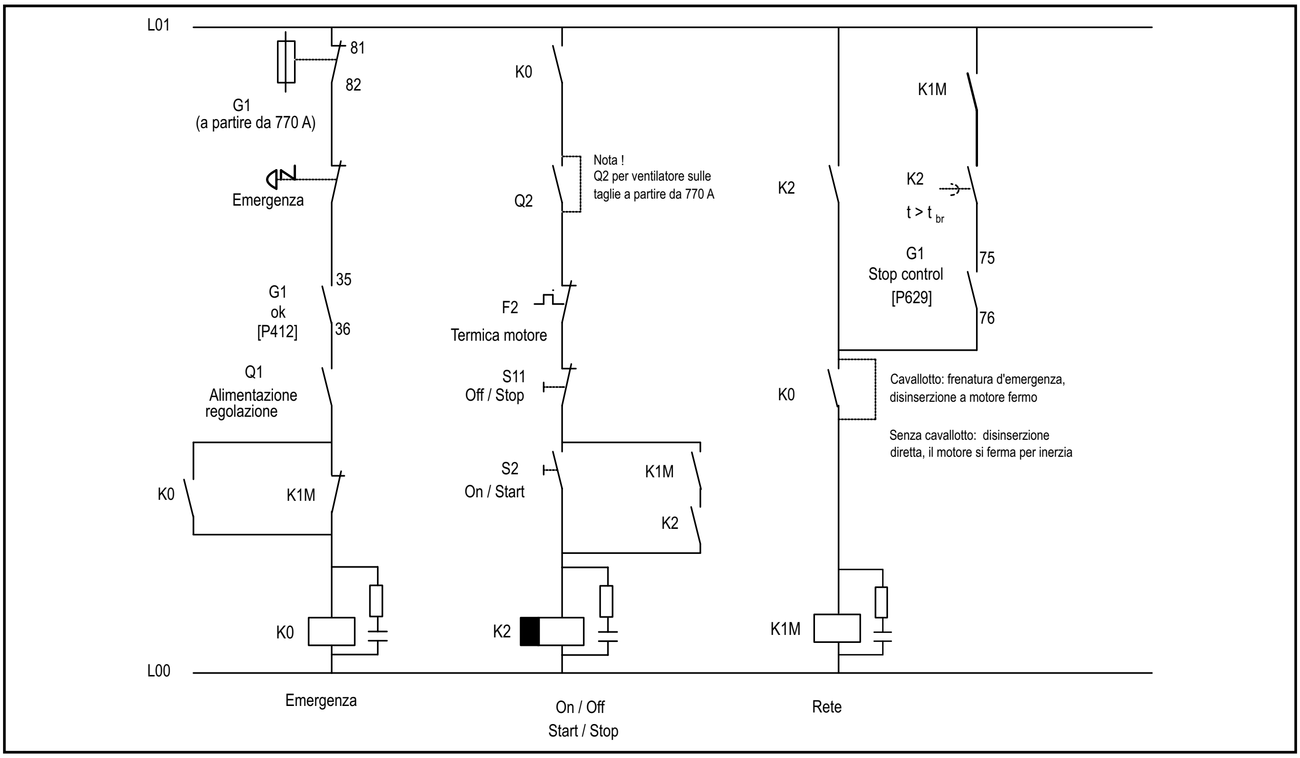


Figure 4.8.1: Control sequencing

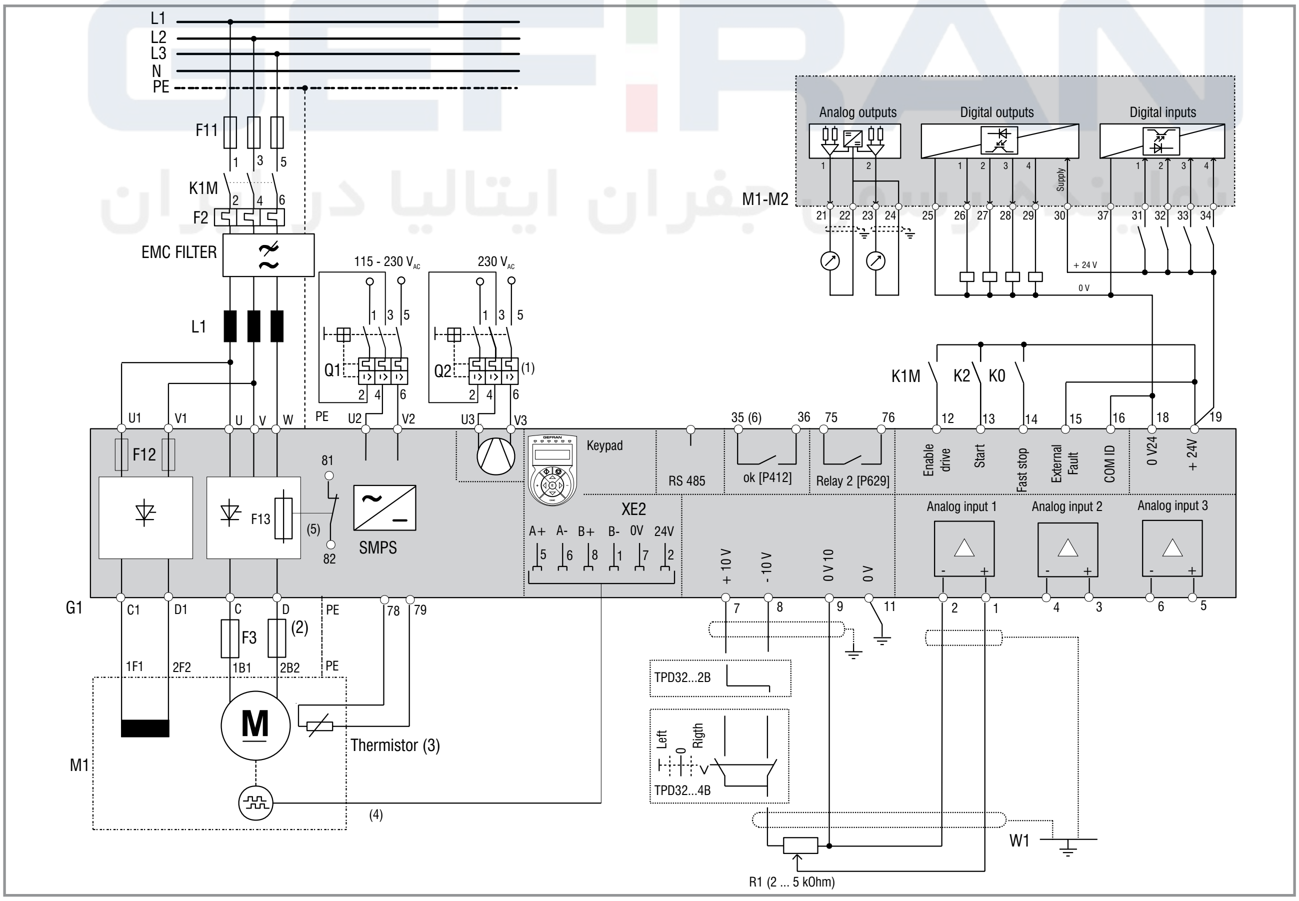
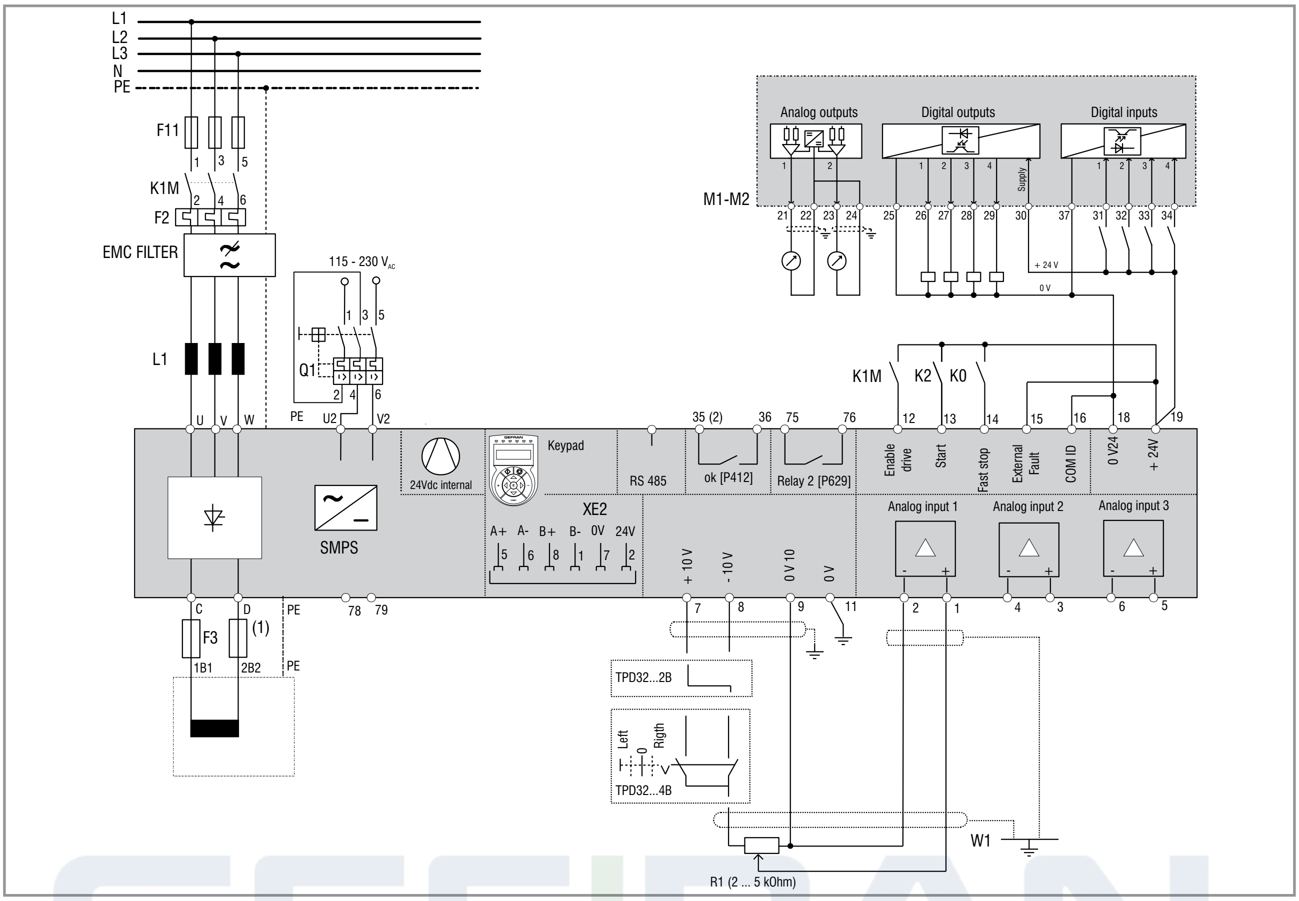


Figure 4.8.2: Typical connections

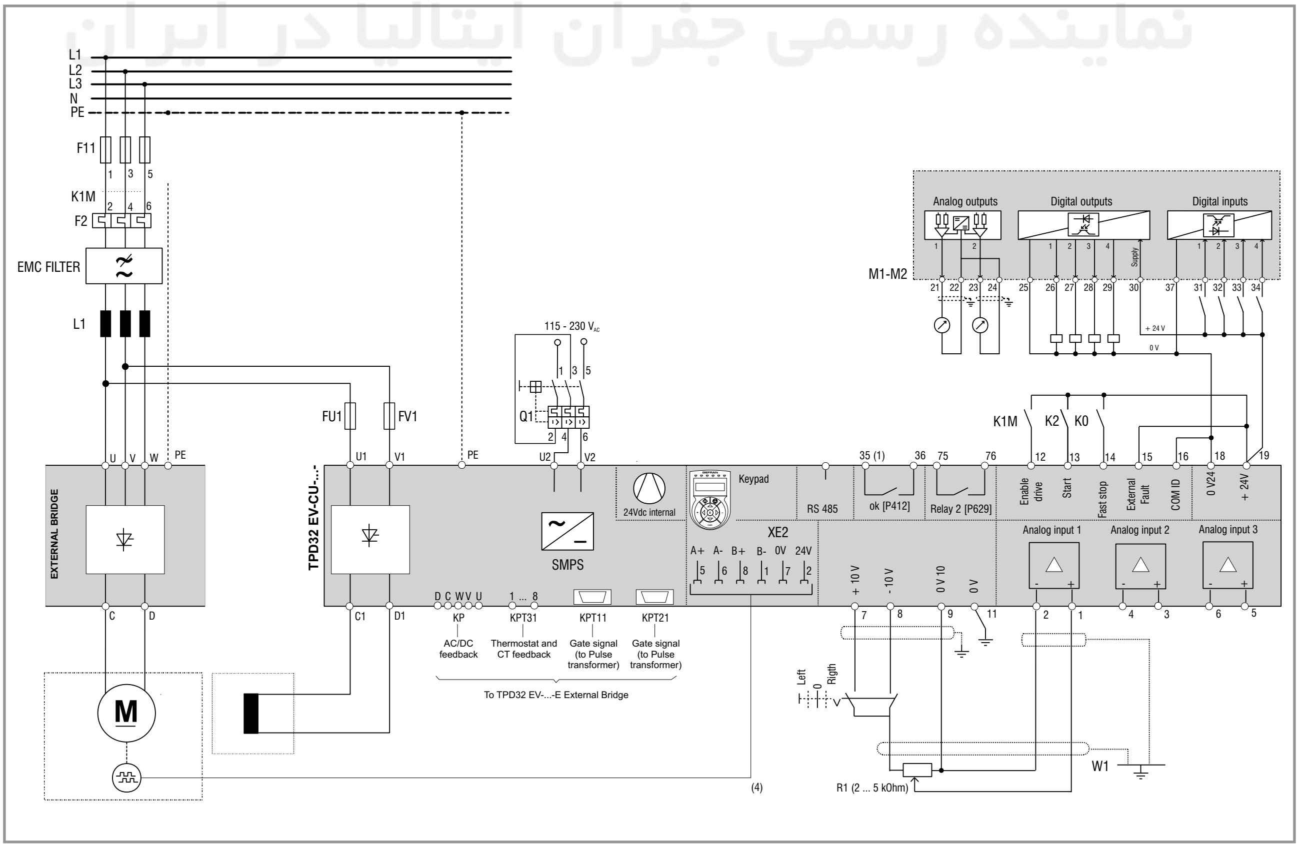
Typical wiring diagram for the standard configuration of the converter.
It is necessary to follow the instructions for mounting and wiring given in the chapters concerning engineering notes and EMC measures.
Option cards connection is not indicated here.
It is not considered the autorestart of the drive after an alarm condition.

(1) Externally-powered fan units with types C and D only.
(2) Fuses for TPD32-EV...4B types A and B only.
(3) 1Kohm resistor connected when the thermistor is not present.
(4) The indicated connections are relative for a digital Encoder.
(5) Types C and D only.
(6) On the Power/Control card "FIR ...".
Connections for sinusoidal encoder and tachogenerator are serately indicated.



(1) Fuses for TPD32 EV-FC-...4B-C only. (2) On the “FIR ...” power/control card.

Figure 4.8.3: TPD32 EV-FC-... typical connection diagram.



(1) On the “FIR ...” power/control card.

Figure 4.8.4: TPD32 EV-CU-... typical connection diagram

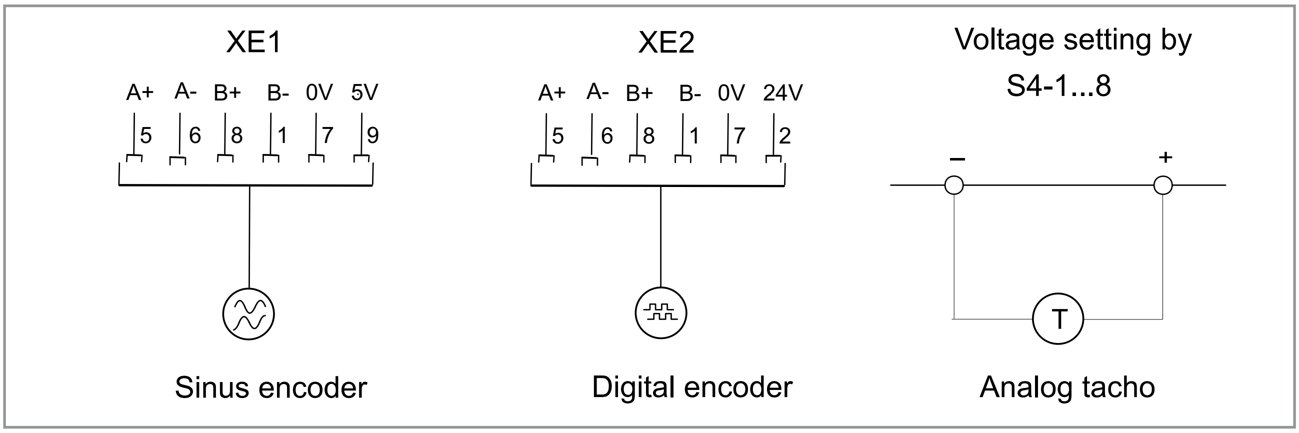


Figure 4.8.5: Encoder and Tachometer Connections

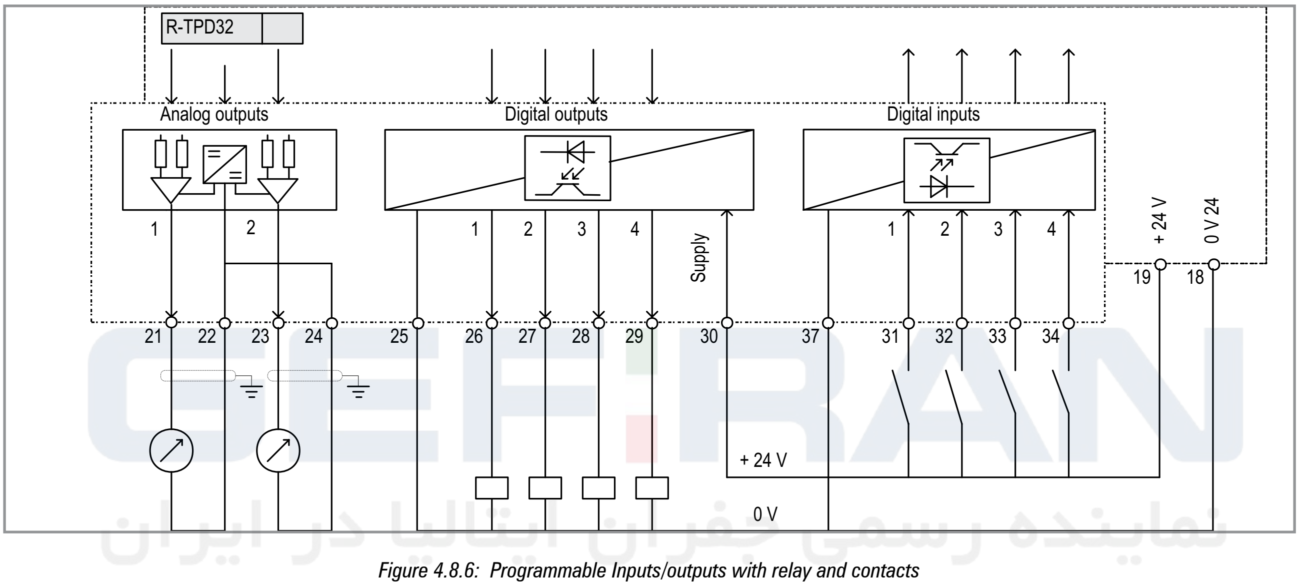


Figure 4.8.6: Programmable Inputs/outputs with relay and contacts

NOTE! To improve the noise immunity it is advisable to connect the common of the outputs (terminals 22/24, 25/37) with the ground (terminals 10 or 20 of the regulation board). It is not possible, the above mentioned common have to be grouded by means of a 0.1 µF/250V capacitor.

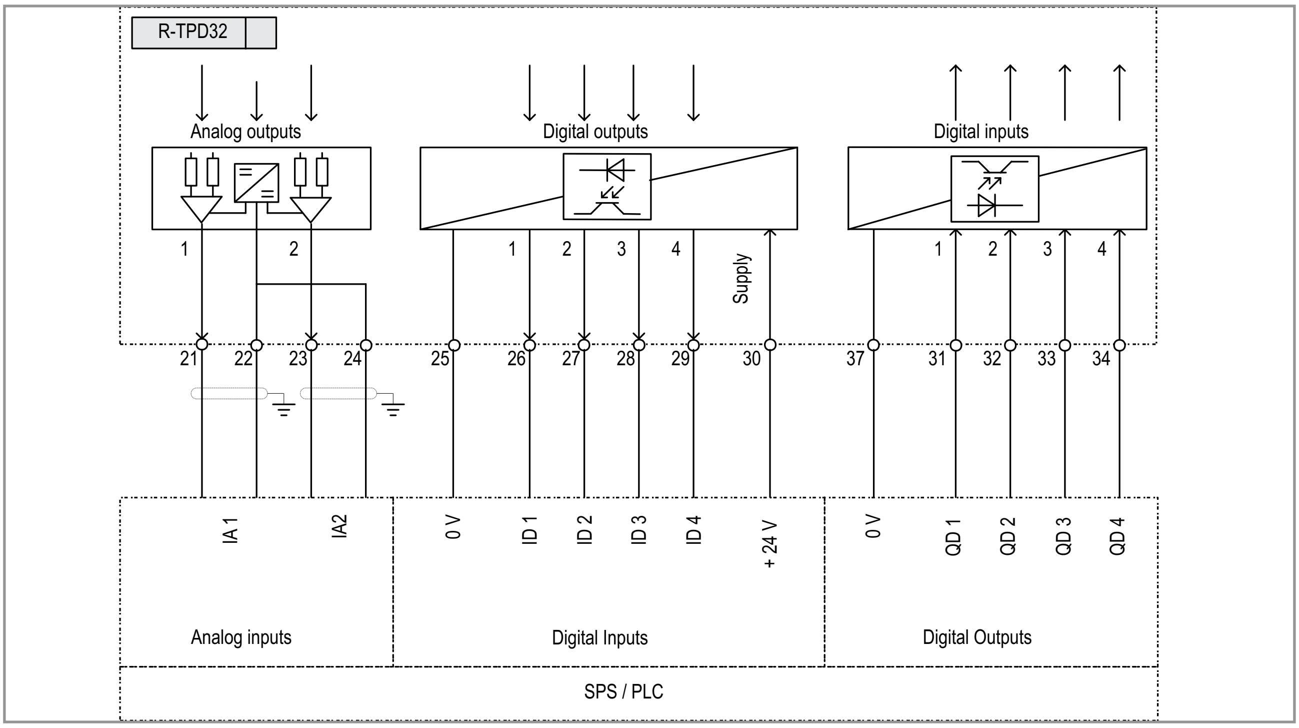


Figure 4.8.7: Programmable Inputs/outputs with PLC

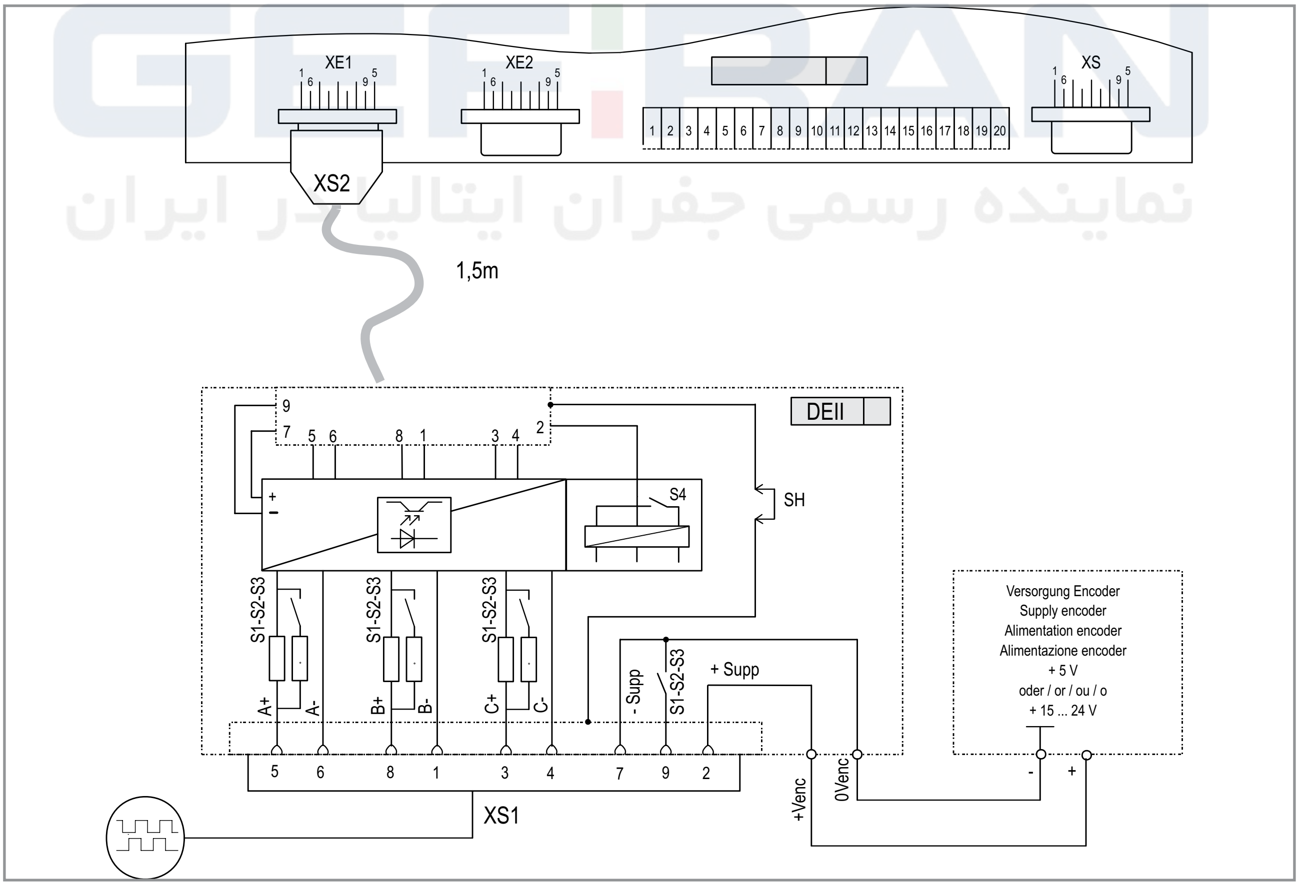


Figure 4.8.8: DEII connection

4.9 CIRCUIT PROTECTION

4.9.1 Fuses

Fuses of the power section

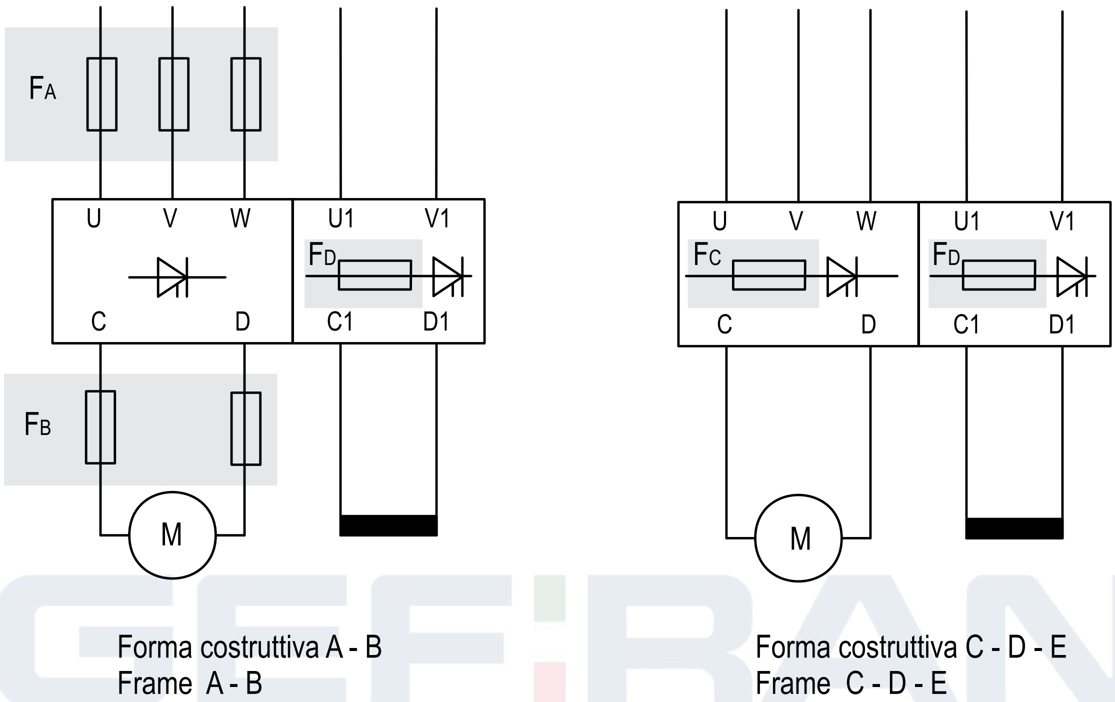


Figure 4.9.1.1: Position of the super fast fuses

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For protection of the bridge thristors use fast acting fuses.
The fuses FA and FB are externally mounted.

Sizes TPD32 EV-...-C, TPD32 EV-...-D and TPD32 EV-...-E are already fitted with fast-acting mains fuses (FC).

Note! Technical characteristics of fuses, including size, weight, dissipation, heat, etc. are provided in the relative fuse manufacturers' catalogues (Z...= Jean Muller; FWP… , 170M...= Bussmann; A...= Gould Shawmut).

Table 4.9.1.1: *FA, External input side fuses*

TPD32 EV Standard sizes	Quantity	Standard		American	
		Type	Code	Type	Code
TPD32-EV-.../...-20-..-A	3	Z14gR20	F4M07	**A70P25**	S7G51
TPD32-EV-.../...-40-..-A	3	Z22gR50	F4M15	**A70P40**	S7G52
TPD32-EV-.../...-70-..-A	3	Z22gR63	F4M17	**A70P80**	S7G54
TPD32-EV-.../...-110-..-A	3	S00C+/üf1/80/100A/660V	F4EAG	**A70P100**	S7G55
TPD32-EV-.../...-140-..-A	3	S00C+/üf1/80/125A/660V	F4EAJ	**A70P150**	S7G56
TPD32-EV-.../...-185-..-A	3	S00üF1/80/200A/660V	F4G23	**A70P175**	S7G57
TPD32-EV-.../...-280-..-B	3	S1üF1/110/250A/660V	F4G28	**A70P300**	S7G60
TPD32-EV-.../...-350-..-B	3	S1üF1/110/315A/660V	F4G30	**A70P350**	S7G61
TPD32-EV-.../...-420-..-B	3	S1üF1/110/400A/660V	F4G34	**A70P400**	S7G62
TPD32-EV-.../...-500-..-B	3	S1üF1/110/500A/660V	F4E30	**A70P500**	S7G63
TPD32-EV-.../...-650-..-B	3	S1üF1/110/630A/660V	F4E31	**A70P600**	S7G65

TPD32 EV American sizes	Quantity	American	
		Type	Code
TPD32 EV-...-.../...-17-..-A-NA	3	A70P25	S7G51
TPD32 EV-...-.../...-35-..-A-NA	3	A70P40	S7G52
TPD32 EV-...-.../...-56-..-A-NA	3	A70P80	S7G54
TPD32 EV-...-.../...-88-..-A-NA	3	A70P100	S7G55
TPD32 EV-...-.../...-112-..-A-NA	3	A70P150	S7G56
TPD32 EV-...-.../...-148-..-A-NA	3	A70P175	S7G57
TPD32 EV-...-.../...-224-..-B-NA	3	A70P300	S7G60
TPD32 EV-...-.../...-280-..-B-NA	3	A70P350	S7G61
TPD32 EV-...-.../...-336-..-B-NA	3	A70P400	S7G62
TPD32 EV-...-.../...-400-..-B-NA	3	A70P500	S7G63
TPD32 EV-...-.../...-450-..-B-NA	3	A70P600	S7G65

Table 4.9.1.2: *FB, External fuses for the armature circuit*

TPD32 EV Standard sizes	Quantity	Standard		American	
		Type	Code	Type	Code
TPD32-EV-500/...-20-4B-A	2	Z14gR20	F4M07	A70P25	S7G51
TPD32-EV-500/...-40-4B-A	2	Z22gR63	F4M17	A70P80	S7G54
TPD32-EV-500/...-70-4B-A	2	S00C+/üf1/80/100A/660V	F4EAG	A70P100	S7G55
TPD32-EV-500/...-110-4B-A	2	S00C+/üf1/80/125A/660V	F4EAJ	A70P150	S7G56
TPD32-EV-500/...-140-4B-A	2	S00C+/üf1/80/160A/660V	F4EAL	A70P175	S7G57
TPD32-EV-500/...-185-4B-A	2	S00üF1/80/200A/660V	F4G23	A70P200	S7G58
TPD32-EV-500/...-280-4B-B	2	S1üF1/110/315A/660V	F4G30	A70P350	S7G61
TPD32-EV-500/...-350-4B-B	2	S2üF1/110/400A/660V	F4G34	A70P400	S7G62
TPD32-EV-500/...-420-4B-B	2	S2üF1/110/500A/660V	F4E30	A70P500	S7G63
TPD32-EV-500/...-500-4B-B	2	S2üF1/110/630A/660V	F4E31	A70P600	S7G65
TPD32-EV-500/...-650-4B-B	2	S2üF1/110/710A/660V	F4G85	A70P700	S7G67
TPD32-EV-575/...-280-4B-B	2	S2üf01/110/315A/1000V	-	A100P350-4	-
TPD32-EV-575/...-350-4B-B	2	S2üf01/110/400A/1000V		A100P400-4	
TPD32-EV-575/...-420-4B-B	2	S2üf01/110/500A/1000V		A100P500-4	
TPD32-EV-575/...-500-4B-B	2	S3üf01/110/630A/1000V	S85C4	A100P600-4	
TPD32-EV-575/...-650-4B-B	2	S3üf01/110/710A/1000V	S85C5	A100P800-4	

TPD32 EV American sizes	Quantity	American	
		Type	Code
TPD32 EV-500/...-17-4B-A-NA	2	A70P25	S7G51
TPD32 EV-500/...-35-4B-A-NA	2	A70P40	S7G52
TPD32 EV-500/...-56-4B-A-NA	2	A70P80	S7G54
TPD32 EV-500/...-88-4B-A-NA	2	A70P100	S7G55
TPD32 EV-500/...-112-4B-A-NA	2	A70P150	S7G56
TPD32 EV-500/...-148-4B-A-NA	2	A70P175	S7G57
TPD32 EV-500/...-224-4B-B-NA	2	A70P300	S7G60
TPD32 EV-500/...-280-4B-B-NA	2	A70P350	S7G61
TPD32 EV-500/...-336-4B-B-NA	2	A70P400	S7G62
TPD32 EV-500/...-400-4B-B-NA	2	A70P500	S7G63
TPD32 EV-500/...-450-4B-B-NA	2	A70P600	S7G65

TPD32 EV American sizes	Quantity	American	
		Type	Code
TPD32 EV-575/...-224-4B-B-NA	2	A100P300-4	
TPD32 EV-575/...-280-4B-B-NA	2	A100P350-4	
TPD32 EV-575/...-336-4B-B-NA	2	A100P400-4	
TPD32 EV-575/...-400-4B-B-NA	2	A100P500-4	
TPD32 EV-575/...-450-4B-B-NA	2	A100P600-4	

Note: Necessary only for the four quadrant functioning.

Table 4.9.1.3: Fc, Internal input side fuses

TPD32 EV Standard sizes	Quantity	Standard		American	
		Type	Code	Type	Code
TPD32 EV-500/600-770-2B-C	3	G2MUF02 800A 660V	S826B	170M 5464 800A 660V	S7792
TPD32 EV-500/600-1000-2B-C	3	170M 5466 1000A 660V	S827B	170M 5466 1000A 660V	S827B
TPD32-EV-500/600-1400-2B-D	6	170M 6263 900A 690V	S86C1	170M 6263 900A 690V	S86C1
TPD32-EV-500/600-1600-2B-D	6	170M 6265 1100A 690V	S86C2	170M 6265 1100A 690V	S86C2
TPD32-EV-500/600-2000-2B-D	6	170M 6267 1400A 690V	S85C2	170M 6267 1400A 690V	S85C2
TPD32-EV-500/600-2400-2B-D	12	170M 6263 900A 690V	S86C1	170M 6263 900A 690V	S86C1
TPD32 EV-500/600-1200-2B-E	6	170M 5464 800A 660V	S7792	170M 5464 800A 660V	S7792
TPD32 EV-500/600-1500-2B-E	6	170M 6464 1000A 660V	S7799	170M 6464 1000A 660V	S7799
TPD32 EV-500/600-1800-2B-E	6	170M 6466 1250A 660V	S7802	170M 6466 1250A 660V	S7802
TPD32 EV-500/600-2000-2B-E	6	170M 6466 1250A 660V	S7802	170M 6466 1250A 660V	S7802
TPD32 EV-500/600-2400-2B-E	6	170M 6467 1400A 660V	S7803	170M 6467 1400A 660V	S7803
TPD32 EV-500/600-2700-2B-E	12	170M 6462 800A 660V	S7797	170M 6462 800A 660V	S7797
TPD32 EV-500/600-2900-2B-E	12	170M 6463 900A 660V	S7798	170M 6463 900A 660V	S7798
TPD32 EV-500/600-3300-2B-E	12	170M 6466 1250A 660V	S7802	170M 6466 1250A 660V	S7802
TPD32-EV-575/680-700-2B-C	3	170M 5463 700A 690V	S7791	170M 5463 700A 690V	S7791
TPD32-EV-575/680-1000-2B-C	3	170M 5466 1000A 690V	S827B	170M 5466 1000A 690V	S827B
TPD32-EV-575/680-1300-2B-D	6	170M 6263 900A 690V	S86C1	170M 6263 900A 690V	S86C1
TPD32-EV-575/680-1600-2B-D	6	170M 6265 1100A 690V	S86C2	170M 6265 1100A 690V	S86C2
TPD32-EV-575/680-2000-2B-D	6	170M 6267 1400A 690V	S85C2	170M 6267 1400A 690V	S85C2
TPD32-EV-575/680-2300-2B-D	12	170M 6263 900A 690V	S86C1	170M 6263 900A 690V	S86C1
TPD32-EV-690/810-560-2B-C	3	170M 5461 550A 690V	S85C11	170M 5461 550A 690V	S85C11
TPD32-EV-690/810-700-2B-C	3	170M 5463 700A 690V	S7791	170M 5463 700A 690V	S7791
TPD32-EV-690/810-900-2B-C	3	170M 5465 900A 690V	S7793	170M 5465 900A 690V	S7793
TPD32-EV-690/810-1300-2B-D	6	170M 6263 900A 690V	S86C1	170M 6263 900A 690V	S86C1
TPD32-EV-690/810-1600-2B-D	6	170M 6265 1100A 690V	S86C2	170M 6265 1100A 690V	S86C2
TPD32-EV-690/810-1900-2B-D	6	170M 6267 1400A 690V	S85C2	170M 6267 1400A 690V	S85C2
TPD32-EV-690/810-2100-2B-D	12	170M 6262 800A 690V	S85C3	170M 6262 800A 690V	S85C3
TPD32 EV-690/810-1010-2B-E	6	170M 5463 700A 660V	S7791	170M 5463 700A 660V	S7791
TPD32 EV-690/810-1400-2B-E	6	170M 6463 900A 660V	S7798	170M 6463 900A 660V	S7798
TPD32 EV-690/810-1700-2B-E	6	170M 6465 1100A 660V	S7801	170M 6465 1100A 660V	S7801
TPD32 EV-690/810-2000-2B-E	6	170M 6466 1250A 660V	S7802	170M 6466 1250A 660V	S7802
TPD32 EV-690/810-2400-2B-E	12	170M 6461 700A 660V	S7796	170M 6461 700A 660V	S7796
TPD32 EV-690/810-2700-2B-E	12	170M 6462 800A 660V	S7797	170M 6462 800A 660V	S7797
TPD32 EV-690/810-3300-2B-E	12	170M 6466 1250A 660V	S7802	170M 6466 1250A 660V	S7802
TPD32 EV-500/520-770-4B-C	6	170M 5462 630A 660V	S825B	170M 5462 630A 660V	S825B
TPD32 EV-500/520-1050-4B-C	6	G2MUF02 800A 660V	S826B	170M 5464 800A 660V	S7792
TPD32-EV-500/520-1400-4B-D	6	170M 6263 900A 690V	S86C1	170M 6263 900A 690V	S86C1
TPD32-EV-500/520-1600-4B-D	6	170M 6265 1100A 690V	S86C2	170M 6265 1100A 690V	S86C2
TPD32-EV-500/520-2000-4B-D	6	170M 6267 1400A 690V	S85C2	170M 6267 1400A 690V	S85C2
TPD32-EV-500/520-2400-4B-D	12	170M 6263 900A 690V	S86C1	170M 6263 900A 690V	S86C1
TPD32 EV-500/520-1500-4B-E	6	170M 5465 900A 660V	S7793	170M 5465 900A 660V	S7793
TPD32 EV-500/520-1700-4B-E	6	170M 6466 1250A 660V	S7802	170M 6466 1250A 660V	S7802
TPD32 EV-500/520-2000-4B-E	6	170M 6466 1250A 660V	S7802	170M 6466 1250A 660V	S7802

TPD32 EV Standard sizes	Quantity	Standard		American	
		Type	Code	Type	Code
TPD32 EV-500/520-2400-4B-E	6	170M 6467 1400A 660V	S7803	170M 6467 1400A 660V	S7803
TPD32 EV-500/520-2700-4B-E	12	170M 6462 800A 660V	S7797	170M 6462 800A 660V	S7797
TPD32 EV-500/520-3300-4B-E	12	170M 6466 1250A 660V	S7802	170M 6466 1250A 660V	S7802
TPD32-EV-575/600-700-4B-C	6	170M 5394 500A 1250V	S85D3	170M 5394 500A 1250V	S85D3
TPD32-EV-575/600-1050-4B-C	6	170M 5398 800A 1000V	S85D2	170M 5398 800A 1000V	S85D2
TPD32-EV-575/600-1300-4B-D	6	170M 6247 900A 1250V	S85C7	170M 6247 900A 1250V	S85C7
TPD32-EV-575/600-1600-4B-D	6	170M 6249 1100A 1250V	S85C10	170M 6249 1100A 1250V	S85C10
TPD32-EV-575/600-2000-4B-D	12	170M 6245 700A 1250V	S85C5	170M 6245 700A 1250V	S85C5
TPD32-EV-575/600-2300-4B-D	12	170M 6247 900A 1250V	S85C7	170M 6247 900A 1250V	S85C7
TPD32-EV-690/720-560-4B-C	6	170M 5392 400A 1250V	S85C12	170M 5392 400A 1250V	S85C12
TPD32-EV-690/720-700-4B-C	6	170M 5394 500A 1250V	S85D3	170M 5394 500A 1250V	S85D3
TPD32-EV-690/720-900-4B-C	6	170M 5396 630A 1100V	S85D1	170M 5396 630A 1100V	S85D1
TPD32-EV-690/720-1300-4B-D	6	170M 6247 900A 1250V	S85C7	170M 6247 900A 1250V	S85C7
TPD32-EV-690/720-1600-4B-D	6	170M 6249 1100A 1250V	S85C10	170M 6249 1100A 1250V	S85C10
TPD32-EV-690/720-1900-4B-D	12	170M 6245 700A 1250V	S85C5	170M 6245 700A 1250V	S85C5
TPD32-EV-690/720-2100-4B-D	12	170M 6246 800A 1250V	S85C6	170M 6246 800A 1250V	S85C6
TPD32 EV-690/720-1010-4B-E	6	170M 6345 700A 1250V	S7795	170M 6345 700A 1250V	S7795
TPD32 EV-690/720-1400-4B-E	6	170M 6497 900A 1250V	S7804	170M 6497 900A 1250V	S7804
TPD32 EV-690/720-1700-4B-E	12	170M 5394 500A 1250V	S85D3	170M 5394 500A 1250V	S85D3
TPD32 EV-690/720-2000-4B-E	12	170M 6344 630A 1250V	S7794	170M 6344 630A 1250V	S7794
TPD32 EV-690/720-2400-4B-E	12	170M 6345 700A 1250V	S7795	170M 6345 700A 1250V	S7795
TPD32 EV-690/720-2700-4B-E	12	170M 6346 800A 1250V	S7805	170M 6346 800A 1250V	S7805
TPD32 EV-690/720-3300-4B-E	12	170M 6500 1250A 1100V	S7806	170M 6500 1250A 1100V	S7806

TPD32 EV American sizes	Quantity	American	
		Type	Code
TPD32-EV-500/600-560-2B-C-NA	3	170M 5464 800A 660V	S7792
TPD32-EV-500/600-800-2B-C-NA	3	170M 5466 1000A 660V	S827B
TPD32-EV-500/600-1000-2B-D-NA	6	170M 6263 900A 690V	S86C1
TPD32-EV-500/600-1200-2B-D-NA	6	170M 6265 1100A 690V	S86C2
TPD32-EV-500/600-1500-2B-D-NA	6	170M 6267 1400A 690V	S85C2
TPD32-EV-500/600-1850-2B-D-NA	12	170M 6263 900A 690V	S86C1
TPD32-EV-500/600-1000-2B-E-NA	6	170M 5464 800A 660V	S7792
TPD32-EV-500/600-1300-2B-E-NA	6	170M 6464 1000A 660V	S7799
TPD32-EV-500/600-1400-2B-E-NA	6	170M 6466 1250A 660V	S7802
TPD32-EV-500/600-1500-2B-E-NA	6	170M 6466 1250A 660V	S7802
TPD32-EV-500/600-1800-2B-E-NA	6	170M 6467 1400A 660V	S7803
TPD32-EV-500/600-2000-2B-E-NA	12	170M 6462 800A 660V	S7797
TPD32-EV-500/600-2200-2B-E-NA	12	170M 6463 900A 660V	S7798
TPD32-EV-500/600-2350-2B-E-NA	12	170M 6466 1250A 660V	S7802
TPD32-EV-575/680-490-2B-C-NA	3	170M 5463 700A 690V	S7791
TPD32-EV-575/680-750-2B-C-NA	3	170M 5466 1000A 690V	S827B
TPD32-EV-575/680-980-2B-D-NA	6	170M 6263 900A 690V	S86C1
TPD32-EV-575/680-1200-2B-D-NA	6	170M 6265 1100A 690V	S86C2
TPD32-EV-575/680-1500-2B-D-NA	6	170M 6267 1400A 690V	S85C2
TPD32-EV-575/680-1800-2B-D-NA	12	170M 6263 900A 690V	S86C1
TPD32-EV-690/810-360-2B-C-NA	3	170M 5461 550A 690V	S85C11
TPD32-EV-690/810-490-2B-C-NA	3	170M 5463 700A 690V	S7791
TPD32-EV-690/810-650-2B-C-NA	3	170M 5465 900A 690V	S7793
TPD32-EV-690/810-920-2B-D-NA	6	170M 6263 900A 690V	S86C1
TPD32-EV-690/810-1200-2B-D-NA	6	170M 6265 1100A 690V	S86C2
TPD32-EV-690/810-1450-2B-D-NA	6	170M 6267 1400A 690V	S85C2
TPD32-EV-690/810-1650-2B-D-NA	12	170M 6262 800A 690V	S85C3

TPD32 EV American sizes	Quantity	American	
		Type	Code
TPD32-EV-690/810-900-2B-E-NA	6	170M 5463 700A 660V	S7791
TPD32-EV-690/810-1150-2B-E-NA	6	170M 6463 900A 660V	S7798
TPD32-EV-690/810-1350-2B-E-NA	6	170M 6465 1100A 660V	S7801
TPD32-EV-690/810-1500-2B-E-NA	6	170M 6466 1250A 660V	S7802
TPD32-EV-690/810-1800-2B-E-NA	12	170M 6461 700A 660V	S7796
TPD32-EV-690/810-2000-2B-E-NA	12	170M 6462 800A 660V	S7797
TPD32-EV-690/810-2350-2B-E-NA	12	170M 6466 1250A 660V	S7802
TPD32-EV-500/520-560-4B-C-NA	6	170M 5462 630A 660V	S825B
TPD32-EV-500/520-850-4B-C-NA	6	170M 5464 800A 660V	S7792
TPD32-EV-500/520-1000-4B-D-NA	6	170M 6263 900A 690V	S86C1
TPD32-EV-500/520-1200-4B-D-NA	6	170M 6265 1100A 690V	S86C2
TPD32-EV-500/520-1500-4B-D-NA	6	170M 6267 1400A 690V	S85C2
TPD32-EV-500/520-1850-4B-D-NA	12	170M 6263 900A 690V	S86C1
TPD32-EV-500/520-1300-4B-E-NA	6	170M 5465 900A 660V	S7793
TPD32-EV-500/520-1350-4B-E-NA	6	170M 6466 1250A 660V	S7802
TPD32-EV-500/520-1500-4B-E-NA	6	170M 6466 1250A 660V	S7802
TPD32-EV-500/520-1800-4B-E-NA	6	170M 6467 1400A 660V	S7803
TPD32-EV-500/520-2000-4B-E-NA	12	170M 6462 800A 660V	S7797
TPD32-EV-500/520-2350-4B-E-NA	12	170M 6466 1250A 660V	S7802
TPD32-EV-575/600-490-4B-C-NA	6	170M 5394 500A 1250V	S85D3
TPD32-EV-575/600-750-4B-C-NA	6	170M 5398 800A 1000V	S85D2
TPD32-EV-575/600-980-4B-D-NA	6	170M 6247 900A 1250V	S85C7
TPD32-EV-575/600-1200-4B-D-NA	6	170M 6249 1100A 1250V	S85C10
TPD32-EV-575/600-1500-4B-D-NA	12	170M 6245 700A 1250V	S85C5
TPD32-EV-575/600-1800-4B-D-NA	12	170M 6247 900A 1250V	S85C7
TPD32-EV-690/720-360-4B-C-NA	6	170M 5392 400A 1250V	S85C12
TPD32-EV-690/720-490-4B-C-NA	6	170M 5394 500A 1250V	S85D3
TPD32-EV-690/720-650-4B-C-NA	6	170M 5396 630A 1100V	S85D1
TPD32-EV-690/720-980-4B-D-NA	6	170M 6247 900A 1250V	S85C7
TPD32-EV-690/720-1200-4B-D-NA	6	170M 6249 1100A 1250V	S85C10
TPD32-EV-690/720-1450-4B-D-NA	12	170M 6245 700A 1250V	S85C5
TPD32-EV-690/720-1650-4B-D-NA	12	170M 6246 800A 1250V	S85C6
TPD32-EV-690/720-900-4B-E-NA	6	170M 6345 700A 1250V	S7795
TPD32-EV-690/720-1150-4B-E-NA	6	170M 6497 900A 1250V	S7804
TPD32-EV-690/720-1350-4B-E-NA	12	170M 5394 500A 1250V	S85D3
TPD32-EV-690/720-1500-4B-E-NA	12	170M 6344 630A 1250V	S7794
TPD32-EV-690/720-1800-4B-E-NA	12	170M 6345 700A 1250V	S7795
TPD32-EV-690/720-2000-4B-E-NA	12	170M 6346 800A 1250V	S7805
TPD32-EV-690/720-2350-4B-E-NA	12	170M 6500 1250A 1100V	S7806

Note! These fuses are fitted inside the device and form an integral part of the equipment (TPD32 EV-...-C, TPD32 EV-...-D and TPD32 EV-...-E series).

Table 4.9.1.4: F_D, Internal fuses for the field circuit

TPD32 EV Standard sizes	Quantity	Standard	
		Type	Code
TPD32 EV-.../...-....-..-A	2	500 V 16 A fast	S824B
TPD32 EV-.../...-....-..-B	2	600 V 25 A fast	S823B
TPD32 EV-.../...-....-..-C	2	600 V 25 A fast	S823B
TPD32 EV-.../...-1300-..-D to TPD32 EV-.../...-2000-..-D	2	600 V 50 A fast	F4M15
TPD32 EV-.../...-2100-..-D to TPD32 EV-.../...-2400-..-D	2	600 V 100 A fast	F4M21
TPD32 EV-.../...-1010-..-E to TPD32 EV-.../...-2000-..-E	2	600 V 50 A fast	F4M15
TPD32 EV-.../...-2400-..-E to TPD32 EV-.../...-3300-..-E	2	600 V 100 A fast	F4M21

TPD32 EV American sizes	Quantity	American	
		Type	Code
TPD32 EV-.../...-....-..-A-NA	2	500 V 16 A fast	S824B
TPD32 EV-.../...-....-..-B-NA	2	600 V 25 A fast	S823B
TPD32 EV-.../...-....-..-C-NA	2	600 V 25 A fast	S823B
TPD32 EV-.../...-920-..-D to TPD32 EV-.../...-1500-..-D-NA	2	600 V 50 A fast	F4M15
TPD32 EV-.../...-1650-..-D to TPD32 EV-.../...-1850-..-D-NA	2	600 V 100 A fast	F4M21
TPD32 EV-.../...-1000-..-E to TPD32 EV-.../...-1500-..-E-NA	2	600 V 50 A fast	F4M15
TPD32 EV-.../...-1800-..-E to TPD32 EV-.../...-2350-..-E-NA	2	600 V 100 A fast	F4M21

Note! These fuses are internally mounted and are provided on the delivery.

Table 4.9.1.5: FU1, FV1, External field circuit fuses for TPD32-EV-CU

TPD32 EV Standard sizes	Quantity	Standard	
		Type	Code
TPD32-EV-CU-.../...-....-40	2	FWP-50A22Fa A70QS50-22F 5014006.50	F4M15
TPD32-EV-CU-.../...-....-70	2	FWP-100A22Fa A70QS100-22F 5.014.006.100	F4M21

NOTE! Technical characteristics of fuses, including size, weight, dissipation, heat, etc. are provided in the relative fuse manufacturers' catalogues (5014006...= SIBA; FWP… = Bussmann; A70...=Ferraz-Shawmut).

Table 4.9.1.5: Other internal fuses

Construction type	Designation	Fuses for	Fuse	Code	Mounted on
A	F1	+ 24V power supply out	IEC 250 V 2.50 A slo-blo 0.2" x 0.8" (5 x 20 mm)	S8B29	SW1-31 ≥ rev. K (*)
B	F1/F2	+ 24V power supply out	IEC 250 V 2.50 A slo-blo 0.2" x 0.8" (5 x 20 mm)	S8B29	SW2-32 ≥ rev. J (**)
	F1/F2/F3	Varistor fuse	IEC 500 V 16 A fast acting 0.24" x 1.26" (6 x 32 mm) IEC 600 V 15 A fast acting 0.4" x 1.5" (10 x 38 mm)	S824B S823B	FIR-2-51 (TPD32 EV-500/...-...) FIR-2-61 (TPD32 EV-575/...-...)
C	F1/F2	+ 24V power supply out	IEC 250 V 2.50 A slo-blo 0.2" x 0.8" (5 x 20 mm)	S8B29	SW3-32
	F1/F2/F3	Varistor fuse	IEC 500 V 25 A fast acting 0.24" x 1.26" (6 x 32 mm) IEC 690 V 25 A fast acting 0.55" x 2" (14 x 51 mm) IEC 690 V 25 A fast acting 0.55" x 2" (14 x 51 mm)	S821B S85B6 S85B6	FL-31 FL-57 (TPD32 EV-575/...-...) FL-69 (TPD32 EV-690/...-...)
D	F1	+ 24V power supply in	IEC 250 V 2.50 A slo-blo 0.2" x 0.8" (5 x 20 mm)	S8B29	SW1-31
	F11/F21/F31	Varistor fuse	IEC 690 V 10 A fast acting 0.55" x 2" (14 x 51 mm)	S7G49	CFSF-..

(*) F1 (SW1-31 < rev. K) = IEC 250 V 1 A slo-blo, 0.2"x 0.8" (5 x 20 mm)

(**) F1 (SW2-32 < rev. J) = IEC 250 V 3.15 A fast acting, 0.2" x 0.8" (5 x 20 mm)

4.9.2 Fuses selection when the Overload function is activated

> 100% for 60 seconds - Standard Setting   > 150% for 60 seconds - American Setting

Different fuses must be used when the current is higher than the rated one (overload current). Maximum values allowed for each type are listed on the next table. Be carefull to coordinate the right dimension.

Example: the 1st fuse type on power section A have to be coordinated with the 1st fuse type on section B and so on.

For type C-D-E converters: see "Table 4.9.1.3: Fc, Internal input side fuses" on page 88.

Table 4.9.2.1: F_A, Overload fuses

Converter type	Code	Pieces	400 VAC Input supply	500 VAC Input Supply	575 VAC Input Supply
TPD32-EV-.../...-20-..-A	F_A F_B*	3 2	Z14gR25 (GRD2/25) Z14gR32 (F4M11)	Z14gR25 (GRD2/25) Z14gR32 (F4M11)	
TPD32-EV-.../...-40-..-A	F_A F_B*	3 2	Z22gR50 (F4M15) Z22gR63 (F4M17)	Z14gR40 (GRD3/35) Z22gR50 (F4M15)	
TPD32-EV-.../...-70-..-A	F_A F_B*	3 2	S00C+/üf1/80/100A/660V (F4EAG) S00C+/üf1/80/100A/660V (F4EAG)	S00C+/üf1/80/100A/660V (F4EAG) S00C+/üf1/80/100A/660V (F4EAG)	
TPD32-EV-.../...-110-..-A	F_A F_B*	3 2	S00C+/üf1/80/100A/660V (F4EAG) S00C+/üf1/80/125A/660V (F4EAJ)	S00C+/üf1/80/100A/660V (F4EAG) S00C+/üf1/80/125A/660V (F4EAJ)	
TPD32-EV-.../...-140-..-A	F_A F_B*	3 2	S00UF1/80/160A/660V (F4EAL) S00UF1/80/200A/660V (F4G23)	S00UF1/80/160A/660V (F4EAL) S00UF1/80/200A/660V (F4G23)	
TPD32-EV-.../...-185-..-A	F_A F_B*	3 2	S00UF1/80/200A/660V (F4G23) S00UF1/80/200A/660V (F4G23)	S00UF1/80/200A/660V (F4G23) S00UF1/80/200A/660V (F4G23)	
TPD32-EV-.../...-280-..-B	F_A F_B*	3 2	S1üF1/110/315A/660V (F4G30) S2üF1/110/400A/660V (F4G34)	S1üF1/110/315A/660V (F4G30) S2üF1/110/400A/660V (F4G34)	S00C+/üf01/315A/690V (...) 170M5242 (...)
TPD32-EV-.../...-350-..-B	F_A F_B*	3 2	S2üF1/110/400A/660V (F4G34) S2üF1/110/500A/660V (F4E30)	S2üF1/110/400A/660V (F4G34) S2üF1/110/500A/660V (F4E30)	S1üf01/110/400A/690V (...) 170M5244 (...)
TPD32-EV-.../...-420-..-B	F_A F_B*	3 2	S2üF1/110/500A/660V (F4E30) S2üF1/110/630A/660V (F4E31)	S2üF1/110/500A/660V (F4E30) S2üF1/110/630A/660V (F4E31)	S1üf01/110/500A/690V (...) 170M6244 (...)
TPD32-EV-.../...-500-..-B	F_A F_B*	3 2	S2üF1/110/630A/660V (F4E31) S2üF1/110/710A/660V (F4G85)	S2üF1/110/630A/660V (F4E31) S2üF1/110/710A/660V (F4G85)	170M4265 (...) 170M4265 (...)
TPD32-EV-.../...-650-..-B	F_A F_B*	3 2	S2üF1/110/630A/660V (F4E31) S2üF1/110/710A/660V (F4G85)	S2üF1/110/630A/660V (F4E31) S2üF1/110/710A/660V (F4G85)	S1üf01/110/630A/690V (...) 170M6246 (...)

Converter type	Code	Pieces	400 VAC Input supply	500 VAC Input Supply	575 VAC Input Supply
TPD32-EV-.../...-17-..-A-NA	F_A F_B*	3 2	Z14gR25 (GRD2/25) Z14gR32 (F4M11)	Z14gR25 (GRD2/25) Z14gR32 (F4M11)	
TPD32-EV-.../...-35-..-A-NA	F_A F_B*	3 2	Z22gR50 (F4M15) Z22gR63 (F4M17)	Z14gR40 (GRD3/35) Z22gR50 (F4M15)	
TPD32-EV-.../...-56-..-A-NA	F_A F_B*	3 2	S00C+/üf1/80/100A/660V (F4EAG) S00C+/üf1/80/100A/660V (F4EAG)	S00C+/üf1/80/100A/660V (F4EAG) S00C+/üf1/80/100A/660V (F4EAG)	
TPD32-EV-.../...-88-..-A-NA	F_A F_B*	3 2	S00C+/üf1/80/100A/660V (F4EAG) S00C+/üf1/80/125A/660V (F4EAJ)	S00C+/üf1/80/100A/660V (F4EAG) S00C+/üf1/80/125A/660V (F4EAJ)	
TPD32-EV-.../...-112-..-A-NA	F_A F_B*	3 2	S00UF1/80/160A/660V (F4EAL) S00UF1/80/200A/660V (F4G23)	S00UF1/80/160A/660V (F4EAL) S00UF1/80/200A/660V (F4G23)	
TPD32-EV-.../...-148-..-A-NA	F_A F_B*	3 2	S00UF1/80/200A/660V (F4G23) S00UF1/80/200A/660V (F4G23)	S00UF1/80/200A/660V (F4G23) S00UF1/80/200A/660V (F4G23)	
TPD32-EV-.../...-224-..-B-NA	F_A F_B*	3 2	S1üF1/110/315A/660V (F4G30) S2üF1/110/400A/660V (F4G34)	S1üF1/110/315A/660V (F4G30) S2üF1/110/400A/660V (F4G34)	S00C+/üf01/315A/690V (...) 170M5242 (...)
TPD32-EV-.../...-280-..-B-NA	F_A F_B*	3 2	S2üF1/110/400A/660V (F4G34) S2üF1/110/500A/660V (F4E30)	S2üF1/110/400A/660V (F4G34) S2üF1/110/500A/660V (F4E30)	S1üf01/110/400A/690V (...) 170M5244 (...)
TPD32-EV-.../...-336-..-B-NA	F_A F_B*	3 2	S2üF1/110/500A/660V (F4E30) S2üF1/110/630A/660V (F4E31)	S2üF1/110/500A/660V (F4E30) S2üF1/110/630A/660V (F4E31)	S1üf01/110/500A/690V (...) 170M6244 (...)
TPD32-EV-.../...-400-..-B-NA	F_A F_B*	3 2	S2üF1/110/630A/660V (F4E31) S2üF1/110/710A/660V (F4G85)	S2üF1/110/630A/660V (F4E31) S2üF1/110/710A/660V (F4G85)	170M4265 (...) 170M4265 (...)
TPD32-EV-.../...-450-..-B-NA	F_A F_B*	3 2	S2üF1/110/630A/660V (F4E31) S2üF1/110/710A/660V (F4G85)	S2üF1/110/630A/660V (F4E31) S2üF1/110/710A/660V (F4G85)	S1üf01/110/630A/690V (...) 170M6246 (...)

F_A External fuses for the armature circuit on the DC side
F_B External fuses for the armature converter on the AC input side
* Necessary only for the four quadrant functioning

Note for sizes 770 ... 1050 A: the armature fuses are internally mounted (see table 4.9.1.1)

4.9.3 AC input contactors

NOTE! The contactor sizes must be selected based on the converter rated current. The sizing basis is the thermo current AC1, which is absorbed by the input during the rated functioning.

NOTE! The technical data of the contactors, as for example weights, dissipated powers, auxiliary contacts etc. can be found in the appropriate data sheets.

4.9.4 Control power protection

The 115 VAC/230 VAC control power input, U2 & V2, for the TPD32-EV are required to be short circuit protected.

This protection can be provided by using standard time delay fuses, or circuit breaker.

The circuit breaker and/or time delay fuses must be selected to survive the short circuit available current of the feeder source for this circuit, and the inrush current of the drive power supply.

The rating of the fuses or circuit breaker should be sized mainly to protect the wiring from the fuses/circuit breaker connections to U2 & V2, and not nuisance trip or blow from the inrush current.

The table below, Table 4.9.5, lists the input current characteristics of the control power.

For version TPD32-EV-FC, refer to the values shown for the TPD32-EV standard model.

Table 4.9.5: Control power protection

Modelli	Regulation Power Supply					
	Card	Power	Rated input current		Inrush input current	
			115 V	230 V	115 V	230 V
TPD32-EV-...-A TPD32-EV-...-D TPD32-EV-...-E TPD32-EV-CU-...	SW1-31	60 W	1 A	0.5 A	20 A	10 A
TPD32-EV-...-B	SW2-32	110 W	1.2 A	0.7 A	15 A	7.5 A
TPD32-EV-...-C	SW3-32	110 W	1.2 A	0.7 A	15 A	7.5 A

The control power input is best served by a power source that is stabilized and buffered from the power system transients.

The control power of many drives can be fed from a single source, as long as proper distribution protection is provided.

4.10 REACTORS / FILTERS

To improve safety during use of the TPD32-EV series of converters (mains noise, disturbance between drives) and guarantee compliance with the conditions as required under EN 60146-1-1, IEC 146-1-2 and EN 61136-1, a three-phase mains choke should be installed upstream of the equipment. In the majority of cases, given a relative short-circuit voltage of at least 100 kA and a simultaneity factor of 1 (EN 50178, A 6.3.6), the inclusion of a switching choke (or transformer) with relative voltage drop of UK = 4% guarantees commutation notches at the common coupling point (CCP) with an amplitude of less than 20%.

4.10.1 AC input choke

According to EN 61800-3 standard (Table B.1), the max. allowable depth of the commutation notches in the PC is limited to 20%-40% depending on the installation environment. This may be obtained installing suitable decoupling reactors or transformers.

On the other hand, for a proper operation, the drive shall be connected to an electrical supply line having a reactance with a relative voltage drop of between 2% (min) and 10% (max). The decoupling reactance requires a specific calculation based on the relative short-circuit power RSC at the connection point and the actual type of connection (single or multiple drives, separating transformers, etc.). But, as an indication, the following tables list the decoupling reactance values Ld (mains spool) having a relative voltage drop of 2% or 4%. The value refers to a drive rated output current, but can be calculated for the motor DC rated current. The line current value is given by ILN = IdN x 0.82. (On shown calculations a safety margin of +5% has been added). It should also be noted that drives having such a high relative voltage usually belong to the "second environment".

The calculation formula is:

$Ld = (Ukd * U_{LN}) / (I_{DN} * \sqrt{2} * 2\pi * f_N)$ or $Ld = (Ukd * U_{LN}) / (I_{LN} * \sqrt{3} * 2\pi * f_N)$ [H]

Table 4.10.1: Mains chokes for 400 Vac input supply

TPD32 EV Standard sizes	Converter rated current [A]	Rated inductance with Ukd = 2% [µH]	Rated inductance with Ukd = 4% [µH]	Rated current inductance [A]
Mains voltage 400 V, 3 ph, 50 Hz				
TPD32-EV-500/...-20-…-A	20	900.3	See "Table 4.10.5 Internal code for mains chokes" on page 98	17
TPD32-EV-500/...-40-…-A	40	450.2		34
TPD32-EV-500/...-70-…-A	70	257.2		60
TPD32-EV-500/...-110-…-A	110	163.7		95
TPD32-EV-500/...-140-…-A	140	128.6		121
TPD32-EV-500/...-185-…-A	185	97.3		159
TPD32-500/…-280-…-B	280	64.3		241
TPD32-500/…-350-…-B	350	51.4		301
TPD32-500/…-420-…-B	420	42.9		362
TPD32-500/…-500-…-B	500	36.0		431
TPD32-500/…-650-…-B	650	27.7		560
TPD32-EV-500/...-770-…-C	770	23.4		663
TPD32-EV-500/...-1000-…-C	1000	18.0		861
TPD32-EV-500/...-1050-…-C	1050	17.1		904
TPD32-EV-500/...-1400-...-D	1400	12.9	**25.7**	1205
TPD32-EV-500/...-1600-...-D	1600	11.3	**22.5**	1378
TPD32-EV-500/...-2000-...-D	2000	9.0	**18.0**	1722
TPD32-EV-500/...-2400-...-D	2400	7.5	**15.0**	2066
TPD32-EV-500/...-1200-…-E	1200	15.0	**30.0**	1033
TPD32-EV-500/...-1500-…-E	1500	12.0	**24.0**	1292
TPD32-EV-500/...-1700-…-E	1700	10.6	**21.2**	1464
TPD32-EV-500/...-1800-…-E	1800	10.0	**20.0**	1550
TPD32-EV-500/...-2000-…-E	2000	9.0	**18.0**	1722
TPD32-EV-500/...-2400-…-E	2400	7.5	**15.0**	2066

TPD32 EV Standard sizes	Converter rated current [A]	Rated inductance with Ukd = 2% [µH]	Rated inductance with Ukd = 4% [µH]	Rated current inductance [A]
TPD32-EV-500/...-2700-…-E	2700	6.7	**13.3**	2325
TPD32-EV-500/...-2900-…-E	2900	6.2	**12.4**	2497
TPD32-EV-500/...-3300-…-E	3300	5.5	**10.9**	2841
Mains voltage 400V, 3ph, 60 Hz				
TPD32-EV-500/...-20-…-A	20	750.3	1500.5	17
TPD32-EV-500/...-40-…-A	40	375.1	750.3	34
TPD32-EV-500/...-70-…-A	70	214.4	428.7	60
TPD32-EV-500/...-110-…-A	110	136.4	272.8	95
TPD32-EV-500/...-140-…-A	140	107.2	214.4	121
TPD32-EV-500/...-185-…-A	185	81.1	162.2	159
TPD32-500/…-280-…-B	280	53.6	107.2	241
TPD32-500/…-350-…-B	350	42.9	85.7	301
TPD32-500/…-420-…-B	420	35.7	71.5	362
TPD32-500/…-500-…-B	500	30.0	60.0	431
TPD32-500/…-650-…-B	650	23.1	46.2	560
TPD32-EV-500/...-770-…-C	770	19.5	39.0	663
TPD32-EV-500/...-1000-…-C	1000	15.0	30.0	861
TPD32-EV-500/...-1050-…-C	1050	14.3	28.6	904
TPD32-EV-500/...-1400-...-D	1400	10.7	21.4	1205
TPD32-EV-500/...-1600-...-D	1600	9.4	18.8	1378
TPD32-EV-500/...-2000-...-D	2000	7.5	15.0	1722
TPD32-EV-500/...-2400-...-D	2400	6.3	12.5	2066
TPD32-EV-500/...-1200-…-E	1200	12.5	25.0	1033
TPD32-EV-500/...-1500-…-E	1500	10.0	20.0	1292
TPD32-EV-500/...-1700-…-E	1700	8.8	17.7	1464
TPD32-EV-500/...-1800-…-E	1800	8.3	16.7	1550
TPD32-EV-500/...-2000-…-E	2000	7.5	15.0	1722
TPD32-EV-500/...-2400-…-E	2400	6.3	12.5	2066
TPD32-EV-500/...-2700-…-E	2700	5.6	11.1	2325
TPD32-EV-500/...-2900-…-E	2900	5.2	10.3	2497
TPD32-EV-500/...-3300-…-E	3300	4.5	9.1	2841

Table 4.10.2: Mains chokes for 500 Vac input supply

TPD32 EV Standard sizes	Converter rated current [A]	Rated inductance with Ukd = 2% [µH]	Rated inductance with Ukd = 4% [µH]	Rated current inductance [A]
Mains voltage 500V, 3ph, 50 Hz				
TPD32-EV-500/...-20-…-A	20	1125.4	2250.8	17
TPD32-EV-500/...-40-…-A	40	562.7	1125.4	34
TPD32-EV-500/...-70-…-A	70	321.5	643.1	60
TPD32-EV-500/...-110-…-A	110	204.6	409.2	95
TPD32-EV-500/...-140-…-A	140	160.8	321.5	121
TPD32-EV-500/...-185-…-A	185	121.7	243.3	159
TPD32-500/…-280-…-B	280	80.4	160.8	241
TPD32-500/…-350-…-B	350	64.3	128.6	301
TPD32-500/…-420-…-B	420	53.6	107.2	362
TPD32-500/…-500-…-B	500	45.0	90.0	431
TPD32-500/…-650-…-B	650	34.6	69.3	560
TPD32-EV-500/...-770-…-C	770	29.2	58.5	663
TPD32-EV-500/...-1000-…-C	1000	22.5	45.0	861
TPD32-EV-500/...-1050-…-C	1050	21.4	42.9	904
TPD32-EV-500/...-1400-...-D	1400	16.1	32.2	1205
TPD32-EV-500/...-1600-...-D	1600	14.1	28.1	1378
TPD32-EV-500/...-2000-...-D	2000	11.3	22.5	1722
TPD32-EV-500/...-2400-...-D	2400	9.4	18.8	2066
TPD32-EV-500/...-1200-…-E	1200	18.8	37.5	1033
TPD32-EV-500/...-1500-…-E	1500	15.0	30.0	1292
TPD32-EV-500/...-1700-…-E	1700	13.2	26.5	1464
TPD32-EV-500/...-1800-…-E	1800	12.5	25.0	1550

TPD32 EV Standard sizes	Converter rated current [A]	Rated inductance with Ukd = 2% [µH]	Rated inductance with Ukd = 4% [µH]	Rated current inductance [A]
TPD32-EV-500/...-2000-…-E	2000	11.3	22.5	1722
TPD32-EV-500/...-2400-…-E	2400	9.4	18.8	2066
TPD32-EV-500/...-2700-…-E	2700	8.3	16.7	2325
TPD32-EV-500/...-2900-…-E	2900	7.8	15.5	2497
TPD32-EV-500/...-3300-…-E	3300	6.8	13.6	2841
Mains voltage 500V, 3ph, 60 Hz				
TPD32-EV-500/...-20-…-A	20	937.8	1875.7	17
TPD32-EV-500/...-40-…-A	40	468.9	937.8	34
TPD32-EV-500/...-70-…-A	70	268.0	535.9	60
TPD32-EV-500/...-110-…-A	110	170.5	341.0	95
TPD32-EV-500/...-140-…-A	140	134.0	268.0	121
TPD32-EV-500/...-185-…-A	185	101.4	202.8	159
TPD32-500/…-280-…-B	280	67.0	134.0	241
TPD32-500/…-350-…-B	350	53.6	107.2	301
TPD32-500/…-420-…-B	420	44.7	89.3	362
TPD32-500/…-500-…-B	500	37.5	75.0	431
TPD32-500/…-650-…-B	650	28.9	57.7	560
TPD32-EV-500/...-770-…-C	770	24.4	48.7	663
TPD32-EV-500/...-1000-…-C	1000	18.8	37.5	861
TPD32-EV-500/...-1050-…-C	1050	17.9	35.7	904
TPD32-EV-500/...-1400-...-D	1400	13.4	26.8	1205
TPD32-EV-500/...-1600-...-D	1600	11.7	23.4	1378
TPD32-EV-500/...-2000-...-D	2000	9.4	18.8	1722
TPD32-EV-500/...-2400-...-D	2400	7.8	15.6	2066
TPD32-EV-500/...-1200-…-E	1200	15.6	31.3	1033
TPD32-EV-500/...-1500-…-E	1500	12.5	25.0	1292
TPD32-EV-500/...-1700-…-E	1700	11.0	22.1	1464
TPD32-EV-500/...-1800-…-E	1800	10.4	20.8	1550
TPD32-EV-500/...-2000-…-E	2000	9.4	18.8	1722
TPD32-EV-500/...-2400-…-E	2400	7.8	15.6	2066
TPD32-EV-500/...-2700-…-E	2700	6.9	13.9	2325
TPD32-EV-500/...-2900-…-E	2900	6.5	12.9	2497
TPD32-EV-500/...-3300-…-E	3300	5.7	11.4	2841

- For 575 V type B TPD32 converters and 575/690 V type C converters, which are usually installed in a second-type environment: in this case UKD values of around 2% can be used, with the advantage that smaller reactors are required. Otherwise, if UKD must be = 4%, always comply with the values shown in the relative columns.

Table 4.10.3: Mains chokes for 575 Vac input supply

TPD32 EV Standard sizes	Converter rated current [A]	Rated inductance with Ukd = 2% [µH]	Rated inductance with Ukd = 4% [µH]	Rated current inductance [A]
Mains voltage 575V, 3ph, 50 Hz				
TPD32-EV-575/...-280-..-B	280	92.4 (*)	184.9	241
TPD32-EV-575/...-350-..-B	350	74.0 (*)	147.9	301
TPD32-EV-575/...-420-..-B	420	61.6 (*)	123.3	362
TPD32-EV-575/...-500-..-B	500	51.8 (*)	103.5	431
TPD32-EV-575/...-650-..-B	650	39.8 (*)	79.6	560
TPD32-EV-575/…-700-...-C	700	37.0	74.0	603
TPD32-EV-575/…-1000-...-C	1000	25.9	51.8	861
TPD32-EV-575/...-1050-…-C	1050	24.7	49.3	904
TPD32-EV-575/...-1300-...-D	1300	19.9	39.8	1119
TPD32-EV-575/...-1600-...-D	1600	16.2	32.4	1378
TPD32-EV-575/...-2000-...-D	2000	12.9	25.9	1722
TPD32-EV-575/...-2300-...-D	2300	11.3	22.5	1980
TPD32-EV-690/...-1010-…-E	1010	25.6	51.3	870
TPD32-EV-690/...-1400-…-E	1400	18.5	37.0	1205

TPD32 EV Standard sizes	Converter rated current [A]	Rated inductance with Ukd = 2% [µH]	Rated inductance with Ukd = 4% [µH]	Rated current inductance [A]
TPD32-EV-690/...-1700-…-E	1700	15.2	30.5	1464
TPD32-EV-690/...-2000-…-E	2000	12.9	25.9	1722
TPD32-EV-690/...-2400-…-E	2400	10.8	21.6	2066
TPD32-EV-690/...-2700-…-E	2700	9.6	19.2	2325
TPD32-EV-690/...-3300-…-E	3300	7.8	15.7	2841
Mains voltage 575V, 3ph, 60 Hz				
TPD32-EV-.../...-280-..-B	280	77.0	154.1	241
TPD32-EV-.../...-350-..-B	350	61.6	123.3	301
TPD32-EV-.../...-420-..-B	420	51.4	102.7	362
TPD32-EV-.../...-500-..-B	500	43.1	86.3	431
TPD32-EV-.../...-560-..-B	650	33.2	66.4	560
TPD32-EV-575/…-700-...-C	700	30.8	61.6 (**)	603
TPD32-EV-575/…-1000-...-C	1000	21.6	43.1 (**)	861
TPD32-EV-575/...-1050-…-C	1050	20.5	41.1	904
TPD32-EV-575/...-1300-...-D	1300	16.6	33.2	1119
TPD32-EV-575/...-1600-...-D	1600	13.5	27.0	1378
TPD32-EV-575/...-2000-...-D	2000	10.8	21.6	1722
TPD32-EV-575/...-2300-...-D	2300	9.4	18.8	1980
TPD32-EV-690/...-1010-…-E	1010	21.4	42.7	870
TPD32-EV-690/...-1400-…-E	1400	15.4	30.8	1205
TPD32-EV-690/...-1700-…-E	1700	12.7	25.4	1464
TPD32-EV-690/...-2000-…-E	2000	10.8	21.6	1722
TPD32-EV-690/...-2400-…-E	2400	9.0	18.0	2066
TPD32-EV-690/...-2700-…-E	2700	8.0	16.0	2325
TPD32-EV-690/...-3300-…-E	3300	6.5	13.1	2841

Table 4.10.4: Mains chokes for 690 Vac input supply

TPD32 EV Standard sizes	Converter rated current [A]	Rated inductance with Ukd = 2% [µH]	Rated inductance with Ukd = 4% [µH]	Rated current inductance [A]
Mains voltage 690V, 3ph, 50 Hz				
TPD32-EV-690/…-560-...-C	560	55.5	110.9	482
TPD32-EV-690/…-700-...-C	700	44.4	88.7	603
TPD32-EV-690/…-900-...-C	900	34.5	69.0	775
TPD32-EV-690/...-1300-...-D	1300	23.9	47.8	1119
TPD32-EV-690/...-1600-...-D	1600	19.4	38.8	1378
TPD32-EV-690/...-1900-...-D	1900	16.3	32.7	1636
TPD32-EV-690/...-2100-...-D	2100	14.8	29.6	1808
TPD32-EV-690/...-1010-…-E	1010	30.8	61.5	870
TPD32-EV-690/...-1400-…-E	1400	22.2	44.4	1205
TPD32-EV-690/...-1700-…-E	1700	18.3	36.5	1464
TPD32-EV-690/...-2000-…-E	2000	15.5	31.1	1722
TPD32-EV-690/...-2400-…-E	2400	12.9	25.9	2066
TPD32-EV-690/...-2700-…-E	2700	11.5	23.0	2325
TPD32-EV-690/...-3300-…-E	3300	9.4	18.8	2841
Mains voltage 690V, 3ph, 60 Hz				
TPD32-EV-690/…-560-...-C	560	46.2	92.4 (**)	482
TPD32-EV-690/…-700-...-C	700	37.0	74.0	603
TPD32-EV-690/…-900-...-C	900	28.8	57.5 (**)	775
TPD32-EV-690/...-1300-...-D	1300	19.9	39.8	1119
TPD32-EV-690/...-1600-...-D	1600	16.2	32.4	1378
TPD32-EV-690/...-1900-...-D	1900	13.6	27.2	1636
TPD32-EV-690/...-2100-...-D	2100	12.3	24.7	1808
TPD32-EV-690/...-1010-…-E	1010	25.6	51.3	870
TPD32-EV-690/...-1400-…-E	1400	18.5	37.0	1205
TPD32-EV-690/...-1700-…-E	1700	15.2	30.5	1464
TPD32-EV-690/...-2000-…-E	2000	12.9	25.9	1722
TPD32-EV-690/...-2400-…-E	2400	10.8	21.6	2066
TPD32-EV-690/...-2700-…-E	2700	9.6	19.2	2325
TPD32-EV-690/...-3300-…-E	3300	7.8	15.7	2841

Note! Tables 4.10.1-2-3-4 show the mains choke electrical ratings, but not the relative codes. Please contact our sales network for further details.

Table 4.10.5 Internal code for mains chokes

TPD32 EV Standard sizes	Three-phase mains choke									
	Choke rating [mH]	Current rating [A]	Saturation current [A]	Frequency [Hz]	Dissipated power @ 50 Hz [W]	Dissipated power @ 60 Hz [W]	Inductance type	Code	Dimensions: W x H x d [mm]	Weight [kg]
Mains voltage 400-460 V, 3Ph, 50 Hz										
TPD32-EV-.../...-20-..-A	1.62	22	42	50	68	74	LR3-011	S7FF6	180 x 183 x 125	8
TPD32-EV-.../...-40-..-A	0.68	41	61	50	95	104	LR3-41-61-0,68	S7D03	180 x 165 x 160	10
TPD32-EV-.../...-70-..-A	0.45	61	91	50	109	121	LR3-61-91-0,45	S7D04	180 x 165 x 185	15
TPD32-EV-.../...-110-..-A	0.3	90	135	50	142	157	LR3-90-135-0,30	S7D05	180 x 165 x 185	14
TPD32-EV-.../...-140-..-A	0.26	107	160	50	125	143	LR3-107-160-0,26	S7D06	180 x 165 x 190	15
TPD32-EV-.../...-185-..-A	0.17	163	244	50	202	214	LR3-163-244-0,17	S7D07	240 x 216 x 240	27
TPD32-EV-.../...-280-..-B	0.11	253	380	50	239	257	LR3-253-380-0,11	S7D09	300 x 265 x 230	34
TPD32-EV-.../...-350-..-B	0.1	287	430	50	268	288	LR3-287-430-0,1	S7D10	300 x 265 x 250	40
TPD32-EV-.../...-420-..-B	0.076	368	552	50	278	305	LR3-368-552-0,076	S7D11	300 x 270 x 280	47
TPD32-EV-.../...-500-..-B	0.06	458	687	50	347	373	LR3-458-687-0,06	S7D12	300 x 265 x 320	56
TPD32-EV-.../...-650-..-B	0.05	605	910	50	470	517	LR3-605-910-0,05	S7D27	380 x 415 x 220	78
TPD32-EV-.../...-770-.. -C	0.04	685	1027	50	533	573	LR3-685-1027-0,04	S7D14	386 x 410 x 270	77
TPD32-EV-.../...-1000-.. -C	0.03	869	1303	50	560	625	LR3-869-1303-0,03	S7D15	420 x 495 x 270	110
TPD32-EV-.../...-1050-.. -C	0.03	869	1303	50	560	625	LR3-869-1303-0,03	S7D15	420 x 495 x 270	110
	0.024	1143	1714	50	861	925	LR3 1143-1714-0.024	S7D16	420 x 465 x 280	140
	0.019	1425	2138	50	825	919	LR3 1425-2138-0,019	S7D17	460 x 520 x 340	150
	0.016	1712	2568	50	962	1062	LR3 1712-2568-0,016	S7D18	430 x 545 x 320	160
Mains voltage 400-500 V, 3Ph, 60 Hz										
TPD32-EV-.../...-17-..-A-NA	1.62	22	42	50 / 60	68	74	LR3-011	S7FF6	180 x 183 x 125	8
TPD32-EV-.../...-35-..-A-NA	0.68	41	61	50 / 60	95	104	LR3-41-61-0,68	S7D03	180 x 165 x 160	10
TPD32-EV-.../...-56-..-A-NA	0.45	61	91	50 / 60	109	121	LR3-61-91-0,45	S7D04	180 x 165 x 185	15
TPD32-EV-.../...-88-..-A-NA	0.3	90	135	50 / 60	142	157	LR3-90-135-0,30	S7D05	180 x 165 x 185	14
TPD32-EV-.../...-112-..-A-NA	0.26	107	160	50 / 60	125	143	LR3-107-160-0,26	S7D06	180 x 165 x 190	15
TPD32-EV-.../...-148-..-A-NA	0.17	163	244	50 / 60	202	214	LR3-163-244-0,17	S7D07	240 x 216 x 240	27
TPD32-EV-.../...-224-..-B-NA	0.11	253	380	50 / 60	239	257	LR3-253-380-0,11	S7D09	300 x 265 x 230	34
TPD32-EV-.../...-280-..-B-NA	0.1	287	430	50 / 60	268	288	LR3-287-430-0,1	S7D10	300 x 265 x 250	40
TPD32-EV-.../...-336-..-B-NA	0.076	368	552	50 / 60	278	305	LR3-368-552-0,076	S7D11	300 x 270 x 280	47
TPD32-EV-.../...-400-..-B-NA	0.06	458	687	50 / 60	347	373	LR3-458-687-0,06	S7D12	300 x 265 x 320	56
TPD32-EV-.../...-450-..-B-NA	0.05	605	910	50 / 60	470	517	LR3-605-910-0,05	S7D27	380 x 415 x 220	78
TPD32-EV-.../...-560-..-C-NA	0.04	685	1027	50 / 60	533	573	LR3-685-1027-0,04	S7D14	386 x 410 x 270	77
TPD32-EV-.../...-800-..-C-NA	0.03	869	1303	50 / 60	560	625	LR3-869-1303-0,03	S7D15	420 x 495 x 270	110
TPD32-EV-.../...-850-..-C-NA	0.03	869	1303	50 / 60	560	625	LR3-869-1303-0,03	S7D15	420 x 495 x 270	110

Note! The line inductance for the field circuit is usually not used because the motor field load already has a very high inductive value which limits the negative effects of transmissions.

If inductance has to be used, you can calculate its value with the following simplified formula. Current for thermal dimensioning is given by Idn * ff. See paragraph 4.10.1 for details.

Ldf = (Ukd*Uln) / (Idn*ff*2π*fn) [H]

Where:
Ukd is the voltage drop (typically 2% or 4%)
Uln is the supply voltage
Idn is the field circuit current
ff is the form factor (typically 1.2)
fn is the supply frequency
The resulting value is total inductance, which is divided equally in the two supply phases.

Note! TPD32-EV-FC-... : reference should be made to the corresponding voltage and current sizes of TPD32 EV Standard sizes.

4.10.2 Interference suppression filters

The converters of TPD32-EV series must be equipped with an external EMI filter in order to reduce the radiofrequency emissions on the mains line. The filter selection is depending on the drive size and the installation environment.

Please refer to the EMC guide supplied with the equipment for details of how to install the electrical panel (connection of filters and mains chokes, cable shielding, grounding, etc.) to ensure compliance with the EMC Directive (2014/30/EU).

The document describes the present situation concerning the EMC standards and the compliance tests made on the Gefran drives.

Table 4.10.2: EMI filters

TPD32 EV Standard sizes	TPD32 EV Standard sizes	Filter type	Code	Dimensions: W x H x d [mm]	Weight [kg]	Category / Environment / Length of motor cable (max)	Dissipated power @ 25 °C / 50Hz [W]
Mains voltage 230-400 V ± 10%							
TPD32-EV-500/600-20-2B-A	TPD32-EV-500/520-20-4B-A	EMI-FTF-480-42	S7GOA	310x50x85	1.3	C3/2°/30m	18
TPD32-EV-500/600-40-2B-A	TPD32-EV-500/520-40-4B-A	EMI-FTF-480-42	S7GOA	310x50x85	1.3	C3/2°/30m	18
TPD32-EV-500/600-70-2B-A	TPD32-EV-500/520-70-4B-A	EMI-FTF-480-75	S7GOC	270x80x135	2.6	C3/2°/30m	26
TPD32-EV-500/600-110-2B-A	TPD32-EV-500/520-110-4B-A	EMI-FTF-480-100	S7GOD	270x90x150	3	C3/2°/30m	30
TPD32-EV-500/600-140-2B-A	TPD32-EV-500/520-140-4B-A	EMI-FTF-480-130	S7GOE	270x90x150	3.6	C3/2°/30m	38
TPD32-EV-500/600-185-2B-A	TPD32-EV-500/520-185-4B-A	EMI-FTF-480-130	S7GOE	270x90x150	3.6	C3/2°/30m	38
TPD32-EV-500/600-280-2B-B	TPD32-EV-500/520-280-4B-B	EMI-480-320	S7DGH	300x260x135	13.2	C3/2°/100m	40
TPD32-EV-500/600-350-2B-B	TPD32-EV-500/520-350-4B-B	EMI-480-400	S7DGI	300x260x135	13.2	C3/2°/100m	50
TPD32-EV-500/600-420-2B-B	TPD32-EV-500/520-420-4B-B	EMI-480-400	S7DGI	300x260x135	13.2	C3/2°/100m	50
TPD32-EV-500/600-500-2B-B	TPD32-EV-500/520-500-4B-B	EMI-480-600	S7DGL	300x260x135	13.6	C3/2°/100m	65
TPD32-EV-500/600-650-2B-B	TPD32-EV-500/520-650-4B-B	EMI-480-600	S7DGL	300x260x135	13.6	C3/2°/100m	65
TPD32-EV-500/600-770-2B-C	TPD32-EV-500/520-770-4B-C	EMI-480-800	S7DGM	350x280x150	23.7	C3/2°/100m	80
TPD32-EV-500/600-1000-2B-C	TPD32-EV-500/520-1050-4B-C	EMI-480-1000	S7DGN	350x280x150	24	C3/2°/100m	91
TPD32-EV-500/600-1400-2B-D	TPD32-EV-500/520-1400-4B-D	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1600-2B-D	TPD32-EV-500/520-1600-4B-D	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-2000-2B-D	TPD32-EV-500/520-2000-4B-D	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-2400-2B-D	TPD32-EV-500/520-2400-4B-D	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-1200-2B-E	-----	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1500-2B-E	TPD32-EV-500/520-1500-4B-E	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1800-2B-E	TPD32-EV-500/520-1700-4B-E	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-2000-2B-E	TPD32-EV-500/520-2000-4B-E	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-2400-2B-E	TPD32-EV-500/520-2400-4B-E	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-2700-2B-E	TPD32-EV-500/520-2700-4B-E	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-2900-2B-E	-----	n.a.					
TPD32-EV-500/600-3300-2B-E	TPD32-EV-500/520-3300-4B-E	n.a.					
Mains voltage 480 V ± 10%							
TPD32-EV-500/600-20-2B-A	TPD32-EV-500/520-20-4B-A	EMI-FTF-480-42	S7GOA	310x50x85	1.3	C3/2°/30m	18
TPD32-EV-500/600-40-2B-A	TPD32-EV-500/520-40-4B-A	EMI-FTF-480-42	S7GOA	310x50x85	1.3	C3/2°/30m	18
TPD32-EV-500/600-70-2B-A	TPD32-EV-500/520-70-4B-A	EMI-FTF-480-75	S7GOC	270x80x135	2.6	C3/2°/30m	26
TPD32-EV-500/600-110-2B-A	TPD32-EV-500/520-110-4B-A	EMI-FTF-480-100	S7GOD	270x90x150	3	C3/2°/30m	30
TPD32-EV-500/600-140-2B-A	TPD32-EV-500/520-140-4B-A	EMI-FTF-480-130	S7GOE	270x90x150	3.6	C3/2°/30m	38
TPD32-EV-500/600-185-2B-A	TPD32-EV-500/520-185-4B-A	EMI-FTF-480-130	S7GOE	270x90x150	3.6	C3/2°/30m	38
TPD32-EV-500/600-280-2B-B	TPD32-EV-500/520-280-4B-B	EMI-480-320	S7DGH	300x260x135	13.2	C3/2°/100m	40
TPD32-EV-500/600-350-2B-B	TPD32-EV-500/520-350-4B-B	EMI-480-400	S7DGI	300x260x135	13.2	C3/2°/100m	50
TPD32-EV-500/600-420-2B-B	TPD32-EV-500/520-420-4B-B	EMI-480-400	S7DGI	300x260x135	13.2	C3/2°/100m	50
TPD32-EV-500/600-500-2B-B	TPD32-EV-500/520-500-4B-B	EMI-480-600	S7DGL	300x260x135	13.6	C3/2°/100m	65
TPD32-EV-500/600-650-2B-B	TPD32-EV-500/520-650-4B-B	EMI-480-800	S7DGM	350x280x150	23.7	C3/2°/100m	80

TPD32 EV Standard sizes	TPD32 EV Standard sizes	Filter type	Code	Dimensions: W x H x d [mm]	Weight [kg]	Category / Environment / Length of motor cable (max)	Dissipated power @ 25 °C / 50Hz [W]
TPD32-EV-500/600-770-2B-C	TPD32-EV-500/520-770-4B-C	EMI-480-800	S7DGM	350x280x150	23.7	C3/2°/100m	80
TPD32-EV-500/600-1000-2B-C	TPD32-EV-500/520-1050-4B-C	EMI-480-1000	S7DGN	350x280x150	24	C3/2°/100m	91
TPD32-EV-500/600-1400-2B-D	TPD32-EV-500/520-1400-4B-D	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1600-2B-D	TPD32-EV-500/520-1600-4B-D	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-2000-2B-D	TPD32-EV-500/520-2000-4B-D	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-2400-2B-D	TPD32-EV-500/520-2400-4B-D	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-1200-2B-E	-----	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1500-2B-E	TPD32-EV-500/520-1500-4B-E	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1800-2B-E	TPD32-EV-500/520-1700-4B-E	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-2000-2B-E	TPD32-EV-500/520-2000-4B-E	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-2400-2B-E	TPD32-EV-500/520-2400-4B-E	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-2700-2B-E	TPD32-EV-500/520-2700-4B-E	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-2900-2B-E	-----	n.a.					
TPD32-EV-500/600-3300-2B-E	TPD32-EV-500/520-3300-4B-E	n.a.					
Mains voltage 500 V ± 10%							
TPD32-EV-500/600-20-2B-A	TPD32-EV-500/520-20-4B-A	EMI-FTF-480-42	S7GOA	310x50x85	1.3	C3/2°/30m	18
TPD32-EV-500/600-40-2B-A	TPD32-EV-500/520-40-4B-A	EMI-FTF-480-42	S7GOA	310x50x85	1.3	C3/2°/30m	18
TPD32-EV-500/600-70-2B-A	TPD32-EV-500/520-70-4B-A	EMI-FTF-480-75	S7GOC	270x80x135	2.6	C3/2°/30m	26
TPD32-EV-500/600-110-2B-A	TPD32-EV-500/520-110-4B-A	EMI-FTF-480-100	S7GOD	270x90x150	3	C3/2°/30m	30
TPD32-EV-500/600-140-2B-A	TPD32-EV-500/520-140-4B-A	EMI-FTF-480-130	S7GOE	270x90x150	3.6	C3/2°/30m	38
TPD32-EV-500/600-185-2B-A	TPD32-EV-500/520-185-4B-A	EMI-FTF-480-130	S7GOE	270x90x150	3.6	C3/2°/30m	38
TPD32-EV-500/600-280-2B-B	TPD32-EV-500/520-280-4B-B	EMI-480-320	S7DGH	300x260x135	13.2	C3/2°/100m	40
TPD32-EV-500/600-350-2B-B	TPD32-EV-500/520-350-4B-B	EMI-480-400	S7DGI	300x260x135	13.2	C3/2°/100m	50
TPD32-EV-500/600-420-2B-B	TPD32-EV-500/520-420-4B-B	EMI-480-400	S7DGI	300x260x135	13.2	C3/2°/100m	50
TPD32-EV-500/600-500-2B-B	TPD32-EV-500/520-500-4B-B	EMI-480-600	S7DGL	300x260x135	13.6	C3/2°/100m	65
TPD32-EV-500/600-650-2B-B	TPD32-EV-500/520-650-4B-B	EMI-480-800	S7DGM	350x280x150	23.7	C3/2°/100m	80
TPD32-EV-500/600-770-2B-C	TPD32-EV-500/520-770-4B-C	EMI-480-800	S7DGM	350x280x150	23.7	C3/2°/100m	80
TPD32-EV-500/600-1000-2B-C	TPD32-EV-500/520-1050-4B-C	EMI-480-1000	S7DGN	350x280x150	24	C3/2°/100m	91
TPD32-EV-500/600-1400-2B-D	TPD32-EV-500/520-1400-4B-D	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1600-2B-D	TPD32-EV-500/520-1600-4B-D	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-2000-2B-D	TPD32-EV-500/520-2000-4B-D	Schaffner FN 3359HV-2500-99 (or TDK-EPCOS B84143B2500S024)		450x370x200 (650x320x221.5)	69 (142)	C3/2°/100m	300 (547)
TPD32-EV-500/600-2400-2B-D	TPD32-EV-500/520-2400-4B-D						
TPD32-EV-500/600-1200-2B-E	-----	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1500-2B-E	TPD32-EV-500/520-1500-4B-E	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1800-2B-E	TPD32-EV-500/520-1700-4B-E	Schaffner FN 3359HV-2500-99 (or TDK-EPCOS B84143B2500S024)		450x370x200 (650x320x221.5)	69 (142)	C3/2°/100m	300 (547)
TPD32-EV-500/600-2000-2B-E	TPD32-EV-500/520-2000-4B-E						
TPD32-EV-500/600-2400-2B-E	TPD32-EV-500/520-2400-4B-E						
TPD32-EV-500/600-2700-2B-E	TPD32-EV-500/520-2700-4B-E						
TPD32-EV-500/600-2900-2B-E	-----	n.a.					
TPD32-EV-500/600-3300-2B-E	TPD32-EV-500/520-3300-4B-E	n.a.					
Mains voltage 575 V ± 10%							
TPD32-EV-575/680-280-2B-B	TPD32-EV-575/600-280-4B-B	EMI-690-320	S7DGR	230x190x116	7.2	C3/2°/100m	35
TPD32-EV-575/680-350-2B-B	TPD32-EV-575/600-350-4B-B	EMI-690-400	S7EMI12	230x190x116	7.5	C3/2°/100m	45
TPD32-EV-575/680-420-2B-B	TPD32-EV-575/600-420-4B-B	EMI-690-400	S7EMI12	230x190x116	7.5	C3/2°/100m	45
TPD32-EV-575/680-500-2B-B	TPD32-EV-575/600-500-4B-B	EMI-690-600	S7DGS	230x190x116	7.8	C3/2°/100m	79
TPD32-EV-575/680-650-2B-B	TPD32-EV-575/600-650-4B-B	EMI-690-600	S6DGS	230x190x116	7.8	C3/2°/100m	79
TPD32-EV-575/680-700-2B-C	TPD32-EV-575/600-700-4B-C	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-575/680-1000-2B-C	TPD32-EV-575/600-1050-4B-C	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-575/680-1300-2B-D	TPD32-EV-575/600-1300-4B-D	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-575/680-1600-2B-D	TPD32-EV-575/600-1600-4B-D	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328

TPD32 EV Standard sizes	TPD32 EV Standard sizes	Filter type	Code	Dimensions: W x H x d [mm]	Weight [kg]	Category / Environment / Length of motor cable (max)	Dissipated power @ 25 °C / 50Hz [W]
TPD32-EV-575/680-2000-2B-D	TPD32-EV-575/600-2000-4B-D	Schaffner FN 3359HV-2500-99 (or TDK-EPCOS B84143B2500S024)		450x370x200 (650x320x221.5)	69 (142)	C3/2°/100m	300 (547)
TPD32-EV-575/680-2300-2B-D	TPD32-EV-575/600-2300-4B-D						
Mains voltage 690 V ± 10%							
TPD32-EV-690/810-560-2B-C	TPD32-EV-690/720-560-4B-C	EMI-690-600	S7DGS	230x190x116	7.8	C3/2°/100m	79
TPD32-EV-690/810-700-2B-C	TPD32-EV-690/720-700-4B-C	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-690/810-900-2B-C	TPD32-EV-690/720-900-4B-C	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-690/810-1300-2B-D	TPD32-EV-690/720-1300-4B-D	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-690/810-1600-2B-D	TPD32-EV-690/720-1600-4B-D	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-690/810-1900-2B-D	TPD32-EV-690/720-1900-4B-D	TDK-EPCOS B84143B2500S021		650x385x221.5	142	C3/2°/100 m	547
TPD32-EV-690/810-2100-2B-D	TPD32-EV-690/720-2100-4B-D						
TPD32-EV-690/810-1010-2B-E	TPD32-EV-690/720-1010-4B-E	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-690/810-1400-2B-E	TPD32-EV-690/720-1400-4B-E	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-690/810-1700-2B-E	TPD32-EV-690/720-1700-4B-E	TDK-EPCOS B84143B2500S021		650x385x221.5	142	C3/2°/100m	547
TPD32-EV-690/810-2000-2B-E	TPD32-EV-690/720-2000-4B-E						
TPD32-EV-690/810-2400-2B-E	TPD32-EV-690/720-2400-4B-E						
TPD32-EV-690/810-2700-2B-E	TPD32-EV-690/720-2700-4B-E						
TPD32-EV-690/810-3300-2B-E	TPD32-EV-690/720-3300-4B-E	n.a.					

TPD32 EV American sizes	TPD32 EV American sizes	Filter type	Code	Dimensions: W x H x d [mm]	Weight [kg]	Category / Environment / Length of motor cable (max)	Dissipated power @ 25 °C / 50Hz [W]
Mains voltage 230-400 V ± 10%							
TPD32-EV-500/600-17-2B-A-NA	TPD32-EV-500/520-17-4B-A-NA	EMI-FTF-480-42	S7GOA	310x50x85	1.3	C3/2°/30m	18
TPD32-EV-500/600-35-2B-A-NA	TPD32-EV-500/520-35-4B-A-NA	EMI-FTF-480-42	S7GOA	310x50x85	1.3	C3/2°/30m	18
TPD32-EV-500/600-56-2B-A-NA	TPD32-EV-500/520-56-4B-A-NA	EMI-FTF-480-75	S7GOC	270x80x135	2.6	C3/2°/30m	26
TPD32-EV-500/600-88-2B-A-NA	TPD32-EV-500/520-88-4B-A-NA	EMI-FTF-480-130	S7GOE	270x90x150	3.6	C3/2°/30m	38
TPD32-EV-500/600-112-2B-A-NA	TPD32-EV-500/520-112-4B-A-NA	EMI-FTF-480-130	S7GOE	270x90x150	3.6	C3/2°/30m	38
TPD32-EV-500/600-148-2B-A-NA	TPD32-EV-500/520-148-4B-A-NA	EMI-FTF-480-180	S7GOF	400x120x170	3.6	C3/2°/30 m	60
TPD32-EV-500/600-224-2B-B-NA	TPD32-EV-500/520-224-4B-B-NA	EMI-480-320	S7DGH	300x260x135	13.2	C3/2°/100m	40
TPD32-EV-500/600-280-2B-B-NA	TPD32-EV-500/520-280-4B-B-NA	EMI-480-400	S7DGI	300x260x135	13.2	C3/2°/100m	50
TPD32-EV-500/600-336-2B-B-NA	TPD32-EV-500/520-336-4B-B-NA	EMI-480-400	S7DGI	300x260x135	13.2	C3/2°/100m	50
TPD32-EV-500/600-400-2B-B-NA	TPD32-EV-500/520-400-4B-B-NA	EMI-480-600	S7DGL	300x260x135	13.6	C3/2°/100m	65
TPD32-EV-500/600-450-2B-B-NA	TPD32-EV-500/520-450-4B-B-NA	EMI-480-600	S7DGL	300x260x135	13.6	C3/2°/100m	65
TPD32-EV-500/600-560-2B-C-NA	TPD32-EV-500/520-560-4B-C-NA	EMI-480-800	S7DGM	350x280x150	23.7	C3/2°/100m	80
TPD32-EV-500/600-800-2B-C-NA	TPD32-EV-500/520-850-4B-C-NA	EMI-480-1000	S7DGN	350x280x150	24	C3/2°/100m	91
TPD32-EV-500/600-1000-2B-D-NA	TPD32-EV-500/520-1000-4B-D-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1200-2B-D-NA	TPD32-EV-500/520-1200-4B-D-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1500-2B-D-NA	TPD32-EV-500/520-1500-4B-D-NA	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-1850-2B-D-NA	TPD32-EV-500/520-1850-4B-D-NA	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-1000-2B-E-NA	-----	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1300-2B-E-NA	TPD32-EV-500/520-1300-4B-E-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1400-2B-E-NA	TPD32-EV-500/520-1350-4B-E-NA	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-1500-2B-E-NA	TPD32-EV-500/520-1500-4B-E-NA	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-1800-2B-E-NA	TPD32-EV-500/520-1800-4B-E-NA	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-2000-2B-E-NA	TPD32-EV-500/520-2000-4B-E-NA	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-2200-2B-E-NA	-----	n.a.					
TPD32-EV-500/600-2350-2B-E-NA	TPD32-EV-500/520-2350-4B-E-NA	n.a.					

TPD32 EV American sizes	TPD32 EV American sizes	Filter type	Code	Dimensions: W x H x d [mm]	Weight [kg]	Category / Environment / Length of motor cable (max)	Dissipated power @ 25 °C / 50Hz [W]
Mains voltage 480 V ± 10%							
TPD32-EV-500/600-17-2B-A-NA	TPD32-EV-500/520-17-4B-A-NA	EMI-FTF-480-42	S7GOA	310x50x85	1.3	C3/2°/30m	18
TPD32-EV-500/600-35-2B-A-NA	TPD32-EV-500/520-35-4B-A-NA	EMI-FTF-480-42	S7GOA	310x50x85	1.3	C3/2°/30m	18
TPD32-EV-500/600-56-2B-A-NA	TPD32-EV-500/520-56-4B-A-NA	EMI-FTF-480-75	S7GOC	270x80x135	2.6	C3/2°/30m	26
TPD32-EV-500/600-88-2B-A-NA	TPD32-EV-500/520-88-4B-A-NA	EMI-FTF-480-130	S7GOE	270x90x150	3.6	C3/2°/30m	38
TPD32-EV-500/600-112-2B-A-NA	TPD32-EV-500/520-112-4B-A-NA	EMI-FTF-480-130	S7GOE	270x90x150	3.6	C3/2°/30m	38
TPD32-EV-500/600-148-2B-A-NA	TPD32-EV-500/520-148-4B-A-NA	EMI-FTF-480-180	S7GOF	400x120x170	3.6	C3/2°/30 m	60
TPD32-EV-500/600-224-2B-B-NA	TPD32-EV-500/520-224-4B-B-NA	EMI-480-320	S7DGH	300x260x135	13.2	C3/2°/100m	40
TPD32-EV-500/600-280-2B-B-NA	TPD32-EV-500/520-280-4B-B-NA	EMI-480-400	S7DGI	300x260x135	13.2	C3/2°/100m	50
TPD32-EV-500/600-336-2B-B-NA	TPD32-EV-500/520-336-4B-B-NA	EMI-480-400	S7DGI	300x260x135	13.2	C3/2°/100m	50
TPD32-EV-500/600-400-2B-B-NA	TPD32-EV-500/520-400-4B-B-NA	EMI-480-600	S7DGL	300x260x135	13.6	C3/2°/100m	65
TPD32-EV-500/600-450-2B-B-NA	TPD32-EV-500/520-450-4B-B-NA	EMI-480-600	S7DGL	300x260x135	13.6	C3/2°/100m	65
TPD32-EV-500/600-560-2B-C-NA	TPD32-EV-500/520-560-4B-C-NA	EMI-480-800	S7DGM	350x280x150	23.7	C3/2°/100m	80
TPD32-EV-500/600-800-2B-C-NA	TPD32-EV-500/520-850-4B-C-NA	EMI-480-1000	S7DGN	350x280x150	24	C3/2°/100m	91
TPD32-EV-500/600-1000-2B-D-NA	TPD32-EV-500/520-1000-4B-D-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1200-2B-D-NA	TPD32-EV-500/520-1200-4B-D-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1500-2B-D-NA	TPD32-EV-500/520-1500-4B-D-NA	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-1850-2B-D-NA	TPD32-EV-500/520-1850-4B-D-NA	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-1000-2B-E-NA	-----	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1300-2B-E-NA	TPD32-EV-500/520-1300-4B-E-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1400-2B-E-NA	TPD32-EV-500/520-1350-4B-E-NA	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-1500-2B-E-NA	TPD32-EV-500/520-1500-4B-E-NA	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-1800-2B-E-NA	TPD32-EV-500/520-1800-4B-E-NA	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-2000-2B-E-NA	TPD32-EV-500/520-2000-4B-E-NA	EMI-FN-3359-480-2500	S7EMI5	450x370x200	69	C3/2°/100m	300
TPD32-EV-500/600-2200-2B-E-NA	-----	n.a.					
TPD32-EV-500/600-2350-2B-E-NA	TPD32-EV-500/520-2350-4B-E-NA	n.a.					
Mains voltage 500 V ± 10%							
TPD32-EV-500/600-17-2B-A-NA	TPD32-EV-500/520-17-4B-A-NA	EMI-600-34	S7DFM	335x60x150	1.8	C3/2°/30m	21
TPD32-EV-500/600-35-2B-A-NA	TPD32-EV-500/520-35-4B-A-NA	EMI-600-62	S7DFO	329x80x185	3	C3/2°/30m	30
TPD32-EV-500/600-56-2B-A-NA	TPD32-EV-500/520-56-4B-A-NA	EMI-600-85	S7DFP	329x80x220	4.3	C3/2°/30m	24
TPD32-EV-500/600-88-2B-A-NA	TPD32-EV-500/520-88-4B-A-NA	EMI-600-113	S7DFQ	379x90x220	5.6	C3/2°/30m	51
TPD32-EV-500/600-112-2B-A-NA	TPD32-EV-500/520-112-4B-A-NA	EMI-600-145	S7DFR	439x110x240	7.1	C3/2°/30m	50
TPD32-EV-500/600-148-2B-A-NA	TPD32-EV-500/520-148-4B-A-NA	EMI-SCHF-600-205	S7DGD	420x210x127	6	C3/2°/30m	34
TPD32-EV-500/600-224-2B-B-NA	TPD32-EV-500/520-224-4B-B-NA	EMI-690-320	S7DGR	230x190x116	7.2	C3/2°/100m	35
TPD32-EV-500/600-280-2B-B-NA	TPD32-EV-500/520-280-4B-B-NA	EMI-690-400	S7EMI12	230x190x116	7.5	C3/2°/100m	45
TPD32-EV-500/600-336-2B-B-NA	TPD32-EV-500/520-336-4B-B-NA	EMI-690-400	S7EMI12	230x190x116	7.5	C3/2°/100m	45
TPD32-EV-500/600-400-2B-B-NA	TPD32-EV-500/520-400-4B-B-NA	EMI-690-600	S7DGS	230x190x116	7.8	C3/2°/100m	79
TPD32-EV-500/600-450-2B-B-NA	TPD32-EV-500/520-450-4B-B-NA	EMI-690-600	S7DGS	230x190x116	7.8	C3/2°/100m	79
TPD32-EV-500/600-560-2B-C-NA	TPD32-EV-500/520-560-4B-C-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-800-2B-C-NA	TPD32-EV-500/520-850-4B-C-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1000-2B-D-NA	TPD32-EV-500/520-1000-4B-D-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1200-2B-D-NA	TPD32-EV-500/520-1200-4B-D-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1500-2B-D-NA	TPD32-EV-500/520-1500-4B-D-NA	Schaffner FN 3359HV-2500-99 or TDK-EPCOS B84143B2500S024		450x370x200 (650x320x221.5)	69 (142)	C3/2°/100m	300 (547)
TPD32-EV-500/600-1850-2B-D-NA	TPD32-EV-500/520-1850-4B-D-NA						
TPD32-EV-500/600-1000-2B-E-NA	-----	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1300-2B-E-NA	TPD32-EV-500/520-1300-4B-E-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-500/600-1400-2B-E-NA	TPD32-EV-500/520-1350-4B-E-NA	Schaffner FN 3359HV-2500-99 (or TDK-EPCOS B84143B2500S024)		450x370x200 (650x320x221.5)	69 (142)	C3/2°/100m	300 (547)
TPD32-EV-500/600-1500-2B-E-NA	TPD32-EV-500/520-1500-4B-E-NA						
TPD32-EV-500/600-1800-2B-E-NA	TPD32-EV-500/520-1800-4B-E-NA						
TPD32-EV-500/600-2000-2B-E-NA	TPD32-EV-500/520-2000-4B-E-NA						

TPD32 EV American sizes	TPD32 EV American sizes	Filter type	Code	Dimensions: W x H x d [mm]	Weight [kg]	Category / Environment / Length of motor cable (max)	Dissipated power @ 25 °C / 50Hz [W]
TPD32-EV-500/600-2200-2B-E-NA	-----	n.a.					
TPD32-EV-500/600-2350-2B-E-NA	TPD32-EV-500/520-2350-4B-E-NA	n.a.					
Mains voltage 575 V ± 10%							
TPD32-EV-575/680-224-2B-B-NA	TPD32-EV-575/600-224-4B-B-NA	EMI-690-320	S7DGR	230x190x116	7.2	C3/2°/100m	35
TPD32-EV-575/680-280-2B-B-NA	TPD32-EV-575/600-280-4B-B-NA	EMI-690-400	S7EMI12	230x190x116	7.5	C3/2°/100m	45
TPD32-EV-575/680-336-2B-B-NA	TPD32-EV-575/600-336-4B-B-NA	EMI-690-600	S7DGS	230x190x116	7.8	C3/2°/100m	79
TPD32-EV-575/680-400-2B-B-NA	TPD32-EV-575/600-400-4B-B-NA	EMI-690-600	S7DGS	230x190x116	7.8	C3/2°/100m	79
TPD32-EV-575/680-450-2B-B-NA	TPD32-EV-575/600-450-4B-B-NA	EMI-690-600	S7DGS	230x190x116	7.8	C3/2°/100m	79
TPD32-EV-575/680-490-2B-C-NA	TPD32-EV-575/600-490-4B-C-NA	EMI-690-600	S7DGS	230x190x116	7.8	C3/2°/100m	79
TPD32-EV-575/680-750-2B-C-NA	TPD32-EV-575/600-750-4B-C-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-575/680-980-2B-D-NA	TPD32-EV-575/600-980-4B-D-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-575/680-1200-2B-D-NA	TPD32-EV-575/600-1200-4B-D-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-575/680-1500-2B-D-NA	TPD32-EV-575/600-1500-4B-D-NA	Schaffner FN 3359HV-2500-99 (or TDK-EPCOS B84143B2500S024)		450x370x200 (650x320x221.5)	69 (142)	C3/2°/100m	300 (547)
TPD32-EV-575/680-1800-2B-D-NA	TPD32-EV-575/600-1800-4B-D-NA						
Mains voltage 690 V ± 10%							
TPD32-EV-690/810-360-2B-C-NA	TPD32-EV-690/720-360-4B-C-NA	EMI-690-600	S7DGS	230x190x116	7.8	C3/2°/100m	79
TPD32-EV-690/810-490-2B-C-NA	TPD32-EV-690/720-490-4B-C-NA	EMI-690-600	S7DGS	230x190x116	7.8	C3/2°/100m	79
TPD32-EV-690/810-650-2B-C-NA	TPD32-EV-690/720-650-4B-C-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-690/810-920-2B-D-NA	TPD32-EV-690/720-980-4B-D-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-690/810-1200-2B-D-NA	TPD32-EV-690/720-1200-4B-D-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-690/810-1450-2B-D-NA	TPD32-EV-690/720-1450-4B-D-NA	TDK-EPCOS B84143B2500S021		650x385x221.5	142	C3/2°/100 m	547
TPD32-EV-690/810-1650-2B-D-NA	TPD32-EV-690/720-1650-4B-D-NA						
TPD32-EV-690/810-900-2B-E-NA	TPD32-EV-690/720-900-4B-E-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-690/810-1150-2B-E-NA	TPD32-EV-690/720-1150-4B-E-NA	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100m	328
TPD32-EV-690/810-1350-2B-E-NA	TPD32-EV-690/720-1350-4B-E-NA	TDK-EPCOS B84143B2500S021		650x385x221.5	142	C3/2°/100 m	547
TPD32-EV-690/810-1500-2B-E-NA	TPD32-EV-690/720-1500-4B-E-NA						
TPD32-EV-690/810-1800-2B-E-NA	TPD32-EV-690/720-1800-4B-E-NA						
TPD32-EV-690/810-2000-2B-E-NA	TPD32-EV-690/720-2000-4B-E-NA						
TPD32-EV-690/810-2350-2B-E-NA	TPD32-EV-690/720-2350-4B-E-NA	n.a.					

Note! TPD32-EV-FC-... : reference should be made to the corresponding voltage and current sizes of TPD32 EV Standard sizes.

4.10.3 Mains harmonic currents generated by converters

Information about mains harmonic currents generated by fully-controlled (six-pulse) three-phase SCR bridge AC/DC converters.

Given their non-linear load, SC AC/DC converters draw non-sinusoidal current from the mains and thus create harmonic current.

The exact calculation of the harmonic current in a system depends on a number of factors that are linked to the actual system and the point at which the converter is installed. For more details reference should be made to EN 61800-3, IEC 146-1-2 or EN 61800-1 (annex B).

Purely by way of example, some “typical” harmonic current values measured in practice and referring to the fundamental value (I_1) are provided below..

Harmonic order h	I_h / I_1 [%]
5	24 ... 28
7	5 ... 10
11	8 ... 9
13	4 ... 6
17	4.5 ... 5
19	3 ... 3.5

4.11 ENGINEERING NOTES

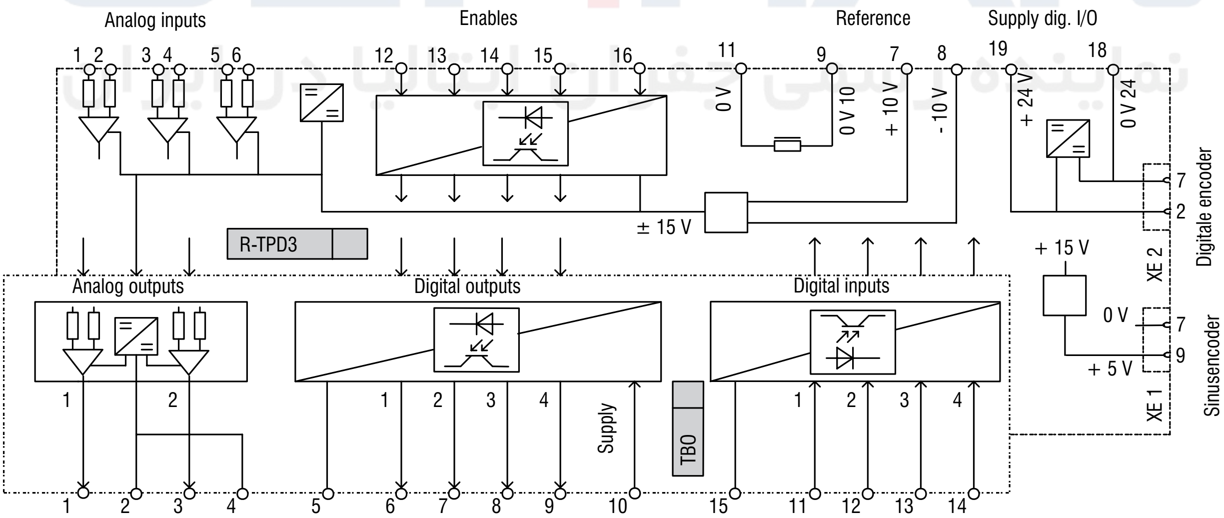


Figure 4.11.1: Potentials of the regulator section

Potentials of the regulator section

The potentials of the regulator section are galvanic divided from the power section. Figure 4.11.1 shows their connection.

- The analog inputs are designed as differential.
- The enables are isolated from the regulation via optoisolators. The terminals 12 to 15 have terminal 16 as a common reference potential.

- The internal potential 0V is connected to terminal 11. In the majority of the cases the interference suppression is decreased!
- The regulation card puts at your disposal the following power supplies, which have a common reference point:
  + 10V and - 10V for the reference
  + 24V for the power supply of the digital inputs and outputs
  + 5V for the encoder power supply

- The analog outputs are divided from the internal potential through a differential amplifier. The two outputs of the option card have the same potential (terminal 22 and 24 of TBO option card). When the TBO option card is used, the potential of the analog outputs are divided. For a better interference suppression and for the “cleaning” of the output signals, the terminals 2 and 4 of the TBO option card are directly ground connected (terminal 10 and /or 20 of the R-TPD32-EV card) or via a 0.1µF/250V capacitor.

- The digital outputs have the same potential (terminal 37) but they are divided from the regulator internal potential via optoisolators. In order to use the outputs, it is necessary to connect a power supply voltage to the terminal 30.
- The digital inputs are divided from the regulator through optoisolators. The terminals 31 to 34 have terminal 37 as a common potential.

External devices

As for the installation of contactors, protection devices, chokes, filters and other external devices it is necessary to follow the indication given in the previous chapters. The same theory is valid for motors, encoders and tachometers.

Connection cables

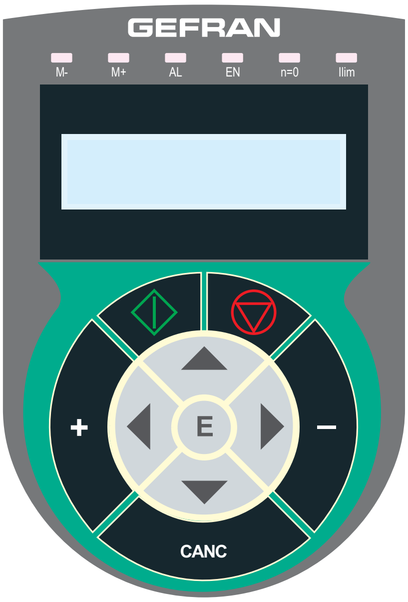
The encoder shielded cable must be made of twisted pairs. The connection cables of the encoders and of the motors, if possible, should be connected directly to the device, without going through support terminal strips.

The shieldings of the signal conductors have to be ground connected on both sides. Anyway, for all analog and digital signals with very long connections (outside the electric board), it is suggested to have a ground connection only on the converter side, in order to avoid possible noises caused by the closing of the ground loops. In particular cases it could be necessary to connect the shielding on both sides, thus granting the point equipotentiality via suitable connection cables.

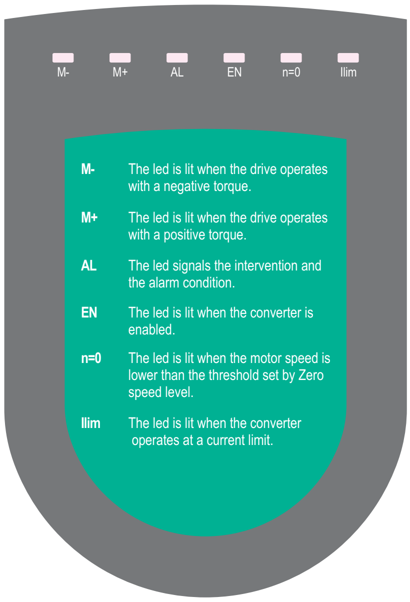
The encoder cable has to be made up of twisted loops with the global shielding connected to the ground on the converter side. Avoid to connect the shielding on the motor side connector. In particular cases (cable longer than 100 meters, strong electromagnetic noise), it could be necessary to use a cable with a shielding on every loop to be connected to the power supply ground. The global shielding has always to be ground connected.

5 - CONVERTER OPERATION

5.1 KEYPAD



KB-TPD32-EV



KC-TPD32-EV

KB-TPD32-EV programmable keypad (optional)

The keypad is made of a LCD display with two 16-digit lines and 10 function buttons. It is used

- to command the drive when this system has been selected
- to display the speed, the voltage and diagnostics during the operating time
- to set parameters

LED module KC-TPD32-EV

In the standard delivery the convert is supplied with the led module mounted on the front cover.

It contains six leds for an easy monitoring of the converter status.

The KC module can be manually removed and replaced with the Keypad , which is connected to the regulation board through the dedicated connector.

On the Keypad, which is supplied as optional, the same leds at the KC module are mounted..

5.1.1 LEDs

The leds present on the keypad are used to diagnose in a fast way the functioning situation of the converter.

Table 5.1.1.1: Diagnostic LEDs

Designation	Color	Function
M-	yellow	the LED is lit, when the drive operates with a negative torque (anti-clockwise rotation or clockwise braking). Only for TPD32-EV-...-4B.
M+	yellow	the LED is lit, when the drive operates with a positive torque (clockwise rotation or anti-clockwise braking). Braking only for TPD32-EV-...-4B.
AL	red	the LED is lit, it signals the intervention and the alarm condition
EN	green	the LED is lit, when the converter is enabled
n=0	yellow	the LED is lit, when the motor speed is lower than the threshold set by Speed zero level
I Lim	yellow	the LED is lit, when the converter operates at a current limit

5.1.2 Moving inside a menu

- The DRIVE STATUS always appears when the converter is switched on.
- Use the ▲ and ▼ keys to select the individual points within the same menu level.
- Press the ENT key to enter the next menu level.
- Use the CANC key to return to the next higher menu level, irrespective of which menu point was selected. The appropriate menu of the next higher level will appear once the return has been made.

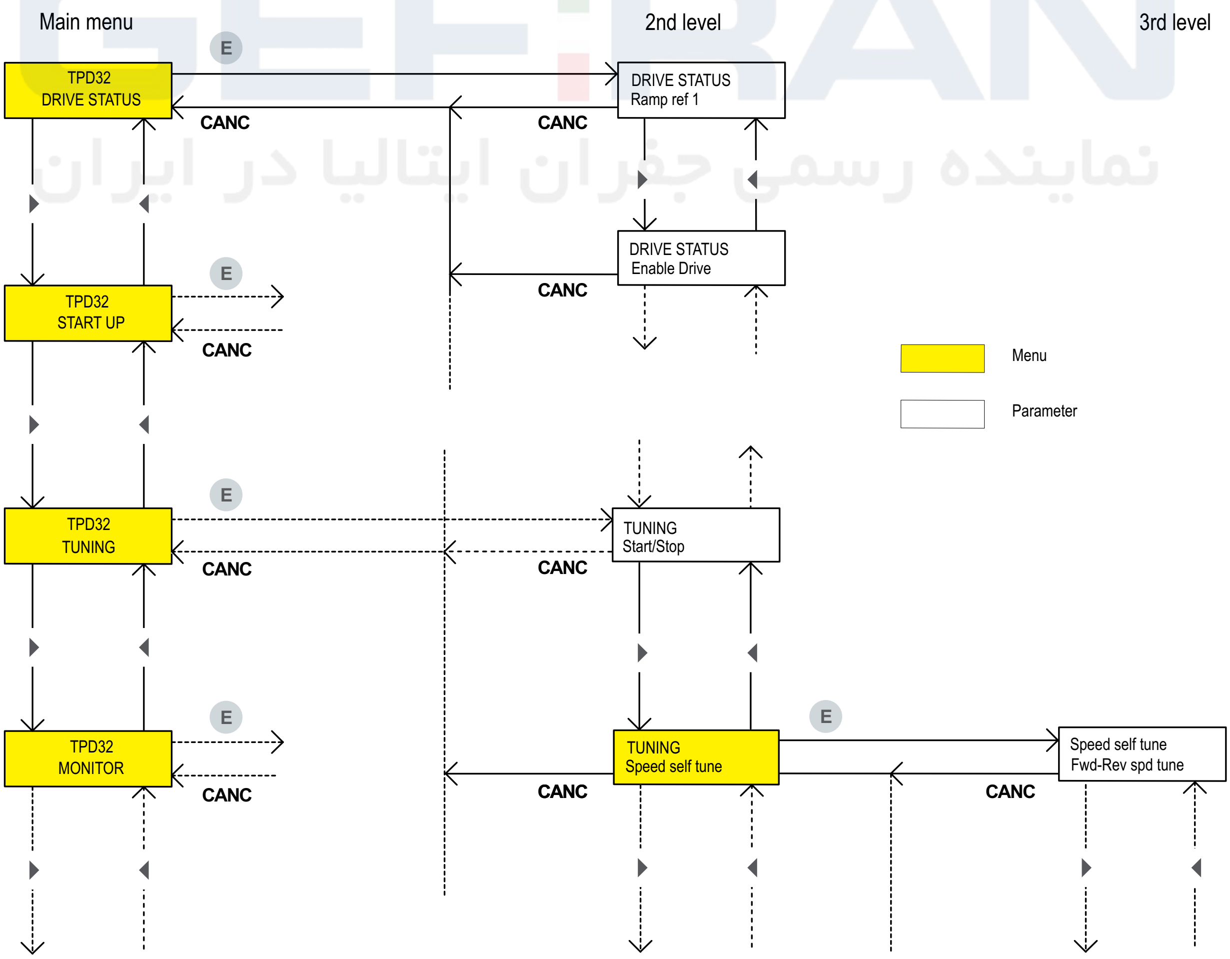
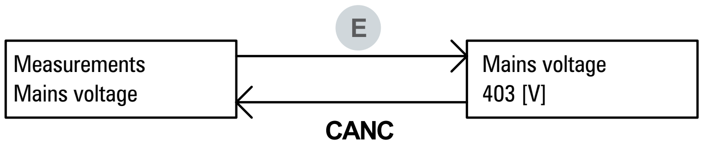


Figure 5.1.2.1: Moving inside a menu

5.1.3 Displaying parameters



- Select the parameters within the menu
- Press E. The parameter with its relative value will appear.
- Return to the menu using CANC.

5.1.4 Changing / Saving parameters / Password

The parameters with changeable values are divided into three groups:

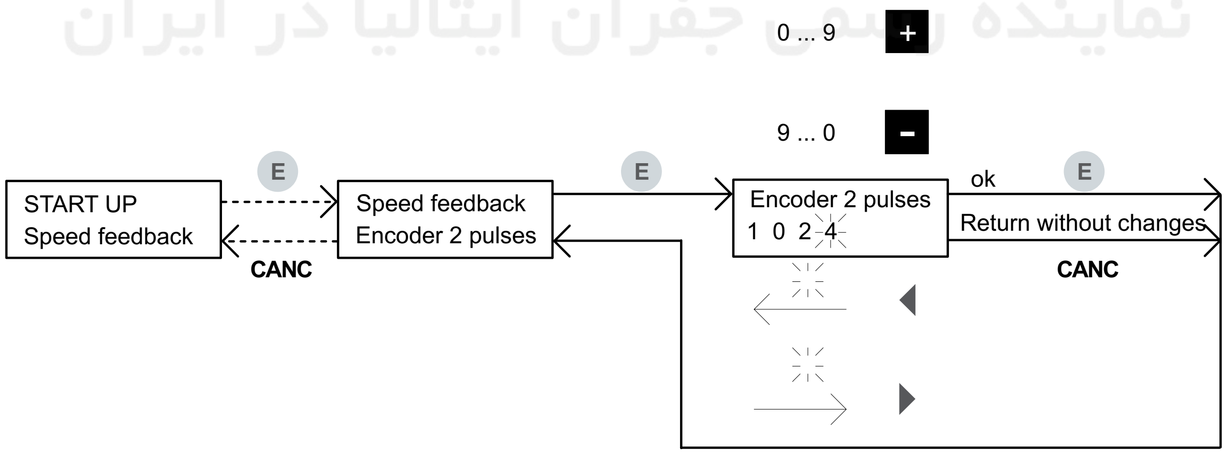
- Parameters whose content is either selected as a number or as text within a defined range e.g. ramp times and reference values
- Parameters whose contents are fixed values that can be selected.

  e.g. **Jog selection** with the "speed input" and "Ramp input" alternatives.
- Parameters that are automatically scaled by the keypad

  e.g. **Auto tune inp XX**

Note! Only those parameters that are not assigned to a digital or analog input/output can be changed with the keypad. The changed parameters must be saved otherwise the previous values will be loaded the next time the device is switched on.

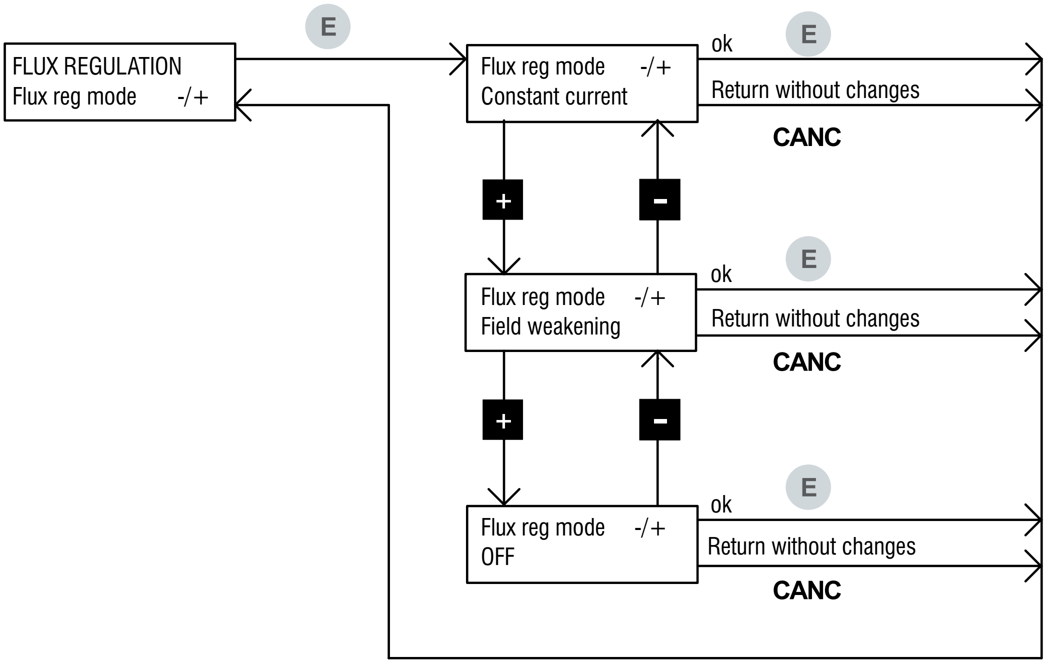
Changing numerical values and text



- Select within the menu the parameters to be changed.
- Press E. The value of the parameter will appear and the last digit will flash. The value of the flashing digit is always the one that can be changed.
- Increase the value with +
- Reduce the value with -
- Select the next digit left with ◀
- Select the next digit right with ▶
- Confirm the new value and return to the previous display by pressing E.
- Press CANC to return without changes.

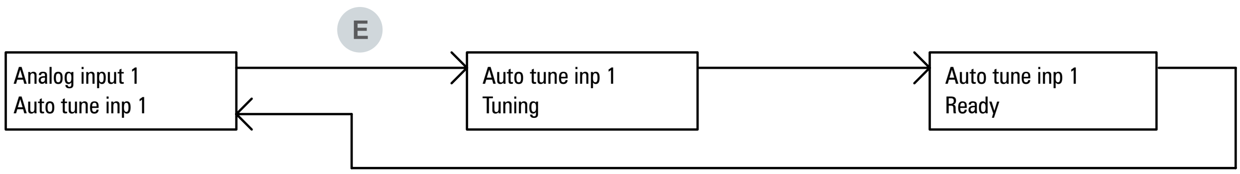
Note! When setting the **Dim factor text** parameter, the following characters are also available in addition to the numbers: / % & + , - . : < = > ? A...Z [ ] a...z

Selection from predefined values



- The parameters that can be selected among the several possiblities are marked with **-/+** on the keypad display.
- To change a value press E. The current value is shown in the display. This can be changed with the + and - keys.
- Confirm the new value and return to the previous display by pressing E.
- Return without changes via CANC

Autotuning of Analog input

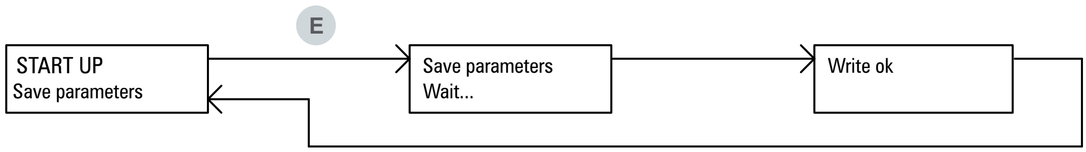


- Select the parameter **Auto tune input XX**.
- Press E.
- The tuning procedure will run automatically. The messages “Tuning” and “Ready” will appear in succession before the original parameter is shown.

Note! The maximum signal possible must be present on the analog input concerned during the tuning procedure.

Parameters Saving

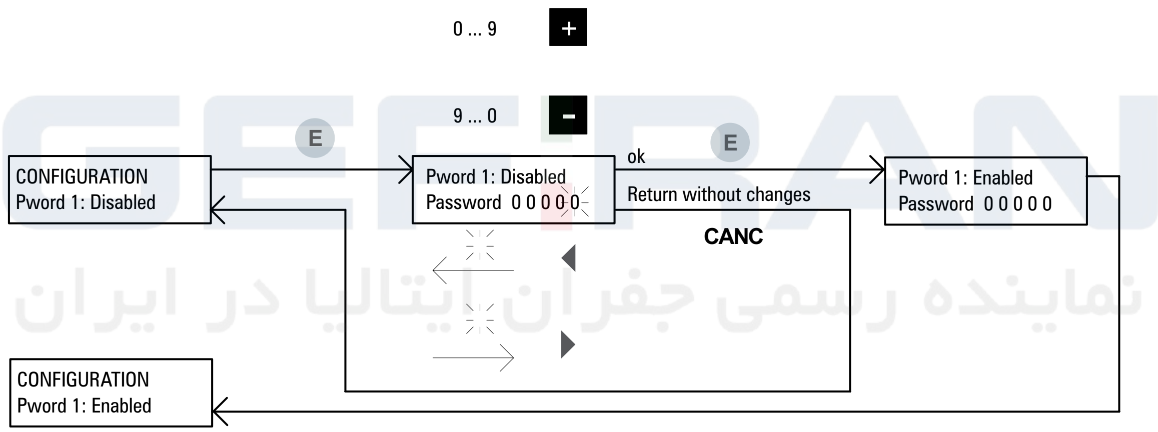
The parameters must be saved, otherwise the previous values will be loaded the next time the device is switched on.



- Select **Save parameters** in the START UP or in the SPEC FUNCTIONS menu.
- Press E
- The saving operation is automatic. The messages "Wait ..." and "Write ok" will appear in succession before the original parameter is shown.

Entering a password

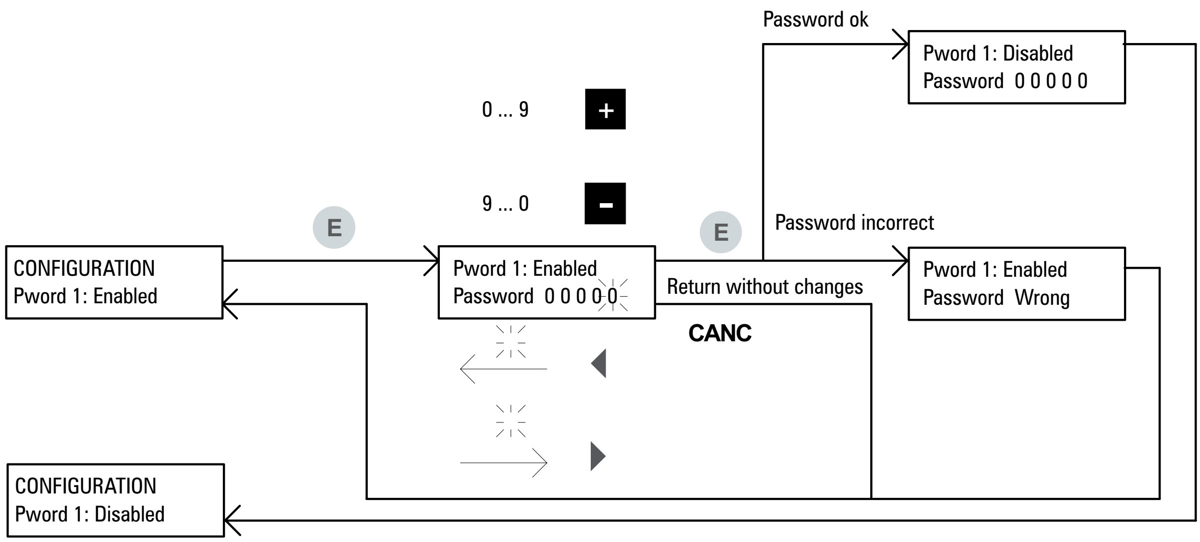
The operator can define a password consisting of a freely selectable five-digit number combination in order to protect the keypad from unauthorized access. This is carried out via the **Pword 1** parameter.



- Select **Pword1** (= Password 1) in the CONFIGURATION menu.
- Press E. The value 00000 will appear with the last digit flashing. The value of the flashing digit is changed.
- Increase the numerical value with +
- Reduce the numerical value with -
- Select the next digit left with ◄
- Select the next digit right with ►
- Confirm the password by pressing E. The message: Pword1: Enabled will then appear shortly with the currently valid password displayed.
- The existing password is indicated in the CONFIGURATION menu via the "Pword 1: Enabled" message.
- Press the CANC key in order to abort the entry of the password.

Note! The password must be saved with **Save parameters** so that it is also active the next time the device is switched on.

General unlocking of the password



- Select the parameter **Pword1** (= Password 1) in the CONFIGURATION menu.
- When the password is enabled, the message “Pword 1: Enabled” appears
- Press E to call the value 00000 with the last digit flashing. The value changed is always the digit that is flashing. The valid password must be re-entered in order to unlock it.
- Increase the numerical value with +
- Reduce the numerical value with -
- Select the next digit left with ◀
- Select the next digit right with ▶
- Confirm the password by pressing E. The message: Pword1: Enabled will then appear for a short time.
- The existing password is indicated in the CONFIGURATION menu via the “Pword 1: Enabled” message.
- Press the CANC key in order to abort the entry of the password if required.
- If the incorrect password is entered and then the E key pressed, the message “Password wrong” will appear and the keypad will return to the CONFIGURATION menu with the display “Pword1: Enabled”

Note! The **Save parameter** function must be used to save the password if the password itself must not only be disabled but completely unlocked.

5.1.5 Operating the drive via the Keypad

In order to operate the drive via the keypad, the following settings must be done :

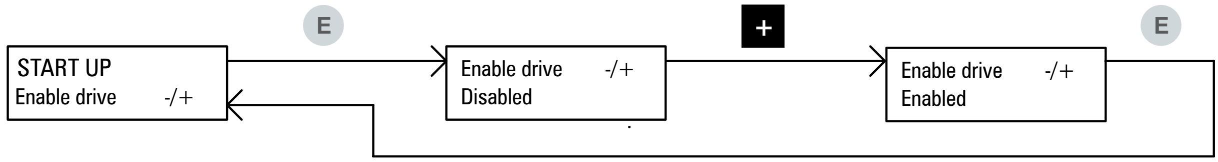
START UP and CONFIGURATION menu	Set **Main commands**	=	Digital
MENU CONFIGURATION	Set **Control Mode**	=	Local

- The hardware enables on terminals 12...15 are also active when the drive is operated via the keypad. This means, for example, that the signal at terminal 13 must also be present for starting the drive in adddition to the command via the keypad.
- If the drive is stopped via the keypad, it can be restarted simply by pressing the Start Key.
- If the stop was caused by removing the voltage signal on terminal 13, both the signal at terminal 13 and the command via the keypad are necessary to restart the drive. The signal at the terminals must be present before giving the keypad command.
- The same applies accordingly to the enabling of the drive via the **Enable drive** parameter.

5.1.5.1 Starting and stopping the drive

Note: The keypad must be enabled (see section 6.11.1) before performing these actions.

Enabling the converter



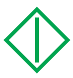
- Select the parameter Enable drive in the DRIVE STATUS or START UP or MONITOR menu.
- Press E
- Use the key + to choose "Disabled" or "Enabled".
- Press E to confirm your entry.

Disabling the converter

- Select the parameter Enable drive in the DRIVE STATUS or START UP or MONITOR menu.
- Press E
- Use the key - to change the display from "Enabled" into "Disabled".
- Press E to confirm your entry.

Start / Stop

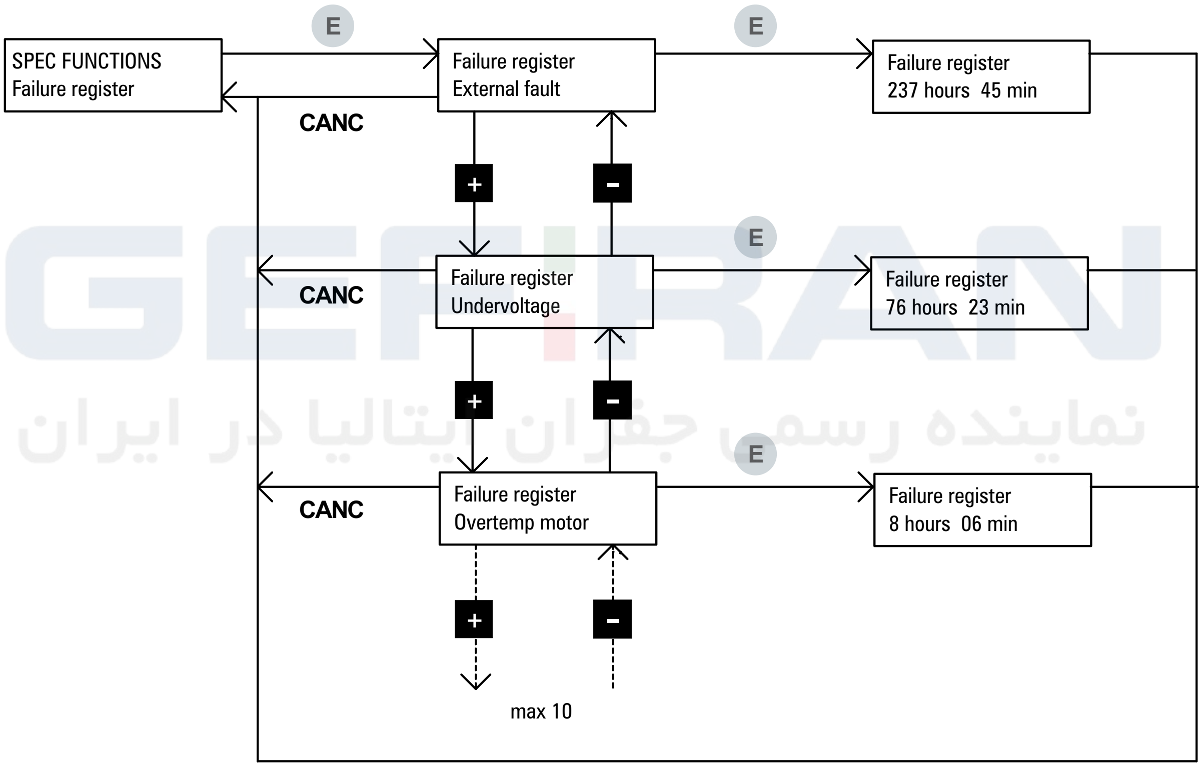
Warning: The keypad STOP can be used only when **Main commands** parameter is set to digital.

- Start: press the key 
- Stop: press the key 

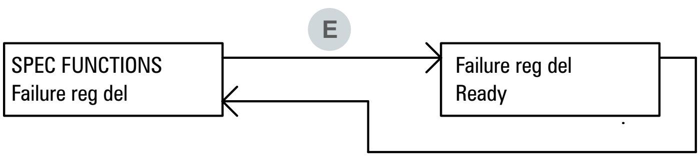
5.1.5.2 Failure register / Acknowledging alarms

Display of the failure register

- Select the parameter **Failure register** in the SPEC FUNCTIONS menu.
- Press E. The last error that has occurred will be displayed.
- Using the key + it is possible to display the previous alarm.
- The failure register can take up to 10 values. If a new failure is reported, the oldest entry in the failure register is overwritten.
- The entries in the failure register are retained until the register is cleared.
- Pressing E the time when the alarm occurred will be displayed. The time refers to the converter functioning period (presence of the supply voltage).
- After displaying, the menu goes back automatically to the **Failure register point**.
- By pressing the key CANC during the alarm display, the intervention time is not shown but on the contrary you go back to the **Failure register menu**.



Clearing the failure register

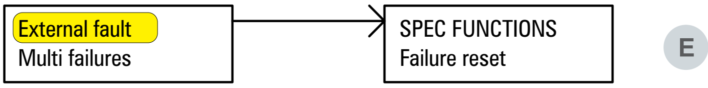


- Select the parameter **Failure reg del** in the SPEC FUNCTIONS menu.
- Press E. The failure register is cleared.

Acknowledging a failure alarm

- If a failure occurs, the appropriate failure alarm will appear in the display and the message will flash.
- Acknowledge or reset the failure by pressing the CANC key. The converter must be disabled for this and a Start command must not be present.

Acknowledging when several failure alarms occur at the same time

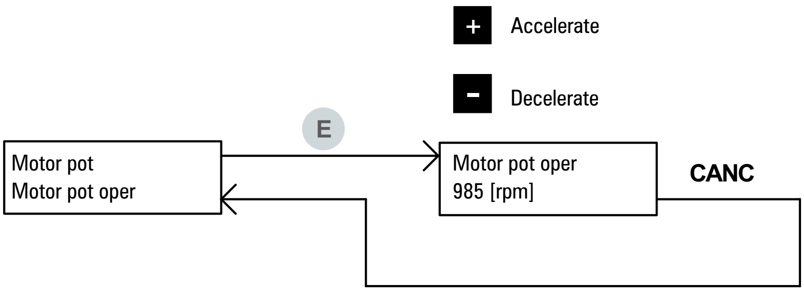


- When several failure alarms occur at the same time, the blinking message “Multi failures” will appear in the display.
- Select the parameter **Failure reset** in the SPEC FUNCTIONS menu.
- Press the E key to acknowledge or reset the failure alarm. The converter must be disabled for this and there should be no Start command present.

5.1.5.3 Motor potentiometer function

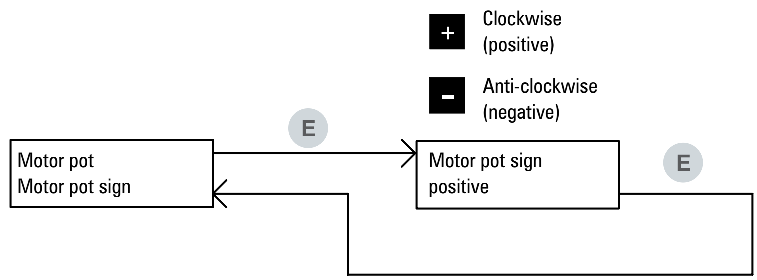
NOTE! To use the motor potentiometer function, this must be enabled with the **Enable motor pot** parameter by selecting configuration "Config 1" or "Config 2". The following information refers to configuration "Config 1".

Acceleration, Deceleration



- Select the Motor pot oper parameter in the “Motor pot” submenu.
- Pressing E the current reference value is displayed.
- Press the + key to increase the reference value and accelerate the drive.
- Press the - key to decrease the reference value and decelerate the drive. This applies to both rotation directions.
- Press CANC to return to the “Motor pot” submenu.

Changing rotation direction



- Select the **Motor pot sign** parameter in the “Motor pot” submenu.
- Pressing E the current rotation direction is displayed.
- Press the + key to select clockwise rotation and the - key for counterclockwise rotation.
- Confirm by pressing E.
- Changing the **Motor pot sign** parameter during operation causes the drive to reverse rotation according to the ramp times set.

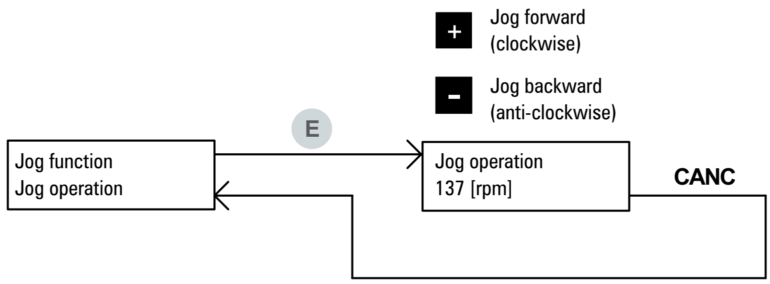
Resetting the speed reference value

- Select the **Motor pot reset** parameter in the “Motor pot” submenu.
- Press E. The reference speed is set to zero.

NOTE! The speed reference value can only be reset when the drive is switched off.

5.1.5.4 Jog function

NOTE! The Jog function must be enabled via the **Enable jog** parameter!



- Select the **Jog operation** parameter in the “Jog function” submenu.
- Press ENT. The selection Jog function is displayed.
- Press the + key to select clockwise rotation and the - key for counterclockwise rotation (counterclockwise rotation for TPD32-EV...4B only).
- Press CANC to return to the “Jog function” submenu.

5.2 MENU STRUCTURE

The menu consists of a main menu with submenus and parameters. The structure can be compared to the organization of files and subdirections on a PC.

main menu	corresponds PC main menu (main menu = Root)
submenu	corresponds to PC submenu
parameter	corresponds to individual parameters

The menu structure is described in the function description given in section 6, “Function description”. The following conventions apply:

Main menu:	Submenu:	Parameter:
Black field, text in upper-case letters	Black field	White field

INPUT VARIABLES				
	Ramp ref			
		Ramp ref 1		
			[44]	Ramp ref 1 [FF]
			[47]	Ramp ref 1 (%)
		Ramp ref 2		
			[48]	Ramp ref 2 [FF]
			[49]	Ramp ref 2 (%)

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5.3 COMMISSIONING

WARNING! The safety instructions, danger warnings and technical data in Section 1 and 2 of this manual must be observed!

DEFINITIONS: **Positive speed** is clockwise rotation seen from the motor shaft end side.
Negative Speed is counter-clockwise rotation seen from the motor shaft end side.
Positive torque is torque in clockwise directionseen from the motor shaft end side.
Negative torque is torque in counter-clockwise direction seen from the motor shaft end side.

5.3.1 Setting jumpers and switch

The hardware configuration set via the jumpers and switches on the R-TPD32 regulator card must be adapted to the application at hand and checked **before switching on the device**.

- Analog inputs 1/2/3

Voltage input 0... 10V	Switch S9/S10/S11 = OFF
Current voltage 0...20 mA / 4...20 mA	Switch S9/S10/S11 = ON
Mixed possible configuration	

- Adaptation for the speed feedback type

Sinusoidal Encoder	Switch S5 in position A
Digital Encoder	Switch S5 any position
Analog tachometer generator	Switch S5 in position B
Armature reaction	Switch S5 any position

- Adaptation for the digital encoder voltage

Voltage = 5 V	Switch S21 = ON
Voltage = 15...30 V	Switch S21 = OFF

- Control of a digital encoder connected to the connector XE2

Channel C controlled	Switch S20 = ON
Channel C not controlled	Switch S20 = OFF

- Adaptation of the max voltage using a tachometer generator:

22.7 / 45.4 / 90.7 / 181.6 / 302.9 V,	depending on the dip switch S4 setting (see chapter 4.4.3)

- Serial interface RS485

On the first and last drop of a line:	Switch S12 = ON
On the other converters	Switch S12 = OFF

- RS485 serial interface

- divided from the regulation (An external 5 V power supply is needed on the PINs 5 and 9) see section 4.5.2	Switch S18 in position OFF
- with a common potential 0 V of the regulation (Internal power supply)	Switch S18 in position ON

For further information see section 4.4, “Regulation section”.

5.3.2 Checking the wiring and the auxiliary voltages

The following should be checked before switching on the device:

- Proper connection of cables (Section 4, “Wiring procedures”)
- Compliance with Section 4.11, “Engineering notes”
- When the device current limit is not set according to the rated current value of the connected motor, a protection thermal relay must be inserted in the upper part of the converter, which has to be scaled according to the motor rated current times 0.86.

WARNING! **It is not allowed to connect an external voltage on the converter output.**

- Drive disabled (disconnect the terminal 12)

- The following voltages must be present:

- terminal 7	+ 10V	to terminal 9
- terminal 8	- 10V	to terminal 9
- terminal 19	+ 24 ... 30V	to terminal 18

- Select the **Actual spd (rpm)** parameter in the DRIVE STATUS menu.

  - With a disabled regulator turn the motor in a clockwise direction (view facing the shaft). The displayed value must be positive.

  - If the value does not change or if wrong values are shown, check the power supply and the cabling of the encoder/tachometer.

  - If the displayed value is negative, the connections of the encoder or of the tachometer generator must be changed: channel A+ with A- or B+ with B- of the encoder, change the connections of the tachometer signal.

5.3.3 Basic settings of the converter

NOTE! It is assumed that the device has the default configuration and is connected and tested according to the diagrams provided in section 4.8, “Standard connection diagrams”. The default setting can be loaded via the **Load default** parameter in the SPEC FUNCTIONS menu. Laoding this parameter will mean that all modifications carried out by the user will be overwritten. An exception is represented by the **Tacho scale** and **Speed parameters**. These are not overwritten when the factory set values are loaded and it is not necessary to scale again the input signal of the tachometer section. The same is valid for the **Size selection** parameter.

The factory setting allows a speed regulation with the cascade current regulation for a DC motor, with an independent excitation and provided with a digital encoder. The drive, in this case, does not operate with a Voltage control. Independently of the desired configuration, it is advised to carry out all the basic settings described in order to avoid possible mistakes. After the commissioning all other available functions can be activated. Their setting is described in the following pages.

The possible values set for each parameter can be found in section 10, “Parameter lists”.

The following settings must be carried out with the disabled converter.

Enable drive = disabled (no voltage on the terminal12).

See section 5.1, “Keypad”, for information about operating the keypad.

Selection of the drive command (via terminals or digital)

- When the converter is controlled only via the terminal strip, set the **Main commands** parameter to "Terminals". Before change this parameter set be sure that no voltage is supplied to terminal 12.
- When the keypad is used, set **Main commands** = Digital

Saving Settings

- Use **Save parameters** in START UP menu (or SPECIAL FUNCTION menu).
- User parameters setting must be saved into memory, so that the stored values are read the next time the device is switched on.
- When using the keypad: press ENT.

On standard setting, to perform the self tuning of cuurent regulator during the commissioning, the **Main commands** parameter is set as "Digital".

5.3.4 START UP procedures

Following START UP menu allows a quick basic commissioning of the drive.

Speed base value	This value determines the max rpm corresponding to the max signal applied to an analog input (e.g. 10V or 20mA).
Nom flux curr	Nominal field current of the drive. Set the range through the dip switches on the regulation board. See table 2.4.3.2.
Speed-0 f weak	Enables Speed-0 f weak at zero speed.
Speed-0 f weak delay	Sets a time delay.
Acc delta …	Acceleration ramp time setting on the speed reference.
Dec delta ...	Deceleration ramp time setting on the speed reference.

Motor data

In this menu all the motor plate data are placed.

In case the speed self-tuning has to be carried out, such values must correspond to the motor nameplate data, as the motor torque constant derives right from them.

Note ! Performing the speed regulator self tuning the following parameters must be set correctly according to the motor used.

Motor nom flux	Motor nom flux in Amps.
Flux reg mode	Flux regulator mode: constant current (fixed field) or Voltage control.
Full load curr	Nominal armature current in Amps. It corresponds to the 100% of the nominal drive output current. The default value is the nominal drive current. The settings for the current limits (**T current limit** parameters) and the *"Overload function"* are based on this value.
Motor max speed	Maximum motor speed value. Set the motor plate data value.
Max out voltage	Maximum armature voltage value. When Flux reg mode is set to fld weakening, it corresponds to the crossover point.
Flux weak speed	**Motor max speed** percentage where the flux weakening range starts. (Crossover point)

Note ! **With speed regulator self tuning performed, the above parameters value can be changed.**

Limits

This menu allows setting of speed limits value, current limits value and field current limits when different from the default values in *Motor data* menu.

T current limit	Armature current limit value as percentage of **Full load curr**. When overload function is used this value must be equal or higher than **Overload current** parameter value (Overload function).
Flux current max	Maximum field current value as percentage of **Motor nom flux**.
Flux current min	Minimum field current value as percentage of **Motor nom flux**. It corresponds to the Speed-0 f weak current value when Speed-0 f weak function is active and it will be the lower field current limit value when the motor is running in Voltage control range.
Speed min amount	Minimum speed reference limit.
Speed max amount	Maximum speed reference limit.

Speed feedback setting

Speed fbk sel	Speed feedback selection: encoder 1, encoder 2, tach generator, armature (CEMF).
Tacho scale	Tach generator feedback scaling (**Speed fbk sel** must be set to **Tacho**)
Encoder 2 pulses	Number of pulses per revolution of the digital encoder to the XE2 connector.
Enable fbk contr	Speed feedback loss control. The **Motor max speed**, **Max out voltage**, **Flux weak speed** parameters must be set correctly according to the motor used.
Refresh enc 2	Enable the monitoring of the encoder 2 (XE2 connector) connection status (A , B, Anot, Bnot channels). **Enable fbk contr** must be enabled.

Alarms

Warning Cfg Configuration of the TPD32-EV drive behaviour during multi "Warning" situation and start with warning active

1 "Stop/No Start" (default): Using this selection, the motor is stopped as a result of multi-Warning and the drive cannot be enabled in presence of warning.

0 "No Stop/No Start : Using this selection, the motor will be not stopped as a result of multi-Warning and the drive <u>can not be </u>enabled in presence of warning.

4 "No Stop/Start" : Using this selection, the motor will be not stopped as a result of multi-Warning and the drive <u>can be</u> enabled in presence of warning

Note! The parameter **Warning Cfg** can be modified only if no warning are active.

To change the configuration please follow below step:

Step1 - set the new value of Warning Cfg parameter

Step2 - store via the Save parameters (BASIC MENU)

Step3 - switch-off and switch-on the drive

The behavior as a result of multi warning when APC300 option is installed does not consider the setting of the **Warning Cfg** parameter for stopping the motor but it is considered for enabling the drive.

Undervolt thr	AC input alarm threshold value.
Overcurrent thr	Overcurrrent alarm threshold value.

Overload control

The overload control function allows an overcurrent for a limited time that can exceed the rated current of the drive. It is used in order to provide an increased acceleration torque.(See Overload control function for more details).

Analog inputs 1, 2 and 3

Three (3) differential analog inputs programmable are available (1-2, 3-4, 5-6 terminals) that allow a large number of configurations.

With the standard setting, analog input 1 (1 - 2 terminals) is set to **Ramp ref 1**. The other analog inputs are set to OFF.

5.3.5 Drive tuning

5.3.5.1 Self tuning of the current regulator

The following operation must be done before enabling the drive for the first time.

The autotuning of the current regulator is enabled via the **R&L Search** command. The values stated for the armature resistence and inductance are recorded as **Arm resistance** and **Arm inductance (**CURRENT REGULAT menu). If necessary the user can change these parameters value.

- If the motor field is externally power supplied (not from the drive), disconnect the motor field supply terminals. It is not necessary when the motor field power supply comes from the drive (C1 & D1 terminals)
- The user must be sure that during the current regulator self tuning the motor shaft does not turn (remanent magnetization, field series motor, etc.). <u>If necessary, lock the motor shaft during the procedure</u>.
- AC input voltage to U2 and V2 terminals,
- Drive disabled (no +24 voltage at terminal 12)
- Set **Main commands** parameter (START UP or CONFIGURATION menu) to “Digital” (Enable & Start/stop command from the keypad).
- Set the Armature current desired via **T current lim +** (positive torque) and **T curent lim -** (Negative torque).
- Set Overload control function to disable. (**Enable overload** = Disabled).
- Set **R&L Search** command to ON (START UP menu)
- Power up the drive
- Power up U, V, W terminals
- Enable the drive (+24V to terminal 12) and Start (+24V to terminal 13 and 14).
- **Enable drive** command = ENABLE (START UP menu).

Note! If **Stop mode** parameter is not set to “OFF” (FUNCTIONS/Stop Control menu), press Start button on the keypad.

- The **R&L Search** takes a few minutes, and can be interrupted by powering off the drive or set **Enable drive** to disable.
- At the end of the current self tuning procedure the drive is automatically set to disabled and the **R&L Search** command to OFF.
- Set the **Enable drive** parameter to disabled (No voltage on terminal 12)
- Set **Main commands** parameter to the desired setting (Terminals or Digital).
- Set Overload control function to enable if used. (**Enable overload** = Enabled).
- Save setting via **Save parameters** command (START UP menu)

Note! The procedure can be interrupted by powering off the drive or set **Enable drive** to disable. The previous parameters setting are stored in the drive. It is not possible to start the procedure if the Enable drive is set to disable.

5.3.5.1.1 Checking current regulator performance using parameter Eint

While running the drive, monitor the parameter (**Eint**), located under menu heading “Current Regulator”. This measure an average internal current error.

Its value should be close to zero, but values dynamically changing between -40 and 40 are acceptable. **The drive must have at least 30% load for this reading to be considered as a valid performance measurement.** If adjustments are needed, make small changes to the parameter (Current regulator\Arm inductance) to fine tune (**Eint**) to an acceptable value.

- If **Eint** is positive value, increase “Arm inductance” value.
- If **Eint** is negative value, decrease “Arm inductance” value.

5.3.5.2 Self tuning of the speed regulator

Speed ***Self tuning*** identifies the total Inertia value at the motor shaft ($Kg*m^2$), the friction value (or Loss compensation) in N*m and computes the Proportional and Integral gains of the speed regulator.

WARNING ! This procedure requires free rotation of the motor shaft coupled to the load. Start/Stop command is disregarded, therefore it can not be used on drives with limited travel.

CAUTION ! The test is performed using the torque limit value set in **Test T curr lim** parameter. The torque is applied stepwise, with no ramp (profile), therefore the mechanical transmission must not have significant backlash, and it must be compatible with operation at the torque limit set in **Test T curr lim** parameter. The user can reduce the torque limit to a suitable value via theTest T curr lim parameter.

Note !

- Application where the system inertia coupled to the motor shaft is much higher than the motor inertia value , increase the **Test T curr lim** parameter to avoid "Time out" error.
- This procedure is not suitable for use with "hoist" or "elevator" drives.

Preliminary operation before the correct execution of the Speed self tuning procedure is the appropriate calculation of the **Torque const** parameter.

Set the motor name plate data parametrs:

Motor max speed	Set the maximum motor speed value
Flux weak speed	**Motor max speed** percentage where the flux weakening range starts. (Crossover point)
T Current limit +/-	Set the nominal motor current value
Motor nom flux	Set the Motor nom flux in Amps.
Max out voltage	Set the maximum armature voltage value

With speed regulator self tunig performed, the above parameters value can be changed according to the application without **Torque const** parameter modification.

- Set the motor shaft direction: Forward or Reverse via the **Fwd-Rev spd tune** parameter
- Select the torque current value to be used during the test via the **Test T curr lim** parameter

TO EXECUTE SELF TUNING, enter START UP \ Self tuning menu.
- Start execution by entering **"Start"**.

The procedure performs an acceleration test at the torque limit value set in **Test T curr lim** parameter up to a speed threshold, then a deceleration test with no torque applied (coasting) down to zero speed.

The speed threshold is 33% of the lowest in the following:
- **Speed base value**
- **Speed max pos** or **Speed max neg** according to direction of rotation.

The procedure may take a few minutes, depending on inertia and friction values.

Based on inertia and friction values, the drive will calculate the speed loop gains (**Speed P** and **Speed I** parameters).

If manual adjustment are required (in case of vibrations, etc.) these should be applied to the integral gain **Speed I [%]**. In case self-tuning of speed regulator is not satisfactory, refer to manual tuning procedure in section 5.3.6 .

After the completion of the Speed self tune by the Drive, the new identified parameter values ("Nw" suffix) can be compared with values prior to the procedure, by browsing the subsequent menu entries. Parameters in this menu are read only. Editing of individual parameters must be done in their specific menus.

New parameters can be accepted all togetheter by entering "**Take val**" after disabling the Drive. In this case, prior values are overwritten. "***Self tuning***" can be repeated, whether values from the previous trial have been accepted or not.

Note! "**Take val**" does not store values in non-volatile memory, so values are lost if Drive power is cycled off and on. You need to enter **Save parameters** in the START UP or SPEC FUNCTIONS menu to permanently store values in non-volatile memory.

In case of extreme parameter ranges, error messages can occurr. Repeat execution in this case. If the error message is persistent, keep default values and use manual tuning of speed regulator (section 5.3.6 Manual tuning of the regulators).

List of self tune error messages

Generic messages

Description	*Note*
"Drive disabled":	Provide enable input by setting terminal 12 high.
"Not ready":	"**Take val**" can not be executed because the measurement has not been completed correctly. Repeat self tune command.
"Time out":	Measurement has not been completed in the proper time
"Start ?":	Press E to confirm start of measurement.
"Tuning aborted":	Measurement aborted by user (CANC button has been pressed).
"Set Main cmd=Dig":	Go to CONFIGURATION menu and set **Main commands** = digital.
"Set Ctrl=Local":	Go to CONFIGURATION menu and set **Control mode** = Local.

Measurement error messages

These messages may occour when extreme parameter values have to be identified. It can be useful to retry the self tune command when any of the following messages occours. If messages persist, alternative manual tuning procedures should be used.

Description	*Note*
"Over speed"	
"Drive stalled":	Increase value of parameter **Test T curr lim** and repeat ***Self tuning***
"Load applied":	Nominal zero load torque at standstill was detected. ***Self tuning*** is impossible for this type of load.
"T curr too high":	Reduce value of **Test T curr lim** parameter for ***Self tuning***
"Friction null":	Value of friction is zero or lower than the accuracy limit of the control system

5.3.5.3 Field converter

The default TPD32-EV converters are set to operate without Voltage control. The following settings must be taken into consideration when a functioning in Voltage control is needed or when the field of the connected motor is not power supplied via the converter.

All the settings described in this chapter must be carried out in disable condition (no voltage on terminal 12).

Selection of the functioning system

- With a constant field current:	**Flux reg mode** = Constant current **Enable flux reg** = Enabled
- With Voltage control:	**Flux reg mode** = Voltage control. In the CONFIGURATION menu set the max output voltage via the **Max out voltage** parameter. **Enable flux reg** = Enabled
- Field circuit not supplied by TPD32-EV	**Flux reg mode** = External control **Enable flux reg** = Disabled

Setting the rated field current

- Set the rated field current of the motor via the **Motor nom flux** parameter.
- When the field motor current is substantially lower than the rated current of the field converter, adapt trough the S14 dip switches the field converter. It must be configured according to the table 5.3.5.3.1 Via the **Nom flux curr** parameter it is possible to select the new field rated current.
- For fixed field current operation, if the actual motor (base) field current ≤ 10% of the maximum rating of the field package it is required to calibrate the field current feedback scaling using dipswitch S14.
- For weak field operation, also referred as “CEMF field control” or “crossover field control”, if the top base speed Motor nom flux ≤ 10% of the maximum rating of the field package it is required to calibrate the field current feedback scaling using dipswitch S14.

Calibration to the exact field current setting is not required, as long as the above conditions are met.

Calibration is not required if the field control is provided by a separate field converter.

See the "Field current setting resistors" table in chapter "2.3.3 Output" on page 29.

Flux current min/max

- Setting in LIMITS / Flux limits menu via the **Flux current max** and **Flux current min** parameters as a percentage of **Nom flux curr**.

5.3.6 Manual tuning of the regulators

The tuning of the TPD32-EV converters is factory set to a typical value for the motor size concerned. This normally ensures satisfactory regulator results. If this setting, however, meets the requirements of the application concerned, the regulator need not be optimized.

The converter contains the following close-loop control circuits:

- Regulator of the armature current. The auto tuning has to be perform via the **R&L Search** parameter.
- Speed regulator
- Field current regulator
- Armature voltage regulator

Following is a description of the system suitable to obtain the optimization, if necessary. In order to have a step function, the internal “Test generator” is used (“SPEC FUNCTIONS” menu). The aim is to obtain a very good step response.

The analog output can be brought back to the terminal strip, with a sampling time of 2 ms.

Using the Test generator

This function generates and makes available some signals with a square wave, with a frequency and a width that can be set and which can be added to an offset that can be set too. With the parameter **Gen access** it is possible to state on which regulator input the signal must be active. Further information can be found in section 6.15.1, “Test generator”.

Manual tuning of speed regulator

- No voltage on terminal 12 (Drive disabled)
- Choose the following settings for the Test generator :
  - **Gen access** = Ramp ref
  - **Gen frequency** = 0.2 Hz
  - **Gen amplitude** = 10 %
  - **Gen offset** = 10 %
- Measuring the reaction on an analog output. To this purpose **“Actual Spd”** and **“Motor current”** variables must be set on two different analog outputs (see “Programming inputs/outputs”).
- In the START UP menu set the **Acc delta speed** parameter with the highest value and the **Acc delta time** parameter at 1 second.
- Set at 0.00 the **Speed P** and **Speed I** parameters in the REG PARAMETERS / ...menu.
- Enable the drive (voltage on terminal 12) and Start (voltage on terminal 13).
- Increase the **Speed P** till when the overshoot is lower by 4% when the reaction time is shorter.
- Increase **Speed I** until the overshoot is higher by 4%. Decrease it, so that it is slightly lower than 4%.
- Stop and disable the drive (remove the voltage on terminal 12 and 13).
- **Gen access** = Not connected
- Save the settings (SAVE PARAMETERS command in the SPECIAL FUNCTION menu).

Note! With the feedback “Bypass” function enabled (**Enable fbk bypas** = Enabled) the converter switch directly to the armature feedback (CEMF) when the speed feedback is no more present. This is possible when the converter is working at constant field. In this case with a disconnected reaction signal, it is necessary to carry out again the above mentioned optimization of the speed regulator. The P section of the speed regulator is set via the **Speed P bypass** parameter and the I section with the **Speed I bypass** parameter.

In some cases it is necessary to have different gains for the speed regulator, above the speed range. To this purpose the converters of the TPD32-EV series are provided with an adaptive speed regulator.

For the tuning see the following pages.

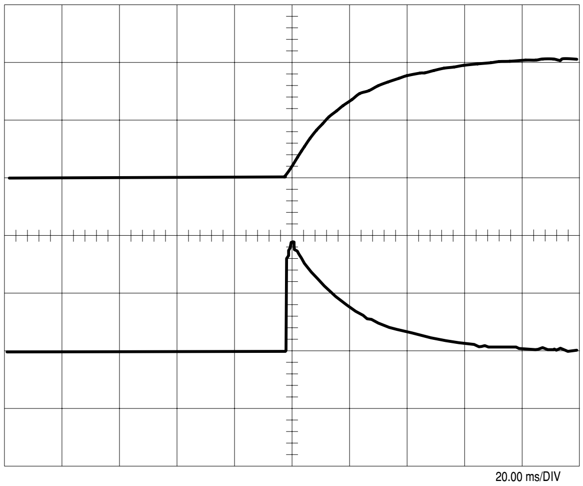


*Figure 5.3.6.1: Above: Actual spd; Below: Motor current. **Speed P** too low.*

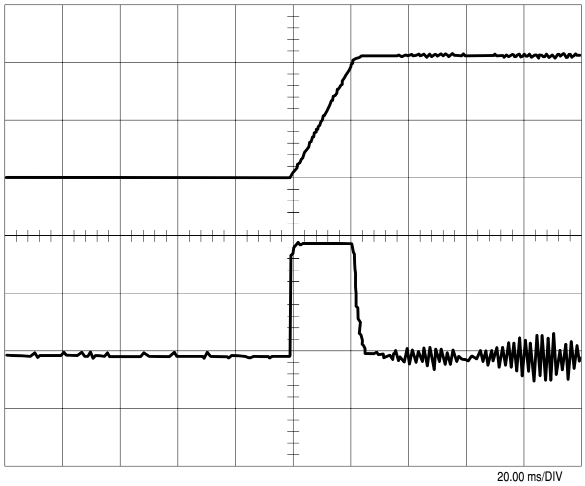


*Figure 5.3.6.2: Above: Actual spd; Below: Motor current. **Speed P** too high.*

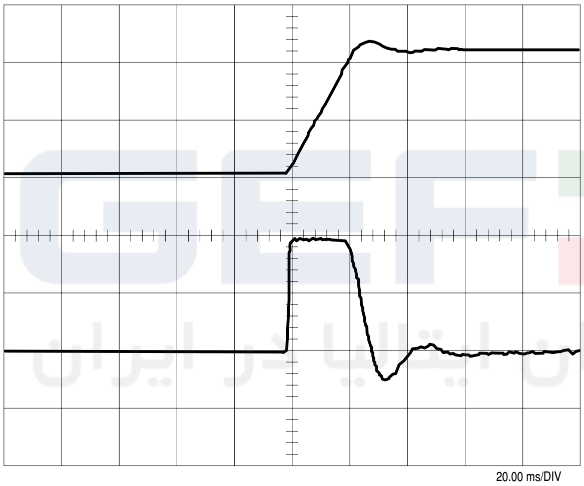


*Figure 5.3.6.3: Above: Actual spd; Below: Motor current. **Speed I** too high..*

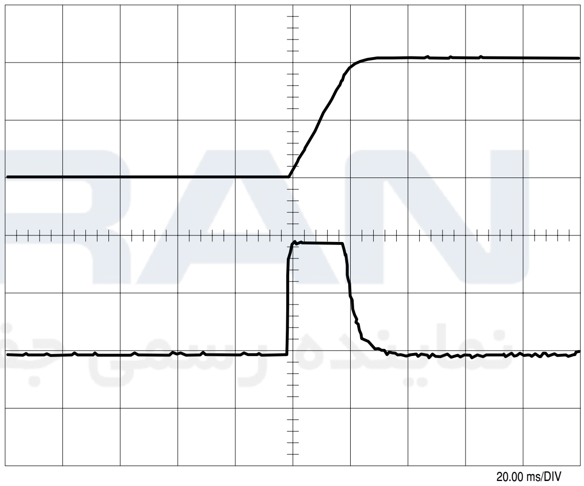


*Figure 5.3.6.4: Above: Actual spd; Below: Motor current. **Speed P** and **Speed I** set correctly.*

Manual tuning of field current regulator

NOTE! In the majority of the cases the dc motors with an independent excitation operate with a direct field (**Flux reg mode** = Constant current). In this case it is not necessary to optimize the regulator of the field current and the regulator of the armature voltage.

The optimization showed below, refers to drives operating with constant power range (armature and field mixed regulation). In these cases it is necessary to configurate the field converter for this particular use. See below.

NOTE! During the optimization of the regulator of the field current, the converter must not receive a Start command.

- Converter disabled (no voltage on terminal 12)
- Menu LIMITS / Flux limits: **Flux current max** = 100% equal to the rated field current of the motor. **Flux current min** = 0
- Set at 0.00 the **Flux I** and **Flux P** parameters in the REG PARAMETERS / ...menu .
- Measure the field current via an analog output. To this purpose the variable “Flux current” has to be parameterized on one output and the variable “Flux reference” on another (see “Input/Output programming”).
- Select the FLUX REGULATION menu.
- **Enable flux reg** = Enabled (default)
- **Flux reg mode** = Voltage control
- **Enable flux weak** = Enabled
- Set **Gen access** = Flux reference and **Gen amplitude** to 70% of the rated field motor current (this to allow the overshoot of the system).
- Increase the value of the **Flux P** parameter till the overshoot of the field current is lower than 4% (**Field curr**).
- Increase the value of **Flux I** untill the overshoot is higher than 4%, then reduce it slightly lower than 4% .

NOTE! Because of the high time constant, the rate of rise of the field current is limited . The increase time with optimal scale conditions can be last several hundreds of milliseconds.

- **Gen access** = Disconnected
- **Enable flux weak** = Disabled
- Set **Flux current min** at the desired value
- Configure the analog outputs on the basis of your needs.
- Save the settings.

Figures 5.3.6.5 ... 5.3.6.7 show some examples of tuning of the Flux regulator.

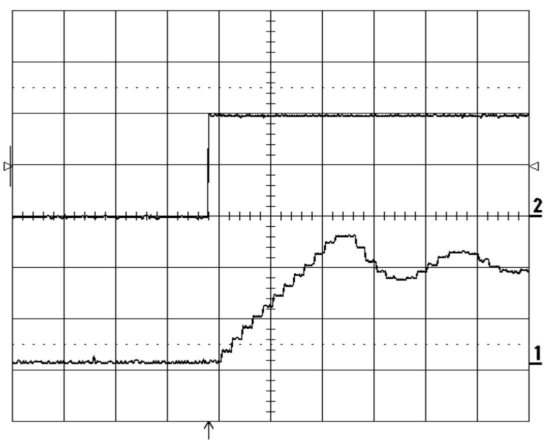


Figure 5.3.6.5: Above: Flux reference; Below: Flux current. The regulator behavior is not good. Jumps are due to field changing.

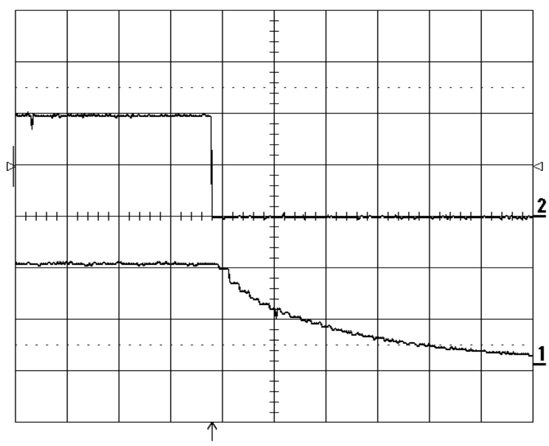


Figure 5.3.6.6: Above: Flux reference; Below: Flux current. The reduction of the field current depends on the field time constant. The reg has no influence.

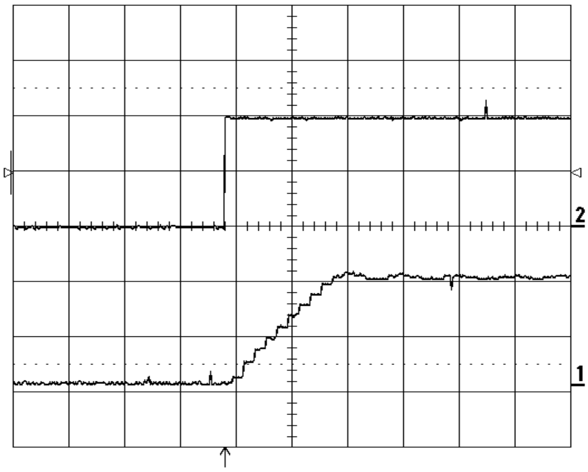


Figure 5.3.6.7: Above: Flux reference; Below: Flux current. The increment in the field current has no jump. Variation compared to Fig.5.3.6.5: Increase of Flux P from 2 to 10%. Flux I = 5%.

Voltage regulator in the field converter

NOTE! In the most of the cases the DC motors with an independent excitation operate with a direct field (**Flux reg mode=Constant current**). In this case it is not necessary to optimize the regulator of the armature voltage.

When a Voltage control occurs, the voltage regulator keeps the armature voltage at a constant level. The most difficult moment for this regulator is the beginning of the Voltage control, because due to the saturation of the motor field, the flux variation requires quicker changes of the field current.

Tune the regulator in order to have small changes of the armature voltage.

NOTE! All the other converter regulators must be set before the optimization of the voltage regulator.

- Drive disabled = no voltage on terminal 12

- Choose the following settings for the Test generator :
  - **Gen access** = Ramp ref
  - **Gen frequency** = 0.2 Hz
  - **Gen amplitude** = 10 %
  - **Gen offset** = according to the changing point from the armature regulation to the field one. Example: **Motor max speed** = 2000 rpm, the Voltage control starts at 1500 rpm. **Gen offset** = 75 %
- Measure the field current and the armature voltage on an analog output. The "Flux current" and the "Output voltage" variables must be set on two different analog outputs (see Programming "Inputs/Outputs).
- Enable the drive and give the Start command (voltage on the terminals 12 and 13)
- Check the armature voltage. After a possible short jump, the voltage should remain constant. See figures 5.3.6.8 ... 5.3.6.10. In the REG PARAMETER /... menu, it is possible to change the P and I section with the **Voltage P** and **Voltage I** parameters.
- Stop and disable the drive.
- Gen access = Not connected
- Save the settings.

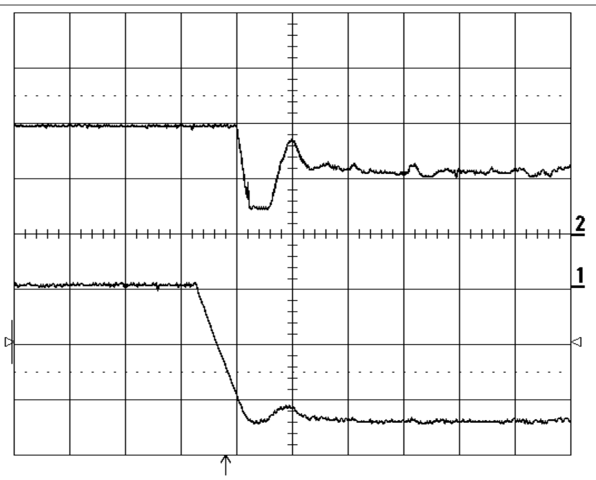


Figure 5.3.6.8: Above: Flux; Below: Output voltage. After a speed change the field current (Flux) has some jumps. Voltage P = 10%, Voltage I = 80%.

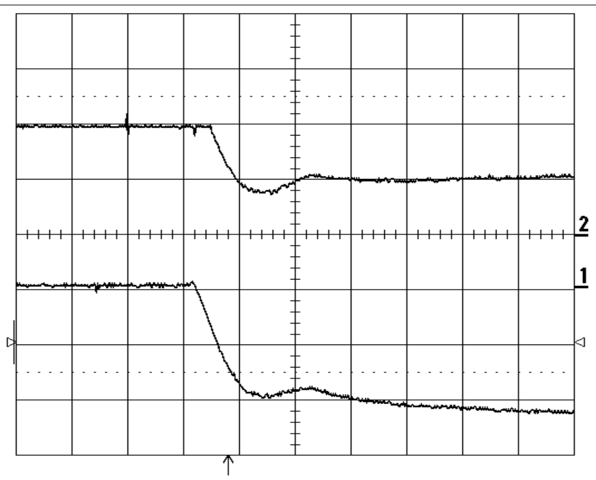


Figure 5.3.6.9: Above: Flux; Below: Output voltage. The gain is too low. The armature voltage increases. Voltage P = 3%, Voltage I = 5%.

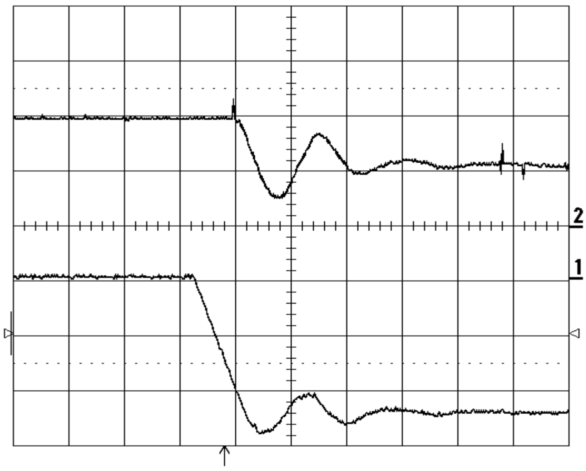


Figure 5.3.6.10: Above: Flux; Below: Output voltage. Optimal Field regulator. After a short transient, the field current and armature voltage are constant. Voltage P = 40%, Voltage I = 50%.

5.3.7 Others tuning

Flux / if curve tuning (Flux / if curve)

The function of this curve is to model the real flux of the motor. The flux model allows the control of torque current to better relate to torque. The figure below describes the relation between flux and flux current in conditions of **Flux /if curve** defined and not defined.

NOTE! The field current (previous section) and the output voltage tunings (next section) must be carried out when a Voltage control is required, whether the relevant flux curve has been defined or not.

The tunings scale is the following:

- ***Field current regulator***
- ***Flux/ if curve tuning (Flux / if curve)***
- ***Voltage regulator in the field converter***

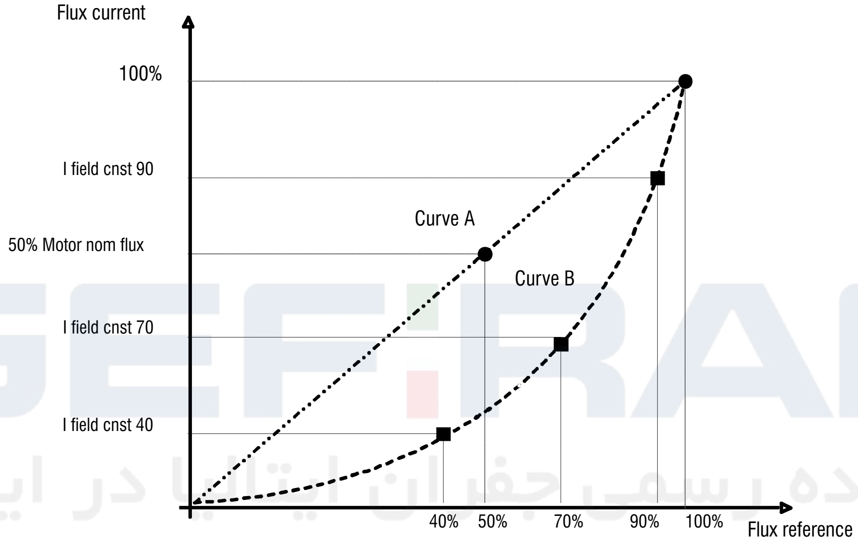


Figure 5.3.7.1: Curve convertion flux/current

Example:

A - With the default setting of the converter, there will be a linear characteristic (Curve A) of the flux current (**Flux current**) when the parameter **Flux reference** changes.

Then:

Flux current max / Flux reference = 100% **Flux current / Flux reference** = Motor nom flux

Flux current max / Flux reference = 50% **Flux current / Flux reference** = 50% of Motor nom flux

B- Carrying out the tuning of the flux curve (see below tuning procedure) the result will be emphasized by curve B. The values of **Flux current** will follow a characteristic determined by the real flux percentage **Flux reference**, necessary to determinate the circulation of that field current for the connected system.

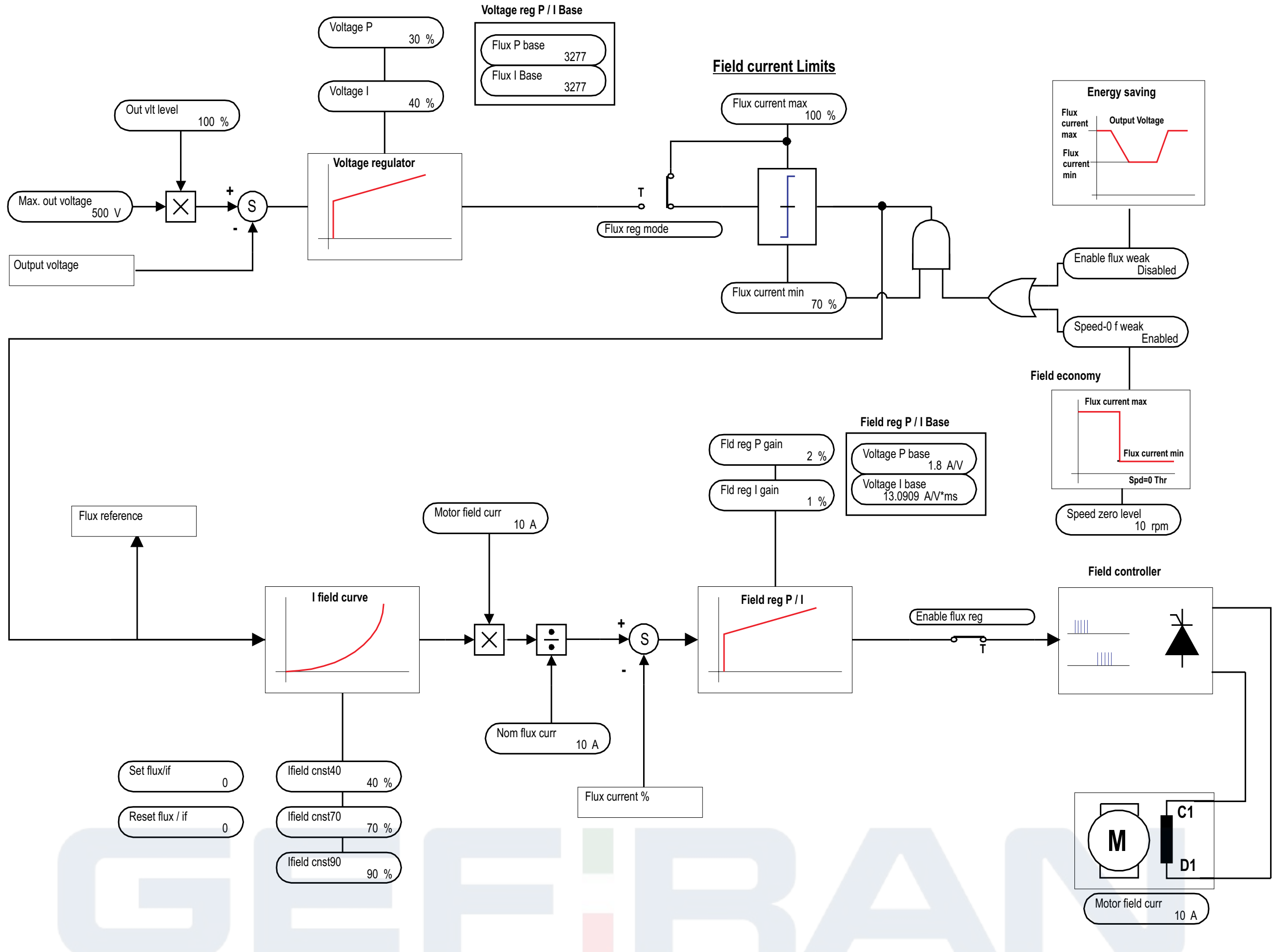


Figure 5.3.7.2: Blocks diagrams of field current regulator

Tuning procedure:

- Reset the curve flux/current via the **Reset flux / if** command (FLUX REGULATION \ Flux / if curve menu)
- Set the Motor nom flux: **Motor nom flux** parameter (FLUX REGULATION menu)
- Set the output voltage via the **Max out voltage** parameter (CONFIGURATION menu) and the correspondent percentage (100%) in the **Out vlt level** parameter (FLUX REGULATION menu)
- Set the Flux regulator **Flux reg mode** = Constant current (FLUX REGULATION menu)
- Set the flux percentage at 100% via the **Flux current max** parameter (FLUX REGULATION menu)
- Operate the Drive speed, so that the **Armature voltage** (MONITOR\Measurements menu) corresponds to the value previously set in **Max out voltage** (CONFIGURATION menu).
- Via the **Flux current max** parameter decrease the voltage displayed in **Armature voltage**, up to obtain an output voltage equal to the 90% of **Max out voltage**.

  Carry out the reading of the current in the **Flux current** parameter (FLUX REGULATION menu) and insert it in the **I field cnst 90** parameter (FLUX REGULATION\Flux if curve menu).
- Via the **Flux current max** parameters decrease the voltage displayed in **Armature voltage**, to obtain an output voltage equal to the 70% of **Max out voltage**.

  Carry out the reading of the current circulating in the **Flux current** parameter (FLUX REGULATION menu) and insert it in the **I field cnst 70** parameter (FLUX REGULATION\Flux if curve menu).
- Via the **Flux current max** parameters decrease the voltage displayed in **Armature voltage**, to obtain an output voltage equal to the 40% of **Max out voltage**.

  Carry out the reading of the current circulating in the **Flux current** parameter (FLUX REGULATION menu) and insert it in the **I field cnst 40** parameter (FLUX REGULATION\Flux if curve menu).
- Disable the converter

- Via the **Set flux / if** parameter (FLUX REGULATION menu) the calculation of the curve parameters will be carried out. Enter this parameter then press ENT to execute the calculation.
  The procedure requires a few seconds.
- Set the operating mode of the field control (**Constant current / Voltage control**), set the value of **Flux current max** at 100% and save the parameters.
- Changing of **Max out voltage** or **Motor nom flux** need a new curve tuning.

Speed-up function

With loads having a high moment of inertia it is possible to check the jumps during the speed changes. They can be reduced using the function "Speed-up". The figures 5.3.7.3 and 5.3.7.4 show the influence of this function.

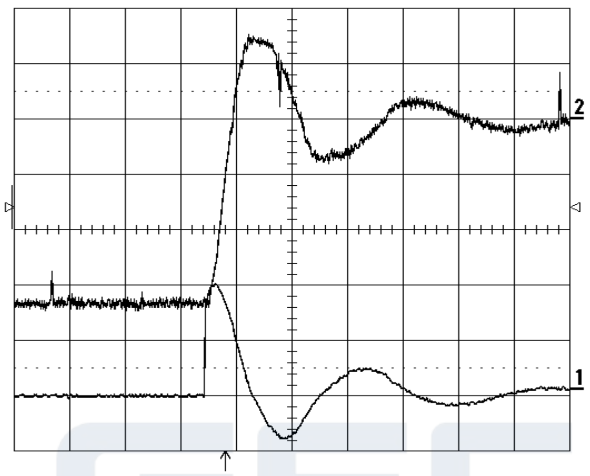


Figure 5.3.7.3: Above: Actual spd; Below: Motor current jumps with the speed changes due to a high moment of inertia. The function Speed-up is not active.

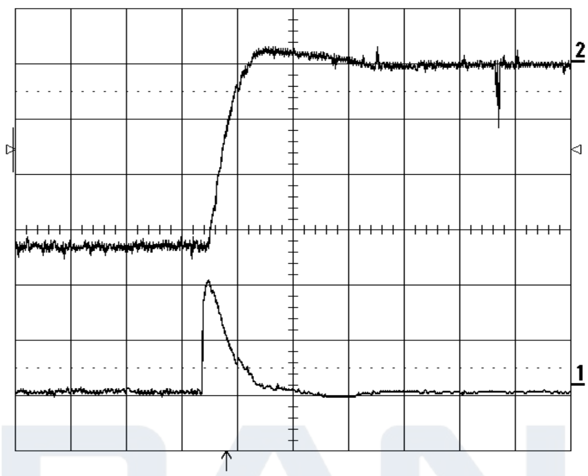


Figure 5.3.7.4: Above: Actual spd; Below: Motor current. The same drive with Speed -up function active.

Parameters used in the example:

Speed up base	14 ms
Speed up gain	50 %
Speed up filter	20 ms

Setting of the speed zero logic

- The speed zero logic is factory set as disabled. See section 6.7.2, "Speed zero logic", for a description of the drive behavior.
- Disable of the I-section of the speed regulator with n=0:
  I-section disabled: **Enable spd=0** I = Enabled
  I-section enabled: **Enable spd=0 I** = Disabled

NOTE! When the motor is at a stop, it is possible to avoid the creep of the drive disabling the I section. In this case when the motor is at a stop, it can not receive any load and therefore this function is not suitable for all applications!

- Suppression of the P-gain set via **Spd=0 P gain**:
- If the reference is above **Ref 0 level**: **Enable spd=0 R** = Enabled
- If the ref.and/or the reaction are above **Ref 0 level**: **Enable spd=0 R** = Disabled

NOTE! **Enable spd=0 R** is active only when **Enable spd=0 P** is enabled.

- Choice of the proportional gain for zero speed:
  The P-gain corresponds to **Spd=0 P gain** **Enable spd=0 P** = Enabled
  The P-gain corresponds to the normal P-gain **Enable spd=0 P** = Disabled
- The P-gain at a zero speed is set via **Spd=0 P gain**, when **Enable spd=0 P** is enabled.
- The intervention threshold for the recognition of zero speed is determined with **Ref 0 level**. It is expressed in the dimension set by the factor function.

Adaptive of the speed regulator

NOTE! The adaptive of the speed regulator is factory set as disabled. It must be used only when the gain of the speed regulator has to get higher than the speed range or it has to be replaced with another unit. As for the interaction among the parameters see section 6.13.2, "Adaptive spd reg".

- Enable of the adaptive with a blocked drive. **Enable spd adap** = Enabled. In this way the settings of **Speed P** and **Speed I** are disabled.
- Determine on the basis of which unit the gain of the speed regulator has to be changed. It normally depends on the speed (**Select adap type** = Speed).
- If the gain has to be changed on the basis of another unit, set **Select adap type** = Adap reference. This unit is connected to the device as an analog value via an analog input. For this reason the **Adap reference** variable must be assigned to an analog input (see in the following pages the configuration of the analog inputs).

  The other possibility is to insert **Adap reference** via the serial interface or a Bus. In this case the insertion via the terminal strip is not necessary.
- Entering **Adap speed 1** and **Adap speed 2** three different speed ranges are available with several gains. Value expressed as a percentage of **Speed base value** and respectively of the max value of **Adap reference**.
- With **Select adap type** = Speed: the optimization is carried out as described for the "Speed regulator". To this purpose the following points must be taken into consideration:
  - Enter with **Gen offset** a value which is at the beginning of the range to be optimized but which at the same time is outside the range set with **Adap joint XX**.
  - Enter with **Gen amplitude** the step, so that the speed remains inside the range to be optimized.
  - The optimization is carried out separately for each range and the paramters of the regulator are set for each range with **Adap P gain XX** and **Adap I gain XX**.
  - After the optimization of the different phases look over the whole speed range.
  - By changing the value of **Adap joint XX** it is possible to reduce the instabilities present in the transients during the changes from one range to the other. Increasing the values the transients are slighter.

- With **Select adap type** = Adap reference: the optimization depends on the system and it is impossible to state here the general information needed.
- When the speed zero logic is disabled (factory setting) with a blocked drive the gains of the speed regulator are active. These are set via **Adap P gain 1** and **Adap I gain 1** . When the speed zero logic is enabled, the values set for a motor at a stop are valid.

6 - FUNCTION DESCRIPTION

Functions and parameters

The converters of the TPD32-EV series feature a number of functions that can be set and assigned parameters in order to meet the requirements of the application at hand.

The device can be controlled in different ways:

- via the terminal strip
- via the keypad
- via the RS 485 serial interface
- via a bus connection (option)

The settings required are made via the **Main commands** and **Control mode** parameters in the CONFIGURATION menu.

The device is supplied with a Windows^{TM}-based user interface software for controlling the drive and setting parameters via the RS 485 serial interface.

The device is factory set for speed regulation with a cascade current regulation and is connected according to the connection diagram shown on in section 4.8, “Standard connection diagrams”. Only the entry of parameters in the START UP of the software is required for the initial commissioning of the drive. The drive is thus controlled via the terminal strip with all parameters set via the keypad.

If functions are required that are not in the standard configuration, these can be selected and their parameters set accordingly via the appropriate menu.

The TBO option card is required for expanding the standard device with programmable inputs/outputs. Up to no. 2 TBOs can be fitted, each providing 4 digital inputs, 4 digital outputs and 2 analog outputs. Three analog inputs are provided on the standard device.

The converters of the TPD32-EV series enable reference values for the ramp and for the speed regulator to be set in different units of measure:

- in percentages of the **Speed base value**
- in a unit of measure (dimension) that the user can define using the factor function, e.g. as speed in m/s.

According to which one is set as last the other will be updated. This means that the other reference value is overwritten with the current value.

A freely selectable password 1 prevents the operation of the converter by unauthorized persons. It is entered in the form of a five-digit number combination. Password 2 is also provided by the manufacturer. This password enables the service personnel to access the Service menu which is not accessible for the user.

Note! All parameter settings must be saved otherwise the last settings saved will be loaded the next time the device is switched on (Save parameters command)

Explanation of parameter tables

In the following pages the parameters list of each menu is shown. For each table the following notes are valid:

"No." column	Parameter number (decimal). In order to address parameters when a serial line/bus or the APC300 card are used, the user **must** add 2000H (= decimal 8192) to the indicated value.
"Value" field	S = value depending on the size of the device.

DRIVE STATUS	Start up parameters status
START UP	Basic commissioning of the drive
TUNING	Drive regulators tuning
MONITOR	Display of reference values, speeed, voltage, current, frequency...
INPUT VARIABLES	Ramp reference, speed reference, current reference
LIMITS	Speed limits, current limits, field current limits
RAMP	Acceleration, deceleration, quick stop, ramp shape
SPEED REGULAT	Configuration of the speed regulator, speed zero logic, speed up , droop function
CURRENT REGULAT	Configuration of the current regulator
FLUX REGULATION	Functioning of the field current regulator
REG PARAMETERS	Parameters for speed, current, field and voltage regulation
CONFIGURATION	Functioning, regulation, encoder type, function factor, programmable alarms, address, password
I/O CONFIG	Configuration of programmable digital and analog input and output
ADD SPEED FUNCT	Motor capture, adaptive speed regulation, speed control, speed zero
FUNCTIONS	Motopotentiometer, jog function, multi-speed, multi-ramps, overload, stop control, Taper current function
SPEC FUNCTIONS	Test generator, saving parameters, loading factory settings, signal adaptation, PAD parameters
OPTIONS	Access to the optional field bus card (Option1), and the APC300 (Option2), PID function
DRIVECOM	Parameter setting for the DRIVECOM profile
SERVICE	Menu, only accessible to service personnel of the manufacturer

6.1 ENABLES

The following hardware enables are always required irrespective of whether the device is to be controlled via the terminal strip, the keypad or the serial interface.

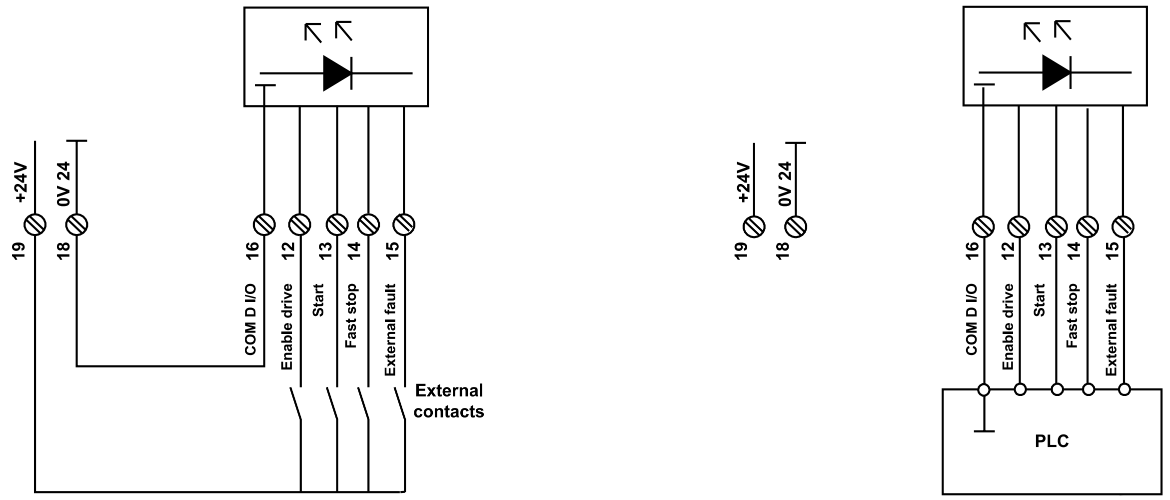


Figure 6.1.1 Enables via potential free contacts and PLC

- Figure 6.1.1 show the connection principle
- The enable signals are activated via a +15 ... 30 V voltage at the appropriate terminals.The inputs are protected against reverse polarity.
- Negative voltage, 0 V and a missing signal are interpreted as disable signals.
- The reference point for the enable signals is terminal 16.
- When using an operator keypad/serial interface (**Mains Command** = Digital), both the signals on the appropriate terminals and the corresponding commands on the keypad/serial interface are necessary. If an enable is removed via a signal on the terminals, the appropriate command must be sent via the keypad/serial interface in addition to the signal on the terminal in order to restart the drive.

There are four types of enable signals that have a different effect on the behavior of the TPD32-EV converter.

- **Enable drive**	enables the entire converter
- **Start**	enables the regulation
- **Fast stop**	sets the speed reference value immediately to zero so that the motor is stopped as quickly as possible
- **External fault**	incorporates external fault condition into the enable.

6.1.1 Enable drive

DRIVE STATUS

START UP

TUNING

MONITOR

[314]	Enable drive

Parameter	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Enable drive Enabled Disabled	314	0	1	Disabled	Disabled	Terminal 12 +15 ... 30 V 0 V

The **Enable drive** command activates the TPD32-EV Drive.

An auxiliary contact on the AC Input contactor may be wired in the Drive enable (terminal 12).

When the **Enable drive**=disable and terminal 12 = 0V, no other control commands (e.g. **Jog +**, **Jog -** or **Start**) are accepted.

Removal of the **Enable drive** command (**Enable drive**=disable) while the drive is running causes the motor coasting to stop. Neither electrical braking nor controlled stopping of the motor within a prescribed time during the run down are possible. The actuation of the Drive is disabled.

When operated via the keypad the **Enable drive** command is provided in the DRIVE STATUS, START UP, TUNING and MONITOR menu.

Using **Enable drive** command from keypad (**mains command**=Digital), active voltage level is also required on terminal 12.

Using **Enable drive** command from terminal 12 set “**Main command**=terminals”.

Enable drive in the menu is read only parameter.

6.1.2 Start / Stop

DRIVE STATUS
START UP
TUNING
MONITOR
[315] Start/Stop

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Start/Stop	315	0	1	Stop (0)	Stop (0)	Terminal 13
Start						+15 ... 30 V
Stop						0 V

When **Main commands** is set to **digital**, **Start/Stop** parameter allows the motor running and the STOP button on the keypad stop the motor.

When **Main commands** is set to **terminals, Start/stop** will be a read only parameter.

Note! The following signals are required for operating the drive in addition to the **Start** command:
Enable drive
Fast stop
External fault

The behavior of the drive after the **Start** command is given or removed depends on the parameter setting at hand:

- When using the ramp (**Enable ramp** = Enabled and **Enable spd reg** = Enabled) the drive accelerates to the required speed according to the ramp specified. If the Start command is removed, the drive runs down to zero according to the ramp defined. If the Start command is selected once more during the deceleration time, the drive accelerates once more to the required speed.

- If the **Speed ref 1** value reaches the input of the speed regulator directly without a ramp (**Enable ramp** = Disabled and **Enable spd reg** = Enabled), the drive accelerates to the required speed in the shortest possible time once the Start command has been given. When the Start command is removed, the **Speed ref 1** value is set to zero immediately.

  The command has not effect on **Speed ref 2**.

- When using torque regulation (**Enable spd reg** = Disabled) the **Start** command enables the torque reference value (**T current ref 1**) or disables it after the **Start** command is removed.

The Start command has no effect on the correction value **Speed ref 2** (with speed regulation) or **Torque ref 2** (with torque regulation).
The **Start** command is not required for Jog function mode.

If the **Start** command and **Jog +** or **Jog -** are given at the same time, the **Start** command is given priority.
If the **Start** command is given during Jog operation, the Jog operation is aborted.
The Start parameter status is shown in the DRIVE STATUS and MONITOR menu.

6.1.3 Fast stop

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Fast/Stop Fast Stop No Fast Stop	316	0	1	No Fast Stop	No Fast Stop	Terminal 14 +15 ... 30 V 0 V

Terminal 14: +15 ... 30V = No Fast stop 0V = Fast stop

Note! **The function <u>cannot be actuated</u> via the keypad!**

Application: **Fast stop** is actuated in emergencies and hazardous situations, in order to stop the drive in the shortest possible time. This method of stopping has the advantage over disconnection in that with a four quadrant drive (TPD32-EV... 4B) energy can be recovered in the AC input and the motor can be brought to a halt in a shorter time than when it coasts down.

The **Fast stop** command is always required for operation of the converter. A removal of the command when the drive is running initiates braking with the ramp specified by the parameters **Qstp delta speed** and **Qstp delta time**.

When the drive is brought to a halt, it is still enabled and has torque. The **Start** command or **Enable drive** command must be removed for it to be disconnected.

The drive behavior after the Fast stop command has been given depends on the type of operating mode selected:

- Operation via the terminal strip (**Main commands** = Terminals):
  The drive executes braking until there is no voltage on terminal 14. When voltage is restored, the drive automatically accelerates to the required reference value (precondition: the other enable commands are still active).

- Operation via serial line with commands given via terminals too (**Main commands** = Digital):
  The drive executes braking until it has come to a halt. When voltage is restored on terminal 14, there is no automatic start. This requires the entry of the Start command.

- If the **Fast stop** command is actuated via the serial interface while there is a voltage present on terminal 14, the fast stop is executed until the drive is at a halt. The **Start** command must be entered for the drive to be restarted.

6.1.4 Quick Stop

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Quick stop Quick stop No Quick stop	343	0	1	No Quick stop	No Quick stop	

Note! This function cannot be executed via the terminal strip or the keypad but can only be actuated via the serial interface or a bus connection!

Application: **Quick stop** is actuated in emergencies or hazardous situations in order to bring the drive to a halt in the shortest possible time. This method of stopping has the advantage over disconnection in that with a tetraquadrant drive (TPD32-EV... 4B) energy can be recovered in the main and the motor can be brought to a halt in a shorter time than when it coastes down.

- If the **Quick stop** command is given when the drive is running, this initiates braking with the ramp specified by the **Qstp delta speed** and **Qstp delta time** parameters.

- When the drive is at a halt, it is disabled and thus has no torque. The **Start** command must be given again for the drive to be started.

6.1.5 External fault

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
External fault External fault No External fault	-	-	-	-	-	Terminal 15 +15 ... 30 V 0 V

The **External fault** command enables an external signal to be incorporated in the failure alarms of the converter.

Application example The converter is being used for closed-loop control of a single drive without contactors. A temperature-dependent contact, which opens under excessive temperature, is located within the motor. Connect this contact between 24 V and terminal 15.
When the contact opens (= overtemperature) the converter will be disabled.

- During operation a signal is always required on terminal 15, irrespective of whether the commands are transmitted via the terminal strip or not.

- In the event of an external fault, the drive will behave according to the configuration set in the “Programmable Alarms, 6.11.7.”.

6.2 BASIC START UP MENUS

The following DRIVE STATUS, START UP and TUNING allow a basic commissioning of the drive.

NOTE ! The parameters in these menus are available in other menus.
See Start up procedure on chapter 5.3 for commissioning information.

DRIVE STATUS

Menu displayed at power up.
Status parameters of the drive are available and **Ramp ref 1** parameter for basic speed reference with ramp time.

START UP

In this menu the start up sequencing is available.

First basic setting

Speed base value	**Speed base value** is defined by the unit in the factor function specified. It is the reference value for all the speed reference values (reference values, adaptive speed regulation) given as a percentage, and corresponds to 100% of the speed. Changing this parameter is only possible when the drive is disabled (**Enable drive**=Disable). The speed base value does not define the maximum possible speed, which in some cases can be formed from the addition of several reference values. This is defined with Speed max amount.
Nom flux curr	Drive field current value.
Speed-0 f weak	Enables the field economy at zero speed.
Acc / Dec ...	Acceleration and deceleration ramp time setting on the speed reference.(see chapter 6.6.1 for more details).

Motor data

Motor plate data:

Motor nom flux	Motor field current in Amps.
Flux reg mode	Field regulator mode.
Full load curr	Nominal motor current in Amps.
Motor max speed	Maximum motor speed value
Max out voltage	Maximum armature voltage value
Flux weak speed	**Motor max speed** percentage where the flux weakening range starts. (Crossover point)

Limits

Speed limits and current limits drive setting:

T current lim	Current limit setting (see chapter 6.5.2 for more details).
Flux current max	Maximum field current value as percentage of **Motor fld curr**.
Flux current min	Minimum field current value as percentage of **Motor fld curr**. (See chapter 6.5.3 for more details).
Speed min amount	Minimum speed reference limit. (see chapter 6.5.1 for more details).
Speed max amount	Maximum speed reference limit. (see chapter 6.5.1 for more details).

Speed feedback

Speed feedback setting (see chapter 6.11.5 for more details) :

Speed fbk sel	Speed feedback selection
Tacho scale	Tach generator feedback scaling (**Speed fbk sel** must be set to **Tacho**).
Speed offset	Speed feedback offset
Encoder 2 pulses	Number of pulses per revolution of the digital encoder to the XE2 connector.
Enable fbk contr	Speed feedback loss control. The **Motor max speed**, **Max out voltage**, **Flux weak speed** parameters must be set correctly according to the motor used.
Refresh enc 2	Enable the monitoring of the encoder 2 (XE2 connector) connection status (A , B, Anot, Bnot channels). **Enable fbk contr** must be enabled.
Volt Enc 1	Output voltage setting on encoder 1.
Volt Enc 2	Output voltage setting on encoder 2.

Alarms

Overvoltage and Overcurrent threshold setting (see chapter 6.11.7 for more details) :

Warning Cfg	Configuration of the TPD32-EV drive behaviour during multi “Warning” situation and start with warning active attivi (see chapter 5.3.4).
Undervolt thr	AC input alarm threshold value
Overcurrent thr	Overcurrrent alarm threshold value.

Overload control

Current overload setting (see chapter 6.14.6 for more details) :

Enable overload	Current overload control enabling.
Overload mode	Overload current mode selection (Curr limited, Curr not limited, I2t Motor, I2t Drive, I2t motor & I2t drive).
Overload current	Drive output current permissible during the overload time.
Base current	Drive output current permissible during the pause time.
Overload time	Maximum time in which the **Overload current** is permissible.
Pause time	Minimum time between overload cycles.

Analog inputs

For programmable analog inputs see chapter 6.12.2 for more details.

Self tuning of current regulator

See chapter 5.3.5.1.

R&L Search	Command for current regulator self tuning execution

- Enable the drive (**Enable Drive** parameter= Enabled)
- Start the drive **(Start/Stop** parameter = Start).

Self tuning of speed regulator

(see chapter 5.3.5.2 for more details):

Fwd-Rev spd tune	Direction of motor shaft rotation for the speed self tune test (Forward or Reverse; Forward is clock-wise as seen from shaft drive end).
Test T curr lim	Torque current limit applied during Speed self tune test.
Start	Speed regulator self tuning start command.
Inertia	Total Inertia value at the motor shaft in Kg*m^2 **(1 Kg*m^2 = 23.76 lb*ft^2).**
Inertia Nw	New total Inertia value at the motor shaft in Kg*m^2 identified during the speed self tune procedure. **(1 Kg*m^2 = 23.76 lb*ft^2)**
Friction	Friction value (or Loss compensation) in N*m **(1 N*m = 0.738 lb*ft).**
Friction Nw	New Friction value (or Loss compensation) in N*m identified during the speed self tune procedure. **(1 N*m = 0.738 lb*ft)**
Speed P	Proportional coefficient of the speed regulator in percentage
Speed P Nw	New value of Proportional coefficient of the speed regulator in percentage computed during the speed self tune procedure.
Speed I	Integral coefficient of the speed regulator in percentage
Speed I Nw	New value of Integral coefficient of the speed regulator in percentage computed during the speed self tune procedure.
Take val	Acquire the parameters after the self tune procedure (overwrite current values).

Note ! This is not a permanent save. Go to “Save parameters” command to save the data in memory.

Final operation

(See chapter 6.11.1 for more parameters detail).

Main commands	This command specifies from where the **Enable drive** and **Start** command has to be actuated.
Control mode	Defines whether the digital channel is the keypad/RS485 or Fieldbus card.
Save parameters	Saving of user parameters value setting

TUNING

This menu allows a fine manual tuning of the drive regulators.

Current self tuning

Current regulator self tuning procedure via **R&L Search** (as indicate in START UP menu).

Speed self tune

Speed regulator self tune procedure (as indicate in START UP\ Speed self tune menu).

Manual tuning of speed regulator, field regulator and voltage regulator

Manual tuning of the drive regulators (see chaper 5.3.6 for other details):

Speed P	Proportional coefficient of the speed regulator in percentage
Speed I	Integral coefficient of the speed regulator in percentage.
Prop filter	Time constant filter to the proportional coefficient of the speed regulator
Flux P	Proportional coefficient of the field regulator in percentage.
Flux I	Integral coefficient of the field regulator in percentage
Voltage P	Proportional coefficient of the voltage regulator in percentage.
Voltage I	Integral coefficient of the voltage regulator in percentage
Save parameters	Saving of user parameters value setting

6.3 MONITOR

MONITOR

[314]	Enable drive
[315]	Start/Stop

Measurements

Speed

Speed in DRC

[109]	Ramp ref (d) [FF]
[112]	Ramp output (d) [FF]
[115]	Speed ref (d) [FF]
[119]	Actual spd (d) [FF]
[925]	F act spd (d) [FF]
[923]	Act spd filter [s]

Speed in rpm

[110]	Ramp ref (rpm)
[113]	Ramp outp (rpm)
[118]	Speed ref (rpm)
[122]	Actual spd (rpm)
[427]	Enc 1 speed (rpm)
[420]	Enc 2 speed (rpm)
[924]	F act spd (rpm)
[923]	Act spd filter [s]

Speed in %

[111]	Ramp ref (%)
[114]	Ramp output (%)
[117]	Speed ref (%)
[121]	Actual spd (%)

[466]	Mains voltage [V]
[588]	Mains frequency [Hz]
[1052]	Output power [Kw]
[233]	Output voltage [V]
[199]	Motor current [%]
[928]	F T curr (%)
[926]	T curr filter [s]
[41]	T current ref [%]
[500]	Flux reference [%]
[234]	Flux current %
[351]	Flux current (A)

I/O

	Digital I/Q
[582]	Virtual dig inp
[583]	Virtual dig out

The MONITOR menu shows all current references, actual reference values for torque and speed, and the situation of the digital inputs/outputs. The values related to the speed are given in rpm (revolutions per minute), as a percentage (related to the **Speed base value**) and in the dimension specified by the factor function.

Parameter description	No.	Value min	Value max	Value Factory American	Value Factory Standard	Standard Configuration
Enable drive Enabled (1) Disabled (0)	314	0	1	Disabled	Disabled	Terminal 12 +15 ... 30 V 0 V
Start/Stop Start (1) Stop (0)	315	0	1	Stop (0)	Stop (0)	Terminal 13 +15 ... 30 V 0 V
Ramp ref (d) [FF]	109	-32768	+32767	-	-	-
Ramp ref (rpm)	110	-32768	+32767	-	-	*
Ramp ref (%)	111	-200.0	+200.0	-	-	-
Ramp output (d) [FF]	112	-32768	+32767	-	-	-
Ramp outp (rpm)	113	-32768	+32767	-	-	*
Ramp output (%)	114	-200.0	+200.0	-	-	-
Speed ref (d) [FF]	115	-32768	+32767	-	-	-
Speed ref (rpm)	118	-32768	+32767	-	-	*
Speed ref (%)	117	-200.0	+200.0	-	-	-
Actual spd (d) [FF]	119	-32768	+32767	-	-	-
Actual spd (rpm)	122	-8192	+8192	-	-	An Output 1 *
Actual spd (%)	121	-200.0	+200.0	-	-	-
F act spd (rpm)	924	-32768	+32767	-	-	*
Act spd filter [s]	923	0.001	1.000	0.100	0.100	-
Enc 1 speed (rpm)	427	-8192	+8192	-	-	-
Enc 2 speed (rpm)	420	-8192	+8192	-	-	-
Mains voltage [V]	466	0	999	-	-	*
Mains frequency [Hz]	588	0.0	70.0	-	-	-
Output power [Kw]	1052	0.01	9999.99	-	-	-
Output voltage [V]	233	0	999	-	-	*
Motor current [%]	199	-250	250	-	-	*
F T curr (%)	928	-500	+500	-	-	*
T curr filter [s]	926	0.001	0.250	0.100	0.100	-
T current ref [%]	41	-200	+200	-	-	*
Flux reference [%]	500	0.0	100.0	-	-	*
Flux current [%]	234	0.0	100.0	-	-	*
Flux current (A)	351	0.1	99.9	S	S	-
Digital I/Q				-	-	-
Dig input term 1	565	0	1	-	-	-
Dig input term 2	566	0	1	-	-	-
Dig input term 3	567	0	1	-	-	-
Dig input term 4	568	0	1	-	-	-
Dig input term 5	569	0	1	-	-	-
Dig input term 6	570	0	1	-	-	-
Dig input term 7	571	0	1	-	-	-
Dig input term 8	572	0	1	-	-	-
Dig input term 9	573	0	1	-	-	-
Dig input term 10	574	0	1	-	-	-
Dig input term 11	575	0	1	-	-	-
Dig input term 12	576	0	1	-	-	-
Dig input term 15	579	0	1	-	-	-
Dig input term 16	580	0	1	-	-	-
Dig output term	581	0	65535	-	-	-
Virtual dig inp	582	0	65535	-	-	-
Virtual dig out	583	0	65535	-	-	-

* This function can be assigned to a programmable analog output.

Enable drive — When the converter is controlled via the keypad, it is activated via the **Enable drive** parameter. A voltage is also required on terminal 12. The **Start** command is required for starting the drive.

Enabled	Enable drive
Disable	Drive disabled

Start/Stop — Using the keypad as Start/Stop control, if E key is pushed, the motor run at the speed set.

Ramp red (d) — Total reference value for the ramp in units specified by the factor function.

Ramp ref (rpm) — Total reference value for the ramp in rpm.

Ramp ref (%) — Total reference value for the ramp as a percentage of the **Speed base value.**

Ramp output (d) — Ramp output in units specified by the factor function.

Ramp outp (rpm) — Ramp output in rpm.

Ramp output (%) — Ramp output as a percentage of the **Speed base value.**

Speed ref (d) — Total speed reference value in units specified by the factor function.

Speed ref (rpm) — Total speed reference value in rpm.

Speed ref (%) — Total speed reference value as a percentage of the **Speed base value.**

Actual spd (d) — Actual speed in units specified by the factor function.

Actual spd (rpm) — Actual speed in rpm (revolutions per minute).

Actual spd (%) — Actual speed as a percentage of the **Speed base value.**

F act spd (d) — Filtered value of **Actual speed** in units specified by the factor function.

F act spd (rpm) — Filtered value of **Actual speed** in rpm.

Act spd filter — 1st order low pass filter time constant on **Actual speed**.

Enc 1 speed (rpm) — Actual speed measured by the encoder 1. The parameter is accessible only when switch S5 is in position A.

If a digital encoder is used as encoder 1, it must be interfaced to the converter by means of card DEII.

Enc. 2 speed (rpm) — Actual speed measured by the encoder 2.

Mains voltage — Mains voltage in V.

Mains frequency — AC input frequency in Hz.

Output power — Output power value in Kw.

Output voltage — Armature Voltage U_{dA} in V_{AV}

Motor current — Armature current in % of **Full load curr**.

F T curr (%) — Filtered value of **Torque current** in percentage.

T curr filter — 1st order low pass filter time constant on **Torque current**.

T current ref — Total current reference value as a percentage of the **Full load current.**

Flux reference — Field current (reference) as a percentage of **Motor nom flux**.

Flux curr (%) — Actual field current value as percentage of **Motor nom flux**.

Flux curr (A) — Actual field current value in amps.

Digital I/O — Status of the digital input and output of the base converter and the card TBO.

Display: I 1 2 3 4 5 6 7 8 E S F
Q 1 2 3 4 5 6 7 8

An I/O is displayed only if a voltage is present on the corresponding terminal. E.g., if the inputs 4 and 6 are displayed, that means that the digital inputs 4 and 6 on the TBO card are to High level.

E= Enable drive (terminal 12)

S= Start (terminal 13)

F= Fast stop (terminal 14)

When a serial line or a Bus is used, the status of the digital I/O can be read by means of the **Dig input term** and **Dig output term** parameters.

Dig input term Status of the digital inputs on the device and TBO option card to be read by serial line or field bus. The information is contained in a word, where each bit is 1 if voltage is present on the corresponding input terminal.

Bit n.	output	Bit n.	Input
0	TBO “A”, Term. 31 (Digital input 1)	8	TPD32-EV, Term. 12 (Enable drive)
1	TBO “A”, Term. 32 (Digital input 2)	9	TPD32-EV, Term. 13 (Start)
2	TBO “A”, Term. 33 (Digital input 3)	10	TPD32-EV, Term. 14 (Fast stop)
3	TBO “A”, Term. 34 (Digital input 4)		
4	TBO “B”, Term. 11 (Digital input 5)		
5	TBO “B”, Term. 12 (Digital input 6)		
6	TBO “B”, Term. 13 (Digital input 7)		
7	TBO “B”, Term. 14 (Digital input 8)		

Dig input term 1* Status of the digital input 1 (terminal 21, integrated TBO “A”)
Dig input term 2* Status of the digital input 2 (terminal 22, integrated TBO “A”)
Dig input term 3* Status of the digital input 3 (terminal 23, integrated TBO “A”)
Dig input term 4* Status of the digital input 4 (terminal 24, integrated TBO “A”)
Dig input term 5* Status of the digital input 5 (terminal 11, option TBO, TBO “B”)
Dig input term 6* Status of the digital input 6 (terminal 12, option TBO, TBO “B”)
Dig input term 7* Status of the digital input 7 (terminal 13, option TBO, TBO “B”)
Dig input term 8* Status of the digital input 8 (terminal 14, option TBO, TBO “B”)
Dig input term 9* Status of the digital input on terminal 12 (Enable drive)
Dig input term 10* Status of the digital input on terminal 13 (Start)
Dig input term 11* Status of the digital input on terminal 14 (Fast stop)
Dig input term 12* Not used
Dig input term 13* Not used
Dig input term 14* Not used
Dig input term 15* Not used
Dig input term 16* Not used
Dig output term Status of the digital outputs on the device and TBO option card to be read by serial line or field bus. The information is contained in a word, where each bit is 1 if voltage is present on the corresponding terminal.

Bit n.	output	Bit n.	Input
0	TBO “A”, Term. 26 (Digital output 1)	4	TBO “B”, Term. 6 (Digital output 5)
1	TBO “A”, Term. 27 (Digital output 2)	5	TBO “B”, Term. 7 (Digital output 6)
2	TBO “A”, Term. 28 (Digital output 3)	6	TBO “B”, Term. 8 (Digital output 7)
3	TBO “A”, Term. 29 (Digital output 4)	7	TBO “B”, Term. 9 (Digital output 8)

Virtual dig inp Status of the virtual digital inputs**
Virtual dig out Status of the virtual digital outputs**

* Available only via RS485 interface line or via a Field Bus.
** The virtual inputs and outputs are used only in connection with a bus interface, in order to allow a faster communication. For further details see the interface bus documentation.

6.4 INPUT VARIABLES

The converters of the TPD32-EV series enable reference values for the ramp and regulator to be specified in different dimensions:

- as a percentage of the **Speed base value**
- in a dimension that the user can define himself with the factor-function, i.eg. as a speed m/s. The default factory setting is rpm.

The value processes inside the device is the same irrespective of how it was defined. This means that the other reference is overwritten with the new value.

Example:

A motor has a maximum speed of 1500 rpm. This corresponds to 100% and at the same time the user-defined value of 10,000 bottles per hour (see 6.11.7).

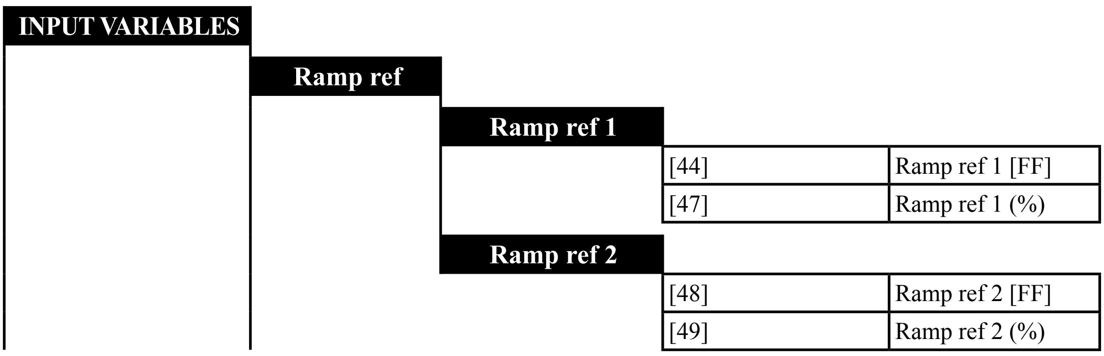
Changing the reference value to 50% will automatically result in a change of the other value to 5,000 bottles per hour.

The table below shows the relationship of reference values. In the event of a change, the other parameters are overwritten automatically.

Parameters with same value	N.	Dimensions
Ramp ref 1	44	according to the Factor function %
Ramp ref 1 (%)	47	
Speed input var*	44	
Speed input perc*	46	
Ramp ref 2	48	according to the Factor function %
Ramp ref 2 (%)	49	
Speed ref 1	42	according to the Factor function %
Speed ref 1 (%)	337	
Speed ref var*	115	
Percent ref var*	116	
Speed ref 2	43	according to the Factor function %
Speed ref 2 (%)	338	

* Defined in the DRIVECOM menu

6.4.1 Ramp ref



The ramp reference value specifies the speed the drive should reach once the acceleration phase has been completed. Modifications to the ramp reference value are therefore transferred to the ramp accordingly. The height of the ramp reference value determines the motor speed. As for the four quadrant drives (TPD32-EV...4B...) the rotation direction is determined by the reference polarity.

NOTE! Two quadrant TPD32-EV...2B... drives accept only positive references. Negative values are not considered!

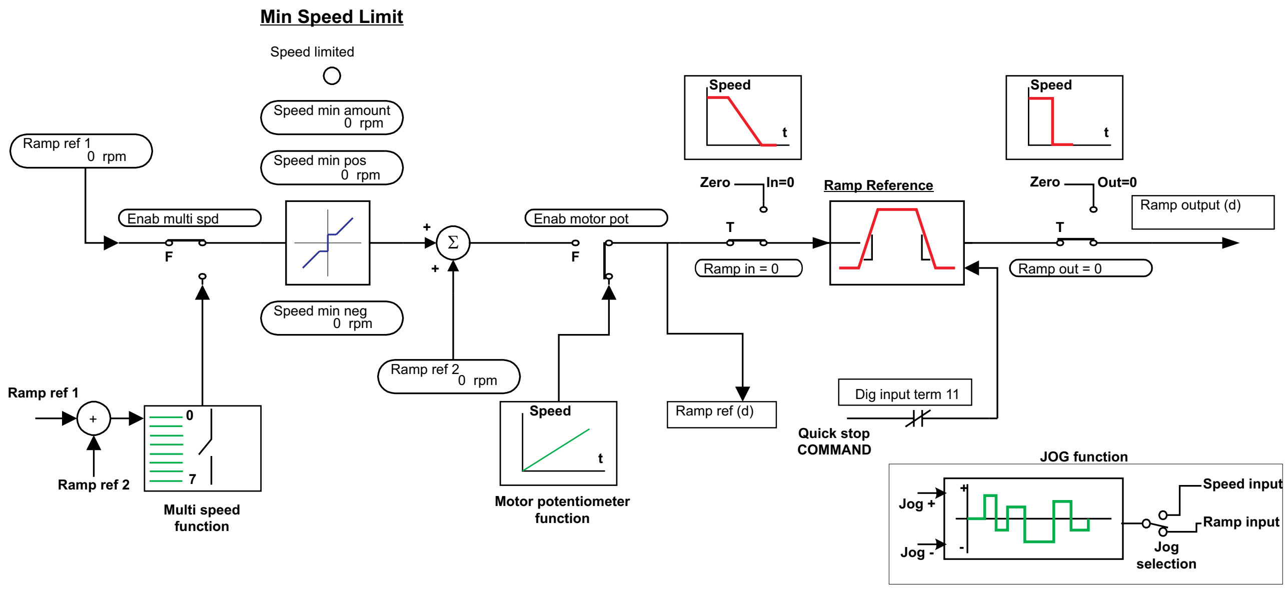


Figure 6.4.1.1: Ramp references

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Ramp ref 1 [FF] **Ramp ref 1 (%)**	44 47	-2 P45 -200.0	+2 P45 +200.0	0 0.0	0 0.0	An. Input 1 (Terminals 1 + 2)*
Ramp ref 2 [FF] **Ramp ref 2 (%)**	48 49	-2 P45 -200.0	+2 P45 +200.0	0 0.0	0 0.0	*
Ramp ref (rpm) **Ramp ref (d) [FF]** **Ramp ref (%)**	110 109 111	-32768 -32768 -32768	+32767 +32767 -200.0	- - +200.0	- - -	**

* This function can be assigned to one of the programmable analog inputs. The converter is already fatory set for a configuration using the terminals stated. The setting can also be modified to suit the application at hand.

** This parameter can be assigned to a programmable analog output.

Ramp ref 1	1st reference value for the ramp. The value to be entered depends on the factor function.
Ramp ref 1 (%)	1st reference value as a percentage of the **Speed base value**
Ramp ref 2	2nd reference value for the ramp. The value to be entered depends on the factor function.
Ramp ref 2 (%)	2nd reference value as a percentage of the **Speed base value**
Ramp ref (rpm)	Total reference value for the ramp in rpm (revolutions per minute)
Ramp ref (d)	Total reference value for the ramp in the dimension specified by the factor function.
Ramp ref (%)	Total reference value of the ramp as a percentage of the **Speed base value**

The total Ramp reference value **Ramp ref** consists of the signed addition of **Ramp ref 1** and **Ramp ref 2** (see Figure 6.4.1.1).

NOTE: Speed base value cannot exceed 8192 rpm.

Example 1: **Ramp ref 1** = + 50 % **Ramp ref 2** = + 30 %
Ramp ref = 50 % + 30 % = 80 %

Example 2: **Ramp ref 1** = + 40 % **Ramp ref 2** = - 60 %
Ramp ref = 40 % - 60 %= - 20 %

0 ... 10 V, 0 ... 20 mA and 4 ... 20 mA signals can be used when setting the reference value via terminals.

The **Ramp ref (rpm)**, **Ramp ref (d)** and **Ramp ref (%)** are influenced by the minimum speed limits. These are directly applied on the **Ramp ref 1**, as well as the Motor potentiometer and Multispeed references.

6.4.2 Speed ref

INPUT VARIABLES

- **Speed ref**
  - **Speed ref 1**

[42]	Speed ref 1 [FF]
[378]	Speed ref 1 (%)

  - **Speed ref 2**

[43]	Speed ref 2 [FF]
[379]	Speed Ref 2 (%)

The speed reference value specifies the required speed of the drive. The drive responds to the reference value progression directly, except in cases where the torque available is insufficient for this purpose. In this case, the drive operates at current limit until the selected speed has been reached. The speed reference value determines the speed of the motor, while the polarity determines the direction of rotation.

NOTE! Two quadrant TPD32-EV...2B drives accept only positive references. Negative values are not considered!

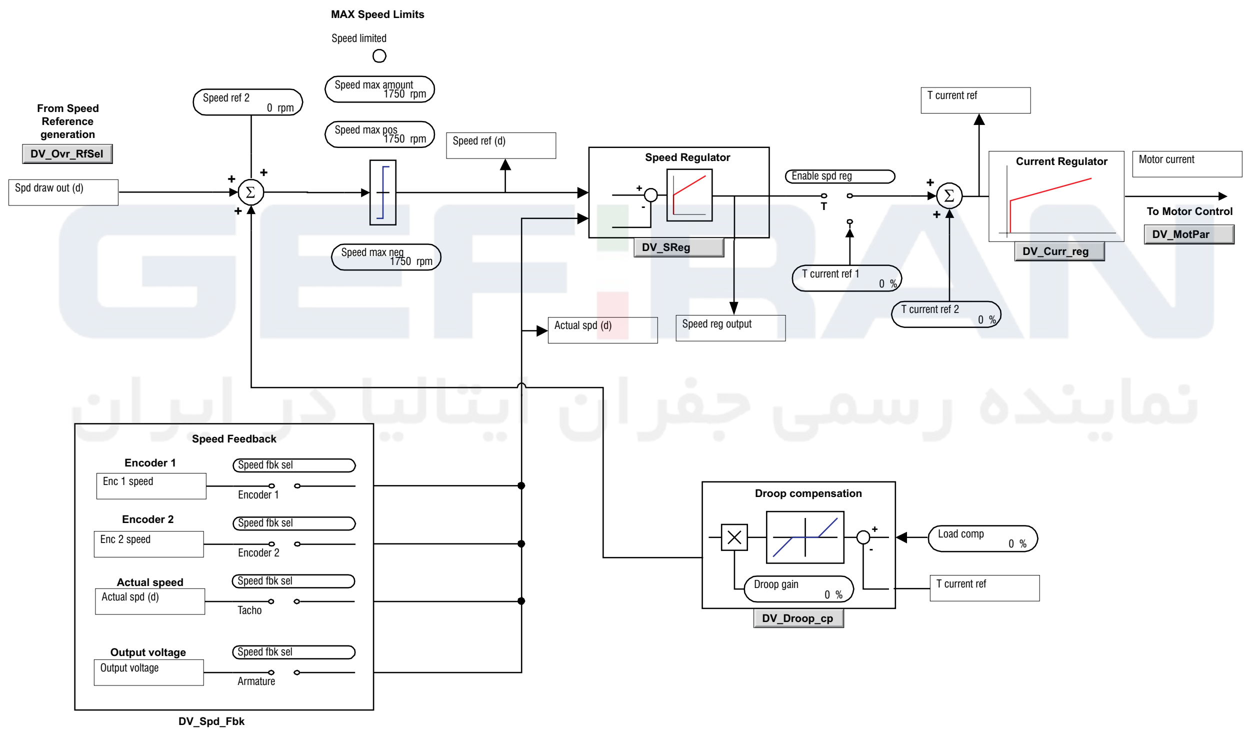


Figure 6.4.2.1: Speed reference

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Speed ref 1 [FF]	42	-2 P45	+2 P45	0	0	Ramp output *
Speed ref 1 (%)	378	-200.0	+200.0	0.0	0.0	
Speed ref 2 [FF]	43	-2 P45	+2 P45	0	0	*
Speed Ref 2 (%)	379	-200.0	+200.0	0.0	0.0	
Speed ref (rpm)	118	-32768	+32767	-	-	**
Speed ref (d) [FF]	115	-32768	+32767	-	-	
Speed ref (%)	117	-32768	-200.0	+200.0	-	

* This function can be assigned to one of the programmable analog inputs.
** This parameter can be assigned to a programmable analog output.

Speed ref 1	1st reference value for the speed. The value to be entered depends on the factor function.
Speed ref 1 (%)	1st speed reference value as a percentage of the **Speed base value**
Speed ref 2	2nd reference value for the speed. The value to be entered depends on the factor function.
Speed ref 2 (%)	2nd speed reference value as a percentage of the **Speed base value**
Speed ref (rpm)	Total speed reference value in rpm.
Speed ref (d)	Total speed reference value in the dimension specified by the factor function.
Speed ref (%)	Total speed reference value as a percentage of the **Speed base value**.

The total speed reference value consists of the signed addition of **Speed ref 1** and **Speed ref 2**.

NOTE: Speed base value cannot exceed 8192 rpm.

Example 1: **Speed ref 1** = + 50 % **Speed ref 2** = + 30 %
Speed ref = 50 % + 30 % = 80 %

Example 2: **Speed ref 1** = + 40 % **Speed ref 2** = - 60 %
Speed ref = 40 % - 60 % = - 20 %

0 ... 10 V, 0 ... 20 mA and 4 ... 20 mA signals can be used when setting the reference value via terminals. The speed reference value has an upper and a lower limit.

If the ramp is selected, **(Enable ramp** parameter= Enabled), the reference value input **Speed ref 1** is automatically linked with the ramp output.

6.4.3 Torque current reference (T current ref)

INPUT VARIABLES

T current ref

[39]	T current ref 1 [%]
[40]	T current ref 2 [%]

The current reference value is proportional to the armature current of the motor and determines the torque, the polarity determines the torque direction. For most applications **T current Ref** comes from the speed regulator output. **T current ref 2** can also be used as a correction value.

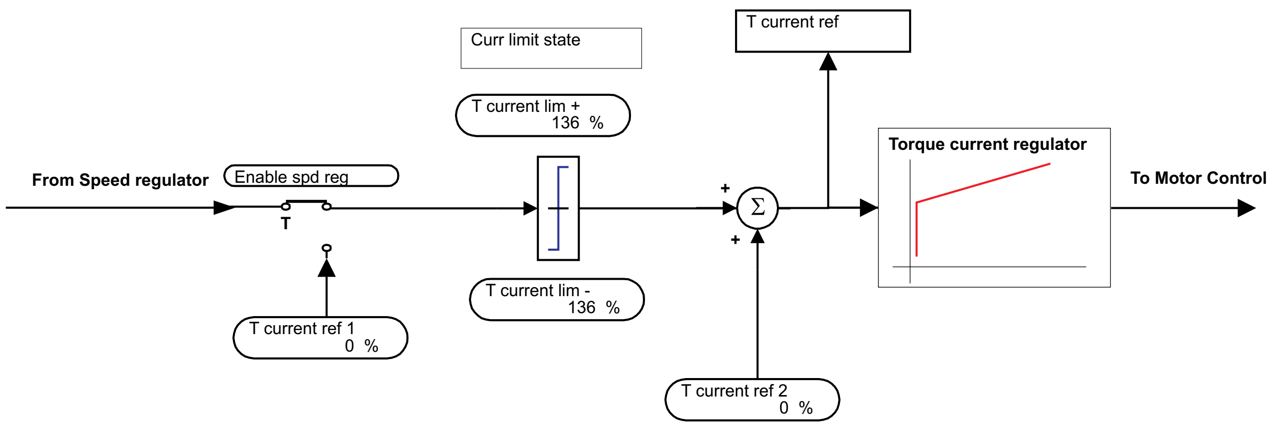


Figure 6.4.3.1: Torque current reference

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
T current ref 1 [%]	39	-200	+200 see 6.4.3	0	0	Speed regulator output *
T current ref 2 [%]	40	-200	+200	0.00	0.00	*
T current ref [%]	41	-200	+200	-	-	**

* This function can be assigned to one of the freely programmable analog inputs.
** This parameter can be assigned to a freely programmable analog output.

T current ref 1 1st current reference value as a percentage of the **Full load curr**. The maximum value possible depends on the **Enable overload** parameter.

Enable overload	disabled	**T current ref 1**	100% max
Enable overload	enabled	**T current ref 1**	200% max

The value of T current ref 1 can always be set via parameter, bus or analog input regardless of the type of speed/torque control that is enabled.

T current ref 2 2nd current reference value as a percentage of the **Full load curr**. The maximum value possible depends on the **Enable overload** parameter.

Enable overload	disabled	**T current ref 2**	100% max
Enable overload	enabled	**T current ref 2**	200% max

T current Ref Total current reference value as a percentage of the **Full load curr** value.

The total current reference value consists of the signed addition of **T current ref 1** and **T current Ref 2**.

Example 1: **T current ref 1** = +50% **T current ref 2**-= +30%
T current ref = 50% + 30% = 80%

Example 2: **T current ref 1** = +40% **T current ref 2** = -60%
T current ref = 40-60% = -20%

0 ... 10 V, 0 ... 20 mA and 4 ... 20 mA signals can be used when setting the reference value via terminals.
Reference set using input current, usually are with sign positive and they are used with biquadrant drives.

The current reference value has an upper limit.

6.5 LIMITS

6.5.1 Speed Limits

LIMITS

Speed limits

Speed amount

[1]	Speed min amount [FF]
[2]	Speed max amount [FF]

Speed min/max

[5]	Speed min pos [FF]
[3]	Speed max pos [FF]
[6]	Speed min neg [FF]
[4]	Speed max neg [FF]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Speed min amount [FF]	1	0	2^{32-1}	0	0	-
Speed max amount [FF]	2	0	2^{32-1}	5000	5000	-
Speed min pos [FF]	5	0	2^{32-1}	0	0	-
Speed max pos [FF]	3	0	2^{32-1}	5000	5000	-
Speed min neg [FF]	6	0	2^{32-1}	0	0	-
Speed max neg [FF]	4	0	2^{32-1}	5000	5000	-
Speed limited Speed not limited (0) Speed limited (1)	372	0	1			*

* This function can be assigned to a programmable digital output.

Speed min amount It defines the minimum speed for both directions TPD32-EV...4B. A value below minimum is not accepted, regardless of the reference value selected. This parameter effects the ramp input. If the **Speed min amount** parameter is changed, the Parameter **Speed min pos** and **Speed min neg** parameters are set to the same value. If any of these parameters are subsequently changed, the last change is valid. The value to be entered is based on the factor function.

Speed max amount It defines the maximum speed for both directions TPD32-EV...4B... This parameter affects the speed regulator input and therefore takes into account both the reference values that come from the ramp as well as the direction of rotation (see Figure 6.4.2.1). If the **Speed max amount** parameter is changed, the **Speed max pos** and **Speed max neg** parameters are set to the same value. If any of these values is subsequently changed, the last change is valid. The value to be entered is based on the factor function.

Speed min pos It defines the minimum speed for the clockwise rotation of the motor. A value below minimum is not accepted, regardless of the reference value selected. This function effects the ramp input (see Figure 6.4.1.1). The value of the parameter to be entered is based on the factor function.

Speed max pos It defines the maximum speed for the clockwise rotation of the motor. This function affects the input of the speed regulator and therefore takes into account both the reference values that come from the ramp as well as the direction of rotation (see Figure 6.4.1.1). The value of the parameter entered is based on the factor function.

Speed min neg It defines the minimum speed for the counterclockwise rotation of the motor TPD32-EV...4B... A value below minimum is not accepted, regardless of the reference value selected. This parameter effects the ramp input (see Figure 6.4.1.1). The value of the parameter entered is based on the factor function.

Speed max neg It defines the maximum speed for the counterclockwise rotation of the motor TPD32-EV...4B... This parameter effects the input of the speed regulator and therefore takes into account both the reference values that come from the ramp as well as the direction of rotation (see Figure 6.4.1.1).The value of the parameter entered is based on the factor function.

Speed limited Message that indicates that the reference value, is currently limited by the entered minimum and maximum limit values.

High	Reference value currently limited since the value entered is out of range of the limit values defined.
Low	Reference value within the defined limit values.

Note! The **Speed min amount**, **Speed min pos** and **Speed min neg** parameters have an effect on the **Ramp ref 1** reference value, the motor potentiometer function and the multi-speed function. They do not, however, have an effect on the **Ramp ref 2** parameter!

6.5.2 Armature current limits (Current limits)

LIMITS

Current limits

[715]	T current lim type
[7]	T current lim [%]
[8]	T current lim + [%]
[9]	T current lim - [%]
[10]	In use Tcur lim+ [%]
[11]	In use Tcur lim- [%]
[13]	Current lim red [%]
[342]	Torque reduct

The current effects the input of the current regulator and only take into account the armature current.

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
T current lim type T lim +/- (0) T lim mot gen (1)	715	0	1	0	0	-
T current lim [%]	7	0	200	150	150	**
T current lim + [%]	8	0	200	150	150	**
T current lim - [%]	9	0	200	150	150	**
Curr limit state Curr. limit not reached (0) Curr. limit reached (1)	349	0	1			Digital output 5 ***
In use Tcur lim+ [%]	10	0	200			-
In use Tcur lim- [%]	11	0	200			-
Current lim red [%]	13	0	200	100	100	-
Torque reduct Not active (0) Active (1)	342	0	1	Not active (0)	Not active (0)	*

* This function can be assigned to one of the programmable digital inputs.
** This parameter can be assigned to a programmable analog input.
*** This function can be assigned to one of the programmable digital outputs.

T curr lim type This parameters determines the behaviour of the drive in current limit condition.

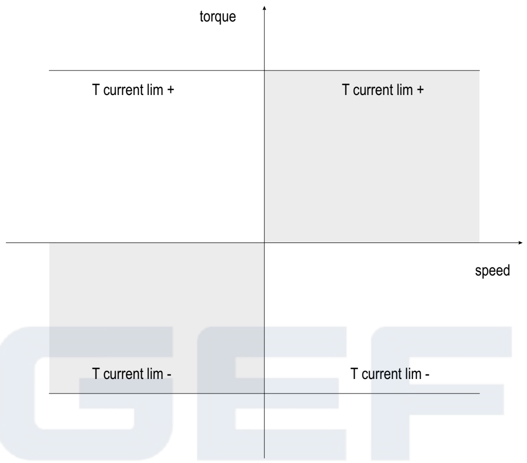
T lim +/- The active positive torque limit is T current lim and the active negative torque limit is T current lim -.

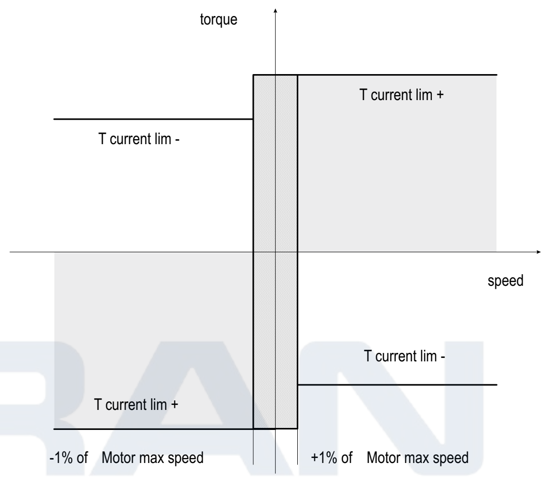
T lim mot/gen With this selection 3 conditions are possible:

1 - If the motor speed > +1% of **Motor max speed** the active positive torque limit is **T current lim+** and the active negative torque limit is T current lim-.

2 - If the motor speed < -1% of **Motor max speed** the active positive torque limit is **T current lim-** and the active negative torque limit is T current lim+.

3 - If -1% of **Motor max speed** < motor speed < +1% of **Motor max speed** the active positive torque limit is **T current lim+** and the active negative torque limit is T current lim+.





T current lim Symmetrical current limit for both current directions for TPD32-EV...4B converters. Defined as a percentage of the **Full load curr** parameter. The maximum value depends on the **Enable overload** parameter.

Enable overload	Disabled	**T current limit**	100 % max
Enable overload	Enabled	**T current limit**	200% max

If the T current limit parameter is changed, the Parameter **T current lim +** and **T current lim -** parameters are set to the same value. If both these parameters are subsequently changed, the last change is valid.

T current lim + Setting of the drive current limit for the positive current direction (clockwise drive and counter-clockwise brake). Entered as a percentage of the **Full load curr** value. The maximum value depends on the value of the **Enable overload** parameter.

Enable overload	Disabled	**T current lim+**	100 % max
Enable overload	Enabled	**T current lim+**	200% max

T current lim - Setting of the drive current limit for the negative current direction (counterclockwise drive and clockwise brake). Entered as a percentage of the **Full load curr** parameter. The maximum value depends on the value of the **Enable overload** parameter. This parameter is not active for the TPD32-EV...4B converters.

Enable overload	Disabled	**T current lim-**	100 % max
Enable overload	Enabled	**T current lim-**	200% max

Curr limit state Status message, indicating whether the drive is working with the set current limit or not.

High Drive working at the current limit. "I_{Limit}" LED lights up.

Low Drive not working at the current limit.

In use Tcur lim + Status message, indicating the used value of the current limit for the positive torque direction as a percentage of **Full load curr**.

In use Tcur lim - Status message, indicating the used value of the current limit for the negative torque direction as a percentage of **Full load curr**.

Current lim red Setting of the armature current limit, as % of Full load curr, when the Torque reduct function is active.

Torque reduct Selection for torque reduction. This function can be assigned to a freely programmable digital input. When the torque reduction function is active, the current limit changes accordingly by the percentage defined with the **Current lim red** parameter.

High Torque reduction not active

Low Torque reduction active

Example of the function of the **Current lim red** and **Torque reduct** parameters.

T current limit (or **T current lim +/-**) = 80 %

Current lim red = 70 %

Torque reduct = High (not active) Current limit = 80 %

Torque reduct = Low (active) Current limit = 70 %

The value for **T current limit** can be set in the START UP\Limits menu.

6.5.3 Flux limits

LIMITS

Flux limits

[467]	Flux current max [%]
[468]	Flux current min [%]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Flux current max [%]	467	P468	100	100	100	*/**
Flux current min [%]	468	0	P467	5	5	-

* This parameter can be set on a programmable analogic outputs.
** This parameter can be set on a programmable analogic input.

The limits regarding the field current are set in this submenu.

Flux current max Percentage of maximum field current according to the **Motor nom flux** parameter.

The max. value (100%) corresponds to the circulation in the field circuit of the motor, of a current equal to the value set in **Motor nom flux**.

If any curve has been set via **I field cnst** parameter, the variation of this parameter influences the field current in a linear way .

(see Flux /if curve section 5.4.5)

Flux current min Percentage of minimum field current according to the **Motor nom flux** parameter .

Its value states the circulation in the field circuit of the motor, of a minimum current compared to the value set in **Motor nom flux**.

The value set here affect the threshold of the “Field loss” alarm indication . The threshold is the half of **Flux current min**.

6.6 RAMP

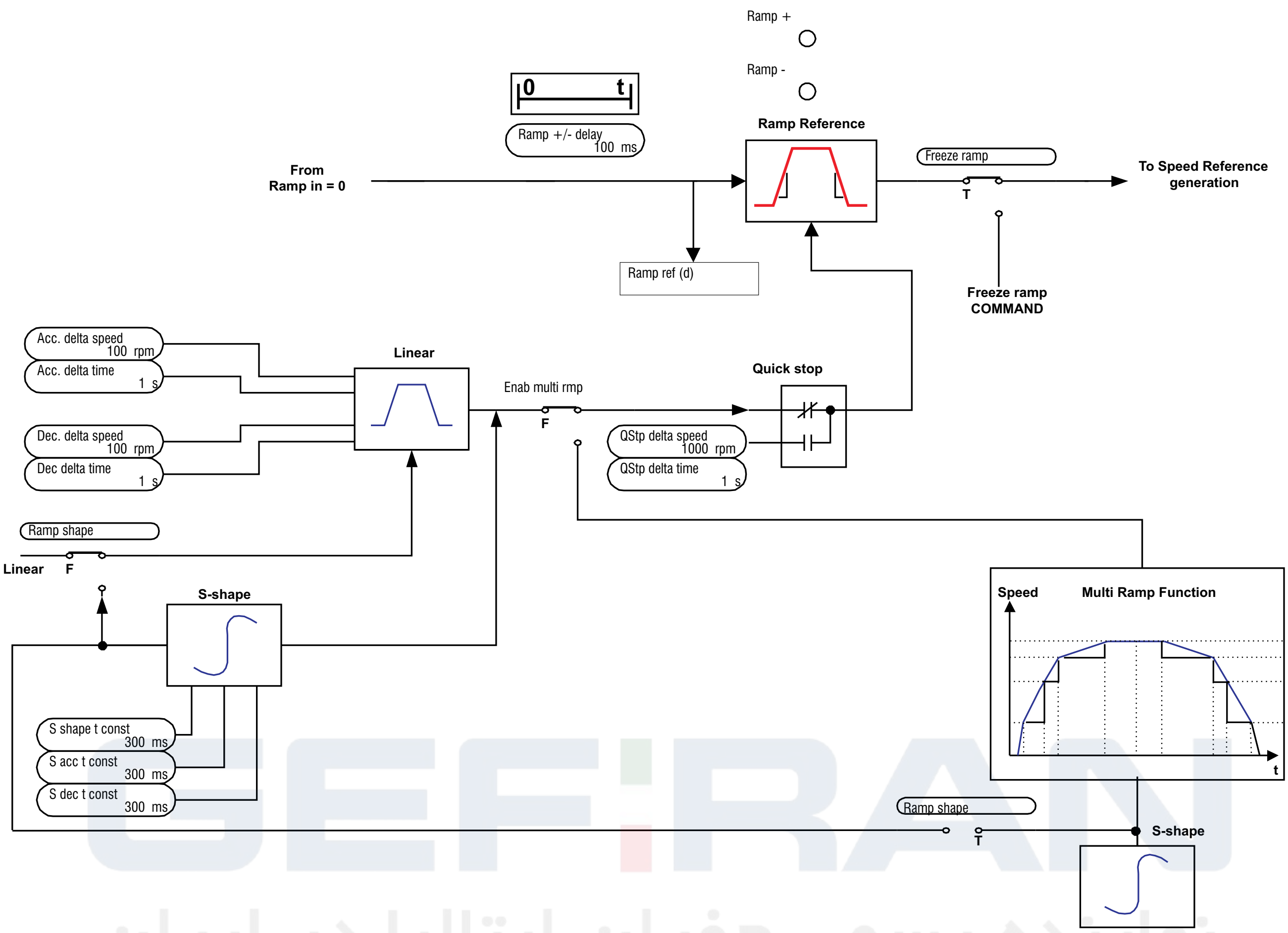


Figure 6.6.1 : Ramp circuit

The ramp (reference value integrator) determines the acceleration and deceleration times of the drive. These times can be set independently of each other.

An additional ramp is provided for a quick stop. This ramp can only be activated via the serial interface or a field bus.

The ramp can either be linear or S-shaped.

The reference values can be defined in different ways:

- with the **Ramp ref 1** and/or **Ramp ref 2** reference values
- with the multi-speed function
- with the motor potentiometer function
- with the Jog function

The Ramp generator can be used in a stand alone configuration. When the Ramp generator is disabled (**Enable ramp** = disabled), the **Enable drive**, **Start/Stop** and **Fast stop** commands have no more influence on Ramp generator. In such a condition it is free to run and can be used separately.

6.6.1 Acceleration, Deceleration, Quick Stop

RAMP

- **Acceleration**
  - [21] Acc delta speed [FF]
  - [22] Acc delta time [s]
- **Deceleration**
  - [29] Dec delta speed [FF]
  - [30] Dec delta time [s]
- **Quick stop**
  - [37] QStp delta speed [FF]
  - [38] QStp delta time [s]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Acc delta speed [FF]	21	0	2^{32-1}	100	100	-
Acc delta time [s]	22	0	65535	1	1	-
Dec delta speed [FF]	29	0	2^{32-1}	100	100	-
Dec delta time [s]	30	0	65535	1	1	-
QStp delta speed [FF]	37	0	2^{32-1}	1000	1000	-
QStp delta time [s]	38	0	65535	1	1	-

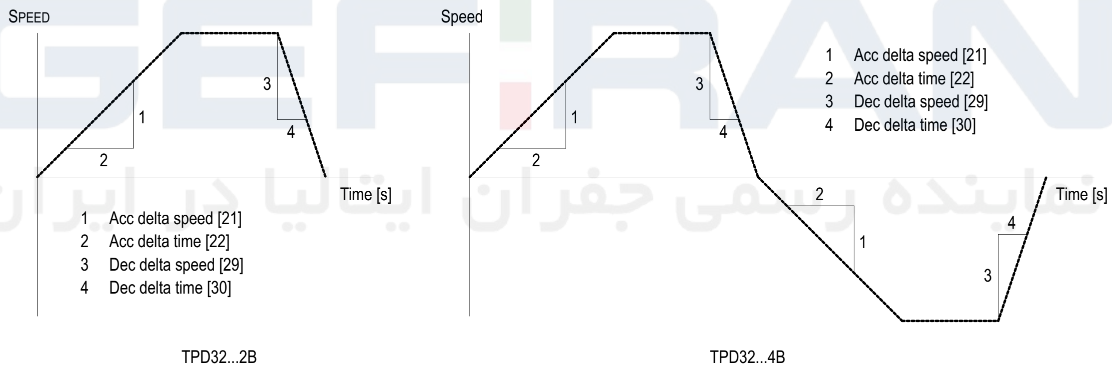


Figure 6.6.1.1: Accel, decel and Quick stop

Acc delta speed	Has the same units as the ramp reference value and is based on the factor function.
Acc delta time	Is defined in seconds. If "0 s" is entered, the ramp output directly follows the reference value.
Dec delta speed	Has the same units as the ramp reference value and is based on the factor function.
Dec delta time	Is defined in seconds. If "0s" is entered, the ramp output directly follows the reference value.
Qstp delta speed	Has the same dimension as the ramp reference value and is based on the factor function.
Qstp delta time	Is defined in seconds. If "0 s" is entered, the ramp output follows the reference value.
Quick stop	Activates the Quick stop ramp

The acceleration of the drive is defined as a quotient of the **Acc delta speed** and Acc delta time parameters (see Figure 6.6.1.1). As for the four quadrant converters (TPD32-EV...4B...) it is the same for both directions of rotation.

The deceleration of the drive is defined as a quotient of the parameters **Dec delta speed** and **Dec delta time** (see Figure 6.6.1.1). As for the four quadrant converters (TPD32-EV...4B...) it is the same for both directions of rotation.

The Quick Stop function provides the possibility of a second deceleration ramp for the emergency braking of the drive. The ramp output in this case is not set to zero immediately but after a set time. The deceleration of the drive via the Quick Stop function is defined as the quotient of the **Qstp delta speed** and **Qstp delta time** parameters. As for the four quadrant converters (TPD32-EV...4B...) it is the same for both directions of rotation. This ramp is activated by the functions **Fast stop** (via terminals) and **Quick stop**.

6.6.2 Ramp shape and control commands

RAMP

[18]	Ramp shape
[19]	S shape t const [ms]
[663]	S acc t const [ms]
[664]	S dec t const [ms]
[20]	Ramp +/- delay [ms]
[673]	Fwd-Rev
[245]	Enable ramp
[344]	Ramp out = 0
[345]	Ramp in = 0
[373]	Freeze ramp

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Ramp shape Linear (0) S-Shaped (1)	18	0	1	Linear (0)	Linear (0)	-
S shape t const [ms]	19	0	15000	300	300	-
S acc t const [ms]	663	0	15000	300	300	-
S dec t const [ms]	664	0	15000	300	300	-
Ramp +/- delay [ms]	20	0	65535	100	100	-
Fwd-Rev No direction (0) Fwd direction (1) Rev direction (2) No direction (3)	673	0	3	1	1	-
Forward sign	293	0	1	0	0	-
Reverse sign	294	0	1	0	0	-
Enable ramp Enabled (1) Disabled (0)	245	0	1	Enabled (1)	Enabled (1)	-
Ramp out = 0 Active (0) Not active (1)	344	0	1	Not active (1)	Not active (1)	*
Ramp in = 0 Active (0) Not active (1)	345	0	1	Not active (1)	Not active (1)	*
Freeze ramp Active (0) Not active (1)	373	0	1	Not active (1)	Not active (1)	*
Ramp + Acc.CW + Dec. anti-CW (1) Other states (0)	346	0	1	-	-	Digital output 1 *
Ramp - Acc.anti-CW + Dec. CW (1) Other states (0)	347	0	1	-	-	Digital output 2 *

* This function can be assigned to one of the programmable digital inputs.
** This parameter can be assigned to a programmable digital output.
*** This function can be assigned to one of the programmable analog outputs.

The shape of the ramp is determined by the **Ramp shape**, **Acc. Delta speed, Acc delta time, Dec delta speed, Dec delta time, S acc t const** and **S dec t const** parameters.

Ramp shape	Linear	Linear ramp
	S shaped	S-shaped ramp

S shape t const	Defines the acceleration/deceleration curve for S-shaped ramp.
S acc t const	Defines the acceleration curve for S-shaped ramp.
S dec t const	Defines the deceleration curve for S-shaped ramp.

For **Ramp Shape** = **Linear** refer to previous section 6.6.1 for ramp description.

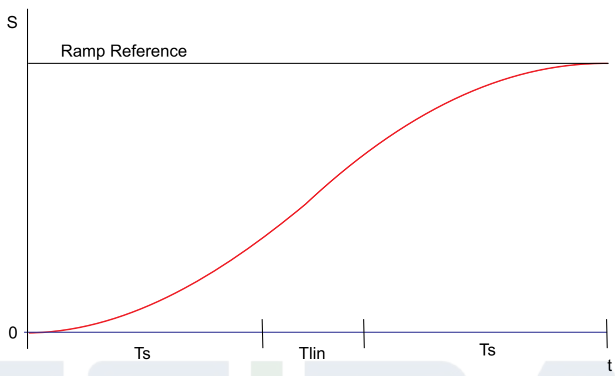
For **Ramp Shape** = **S-Shaped** refer to the description reported hereafter.

During a motor acceleration, the S ramp is defined by 3 section.

The first and the third, named Ts in the following picture, are equal. Their shape depends on the jerk set in the parameter **S acc t cons**. The second section, named Tlin, is a linear ramp expressed as delta speed / delta time.

The same consideration can be done for the motor deceleration.

Figure 6.6.2.1: S shape acceleration ramp



<u>*Example: calculation of the total ramp time*</u>

P21 **Acc. Delta speed** = 10rpm
P22 **Acc. Delta time** = 10s
P110 **Ramp ref** = 60rpm
P663 **S acc t const** = 6000ms

Acc Jerk= Acceleration Jerk [rpm/s^2]
Acc Jerk= 2***Acc. Delta speed**/(**S acc t const**/1000)^2
Acc Jerk= 2*10/(6000/1000)^2 =0.56 [rpm/s^2]

Alin= Linear Acceleration [rpm/s]
Alin= **Acc. Delta speed/Acc Delta time** [rpm/s]
Alin= 10/10=1 [rpm/s]

T1= Theoretic time to end the S shape [s]
T1= Alin/Acc Jerk [s]
T1= 1/0.56=1.8 [s]

VT1= Speed reached at T1 [rpm]
VT1=1/2*Acc Jerk*T1^2 [rpm]
VT1=1/2*0.56*(1.8)^2=0.9 [rpm]

If
VT1<**Ramp ref**/2
Jerk time Ts=T1=1.8 [s]
Linear acceleration time= Tlin [s]
Tlin=((**Ramp ref**-(2*VT1)))/Alin [s]
Tlin=(60-(2*0.9))/1.8=58.2 [s]
Total acceleration time=Ttacc=Tlin+(2*Ts) [s]
Ttacc=58.2+(2*1.8)=61.8 [s]

If
*VT1>***Ramp ref***/2*

Than
*Jerk time Ts=√(***Ramp ref***/Acc Jerk) [s]*
Tlin=0 [s]

The same calculation can be done for the deceleration time (using **Dec Delta speed** – **Dec Delta time** and **S dec t const**).

Speed changes (=Active ramp) are indicated by the **Ramp +** and **Ramp -** parameters.

Ramp +/- delay Defines a delay time. It is only valid if the ramp is active.

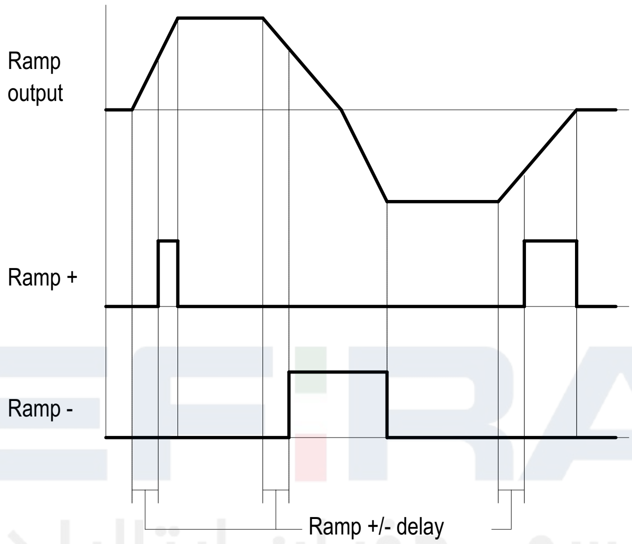


Figure 6.6.2.2: Ramp delay

Fwd-Rev Changes the sign of the Ramp reference. When Fwd direction is selected the Ramp reference is multiplied by +1. When Rev direction is selected the Ramp reference is multiplied by-1.

Forward sign Set the Fwd direction of the Ramp reference. It can be programmed on a digital input.

Reverse sign Set the Rev direction of the Ramp reference. It can be programmed on a digital input.

When both Fwd and Rev sign are 0 or 1, or **Fwd-Rev** is 0 or 1, the multiplexer is 0.

The behavior of the ramp circuit is defined by the **Enable Ramp**, **Ramp In = 0**, **Ramp Out = 0** and **Freeze ramp** parameters.

Enable Ramp This parameter can be changed only with a disabled drive.

Enabled	The ramp is enabled.
Disabled	The ramp is disabled.

Ramp out = 0

Not active (H)	Enabled ramp output.
Active (L)	The ramp ouput is immediately set to zero.

Ramp in = 0

Not active (H)	Enabled ramp input. The **Ramp Ref** parameter corresponds to the set reference.

Active (L)	Disabled ramp input. **Ramp Ref** = 0

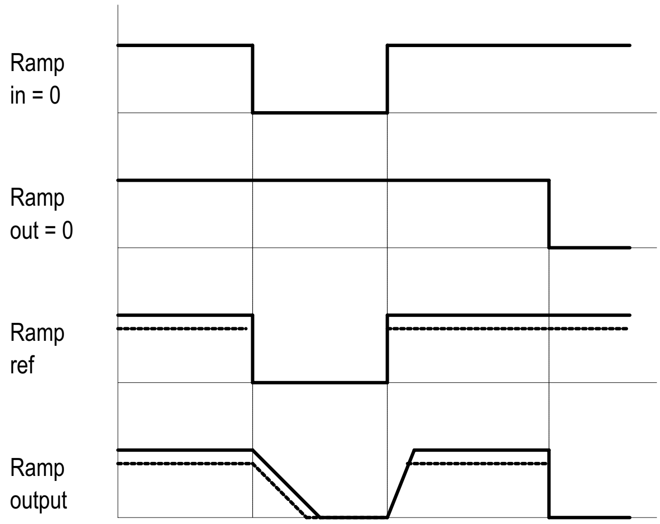


Figure 6.6.2.3: Ramp control

Freeze ramp	Not active (H)	The value at the ramp ouput is kept, irrespective of any possible reference value changes at the ramp input.
	Active (L)	The ramp output follows the reference value changes at the ramp input according to the times set.
Ramp +	Active if the drive uses a positive torque (clockwise rotation and counter-clockwise braking).	
Ramp -	Active if the drive uses a negative torque (counter-clockwise rotation and clockwise braking). Only for TPD32-EV...4B...	

Drive operation is only possible with the ramp functionenabled. **Enable ramp**=Enabled.

When the ramp input is enable via **Ramp in = 0,** the acceleration time of the drive starts. If the input is disabled, the drive slows down according to the decelertion time set until zero speed is reached.

When the ramp output is set to zero via **Ramp out = 0,** the drive brakes through the maximum available torque. With the TPD32-EV...2B converters no braking is possible. The function (also Quick Stop) causes the motor to coast.

6.7 SPEED REGULATION (SPEED REGULAT)

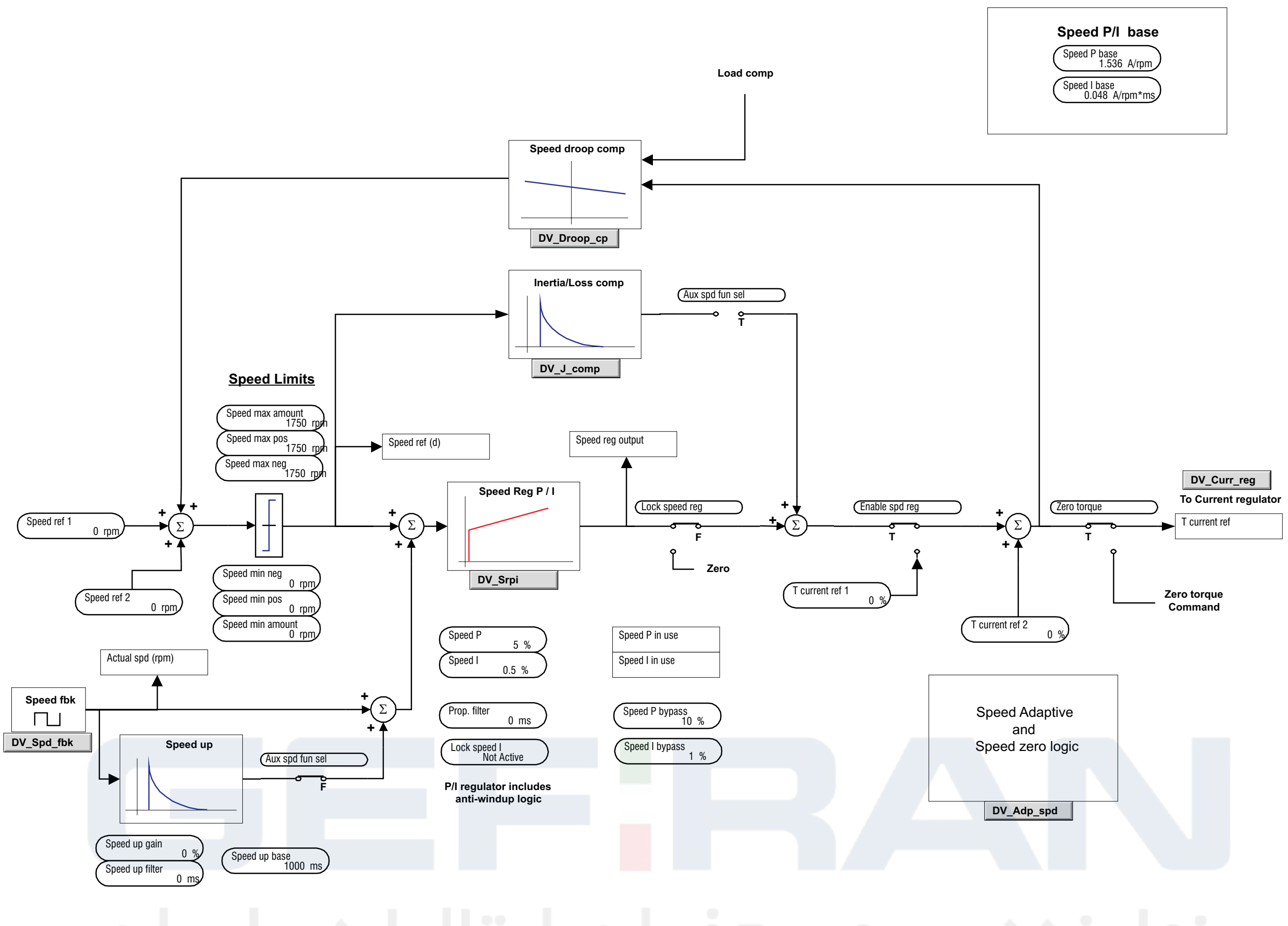


Figure 6.7.1: Speed regulation

The converters of the TPD32-EV series are provided with a speed regulator circuit that can adapt flexibly to the requirements of various applications. The device is factory set for PI regulation and regulator parameters that stay the same throughout the entire speed range.

The following functions are also provided:

- “Speed-up” function in order to avoid oscillations in presence of loads with a high moment of inertia.
- Speed zero logic for regulator behavior when the motor is stopped.
- Speed regulator adaption for optimizing the regulator according to the actual speed or to an external reference (Adap Reference)..
- Auto capture function of a running motor
- Speed signals
- Droop function for current balancing

For the speed PI regulator diagram block, please refer to “Speed regulator PI part” block diagram on chapter 9.

6.7.1 Speed regulator

SPEED REGULAT

[118]	Speed ref [rpm]
[236]	Speed reg output [%]
[322]	Lock speed reg
[242]	Enable spd reg
[348]	Lock speed I
[1016]	Aux spd fun sel
[444]	Prop filter [ms]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Speed ref [rpm]	118	-32768	+32767	-	-	**
Speed reg output [%]	236	-200	+200 see 6.7.1	-	-	T current ref 1 **
Lock speed reg ON (1) OFF (0)	322	0	1	OFF	OFF	*
Enable spd reg Enable (1) Disable (0)	242	0	1	Enabled	Enabled	-
Lock speed I Active (0) Not active (1)	348	0	1	Not active (1)	Not active (1)	*
Aux spd fun sel Speed up (0) Inertia-loss cp (1)	1016	0	1	Speed up (0)	Speed up (0)	
Prop filter [ms]	444	0	1000	0	0	

* This function can be assigned to one of the programmable digital inputs.
** This parameter can be assigned to a programmable analog output.

Speed ref Total speed reference value in rpm

Speed reg output Output value of the speed regulator, used as the reference value for the current regulator

Note! The speed regulator is still active even if disabled (**Enable spd reg** = Disabled), therefore the **Speed reg output** contains valid information also in this case. Such a data can be transferred to the APC300 board to be used for other regulation. If the speed regulator is enabled (**Enable spd reg** = Enabled) the **Speed reg output** contains the sum of the actual speed regulator output and **T current ref 2**.

Lock speed reg This parameter is used in order to lock the speed regulator. When this happens, it stops to work, the current reference value is set to zero and the drive comes to a stop. This coasting time then depends on the rotating mass and the friction within the system concerned. If the connection between the speed regulator and the current regulator is restored, the drive will restart in the shortest possible time.

ON Speed regulator locked (= 0 V when using a digital input).
OFF Speed regulator unlocked (= 15...30 V when using a digital input).

Enable spd reg This enables dynamic switching, with the drive enabled or disabled, from speed control to torque control by changing the parameter selection:

Enabled The speed regulator is enabled. The speed regulator output becomes the current regulator input. **Speed reg output = T current ref 1**.

Disabled The speed regulator is blocked, parameter **T current ref 1** (IPA 39) becomes the current regulator reference.

Lock speed I Not active (H) I component of the speed regulator is enabled
Active (L) I component of the speed regulator is disabled

Aux spd fun sel Selection of the ***Speed up*** or ***Inertia/loss cp*** (see chapter 6.7.3. ***Speed up function*** and chapter 6.7.5. ***Inertia/loss cp*** for more details).

Prop filter Time constant of the filter belonging to the circuit of the speed feedback. Filtering of the high frequency components of speed feedback signal is useful in case of elastic coupling between motor and load (joint or belts).

The speed regulator must be enabled with the **Enable spd reg** parameter in order for it to be used.

The reference value for the speed regulator consists of the signed addition of **Speed ref 1** and **Speed ref 2.**

The speed feedback is supplied by an encoder or a tachometer that are mounted to the motor shaft. The higher the resolution of the encoder, the better the control accuracy of the regulator.

The regulator parameters can be set separately.

For the speed PI regulator diagram block, please refer to diagram on chapter 9.

6.7.1.1 Self tuning of Speed regulator

SPEED REGULAT

Self tuning

[1029]	Fwd-Rev spd tune
[1048]	Test T curr lim [%]
[1027]	Start
[1014]	Inertia [kg*m*m*]
[1030]	Inertia Nw [kg*m*m*]
[1015]	Friction [N*m]
[1031]	Friction Nw [N*m]
[87]	Speed P [%]
[1032]	Speed P Nw [%]
[88]	Speed I [%]
[1033]	Speed I Nw [%]
[1028]	Take val

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Fwd-Rev spd tune Fwd direction (1) Rev direction (2)	1029	1	2	Fwd Direction (1)	Fwd Direction (1)	
Test T curr lim [%]	1048	0	S	20	20	
Start	1027	0	65535	-	-	
Inertia [kg*m*m*]	1014	0.001	999.999	S	S	
Inertia Nw [kg*m*m*]	1030	0.001	999.999	-	-	
Friction [N*m]	1015	0.000	99.999	S	S	
Friction Nw [N*m]	1031	0.00	99.99	-	-	
Speed P [%]	87	0.00	100.00	S	S	
Speed P Nw [%]	1032	0.00	100.00	-	-	
Speed I [%]	88	0.00	100.00	S	S	
Speed I Nw [%]	1033	0.00	100.00	-	-	
Take val	1028	0	65535	-	-	

Fwd-Rev spd tune Direction of motor shaft rotation for the speed self tune test (Forward or Reverse; Forward is clock-wise as seen from shaft drive end).

Test T curr lim Torque current limit applied during Speed self tune test.

Start Start-up speed self tune.

Inertia Inertia value in Kg*m^2 (1 Kg*m^2 = 23.76 lb*ft^2).

Inertia Nw New Inertia value in Kg*m^2 identified during the speed self tune procedure.

Friction	Friction value (or Loss compensation) in N*m (1 N*m = 0.738 lb*ft).
Friction Nw	New Friction value (or Loss compensation) in N*m identified during the speed self tune procedure.
Speed P	Proportional coefficient of the speed regulator in percentage.
Speed P Nw	New value of Proportional coefficient of the speed regulator in percentage computed during the speed self tune procedure.
Speed I	Integral coefficient of the speed regulator in percentage.
Speed I Nw	New value of Integral coefficient of the speed regulator in percentage computed during the speed self tune procedure.
Take val	Acquire the parameters after the speed self tune procedure (overwrite current values). ***Note!*** This is not a permanent save. Go to "Save parameters" command.

6.7.2 Spd zero logic

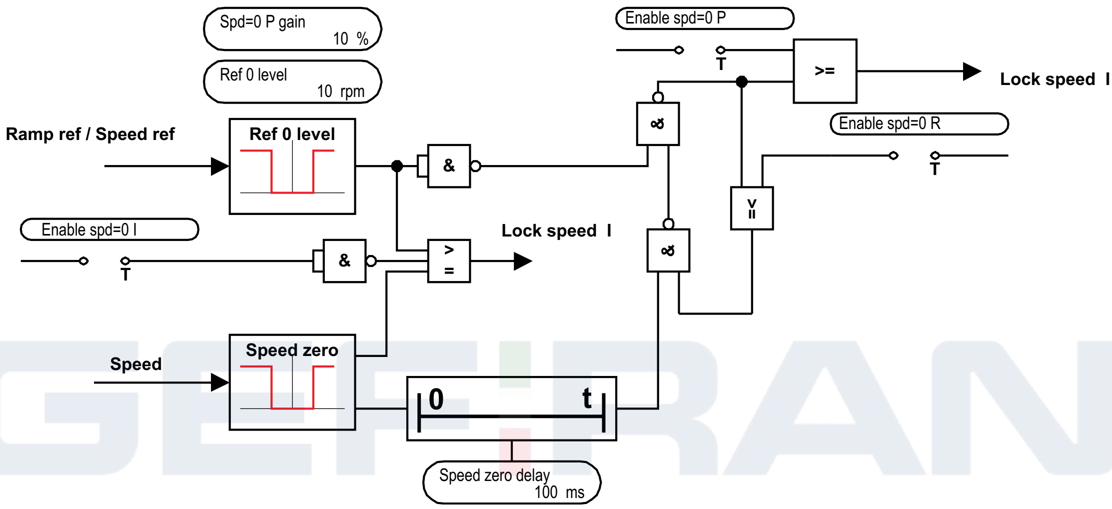


Figure 6.7.2.1: Speed zero logic

SPEED REGULAT

Spd zero logic

[123]	Enable spd=0 I
[124]	Enable spd=0 R
[125]	Enable spd=0 P
[126]	Spd=0 P gain [%]
[106]	Ref 0 level [FF]

The speed zero logic determines the behavior of the drive when the motor shaft is at a stop.

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Enable spd=0 I Enabled (1) Disabled (0)	123	0	1	Disabled	Disabled	-
Enable spd=0 R Enabled (1) Disabled (0)	124	0	1	Disabled	Disabled	-
Enable spd=0 P Enabled (1) Disabled (0)	125	0	1	Disabled	Disabled	-
Spd=0 P gain [%]	126	0.00	100.00	10.00	10.00	-
Ref 0 level [FF]	106	1	32767	10	10	-

Enable spd=0 I	Enabled	The I component of the speed regulator is set to 0 when the reference value and the actual value = 0. The drive control is then only proportional. The I component is enabled when a reference value is entered to restart acceleration.
	Disabled	Disable the function.
Enable spd=0 R	Only effective if **Enable spd=0 P** is enabled.	
	Enabled	The proportional gain, equal to **Spd=0 P** gain at zero speed, is equal to **Speed P** when the speed reference becomes higher than the value defined by **Ref 0** level.
	Disabled	The proportional gain, equal to **Spd=0** P gain at zero speed, is equal to **Speed P** when the speed reference or the actual speed become higher than the value defined by **Ref 0** level.
Enable spd=0 P	Enabled	When both reference value and actual value = 0, the proportional **Spd=0 P** gain component is active after the delay time defined by Speed zero delay.
	Disabled	The speed regulator also keeps its proportional gain component when the drive is at a stop.

Spd=0 P gain Proportional gain of the speed regulator, that is only active when both reference value and actual value = 0, and if the **Enable spd=0 P** function has been enabled.

Ref 0 level Switch threshold for speed zero logic. Defined in the dimension specified in the factor function. Speeds below this threshold are defined as zero.

6.7.3 Speed up

SPEED REGULAT

Speed up

[445]	Speed up gain [%]
[446]	Speed up base [ms]
[447]	Speed up filter [ms]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Speed up gain [%]	445	0.00	100.00	0.00	0.00	-
Speed up base [ms]	446	0	16000	1000	1000	-
Speed up filter [ms]	447	0	1000	0	0	-

The Speed-up function is used in order to avoid oscillations in presence of loads with a high moment of inertia. It is made up of a derivative part in the speed feedback circuit, which allows to increase the integral gain of the speed regulator. It is also useful in case of cyclical non constant loads on the motor (ex. cams). The feedback applied to the speed regulator is made of two components:

- the motor speed
- the output signal from the Speed up function

This function is mutually exclusive to the **Inertia/loss comp** function, This selection must be done via the **Aux spd fun sel [1016]** parameter. (SPEED REGULAT menu). See section 6.7.1 Speed regulator.

Speed up gain Speed up function gain as a percentage of **Speed up base**

Speed up base Speed up function max. gain. The defined value corresponds to 100% of the **Speed up gain** parameter.

Speed up filter Time constant of the filter belonging to the D part of the Speed up function.

See example figure 5.3.7.3. and 5.3.7.4.

6.7.4 Droop function

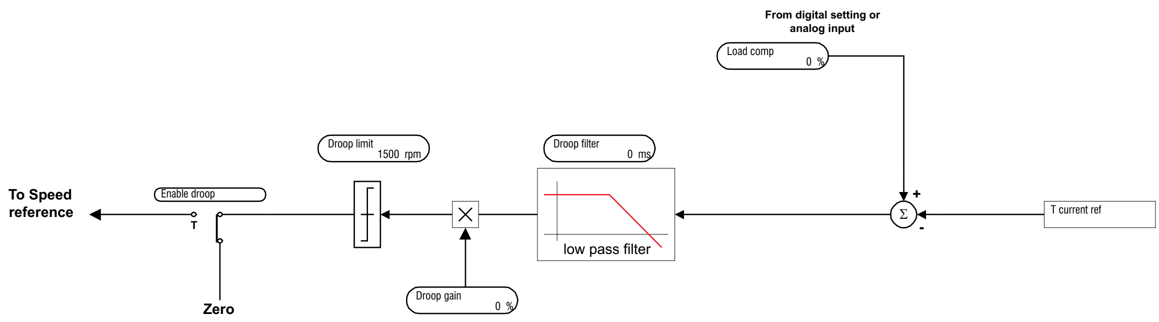


Figure 6.7.4.1: Droop compensation

SPEED REGULAT

Droop function

[696]	Droop gain [%]
[697]	Droop filter [ms]
[698]	Load comp [%]
[700]	Droop limit [FF]
[699]	Enable droop

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Droop gain [%]	696	0.00	100.00	0.00	0.00	
Droop filter [ms]	697	0	1000	0	0	
Load comp [%]	698	-200	+200	0	0	*
Droop limit [FF]	700	0	2*P45	1500	1500	**
Enable droop Enabled (1) Disabled (0)	699	0	1	Disabled (0)	Disabled (0)	

* This parameter can be assigned to one of the programmable analog inputs.
** This parameter can be assigned to one of the programmable digital inputs.

The Droop function is used when a current balancing between two drives is required. A typical situation is when two motors are mechanically coupled and have to run at the same speed. If, because of a different characteristic of the two speed regulators, one of the motors is driven to run at a higher speed, it will be overloaded and the second motor will work as a brake. The Droop function permits to avoid this bad functioning by adding a component in the in the speed reference of the drive, which is proportional to the actual load difference of the drives. The effect is the balancing of the two motor current.

Droop gain Droop function gain. It is defined as a percentage of the ratio between **Speed base value** ant the difference **Load comp - T current ref**. This means that when the difference **Load comp - T current ref** is 100% and **Droop gain** = 100%, the speed reference correction signal is equal to **Speed base value**.

Droop filter Filter time constant

Load comp Load compensation signal. It is typically equal to the "master" drive current, but it can also be assigned to a programmable analog output. It is defined as a percentage of Idn.

Enable droop Enabled Droop function enabled.
Disabled Droop function disabled.

Droop limit It defines the speed reference correction range in which the droop function is active. The value to be entered is based on the factor function.

(For more detail see Figure 6.7.1 "Speed regulator").

EXAMPLE (PIPE MILL)

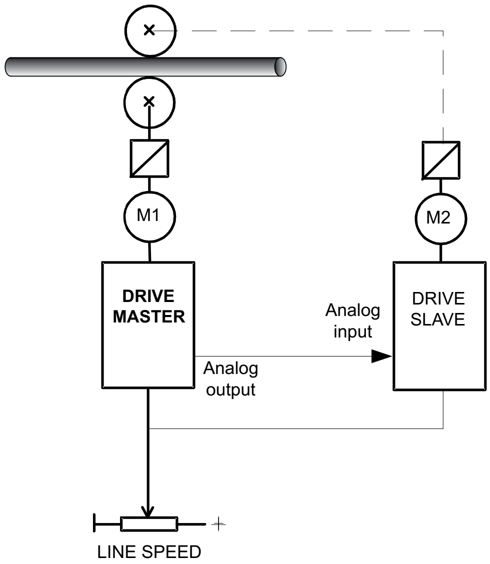


Figure 6.7.4.2: Droop function example

Example setting: ----> Pourpose: Torque of motor 1 has to be equal to torque of motor 2

<u>Drive Master</u>

Analog input 1= Speed ref 1

Analog output 1= Tcurr ref

<u>Drive slave</u>

Analog input 1= Speed ref 1

Analog input 2= Load comp

Enable droop= enables

Droop gain= 5%

Droop filter= 100ms

Droop limit=1000

6.7.5 Inertia/Loss compensation

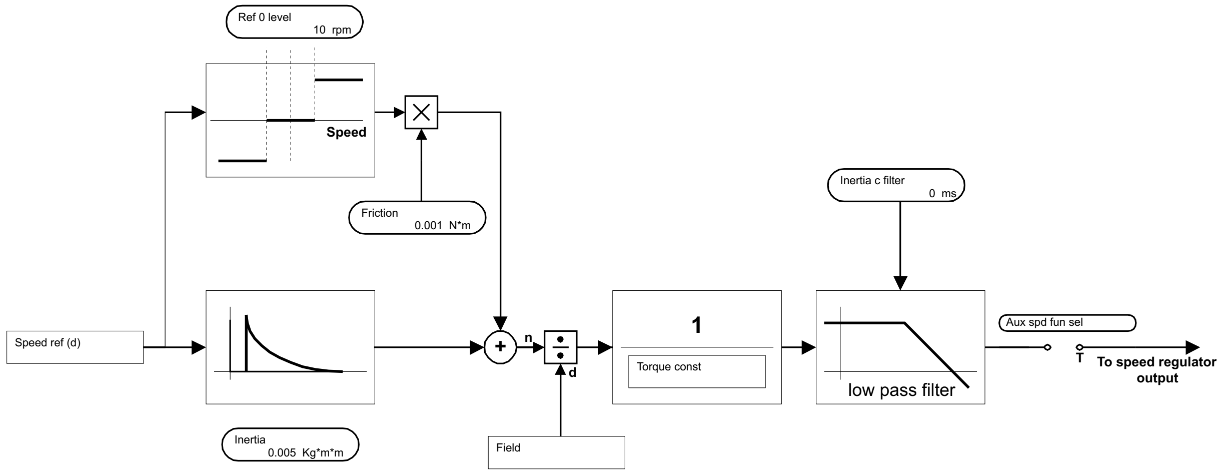


Figure 6.7.5.1: Inertia/Loss compensation

SPEED REGULAT

Inertia/loss cp

[1014]	Inertia [kg*m*m]
[1015]	Friction [N*m]
[1013]	Torque const [N*m/A]
[1012]	Inertia c filter [ms]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Inertia [kg*m*m]	1014	0.001	999.999	S	S	
Friction [N*m]	1015	0.000	99.999	S	S	
Torque const [N*m/A]	1013	0.01	99.99	S	S	
Inertia c filter [ms]	1012	0	1000	0	0	

Speed regulator feedforward term that allows to increase the dynamic response to a speed reference variation. These parameters are identified from the **Speed self tune** function (START UP\Speed self tune and SPEED REGULAT\Self tuning) but they can also be set from the user.

This function is mutually exclusive to the Speed up function, This selection must be done via the **Aux spd fun sel [1016]** parameter. (SPEED REGULAT menu). See section 6.7.1, Speed regulator.

Inertia Total Inertia value at the motor shaft in Kg*m^2 identified during the speed self tune procedure. (**1 Kg*m^2 = 23.73 lb*ft^2**)

Friction Friction value (or Loss compensation) in N*m identified during the speed self tune procedure. (**1 N*m = 0.738 lb*ft**)

Torque const Total torque constant value internally computed that allows to obtain the N*m/A conversion when the motor operates within the specified speed range. This value is identified during the speed self tune procedure (See Chapter "5.3.5.2 Self tuning of the speed regulator" on page 123).

Inertia c filter 1st order low pass filter time constant. The filter reduces the noise value owed to the operation of the speed differentiation in the Inertia compensation block.

6.8 CURRENT REGULATION (CURRENT REGULAT)

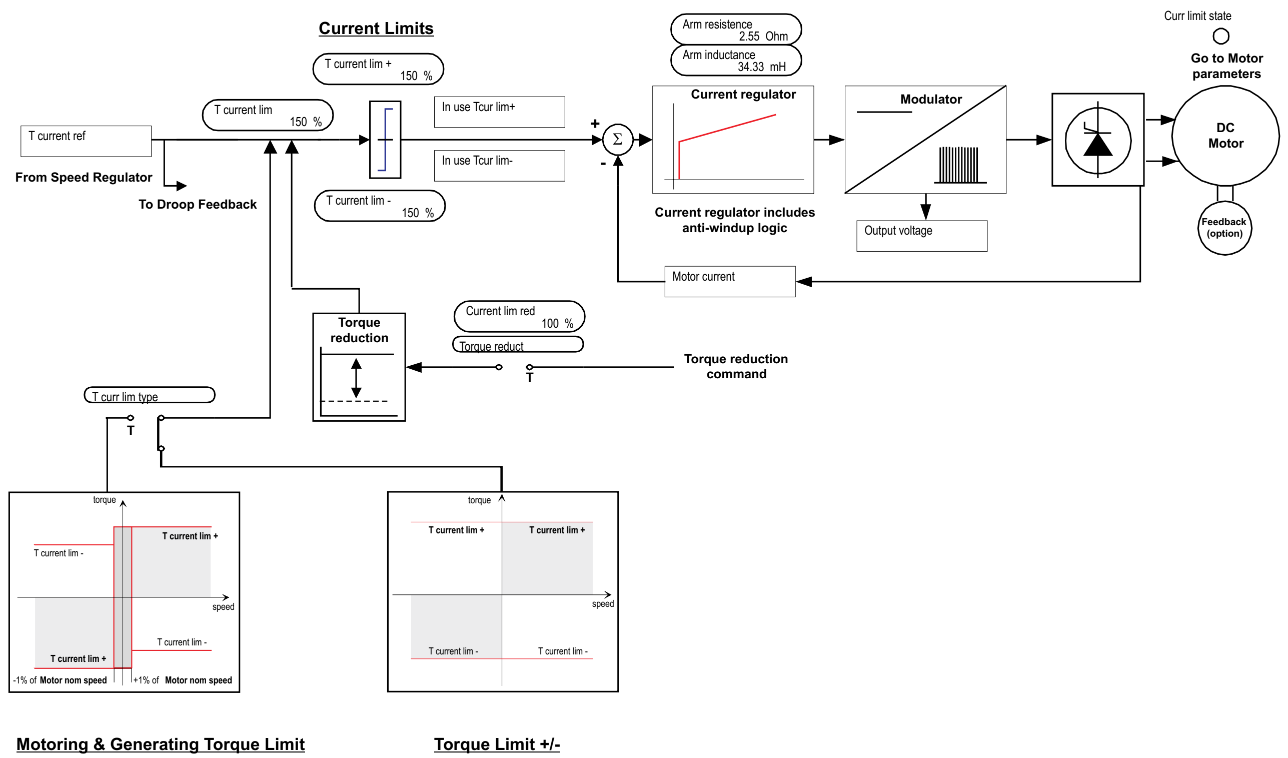


Figure 6.8.1: Torque current regulaton

CURRENT REGULAT

[41]	T current ref [%]
[199]	Motor current [%]
[1430]	Mot cur threshld [%]
[1431]	Mot cur th delay [ms]
[1520]	dI/dt delta time
[453]	Arm resistance [ohm]
[454]	Arm inductance [mH]
[587]	E int [V]
[452]	R&L Search
[353]	Zero torque

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
T current ref [%]	41	-200	+200	-	-	**
Motor current [%]	199	-250	250	-	-	-
Mot cur threshld [%]	1430	0	200	100	100	
Mot cur th delay [ms]	1431	0	65535	1000	1000	
Arm resistance [ohm]	453	S	S	0.500	0.500	-
Arm inductance [mH]	454	S	S	4.00	4.00	-
E int [V]	587	-80	+80	-	-	**
R&L Search OFF ON	452	0	1	OFF	OFF	-
Zero torque Active Not active	353	0	1	Not active (1)	Not active (1)	*

* This function can be assigned to one of the programmable digital inputs.
** This parameter can be assigned to a programmable analog output.

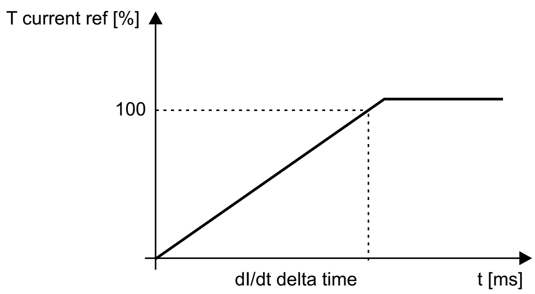
The user defines the full load current of the motor via the **Full load curr** (FLC) parameter in the CONFIGURATION menu. This is at the same time the output current of the inverter when **T current ref** = 10%.

T current ref Total current reference as a percentage of **Full load curr**. For this parameter the TPD32-EV...4B... converters need a positive value. In this case the negative references are processed and correspond to a zero reference.

Mot cur threshld When the motor current exceeds the Full Load Current percentage threshold, this condition is signalled via a digital output.

Mot cur th delay The *Mot cur th delay* parameter can be used to set the delay after which the current within limit condition is signalled..

dI/dt delta time This parameter is used to change the time (and thus the ramp gradient) within which the value of **T current ref** (parameter 41) changes from 0 to 100%.



Arm resistance Motor armature resistance in Ω. When self-tuning cycle is performed via **R&L Search** this parameter is set to the obtained value. Therefore, if necessary, it can be changed.

Arm inductance Motor armature inductance in mH. When self-tuning cycle is performed via **R&L Search** this parameter is set to the obtained value. Therefore, if necessary, it can be changed.

Parameter	N.	Value max	
		sizes 185 ... 1050 A	sizes > 1050 A
Arm inductance [mH]	454	50 mH	30 mH

E int Auxiliary signal used to determine whether the current regulator is correctly tuned. Its value should be close to zero, but values dynamically changing between -40 and 40 are accettable.

The drive must have at least 30% load for this reading to be considered as a valid performance measurement (see chapter 5.3.5.1.1 for more detail setting) .

R&L Search Execution of self-tuning for the current regulator. The identified values for resistance and inductance armature are set to the **Arm resistance** and **Arm inductance** parameters.

Zero torque The parameter can be used to set the reference value for the armature current **T current ref** to zero so that the drive has no more torque.

Not active (H) **T current ref** not set to zero
Active (L) **T current ref** set to zero. The drive has no torque.

6.9 FLUX REGULATION

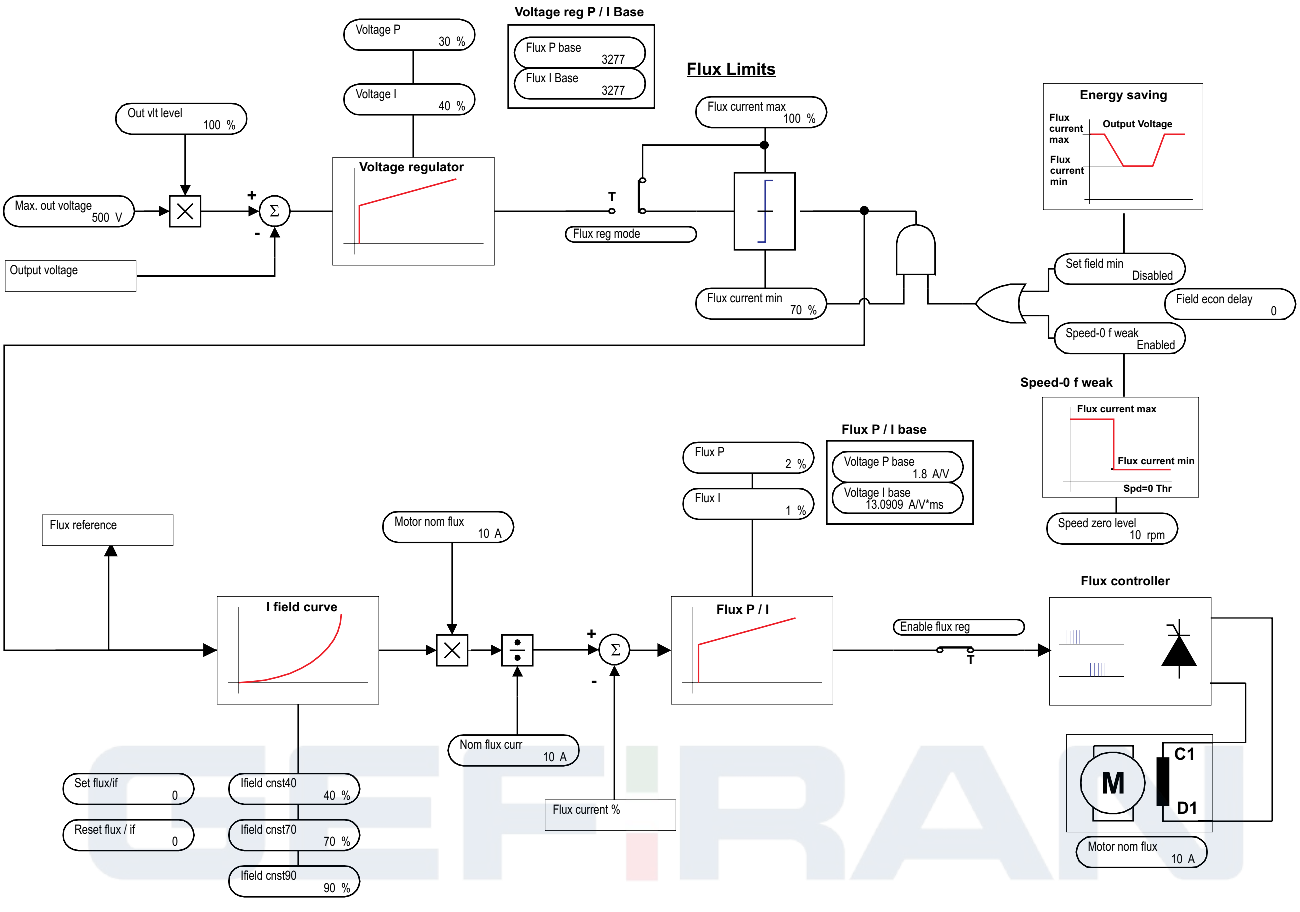


Figure 6.9.1: Motor control

FLUX REGULATION

[497]	Enable flux reg
[469]	Flux reg mode
[498]	Enable flux weak
[499]	Speed-0 f weak
[500]	Flux reference [%]
[234]	Flux current %
[921]	Out vlt level
[1522]	FC cur ref hyst
[374]	Nom flux curr [A]
[280]	Motor nom flux [A]
[411]	FC limit ramp
[888]	FC lmt ramp time [ms]

Flux \ if curve

[916]	I field cnst 40
[917]	I field cnst 70
[918]	I field cnst 90
[919]	Set flux / if
[920]	Reset flux / if

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Enable flux reg ON / OFF	497	0	1	Enabled	Enabled	*

Parameter description	No.	Value min	Value max	Value Factory American	Value Factory Standard	Standard Configuration
Flux reg mode Constant current (0) Voltage control (1) External control (2) Ext digital FC (3) Ext wired FC (4) Ext digital FC Const (5) Ext wired FC Cons (6)	469	0	6	Const. current (0)	Const. current (0)	-
Enable flux weak ON / OFF	498	0	1	1	1	*
Speed-0 f weak ON / OFF	499	0	1	0	0	
Flux reference [%]	500	0.0	100.0	0.0	0.0	**
Flux current [%]	234	0.0	100.0	-	-	**
Out vlt level	921	0.00	100.0	100.0	100.0	**/***
FC cur ref hyst	1522	1	100	5	5	
I field cnst 40	916	0.0	100.0	40.0	40.0	
I field cnst 70	917	0.0	100.0	70.0	70.0	
I field cnst 90	918	0.0	100.0	90.0	90.0	
Set flux / if	919	0	1	0	0	
Reset flux / if	920	0	1	0	0	
Nom flux curr [A]	374	0.5	80.0	S	S	
Motor nom flux	280	0.00	P374	P374	P374	
FC limit ramp Disabled (0) Enabled (1)	411	-	-	Disabled	Disabled	
FC lmt ramp time [ms]	888	200	10000	800	800	

* This function can be set on a programmable digital input.
** This parameter can be set on a programmable analog output.
*** This parameter can be set on a programmable analog input.

Enable flux reg Enabling of the field converter

ON Field converter Enabled

OFF Field converter Disabled. The field current is zero.

Flux reg mode Operating mode of the field converter .

Constant current — The motor field works with a constant current. The current value corresponds to the setting of the **Motor nom flux** parameter.

If any curve via the **I field cnst** parameters will be defined, this value can be changed linearly, through **Motor nom flux** (percentage of nominal flux **Motor nom flux**)

(see Flux /if curve paragraph 5.4.5)

Voltage control — The motor field is regulated with a combination of torque and constant power (armature and field regulation -- field weakening). Via the **Max out voltage** parameter in the CONFIGURATION menu, is set the max. armature voltage.

When **Enable fbk bypass** (PAR 458) is enabled (default) the **Voltage control selection** is disabled.

External control — The field is supplied through an external excitation (rectifier/field converter).

Ext digital FC — Setting required for field control by TPD32 EV-FC with use of optical fiber connection.

Ext wired FC — Setting required for field control by TPD32 EV-FC with use of standard digital and analog I/Os.

Ext digital FC Const — Setting required for the field control without field weakening via TPD32 EV-FC using a fibre optic connection.

Ext wired FC Const — Setting required for the field control without field weakening from TPD32 EV-FC using standard digital and analogue I/Os.

NOTE! Flux reg modes **Ext digital FC** and **Ext wired FC** use same field weakening regulation of flux reg mode **Voltage control**.

Ext wired FC control mode cannot be selected before you have correctly configured the analog output and the digital inputs needed for its operation. If **2B+E** mode is not enabled only **Wired FC EN** digital input is needed, if **2B+E** mode is enabled also digital inputs **Wired FC Inv Seq** and **Wired FC Act Brg** are needed.

Ext digital FC Const and **Ext wired FC Const** modes are equivalent to the **Constant Current** mode with regard to the flow reference calculation.

Suggested I/O configuration

TPD32-EV			
IPA 66 Select output 1	IPA 139 Digital Input 3	IPA 138 Digital Input 2	IPA 137 Digital Input 1
[95] **Field cur ref**	[90] **Wired FC Act Brg**	[89] **Wired FC Inv Seq**	[88] **Wired FC EN**
21	33	32	31
1	28	27	26
[6] **T current ref 1**	[82] **Wired FC Act Brg**	[81] **Wired FC Inv Seq**	[80] **Wired FC EN**
IPA 70 Select input 1	IPA 147 Digital Output 3	IPA 146 Digital Output 2	IPA 145 Digital Output 1
TPD32-EV-FC			

Enable flux weak Command for **Voltage control**.

ON The field current corresponds to the value set via the **Flux current min** parameter.

OFF The field current is regulated on the basis of the functioning mode and on the drive working setpoint.

Speed-0 f weak When this function is enabled, and the speed 0 threshold is reached, it will be produced the minimum field current set via **Flux current min**.

Supposing that: **Start** = Low level and/or **Fast stop** = Low level

Set as field economy:

To avoid the overheating of motors which should not run or to avoid the presence of condensation in motor which work externally (the field will be used as anti condensation heating).

ON Enabled function

OFF Disabled function

Flux reference Flux/current reference : the 100% corresponds to the **Motor nom flux** parameter.

With the function Flux / if curve defined, this reference corresponds to the flux reference.

With the function Flux / if curve not defined (default conditions), this reference corresponds to the field current reference.

Flux curr (%) Field current feedback, expressed as percentage of the **Motor nom flux** parameter.

Out vlt level Percentage of the maximum output voltage according to the **Max out voltage** parameter.

This parameter allows the changing of the output voltage in “Voltage control” (FLUX REGULATION\Flux reg mode).

FC cur ref hyst Parameter of the “Three-phase external exciter control” function, see "A2.5 External Three-phase Field Exciter Control" on page 493.

This parameter can be used to avoid continuous reversal of field current polarity when the motor is running with no load or a limited load applied and thus with a Speed reg output value that is almost null.

I field cnst 40 Current value at 40% of flux (see Flux /if curve, paragraph 5.3.7)

I field cnst 70 Current value at 70% of flux (see Flux /if curve, paragraph 5.3.7)

I field cnst 90 Current value at 90% of flux (see Flux /if curve, paragraph 5.3.7)

Set flux / if Command for the setting of the flux curve according to the setting of **I field cnst 40-70-90** parameter. With the defined curve, the meaning of **Flux current max/Flux reference** indicates only the flux percentage according to the characteristic of this curve. As a consequence, the value of the field current will be determined by this characteristic (see Flux /if curve paragraph 5.3.7).

Reset flux / if Command for the reset of the flux curve set via command **Set flux / if**.

With this command the **Motor nom flux** parameter will be again linearly changed through **Flux current max/Flux reference**. (see Flux /if curve paragraph 5.3.7)

Nom flux curr Rated current I_{FN} of the field regulator. In order to improve the behaviour of the regulation, the maximum field current can be reduced by setting the S14 dip-switches (on the regulation board, see table 2.4.3.2).

Example

Armature:	500 VDC	Field:	230 VDC
	102 ADC		0.8 ADC
Drive type:	TPD32-EV-500/...-140...		(Field current set to 14 Amps = default)

Set the dip switches S14 to decrease the field current from the drive supplied, as below:

Switch ohms	168.5 Ohm	333 Ohm	182 Ohm	36.4 Ohm	845 Ohm	1668 Ohm	**Equivalent resistance**
Nom flux curr	**S14-1**	**S14-2**	**S14-3**	**S14-4**	**S14-5**	**S14-6**	
1.0 A	OFF	OFF	OFF	OFF	OFF	ON	1668 Ohm

GD6111g

Set **Nom flux curr** parameter to 1.0.
Set **Motor nom flux** parameter to 0.8.

Motor nom flux Rated field current I_{FN} of the connected motor.

FC limit ramp When using the TPD32EV-FC, you can add a ramp time at the current limits of the armature to achieve best control of armature current during reversal of the bridge from "positive" to "negative" (and vice versa).

If **Enabled**, after switching of the SCR bridge, the setting used for the armature current limit is 1% of the current setting. This limit will gradually be set to 100% based on the ramp time specified in the **FC lmt ramp time** parameter.

FC lmt ramp time Ramp time value relative to change in armature current from 0 to 100%.

6.10 REG PARAMETERS

REG PARAMETERS

- **Percent values**
  - **Speed regulator**
    - [87] Speed P [%]
    - [88] Speed I [%]
    - [459] Speed P bypass [%]
    - [460] Speed I bypass [%]
  - **Flux regulator**
    - [91] Flux P [%]
    - [92] Flux I [%]
  - **Voltage reg**
    - [493] Voltage P [%]
    - [494] Voltage I [%]
- **Base values**
  - **Speed regulator**
    - [93] Speed P base [A/rpm]
    - [94] Speed I base [A/rpm·ms]
  - **Flux regulator**
    - [97] Flux P base
    - [98] Flux I base
  - **Voltage reg**
    - [495] Voltage P base [f%/V]
    - [496] Voltage I base [f%/V·ms]
- **In use values**
  - [99] Speed P in use [%]
  - [100] Speed I in use [%]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Speed P [%]	87	0.00	100.00	10.00	10.00	-
Speed I [%]	88	0.00	100.00	1.00	1.00	-
Speed P bypass [%]	459	0.00	100.00	10.00	10.00	-
Speed I bypass [%]	460	0.00	100.00	1.00	1.00	-
Flux P [%]	91	0.00	100.00	2.00	2.00	-
Flux I [%]	92	0.00	100.00	1.00	1.00	-
Voltage P [%]	493	0.00	100.00	30.00	30.00	-
Voltage I [%]	494	0.00	100.00	40.00	40.00	-
Speed P base [A/rpm]	93	000.1	S	0.3 x P93max P93max	0.3 x P93max P93max	-
Speed I base [A/rpm·ms]	94	0.001	S	0.3 P94max	0.3 P94max	-
Flux P base	97	1	32767	3277	3277	-
Flux I base	98	1	32767	3277	3277	-
Voltage P base [f%/V]	495	0.0100	S	S	S	-
Voltage I base [f%/V·ms]	496	0.01	S	S	S	-
Speed P in use [%]	99	0.00	100.00	S	S	-
Speed I in use [%]	100	0.00	100.00	S	S	-

Speed P Proportional gain K_P* of the speed regulator expressed as a percentage of **Speed P base**.

Speed I Integral gain K_I* of the speed regulator expressed as a percentage of **Speed I** base.

Speed P bypass	Proportional gain K_P* of the speed regulator expressed as a percentage of **Speed P base**, when a feedback via encoder or tachometer is changed into a armature feedback (**Enable fbk bypas** = Enabled).
Speed I bypass	Integral gain K_I* of the speed regulator expressed as a percentage of Speed I base, when a feedback via encoder or tachometer is changed into a armature feedback (Enable fbk bypas = Enabled).
Fld reg P gain	Proportional gain K_P* of the field current regulator expressed as percentage of **Flux P base**.
Fld reg I gain	Integral gain K_I* of the field current regulator expressed as a percentage of **Flux I Base**.
Voltage P	Proportional gain K_P* of the field voltage regulator expressed as a percentage of **Voltage P base**.
Voltage I	Integral gain K_I* of the field voltage regulator expressed as a percentage of **Voltage I base**.
Speed P base	Proportional gain K_{P0} of the speed regulator in A/rpm (base value)
Speed I base	Integral gain K_{I0} of the speed regulator in A/rpm·ms (base value)
Flux P base	Proportional gain K_{P0} of the field current regulator (base value)
Flux I Base	Integral gain K_{I0} of the field current regulator in (base value)
Voltage P base	Proportional gain K_{P0} of the field voltage regulator in A / Vs (base value)
Voltage I base	Integral coefficient K_{I0} of the field voltage regulator in A / V · ms (base value)
Speed P in use	Display of the active proportional coefficient of the speed regulator as a percentage of **Speed P base.**
Speed I in use	Display of the active derivative coefficient of the speed regulator as a percentage of **Speed I base.**

The maximum value for the regulator parameters is defined by the base values. The settings possible depend on the size of the device.

The user can optimize the function of the regulator by changing the percentage values (values marked with *).

The resulting gains for the regulator are calculated as follows:

$K_P = K_{P0} \cdot K_P^* / 100\ \%$ $\qquad$ $K_I = K_{I0} \cdot K_I^* / 100\ \%$

Example of the speed regulator:

Speed P base = 12 (= K_{P0}) **Speed P** = 70 % (= K_P*)

Proportional gain $K_P = 12 \cdot 70\ \% / 100\ \% = 8.4$

The base values ... base are also the basis for setting the adaptive speed regulator.

When the adaptive speed regulator is enabled (**Enable spd adap** = Enabled), the **Speed P** and **Speed I** parameters have no effect. They still retain their value and are effective again when the speed regulator adaption is disabled.

The **Speed P in use** and **Speed I in use** parameters indicate the current gains for the speed regulator. This also applies when the speed regulator adaption is active.

6.11 CONFIGURATION

6.11.1 Operating mode selection

CONFIGURATION		
	[252]	Main commands
	[253]	Control mode

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Main commands Terminals (0) Digital (1)	252	0	1	Term.(0)	Term.(0)	-
Control mode Local (0) Bus (1)	253	0	1	Local (0)	Local (0)	-

Main commands These commands specify from where the **Enable drive**, **Start** and **Fast stop** commands are to be actuated.

Terminals The above commands are actuated exclusively via the terminal strip.

Digital Commands must be selected both via the terminal strip and via the digital channel (keypad or RS485 or bus, depending on the **Control mode**). If, for example, a stop of the drive is initiated by removing the **Start** command on terminal 13, both the voltage on terminal 13 and the command via the digital channel are necessary to restart the drive. This also applies to a removal of the **Fast stop** command. If the **Stop** is initiated via the digital channel, the digital command is sufficient to restart the drive.

The control method through terminal commands (Terminals) is selectable only when terminals 12 (Enable) and 13 (Start) are not supplied.

Carrying out the passage of the commands from Digital to Terminals with those terminals supplied, it will appear the message "**Change input**", signalling the wrong action.

Control mode Defines whether the digital channel is the keypad/RS485 or a bus system (Option).

Local The digital channel is the keypad or the RS485 serial interface

Bus The digital channel is a bus system (Option)

The following tables show the operating modes possible.

Parameters		Actuation of: Enable drive Start Fast stop	Control mode selection	Failure reset	Save parameters
Main commands	**Control mode**				
Terminals	Local	Terminals	Keypad /RS485	Terminals of Keypad	Keypad /RS485
Digital	Local	Terminals and keypad/RS485	Keypad /RS485	Terminals of Keypad	Keypad /RS485
Terminals	Bus	Terminals	Keypad* / RS485* or Bus	Terminals or keypad* or Bus	Keypad RS485 or Bus
Digital	Bus	Terminals and Field Bus	Keypad* / RS485* or Bus	Terminals or keypad*/ RS485* or Bus	Keypad RS485 or Bus

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Parameters		Write Access Restrictions		
Main commands	**Control mode**	Terminals	Keypad / RS485	Bus
Terminals	Local	Access to everything assigned to programmable I/Os	Access to all parameters not assigned to programmable I/Os	None
Digital	Local	Access to everything assigned to programmable I/Os	Access to all parameters not assigned to programmable I/Os	None
Terminals	Bus	Access to everything assigned to programmable I/Os	- read all - save parameters -reset failures* - select Control mode*	Access to all parameters not assigned to programmable I/Os
Digital	Bus	Access to everything assigned to programmable I/Os	- read all - save parameters -reset failures* - select Control mode*	Access to all parameters not data channel is not assigned to programmable I/Os

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* Access via the keypad or the RS485 serial interface is protected in this configuration by **Password level 1**

NOTE! Write access from Bus through data channel is not affected by Control Mode selection.

6.11.2 Speed base value, Full load current and Encoder Speed Resolution

CONFIGURATION

[45]	Speed base value [FF]
[179]	Full load curr [A]
[175]	Max out voltage [V]
[1550]	Encoder Spd Res
[1429]	Speed res

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Speed base value [FF]	45	1	16383	1500	1500	-
Full load curr [A]	179	0.1	P465	P465	P465	-
Max out voltage [V]	175	20	999	400	400	-
Encoder Spd Res	1550	1	20	1	1	-
Speed res 1/4 (0) 1/8 (1) 1/16 (2) 1/32 (3) 1/64 (4)	1429	0	4	0	0	-

Speed base value The **Speed base value** is defined by the unit specified in the factor function. It is the reference value for all speed values (reference values, adaptive speed regulation.) given as a percentage, and corresponds to 100% of the speed. Changing this parameter is only possible when the drive is disabled (**Enable drive** = Disabled). The **Speed base value** does not define the maximum possible speed, which in some cases can be formed from the addition of several reference values. This is defined with **Speed max amount**.

Full load curr The **Full load curr** (FLC) parameter is defined in Amps. It corresponds to 100 % of the current limit. The settings for the current limit and the overload function are based on this active current value.

Max out voltage Max armature voltage supplied from the drive. When it has been set as **Flux reg mode** "Voltage control", **Max out voltage** corresponds to the crossover point. This parameter has an influence on the intervention threshold of the "Overvoltage" message.

Encoder Spd Res This parameter allows to achieve a greater resolution on the speed reference. Its value is the reverse of the desired speed resolution. Default and minimum value = 1. Max value = 20.

Setting 1 (default condition) the resolution is 1rpm

Setting 10 the speed resolution is 0.1rpm

This parameter can be used only in case, as feedback of the motor speed, it is used an encoder connected to the Encoder 2 connector (XE2). The FW of the drive does not allow to set **Encoder Sped Res** > 1 in case the feedback is different from Encoder 2 or in case the function "**Enable fbk bypass**" is enabled.

In the same way, the FW does not allow to set a speed feedback different from Encoder 2 or enable the function "**Enable fbk bypass**" in case **Encoder Spd Res** has been set > 1.

When **Encoder Spd Res** is > 1, it is necessary to set all the parameters representing the speed of the motor in [rpm], multiplied times the E**ncoder Spd Res** value. For example, if **Encoder Spd Res** = 10 and the motor max speed is 60.4 rpm, the **Motor max speed** value must be set to 604.

Similarly, the speed feedback and speed measurements in [rpm] are displayed as real speed multiplied times the **Encoder Spd Res** value.

NOTE ! The higher resolution is normally requested in case of motors with low speed. In any case the max speed reference multiplied times **Encoder Spd res** value must not exceed 7000 (700.0 rpm if **Encoder Spd Res** = 10)

NOTE ! When **Encoder Spd res** is > 1, in interpreting the figure 6.11.5.2 of the TPD32-EV Instruction manual, should be considered on the X axis the number of the **Encoder 2 pulses** [ppr] divided by the **Encoder Spd Res** value and, on the Y axis, the max motor speed value multiplied by the **Encoder Spd Res** value.

Table 1 : List of the parameter effected by the Encoder ***Spd Res value***

W/R parameter					
[162]	**Motor max speed**	[rpm]	[107]	**Speed zero level**	[rpm]
[45]	**Speed base value**	[rpm]	[106]	**Ref 0 level**	[rpm]
[1]	**Speed min amount**	[rpm]	[700]	**Doop limit**	[rpm]
[2]	**Speed max amount**	[rpm]	[1426]	**Overspeed thr**	[rpm]
[3]	**Speed max pos**	[rpm]	[1530]	**MPot Lower Limit**	[rpm]
[4]	**Speed max neg**	[rpm]	[1531]	**MPot Upper Limit**	[rpm]
[5]	**Speed min pos**	[rpm]	[266]	**Jog reference**	[rpm]
[6]	**Speed min neg**	[rpm]	[154 … [160]	**Multi speed 1 … 7**	[rpm]
[44]	**Ramp ref 1**	[rpm]	[659]	**Acc delta speed 0**	[rpm]
[48]	**Ramp ref 2**	[rpm]	[23]	**Acc delta speed 1**	[rpm]
[42]	**Speed ref 1**	[rpm]	[25]	**Acc delta speed 2**	[rpm]
[43]	**Speed ref 2**	[rpm]	[27]	**Acc delta speed 3**	[rpm]
[21]	**Acc. delta speed**	[rpm]	[661]	**Dec delta speed 0**	[rpm]
[29]	**Dec. delta speed**	[rpm]	[31]	**Dec delta speed 1**	[rpm]
[37]	**QStp delta speed**	[rpm]	[33]	**Dec delta speed 2**	[rpm]
[183]	**Adap reference**	[rpm]	[35]	**Dec delta speed 3**	[rpm]
[101]	**Spd threshold +**	[rpm]	[1262]	**Closing speed**	[rpm]
[102]	**Spd threshold -**	[rpm]	[756]	**I/n Speed**	[rpm]
[104]	**Set error**	[rpm]	[795]	**Positioning spd**	[rpm]

R parameter		
[110]	**Ramp ref**	[rpm]
[113]	**Ramp out**	[rpm]
[118]	**Speed ref**	[rpm]
[122]	**Actual spd**	[rpm]
[420]	**Enc 2 speed**	[rpm]
[427]	**Enc 1 speed**	[rpm]
[924]	**F act spd**	[rpm]
[1537]	**Motor pot out**	[rpm]
[1018]	**Spd draw out**	[rpm]

Speed res This parameter manages the internal speed resolution between 1/4 rpm (default) and 1/64 rpm.

6.11.3 Configuration of the OK relay (Terminals 35,36)

CONFIGURATION		
	[412]	Ok relay funct

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Ok relay funct Drive healthy (0) Ready to Start (1)	412	0	1	0	0	-

Ok relay func This parameter defines the condition in which the relay contact will close.

Drive healthy — The contact will close when the drive is supplied with voltage and when there are no failure alarms or "warning" set to stop the motor. Standard warning will not open the relay.

Note: The relay will open if multi-warning are active and IPA 9287 **Warning Cfg** parameter is set to 1 "Stop/No Start" (In this case, the motor will be stopped too). In case of "warning" when drive is disabled, OK Relay will be open only if IPA 9287 **Warning Cfg** parameter is set to 4 "No Stop/Start" or 1 "Stop/No Start.

Ready to start — The contact closes when the following conditions are fulfilled:

- The drive has a voltage supply
- There are no failure alarms present
- The drive is enabled with **Enable drive**.

6.11.4 To increase the resolution of current limits and references

CONFIGURATION

	[1521]	En TCurr HiRes

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
En TCurr HiRes Disable (0) Enable (1)	1521	0	1	0	0	-

When the **En TCurr HiRes** parameter is enabled the resolution of the parameters in the table can be increased:

Values with En TCurr HiRes disabled

Parameter	N.	UdM	Min	Max	Default US	Default EU	
T current lim	7	[%]	0	200	150	100	R/W
T current lim +	8	[%]	0	200	150	100	R/W
T current lim -	9	[%]	0	200	150	100	R/W
In use Tcur lim+	10	[%]	0	200	---	---	R
In use Tcur lim-	11	[%]	0	200	---	---	R
T current ref 1	39	[%]	-200	200	0	0	R/W
T current ref 2	40	[%]	-200	200	0	0	R/W
Motor current	199	[%]	-200	200	---	---	R
F T curr	928	[%]	-200	200	---	---	R

Values with En TCurr HiRes enabled

Parameter	N.	UdM	Min	Max	Default US	Default EU	
T current lim	7	[--]	0	2000	1500	1000	R/W
T current lim +	8	[--]	0	2000	1500	1000	R/W
T current lim -	9	[--]	0	2000	1500	1000	R/W
In use Tcur lim+	10	[--]	0	2000	---	---	R
In use Tcur lim-	11	[--]	0	2000	---	---	R
T current ref 1	39	[--]	-2000	2000	0	0	R/W
T current ref 2	40	[--]	-2000	2000	0	0	R/W
Motor current	199	[--]	-2000	2000	---	---	R
F T curr	928	[--]	-2000	2000	---	---	R

The maximum resolution for parameters relating to **Full load current** (IPA 179) is 1/1000.
If the function is disabled the maximum resolution remains at 1/100.

Important note: Each time the **En TCurr HiRes** selection changes the parameters shown in the table are automatically set to their default value.

6.11.5 Configuration of the speed feedback circuit

CONFIGURATION

Speed fbk

[162]	Motor max speed [rpm]
[414]	Speed fbk sel
[457]	Enable fbk contr
[458]	Enable fbk bypas
[456]	Flux weak speed [%]
[455]	Speed fbk error [%]
[562]	Tacho scale
[563]	Speed offset
[416]	Encoder 1 pulses
[169]	Encoder 2 pulses
[649]	Refresh enc 1
[652]	Refresh enc 2
[911]	Enable ind store
[1602]	Volt Enc 1
[1603]	Volt Enc 2

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Motor max speed [rpm]	162	0	6553	1500	1500	-
Speed fbk sel Encoder 1 (0) Encoder 2 (1) Tacho (2) Armature (3)	414	0	3	1	1	-
Encoder 1 state Encoder Fault (0) Encoder ok (1)	648	0	1			-
Enable fbk contr Enabled (1) Disabled (0)	457	0	1	Enabled (1)	Enabled (1)	-
Enable fbk bypas Enabled (1) Disabled (0)	458	0	1	0	0	-
Flux weak speed [%]	456	0	100	100	100	-
Speed fbk error [%]	455	0	100	22	22	-
Tacho scale	562	0.90	3.00	1.00	1.00	-
Speed offset	563	-20.00	+20.00	0.00	0.00	-
Encoder 1 pulses	416	600	9999	1024	1024	-
Encoder 2 pulses	169	150	9999	1000	1000	-
Refresh enc 1 Enabled (1) Disabled (0)	649	0	1	Disabled (0)	Disabled (0)	-
Encoder 2 state Encoder Fault (0) Encoder ok (1)	651	0	1			-
Refresh enc 2 Enabled (1) Disabled (0)	652	0	1	Disabled (0)	Disabled (0)	-
Enable ind store Enabled (1) Disabled (0)	911	0	1	Disabled (0)	Disabled (0)	-
Ind store ctrl	912	0	65535	0	0	-
Index storing	913	0	+232-1	0	0	-
Volt Enc 1 [V} 5.2 (0) 5.6 (1) 6.1 (2) 6.5 (3)	1602	0	3	0	0	-

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Volt Enc 2 [V} 5.2 (0) 5.6 (1) 6.1 (2) 6.5 (3)	1603	0	3	0	0	-

Note! The encoder or the tachometer are necessary for the regulation mode Flux reg mode "Voltage control" and "External control". The features of the electrical data of the encoder and the tachometer are defined in sections 2.7.2, "Encoder / Tachometer", and 2.4.5, "Accuracy".

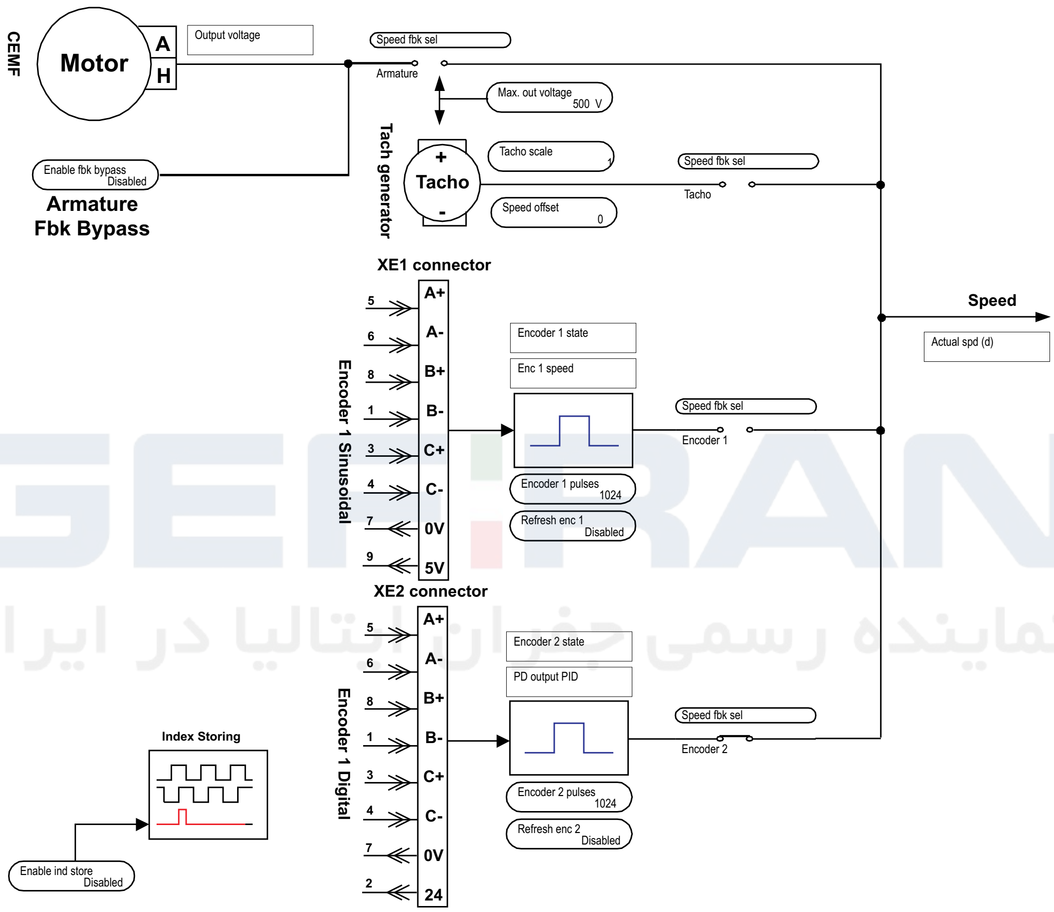


Figure 6.11.5.1: Speed feedback

Motor max speed Max motor speed. It is used to convert tach and armature feedback values in rpm. In case of speed feedback from tachogenerator it is used to convert the tach voltage in an rpm value. In case of armature voltage feedback **Max out voltage** parameter is considered equivalent to **Motor max speed**.

Speed fbk sel Select which feedback has to be used.

Encoder 1	The sinusoidal encoder connected th the XE1 connector is used.
Encoder 2	The digital encoder connected to the XE2 connector is used (standard).
Tacho	The analog tachogenerator connected to the terminals + and - is used.
Armature	The internal measurement of the armature voltage is used. No external connection is required.

Enable fbk contr
Enable of the control for the speed feedback.

Enabled	Enabled control
Disabled	Disabled control

This function controls the speed feedback, where a comparison between the armature voltage and the speed value read by the encoder or by the tachometer is made. When an excursion higher of the value set via **Speed fbk error** is signaled, the failure message “Speed fbk loss” appears. This function is automatically disabled when the armature feedback has been selected. (**Speed fbk sel** = Armature).

Enable fbk bypas
Enable of the automatic change into an armature feedback when the failure message “Speed fbk loss” is caused by a lack of the encoder or tachometer feedback.

Enabled	Enabled automatic change
Disabled	Disabled automatic change

After an automatic change into an armature feedback, the speed regulator works with the **Speed P bypass** and **Speed I bypass** parameters of the REG PARAMETERS/Percent values/Speed regulator menu. The failure message “Speed fbk loss” with an enable must be configured so that it is set as “Activity = Warning”.
Possible working only with constant field current.

Flux weak speed
Speed value as a percentage of **Motor max speed**, when the Voltage control phase starts. The **Flux weak speed** parameter, when the speed feedback control is enabled (Enable fbk contr = Enabled), is used to underline the fact that during the Voltage control phase the armature voltage and the feedback signal are not proportional. If the drive works with a constant torque on the whole regulation range (**Flux reg mode** = Constant Current), it is necessary to insert the factory set 100% value.

Speed fbk error
Max. allowed error expressed as a percentage of the max. output voltage (**Max out voltage**). By means of **Max out Voltage**, **Flux weak speed** and **Motor max speed** a relation between motor speed and armature voltage is obtained. If a difference higher than **Speed fbk error** occurs a **Speed fbk loss** failure occours.

Tacho scale
Fine scaling of the speed feedback using a tachometer analog generator (**Speed fbk sel** = Tacho). It is a multiplier of the read tach voltage.
For example:
Analog tach = 60V/1000 rpm, motor top running speed 3000 rpm.
Maximum tach volts = (60V/1000 rpm*3000rpm)= 180 VDC.

- Set dip-switch S4 for 181.6V (see table 4.4.3)
- Set the tacho scale parameter = 181.6V / 180V = 1.01
- Fine adjust the value of Tacho scale if the 180 VDC tach voltage is not perfectly reached.

Speed offset
Offset scaling of the feedback circuit.

Encoder 1 pulses
Number of pulses per revolution of the sinusoidal encoder connected to the XE1 connector.

Encoder 2 pulses
Number of pulses per revolution of the digital encoder connected to the XE2 connector. The Encoder 2 pulses and Motor max speed shall be inside the allowed area shown in figure 6.11.5.2.

Volt Enc 1 Output voltage setting on encoder 1 (parameter only available with the R-TPD32 regulation card from the "Q" revision and fw 11.02A and subsequent versions).

Volt Enc 2 Output voltage setting on encoder 2 (parameter only available with the R-TPD32 regulation card from the "Q" revision and fw 11.02A and subsequent versions).

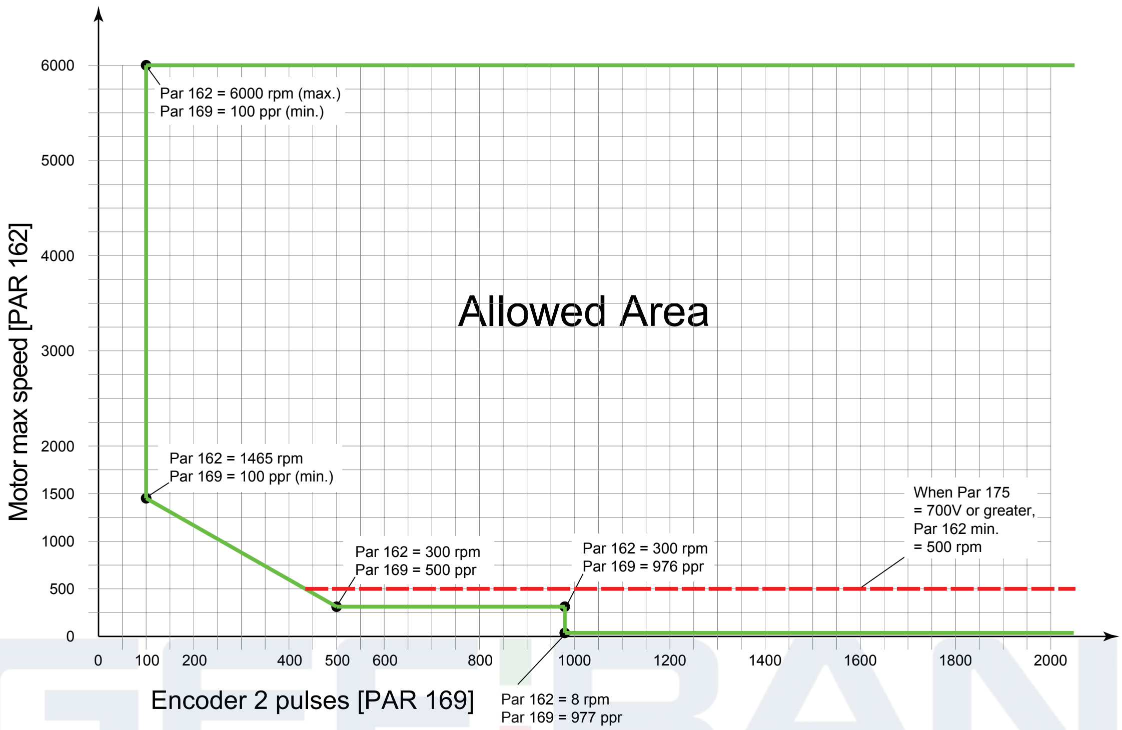


Figure 6.11.5.2: Allowed area for Encoder 2 pulses and Motor max speed

Refresh enc 1 Enable the monitoring of the encoder 1(connector XE1) connection status, in order to detect a speed feedback loss alarm.

When an alarm is detect, the keypad will shown „Speed fbk loss“. **Encoder 1 state** provides the indication of encoder 1 connection status. The parameter can be programmed on a digital output. This function is activate setting **Enable fbk contr** = Enabled.

Refresh enc 2 Enable the monitoring of the encoder 2 (connector XE2) connection status, in order to detect a speed feedback loss alarm.

When an alarm is detect, the keypad will shown „Speed fbk loss“. **Encoder 2 state** provides the indication of encoder 2 connection status. The parameter can be programmed on a digital output. This function is activate setting **Enable fbk contr** = Enabled.

Encoder 1 state Provides the indication of the encoder 1 (connector XE1) connection status. The parameter can be programmed on a digital output.

Encoder 2 state Provides the indication of the encoder 2 (connector XE2) connection status. The parameter can be programmed on a digital output.

Note! The **Tacho scale** and **Speed offset** parameters are used for a fine scaling of the speed feedback circuit. When the factory set parameters are loaded (**Load default**) these two parameters do not undergo any change, so that a new scaling is not necessary!

Following parameters allows to determine the machine absolute zero and perform a positioning control by using the APC300 option card:

Enable ind store This parameter enables the reading of the encoder index and qualifying signal that could be used in a system for implementation of position control.

Enabled — This setting enables the reading of the encoder index.

Disabled — This setting disables the reading of the encoder index

Ind store ctrl Control register for the encoder index and qualifying signal (*).

Index storing Status register and function data.

(*) Index qualifier signal is not supported by regulation card R-TPD3G revision f (product configuration "D1") and lower

Ind store ctrl parameter [92]

No. bit	Name	Description	Access (Read/Write)	Default
0-1	-	Not used	-	-
2	POLNLT	It indicates the encoder index edge polarity: 0 = rising edge 1 = falling edgec	R/W	0
3	-	Not used	-	-
4-5	ENNQUAL	It indicates the qualifier level that activates the encoder index reading: 0 = Switched off 1 = Switched off 2 = Through signal = 0 3 = Through signal = 1	W	0
6	Target Enc Num	It points out for which encoder the values of this parameter are reported: 0 = operations requested on the Encoder 1 1 = operations requested on the Encoder 2	R/W	0
7	-	Not used	-	-
8-9	ENNLT	Control function of the encoder index reading: 0 = Switched off, function disabled 1 = Once, enables the reading of the first index signal edge only 2 = Continuous, enables the reading of the index signal	R/W	0

Index storing parameter [13]

No. bit	Name	Description	Access (Read/Write)	Default
0	Source Enc Num	It indicates to which encoder the values in this register are referred to: 0 = register data are referred to the Encoder 1 1 = register data are referred to the Encoder 2	R	0
1	MP_IN	Actual Qualifier level value: 0 = qualifier input level is low 1 = qualifier input level is high	R	0
2-3	STATNLT	Status of the acquisition function: 0 = Switched off 1 = Once, storing is not executed yet 2 = Once, storing is already executed 3 = Continuous	R	0
16-31	CNTNLT	Position counter value corresponding to the index. 0 = Switched off Value is only valid when STANLT is equal to 2 or 3	R	0

6.11.6 "Standard / American" selection, Software Version

CONFIGURATION

Drive type

[465]	Drive size [A]
[201]	2B + E
[464]	Size selection
[331]	Software version

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Drive size [A]	465	0	S	S	S	-
2B + E ON (Off) (0) OFF (On) (1)	201	0	1	0	0	-
Size selection Standard (0) American (1)	464	0	1	1	0	-
Software version	331					-
Drive type TPD32-EV-...-2B TPD32-EV-...-4B	300	10	11	S	S	-

Drive size Display of the converter armature current in ampere (it is codified by the SW15 Switch placed on the R-TPD32-EV regulation card). The stated value depends on the setting of the **Size selection** parameter.

2B + E Selection of the 2B + external excitation configuration. Only for 2B converters. The function allows the drive to work with an external 4 quadrant field controller. When the parameter is On the Ramp / Speed / T current references and Speed measurement have the same behaviour of the 4B drive.

Size selection With the "Standard" selection the converter produces rated current in a continuative way in the preset ambient conditions without overload (for overload see 6.14.5). With "America" selection the rated current is defined considering an overload of 1.5 times for 60 seconds. This causes a reduction of the converter rated current (continuative current) for the same type of drive. See section 4.4, R-TPD32-EV Regulation card.

Standard — The converter produces rated current in a continuative way. It is stated as **Drive size**. No overload functions are set.

American — The rated current (produced continuously) will be reduced to the value stated in the mentioned table and indicated in **Full load current** and **Drive size** parameters.

Automatically, the overload function (FUNCTION\Overload control), is set to the following:

Enable overload = ON
Overload time = 60s
Pause time = 540s
Overload current = 150%
Base current = 100%
Overload mode = I2t motor
Full load current= American
T current lim = 150%
T current lim+ = 150%
T current lim - = 150%

If the size "American"is selected, the parameter **Overcurrent thr** [584] will be set at 160%

NOTE! If the converter is reconfigured as "Standard", these parameters and the continuous current limit take the values corresponding to the previous configuration (overload disabled) and the parameter **Overcurrent thr [584]** returns to 110%.

Software version Display of the software version number active in the converter.

Drive type Display of the drive type: 2B or 4B.

6.11.7 Dimension factor, Face value fator

CONFIGURATION

- **Dimension fact**
  - [50] Dim factor num
  - [51] Dim factor den
  - [52] Dim factor text
- **Face value fact**
  - [54] Face value num
  - [53] Face value den

The factor function consists of two factors - the dimension factor and the face value factor. Both factors are defined as fractions. The dimension factor is used to specify the drive speed in a dimension related to the machine concerned, e.g. kg/h or m/min. The face value factor is used to increase the resolution.

See the calculation examples given beow.

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Dim factor num	50	1	65535	1	1	-
Dim factor den	51	1	+231 -1	1	1	-
Dim factor text	52			rpm	rpm	-
Face value num	54	1	+32767	1	1	-
Face value den	53	1	+32767	1	1	-

Dim factor num Numerator of the dimension factor

Dim factor den Denominator of the dimension factor

Dim factor text Unit of the dimension factor (5 characters). This text is shown in the keypad display for reference value entry. Possible characters: /%&+,-.0...9:<=>?A...Z[]a...z

Face value num Numerator of the face value factor

Face value den Denominator of the face value factor

The reference value given multiplied with the dimension factor and the face value factor defines the motor speed in rpm

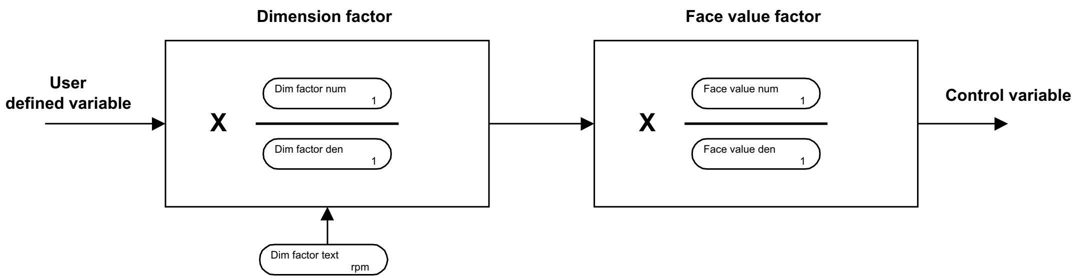


Figure 6.11.7.1: Calculation using dimension and face value factors

Example 1 of the calculation of the dimension factor

The drive speed is given in m/s. The conversion ratio is 0.01 m per revolution of the motor (Note: face value factor = 1).

The dimension factor is calculated from

$$\text{Dimension factor} = \frac{\text{output (rpm)}}{\text{input (here: m/s)}}$$

for01

0.01 m corresponds to 1 revolution of the motor shaft

0.01 m/min corresponds to 1/min

0.01 m/60s corresponds to 1/min

$$\text{Dimension factor} = \frac{1}{\text{min}} \bullet \frac{60\ \text{s}}{0.01\ \text{m}} = \frac{6000}{1} \bullet \frac{1}{\text{min}} \bullet \frac{\text{s}}{\text{m}}$$

for02

When calculating the dimension factor, units should not be shortened (1 min is not shortened as 60 s)

Dim factor num	6000
Dim factor den	1
Dim factor text	m/s

Example 2 of the calculation of the dimension factor

The reference values for a bottling plant are given in bottles per minute. One revolution of the drive corresponds to the filling of 0.75 bottles. This corresponds to a dimension factor of 4/3. The speed limitation and the ramp function are also given in bottles per minute

$$\text{Dimension factor} = \frac{\text{output (rpm)}}{\text{input (here: bottles / min)}}$$

for03

3/4 of a bottle corresponds to 1 revolution of the motor shaft

$$\text{Dimension factor} = \frac{1}{\text{min}} \bullet \frac{4\ \text{min}}{3\ \text{bottles}} = \frac{4}{3} \bullet \frac{1}{\text{min}} \bullet \frac{\text{min}}{\text{bottles}}$$

for04

Units should not be shortened when calculating the dimension factor.

Dim factor num	4
Dim factor den	3
Dim factor text	F/min (bottles per minute)

Example of the face value factor

Normally the reference value has a resolution of 1 rpm. In order to exploit the available resolution, the face value factor is used.

The motor speed range required is, for example, 0...1500 rpm. A more accurate resolution (i.e. 1/4 revolution) can be obtained by setting hte face value factor to 1/4.

The value 4 000 is entered, for example, in order to select 1000 rpm This is then multiplied with the face value factor to give the value 1000 rpm.

Face value num	1
Face value den	4

6.11.8 Programmable alarms

CONFIGURATION

Prog alarms

Failure supply

[194]	FS Latch
[195]	FS Ok relay open

Undervoltage

[481]	Undervolt thr [V]
[357]	UV Latch
[358]	UV Ok relay open
[470]	UV Hold off time [ms]
[359]	UV Restart time [ms]

Overvoltage

[203]	OV Activity
[361]	OV Latch
[362]	OV Ok relay open
[482]	OV Hold off time [ms]
[483]	OV Restart time [ms]

Overspeed

[1426]	Overspeed thr [rpm]
[1422]	OS Activity
[1421]	OS Latch
[1423]	OS Ok relay open
[1424]	OS Hold off time [ms]
[1425]	OS Restart time [ms]

Heatsink

[368]	HS Activity
[370]	HS Ok relay open

Overtemp motor

[365]	OM Activity
[367]	OM Ok relay open

External fault

[354]	EF Activity
[355]	EF Latch
[356]	EF Ok relay open
[502]	EF Hold off time [ms]
[501]	EF Restart time [ms]

Brake fault

[1296]	BF Activity
[1297]	BF Ok relay open

Motor I2t ovrld

[1419]	Motor I2t Activity
[1442]	Motor I2t Latch
[1420]	Motor I2t Ok relay open

Drive I2t ovrld

[1441]	Drive I2t Ok relay open

Overcurrent

[584]	Overcurrent thr [%]
[212]	OC Activity
[363]	OC Latch
[364]	OC Ok relay open

	[586]	OC Hold off time [ms]
	[585]	OC Restart time [ms]
Field loss		
	[473]	FL Activity
	[471]	FL Latch
	[472]	FL Ok relay open
	[475]	FL Hold off time [ms]
	[474]	FL Restart time [ms]
Delta frequency		
	[1437]	Delta freq thres [%]
	[1432]	DF Activity
	[1433]	DF Latch
	[1434]	DF Ok relay open
	[1435]	DF Hold off time [ms]
	[1436]	DF Restart time [ms]
SSC error		
	[8601]	Threshold
Speed fbk loss		
	[478]	SL Activity
	[477]	SL Ok relay open
	[480]	SL Hold off time [ms]
Opt2 failure		
	[639]	O2 Activity
	[640]	O2 Ok relay open
Bus loss		
	[634]	BF Activity
	[633]	BF Latch
	[635]	BF Ok relay open
	[636]	BF Hold off time [ms]
	[637]	BF Restart time [ms]
SCR test		
	[1527]	Open test act
	[1524]	SCR test enable
	[1525]	SCR diag status
	[1528]	Open SCR thr [%]
Hw opt1 failure		
	[386]	HO Activity
	[387]	HO Ok relay open
Enable seq err		
	[728]	ES Activity
	[729]	ES Latch
	[730]	ES Ok relay open

The converters of the TPD32-EV series contain extensive monitoring functions. The effect of possible alarms on the behaviour of the drive are defined in the PROG ALARMS submenu:

- Saving of alarm status
- How the drive is to react to the alarm
- Indication via the relay between terminal 35 and 36 (central alarm). The switch conditions for the relay can be defined with the **Ok relay** func parameter in the CONFIGURATION menu.
- Automatic restart
- Failure reset

For some alarms, the behaviour of the drive can be configured separately. All alarms can also be assigned to a freely programmable digital output.

Alarm	N.	Factory					Standard
		Activity	Latch	Open OK relay	Hold off time [ms]	Restart time [ms]	
Failure Supply		Disable drive	ON	ON	-	-	-
Undervoltage		Disable drive	ON	ON	0	1000	Dig. Outp. 7*
Overvoltage		Ignore	ON	ON	0	0	Dig. Outp. 6*
Overspeed		Ignore	ON	ON	0	0	
Heatsink		Disable drive	ON **	ON	-	-	*
Overtemp motor		Disable drive	ON **	ON	-	-	*
External fault		Disable drive	ON	ON	0	0	*
Brake fault		Disable drive	ON **	ON	-	-	-
Motor I2t ovrld		Disable drive	ON	ON	-	-	-
Drive I2t ovrld		Disable drive	ON **	ON	-	-	-
Overcurrent		Ignore	ON	ON	0	0	Dig. Outp. 8*
Field loss		Disable drive	ON	ON	0	0	*
Delta frequency		Ignore	ON	ON	0	0	
SSC error		Disable drive	ON **	ON	-	-	
Speed fbk loss		Disable drive	ON **	ON	8	-	*
Opt 2 failure		Disable drive	ON	ON	-	-	*
Bus loss		Disable drive	ON	ON	0	0	*
SCR test		Disable drive	ON	ON	-	-	-
Hw Opt 1 failure		Disable drive	ON **	ON	-	-	*
Enable seq err		Disable drive	ON	ON	-	-	

GD6160g

* This function can be assigned to one of the programmable digital outputs. ** Setting can not be changed.

If the serial interface or a bus system is used, the alarms can be evaluated via the **Malfunction Code** parameter. The parameters required to configure the alarm are shown in Table in Section 10 of the manual.

Activity

Warning — The alarm does not cause reaction of the drive. A warning message can be output via a digital output. When the drive is disabled, it will not restart until the failure has been canceled.

Disable drive — The alarm causes the immediate disabling of the converter. The motor runs to an uncontrolled stop.

Quick stop — When the alarm occurs, the drive stops according to the ramp set in the RAMP / QUICK STOP menu. The converter is then disabled.

Normal stop — When the alarm occurs, the drive stops according to the ramp set. The converter is then disabled.

Curr lim stop — When the alarm occurs, the converter brakes with the maximum possible current. The converter is then disabled when stopped.

Ignore — No reaction is present. A warning message can be output via a digital output.

Not all alarms can initiate a controlled stop of the drive. The possibility of setting the particular “Activity” for individual alarms is described in the table below.

Alarm	Ignore	Warning	Disable drive	Quick stop	Normal stop	Curr lim stop
Failure Supply	-	-	X	-	-	-
Undervoltage	-	-	X	-	-	-
Overvoltage	X	X	X	-	-	-
Overspeed	X	X	X	X	X	X
Heatsink	-	X	X	X	X	X
Overtemp motor	X	X	X	X	X	X
External fault	-	X	X	X	X	X
Brake fault	X	X	X	X	X	X
Motor I2t ovrld	X	X	X	-	-	-
Drive I2t ovrld	-	-	X	-	-	-
Overcurrent	X	X	X	-	-	-
Field loss	X	X	X	-	-	-
Delta frequency	X	X	X	-	-	-
SSC error	-	-	X	-	-	-
Speed fbk loss	-	X	X	-	-	-
Opt 2 failure	-	-	X	X	X	X

Alarm	Ignore	Warning	Disable drive	Quick stop	Normal stop	Curr lim stop
Bus loss	X	X	X	X	X	X
SCR test	X	X	X	-	-	-
Hw Opt 1 failure	-	X	X	X	X	X
Enable seq err	X	-	X	-	-	-

GD6165g

Latch ON The alarm is stored. The programmed actions (e.g. opening the OK relay) are enabled. This status is kept latched even if the fault condition is restored. A Reset command is required before a restart.

OFF In case of alarm, the drive is disabled and the programmed functions are enabled. The alarm is not latched. When the failure is removed, the alarm is automatically reset and the device tries restarting.

Ok relay open ON An alarm causes the opening of the potential isolated contact between terminals 35 and 36.

OFF The alarm does not cause the opening of the potential free contact of the OK relay.

Hold off time Delay time between the alarm condition detection and the alarm activation. If an alarm condition occurs the alarm stay OFF for the **Hold off time**. When this time is elapsed and the alarm is still present, the alarm activates.

Restart time If **Latch**=Off and the alarm condition persists even after the time defined via **Restart time**, the alarm is stored and no restart is possible (**Latch**=OFF).

NOTE! In Terminal mode to reset the fault the terminals enable and start must be at zero voltage. The occurrence of a failure is indicated in the display of the keypad. If “Latch”=ON is selected, a Reset command is necessary. This can be carried out, for example, by pressing the CANC key on the keypad. If a second error occurs before the first one was reset, the text “Multiple failures” will appear in the display. In this case, a reset is only possible via **Failure reset** parameter in the SPEC FUNCTIONS menu. The reset can be obtained by pressing the E key with a disabled inverter.

Failure supply Failure on the supply voltage.

It indicates a failure on the internal voltage of the regulation circuit. The message “Failure supply” occurs if an enabled converter has no voltage on the U2 and V2 terminals. If it is of a short duration and restored, a possible digital output prepared for the message is set to a Low condition. A normal reset can be carried out.

Undervoltage AC Input undervoltage.

In case of an AC Input voltage when the regulation is enabled (**Enable drive** = Enabled) the message **Undervoltage** appears. The converter is immediately disabled. To this purpose an intervention threshold is preset via the **Undervolt thr** parameter.

If the alarm is not saved (Latch=OFF), the drive tries to start automatically after the voltage has been restored. Using the ramp, when the voltage is restored, if the function Auto capture is active, the ramp output is set to the value corresponding to the current motor speed. This avoids speed jumps.

Overvoltage Armature overvoltage. Ther message appears when the armature voltage exceeds the value set via **Max out voltage** by 20%.

If the alarm is not saved (Latch = OFF), the drive will attempt to restart automatically after the voltage has been restored.

Using the ramp, when the voltage is restored, if the function Auto capture is active, the ramp output is set to the value corresponding to the current motor speed. This avoids speed jumps.

Overspeed This alarm condition is signalled if the speed limit set in the *Overspeed thr* parameter is exceeded.

Heatsink	Heatsink temperature of the converter is too high This alarm always initiates the disconnection of the device 10 seconds after the failure has been detected (Latch=ON). An external controller (PLC,etc.) can read the alarm via programmable output, RS485 or Bus and it can execute a controlled stop within a 10 second delay.
Overtemp motor	Motor temperature (connection for thermistor:terminals 78 and 79).
External Fault	External fault (no voltage on terminal 15)
Brake fault	(See chapter 6.14.8) The converter was unable to complete the transient phase between the start command and the release mechanical brake command within the time limit set in the Torque Delay parameter. The mechanical brake feedback (Brake fbk) was not received within the time allowed. The mechanical brake feedback (Brake fbk) remains for 1 second after the close brake command has been sent.
Motor I2t ovrld	If the **Motor I2t accumulator** parameter reaches 100% the relative alarm is signalled.
Drive I2t ovrld	If the **Drive I2t accumulator** parameter reaches 100% the relative alarm is signalled.
Overcurrent	Overcurrent (short-circuit / earth fault). The intervention point is determined by the **Overcurrent thr** parameter. This can also be used as indication of threshold overpass for system applications.
Field loss	Too low field current. The intervention point corresponds to 50% of the min. field current set with the **Flux current min** parameter. This alarm message is active with the enabled converter (**Enable** drive=Enabled).
Delta frequency	This alarm condition is active if the frequency of the three-phase power supply to the drive exceeds the positive or negative percentage threshold set via the **Delta freq thres** parameter. The power supply frequency (50 or 60 Hz) and thus the relative thresholds are automatically calculated by the drive as soon as the three-phase power supply is available.
SSC error	Functionality available starting from Firmware Standard=10.08A (TPD32-EV). **Threshold** parameter: thru this parameter is possible to set the number of consecutive wrong data received through the fiber optical cable without generating an SSC Error. The alarm cause reaction of the drive. A warning message can be output via a digital output. When the drive is disabled, it will not restart until the failure has been cancelled.
Speed fbk loss	No speed feedback available. When Activity=Warning in the CONFIGURATION /Speed fbk menu is chosen, the **Enable fbk bypass** parameter has to be set as “Enabled”, otherwise the drive reaches an uncontrolled speed which can not be stopped.
Opt2 failure	Failure on the card “Option 2” (optional).
Bus loss	Failure in the connection on the field bus (only in connection with an option card of bus interface).
SCR test	SCR test. This function detects the status of the drive’s SCR modules, if working correctly, in short circuit and/or open.

Note! The SCR test cannot be used for the TPD32-EV-FC and TPD32-EV series in 12-pulse configuration.

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Open test act Ignore (0) Warning (1) Disable drive (2)	1527	-	-	Disable drive	Disable drive	-
SCR test enable OFF (0) Open SCR test (1) Test SCR (2) Open/Short test (3)	1524	-	-	Off	Off	
SCR diag status No SCR Fault Short <SCR> Open W <SCR> Open F <SCR>	1525			No SCR Fault	No SCR Fault	
Open SCRX thr [%]	1528	0	100	50	50	

Open test act

Activity setting for "**Open SCR**" test (for "**Shorted SCR**" = "**Disable drive**". Not configurable).

SCR test enable

Enable SCR test with selection of test type to be run.

OFF

Open SCR test Once enabled, this selection (to detect open SCRs) always remains enabled if drive control is on (Enabled + Start),

Short SCR Test This selection (to detect SCRs in short circuit) is on at the first enabling of the drive (Enabled + Start with generation of pulses to SCR modules).

Note: If IPA 8818 = Stop mode = OFF, the SCR Short test is run without the Start command on). When the SCR Short test is run, 5s of delay is included between execution of the Start command and enabling of the control.

Open/Short test This selection simultaneously detects SCRs in short circuit and/or open. When enabled (Enable + Start), any SCRs in short are detected (requires 5s), after which any open SCRs are detected.

SCR diag status

Displays status of modules after SCR test is run.

No SCR Fault: No SCR in fault status.

Short <SCR>: SCR in short circuit detected. The number of the SCR module in short circuit is shown in <…>. (For the 2B drive, the SCR in short circuit is shown. For the 4B drive, the "pair" of modules making up part of the shorted SCR are shown.) Note: **Short <5/15>**; SCR no.5 or no.15 in short circuit in figure 3.

Open W <SCR>: Warning that an SCR is open.

Open F <SCR>: SCR open alarm. Note: Open F <4>: SCR no. 4 open in figure 2.

Figure 1: SCR test

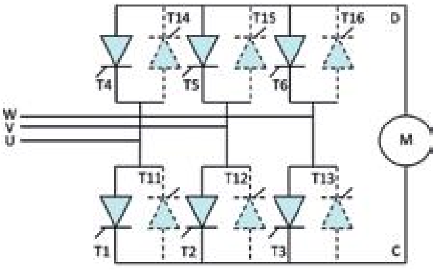


Figure 2: Example. Open SCR (white) displayed with GF_eXpress Tool

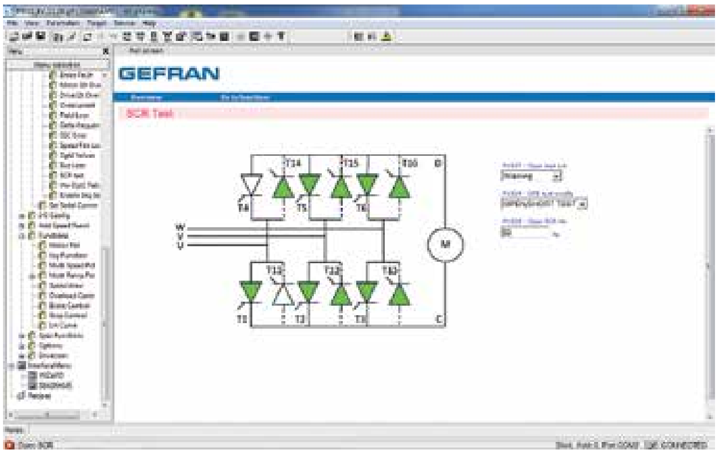
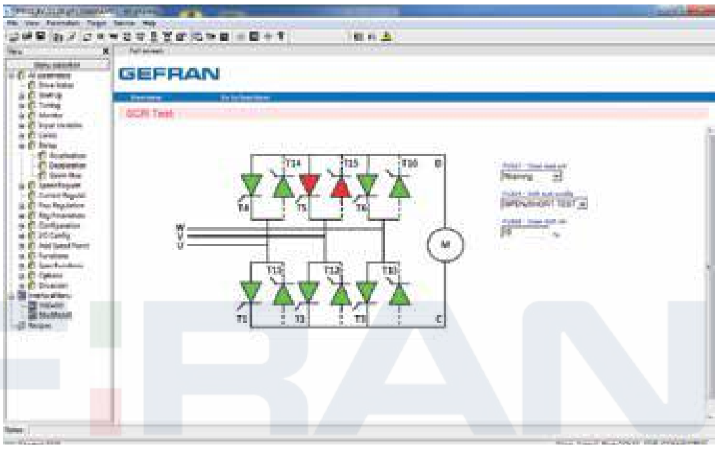


Figure 3: Example. SCR shorted (red) displayed with GF_eXpress Tool



Open SCR thr Setting of current limit for detection of open SCR. .

Note! If the current flowing through the SCR module is below 50% (factory setting) of the average level measured in the period, the message SCR open: “Open F <…>” is shown.
Higher settings increase the sensitivity of measurement. (Example: a setting of 90% is very sensitive but could generate false detections of open SCRs.)

1527 Open test act Setting	Drive Status	1525 SCR diag status	Displayed on TPD32-EV Keypad
Open test act = Disable Drive		Open W <SCR> @ 50% of Internal Integer value	-
	DISABLED	Open F <SCR> @ 100% of Internal Integer value	Open SCR
Open test act = Ignore		Open W <SCR> @ 50% of Internal Integer value	-
	IGNORE	Open F <SCR> @ 100% of Internal Integer value	-
Open test act = Warning		Open W <SCR> @ 50% of Internal Integer value	-
	WARNING	Open F <SCR> @ 100% of Internal Integer value	Open SCR

Note - Internal integrator

At each line frequency period, the software compares the current that flows when the SCRs are active to the average current in the period, increasing or decreasing the value of the integrator if the current flowing through the SCR is below or above, respectively, that of the period based on the set limit.

Example:
- Limit at 50% (default) - IPA 1528 Open SCR thr
The current flowing through the SCR is 30% of the average in the period --> The integrator is increased by 20 counts.
The current flowing through the SCR is 60% of the average in the period --> The integrator is

decreased by 10 counts (if greater than 0).

Integrator default limit generating Warning signal = 1024 counts
Integrator default limit generating Fault signal = 2048 counts

Hw opt1 failure Failure on the card “Option 1” (optional).

Enable seq err Wrong drive enabling sequence. The correct sequence is as follows:

Case a: **Main commands** = Terminal

1 - Regulation board power-up: Enable terminal (term.12) in any state.
2 - Drive initialization. Max duration time: 5 s.
3 - End of drive initialization. The Enable drive terminal (12) is L (0V).
4 - Delay time during which the Enable drive terminal must be L (0V): 1s.
5 - Drive enabling. Terminal 12 is H (+24V).

If at the end of the drive initialization (step 3) or during the 1s delay time the Enable drive terminal (term. 12) is High (+24V) a fault is detected

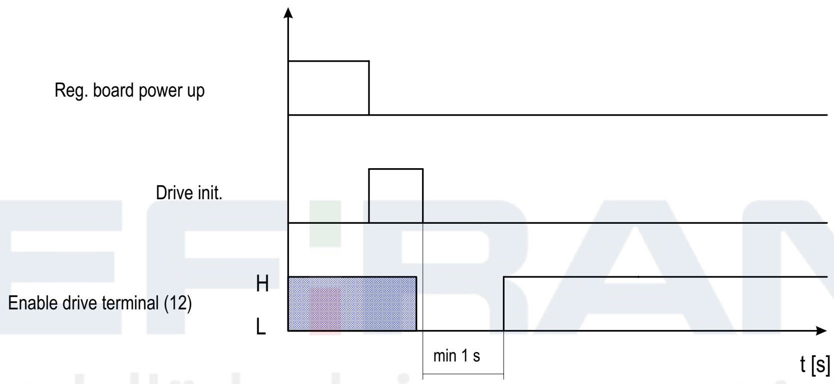


*Figure 6.11.8.1 Drive enabling sequence: **Main command** = Terminals*

Case b: **Main command** = Digital

1 - Regulation board power-up: Enable terminal (term.12) in any state.
2 - Drive initialization. Max duration time: 5 s.
3 - End of drive initialization.
4 - Delay time during which the Enable drive terminal must be L (0V) and **Enable drive** [314] = Disable (0): 1s. During this time the Process data channels setup initialization occurs.
5 - Drive enabling. Terminal 12 is H (+24V) and **Enable drive** [314] = Enable (1).

If at the end of the drive initialization (step 3) or during the 1s delay time the Enable drive terminal (term. 12) is High (+24V) and **Enable drive** [314] = Disable (0) a fault is detected.

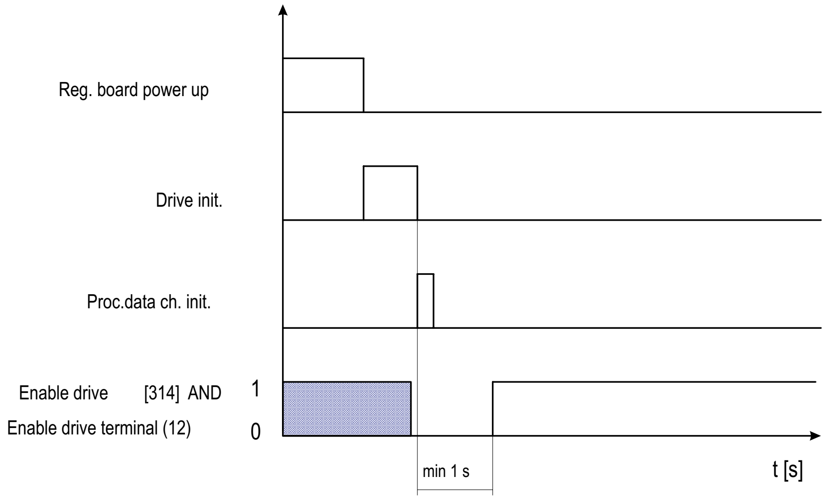


*Figure 6.11.8.2 Drive enable sequence: **Main command** = Digital*

In case of fault the reset sequence is as follows:

Case a: **Latch** = ON

1 - Set Enable drive terminal (term. 12) = L (0V)

2 - Set **Enable drive** [314] = Disable (0)

3 - If **Main commands** = Terminals set Start/Stop terminal (term. 13) = L (0V)

4 - Failure reset command. The failure is reset and the drive can work normally.

Case b: **Latch** = OFF

1 - Set Enable drive terminal (term. 12) = L (0V) and **Enable drive** [314] = Disable (0) for at least 30 ms. The failure is automatically reset.

NOTE: In case of Enable seq err alarm, the behaviour of the Ok Relay function can be affected only if **OK relay funct** = Drive Healty. If **OK relay funct** = Ready to start, the contact will be open anyway.

6.11.9 Address for bus operation

CONFIGURATION

Set serial comm

[319]	Device address
[408]	Ser answer delay
[323]	Ser protocol sel
[326]	Ser baudrate sel

The configuration modes relating to the serial communication are defined in the submenu **Set serial comm**.

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Device address	319	0	127	0	0	-
Ser answer delay	408	0	900	0	0	-
Ser protocol sel SLINK3* (0) MODBUS RTU (1) JBUS (2)	323	0	2	SLINK3 (0)	SLINK3 (0)	-
Ser baudrate sel 19200 (0) 9600 (1) 4800 (2) 2400 (3) 1200 (4)	326	0	4	9600 (1)	9600 (1)	-

* For SLINK3 the baud rate is steady at 9600.

NOTE! The setting of Ser protocol sel and Ser baudrate sel become active during the Drive start up: they must therefore be stored and the drive has to be switched off. See the specific manual for the numbering system of the registers and coils MODBUS RTU and JBUS.

Device address Address with the drive can be accessed if it is networked via the RS485 interface. (For connection see section 4.5. “Serial interface”).

Ser answer delay Setting of the minimum delay between the receiving of the last byte from the converter and the beginning of its answer. This delay avoids conflicts on the serial line, in case the interface RS485 of the master is not arranged for an automatic communication Tx/Rx.

The parameter only concerns the working with standard serial line RS485.

EXAMPLE: if the delay of the commutation Tx/Rx on the master is at its max. 20ms, the setting of the parameter **Ser answer delay** should be at a higher numeber of 20ms: 22ms.

Ser protocol sel Serial protocol signaling procedure.

Ser baudrate sel Baud rate selection (except for SLINK3)

6.11.10 Password

CONFIGURATION			SERVICE	
	[85]	Pword 1		Password 2

Passwords are used by the operator to protect the parameters from unauthorized accss.

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Pword 1	85	0	99999	0	0	-

Pword 1 Protects the parameters entered by the user from unauthorized changes. It allows the reset of failure messages **(Failure reset)** and to change on the keypad the **Control mode** even when the bus functioning system has been chosen (**Control mode**= Bus). The password can be freely defined by the user in the form of a 5-digit combination.

Proceed as follows to activate **Pword 1**:
- Select **Pword 1** in the CONFIGURATION menu
- This indicates whether the Password is active (Enabled) or not (Disabled)
- If not, press E and enter the password (see Commissioning).
- Press E once more. The keypad indicates that the Password is active (Enabled).
- The password must be saved so that it is valid when the power supply is switched off and then later switched back on. —> Saving parameters

Proceed as follows to unlock the **Pword 1**:
- Select **Pword** in the CONFIGURATION menu
- The display indicates whether the password is active (Enabled) or not (Disabled)
- If yes, press E and enter the password (see start-up)
- Press E again. The display now indicates that the password is not active (Disabled)
- This configuration must be saved in order to keep the password switched off even after the power supply is turned off and switched back on again. -> Saving parameters

The message **Wrong password** appears if an incorrect password is entered.

If the drive shows the message **EEPROM** the password is deactivated. This takes place the first time the drive is switched on and after a possible change of the operating system.

On delivery the Service menu of the drive is protected by **Password 2**. No **Pword 1** has been entered. The user has free access to all parameters.

Password 2 cannot be deactivated.

NOTE: In case personal password has been forgotten, it is possible to deactivate it through the setting of the universal password.
The code of this password is: 51034
The setting mode of this one remains unchanged compared to the personal password.

6.12 I/O CONFIG

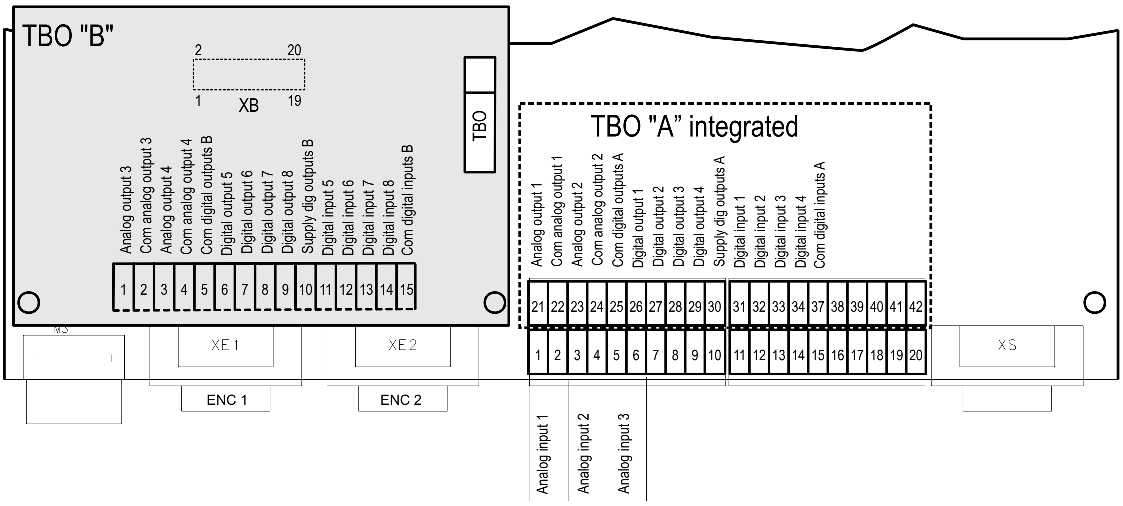


Figure 6.12.1: Arrangement of the programmable I/O

Apart from the terminals which have fixed functions (e.g. for Enables), the converters of the TPD32-EV series provide the possibility of assigning freely programmable inputs/outputs to particular functions. This can either be carried out via the keypad, the serial interface or any bus connection present.

The freely programmable inputs/outputs are factory set for assignment to the most frequently required functions. However, these can be modified by the user accordingly to meet the requirements of the applicationn at hand.

The device inputs/outputs are subdivided as follows:

- converter with integrated TBO “A”:

3	Analog inputs (1...3), designed as differential inputs
2	Analog outputs (1 and 2) with common reference point
4	Digital outputs (1...4) with common reference point and common voltage supply
4	Digital inputs (1...4) with common reference point.

When other digital inputs/outputs and/or analog outputs are required, together with the already existing ones, the TBO option card has to be used, which is inserted on the converter regulation card. A converter card can also be mounted (see figure):

- with TBO “B” option card:

Option “B”:	2	Analog outputs (3 and 4) with common reference point
	4	Digital outputs (5 ...8) with common reference point and common voltage supply
	4	Digital inputs (5...8) with common reference point.

NOTE! If parameters are assigned to particular terminals, the parameter value (e.g. speed reference value) can only be entered via this terminal and not via the keypad or bus.

6.12.1 Analog Ouputs

I/O CONFIG
- **Analog outputs**
  - **Analog output 1**
    - [66] Select output 1
    - [62] Scale output 1
  - **Analog output 2**
    - [67] Select output 2
    - [63] Scale output 2
  - **Analog output 3**
    - [68] Select output 3
    - [64] Scale output 3
  - **Analog output 4**
    - [69] Select output 4
    - [65] Scale output 4

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Select output 1	66	0	94	Actual speed (8)	Actual speed (8)	
Scale output 1	62	Float	-10.000	+10.000	0.000	0.000
Select output 2	67	0	94	Motor current (16)	Motor current (16)	
Scale output 2	63	-10.000	+10000	0.000	0.000	
Select output 3	68	0	94	Flux current (27)	Flux current (27)	*
Scale output 3	64	-10.000	+10000	0.000	0.000	
Select output 4	69	0	94	Output voltage (20)	Output voltage (20)	*
Scale output 4	65	-10.000	+10000	0.000	0.000	

* TBO option card (TBO “B”) has to be installed.

Select output XX Selection of the parameter assigned as a variable to the corresponding analog output. The following assignments are possible:

OFF	0	**Output voltage** [3)]	20	**F act spd** [1)]	81
Speed ref 1 [1)]	1	**Analog input 1** [4)]	24	**F T curr** [2)]	82
Speed ref 2 [1)]	2	**Analog input 2** [4)]	25	**Speed draw out** [9)]	84
Ramp ref 1 [1)]	3	**Analog input 3** [4)]	26	**Output power** [10)]	88
Ramp ref 2 [1)]	4	**Flux current** [5)]	27	**Roll diameter**	89
Ramp ref [1)]	5	**Pad 0** [6)]	31	**Act tension ref**	90
Speed ref [1)]	6	**Pad 1** [6)]	32	**Torque current**	91
Ramp out [1)]	7	**Pad 4** [6)]	33	**W reference**	92
Actual speed [1)]	8	**Pad 5** [6)]	34	**Actual comp**	93
T current ref 1 [2)]	9	**Flux reference** [7)]	35	**Brake current** [11)]	94
T current ref 2 [2)]	10	**Pad 6** [6)]	38	**Field cur ref** [12)]	95
T current ref [2)]	11	**PID output** [8)]	39	**Motor Pot Out**	96
Speed reg out [2)]	15	**Out vlt level** [3)]	79		
Motor current [2)]	16	**Flux current max** [5)]	80		

[11)] Output that monitors the value of the **Torque proving** parameter.

[12)] It indicates the field current reference.

Scale output XX Scaling of the analog output concerned

[1)] With a scaling factor of 1 the output supplies 10 V when the reference value or speed corresponds to the value defined by **Speed base value**.

[2)] With a scaling factor of 1, the analog output = 10V when the reference or current is 100%.

[3)] With a scaling factor of 1 the output supplies 10V when the voltage corresponds to the Volt value defined via **Max out voltage**.

4) With a scaling factor of 1 the output supplies 10V when the voltage reaches 10V on the analog input (with scaling factor and **Tune value** of the input= 1). See figure 6.12.2.1.

5) With a scaling factor of 1 the output supplies 10V when the field current corresponds to **Nom flux curr**.

6) With a scaling factor of 1 the output supplies 10V when a Pad value corresponds to 2047.

7) With a scaling factor of 1 the output supplies 10V when the field current reference corresponds to **Nom flux curr**.

8) For the max. full-scale values, refer to paragraph 6.16.3 **PID function**

9) With a scaling factor of 1 the output is 10V when the **Speed ratio** = 20000.

10) With a scale factor equal to 1, the output supplies 5 volts to the rated power given by: **Full load current** * **Max out voltage**

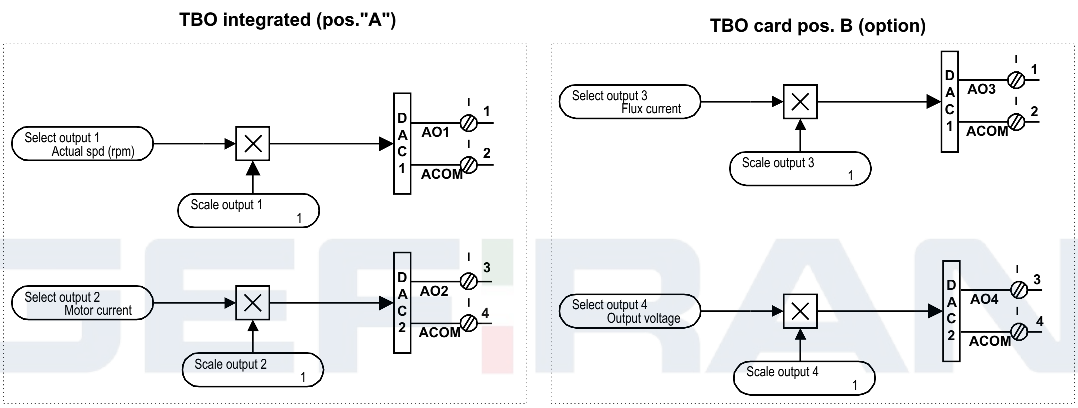


Figure 6.12.1.1: Option card, analog output blocks

Example for calculating the scaling **factor Scale output XX**:

You have at your disposal an analog display device for indicating the speed of the drive. The instrument has a measuring range of 0 ... 2 V.

This means that at maximum speed 2 V is required at the analog output of the converter. A scaling factor of 1 would supply 10 V. (Scaling factor = 2 V / 10 V = 0.200).

NOTE! Using Regen Drive (4 quadrant) the analog output supplies bipolar 10V.

6.12.2 Analog Inputs

I/O CONFIG

- **Analog inputs**
  - **Analog input 1**

[70]	Select input 1
[295]	An in 1 target
[71]	Input 1 type
[389]	Input 1 sign
[72]	Scale input 1
[73]	Tune value inp 1
[259]	Auto tune inp 1
[792]	Input 1 filter [ms]
[1042]	Input 1 compare
[1043]	Input 1 cp error
[1044]	Input 1 cp delay
[74]	Offset input 1

  - **Analog input 2**

[75]	Select input 2
[296]	An in 2 target
[76]	Input 2 type
[390]	Input 2 sign
[77]	Scale input 2
[78]	Tune value inp 2
[260]	Auto tune inp 2
[801]	Input 2 filter [ms]
[79]	Offset input 2

  - **Analog input 3**

[80]	Select input 3
[297]	An in 3 target
[81]	Input 3 type
[391]	Input 3 sign
[82]	Scale input 3
[83]	Tune value inp 3
[261]	Auto tune inp 3
[802]	Input 3filter [ms]
[84]	Offset input 3

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Select input 1	70	0	32	Ramp ref 1 (4)	Ramp ref 1 (4)	Terminals 1/2
An in 1 target Assigned (0) / Not assigned (1)	295	0	1	0	0	
Input 1 type -10V ... + 10 V (0) 0...20 mA, 0...10 V (1) 4...20 mA (2)	71	0	2	± 10 V	± 10 V	
Input 1 sign Positive (1) / Negative (0)	389	0	1	1	1	
Input 1 sign +	-					*
Input 1 sign -	-					*
Scale input 1	72	-10000	+10000	1.000	1.000	

Tune value inp 1	73	0.100	10.000	1.000	1.000	
Auto tune inp 1 Auto tune	259					
Input 1 filter [ms]	792	0	1000	0	0	
Input 1 compare	1042	-10000	+10000	0	0	
Input 1 cp error	1043	0	10000	0	0	
Input 1 cp delay	1044	0	65000	0	0	
Input 1 cp match Input 1 not thr.val. (0) Input 1=thr.val (1)	1045	0	1	-	-	
Offset input 1	74	-32768	+32767	0	0	
Select input 2	75	0	32	OFF (0)	OFF (0)	Terminals 3/4
An in 2 target Assigned (0) / Not assigned (1)	296	0	1	0	0	
Input 2 type -10V ... + 10 V (0) 0...20 mA, 0...10 V (1) 4...20 mA (2)	76	0	2	± 10 V	± 10 V	
Input 2 sign Positive (1) / Negative (0)	390	0	1	1	1	
Input 2 sign +	-					*
Input 2 sign -	-					*
Scale input 2	77	-10.000	+10000	1.000	1.000	
Tune value inp 2	78	0.100	10.000	1.000	1.000	
Auto tune inp 2 Auto tune	260					
Input 2 filter [ms]	801	0	1000	0	0	
Offset input 2	79	-32768	+32767	0	0	
Select input 3	80	0	32	OFF (0)	OFF (0)	Terminals 5/6
An in 3 target Assigned (0) / Not assigned (1)	297	0	1	0	0	
Input 3 type -10V ... + 10 V (0) 0...20 mA, 0...10 V (1) 4...20 mA (2)	81	0	2	± 10 V	± 10 V	
Input 3 sign Positive (1) / Negative (0)	391	0	1	1	1	
Input 3 sign +	-					*
Input 3 sign -	-					*
Scale input 3	82	-10.000	+10000	1.000	1.000	
Tune value inp 3	83	0.100	10.000	1.000	1.000	
Auto tune inp 3 Auto tune	261					
Input 3 filter [ms]	802	0	1000	0	0	
Offset input 3	84	-32768	+32767	0	0	

* This function can be assigned to one of the programmable digital inputs.
** This parameter can be assigned to one of the programmable digital outputs.

Select input XX Selection of the parameter to be assigned its value via an analog input. The following assignments are possible:

OFF	0	**T current lim +** 2)	10	**Flux current max**	25
Jog reference 1)	1	**T current lim -** 2)	11	**Out vlt level**	26
Speed ref 1 1)	2	**Pad 0** 3)	12	**Speed ratio** 5)	28
Speed ref 2 1)	3	**Pad 1** 3)	13	**Tension red**	29
Ramp ref 1 1)	4	**Pad 2** 3)	14	**Tension ref**	30
Ramp ref 2 1)	5	**Pad 3** 3)	15	**Preset 3**	31
T current ref 1 2)	6	**Load comp**	19	**Brake Ref** *	32
T current ref 2 2)	7	**PID offset 0** 4)	21		
Adap reference 1)	8	**PI central v3** 4)	22		
T current limit 2)	9	**PID feed-back** 4)	23		

* Reference for the **Torque proving** parameter setting (See "6.14.8 Brake control" on page 271).

An in xx target Assign the analog input xx sampling. If **assigned**, the sampled value is copied into the parameter programmed on the analog input. If **not assigned**, the programmed parameter takes the value preset via keypad or RS485 or BUS, before to assign an analog input. Exception are the “PAD” parameters, where the last value on the analog input is stored when An in XX target = not assigned is executed.

Input XX type Selection of input type (voltage or current input)

Jumpers on the regulator card of the TPD32-EV should be fitted or removed according to the input signal used. The inputs of the device are factory set for voltage signls.

Analog Input	**Input Signal**	
	-10 V ... + 10 V **0 - 10 V**	**0 - 20 mA** **4 - 20 mA**
Analog input 1	S9 = OFF	S9 = ON
Analog input 2	S10 = OFF	S10 = ON
Analog input 3	S11 = OFF	S11 = ON

GD6185g

ON — Jumper fitted

OFF — Jumper not fitted

10 V...+10 V — A voltage of max ±10 V is connected to the analog input concerned. If the signal is used as a reference value, a polarity reversal can be used to reverse the rotation direction of the drive (only with TPD32-EV...4B converters). The TPD32-EV...2B converters accept as speed reference only positive references. Negative references are not accepted and the drive does not start.

0-10V, 0-20mA — A voltage of max. 10 V or a current signal of 0...20 mA is connected to the analog input concerned. The signal must be positive. If the signal is used as a reference value for TPD32-EV...4B converters, the rotation direction can be reversed via the **Input XX sign +** and **Input XX sign -** parameters.

4-20 mA — A current signal of 4...20 mA is connected to the analog input concerned. The signal must be positive. If the signal is used as a reference value for TPD32-EV...4B converters, the drive rotation direction can be reversed via the **Input XX sign +** and **Input XX sign -** parameters.

Input XX sign Selection of rotation direction when operated via the serial interface or bus for the tetraquadrant TPD32-EV...4B converters.

Input XX sign + Selection of “Clockwise” rotation when operated via the terminal strip for the TPD32-EV...4B converters, when the reference value is only given with one polarity.

High — Clockwise selected

Low — Clockwise not selected

Input XX sign - Selection of “Counter-clockwise” rotation when operated via the terminal strip for the TPD32-EV...4B converters, when the reference value is only given with one polarity.

High — Counterclockwise selected

Low — Counterclockwise not selected

If both **Input XX sign+** and **Input XX sign-** are 0 or 1 the reference value is zero.

Scale input XX Scaling of the corresponding analog input

1) With a scaling factor of 1 and a **Tune value inp XX** = 1, 10 V or 20 mA on the input correspond to the **Speed base value**.

2) With a scaling factor of 1 and a **Tune value inp XX** = 1, 10 V or 20 mA on the input correspond to max possible current.

3) With a scaling factor of 1, 10V or 20 mA in the input correspond to the Pad value of 2047.

[4] For the max. full scale values, refer to paragraph 6.16.3 **PID function**

[5] With a scaling factor of 1.0 and **Tune value inp** XX=1, 10V or 20mA correspond to **Speed ratio** = 20000.

Tune value inp XX Fine tuning of the input when the max. signal does not exactly correspond to the rated value. Example see below.

Auto tune inp XX Automatic fine tuning of the input. If this command is given, **Tune value inp XX** is automatically selected so that the input signal present corresponds to the max. variable value, such as the **Speed base value**. Two conditions are necessary for automatic fine tuning:

Input voltage greater than 1 V or input current greater than 2 mA

Positive polarity. The value found is automatically set for the other direction for the TPD32-EV...4B converters.

Note: The automatically calculated value can, if necessary, be modified manually via **Tune value inp XX**.

Input X filter Filtering of analog input X measurement.

Offset inp XX If the analog signal has an offset or if the variable assigned to the input already has a value although there is no input signal present, this can be compensated via the **Offset inp XX**.

The converter is factory set so that analog values as +10V/-10V.

With field bus operation (Option), the **Input XX sign** parameter specifies the sign for the rotation direction.

If a parameter is already internally assigned (e.g. if **Speed ref 1** is automatically connected with the ramp output when the ramp is enabled), it will no longer appear in the list of parameters that can be assigned to an analog input.

The **Input XX sign +** and **Input sign -** parameters cannot be addressed via the serial interface.

Example 1: The speed reference value of a drive is defined with an external voltage of 5V. With this value the drive should reach the max. allowed speed (set via **Sped base value**).

As parameter **Scale input XX** the scaling factor 2 is entered (10V : 5V)

Example 2: An external analog reference reaches only max. 9.8V instead of 10V.

As parameter **Tune value inp XX** 1.020 is entered (10V : 9.8V).

The same result would have been obtained via the **Auto tune inp XX** function. The appropriate parameters would have to be entered in the menu of the keypad. The maximum possible analog value (in this case 9.8 V) would have to be present at the terminal with a positive polarity. The keypad will adjust the "Tune value" automatically if the E key is pressed.

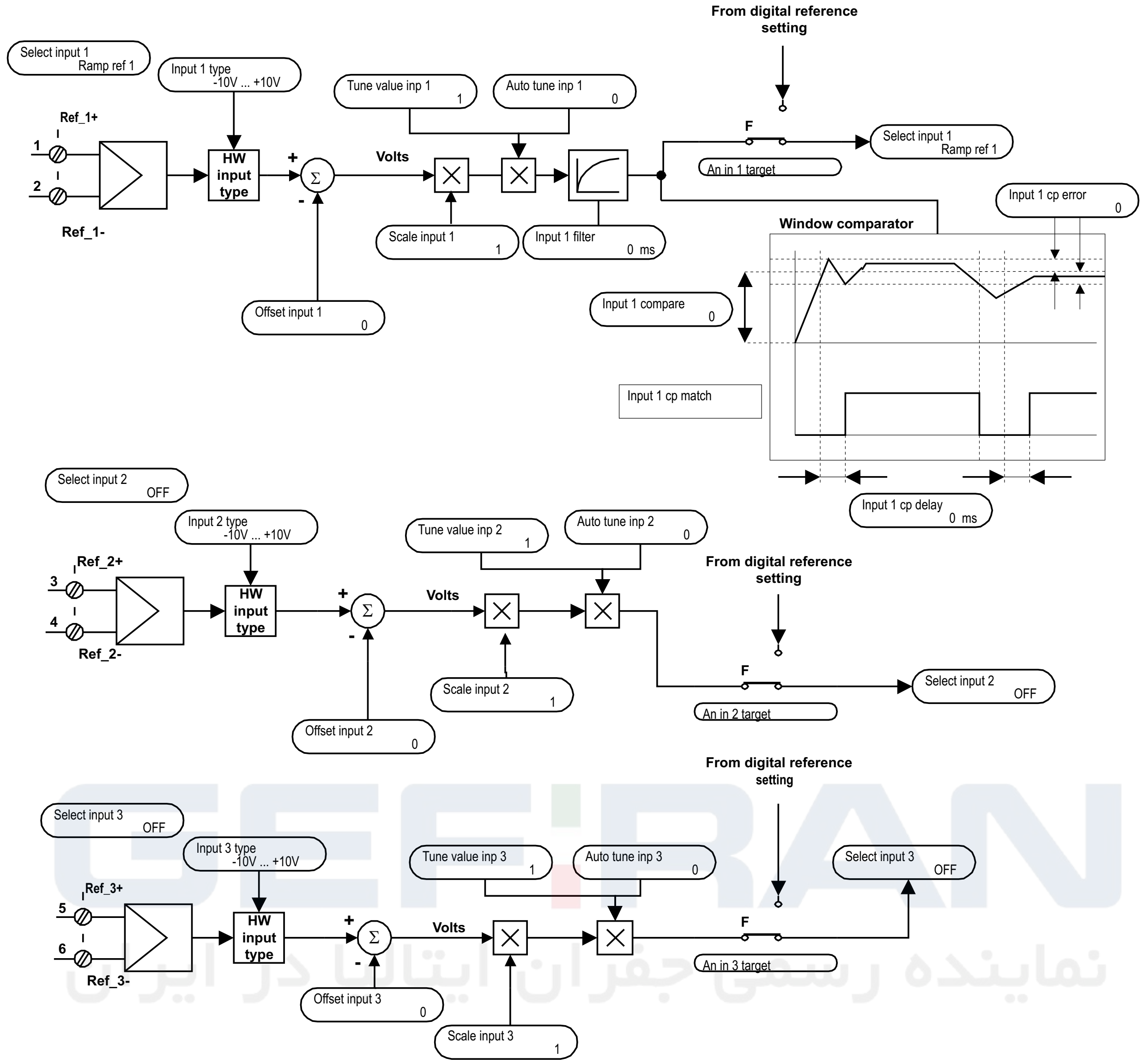


Figure 6.12.2.1: Analog input

Analog Input 1 window comparator

This function allows to signal the match of a programmable value on analog input 1.

Input 1 compare Sets the level for the comparator.

Input 1 cp error Defines a tolerance window around **Input 1 compare**.

Input 1 cp delay Millisecond delay during the switching from the low to the high level **Input 1 cp match**.

Input 1 cp match Signalling output of the video comparator.
It can be read through a Field Bus LAN or digital output.

High	**Analog input 1** value is within the comparation window.
Low	**Analog input 1** value is out the comparation window.

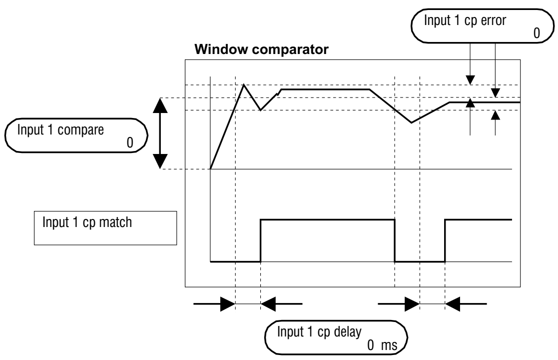


Figure 6.12.2.2: Analog Input 1 window comparator

NOTE! How to calculate Input 1 compare and Input 1 cp error parameters:
Input 1 compare = (Compare value) * 10000 / (Full range value)
Input 1 error = (Tolerance half window) 10000 / (Full range value)

Example 1:

Select analog input 1 to **Ramp ref 1**
Speed base value equal to 1500 [RPM]
10Volt or 20 mA on analog input 1 (Ramp ref 1=Speed base value).
The application requires a signaling at 700 [RPM] via a digital output, with a tolerance window equal to 100 [RPM]
Input 1 cp match assigned to a programmable digital output.
Input 1 compare = 700 * 10000 / 1500 = 4667
Input 1 cp error = 100 * 10000 / 1500 = 666

Example 2:

Select analog input 1 to **Ramp ref 1**
Speed base value equal to 1500 [RPM]
10Volt or 20 mA on **Analog input 1** (**Ramp ref 1**=**Speed base value**).
The application requires a signaling at –700 [RPM] via LAN, with a tolerance window equal to ±100 [RPM]
Input 1 compare = -700 * 10000 / 1500 = -4667
Input 1 cp error = 100 * 10000 / 1500 = 666

Example 3:

Select analog input 1 to **Pad 0**
10Volt or 20 mA on **Analog input 1** corresponds to Pad 0=2047.
The application requires a signaling at 700 [count] via a digital output, with a tolerance window equal to ±50 [count]
Input 1 cp match assigned to a programmable digital output
Input 1 compare = 700 * 10000 / 2047 = 3420
Input 1 cp error = 50 * 10000 / 2047 = 244

Example 4:

Select analog input 1 to **PID feedback**
10Volt or 20 mA on **Analog input 1** corresponds to **PID feedback**=10000.
The application requires a signaling at 4000 [count] via a digital output, with a tolerance band equal to ±1000 [count]
Input 1 cp match assigned to a programmable digital output
Input 1 compare = 4000 * 10000 / 10000 = 4000
Input 1 cp error = 1000 * 10000 / 10000 = 1000

Example 5:

Select input 1 to **T current lim**
10Volt or 20 mA on **Analog input 1** corresponds to **T current lim** = 100 [%]
The application requires a signaling at 50 [%] via a digital output, with a tolerance band equal to ±2 [%]
Input 1 cp match assigned to a programmable digital output
Input 1 compare = 50 * 10000 / 100 = 5000
Input 1 cp error = 2 * 10000 / 100 = 200

6.12.3 Digital Outputs

I/O CONFIG

Digital outputs

[145]	Digital output 1
[1267]	Inversion out 1
[146]	Digital output 2
[1268]	Inversion out 2
[147]	Digital output 3
[1269]	Inversion out 3
[148]	Digital output 4
[1270]	Inversion out 4
[149]	Digital output 5
[1271]	Inversion out 5
[150]	Digital output 6
[1272]	Inversion out 6
[151]	Digital output 7
[1273]	Inversion out 7
[152]	Digital output 8
[1274]	Inversion out 8
[629]	Relay 2
[1275]	Inversion relay 2

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Digital output 1	145	0	77	Ramp + (8)	Ramp + (8)	
Inversion out 1 Enabled (1) / Disabled (0)	1267	0	1	Disabled (0)	Disabled (0)	
Digital output 2	146	0	77	Ramp - (9)	Ramp - (9)	
Inversion out 2 Enabled (1) / Disabled (0)	1268	0	1	Disabled (0)	Disabled (0)	
Digital output 3	147	0	77	Spd thr. (2)	Spd thr. (2)	
Inversion out 3 Enabled (1) / Disabled (0)	1269	0	1	Disabled (0)	Disabled (0)	
Digital output 4	148	0	77	Overld avail. (6)	Overld avail. (6)	
Inversion out 4 Enabled (1) / Disabled (0)	1270	0	1	Disabled (0)	Disabled (0)	
Digital output 5	149	0	77	Curr lim. state (4)	Curr lim. state (4)	
Inversion out 5 Enabled (1) / Disabled (0)	1271	0	1	Disabled (0)	Disabled (0)	
Digital output 6	150	0	77	Over-voltage (12)	Over-voltage (12)	
Inversion out 6 Enabled (1) / Disabled (0)	1272	0	1	Disabled (0)	Disabled (0)	
Digital output 7	151	0	77	Under-voltage (11)	Under-voltage (11)	
Inversion out 7 Enabled (1) / Disabled (0)	1273	0	1	Disabled (0)	Disabled (0)	
Digital output 8	152	0	77	Over-current (14)	Over-current (14)	
Inversion out 8 Enabled (1) / Disabled (0)	1274	0	1	Disabled (0)	Disabled (0)	
Relay 2	629	0	77	Stop ctrl (23)	Stop ctrl (23)	
Inversion relay 2 Enabled (1) / Disabled (0)	1275	0	1	Disabled (0)	Disabled (0)	

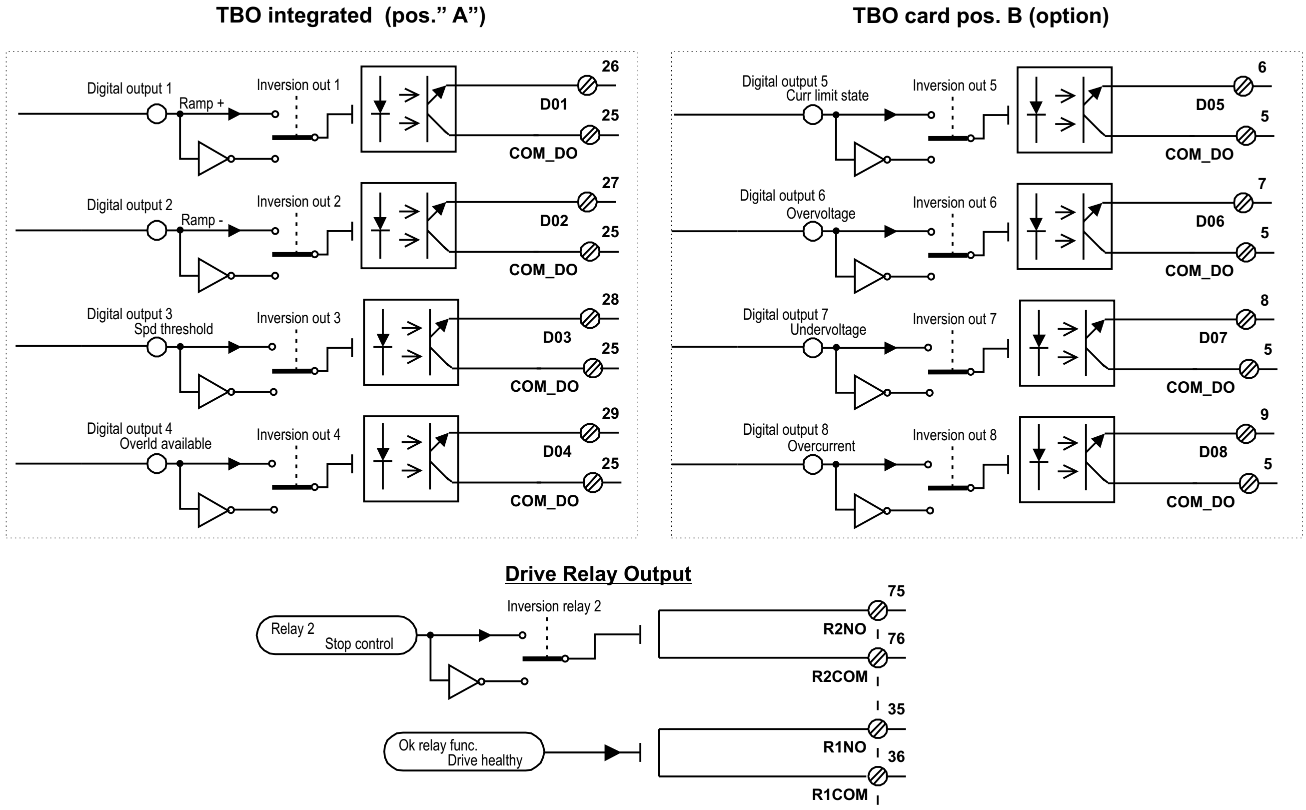


Figure 6.12.3.1: Digital outputs

Digital output XX Selection of the parameter that is assigned to the digital output concerned. The following assignments are possible:

OFF	0	**Pad A bit**	18	**Acc state**	60
Speed zero thr	1	**Pad B bit**	19	**Dec state**	61
Spd threshold	2	**Virt dig input**	20	**Brake comand** [2]	62
Set speed	3	**Torque sign**	21	**Brake failure** [3]	63
Curr limit state	4	**Stop control**	23	**Mot ovrld preal** [4]	65
Drive ready [19]	5	**Field loss**	24	**Dvr ovrld preal** [5]	66
Mot ovrld avail [6]	6	**Speed fbk loss**	25	**Dvr ovrld avail** [7]	67
Overload state	7	**Bus loss**	26	**I2t mot ovrld fail** [8]	68
Ramp +	8	**Hw opt1 failure**	28	**I2t drv ovrld fail** [9]	69
Ramp -	9	**Opt2 failure**	29	**Mot cur threshld** [10]	70
Speed limited	10	**Encoder 1 state**	30	**Overspeed** [11]	71
Undervoltage	11	**Encoder 2 state**	31	**Delta frequency** [12]	72
Overvoltage	12	**Enable seq err**	35	**Drv rdy to start** [14]	76
Heatsink	13	**Diameter calc st** [1]	38	**BUS control mode** [15]	77
Overcurrent	14	**Drive healthy** [13]	42	**SSC Error** [16]	79
Overtemp motor	15	**Input 1 cp match**	49	**Firing** [17]	80
External fault	16	**Diam reached**	58	**Cont Current** [18]	81
Failure supply	17	**Spd match compl**	59		

1) Refer to paragraph 6.16.3 **PID function**

2) Mechanical brake relay control; indicates the presence of adequate current to sustain the load (**Torque proving** parameter).

3) Mechanical brake alarm signal.

4) this signal is enabled when the thermal image of the motor **Motor I2t accum** = 90 % and returns to 0 when **Motor I2t accum** = 0.

5) this signal is enabled when the thermal image of the drive **Drive I2t accum** = 90 % and returns to 0 when **Drive I2t accum** = 0.

6) The default condition of this signal is enabled. It is disabled when **Motor I2t accum** = 100 % and is re-enabled when **Motor I2t accum** = 0.

7) The default condition of this signal is enabled. It is disabled when **Drive I2t accum**

= 100 % and is re-enabled when **Drive I2t accum** = 0.

8) I2t motor overload alarm signal.

9) I2t drive overload alarm signal.

10) current threshold exceeded signal.

11) overspeed alarm signal.

12) frequency alarm signal.

13) The following drive condition is signalled, via a digital output:
- regulator power supply present
- no alarms present

14) The following drive condition is signalled, via a digital output:
- power supply present
- no alarms present
- Enable signal present
- three-phase network synchronisation achieved
- excitation current present (only necessary if Field Loss alarm Activity is other than IGNORE)

15) A signal is sent via a digital output to indicate whether the drive is in a data transfer via fieldbus condition (Control mode = BUS).

16) Indicates the absence of communication by the slave with three-phase external exciter control.

17) Active when the converter is firing the SCRs of the armature bridge.

18) Active when the converter output current is continuous. Its value has to be considered only when the armature power section of the converter is powered.

19) Active when the unlocking signals at terminals 12,13,14,15 are high.

Inversion out XX Reverse the digital outputs signal.

Relay 2 Selection of the parameters, that are assigned to the relay contact on terminals 75 and 76 has to trip.

NOTE! As for an alarm signal the following are valid:
Output = Low and open relay contact: Alarm
Output = High and closed relay contact: No alarm
See the chapters concerning the output behavior with other messages.

6.12.4 Digital Inputs

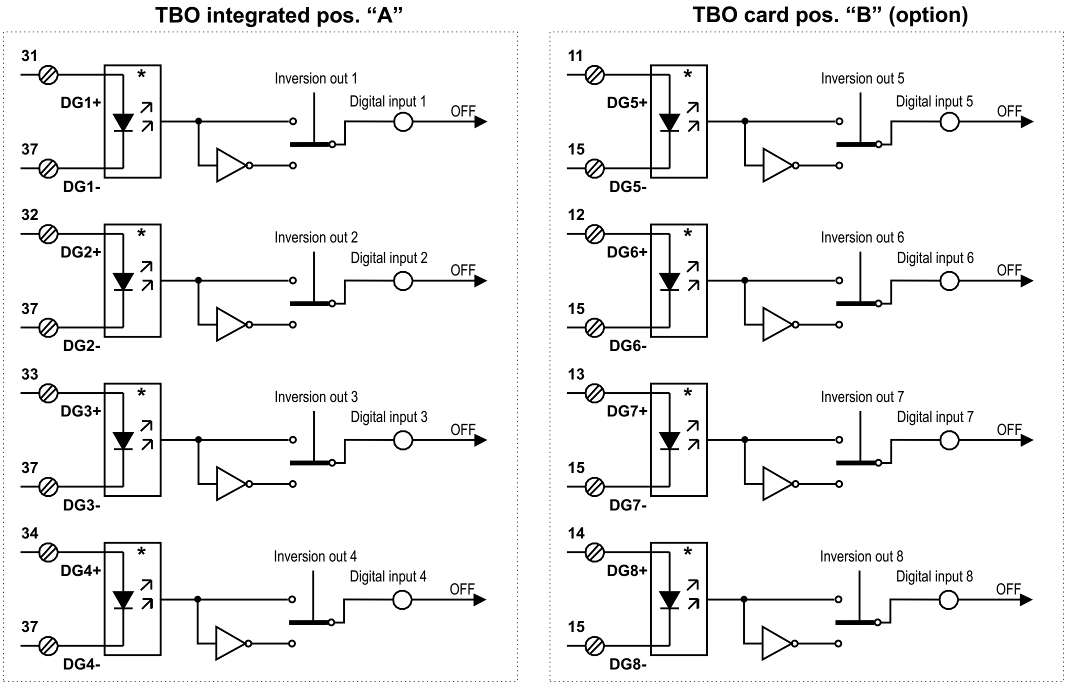


Figure 6.12.4.1: Digital inputs

I/O CONFIG

Digital inputs

137	Digital input 1
[1276]	Inversion in 1
[138]	Digital input 2
[1277]	Inversion in 2
[139]	Digital input 3
[1278]	Inversion in 3
[140]	Digital input 4
[1279]	Inversion in 4
[141]	Digital input 5
[1280]	Inversion in 5
[142]	Digital input 6
[1281]	Inversion in 6
[143]	Digital input 7
[1282]	Inversion in 7
[144]	Digital input 8
[1283]	Inversion in 8

Parameter	N.	Value				Standard configuration
		min	max	factory America	factory Standard	
Digital input 1	137	0	87	OFF (0)	OFF (0)	
Inversion in 1 Enabled (1) / Disabled (0))	1267	0	1	Disabled (0)	Disabled (0)	
Digital input 2	146	0	87	OFF (0)	OFF (0)	
Inversion in 2 Enabled (1) / Disabled (0)	1268	0	1	Disabled (0)	Disabled (0)	
Digital input 3	147	0	87	OFF (0)	OFF (0)	

Parameter	N.	Value				Standard configuration
		min	max	factory America	factory Standard	
Inversion in 3 Enabled (1) / Disabled (0)	1269	0	1	Disabled (0)	Disabled (0)	
Inversion in 4 Enabled (1) / Disabled (0)	1270	0	1	Disabled (0)	Disabled (0)	
Digital in 5	149	0	87	OFF (0)	OFF (0)	
Inversion in 5 Enabled (1) / Disabled (0)	1271	0	1	Disabled (0)	Disabled (0)	
Digital in 6	150	0	87	OFF (0)	OFF (0)	
Inversion in 6 Enabled (1) / Disabled (0)	1272	0	1	Disabled (0)	Disabled (0)	
Digital in 7	151	0	87	OFF (0)	OFF (0)	
Inversion in 7 Enabled (1) / Disabled (0)	1273	0	1	Disabled (0)	Disabled (0)	
Digital in 8	152	0	87	OFF (0)	OFF (0)	
Inversion in 8 Enabled (1) / Disabled (0)	1274	0	1	Disabled (0)	Disabled (0)	

Digital input XX Selection of the parameter that is addressed by the digital input concerned. The following assignments are possible:

OFF	0	**Speed sel 2** [2]	25	**PI central vs1** [4]	57
Motor pot reset	1	**Ramp sel 0** [3]	26	**Diameter calc** [4]	58
Motor pot up	2	**Ramp sel 1** [3]	27	**Diam reset**	68
Motor pot down	3	**Field loss**	29	**Diam calc Dis**	69
Motor pot sign +	4	**Enable flux reg**	30	**Torque winder EN**	70
Motor pot sign -	5	**Enable flux weak**	31	**Line acc status**	71
Jog +	6	**Pad A bit 0**	32	**Line dec status**	72
Jog -	7	**Pad A bit 1**	33	**Line fstp status**	73
Failure reset	8	**Pad A bit 2**	34	**Speed match**	74
Torque reduct	9	**Pad A bit 3**	35	**Diam inc/dec En**	75
Ramp out = 0	10	**Pad A bit 4**	36	**Wind/unwind**	76
Ramp in = 0	11	**Pad A bit 5**	37	**Diam preset SEL0**	77
Freeze ramp	12	**Pad A bit 6**	38	**Diam preset SEL1**	78
Lock speed reg	13	**Pad A bit 7**	39	**Taper enable**	79
Lock speed I	14	**Forward sign**	44	**Speed demand En**	80
Auto capture	15	**Reverse sign**	45	**Winder side**	81
Input 1 sign + [1]	16	**An in 1 target**	46	**Enable PI-PD PID**	82
Input 1 sign - [1]	17	**An in 2 target**	47	**Jog TW enable**	83
Input 2 sign + [1]	18	**An in 3 target**	48	**Brake fbk** [5]	84
Input 2 sign - [1]	19	**Enable droop**	49	**Adapt Sel 1** [6]	86
Input 3 sign + [1]	20	**Enable PI PID** [4]	52	**Adapt Sel 2** [7]	87
Input 3 sign - [1]	21	**Enable PD PID** [4]	53	**Wired FC EN** [8]	88
Zero torque	22	**PI integral freeze** [4]	54	**Wired FC Inv Seq** [9]	89
Speed sel 0 [2]	23	**PID offs. Sel** [4]	55	**Wired FC Act Brg** [10]	90
Speed sel 1 [2]	24	**PI central vs0** [4]	56		

1) The **Input xx sign +** and **Input XX sign -** parameters can only be used in conjunction with the other parameter.

2) The **Speed sel 0**, **Speed sel 1** and **Speed sel 2** parameters can only be used together.

3) The **Ramp sel 0** and **Ramp sel 1** parameters can only be used together.

4) Refer to paragraph 6.16.3 **PID function**

5) External mechanical brake relay feedback; if set to digital input (selection: Brake fbk), this command is necessary in order for the brake to be released or closed without triggering the alarm. If not set to digital input, it is not considered in the brake control sequence.

6) Gains value selection with the significance 2^1

7) Gains value selection with the significance 2^2

8) Enables field control by TPD32-EV-FC via standard I/O.

9) Indication if field control is during inversion sequence

10) Indication of the actual active bridge (positive or negative) of the FC unit

6.12.5 Speed reference from encoder input (Tach follower function)

I/O CONFIG

Encoder inputs

[1020]	Select enc 1
[1021]	Select enc 2
[416]	Encoder 1 pulses
[169]	Encoder 2 pulses
[649]	Refresh enc 1

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Select enc 1 OFF (0) Speed ref 1 (1) Speed ref 2 (2) Ramp ref 1 (3) Ramp ref 2 (4)	1020	0	5	OFF (0)	OFF (0)	
Select enc 2 OFF (0) Speed ref 1 (1) Speed ref 2 (2) Ramp ref 1 (3) Ramp ref 2 (4)	1021	0	5	OFF (0)	OFF (0)	
Encoder 1 pulses	416	600	9999	1024	1024	
Encoder 2 pulses	169	150	9999	1024	1024	
Refresh enc 1 Enabled (1) Disabled (0)	649	0	1	Disabled (0)	Disabled (0)	
Refresh enc 2 Enabled (1) Disabled (0)	652	0	1	Disabled (0)	Disabled (0)	

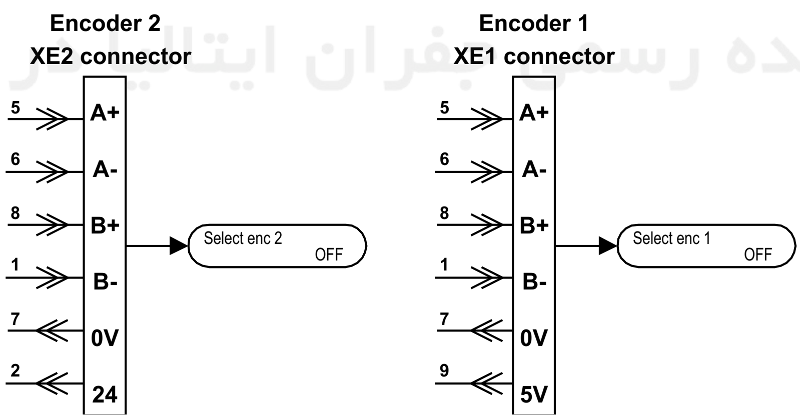


Figure 6.12.5.1: Tach follower

This configuration allows the use of the encoder inputs, as a speed reference. Compared to an analog input, these inputs have higher resolution and higher noise immunity.

Using for this purpouse the encoder input (XE1 or XE2 connector), it is necessary to define the destination, selecting properly the type of speed reference on which it has to interact (**Ramp ref 1**, **Speed ref 1**, etc.)

When the encoder input is used as a speed reference source, using the same encoder input as speed feedback is disallowed. It is impossible to configure the same speed reference to the encoder input and an analog input.

The function "Tach follower" can be used in accordance with the tabe below:

Speed fbk sel [414]	Encoder 1 as reference	Encoder 2 as reference
Encoder 1	Not available	Not available

Speed fbk sel [414]	Encoder 1 as reference	Encoder 2 as reference
Encoder 2	Available	Not available
Tacho	Not available	Available
Armature	Available	Available

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Note! It is possible to set any configuration. Follow the configuration possible in the table above.

Select enc 1 These parameters define which speed reference the encoder signal will reference to.

Select enc 2 The OFF condition indicates that the encoder connector is not used as speed reference and then it could be used as speed feedback. (CONFIGURATION/Speed fbk sel menu).

The speed reference destination choice must be done according to the speed regulator configuration (e.g. can not use **Speed ref 1** with the ramp active).

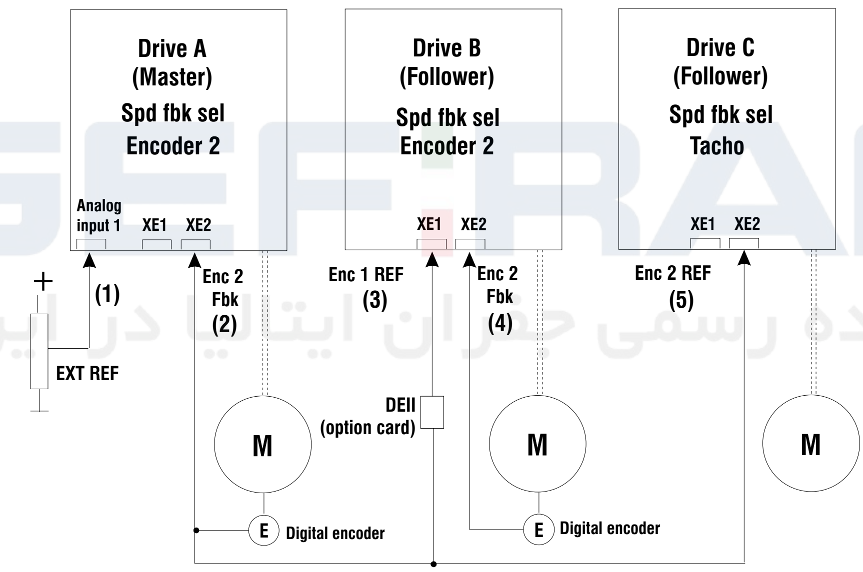
Encoder 1 type It defines the encoder type to the XE1 connector connected.
Sinusoidal — Sinusoidal encoder
Digital — Digital encoder (DEII option required)

Encoder 1 pulses Pulse number of the encoder to the XE1 connector connected.

Encoder 2 pulses Pulse number of the encoder to the XE2 connector connected.

Refresh enc 1 Enables the monitoring of the encoder 1 connection status, in order to detect a speed feedback loss alarm

Refresh enc 2 Enables the monitoring of the digital encoder 2 connection status, in order to detect a speed feedback loss alarm



(1) Analog inputs/ Select input 1 = Ramp ref 1
(2) Speed fbk sel = Encoder 2
(3) Select enc 1 = Ramp ref 1
(4) Speed fbk sel = Encoder 2
(5) Select enc 2 = Ramp ref 1

Figure 6.12.5.2: Example of application of the encoder reference

The Drive A speed reference is provided in this case by an external analog signal but it could be set from internal digital sources (e.g. APC300 optional card or field bus).

A configuration using the encoder signal as the line speed reference, is only possible when the speed reference source is provided by an additional encoder, independent from the motor shaft.

6.13 ADDITIONAL SPEED FUNCTIONS (ADD SPEED FUNCT)

6.13.1 Auto capture

ADD SPEED FUNCT		
	[388]	Auto capture

The auto capture function enables the converter to engage a unning motor.

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Auto capture ON (1) OFF (0)	388			OFF (0)	OFF (0)	*

* This function can be assigned to one of the programmable digital inputs.

Auto capture ON: When the converter is switched on, the speed of the motor is measured and the ramp output is set accordingly. The drive then runs to the set reference value.

OFF: When the converter is switched on, the ramp starts from zero.

Main uses: Connection to a motor that is already running due to its load (e.g. in the case of pumps, the flowing medium).
Reconnection after a fault alarm.

If the speed reference value is defined via the ramp, with **Auto capture** = ON, starting at a reference value corresponding to the motor speed.

NOTE! If the function is switched off, ensure that the motor is not turning when the converter is switched on. If this is not the case, this may cause a harsh motor deceleration in current limit.

6.13.2 Adptive spd reg

ADD SPEED FUNCT

Adaptive spd reg

[181]	Enable spd adap
[182]	Select adap type
[183]	Adap reference [FF]
[1464]	Adap selector
[184]	Adap speed 1 [%]
[185]	Adap speed 2 [%]
[186]	Adap joint 1 [%]
[187]	Adap joint 2 [%]
[188]	Adap P gain 1 [%]
[189]	Adap I gain 1 [%]
[190]	Adap P gain 2 [%]
[191]	Adap I gain 2 [%]
[192]	Adap P gain 3 [%]
[193]	Adap I gain 3 [%]
[1462]	Adap P gain 4 [%]
[1463]	Adap I gain 4 [%]

The adaptive speed regulator function enables different gains of the speed regulator depending on the speed or another variable (Adaptive Reference). This allows optimum adaptation of the speed regulator to the applicaion at hand.

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Enable spd adap Enabled (1) Disabled (0)	181	0	1	Disabled	Disabled	-
Select adap type Speed (0) Adap reference (1) Parameter (2)	182	0	2	Speed	Speed	-
Adap reference [FF]	183	-32768	+32767	1000	1000	*
Adap selector	1464	0	3	0	0	-
Adap speed 1 [%]	184	0.0	200.0	20.3	20.3	-
Adap speed 2 [%]	185	0.0	200.0	40.7	40.7	-
Adap joint 1 [%]	186	0.0	200.0	6.1	6.1	-
Adap joint 2 [%]	187	0.0	200.0	6.1	6.1	-
Adap P gain 1 [%]	188	0.00	100.00	10.00	10.00	-
Adap I gain 1 [%]	189	0.00	100.00	1.00	1.00	-
Adap P gain 2 [%]	190	0.00	100.00	10.00	10.00	-
Adap I gain 2 [%]	191	0.00	100.00	1.00	1.00	-
Adap P gain 3 [%]	192	0.00	100.00	10.00	10.00	-
Adap I gain 3 [%]	193	0.00	100.00	1.00	1.00	-
Adap P gain 4 [%]	1462	0.00	100.00	10.00	10.00	-
Adap I gain 4 [%]	1463	0.00	100.00	1.00	1.00	-

* This function can be assigned to one of the programmable analog inputs.

Enable spd adap
- Enabled: Adaptive speed regulation enabled.
- Disabled: Adaptive speed regulation is not enabled. The regulator operates with the parameters set in the REG PARAMETERS menu.

Select adap type
- Speed: The regulator parameters are modified according to the speed.
- Adap reference: The regulator parameters are modified according to the **Adap reference** parameter.
- Parameter: It allows to change the gains via parameter or via dual digital input. Only in these operating conditions are 4 sets of PI gains available.

Adap reference The variable according to which the speed regulator parameters are to be modified (only with **Select adap type** = Adap reference).

Adap selector The Adap selector parameter selects a pair of parameters: **Adap P gain** and **Adap I gain** from 1 to 4, if Sel adap type is set to Parameter. If the Adap selector parameter is programmed on digital inputs **Adapt Sel 1** or **Adapt Sel 2**, it only indicates which pair of gains has been selected.

Adap speed 1 Parameter set 1 is valid below this point, and parameter set 2 above it. The transition behaviour between the values is defined by the **Adap joint 1** parameter. The definition is a percentage of the **Speed base value** and the maximum value of **Adap reference.**

Adap speed 2 Parameter set 2 is valid below this point, and parameter set 3 above it. The transition behaviour between the values is defined by **Adap joint 2**. The definition is a percentage of the **Speed base value** and the maximum value of **Adap reference.**

Adap joint 1 Defines a range around **Adap speed 1** in which there is a linear change in gain from parameter set 1 to parameter set 2 in order to prevent jumps in the behavior of the regulator. It is defined as a percentage of **Speed base value**.

Adap joint 2 Defines a range around **Adap Speed 2** in which there is a linear change in gain from parameter set 2 to parameter set 3 in order to prevent jumps in the behavior of the regulator. It is defined as a percentage of **Speed base value**.

Adap P gain 1 Proportional gain for the range from zero to **Adap speed 1**. Defined as a percentage of **Speed P base**.

Adap I gain 1 Integral gain for the range from zero to Adap speed 1. Defined as a percentage of **Speed I base**.

Adap P gain 2	Proportional gain for the range from **Adap speed 1** to **Adap speed 2**. Defined as a percentage of **Speed P base**.
Adap I gain 2	Integral gain for the range from **Adap speed 1** to **Adap speed 2**. Defined as a percentage of **Speed I base**.
Adap P gain 3	Proportional gain for the range above **Adap speed 2**. Defined as a percentage of **Speed P base**.
Adap I gain 3	Integral gain for the range above **Adap speed 2**. Defined as a percentage of **Speed I base**.
Adap P gain 4	Proportional gain for the range above **Adap speed 3**. Defined as a percentage of **Speed P base**.
Adap I gain 4	Integral gain for the range above **Adap speed 3**. Defined as a percentage of **Speed I base**.

In order to activate Adaptive speed regulation, the function must be enabled with the **Enable spd adap** parameter.

Normally the gain depends on the speed of the drive. It can, however, also vary according to another variable, defined by the **Adap reference** parameter. This must be selected with the **Select adap type** parameter.

The **Adap speed 1** and **Adap speed 2** parameters are used to define the three ranges that may have different gains. A parameter set can be defined for each of these ranges, with each set containing an individually definable P and I component.

The **Adap joint 1** and **Adap joint 2** parameters ensure a smooth transition between the different parameter sets. The fields must be defined so that **Adap joint 1** and **Adap joint 2** do not overlap.

When the Adaptive speed regulation is enabled (**Enable spd adap** = Enabled) the **Speed P** and **Speed I** parameters have no effect. They still retain their value and are effective after any disabling of the adaptive speed regulation.

When the drive is not enabled, the gain of the speed regulator is determined by the zero speed logic. See section 6.7.2, "Zero speed logic".

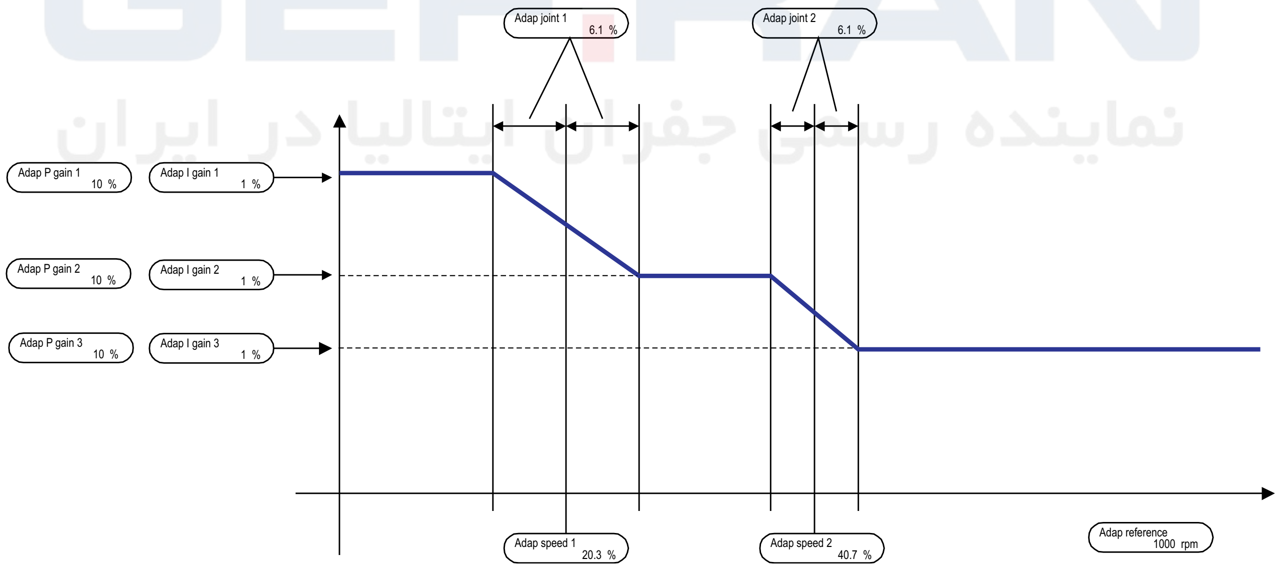


Figure 6.13.2.1: Adaptive of the speed regulator

6.13.3 Speed control

ADD SPEED FUNCT

Speed control

[101]	Spd threshold + [FF]
[102]	Spd threshold - [FF]
[103]	Threshold delay [ms]
[104]	Set error [FF]
[105]	Set delay [ms]

Two speed control messages are provided:
- when a particular, adjustable speed is not exceeded.
- when the speed corresponds to the set rference value

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Spd threshold + [FF]	101	1	32767	1000	1000	-
Spd threshold - [FF]	102	1	32767	1000	1000	-
Threshold delay [ms]	103	0	65535	100	100	-
Spd threshold Speed exceeded (0) Speed not exceeded (1)	393	0	1			Digital output 3 *
Set error [FF]	104	1	32767	100	100	-
Set delay [ms]	105	1	65535	100	100	-
Set speed Speed not ref. val. (0) Speed = ref. val. (1)	394	0	1			-

* This function can be assigned to a programmable digital output.

Spd threshold + Switch point for the "Speed not exceeded" for clockwise rotation of the drive in the units defined by the Factor function.

Spd threshold - Switch point for the "Speed not exceeded" for counter-clockwise rotation of the drive in the units defined by the Factor function.

Threshold delay Setting of a delay time in milliseconds which is active when the speed is lowered within the limits of the set threshold.

Spd threshold Message "Set speed not exceeded" (via a programmable digital input)

High Speed not exceeded

Low Speed exceeded

Set error Defines a tolerance band around the speed reference in the units specified by the Factor function.

Set delay Setting of a delay time in milliseconds which is active when the speed is lowered within the limits of the set threshold.

Set speed Message "The speed corresponds to the reference value" (via a programmable digital output)

High Speed corresponds to the reference value

Low Speed does not corresponds to the reference value

The message "The speed corresponds to the reference value" refers to the total reference value in front of the **Speed ref** speed regulator and to the **Ramp Ref** ramp reference when the ramp is selected.

When the references are lower than ± 1 %, the signal is always low!

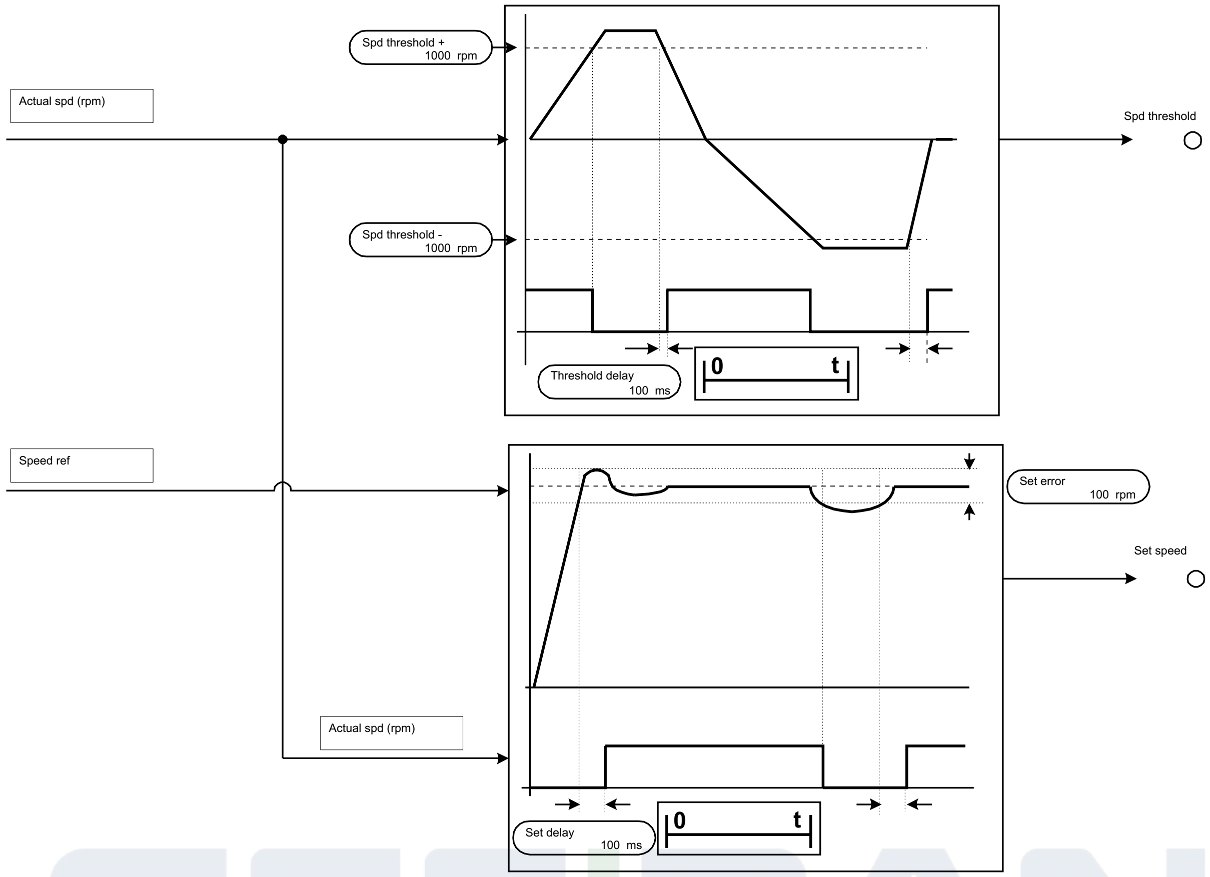


Figure 6.13.3.1: "Speed threshold" (up) and "Set speed" (down) messages

6.13.4 Speed zero

ADD SPEED FUNCT

Speed zero

[107]	Speed zero level [FF]
[108]	Speed zero delay [ms]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Speed zero level [FF]	107	1	32767	10	10	-
Speed zero delay [ms]	108	0	65535	100	100	-
Speed zero thr Drive not rotating (0) Drive rotating (1)	395	0	1			*

* This function can be assigned to a programmable digital output.

Speed zero level Switch threshold for **Speed zero level**. The value applies to both rotation directions for the TPD32-EV...4B converters. Defined by the units specified in the factor function.

Speed zero delay Definition of a delay time in milliseconds, when the zero speed is reached.

Speed zero thr ”Speed zero thr” message “Drive turning” (via a programmable digital output).

High	Drive turning
Low	Drive not turning

The LED “Zero Speed” is lit when the drive is not turning.

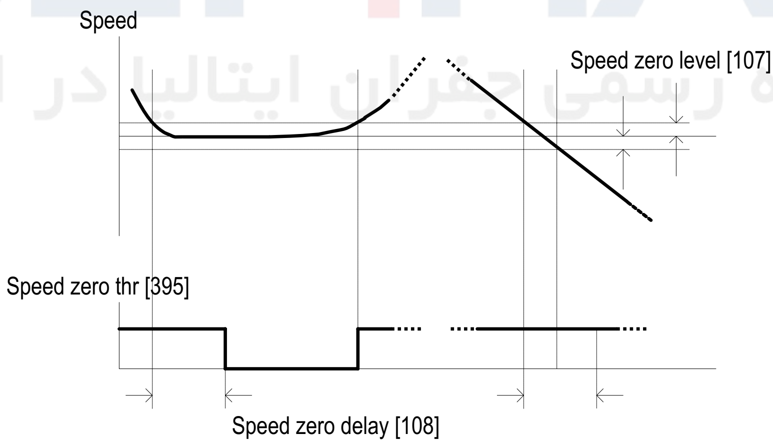


Figure 6.13.4.1: Speed zero

6.14 FUNCTIONS

6.14.1 Motorpotentiometer

FUNCTIONS	Motor pot		
		[246]	Enable motor pot
		[247]	Motor pot oper
		[248]	Motor pot sign
		[249]	Motor pot reset
		[1530]	MPot Lower Limit [rpm]
		[1531]	MPot Upper Limit [rpm]
		[1532]	MPot Acc Time [s]
		[1533]	MPot Dec Time [s]
		[1534]	MPot Mode
		[1535]	PowerOn Cfg
		[1536]	Reset Cfg
		[1537]	Motor pot out [rpm]

The motor potentiometer function allows the speed of the drive to be adjusted by using the +/- keys on the keypad or by digital inputs. The speed is then adjusted according to the defied ramp time.

Parameter description	No.	Value min	Value max	Value Factory American	Value Factory Standard	Standard Configuration
Enable motor pot Disabled (0); Config1(1); Config2 (2)	246	0	1	Disabled	Disabled	-
Motor pot oper	247					-
Motor pot sign Positive (1) / Negative (0)	248	0	1	Positive	Positive	-
Motor pot sign +	-					**
Motor pot sign -	-					**
Motor pot reset	249					*
Motor pot up No acceleration (0) Acceleration (1)	396	0	1			*
Motor pot down No deceleration (0) Deceleration (1)	397	0	1			*
MPot Lower Limit	1530	0	8000	0	0	
MPot Upper Limit	1531	0	8000	1000	1000	
MPot Acc Time	1532	0	65535	10	10	
MPot Dec Time	1533	0	65535	10	10	
MPot Mode Ramp & LastVal (0) Ramp & Follow (1) Fine & LastVal (2) Fine & Follow (3)	1534			0	0	
PowerOn Cfg Last Power Off (0) Zero (1) Lower Limit (2) Upper Limit (3)	1535			0	0	
Reset Cfg None (0) Inp Zero (1) Inp Low Limit (2) Inp Ref Zero (3) Inp Ref Low Lim (4) Out Zero (5) Out Low Limit (6) Out Ref Zero (7) Out Ref Low Lim (8) Inp Up Limit (9) Inp Ref Up Lim (10) Inp Freeze (11)	1536					
Motor pot out	1537					

* This function can be assigned to one of the programmable digital inputs.
** This parameter can be assigned to a programmable analog output.

Motor potentiometer function can be activated (**Enable motor pot**) by selecting "**Config1**" or "**Config2**" . They act as indicated in the figure 6.14.1.1 and 6.14.1.2 . The actual motorpot output value is shown in the **Motor pot** submenu of the keypad. When controlled via the keypad, the drive can be accelerated by pressing the "+" key and decelerated by pressing the "-" key. This corresponds to the commands **Motor pot u**p and **Motor pot down**. Select the menu point **Motor pot oper** for this purpose.

The motor potentiometer output can be adjusted between 0 to 100 % by setting the command **Motor pot up**. The motor potentiometer output can be reduced between 100 and 0 % by setting the command **Motor pot down**. If the command is given when the drive is already at a stop, it will not cause the reverse running of the drive.

If the **Motor pot up** and **Motor pot down** commands are given at the same time, they will not change the motor pot output value. When **Config2** is selected the last motor pot output value is saved when the drive is switched off or if there is a fault. When the drive is restarted, it accelerates to this speed according to the ramp set. If the command **Motor pot reset** is given with the drive switched off when **Config1** is selected, the motor pot output value is deleted and the drive starts at zero speed, when **Config2** is selected the behaviour is configured through parameter **Reset cfg**. If the status of the **Motor pot sign** command is changed while the drive is running, the drive will reverse according to the specified ramp times. Using **Config1**, If both **Motor pot sign+** and **Motor pot sign-** commands are ON or OFF, the motor pot output will be set to zero. Using **Config2**, the motor pot output will not be set to zero. Using **Config2**, the output of the motor potentiometer can be active also when the drive is disabled or the ramp block is not enabled. In those case, it will not have any effect on the speed of the motor until the drive and the ramp block is enabled.

When **Config1** is selected the ramp must be enabled and the Start command must be present in order to use the motor potentiometer function. When **Config2** is selected the function can be used also when the ramp is not enabled or the Start command is not present, but of course the motor potentiometer output will not affect the drive behaviour in these cases, except for the fact that if an analog output is configured as **Motor pot out** it will change according to the internal motor pot output.

Three different motorpot configuration mode can be selected.

Enable motor pot	Disabled	The reference value of potentiometer function is disabled.
	Config1	The motor potentiometer "**Config1**" function mode is enabled. The ramp block receives its reference value directly from the motor potentiometer function.
	Config2	The motor potentiometer "**Config2**" function mode is enabled. The reference from the motor potentiometer function is added to the **Ramp ref1** + **Ramp Ref2** block.

Default configuration = Disabled.

Motor pot oper

By pressing the "+" and "-" keys of the keypad the drive can be accelerated or decelerated.

+ Accelerate - Decelerate

Motor pot sign

This parameter is only accessible via the keypad and via the serial interface or Bus. When the drive is operated via the terminal strip, the parameters **Motor pot sign +** and **Motor pot sign -** must be used. As for TPD32-EV...2B... converters the "Positive" function must be selected.

Positive	"Clockwise" rotation selected.
Negative	"Counterclockwise" rotation selected.

Motor pot sign +

Selection of the "Clockwise" rotation direction when the selection is carried out via the terminal strip. The **Motor pot sign +** parameter is linked with the **Motor pot sign -** parameter via an XOR function. This means that the command (+24V) must be given only to one of the two terminals

High	"Clockwise" rotation direction selected.
Low	"Clockwise" rotation direction not selected.

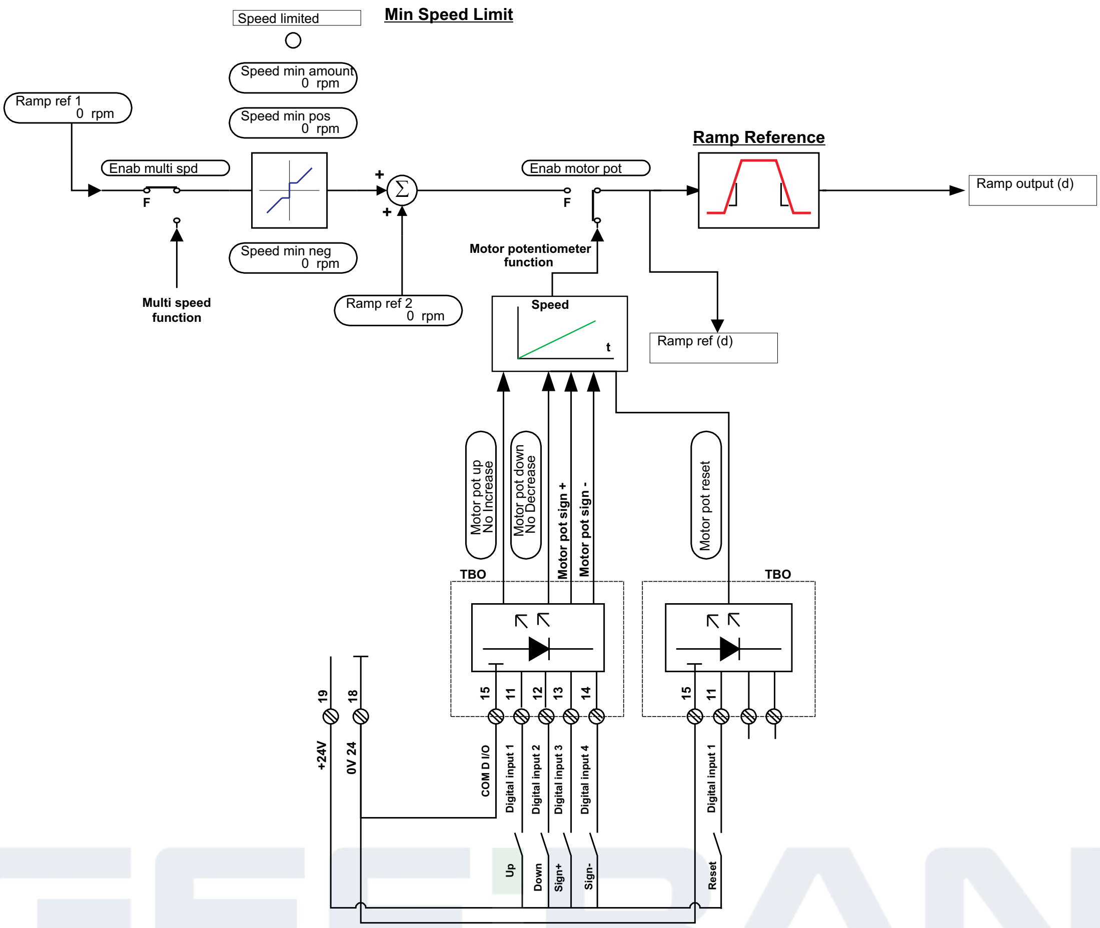


Figure 6.14.1.1: CONFIG 1

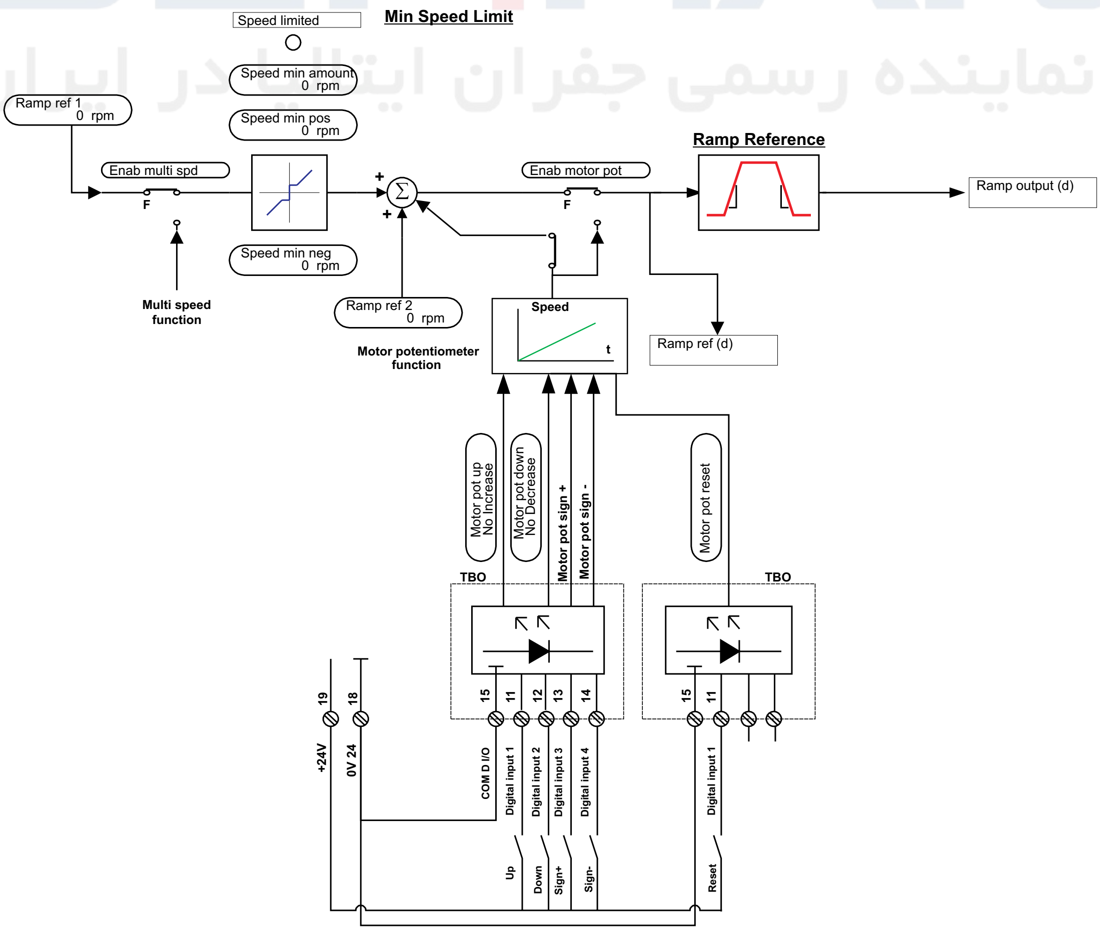


Figure 6.14.1.2: CONFIG 2

otor pot sign - Selection of the “Counterclockwise” rotation direction when the selection is carried out via the terminal strip. The **Motor pot sign -** parameter is linked with the **Motor pot sign +** parameter via an XOR function. This means that the command (+24V) must be given only to one of the two terminals.

High “Counter-clockwise” rotation direction selected.

Low “Counter-clockwise” rotation direction not selected.

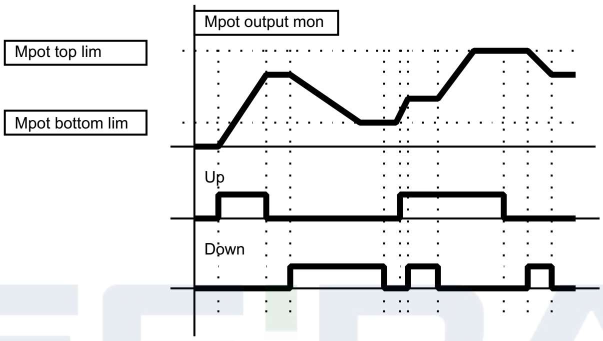
Motor pot reset. In **Config1**, when the Reset command is activated and the drive is switched off, the restart begins at “**Zero**” speed. In this case the command is only possible with the drive switched off! In **Config2**, the commad is possible also when the drive is switched on and the behaviour follows the configuration of parameter **Reset Cfg.**

Motor pot up The drive is accelerated with the preselected ramp. The setting can be carried out via keypad button, via the terminal or Bus.

Motor pot down The drive is decelerated with the preselected ramp. The setting can be carried out via keypad button, via the terminal or Bus

MPot Lower Limit Setting of the lower limit (RPM) of the motor pot value when **Config2** is selected..

MPot Upper Limit Setting of the Upper limit (RPM) of the motor pot value when **Config2** is selected..



MPot Acc Time Setting of acceleration time (s) between lower and upper limits set when **Config2** is selected.

MPot Dec Time Setting of deceleration time (s) between upper and lower limits set when **Config2** is selected.

MPot Mode Functioning mode when **Config2** is selected.

Setting of the configuration of two possible options of the Motor potentiometer function. There are two operating modes for each of the two options.

Ramp&Last val

Ramp&Follow

Fine&Last val

Fine&Follow

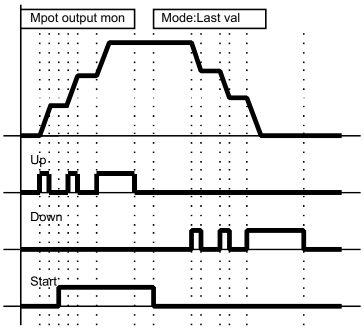
Option 1:

Behaviour of the Motor potentiometer function with the **Stop** or **FastStop** command present.

The two operating modes are: **Last val** or **Follow**.

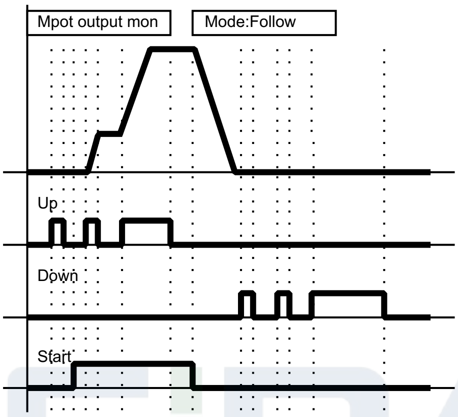
In **Last val** mode with the **Stop** or **FastStop** command present, the output of the Motor potentiometer function is not modified.

The motor speed moves to 0. When the **Run** command is sent, the motor speed moves to the speed reference set by **Ramp ref 1** + **Ramp ref 2** + the motor potentiometer output



In **Follow** mode with the **Stop** or **FastStop** command present, the **Down** command is simulated, i.e. the output of the Motor potentiometer function moves to lower limit with the set ramp time.

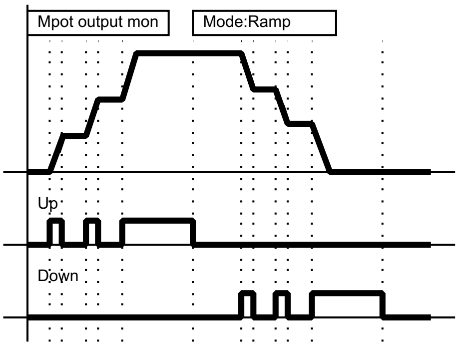
If the **Run** command is sent the motor potentiometer output decrease is stopped and the current value used in addition to **Ramp Ref 1** and **Ramp Ref 2** to set the actual **Ramp Ref**.



Option 2:

The two operating modes are: **Ramp** or **Fine.**

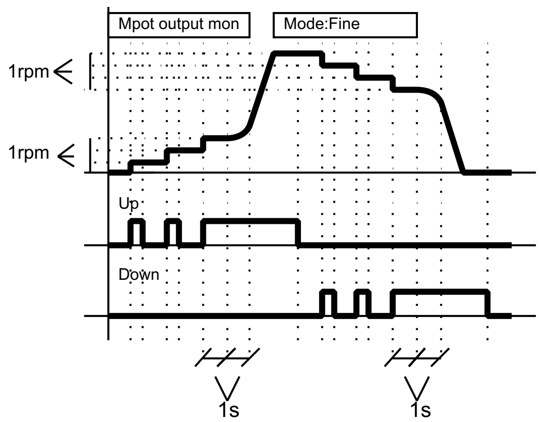
In **Ramp** mode, each time the **Up** or **Down** commands are enabled, the output of the Motor potentiometer function increases or decreases with the set ramp. When the **Up** or **Down** command is removed, the last value that was reached is maintained.



In **Fine** mode, each time the **Up** or **Down** commands are enabled, the output of the Motor potentiometer function increases or decreases by 1 rpm.

If the command persists for less than 1 second, no other changes are made on the output.

If the command persists for more than 1 second, the output increases or decreases with the set ramp. The variation with the set ramp is performed gradually (1 second). When the **Up** or **Down** command is removed the last value that was reached is maintained.



Mpot mode	Ramp behaviour	Behaviour of the Motor potentiometer function with the **Stop** or **FastStop** command present with the **Control mode = Ramp** parameter.
0	Ramp	Last val
1	Ramp	Follow
2	Fine	Last val
3	Fine	Follow

For fine-tuning of the Motor potentiometer output value the recommended settings are **Mpot Mode = Fine&Follow** or **Fine&Last Val**. Each time they are pressed for 1 second, the speed increases by 1 rpm. For an immediate effect on motor speed, the Acceleration time and Deceleration time parameters should be set to short times.

PowerOn Cfg Configuration of the motorpot at power on when **Config2** is selected.
This parameter is needed to configure the output value of the Motor potentiometer at drive start-up.

Last Power off	When set to **Last power off**, the motor potentiometer output starts from the last reference that was set before the drive was switched off.
Zero	When set to **Zero** the motor potentiometer output starts from a value of 0.
Lower Limit	When set to **Lower limit** the output of the motor potentiometer starts from the value of the lower limit set in the **Mpot bottom limit** parameter.
Upper Limit	When set to **Upper limit** the output of the motor potentiometer starts from the value of the upper limit set in the **Mpot top limit** parameter.

Reset Cfg Configuration of the **Motorpot reset** when **Config2** is selected.

This parameter can be used to configure the reset of the Motor potentiometer function, i.e. to configure the value at which the Motor potentiometer input and output are set when the reset command is enabled.

The reset command has priority over the **Up** command and the **Down** command.

The **Up** and **Down** commands are enabled again when the reset command is disabled.

None	When set to **None**, no setting is executed
Inp Zero	sets input = 0 i.e. a temporary reference setting is performed and the previous reference value is maintained. The output of the Motor potentiometer function varies with the set ramp times. The previous reference value is restored when the reset command is removed.
Inp Low Limit	sets Inp = low lim i.e. a temporary reference setting is performed

	and the previous reference value is maintained. The output of the Motor potentiometer function varies with the set ramp times. The previous reference value is restored when the reset command is removed.
Inp Ref Zero	sets Inp = 0 and Ref = 0 i.e. a definitive reference setting is performed. The output of the Motor potentiometer function varies with the set ramp times.
Inp Ref Low Limit	sets Inp = low lim and Ref = low lim i.e. a definitive reference setting is performed. The output of the Motor potentiometer function varies with the set ramp times.
Out Zero	sets Out = 0 i.e. a temporary output setting for the Motor potentiometer function is performed. The previous reference value is maintained. If the reset command is enabled, the output of the Motor potentiometer function continues to be = 0, if the reset command is not enabled the output of the Motor potentiometer function varies with the set ramp times.
Out Low Limit	sets Out = low lim i.e. a temporary setting for the output of the Motor potentiometer function is performed.The previous reference value is maintained. If the reset command is enabled, the output of the Motor potentiometer function continues to be = low limit, if the reset command is not enabled the output of the Motor potentiometer function varies with the set ramp times.
Out Ref Zero	sets Out = 0 i.e. a definitive setting for the output of the Motor potentiometer function is performed.
Out Ref Low Limit	sets Out = low lim i.e. a definitive setting for the output of the Motor potentiometer function is performed.
Inp Up Limit	sets Inp = upper lim i.e. a temporary setting for the reference is performed and the previous reference value is maintained. The output of the Motor potentiometer function varies with the set ramp times. The previous reference value is restored when the reset command is removed.
Inp Ref Up Limit	sets Inp = upp lim and Ref = upp lim i.e. a definitive reference setting is performed. The output of the Motor potentiometer function varies with the set ramp times
Inp Freeze	When Inp Freeze input is set, the **Up** and **Down** commands are temporarily disabled.

Motor pot out (Available thru GF_eXpress). The value of the output of the motor potentiometer function when **Config2** is used is displayed (RPM). This value can be sent on an analog output.

6.14.2 Jog function

FUNCTIONS

Jog function

[244]	Enable jog
[265]	Jog operation
[375]	Jog selection
[266]	Jog reference [FF]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Enable jog Enabled (1) / Disabled (0)	244	0	1	Disabled	Disabled	-
Jog operation	265	-	-	-	-	
Jog selection Speed input (0) / Ramp input (1)	375	0	1	0	0	-
Jog reference [FF]	266	0	32767	0	0	**
Jog + No jog forwards (0) Forwards jog (1)	398	0	1			*
Jog - No backwards jog (0) Backwards jog (1)	399	0	1			*

* This function can be assigned to one of the programmable digital inputs.
** This parameter can be assigned to a programmable analog input.

Enable jog
Enabled — Enabled Jog function (this selection is possible only when the drive is switched off).
Disabled — Disabled Jog function

Jog operation
Pressing the "+" and "-" keys on the keypad enables the drive to be moved forward and backward. In connection with the TPD32-EV...4B converters it is possible to operate the Jog function in an anti-clockwise rotation by pressing the "-" key.
\+ — Jog clockwise rotation
\- — Jog counter-clockwise rotation

Jog reference
Reference value for jog mode. Defined by the units, specified by the factor function.

Jog selection
This parameter determines if the Jog function reference must go through the ramp or directly to the speed regulator.
Speed input — The Jog reference is directly defined. The ramp is not active.
Ramp input — The Jog reference is defined with a set ramp.

Jog +
High — Clockwise Jog function when the Jog function is enabled and the **Start** command is not present.
Low — Disabled

Jog -
High — Counter-clockwise Jog function for the TPD32-EV...4B when the Jog function is enabled and the Start command is not present.

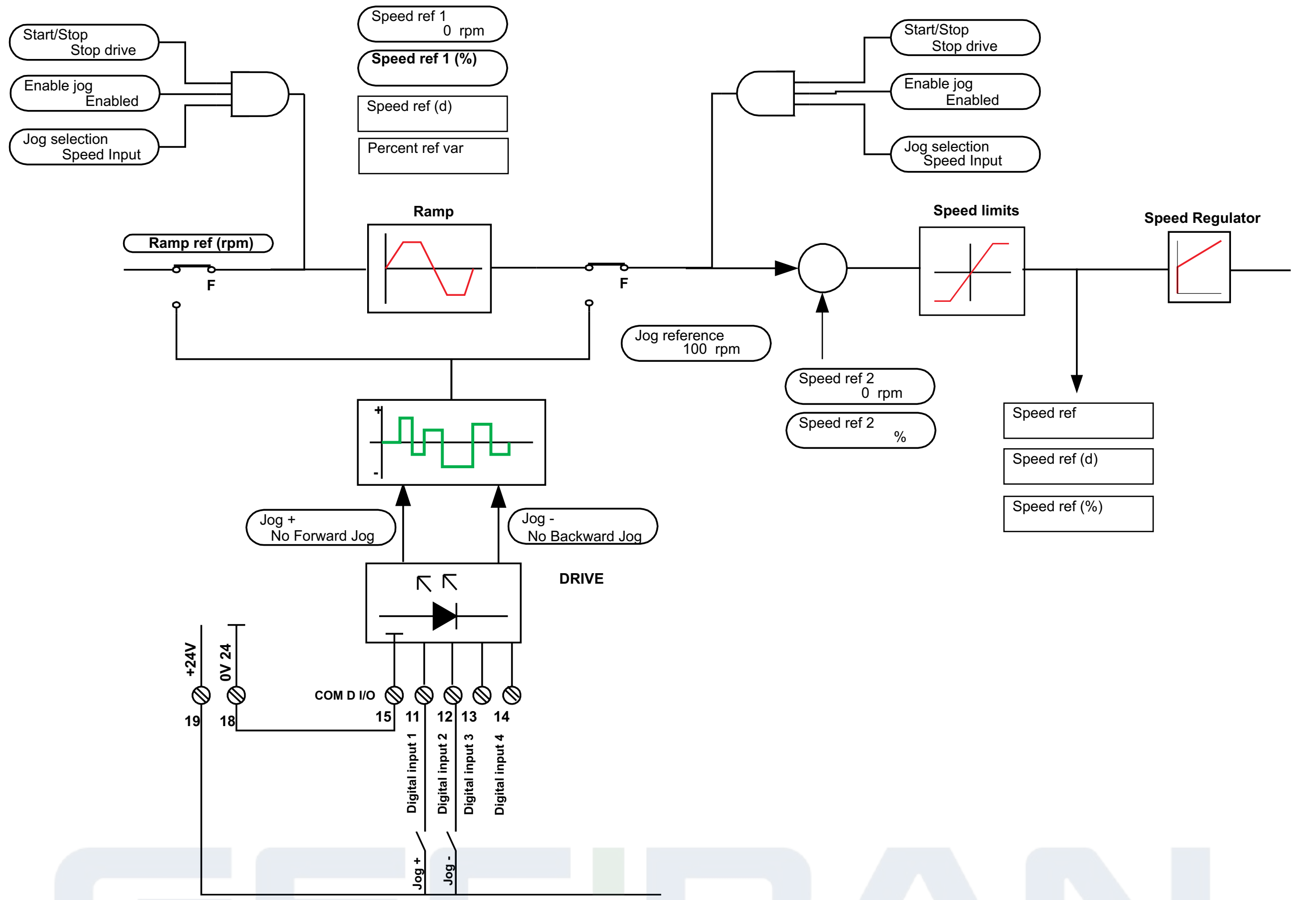


Figure 6.14.2.1: Example of external activation in Jog mode

Note! The following signals are required for Jog mode in addition to the commands **Jog** + and **Jog -** :

Enable drive	**Fast Stop**	**External fault**	Low	Disabled

The jog speed corresponds to the value which is defined by the **Jog reference** parameter. In this case no ramp is used.

The jog reference value can only be activated by the **Jog** + or **Jog -** command if there is no **Start** command active.

If the **Start** command is given in addition to the **Jog** + and **Jog -** command, Jog mode will be aborted and the drive will react according to the Start command.

When controlled via the keypad the “+” and “-” keys can be used in the Jog function menu. (only for TPD32-EV...4B...). For this select the **Jog operation** menu point.

The correction value **Speed ref 2** for the speed regulator is also active in jog operation.

Note! If the **Stop control** function is activated, to enable the Jog function the **Jog Stop control** (FUNCTION/Stop control) must also be set to ON (1).

6.14.3 Multi speed function

FUNCTIONS

Multi speed fct

[153]	Enab multi spd
[154]	Multi speed 1 [FF]
[155]	Multi speed 2 [FF]
[156]	Multi speed 3 [FF]
[157]	Multi speed 4 [FF]
[158]	Multi speed 5 [FF]
[159]	Multi speed 6 [FF]
[160]	Multi speed 7 [FF]
[208]	Multispeed sel

The Multi speed function allows up to seven internally saved reference values to be called up via a digital signal.

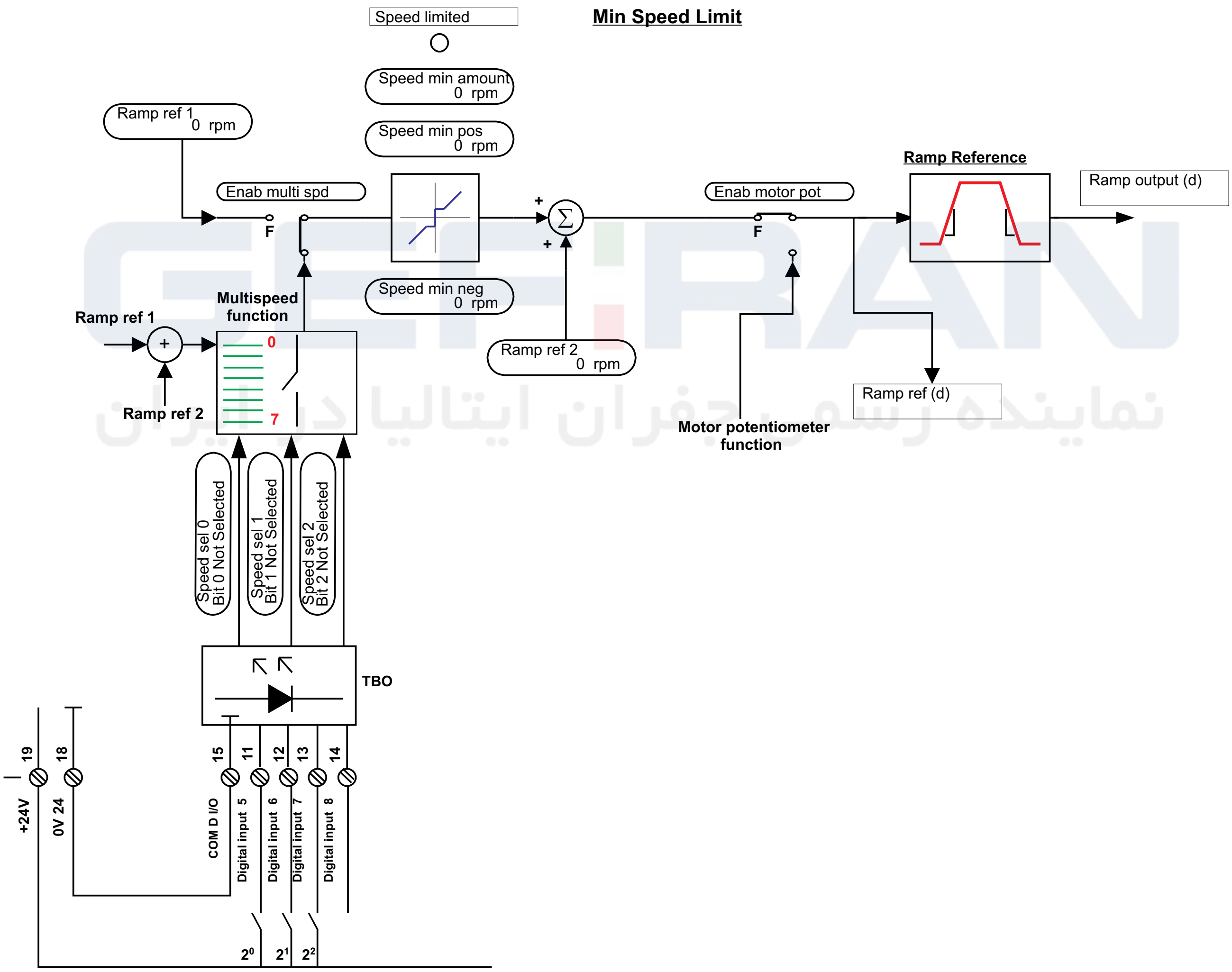


Figure 6.14.3.1: Selection of different references via terminals

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Enab multi spd Enabled (1) Disabled (0)	153	0	1	Disabled	Disabled	
Multi speed 1 [FF]	154	-32768	+32767	0	0	-
Multi speed 2 [FF]	155	-32768	+32767	0	0	-
Multi speed 3 [FF]	156	-32768	+32767	0	0	-
Multi speed 4 [FF]	157	-32768	+32767	0	0	-
Multi speed 5 [FF]	158	-32768	+32767	0	0	-
Multi speed 6 [FF]	159	-32768	+32767	0	0	-
Multi speed 7 [FF]	160	-32768	+32767	0	0	-
Speed sel 0 Value 2^0 not selected (0) Value 2^0 selected (1)	400	0	1	0	0	Digital inp 5 *
Speed sel 1 Value 2^1 not selected (0) Value 2^1 selected (1)	401	0	1	0	0	Digital inp 6 *
Speed sel 2 Value 2^2 not selected (0) Value 2^2 selected (1)	402	0	1	0	0	Digital inp 7 *
Multispeed sel	208	0	7	0	0	

* This function can be assigned to one of the programmable digital inputs.

Enab multi spd Enabled Enabled multi speed function
Disabled Disabled multi speed function

Multi speed 1 Reference value 1 for enabled multi speed function. Defined by the units specified in the factor function

Multi speed 2 Reference value 2 for enabled multi speed function. Defined by the units specified in the factor function

Multi speed 3 Reference value 3 for enabled multi speed function. Defined by the units specified in the factor function

Multi speed 4 Reference value 4 for enabled multi speed function. Defined by the units specified in the factor function

Multi speed 5 Reference value 5 for enabled multi speed function. Defined by the units specified in the factor function

Multi speed 6 Reference value 6 for enabled multi speed function. Defined by the units specified in the factor function

Multi speed 7 Reference value 7 for enabled multi speed function. Defined by the units specified in the factor function

Speed sel 0 Reference value selection with the significance 2^0 (=1) (Bit 0). Parameter can only be used in conjunction with **Speed sel 1** and **Speed sel 2**.
High Significance 2^0 selected
Low Significance 2^0 not selected

Speed sel 1 Reference value selection with the significance 2^1 (=2) (Bit 1). Parameter can only be used in conjunction with **Speed sel 0** and **Speed sel 2**.
High Significance 2^1 selected
Low Significance 2^1 not selected

Speed sel 2 Reference value selection with the significance 2^2 (=4) (Bit 2). Parameter can only be used in conjunction with **Speed sel 0** and **Speed sel 1**.
High Significance 2^2 selected
Low Significance 2^2 not selected

Multi speed sel It is the word representation of the three parameters **Speed sel 1** (bit0), **Speed sel 2** (bit1) and **Speed sel 3** (bit2). Used to change the speed selection by changing only one parameter instead of three. This allows selecting different speeds via serial line or Bus instantaneously.

The table and graph below show the interaction between the selection and the corresponding reference value.

Speed sel 0 Bit 0 Not Selected	Speed sel 1 Bit 1 Not Selected	Speed sel 2 Bit 2 Not Selected	REFERENCE
0	0	0	Ramp ref 1 0 rpm + Ramp ref 2 0 rpm
1	0	0	Multi speed 1 0 rpm
0	1	0	Multi speed 2 0 rpm
1	1	0	Multi speed 3 0 rpm
0	0	1	Multi speed 4 0 rpm
1	0	1	Multi speed 5 0 rpm
0	1	1	Multi speed 6 0 rpm
1	1	1	Multi speed 7 0 rpm

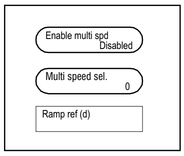


Table 6.14.2.1: Multi speed function

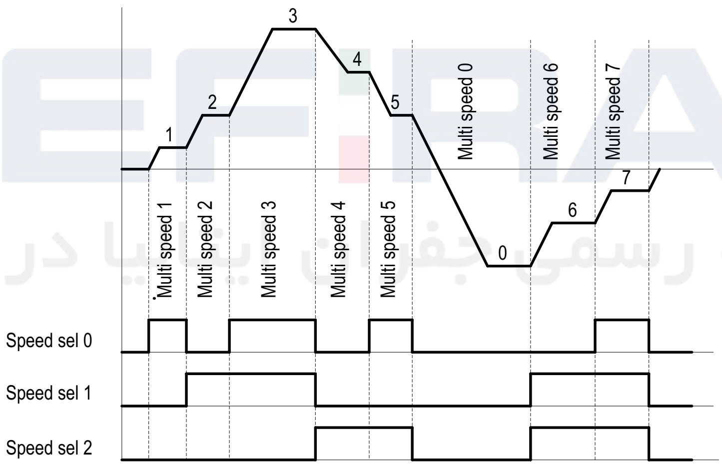


Figure 6.14.3.2: Multi speed function

In order to operate the Multi speed function, it must be enabled with **Enab multi spd** parameter.

The required reference value is selected with the **Speed sel 0**, **Speed sel 1** and **Speed sel 2** signals.

The selection of the reference values is carried out via the keypad or the serial interface.

The reference values are signed so that they can be defined for a particular rotation direction of the drive. As for the TPD32-EV...2B... the reference must have a positive polarity.

When the Multi speed function is enabled, **Multi speed 0** is defined by the addition of the reference values **Ramp ref 1** and **Ramp ref 2**.

6.14.4 Multi ramp function

FUNCTIONS

- **Multi ramp fct**

[243]	Enab multi rmp
[202]	Ramp selector

- **Multi ramp fct**
  - **Ramp 0**
    - **Acceleration 0**

[659]	Acc delta speed0 [FF]
[660]	Acc delta time 0 [s]
[665]	S acc t const 0 [ms]

    - **Deceleration 0**

[661]	Dec delta speed0 [FF]
[662]	Dec delta time 0 [s]
[666]	S dec t const 0 [ms]

  - **Ramp 1**
    - **Acceleration 1**

[23]	Acc delta speed1 [FF]
[24]	Acc delta time 1 [s]
[667]	S acc t const 1 [ms]

    - **Deceleration 1**

[31]	Dec delta speed1 [FF]
[32]	Dec delta time 1 [s]
[668]	S dec t const 1 [ms]

  - **Ramp 2**
    - **Acceleration 2**

[25]	Acc delta speed2 [FF]
[26]	Acc delta time 2 [s]
[669]	S acc t const 2 [ms]

    - **Deceleration 2**

[33]	Dec delta speed2 [FF]
[34]	Dec delta time 2 [s]
[670]	S dec t const 2 [ms]

  - **Ramp 3**
    - **Acceleration 3**

[27]	Acc delta speed3 [FF]
[28]	Acc delta time 3 [s]
[671]	S acc t const 3 [ms]

    - **Deceleration 3**

[35]	Dec delta speed3 [FF]
[36]	Dec delta time 3 [s]
[672]	S dec t const 3 [ms]

The Multi ramp function enables up to four different ramps to be called up. The acceleration and deceleration times can also be defined here separately. The ramps are called up via digital signals.

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Enab multi rmp Enabled (1) / Disabled (0)	243	0	1	Disabled	Disabled	-
Ramp selector	202	0	3	0	0	-
Acc delta speed0 [FF]	659	0	2^{32-1}	100	100	-
Acc delta time 0 [s]	660	0	65535	1	1	-
S acc t const 0 [ms]	665	0	15000	300	300	
Dec delta speed0 [FF]	661	0	2^{32-1}	100	100	-
Dec delta time 0 [s]	662	0	65535	1	1	-
S dec t const 0 [ms]	666	0	15000	300	300	
Acc delta speed1 [FF]	23	0	2^{32-1}	100	100	-
Acc delta time 1 [s]	24	0	65535	1	1	-
S acc t const 1 [ms]	667	0	15000	300	300	
Dec delta speed1 [FF]	31	0	2^{32-1}	100	100	-
Dec delta time 1 [s]	32	0	65535	1	1	-
S dec t const 1 [ms]	668	0	15000	300	300	
Acc delta speed2 [FF]	25	0	2^{32-1}	100	100	-
Acc delta time 2 [s]	26	0	65535	1	1	-
S acc t const 2 [ms]	669	0	15000	300	300	
Dec delta speed2 [FF]	33	0	2^{32-1}	100	100	-
Dec delta time 2 [s]	34	0	65535	1	1	-
S dec t const 2 [ms]	670	0	15000	300	300	
Acc delta speed3 [FF]	27	0	2^{32-1}	100	100	-
Acc delta time 3 [s]	28	0	65535	1	1	-
S acc t const 3 [ms]	671	0	15000	300	300	
Dec delta speed3 [FF]	35	0	2^{32-1}	100	100	-
Dec delta time 3 [s]	36	0	65535	1	1	-
S dec t const 3 [ms]	672	0	15000	300	300	
Ramp sel 0 Value 2^0 not selected (0) Value 2^0 selected (1)	403	0	1	0	0	*
Ramp sel 1 Value 2^1 not selected (0) Value 2^1 selected (1)	404	0	1	0	0	*

* This function can be assigned to one of the programmable digital inputs.

Enab multi rmp Enabled The Multi ramp function is enabled

Disabled The Multi ramp function is disabled

Ramp selector It is the word representaton of the two parameters **Ramp sel 0** (bit0) and **Ramp sel 1** (bit1). Used to change the ramp selection by changing only one parameter instead of two. This allows to select different ramps via serial line or Bus instantaneously.

Acc delta speed 0 It defines together with **Acc delta time 0** the acceleration ramp 0. Defined by the units specified in the factor function.

Acc delta time 0 It defines together with **Acc delta speed 0** the acceleration ramp 0. Defined in seconds.

S acc t const 0 Defines the acceleration curve for S-shape ramp 0. Defined in ms.

Dec delta speed0 It defines together with **Dec delta time 0** the deceleration ramp 0. Defined by the units specified in the factor function.

Dec delta time 0 It defines together with **Acc delta speed 0** the acceleration ramp 0. Defined in seconds.

S dec t const 0 Defines the deceleration curve for **S-shape ramp 0.** Defined in ms.

Acc delta speed1 It defines together with **Acc delta time 1** the acceleration ramp 1. Defined by the units specified in the factor function.

Acc delta time 1 It defines together with **Acc delta speed 1** the acceleration ramp 1. Defined in seconds.

S acc t const 1 Defines the acceleration curve for **S-shape ramp 1**. Defined in ms.

Dec delta speed1 It defines together with **Dec delta time 1** the deceleration ramp 1. Defined by the units specified in the factor function.

Dec delta time 1 It defines together with **Dec delta speed** 1 the deceleration ramp 1. Defined in seconds.

S dec t const 1 Defines the deceleration curve for **S-shape ramp 1**. Defined in ms.

Acc delta speed2 It defines together with **Acc delta time 2** the acceleration ramp 2. Defined by the units specified in the factor function.

Acc delta time 2 It defines together with **Acc delta speed 2** the acceleration ramp 2. Defined in seconds.

S acc t const 2 Defines the acceleration curve for **S-shape ramp 2**. Defined in ms.

Dec delta speed2 It defines together with **Dec delta time 2** the deceleration ramp 2. Defined by the units specified in the factor function.

Dec delta time 2 It defines together with **Dec delta speed 2** the deceleration ramp 2. Defined in seconds.

S dec t const 2 Defines the deceleration curve for **S-shape ramp 2**. Defined in ms.

Acc delta speed3 It defines together with **Acc delta time 3** the acceleration ramp 3. Defined by the units specified in the factor function.

Acc delta time 3 It defines together with **Acc delta speed 3** the acceleration ramp 3. Defined in seconds.

S acc t const 3 Defines the acceleration curve for **S-shape ramp 3**. Defined in ms.

Dec delta speed3 It defines together with **Dec delta time 3** the deceleration ramp 3. Defined by the units specified in the factor function.

Dec delta time 3 It defines together with **Dec delta speed 3** the deceleration ramp 3. Defined in seconds.

S dec t const 3 Defines the deceleration curve for **S-shape ramp 3**. Defined in ms.

Ramp sel 0 Ramp selection with the significance 2^0 (Bit 0). Parameter can only be used in conjunction with **Ramp sel 1**.

High	Significance 2^0 selected
Low	Significance 2^0 not selected

Ramp sel 1 Ramp selection with the significance 2^1 (Bit 1). Parameter can only be used in conjunction with **Ramp sel 0**.

High	Significance 2^1 selected
Low	Significance 2^1 not selected

See in the following table and graph the interaction between the selection and the ramp

	Ramp sel 0	Ramp sel 1
Ramp 0	Low	Low
Ramp 1	High	Low
Ramp 2	Low	High
Ramp 3	High	High

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Table 6.14.4.1: Ramp selection

In order to activate the **Multiramp function**, it must be enabled with the **Enab multi rmp** parameter.

The ramp required is selected via the **Ramp sel 0** and **Ramp sel 1** signals. When the selection is made via the terminal strip, it is possible to select only one digital input. This configuration enables only the ramp time selected. Another ramp can be selected at any time. If this happens during an acceleration or deceleration phase, the reference value will then follow the new ramp. The ramp parameter are defined via the keypad or serial line.

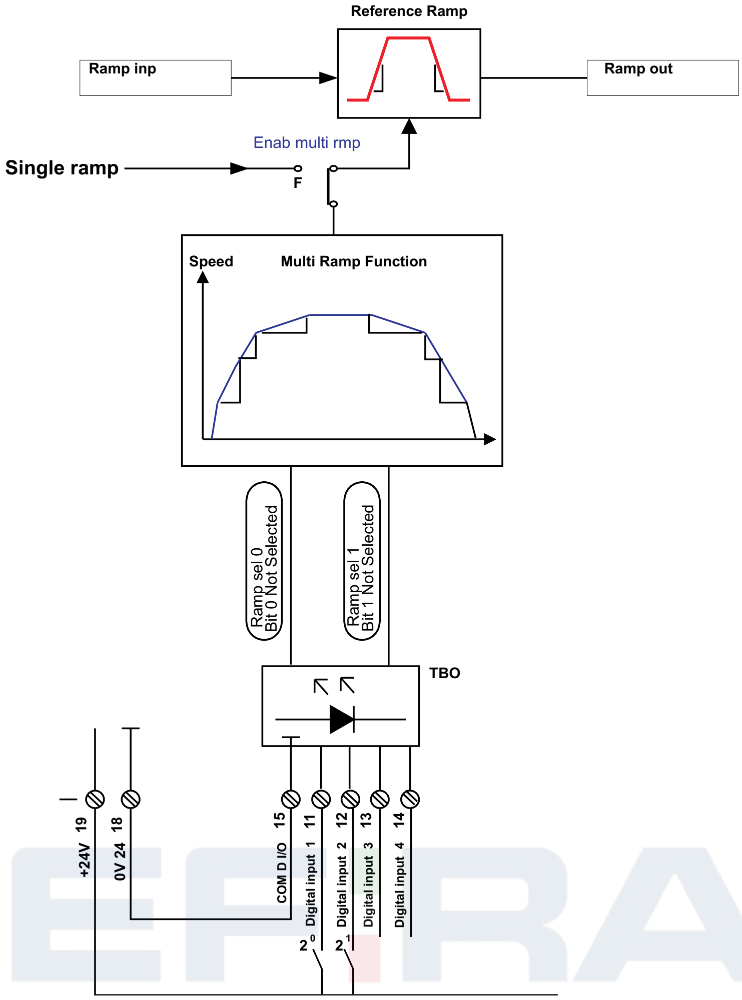

Figure 6.14.4.1: Multi ramp selection via terminals

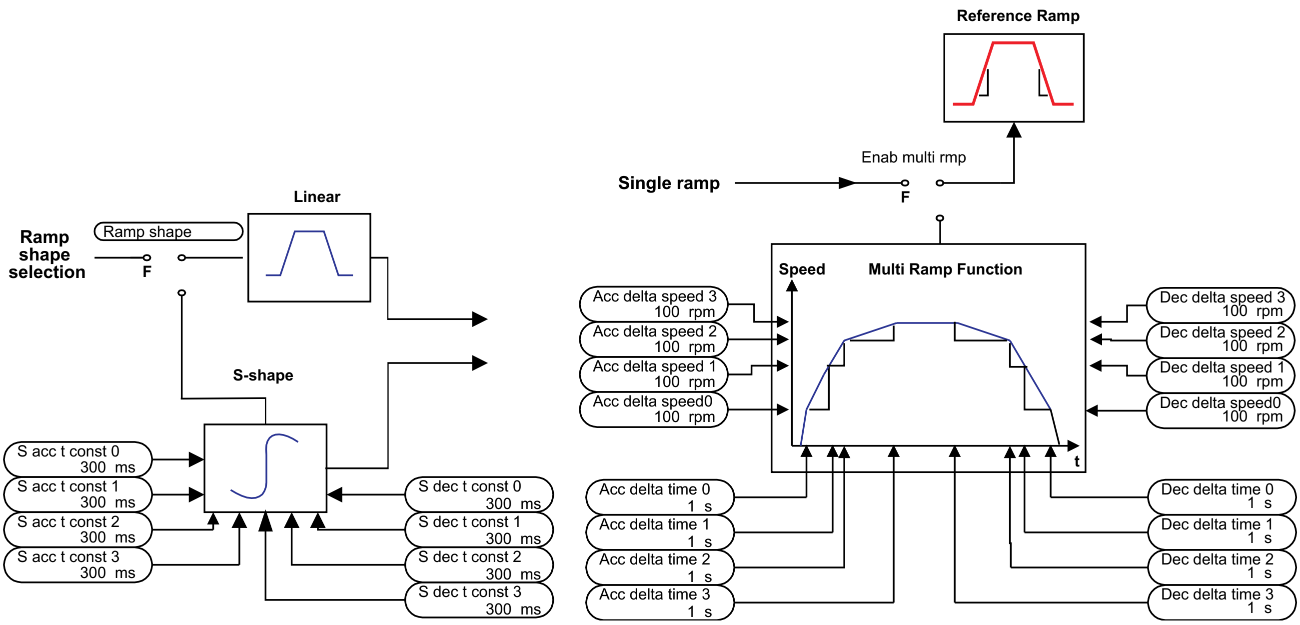

Figure 6.14.4.2: Multi ramp selection via signals

6.14.5 Speed Draw function

FUNCTIONS

Speed draw

[1017]	Speed ratio
[1018]	Speed draw out (d)
[1019]	Speed draw out (%)

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Speed ratio	1017	0	+32767	+10000	+10000	
Speed draw out (d)	1018	-32768	+32767	-	-	
Speed draw out (%)	1019	-200.0	+200.0	-	-	

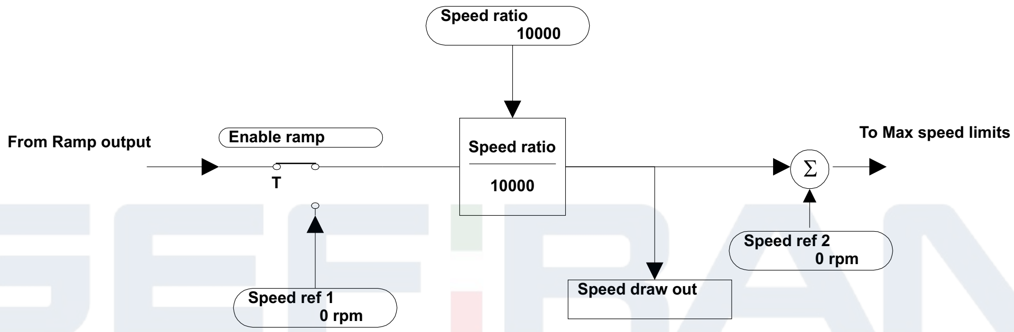

Figure 6.14.5.1: Speed draw block diagram

This function allows a configurable **Speed ratio** to be applied to the main reference **Speed ref 1**.

The Speed ratio range can be set between 0 and 32767 if written in digital form. It can be set from 0 to 20000 (0 to +10V) if assigned via an analog input.

This function is useful in a multidrive system where a **speed ratio** between the motors is required (see example in figure 6.14.5.2).

The speed resulting value can be read through the **Spd draw out** parameter via an analog output.

Speed ratio This parameter determines the speed ratio value.This setting can be done in digital form, via LAN or through an analog input.

Spd draw out (d) Speed value in the unit specified by the factor function.

Spd draw out (%) Speed value as a percentage of **Speed base value**.

EXAMPLE (RUBBER CALENDER)

Example Setting:

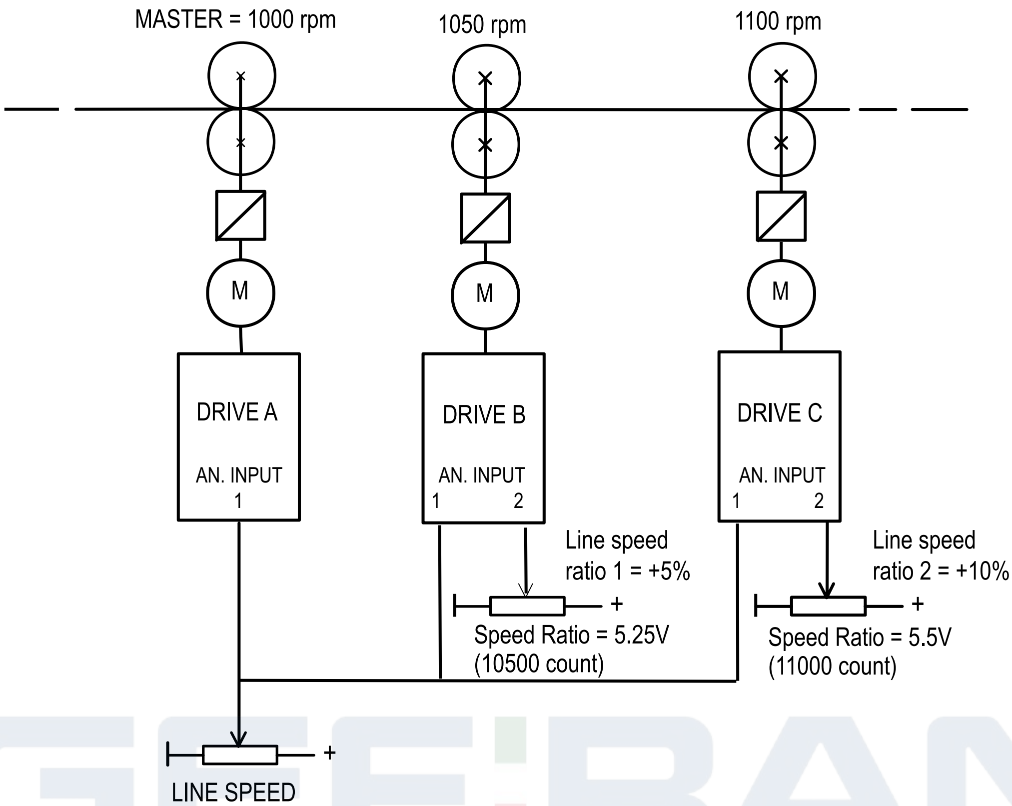

Figure 6.14.5.2: Rubber calender example

DRIVE A (master)
Set **Analog input 1** = **Ramp ref 1**

DRIVE B
Line speed ratio 1 = Line speed + 5%
Set **Analog input 1** = **Ramp ref 1**
Set **Analog input 2** = **Speed ratio**
Set **Speed ratio** parameter = **10500**

DRIVE C
Line speed ratio 2 = Line speed + 10%
Set **Analog input 1** = **Ramp ref 1**
Set **Analog input 2** = **Speed ratio**
Set **Speed ratio** parameter = **11000**

6.14.6 Overload control

FUNCTIONS

Overload contr

[309]	Enable overload
[318]	Overload mode
[312]	Overload current [%]
[313]	Base current [%]
[310]	Overload time [s]
[1289]	Motor ovrld preal.
[655]	Motor I2t accum
[1438]	Drive ovrld preal.
[1439]	Drive I2t accum
[311]	Pause time [s]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Enable overload Enabled (1) / Disabled (0)	309	0	1	Enabled	Disabled	-
Overload mode Curr limited (0) Curr not limited (1) I2t Motor (2) I2t Drive (3) I2t Motor & Drv (4)	318	0	4	I^2t Motor	Curr limited	-
Overload current [%]	312	P313	200	150	100	
Base current [%]	313	0	P312 < 100	100	80	-
Overload time [s]	310	0	65535	60	30	-
Ventil. Type SERVO (0) AUTO (1)	914					
Derating factor [%]	915	0	100	50	50	
Motor ovrld preal.	1289	0	1	-	-	
Motor I2t accum	655	0.00	100.00	-	-	
Drive ovrld preal.	1438	0	1	-	-	
Drive I2t accum	1439	0.00	100.00	-	-	
Pause time [s]	311	0	65535	540	300	-
Overld available Overload not possible (0) Overload possible (1)	406	0	1	-	-	Digital outp.4 *
Overload state Current limit value (0) Current > limit value (1)	407	0	1	-	-	*

* This parameter can be assigned to a programmable digital output.

The Overload control function allows an overcurrent for a limited time that can also exceed the rated current of the inverter. It is used in order to provide the drive with an increased acceleration torque or for example to allow peak loads, such as with cyclical loads characteristis.

Enable overload	Enabled	Overload control is enabled
	Disabled	Overload control is disabled
Overload mode	Curr limited	The armature current is restricted to the limits set by the Overload control (size and duration of overcurrent).
	Curr not limited	The armature current is not limited by the Overload control. However, an alarm is possible via the **Overload state** parameter. This alarm indicates whether the current is within

	the set limits or not.
I2t Motor	• If **Motor I2t ovrld** is set to **Activity = Ignore**, the current is reduced from **Overload current** parameter value to **Base current** parameter value when **Motor I2t accum** = 100% (Overload current^2 x Overload time) • If **Motor I2t ovrld** is set to **Activity = Warning**, the current is maintained at **Overload current** parameter value also when **Motor I2t accum** = 100% (Overload current^2 x Overload time)

NOTE ! **Motor I2t accum** is equal to 100% if (**Overload current**^{2} x **Overload time**) is reached but in any case the limit maximum is [(150% FLC)2 x 60 sec]

I2t Drive	The current is limited to **T current lim** (+/-) value until **Drive I2t accum** = 100% i.e. equal to [(150% Derated Drive Current(*))^2 x 60 sec]. When this value is reached, the drive is disabled.
I2t Motor & Drv	The current is limited to **T current lim** (+/-) value until reaching **Drive I2t accum** = 100% [(150% Derated Drive Current(*))^2 x 60 sec] if **Motor I2t ovrld** Activity is set to Warning & Ignore or, If set to Disable drive until reaching **Motor I2t accum** = 100% (Overload current^2 x Overload time).

(*) Derated Drive Current:

If using the drive with Standard sizes (Size selection = Standard) the Derated Drive Current is calculated as follows:
• Derated Drive Current = Drive size x Derating_fact (see table "Table 6.14.6.1: I2t derating" on page 249).

If using the drive with American sizes (Size selection = American) the Derated Drive Current is calculated as follows:
• Derated Drive Current = Drive size.

The motor overload function is designed to allow the current selected with **Overload Current** for a time equal to **Overload Time**.

$(I\ load^2 - I\ ovld^2)*ts[sec] = ((Over\ Curr / 100)^2 - 1^2)*I\ Flc^2 * (Overload\ time)$

I flc = full load current

The motor overload function gives the possibility to have 1.5 the **Overload current** for 60 sec.

If the threshold is higher than the value is limited to:

$(I\ load^2 - I\ Flc^2)*ts[sec] = (1.5^2 - 1^2)*I\ Flc^2 * 60$

The **Motor ovrld preal.** is available on digital output (code 65), it is 1 with **Motor I2t accum** = 90 % and 0 when **Motor I2t accum** = 0.

The **Overld available** signal is available on digital output (code 6), it is 0 with **Motor I2t accum** = 100 % and 1 with **Motor I2t accum** 0.

The **Drive ovrld preal.** is available on digital output (code 66), it is 1 with **Drive I2t accum** = 90 % and 0 when **Drive I2t accum** = 0.

The **Overld available** signal is available on digital output (code 67), it is 0 with **Drive I2t accum** = 100 % and 1 with **Drive I2t accum** 0.

European sizes	American sizes	Derating _fct	European sizes	American sizes	Derating _fct
TPD32-EV-.../...-20-2B/4B-A	TPD32-EV-.../...-17-2B/4B-A-NA	0.85	TPD32-EV-.../...-1200-2B-E	TPD32-EV-.../...-1000-2B-E-NA	0.83
TPD32-EV-.../...-40-2B/4B-A	TPD32-EV-.../...-35-2B/4B-A-NA	0.88	TPD32-EV-.../...-1500-2B/4B-E	TPD32-EV-.../...-1300-2B/4B-E-NA	0.87
TPD32-EV-.../...-70-2B/4B-A	TPD32-EV-.../...-56-2B/4B-A-NA	0.80	TPD32-EV-.../...-1700-4B-E	TPD32-EV-.../...-1350-4B-E-NA	0.79
TPD32-EV-.../...-110-2B/4B-A	TPD32-EV-.../...-2B/4B-A-NA	0.80	TPD32-EV-.../...-1800-2B/4B-E	TPD32-EV-.../...-1400-2B/4B-E-NA	0.78
TPD32-EV-.../...-140-2B/4B-A	TPD32-EV-.../...-112-2B/4B-A-NA	0.80	TPD32-EV-.../...-2000-2B/4B-E	TPD32-EV-.../...-1500-2B/4B-E-NA	0.75
TPD32-EV-.../...-185-2B/4B-A	TPD32-EV-.../...-148-2B/4B-A-NA	0.80	TPD32-EV-.../...-2400-2B/4B-E	TPD32-EV-.../...-1800-2B/4B-E-NA	0.75
TPD32-EV-.../...-280-2B/4B-B	TPD32-EV-.../...-224-2B/4B-B-NA	0.80	TPD32-EV-.../...-2700-2B/4B-E	TPD32-EV-.../...-2000-2B/4B-E-NA	0.74
TPD32-EV-.../...-350-2B/4B-B	TPD32-EV-.../...-280-2B/4B-B-NA	0.80	TPD32-EV-.../...-2900-2B/4B-E	TPD32-EV-.../...-2200-2B/4B-E-NA	0.76
TPD32-EV-.../...-420-2B/4B-B	TPD32-EV-.../...-336-2B/4B-B-NA	0.80	TPD32-EV-.../...-3300-2B/4B-E	TPD32-EV-.../...-2350-2B/4B-E-NA	0.71
TPD32-EV-.../...-500-2B/4B-B	TPD32-EV-.../...-400-2B/4B-B-NA	0.80	TPD32-EV-.../...-1010-2B/4B-E	TPD32-EV-.../...-900-2B/4B-E-NA	0.89
TPD32-EV-.../...-560-2B/4B-C	TPD32-EV-.../...-360-2B/4B-C-NA	0.64	TPD32-EV-.../...-1400-2B/4B-E	TPD32-EV-.../...-1150-2B/4B-E-NA	0.82
TPD32-EV-.../...-650-2B/4B-B	TPD32-EV-.../...-450-2B/4B-B-NA	0.69	TPD32-EV-.../...-1700-2B/4B-E	TPD32-EV-.../...-1350-2B/4B-E-NA	0.79
TPD32-EV-.../...-700-2B/4B-C	TPD32-EV-.../...-490-2B/4B-C-NA	0.70	TPD32-EV-.../...-2000-2B/4B-E	TPD32-EV-.../...-1500-2B/4B-E-NA	0.75
TPD32-EV-.../...-770-2B/4B-C	TPD32-EV-.../...-560-2B/4B-C-NA	0.73	TPD32-EV-.../...-2400-2B/4B-E	TPD32-EV-.../...-1800-2B/4B-E-NA	0.75
TPD32-EV-.../...-900-2B/4B-C	TPD32-EV-.../...-650-2B/4B-C-NA	0.72	TPD32-EV-.../...-2700-2B/4B-E	TPD32-EV-.../...-2000-2B/4B-E-NA	0.74
TPD32-EV-.../...-1000-2B-C	TPD32-EV-.../...-750-2B-C-NA	0.75	TPD32-EV-.../...-3300-2B/4B-E	TPD32-EV-.../...-2350-2B/4B-E-NA	0.71
TPD32-EV-.../...-1050-4B-C	TPD32-EV-.../...-750-4B-C-NA	0.71			
TPD32-EV-.../...-1000-2B-C	TPD32-EV-.../...-800-2B-C-NA	0.80			
TPD32-EV-.../...-1050-4B-C	TPD32-EV-.../...-850-4B-C-NA	0.81			
TPD32-EV-.../...-1300-4B-D	TPD32-EV-.../...-920-4B-D-NA	0.71			
TPD32-EV-.../...-1300-4B-D	TPD32-EV-.../...-980-4B-D-NA	0.75			
TPD32-EV-.../...-1300-2B-D	TPD32-EV-.../...-980-2B-D-NA	0.75			
TPD32-EV-.../...-1400-2B/4B-D	TPD32-EV-.../...-1000-2B/4B-D-NA	0.71			
TPD32-EV-.../...-1600-2B/4B-D	TPD32-EV-.../...-1200-2B/4B-D-NA	0.75			
TPD32-EV-.../...-1900-2B/4B-D	TPD32-EV-.../...-1450-2B/4B-D-NA	0.76			
TPD32-EV-.../...-2000-2B/4B-D	TPD32-EV-.../...-1500-2B/4B-D-NA	0.75			
TPD32-EV-.../...-2100-2B/4B-D	TPD32-EV-.../...-1650-2B/4B-D-NA	0.79			
TPD32-EV-.../...-2300-2B/4B-D	TPD32-EV-.../...-1800-2B/4B-D-NA	0.78			
TPD32-EV-.../...-2400-2B/4B-D	TPD32-EV-.../...-1850-2B/4B-D-NA	0.77			

Table 6.14.6.1: I2t derating

Overload current Armature current that is permissible during the overload time (set with **Overload time**). It is always 200% as a maximum of the active current at **Full load curr** and therefore proportional to the torque.

Base current Armature current that is permissible during the pause time (set with Pause time). The percentage refers to the active current at **Full load curr**.

Overload time Maximum time in which the **Overload current** is permissible.

Ventil. Type

AUTO — Auto fan indicates the presence of a fan unit mounted on the motor shaft that therefore turns at a speed propor-tional to the motor speed. Cooling is not very effective at low motor speeds.

SERVO — Servo fan indicates the presence of an independent fan unit that therefore always runs at the rated speed. It en-sures optimum cooling efficiency at all motor speeds.

Note ! The management of motor control overload with auto-ventilated motor has the aim of generating a motor Overload alarm before the threshold (configured by the parameters 310 **Overload time** and 312 **Overload current** is reached) when the motor speed is less than half of the nominal .

It is also implemented to save the internal I2t accumulator of the drive and motorat the power off. In this way, at the power on the parameter value 655 (**Motor I2t accum**) and 1439 (**Drive I2t accum**) will be equal to the present value at the time of the previous power off.

Derating factor This parameter is used to set the derating factor for Auto fan motor and represents the continuous output current value at zero speed expressed as percentage of the full load current. When motor speed is below 50% of nominal value the continuous output current is linearly decreased from 100% of full load current to this value.

Pause time Minimum time between two Overload cycles. During this time the **Base current** is permissible.

Motor I2t accum It gives a percentage definition of the integration of the rms current. 100% = trip level motor I2t . **Motor I2t accum** is equal to 100% if (**Overload current**^{2} x **Overload time**) is reached but in any case with a maximum limit of [(150% FLC) ^{2} x 60 sec].

Motor ovrld preal. This signal can be set on a digital output (code 65). It goes to the high level (1) when **Motor I2t accum** = 90 %. It goes to low level (0) when **Motor I2t accum** = 0.

Drive I2t accum It gives a percentage definition of the integration of the rms current. 100% = trip level drive I2t. **Drive I2t accum** is equal to 100% if [(150% Derated Drive Current$^{(*)}$)^2 x 60 sec] is reached.

Drive ovrld preal. This signal can be set on a digital output (code 66). It goes to the high level (1) when **Drive I2t accum** = 90 %. It goes to low level (0) when **Drive I2t accum** = 0.

Overld available Indicates whether an overload is possible this very instant or whether this is not yet the case, due to the set cycle (**Pause time** not yet expired).

High Overload possible
Low Overload currently not possible

Overload state If the **Overload mode** parameter is defined so that the current is not limited by the Overload control, the **Overload state** can be used to determine whether the current is within the set limits or not.

High Current exceeds the set limits
Low Current does not exceed the set limits.

Note! Overload state is not a latched output. For I2t, it is can be considered as a one shot.

The Overload control is enabled with the **Enable overload** parameter. It can be used to protect the drive or motor from thermal overloads with cyclical loads.

The max. possible values (as for the converter) are obtainable through the following curves. The operating point must always be below the corresponding curve. At the verification it is to state, that the torque and the current are proportional.

The **Overld available** parameter allows to understand if the drive is ready to supply an overload current. If the current exceeds the value defined by the **Base current** parameter, the time set by the **Overload time** parameter starts to run. Once this time has expired, the current is limited again to the Base current. This takes place irrespective of how high the overload was and how long it lasted. A subsequent overload is permissable immediately after the time set by the **Pause time** parameter. If **Overload mode** is set to "Curr not limited", The current is not limited but the **Overload state** parameter indicates whether it is out of the defined range.

Caution! A wrong input of the values may cause the destruction of the device!

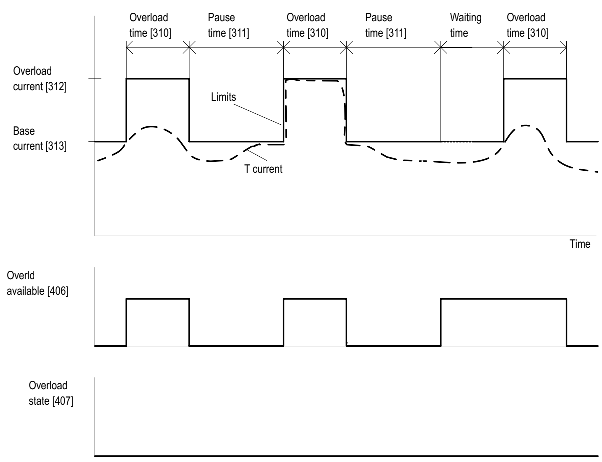

Figure 6.14.6.1: Overload control (Overload mode = curr limited)

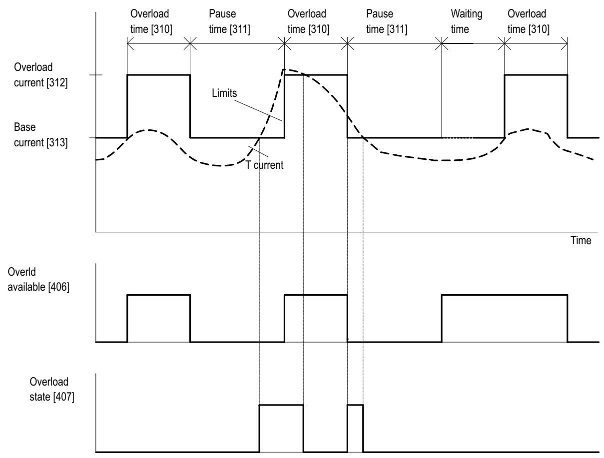

Figure 6.14.6.2: Overload control (Overload mode= curr not limited)

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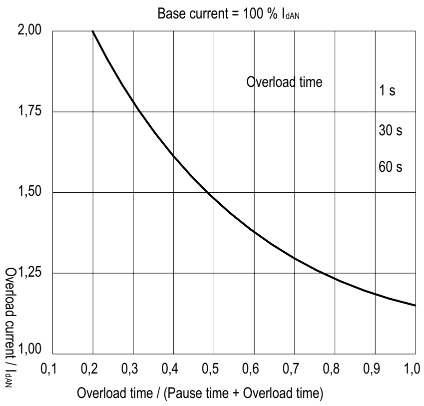
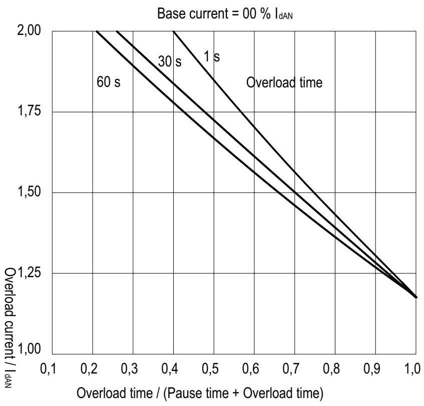
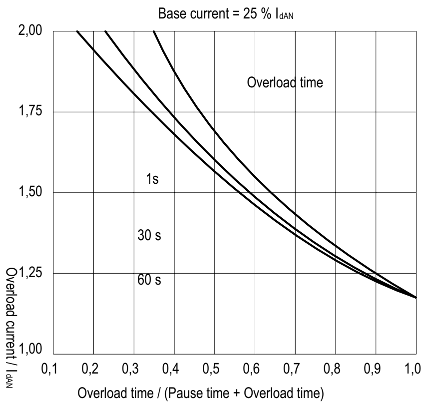
Acceptable overload curves (American sizes)

IdAN = 17A (-NA)

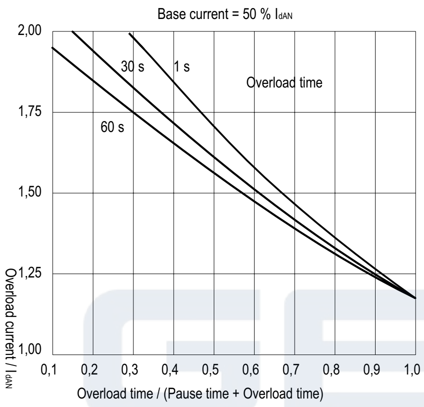


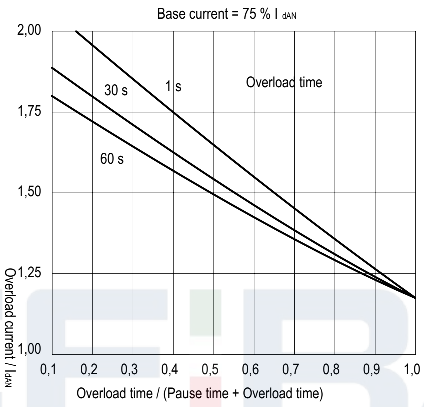
IdAN = 35A (-NA)

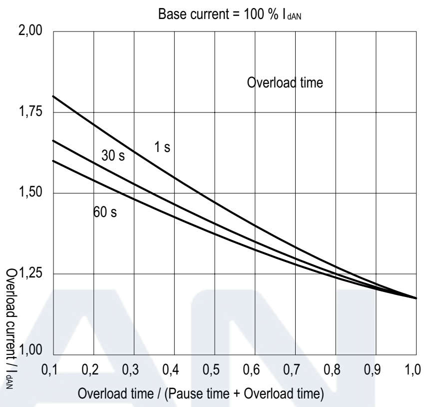




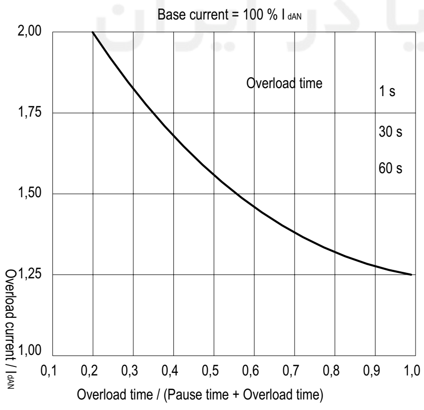
IdAN = 35A (-NA)



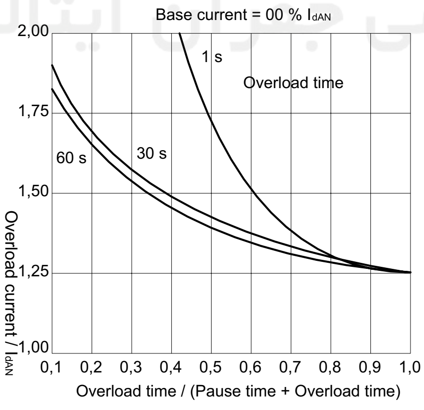


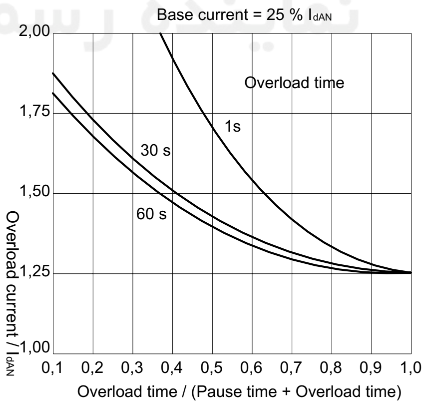


IdAN = 56A (-NA)

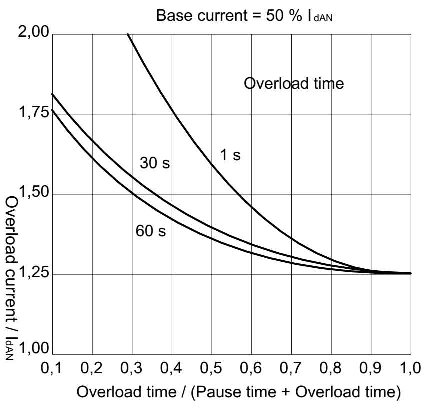


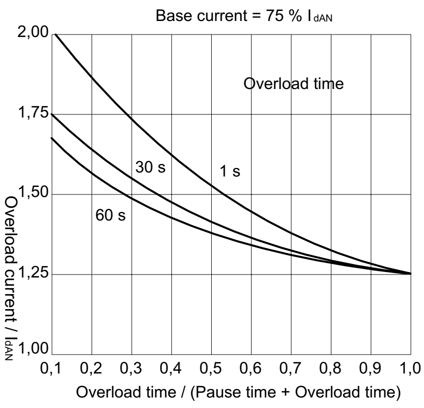
IdAN = 88A (-NA)

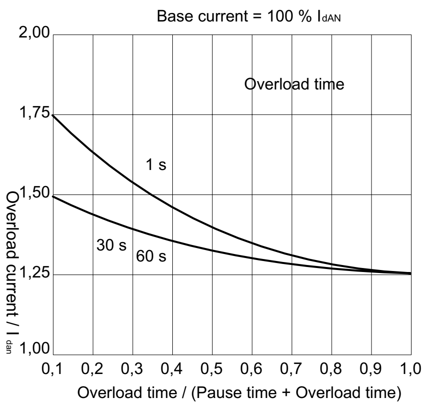




IdAN = 88A (-NA)

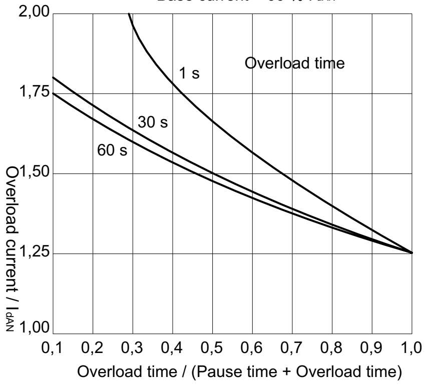




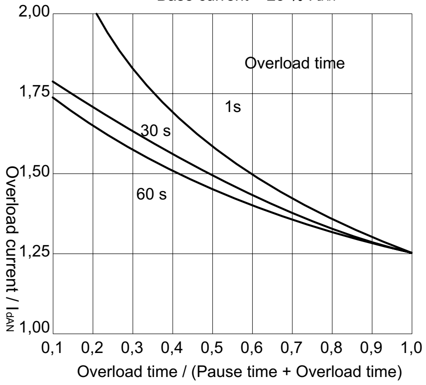


IdAN = 112A (-NA)

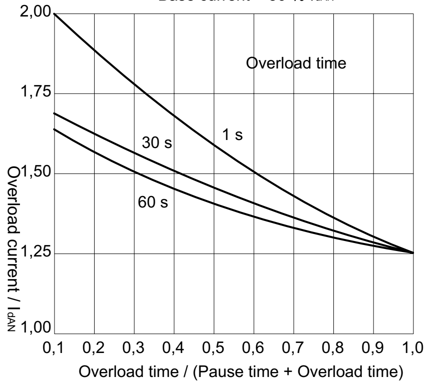
Base current = 00 % I dAN



Base current = 25 % I dAN

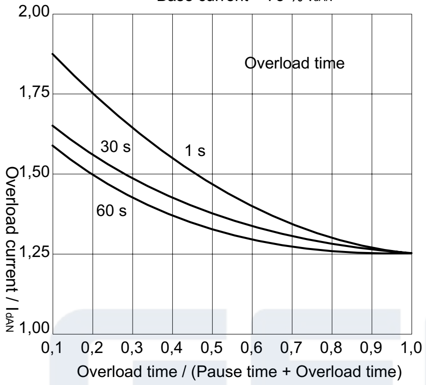


Base current = 50 % IdAN

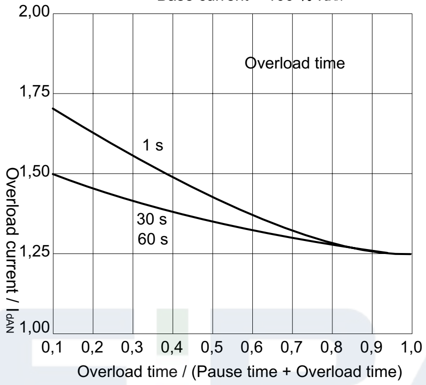


IdAN = 112A (-NA)

Base current = 75 % IdAN

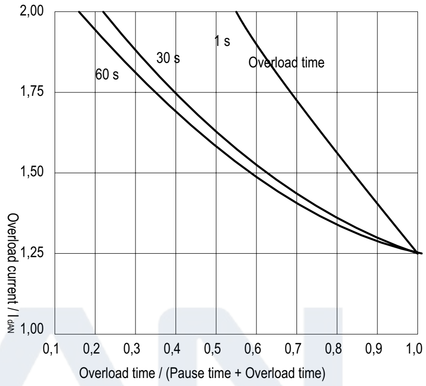


Base current = 100 % IdAN



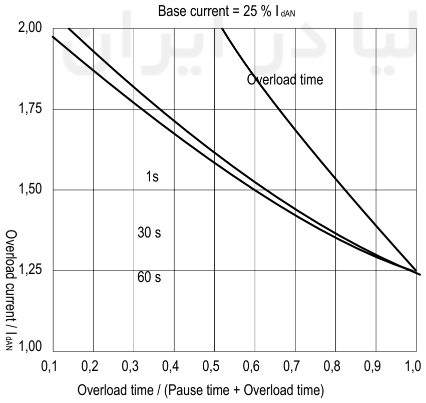
IdAN = 148A (-NA)

Base current = 00 % IdAN

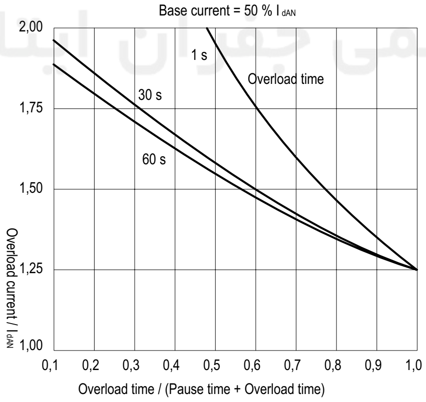


IdAN = 148A (-NA)

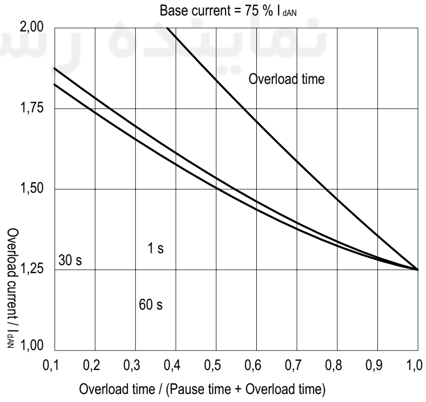
Base current = 25 % IdAN



Base current = 50 % IdAN

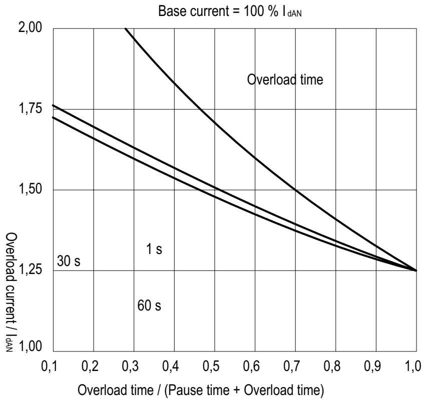


Base current = 75 % IdAN



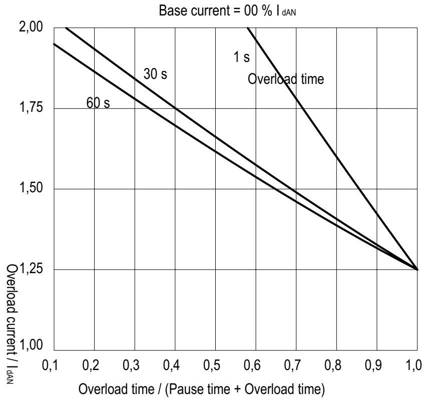
IdAN = 148A (-NA)

Base current = 100 % IdAN

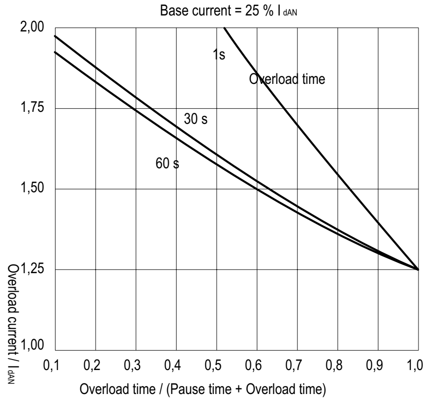


IdAN = 224A (-NA)

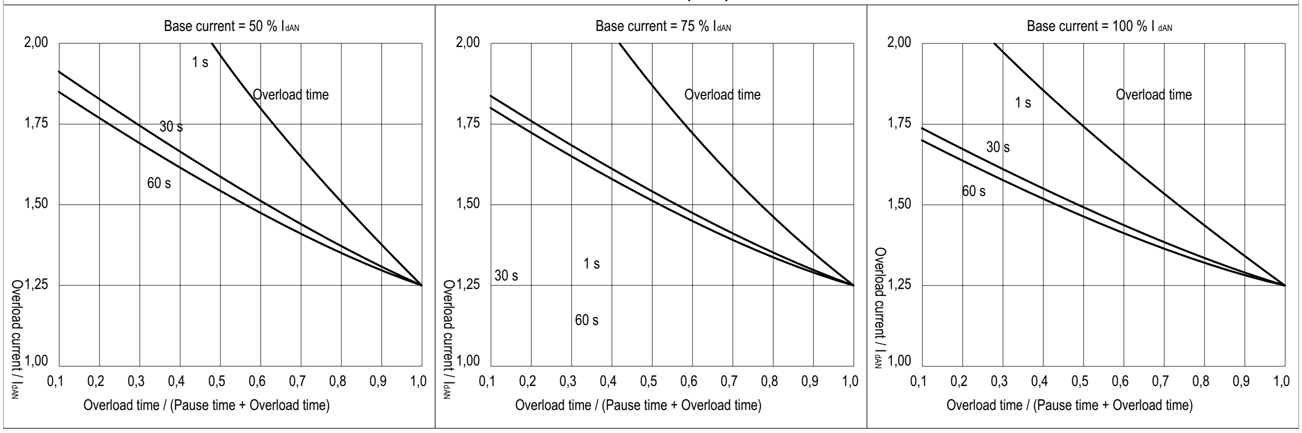
Base current = 00 % IdAN



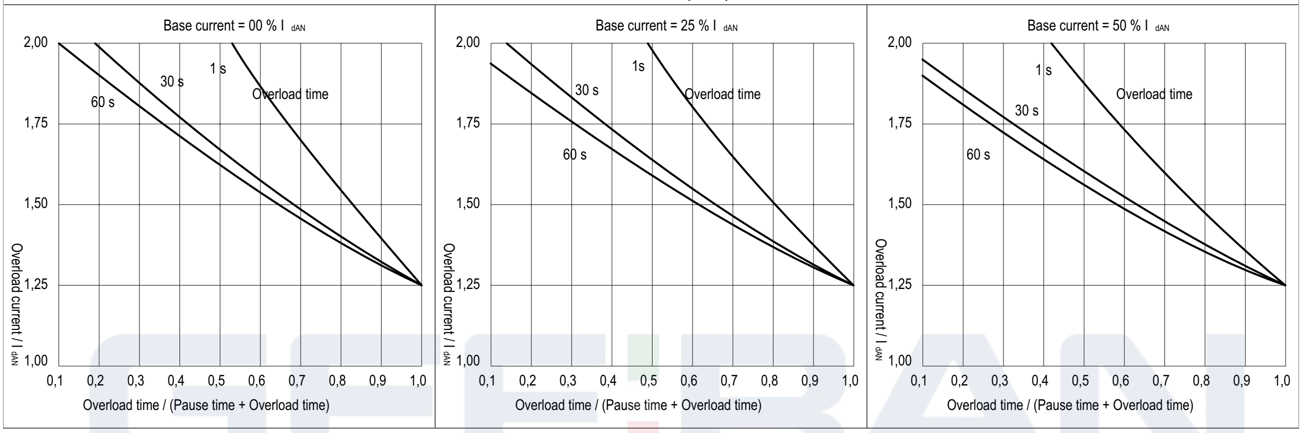
Base current = 25 % IdAN



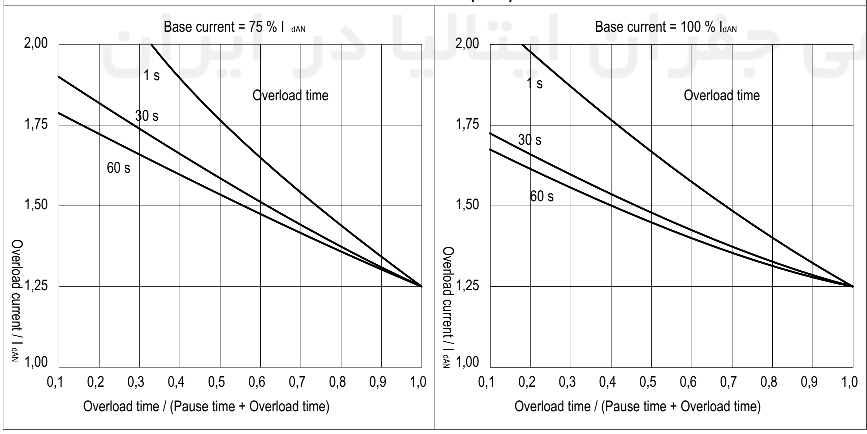
Id_{AN} = 224A (-NA)



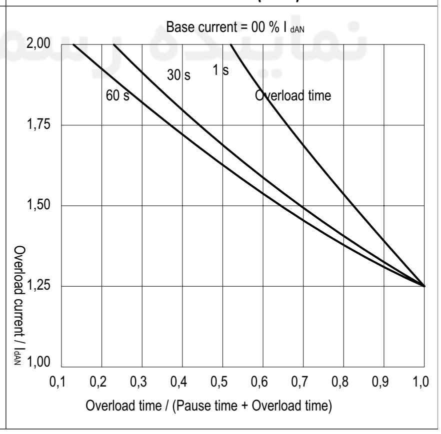
Id_{AN} = 280A (-NA)



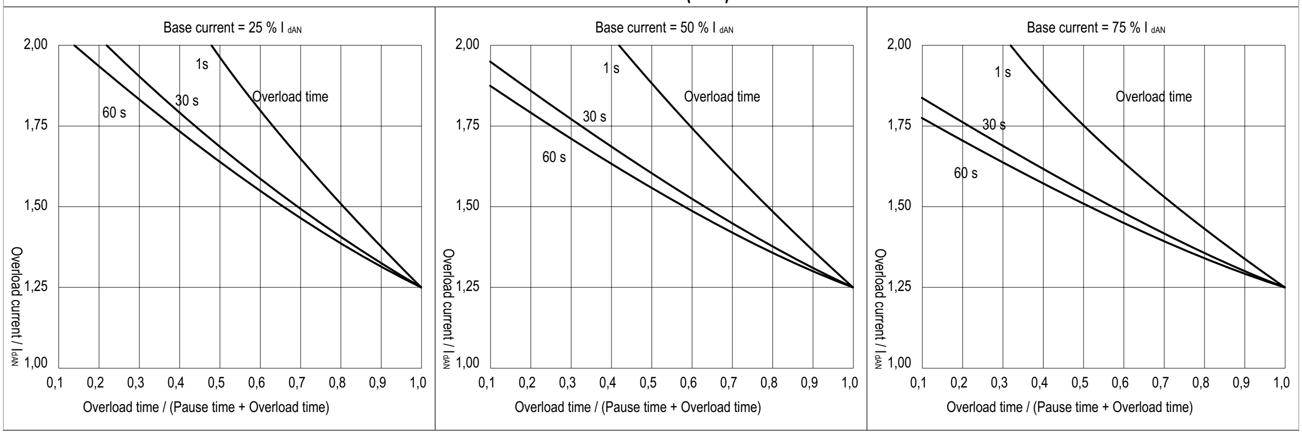
Id_{AN} = 280A (-NA)



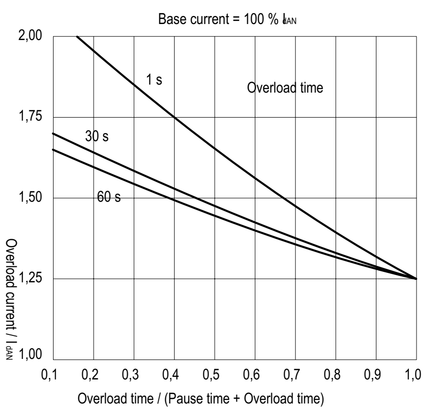
Id_{AN} = 336A (-NA)

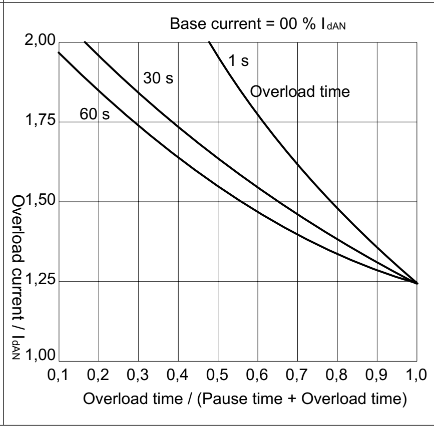


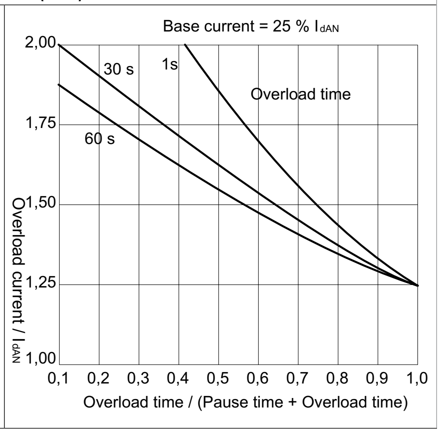
Id_{AN} = 336A (-NA)



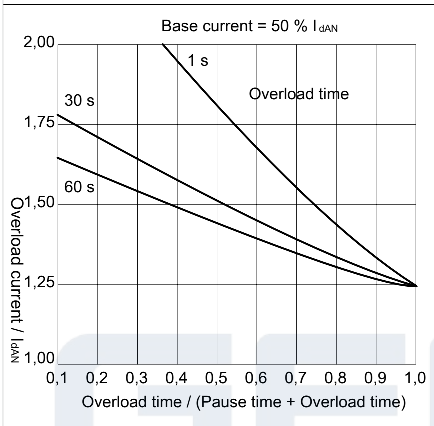
I_{dAN} = 336A (-NA)	I_{dAN} = 400A (-NA)	

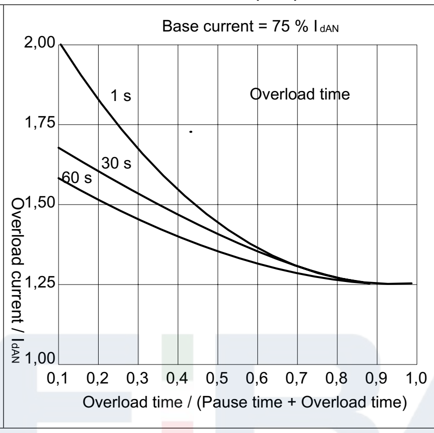


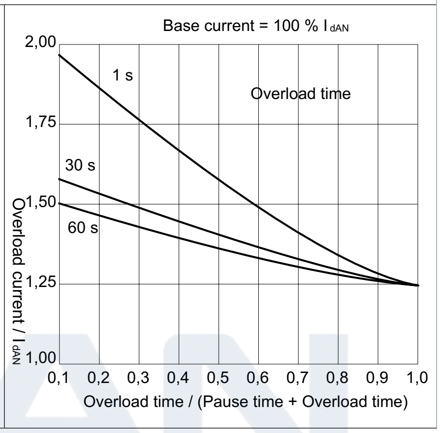




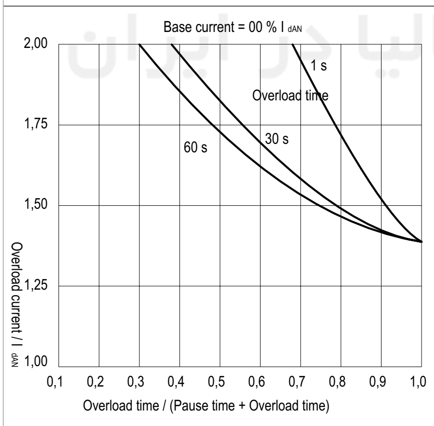
I_{dAN} = 400A (-NA)

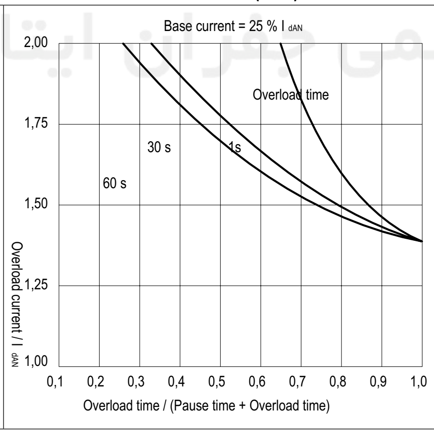


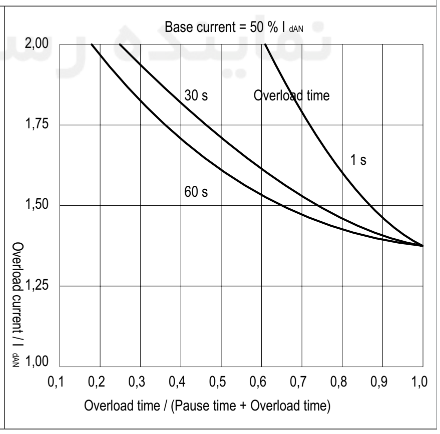




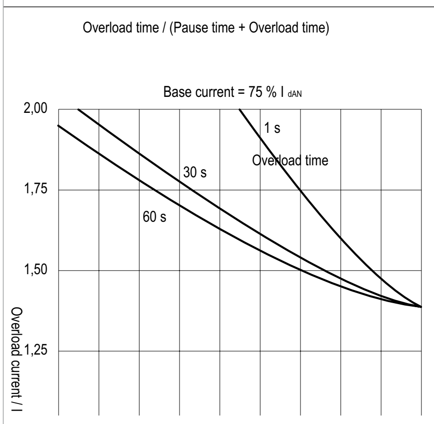
I_{dAN} = 450A (-NA)

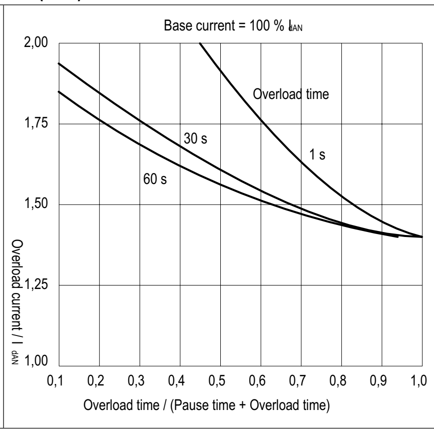


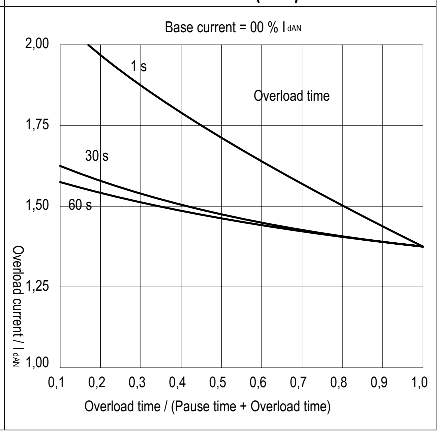




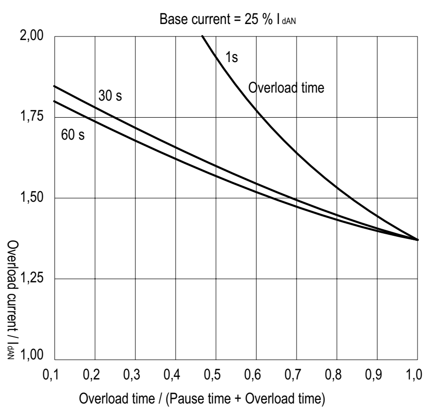
I_{dAN} = 450A (-NA)		I_{dAN} = 560A (-NA)

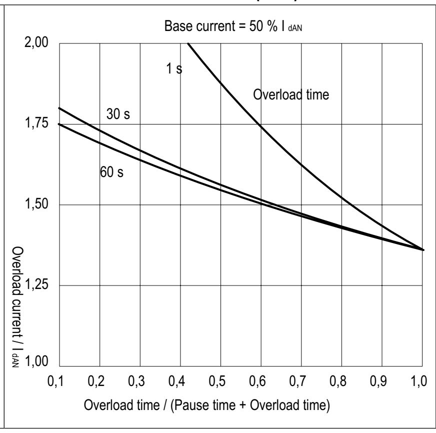


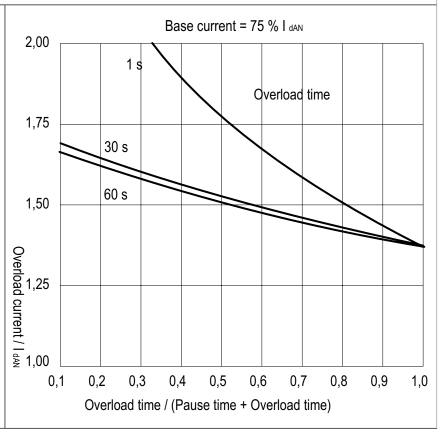




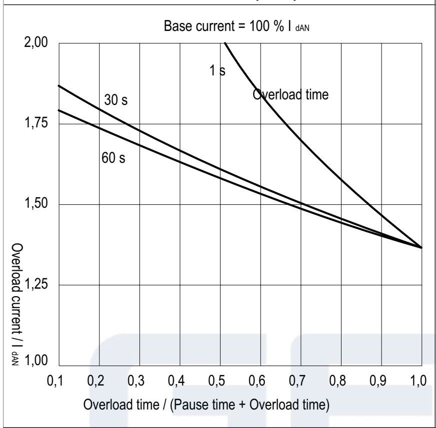
I_{dAN} = 560A (-NA)



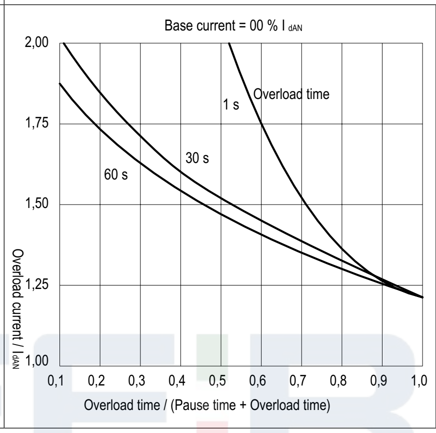


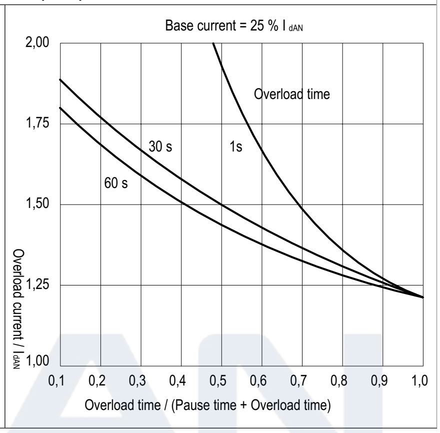


I_{dAN} = 560A (-NA)

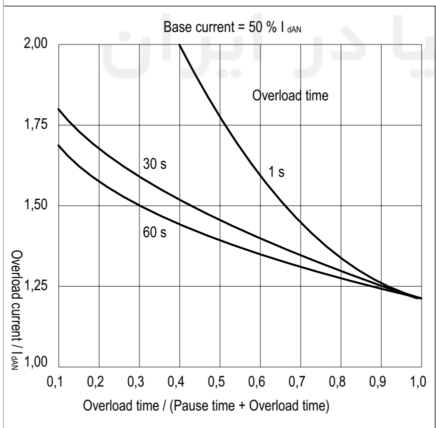


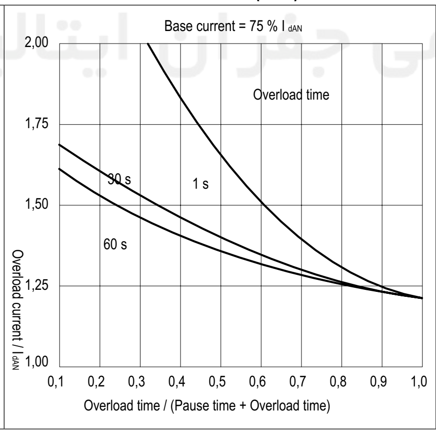
I_{dAN} = 850A (-NA)

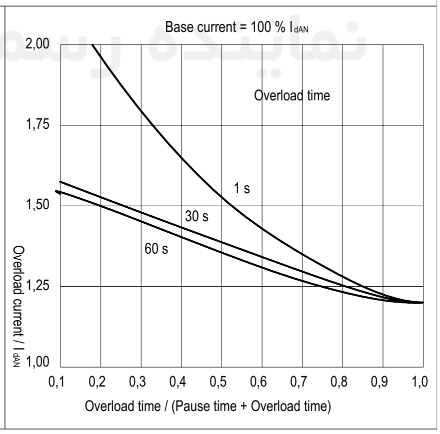




I_{dAN} = 850A (-NA)

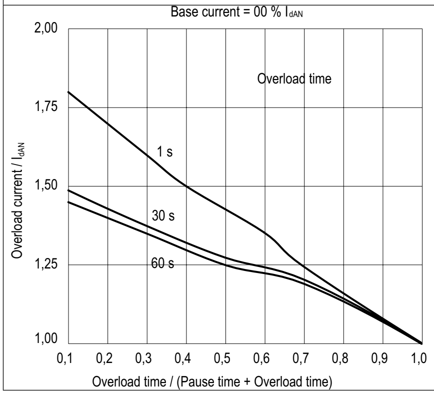


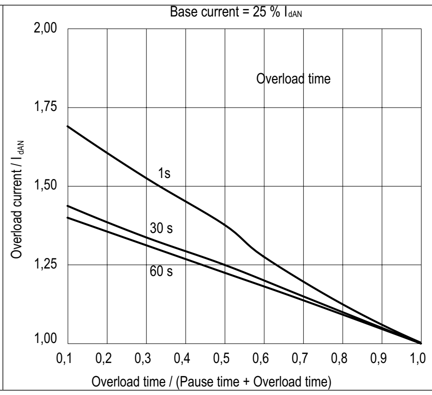


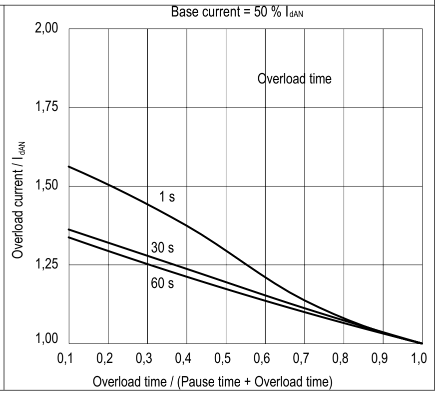


Acceptable overload curves (Standard sizes)

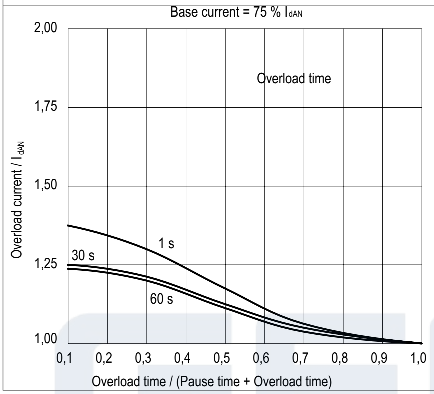
I_{dAN} = 20 ... 70A



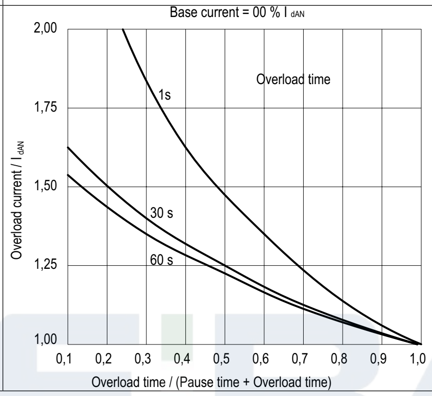


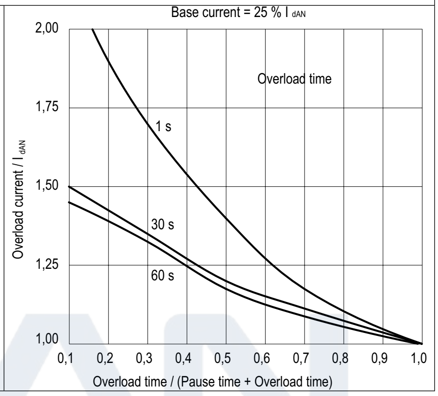


I_{dAN} = 20 ... 70A

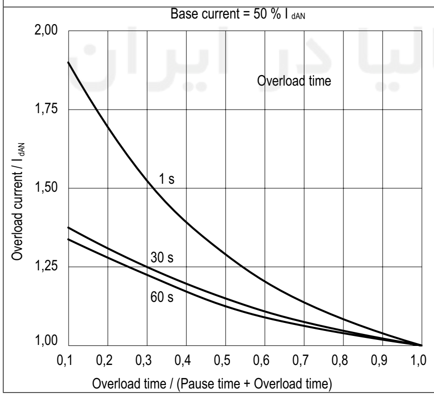


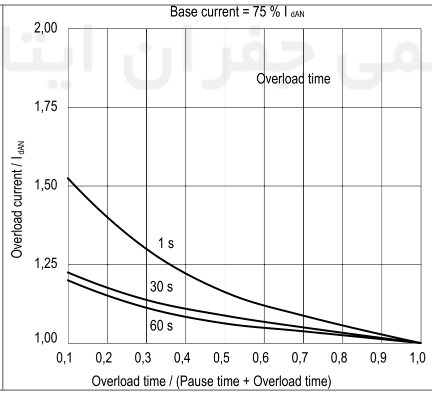
I_{dAN} = 110 ... 185A



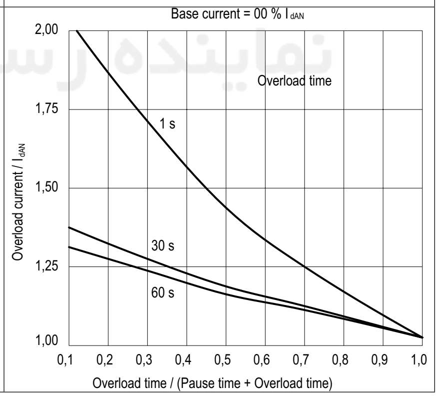


I_{dAN} = 110 ... 185A

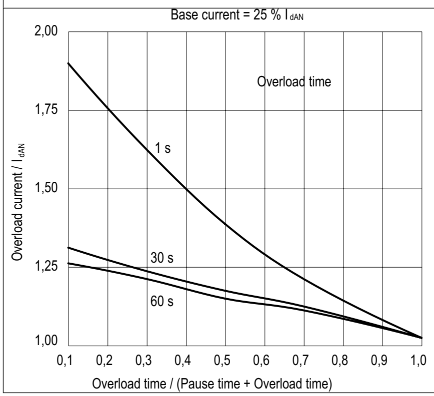


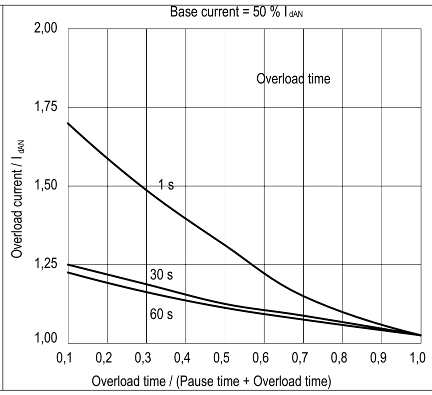


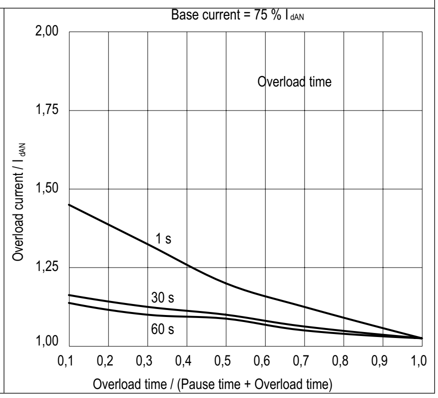
I_{dAN} = 280 ... 650A



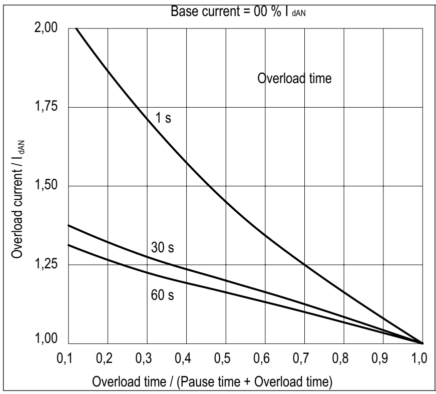
I_{dAN} = 280 ... 650A

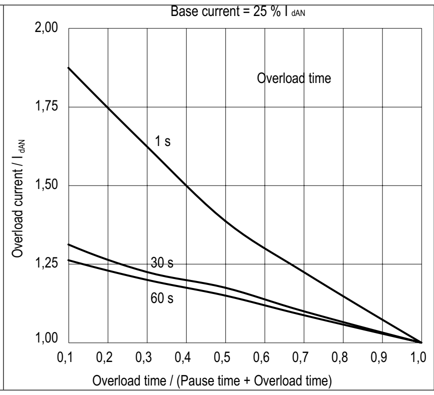


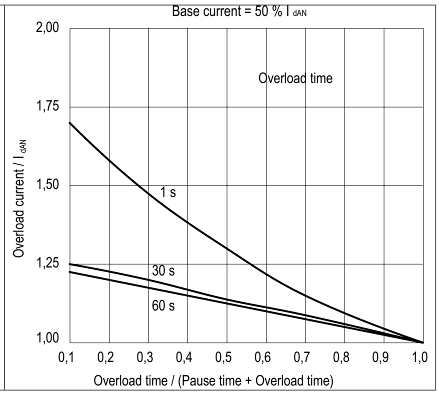




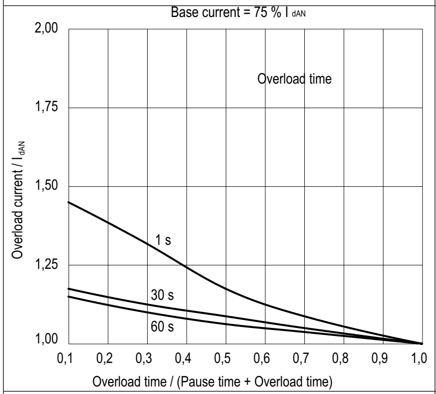
I_{dAN} = 770 ... 1050A



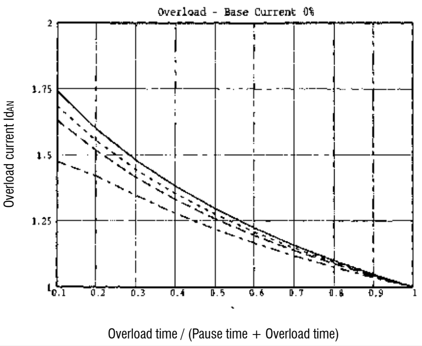


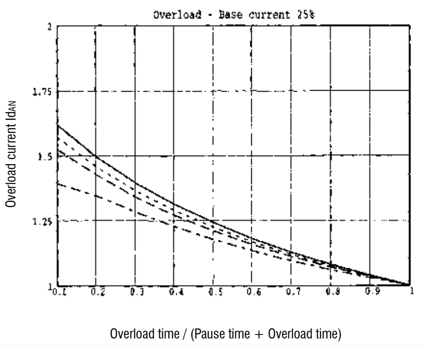


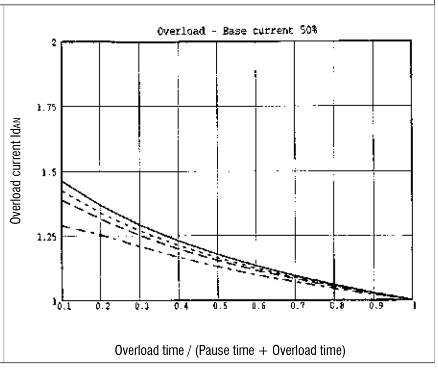
Id_{AN} = 770 ... 1050A



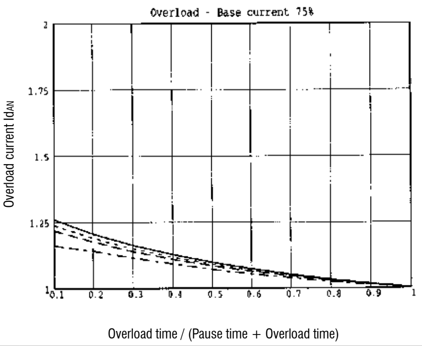
TPD32-690/810-1010-2B-E



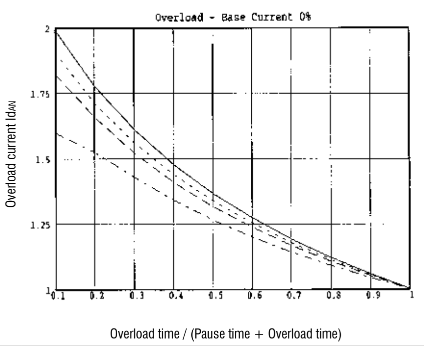


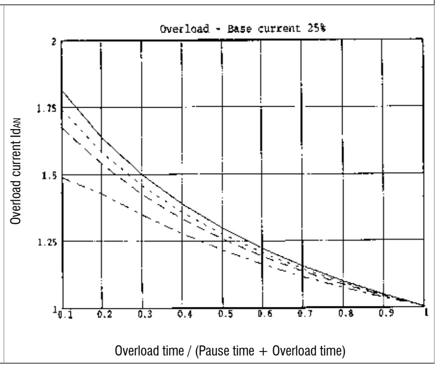


TPD32-690/810-1010-2B-E

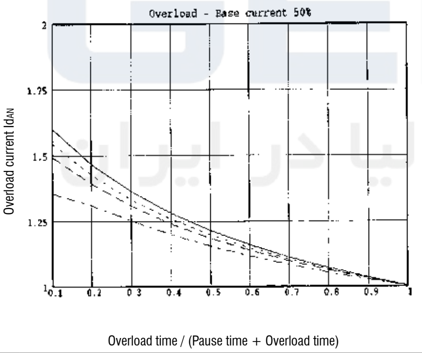


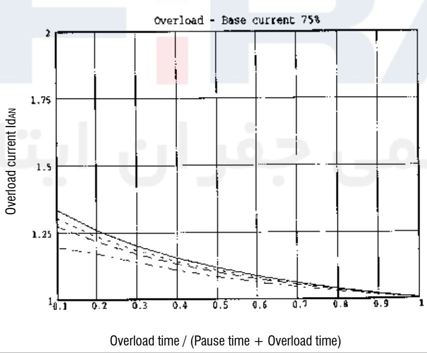
TPD32-500/600-1200-2B-E



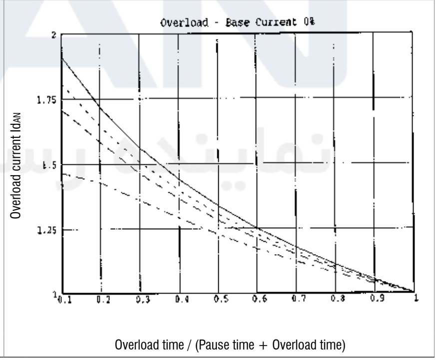


TPD32-500/600-1200-2B-E

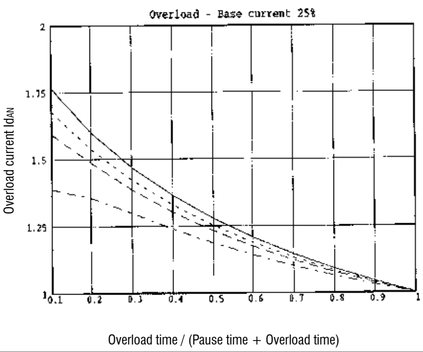


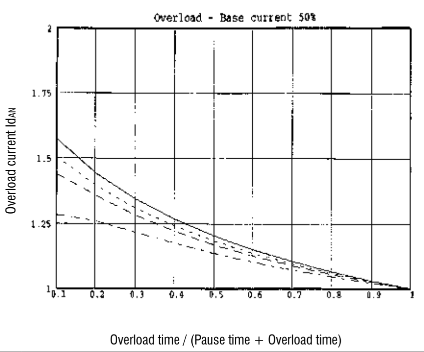


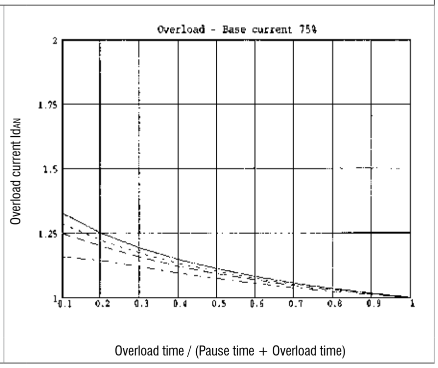
TPD32-690/810-1400-2B-E



TPD32-690/810-1400-2B-E

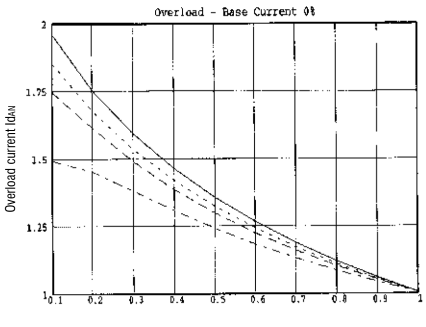




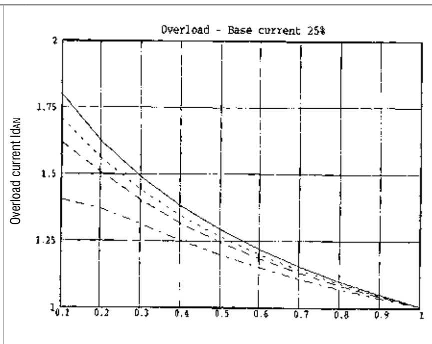


____ = 10 s. ...... = 20 s. ---- = 30 s. - . - = 60 s.

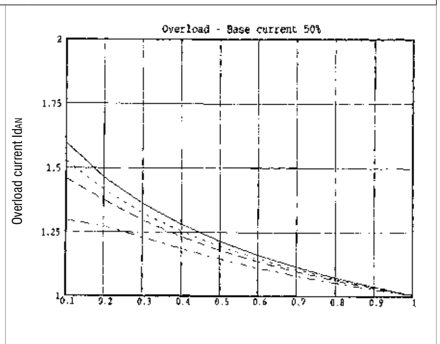
TPD32-500/600-1500-2B-E



Overload time / (Pause time + Overload time)

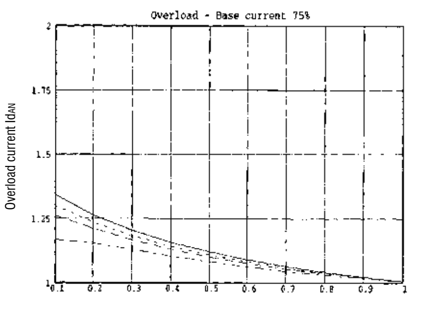


Overload time / (Pause time + Overload time)



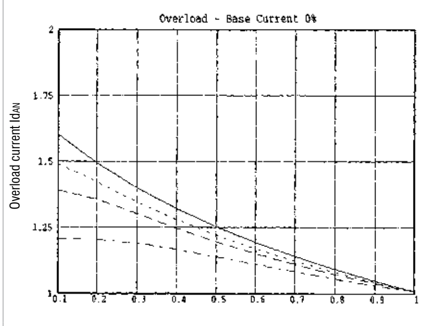
Overload time / (Pause time + Overload time)

TPD32-500/600-1500-2B-E

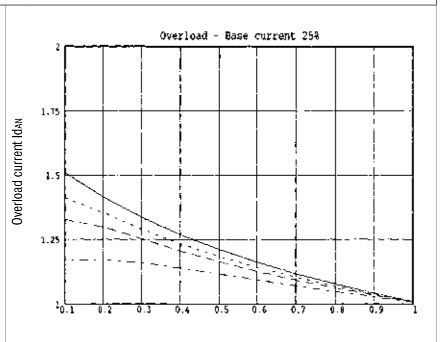


Overload time / (Pause time + Overload time)

TPD32-690/810-1700-2B-E

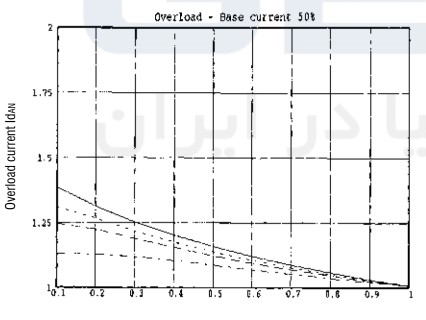


Overload time / (Pause time + Overload time)

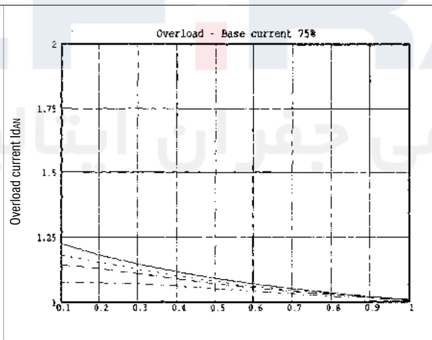


Overload time / (Pause time + Overload time)

TPD32-690/810-1700-2B-E

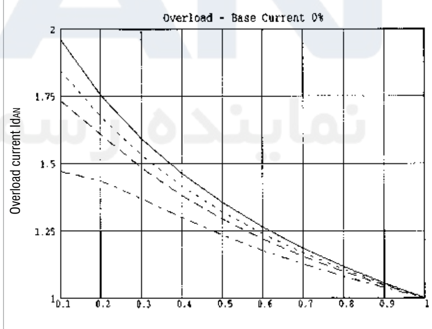


Overload time / (Pause time + Overload time)



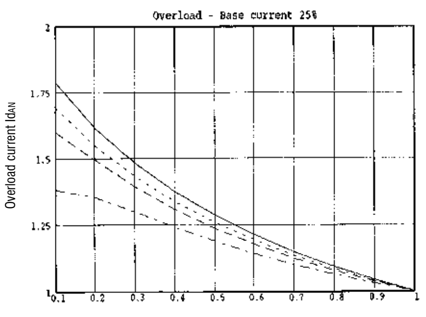
Overload time / (Pause time + Overload time)

TPD32-500/600-1800-2B-E

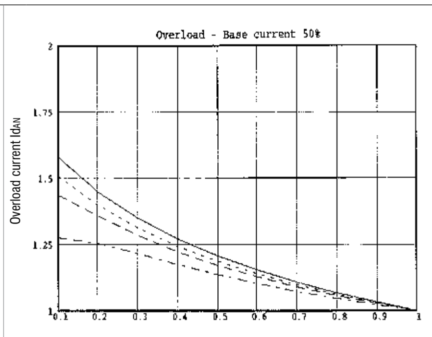


Overload time / (Pause time + Overload time)

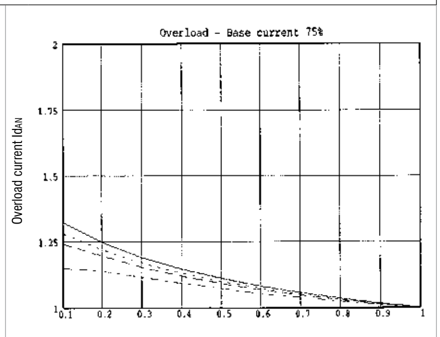
TPD32-500/600-1800-2B-E



Overload time / (Pause time + Overload time)



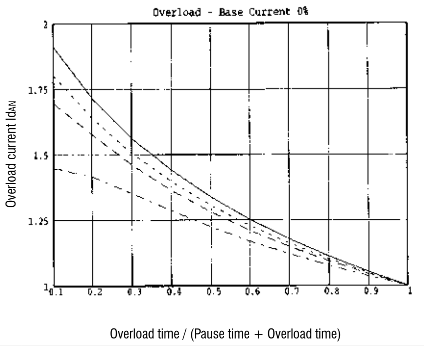
Overload time / (Pause time + Overload time)

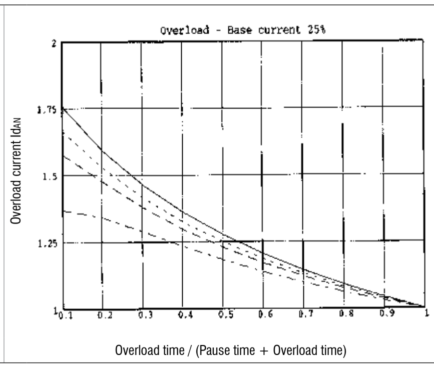


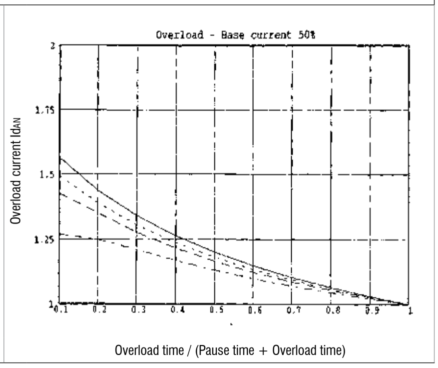
Overload time / (Pause time + Overload time)

____ = 10 s.	...... = 20 s.	---- = 30 s.	_ . _ = 60 s.

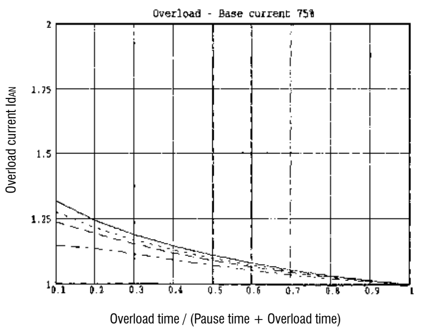
TPD32-500/600-2000-2B-E







TPD32-500/600-2000-2B-E



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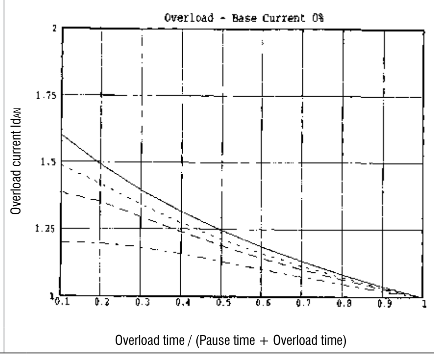

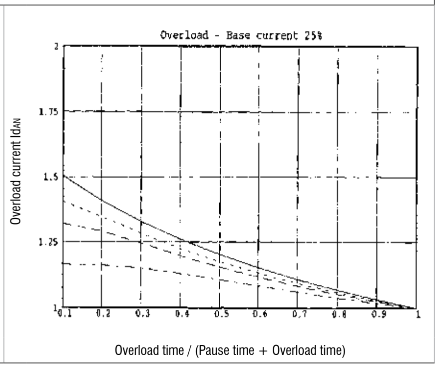

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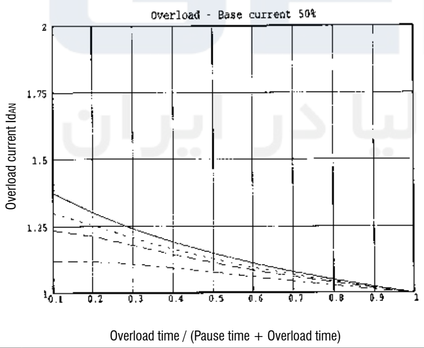

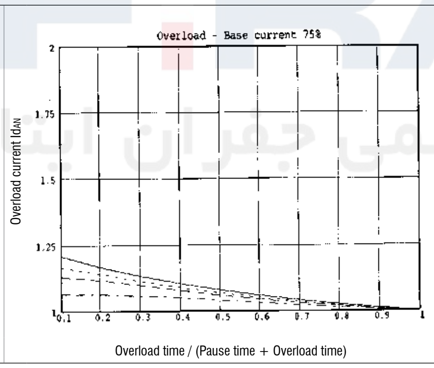

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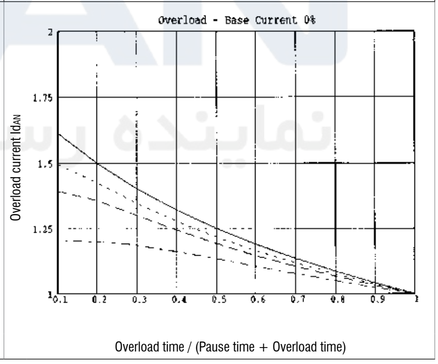

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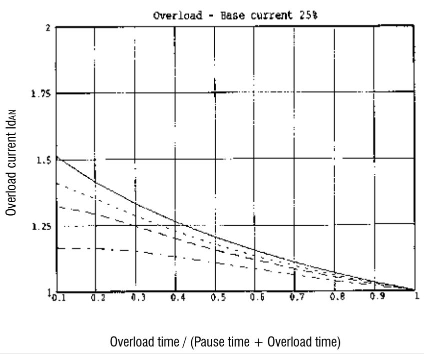
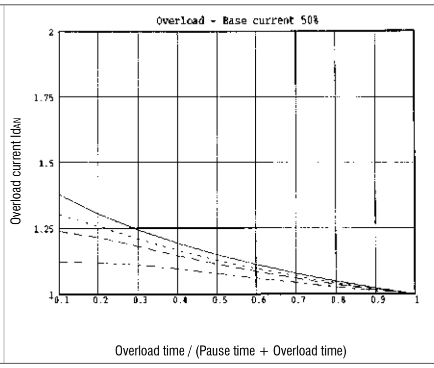
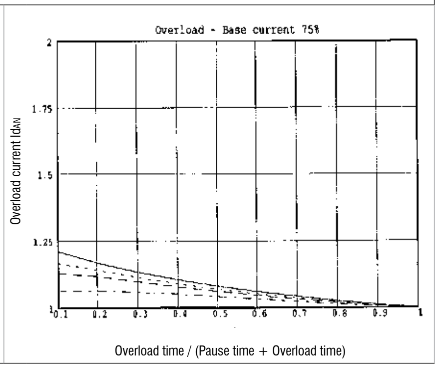
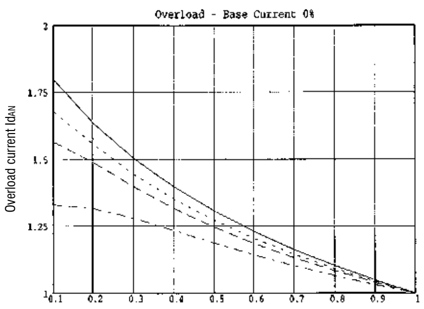




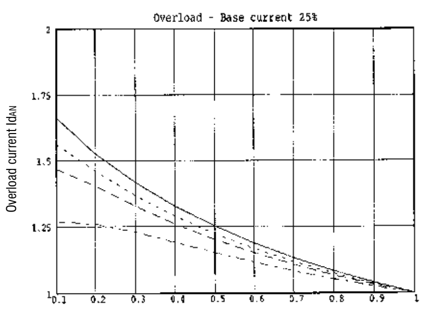


____ = 10 s. ...... = 20 s. _ _ _ _ = 30 s. _ . _ = 60 s.

TPD32-690/810-2400-2B-E



Overload time / (Pause time + Overload time)



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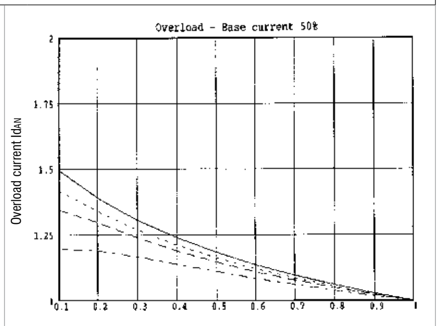
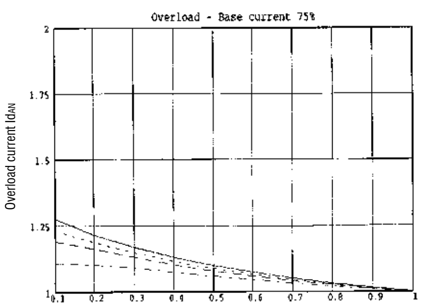


Overload time / (Pause time + Overload time)

TPD32-690/810-2400-2B-E



Overload time / (Pause time + Overload time)

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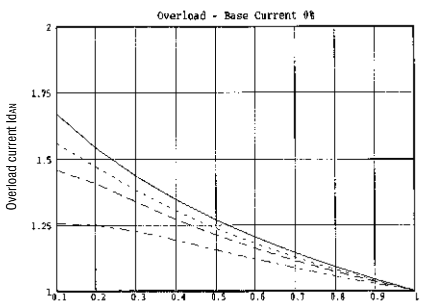

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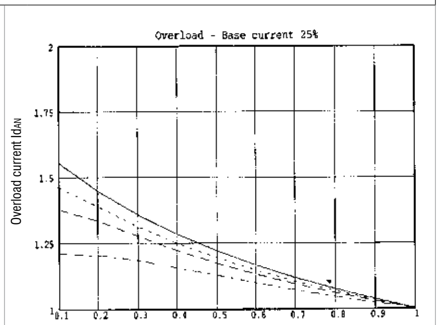

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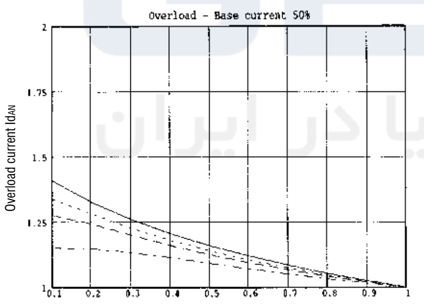
TPD32-500/600-2700-2B-E



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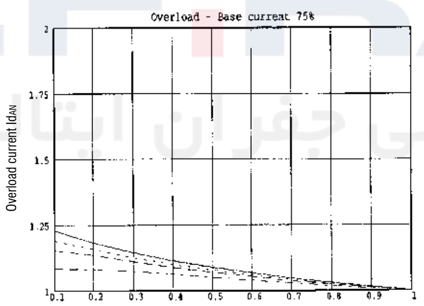

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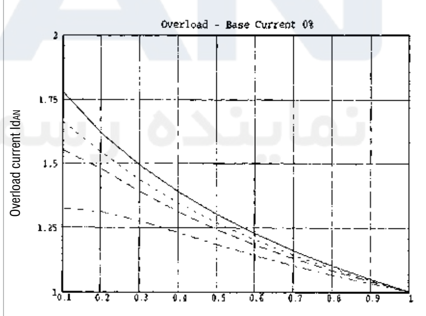

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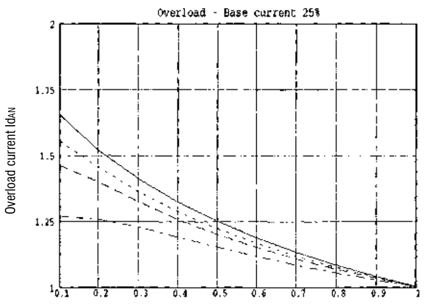

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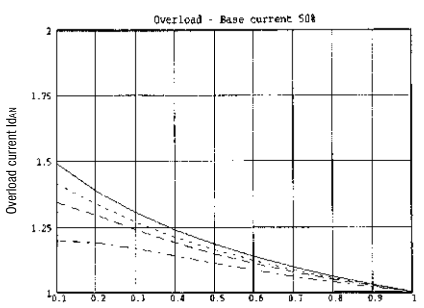

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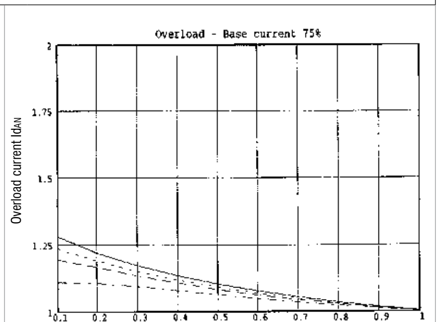
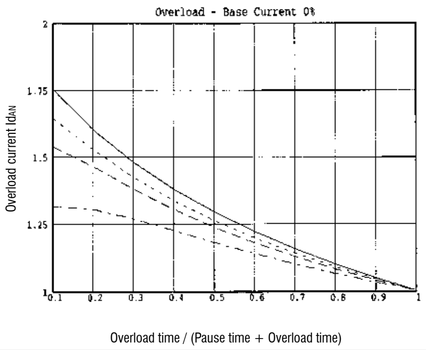
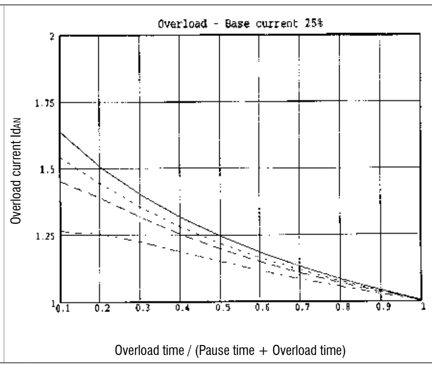


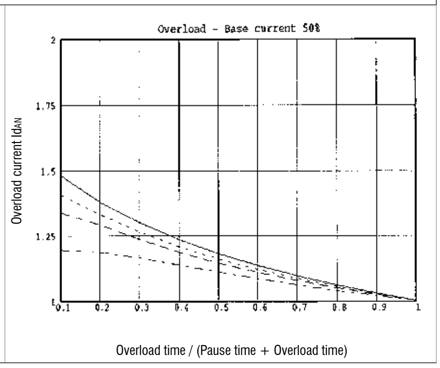
Overload time / (Pause time + Overload time)

____ = 10 s. ...... = 20 s. - - - - = 30 s. _ . _ = 60 s.

TPD32-500/600-2900-2B-E







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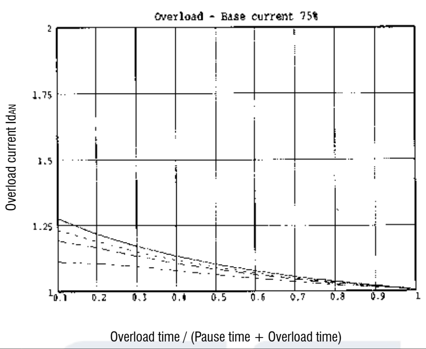
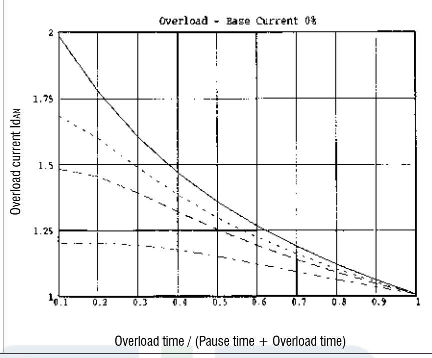
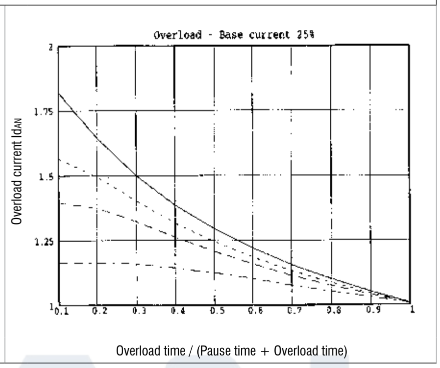
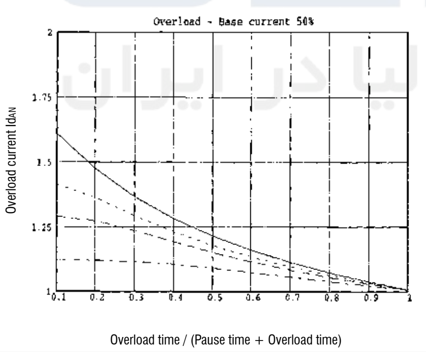


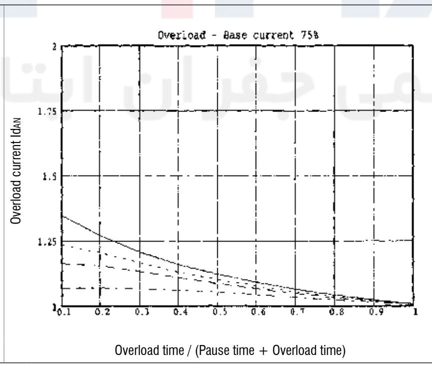
TPD32-500/600-3300-2B
TPD32-690/810-3300-2B





TPD32-500/600-3300-2B-E
TPD32-690/810-3300-2B-E





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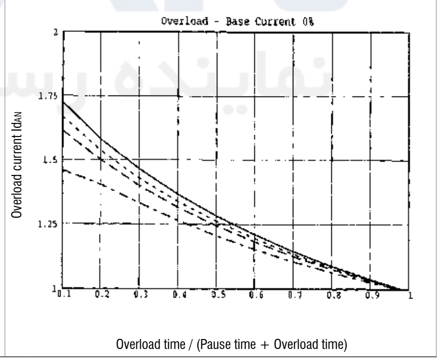

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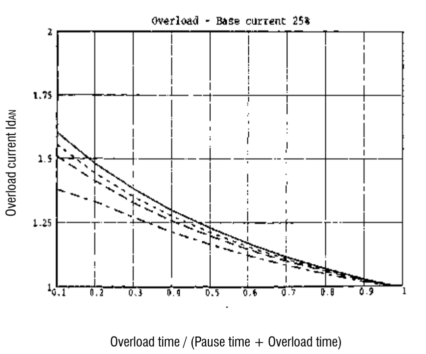
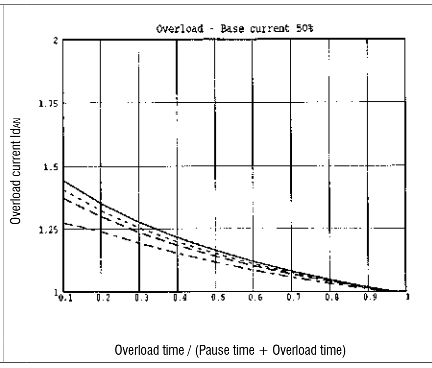
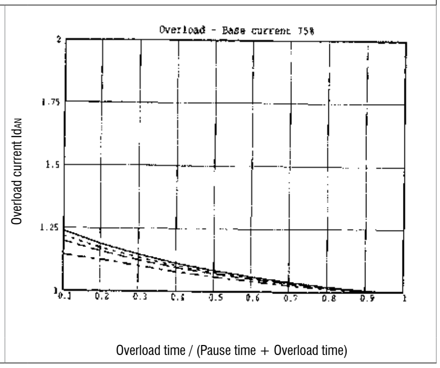
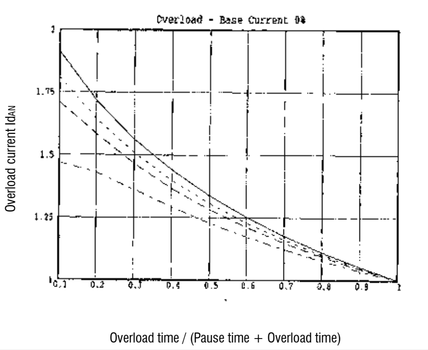


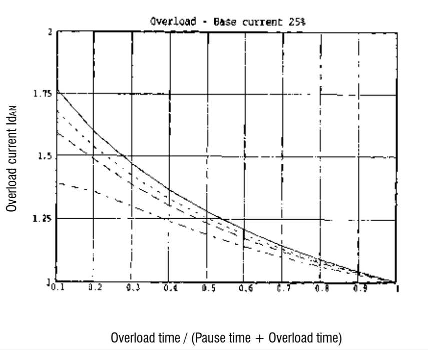


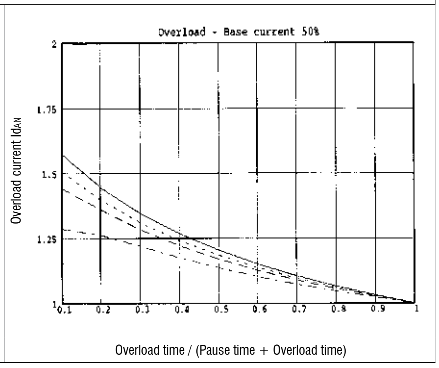


___ = 10 s.	...... = 20 s.	---- = 30 s.	- . - = 60 s.

TPD32-690/720-1400-4B-E







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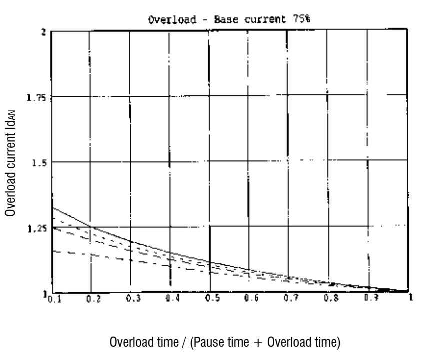

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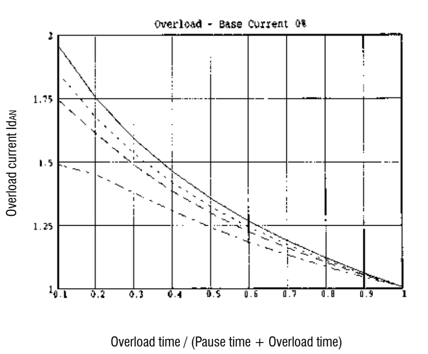

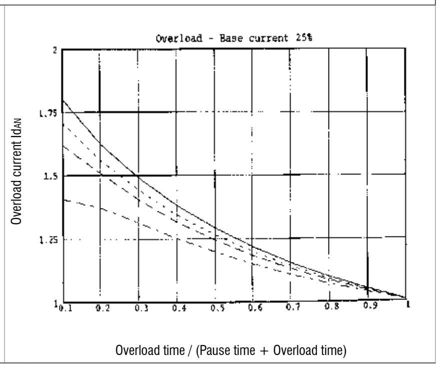

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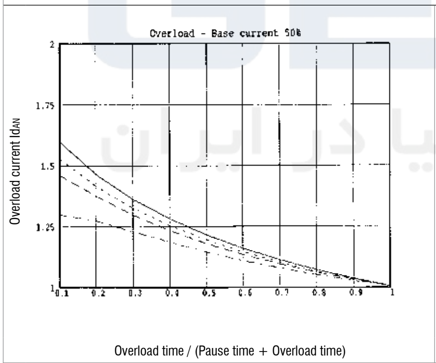

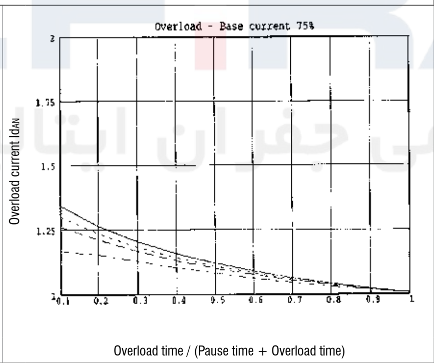

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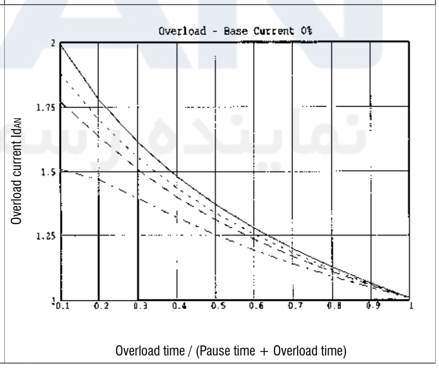

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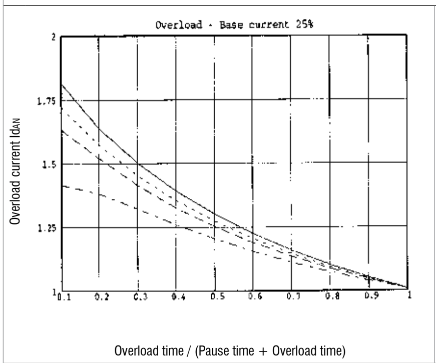
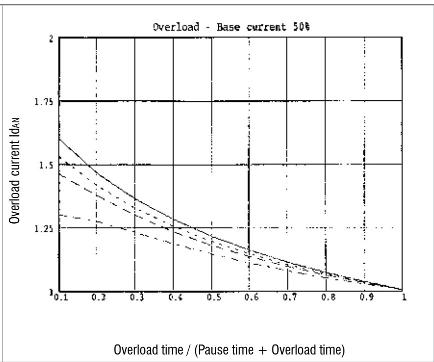
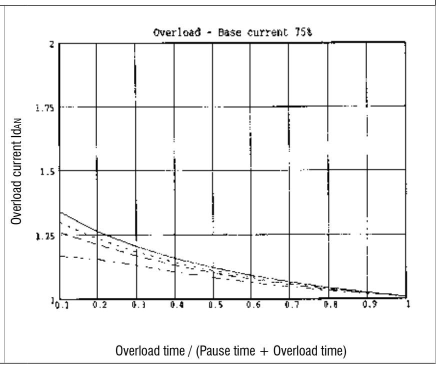
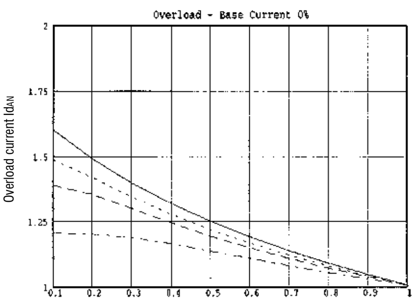




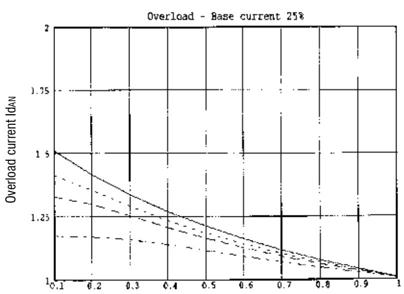


____ = 10 s.	...... = 20 s.	_ _ _ _ = 30 s.	_ . _ = 60 s.

TPD32-690/720-1700-4B-E



Overload time / (Pause time + Overload time)



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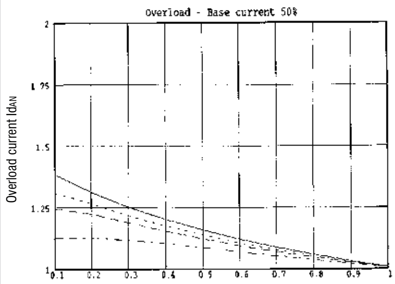
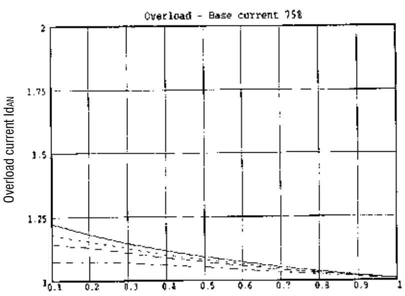


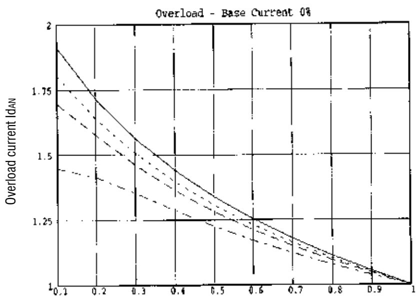
Overload time / (Pause time + Overload time)

TPD32-690/720-1700-4B-E



Overload time / (Pause time + Overload time)

TPD32-500/520-2000-4B-E



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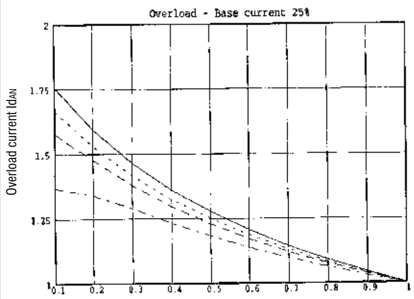
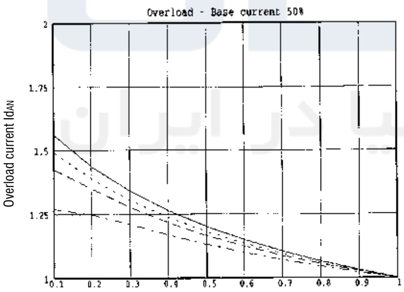


Overload time / (Pause time + Overload time)

TPD32-500/520-2000-4B-E



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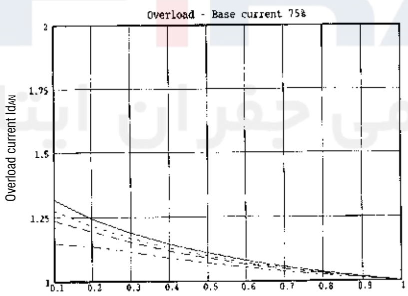
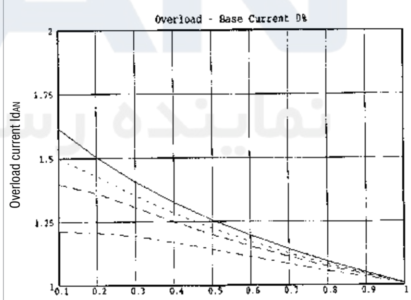


Overload time / (Pause time + Overload time)

TPD32-690/720-2000-4B-E



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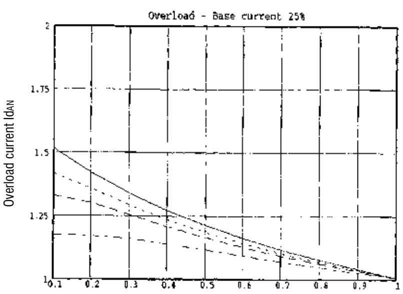

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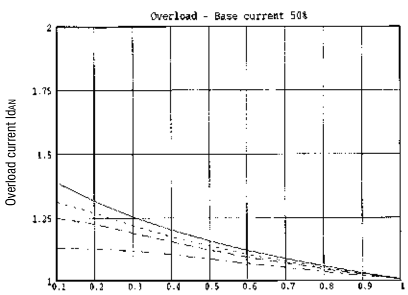

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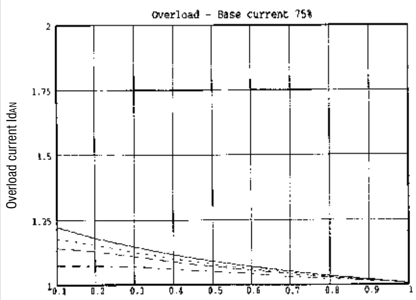
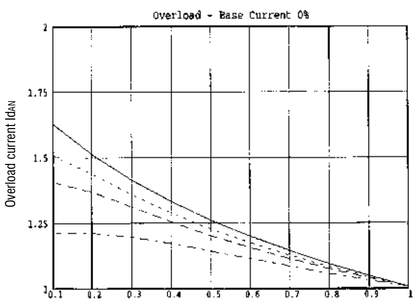


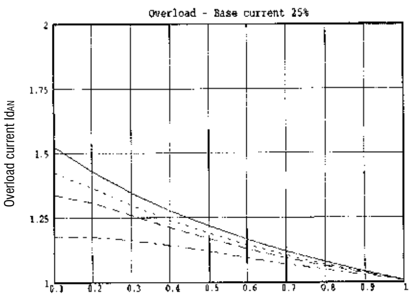
Overload time / (Pause time + Overload time)

___ = 10 s.	...... = 20 s.	---- = 30 s.	-.- = 60 s.

TPD32-500/520-2400-4B-E



Overload time / (Pause time + Overload time)



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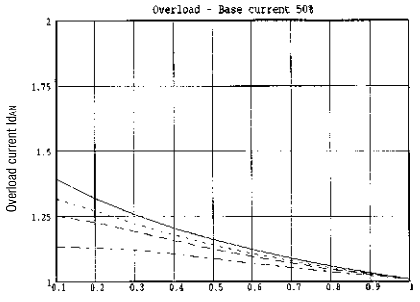
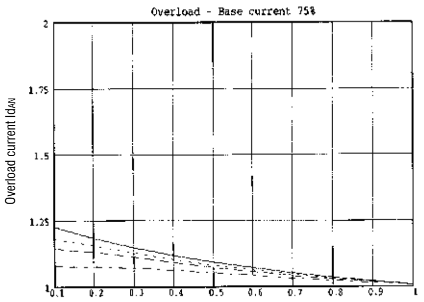


Overload time / (Pause time + Overload time)

TPD32-500/520-2400-4B-E



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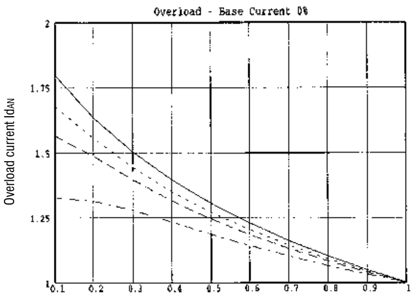

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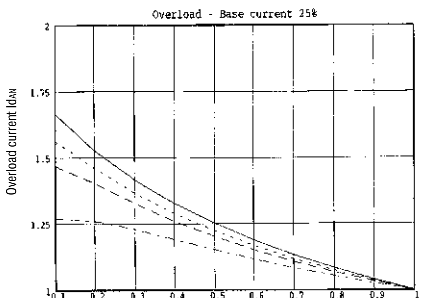

Overload time / (Pause time + Overload time)

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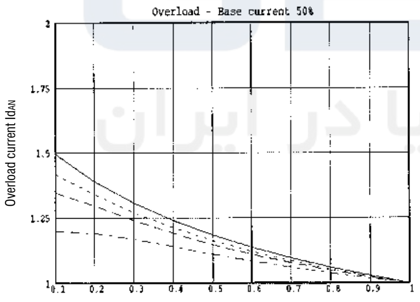

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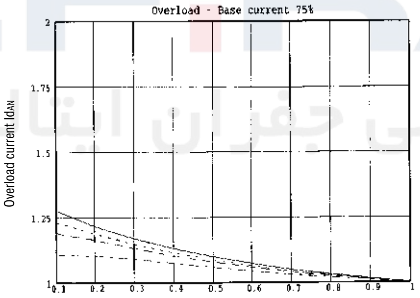

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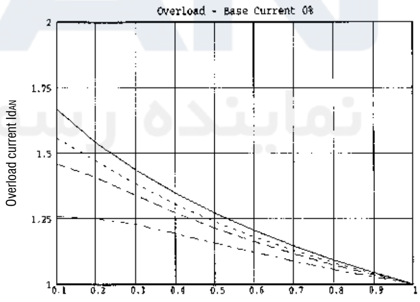
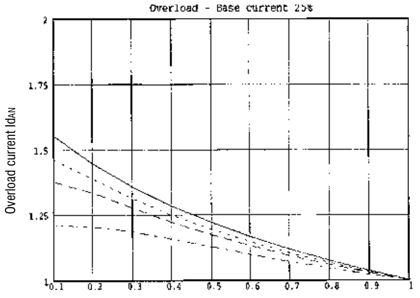
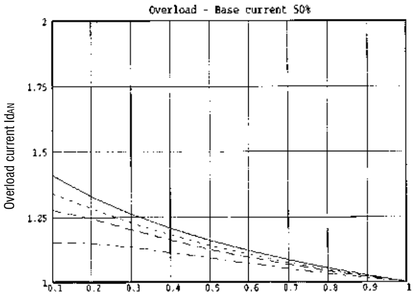


Overload time / (Pause time + Overload time)

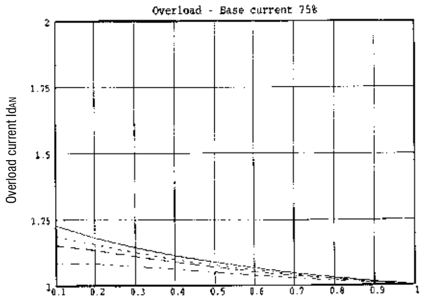
TPD32-500/520-2700-4B-E



Overload time / (Pause time + Overload time)



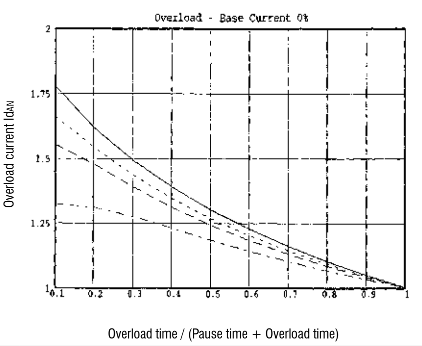
Overload time / (Pause time + Overload time)

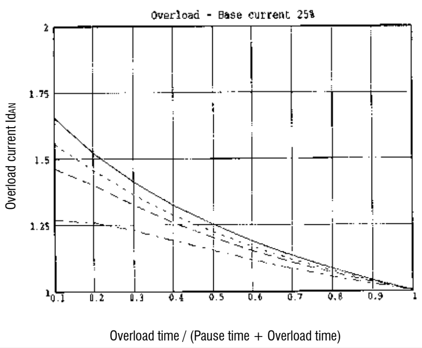


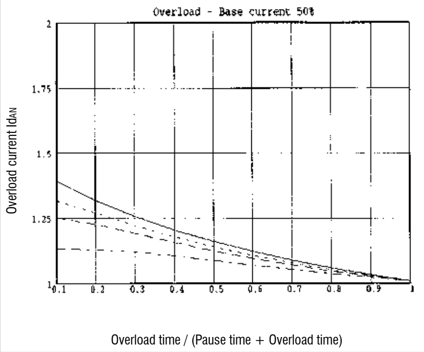
Overload time / (Pause time + Overload time)

___ = 10 s. ...... = 20 s. ---- = 30 s. -.- = 60 s.

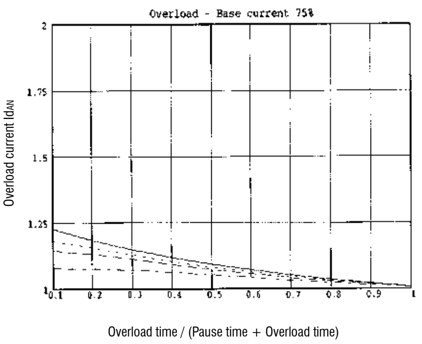
TPD32-690/720-2700-4B-E







TPD32-690/720-2700-4B-E



——— = 10 s.	...... = 20 s.	- - - - = 30 s.	_ . _ = 60 s.

Example

Motor	P = 30 kW, Armature volts = 420 V, Armature current = 82 A
Loadcycle	The motor is overloaded for 1 s at 180 % of the rated current, then it works at the rated load for at least 5 s. Four quadrant converter.
Procedure	At first select the dc current according to the motor rated current. Usually it is the motor rated current. If the determined motor operating point is not below the Overload curve of the converter, the calculation should be repeated with the next larger converter size.
Converter	TPD32-EV-500/520-110-4B-A

Diagram

$$\frac{\text{Base current}}{I_{dAN}} = \frac{82\text{ A}}{110\text{ A}} = 0.75$$

This means that the diagram for the converters 110 A ... 185 A with a Base current = 75 % has to be considered for the calculation.

Operating point

Basis: rated data of the converter

$$\text{Overload current} = 82\text{A} \cdot 1.8 = 147.6\text{A}$$

$$\text{Overload factor} = \frac{\text{Overload current}}{I_{dAN}\text{ (of converter)}} = \frac{147.6\text{ A}}{110\text{A}} = 1.34$$

$$\frac{\text{Overload time}}{\text{Pause time + Overload time}} = \frac{1\text{s}}{5\text{s} + 1\text{s}} = 0.16$$

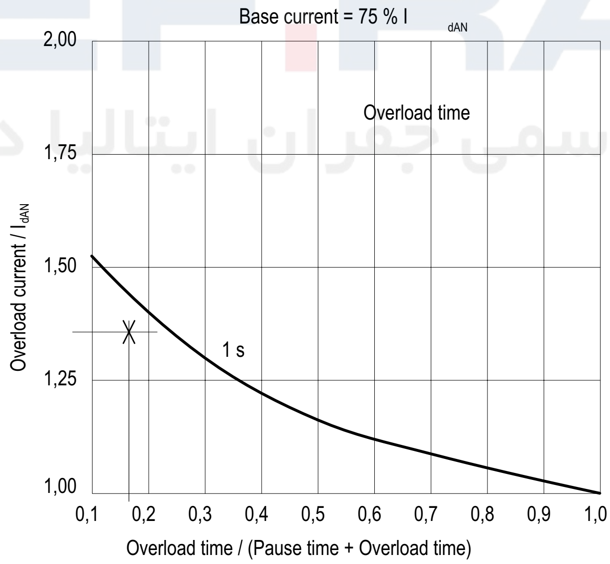


Figure 6.14.6.3: Example- Operating point of drive

The calculated operating point is below the corresponding curve for an overload time of 1 s. Therefore the converter is suitable for the application. The following two settings are possible:

Full load curr	82 A	or	110 A
Enable overload	Enabled		
Overload current	180 %	or	134 %
Base current	100 %	or	75 %
Overload time	1 s		
Pause time	5 s		

Note! The percentages for **Overload current** and **Base current** are referred to **Full load curr** and not to the converter rated current!

6.14.7 Stop control

FUNCTIONS

Stop control

[626]	Stop mode
[627]	Spd 0 trip delay [ms]
[628]	Trip cont delay [ms]
[630]	Jog stop control

This function is intended to help the system engineer to coordinate the AC input contactor with the drive enabling. According to the selected mode the terminals 75 and 76 drive the ON/OFF of the AC input contactor.

Basically, when the drive receives the Start command the Relay 2 closes the AC input contactor, the drive waits for a certain time the AC input voltage, syncronizes itself and starts the motor. When the drive stops , the motor goes to zero speed. When the zero speed is reached, the drive is disabled only when a “Spd 0 trip” delay is elapsed. Then after the “Trip cont delay” the Relay 2 opens to remove the supply from the drive.

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Stop mode OFF (0) Stop & speed 0 (1) Fast stp & spd 0 (2) Fst / stp & spd 0 (3)	626	0	3	Stop & Speed 0	Stop & Speed 0	* Relay 75 / 76
Spd 0 trip delay [ms]	627	0	40000	0	0	-
Trip cont delay [ms]	628	0	40000	0	0	-
Jog stop control OFF (0) ON (1)	630	0	1	OFF	OFF	-

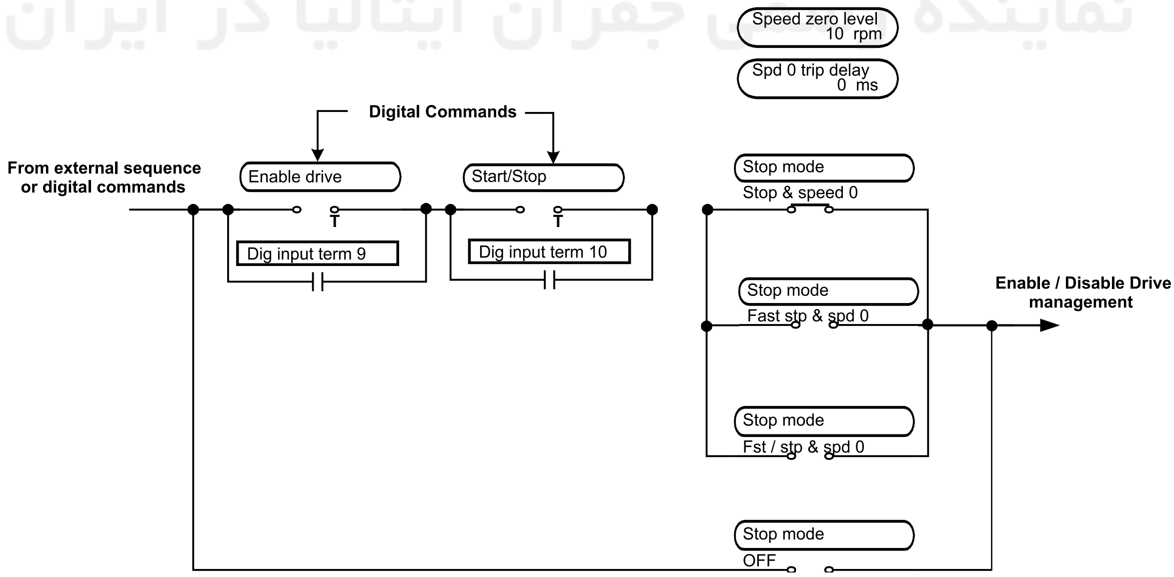


Figure 6.14.7.1: Start and stop management

Stop mode

OFF — The function is disabled.

Stop & Speed 0 — The Start command determines the behavior. If the Start command is not present (digital or via terminal strip) and the drive is stopped, the converter is blocked and the contact is open. When the Start command is given, the converter is enabled and the contact is closed. Disabling the Start command and after reaching zero speed, the converter is blocked after a timespan set by **Spd 0 trip delay**. The relay contact between the terminals 75/76 opens after a timespan set by **Trip cont delay**.

Fast stp & spd 0 — The Fast Stop command determines the behavior. If the Fast Stop command is present (digital or via terminal strip; f.e. with 0 V on the terminal 14) and the drive is stopped, the converter is blocked and the contact is open.When the Fast Stop command is disabled (i.e. with 24 V on the terminal 14), The converter is enabled and the contact is closed. Entering the Fast Stop command, when the zero speed has been reached, the converter is blocked after a timespan set with **Spd 0 trip delay.**

Fst / stp & spd 0 — The Fast Stop and Start commands determine the behavior. When the Stop or Fast Stop commands are present and the drive is stopped, the converter is blocked and the contact is open. When the Start command is given or when the Fast Stop command is disabled, the converter is blocked and the contact is closed. When the Start command is disabled or when a Fast Stop command is entered and after reaching zero speed, the converter is stopped after a timespan set by **Spd 0 trip delay**. The relay contact between the terminals 75/76 opens after a timespan set by **Trip cont delay**.

Spd 0 trip delay — Delay time in ms between reaching zero speed and disenabling of the converter.

Trip cont delay — Delay time in ms between disenabling and opening of the contact between the terminals 75 and 76.

Jog stop control

- OFF — The behavior selected by **Stop mode** has no influence on the Jog function.
- ON — The behavior selected by **Stop mode** is active also on the Jog function.

The mentioned "contact" can be either the one between the terminals 75/76 or a digital output (option TBO). In both cases during the display of the message the "**Stop control**" parameter must be selected. The function is factory set on the relay contact. The open contact, mentioned in the description, corresponds to 0 V on the digital output, while the closed contact corresponds to +24 V on the digital output.

Note! At all the described possiblilities for **Stop mode**, the stop signal on the terminal 13 must be present. With **Main commands** = Digital, it is necessary to select **Enable drive** parameter = Enabled via keypad or Bus.

6.14.8 Brake control

FUNCTIONS

Brake control

[1295]	Enable Torque pr
[1262]	Closing speed [rpm]
[1293]	Torque delay [ms]
[1294]	Torque proving [%]
[1266]	Actuator delay [ms]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Enable Torque pr	1295	0	1	Disabled	Disabled	-
Closing speed [rpm]	1262	0	200	30	30	-
Torque delay [ms]	1293	0	30000	3000	3000	-
Torque proving [%]	1294	0	200	75	75	-
Actuator delay [ms]	1266	0	30000	1000	1000	-

The purpose of this function is to make sure the drive generates sufficient torque to support the load of cranes or other hoisting equipment, during the brake release transient phase.

Enable Torque pr Enables the mechanical brake control function. It is used to apply a torque capable of sustaining a load during the transient phase of releasing/opening the brake.

Closing speed After sending a stop command to the drive, this is the speed of the motor for which the brake is closed.

Torque delay The delay, after a start command, within which the brake opening transient phase must be completed so that the "Brake Fault" alarm is not enabled.

Torque proving The value of the current capable of sustaining the load before the brake is released (percentage of FLC). This can be set via parameter or analog input set as **Brake Ref** (32).

Actuator delay The time from when an open brake command is sent until the reference is active.

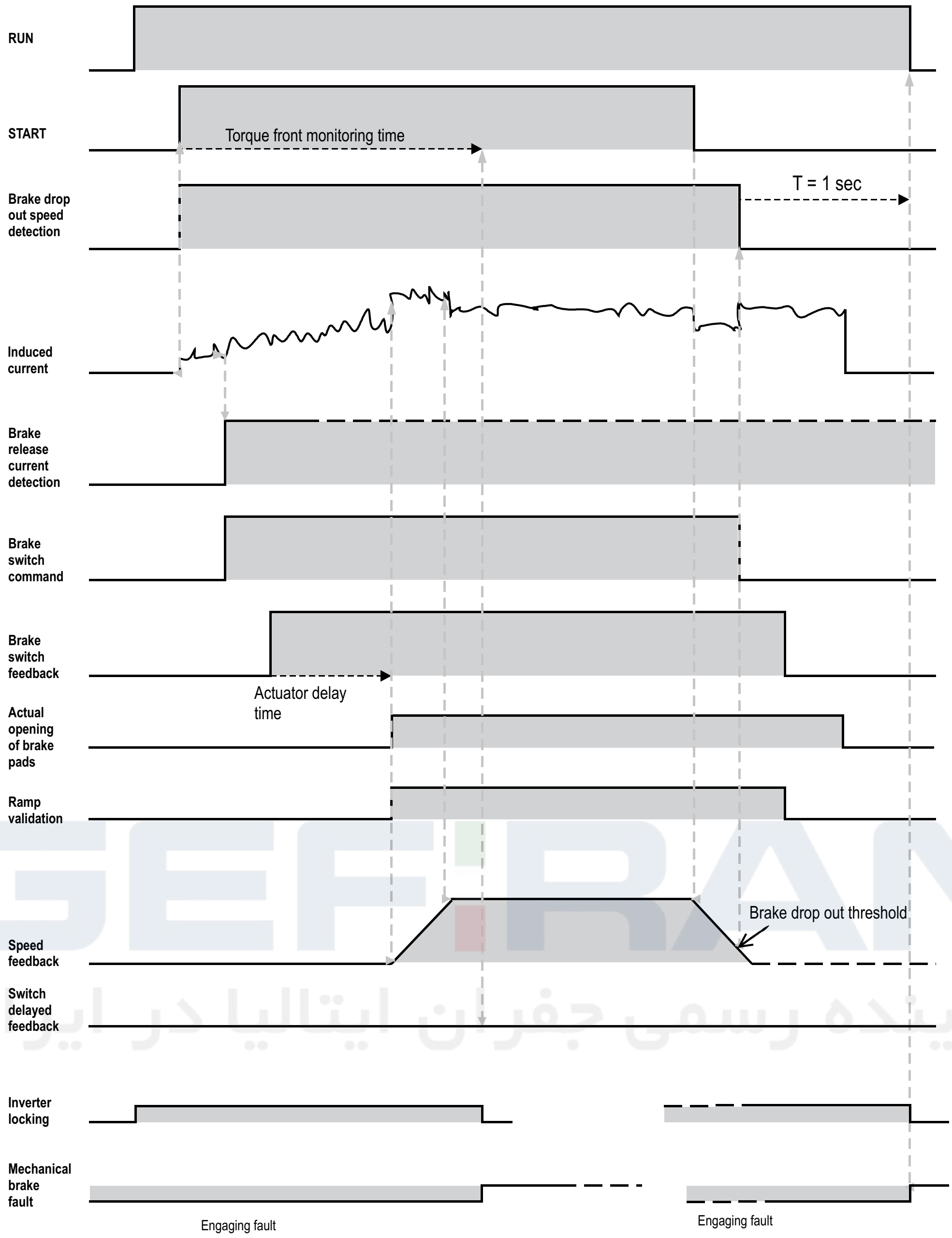


Figure 6.14.8.1: Diagram of control

Diagram of control

Functional diagram with minimal use of inputs and outputs. Specific assignments of this diagram:

DI1:	Fwd sign Ascending, conventionally “Forward”
DI2 :	Rev sign Descending, conventionally “Reverse”
DI3:	Brake fbk, mechanical brake feedback/relay status
Relay 2:	Brake command KM10 contactor command

With reference to the previous graph, a brake alarm condition occurs if:

- **when the brake is released**, following the Enable and Start commands, the value of the current supplied by the drive is unable to sustain the load (indicated by the Torque proving parameter and signalled by the brake command digital output) in a time that is less than the Torque delay time; or, if the current is adequate, the signal confirming that the brake has been released (Brake fbk) has not been received, again within the time set in Torque delay.

- **when the brake is closed**, once the speed set in the Closing speed parameter has been reached (signalled by the digital output of the brake command), the input signal (Brake fbk) has not been sent in less than 1 second.

If no brake feedback (**Brake fbk**) has been set the sequence continues without the test and no alarm is triggered.

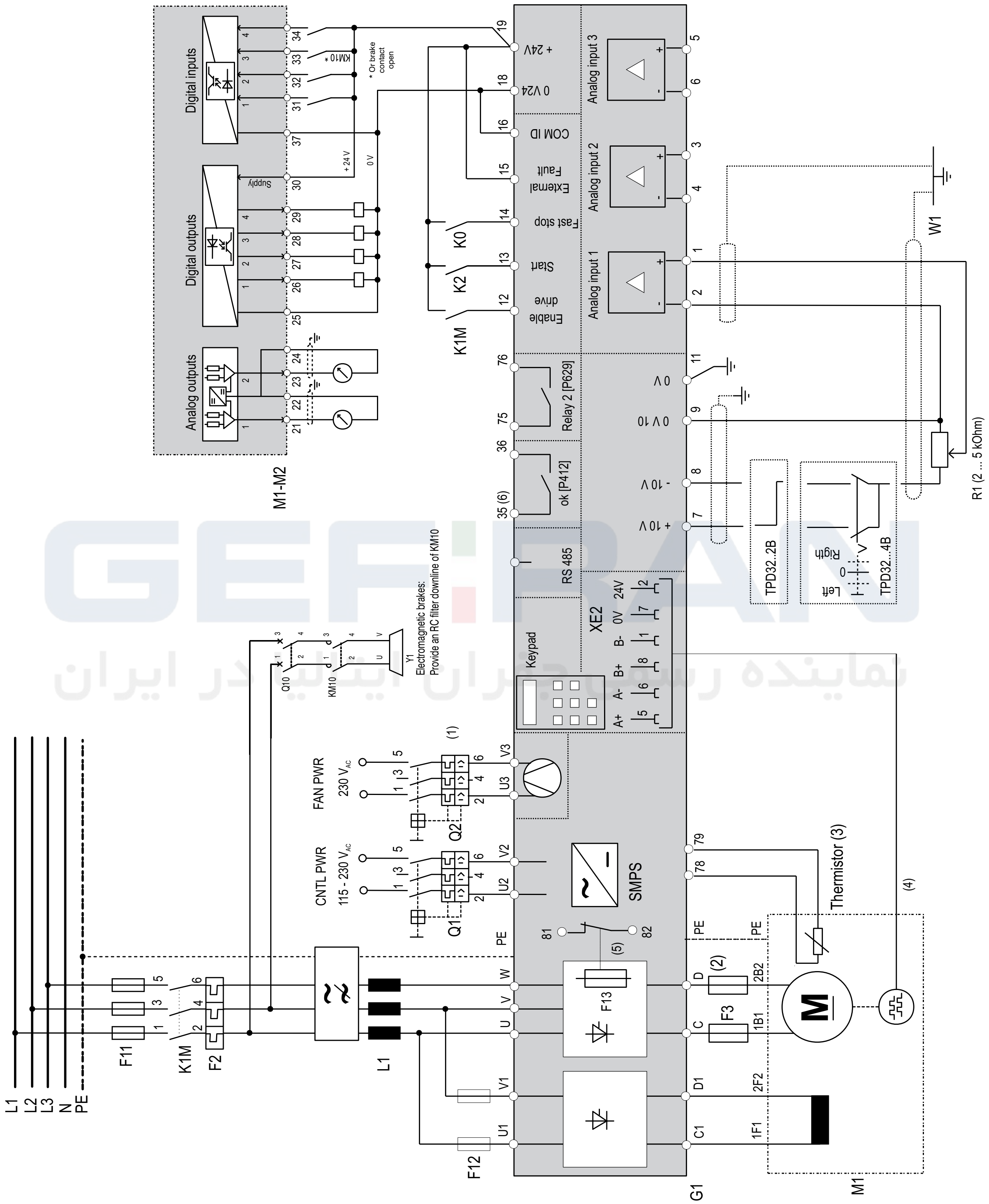


Figure 6.14.8.2: Brake control diagram

6.14.9 Current limitation according to the speed (I/n curve)

FUNCTIONS

I/n curve

[750]	I/n curve
[751]	I/n lim 0 [%]
[752]	I/n lim 1 [%]
[753]	I/n lim 2 [%]
[754]	I/n lim 3 [%]
[755]	I/n lim 4 [%]
[756]	I/n speed [rpm]

This function allows the changing of the current limits “**In use Tcur lim + / -**“ according to the motor speed, through a curve composed by six setpoints. The “**I/n speed**” and “**I/n lim 0,1,2,3,4**”are the parameters that allow to define the curve.

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
I/n curve Enabled (1) Disabled (0)	750	0	1	0	0	-
I/n lim 0 [%]	751	0	200	0	0	-
I/n lim 1 [%]	752	0	200	0	0	-
I/n lim 2 [%]	753	0	200	0	0	-
I/n lim 3 [%]	754	0	200	0	0	-
I/n lim 4 [%]	755	0	200	0	0	-
I/n speed [rpm]	756	0	P162	0	0	-

“**I/n speed**” parameter defines the speed range in which the current limits are kept at the value of “**I/n lim 0**”. The speed range included between “**I/n speed**” and the 100% of the max. speed will be divided internally in four equal segments, at the ends of which the current limits “**I/n lim 0,1,2,3,4**” are associated. The set values must decrease , starting from “**I/n lim 0**” up to “**I/n lim 4**”.

I/n curve — Enabled: Limits current /speed curve enabled; Disabled: Limits current /speed curve disabled

I/n lim 0 — Current limit of the I/n curve that operates constantly up to the speed set by the “**I/n speed**” parameter.

I/n lim 1 — First current limit which states the Taper current curve construction.

I/n lim 2 — Second current limit which states the curve construction.

I/n lim 3 — Third current limit which states the curve construction.

I/n lim 4 — Fourth current limit which states the curve construction.

I/n speed — Threshold speed at which torque reduction starts.

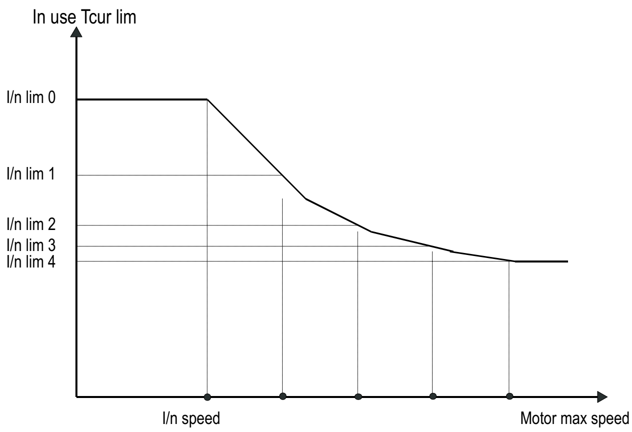


Figure 6.14.9.1 Current limitation according to the speed

6.15 SPEC FUNCTIONS

6.15.1 Test generator

SPEC FUNCTIONS

Test generator

[58]	Generator access
[59]	Gen frequency [Hz]
[60]	Gen amplitude [%]
[61]	Generator offset [%]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Generator access Not connected (0) T current ref (2) Flux ref (3) Ramp ref (4) Speed ref (5)	58	0	5	Not conn.	Not conn.	
Gen frequency [Hz]	59	0.1	62.5	0.1	0.1	
Gen amplitude [%]	60	0	200.00	0	0	
Generator offset [%]	61	-200.00	+200.00	0	0	

The test generator of the TPD32-EV converter is used to manual tune the regulators. It consists of a square wave generator whose frequency, offset and amplitude can be set. The output signal of the "Test Generator" can be set on a programmable analog output.

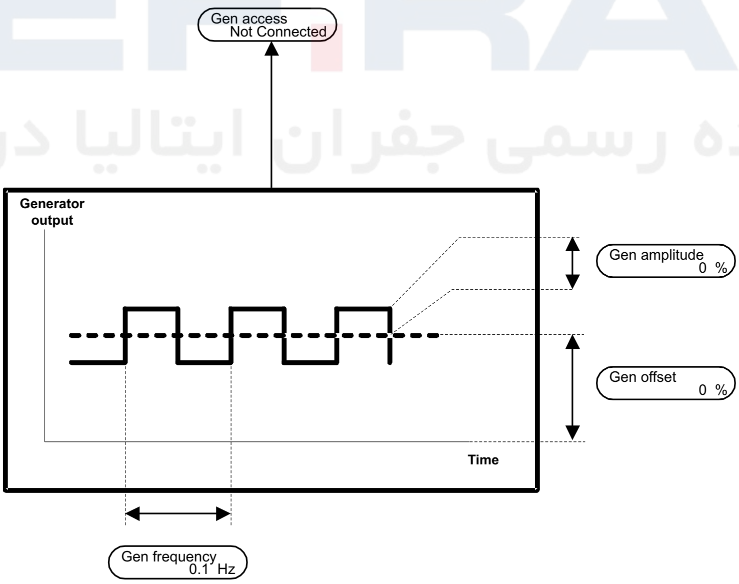


Figure 6.15.1.1: Test generator output

Gen access Different parameters can be simulated by the test generator. The parameter concerned then has the value of the generator output.

Gen frequency Output frequency of the generator in Hz.

Gen amplitude Amplitude of the square-wave signal produced by the generator in percent.

Generator offset Offset of the generator in percent.

The generator output consists of the addition of **Gen amplitude** and **Generator offset**.

6.15.2 Saving parameters, loading default factory settings, life time

SPEC FUNCTIONS

[256]	Save parameters
[258]	Load default
[235]	Life time [h.min]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Save parameters	256					-
Load default	258					-
Life time [h.min]	235	0.00	65535.00			-

Save parameters Saving of parameters that are currently set by the user. This command can also be given from keypad, when “Bus” through the Control mode parameter, has been selected.

Load default Loading of the default settings (“Factory” column in the parameter table).

Life time Shows the operating time of the converter. This parameter counts the time in which the converter is powered on (even if disabled).

Default values for individual parameters are factory set in the device. These values are shown in the “Factory” column of the individual parameter tables. In order to obtain the values specific to your application when the device is switched on, they must be saved via the Save parameters command after being set.
The factory default values can be re-loaded by selecting **Load default**. If these are not saved, the application specific drive settings will still be available the next time the drive is switched on.
When the device is switched on the saved parameter set is loaded.

Note! The **Tacho scale** and **Speed offset** parameters are used for the fine scaling of the speed feedback circuit. When the factory set parameters are loaded (**Load Default**) these two parameters do not change, so that a new scaling is not required!

6.15.3 Failure Register

SPEC FUNCTIONS

[330]	Failure register
[262]	Failure reset
[263]	Failure reg del

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Failure register	330	1	10	10	10	-
Failure reset	262					-
Failure reg del	263					-

Failure register The Failure register contains the last 10 failures that have occurred. It also contains information about the time the failure occurred, based on the operating hours (**Life time**), as well as information on the type of failure. This information can be accessed by pressing the E key on the keypad when a failure is indicated. If several failures occur in sequence, all the failures are stored in the failure register until a failure occurs that causes the disconnection of the drive (Latch = ON, see Programmable alarms).The content of the failure register can also be read out via the bus or the serial interface.

Failure reset Acknowledgement of a failure. The failure reset can be initiated by pressing the CANC key when the failure is shown in the display of the keypad. If, however, several failures occur in sequence, these can only be reset by selecting **Failure reset** command through the E key.

Failure reg del Clearing the failure register.

The informations about the last 10 failures that have occurred are available thru serial line in the following way:

- Set the parameter FAILURE REGISTER [330], it indicates the position number of the failure occurred: Example, if set to 10 it will be the last failure.
- Read: FAILURE TEXT [327], FAILURE HOUR [328], FAILURE MIN [329], they indicate the type and when the alarm is occurred

6.15.4 Signal adaptation

SPEC FUNCTIONS

Links

Link 1

[484]	Source
[485]	Destination
[486]	Mul gain
[487]	Div gain
[488]	Input max
[489]	Input min
[490]	Input offset
[491]	Output offset
[492]	Inp absolute

Link 2 ... 6

[553]	[1218]	[1227]	[1236]	[1245]	Source
[554]	[1219]	[1228]	[1237]	[1246]	Destination
[555]	[1220]	[1229]	[1238]	[1247]	Mul gain
[556]	[1221]	[1230]	[1239]	[1248]	Div gain
[557]	[1222]	[1231]	[1240]	[1249]	Input max
[558]	[1223]	[1232]	[1241]	[1250]	Input min
[559]	[1224]	[1233]	[1242]	[1251]	Input offset
[560]	[1225]	[1234]	[1243]	[1252]	Output offset
[561]	[1226]	[1235]	[1244]	[1253]	Inp absolute

Parameter description	*Link 1*	*Link 2*	*Link 3*	*Link 4*	*Link 5*	*Link 6*	Value				Standard Configuration
	No.	No.	No.	No.	No.	No.	min	max	Factory American	Factory Standard	
Source	484	553	1218	1227	1236	1245	0	65535	0	0	-
Destination	485	554	1219	1228	1237	1246	0	65535	0	0	-
Mul gain	486	555	1220	1229	1238	1247	-10000	+10000	1	1	-
Div gain	487	556	1221	1230	1239	1248	-10000	+10000	1	1	-
Input max	488	557	1222	1231	1240	1249	-231	231-1	0	0	-
Input min	489	558	1223	1232	1241	1250	-231	231-1	0	0	-
Input offset	490	559	1224	1233	1242	1251	-231	231-1	0	0	-
Output offset	491	560	1225	1234	1243	1252	-231	231-1	0	0	-
Inp absolute OFF / ON	492	561	1226	1235	1244	1253	0	1	OFF	OFF	-

The Link1 and Link 6 functions are two control section operating independently of each other for the signal adaptation. With the Links, parameters can be: rectified, limited, multiplied by a factor, divided by a factor and provided with an offset.

Source Parameter number used as an input quantity. For example “8236” for the **Ramp ref 1** parameter (44+8192 offset). Select the parameter number in the individual descriptions or in the list of all parameters in section 10, “Parameter list”.

Destination Parameter number, which determines the output quantity. Select the parameter number (+8192 offset) in the individual description column or in the list of all parameters in section 10, “Parameter lists”.

Mul gain Multiplicative factor of the input quantity (after a possible limitation). Resolution: 5 digits.

Div gain Divisor, through which it is possible to divide the input quantity already multiplied and limited. Resolution: 5 digits.

Input max Max. limit of the input quantity. Resolution: 5 digits.

Input min Min. limit of the input quantity. Resolution: 5 digits.

Input offset Offset to be added to the input quantity. Resolution: 5 digits.

Output offset Offset to be added to the output quantity. Resolution: 5 digits.

Inp absolute The input behavior can be determined with this parameter.

OFF	The input quantity is processed with its sign.
ON	The input quantity is processed with a positive sign (absolute value). It is possible to have a polarity change with the signs of **Mul gain** or **Div gain**.

In order to write SOURCE LINK (1/6) parameter or DESTINATION LINK (1/6) parameter it is necessary to add to the parameter number the offset "8192"

Eg. **RAMP REF 1 "44"**
SOURCE LINK (1/2) = 44+8192 = 8236

NOTE! The Links are executed with an approximate cycle time of 20 ms. They are not mainly intended to be used for regulation but to access or connect parameters otherwise not accessible. The use of Links according to the parameter chosen as a destination involves a CPU overhead that can slow down the keypad/display operation. Check that the functionality corresponds to the needs before plant-wide implementation.

NOTE! The following parameters cannot be used as a destination of a Link:
- All parameters with only "R" access code
- All parameters with "Z" access code
- All parameters with "C" access code
- All the following:

19	S shape t const	474	Field loss - Restart time	665	S acc t const 0
55	Control word	475	Field loss - Hold off time	666	S dec t const 0
72	Scale input 1	480	Speed fbk loss - Hold off time	667	S acc t const 1
73	Tune value inp 1	482	Overvoltage - Hold off time	668	S dec t const 1
77	Scale input 2	483	Overvoltage - Restart time	669	S acc t const 2
78	Tune value inp 2	484	Link1 - Source	670	S dec t const 2
82	Scale input 3	485	Link1 - Destination	671	S acc t const 3
85	Pword1	501	External fault - Restart time	672	S dec t const 3
83	Tune value inp 3	502	External fault - Hold off time	776	PI central V1
86	Password2	553	Link2 - Source	785	PI bottom lim
318	Overload mode	554	Link2 - Destination	786	PID source
408	Ser answer delay	562	Tacho scale	792	Input 1 filter
425	Enable OPT2	585	Overcurrent - Restart time	1012	Inertia c filter
444	Prop. Filter	586	Overcurrent - Hold off time	1013	Torque const
453	Arm resistance	636	Bus loss - Hold off time	1014	Inertia
454	Arm inductance	637	Bus loss - Restart time	1015	Friction
456	Flux weak speed	649	Refresh enc 1	1042	Input 1 compare
467	Flux current max	652	Refresh enc 2	1043	Input 1 cp error
468	Flux current min	663	S acc t const	1044	Input 1 cp delay
470	Undervoltage - Hold off time	664	S dec t const		

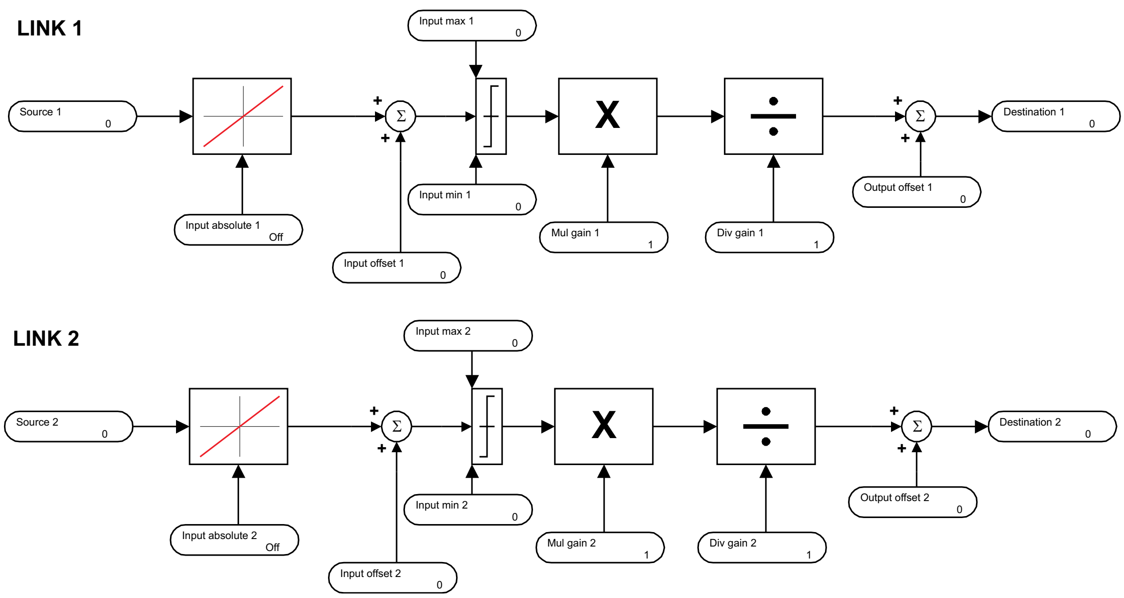


Figure 6.15.4.1: Structure of the signal adaptation

6.15.5 Pads

The pads are used for the data exchange among the several components of a Bus system. They can be compared to the variables of a PLC. The figure 6.15.5.1 shows the overall structure of the system. With the help of pads it is possible for example to send information from a field Bus to an option card. All the pads can be written and read. See the several access possibilities in section 10, "Parameter list".

SPEC FUNCTIONS

Pad Parameters

[503]	Pad 0
[504]	Pad 1
[505]	Pad 2
[506]	Pad 3
[507]	Pad 4
[508]	Pad 5
[509]	Pad 6
[510]	Pad 7
[511]	Pad 8
[512]	Pad 9
[513]	Pad 10
[514]	Pad 11
[515]	Pad 12
[516]	Pad 13
[517]	Pad 14
[518]	Pad 15
[519]	Bitword pad A
[536]	Bitword pad B

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Pad 0	503	-32768	+32767	0	0	*, **
Pad 1	504	-32768	+32767	0	0	*, **
Pad 2	505	-32768	+32767	0	0	*
Pad 3	506	-32768	+32767	0	0	*
Pad 4	507	-32768	+32767	0	0	**
Pad 5	508	-32768	+32767	0	0	**
Pad 6	509	-32768	+32767	0	0	-
Pad 7	510	-32768	+32767	0	0	-
Pad 8	511	-32768	+32767	0	0	-
Pad 9	512	-32768	+32767	0	0	-
Pad 10	513	-32768	+32767	0	0	-
Pad 11	514	-32768	+32767	0	0	-
Pad 12	515	-32768	+32767	0	0	-
Pad 13	516	-32768	+32767	0	0	-
Pad 14	517	-32768	+32767	0	0	-
Pad 15	518	-32768	+32767	0	0	-
Bitword pad A	519	0	65535	0	0	***, ****
Pad A Bit 0	520	0	1	0	0	***, ****
Pad A Bit 1	521	0	1	0	0	***, ****
Pad A Bit 2	522	0	1	0	0	***, ****
Pad A Bit 3	523	0	1	0	0	***, ****
Pad A Bit 4	524	0	1	0	0	***, ****
Pad A Bit 5	525	0	1	0	0	***, ****
Pad A Bit 6	526	0	1	0	0	***, ****
Pad A Bit 7	527	0	1	0	0	***, ****
Pad A Bit 8	528	0	1	0	0	
Pad A Bit 9	529	0	1	0	0	
Pad A Bit 10	530	0	1	0	0	
Pad A Bit 11	531	0	1	0	0	
Pad A Bit 12	532	0	1	0	0	
Pad A Bit 13	533	0	1	0	0	
Pad A Bit 14	534	0	1	0	0	*****
Pad A Bit 15	535	0	1	0	0	
Bitword pad B	536	0	65535	0	0	****
Pad B Bit 0	537	0	1	0	0	****
Pad B Bit 1	538	0	1	0	0	****
Pad B Bit 2	539	0	1	0	0	****
Pad B Bit 3	540	0	1	0	0	****
Pad B Bit 4	541	0	1	0	0	****
Pad B Bit 5	542	0	1	0	0	****
Pad B Bit 6	543	0	1	0	0	****
Pad B Bit 7	544	0	1	0	0	****
Pad B Bit 8	545	0	1	0	0	

Pad B Bit 9	546	0	1	0	0	
Pad B Bit 10	547	0	1	0	0	
Pad B Bit 11	548	0	1	0	0	
Pad B Bit 12	549	0	1	0	0	
Pad B Bit 13	550	0	1	0	0	
Pad B Bit 14	551	0	1	0	0	*****
Pad B Bit 15	552	0	1	0	0	

* These parameters can be set on a programmable analog inputs.
** These parameters can be set on a programmable analog output.
*** These parameters can be set on a programmable digital input.
**** These parameters can be set on a programmable digital output.
***** These parameters can be set on Relay 2.

Pad 0...15 General variables, 16 Bit. The Pads 0...3 can be set via analog inputs. The values of the Pads 0, 1, 4 , 5 and 6 can be set on analog outputs.

Bitword pad A (B) Bitmap of the parameters **Pad A (B)** bit 0 up to Pad **A (B) bit 15**. With a parameter it is possible to read or write all the Bits inside a Word.

Example:

Pad A bit 0	0		
Pad A bit 1	1	$= 2^1$	$=2$
Pad A bit 2	0		
Pad A bit 3	0		
Pad A bit 4	0		
Pad A bit 5	1	$= 2^5$	$= 32$
Pad A bit 6	1	$= 2^6$	$= 64$
Pad A bit 7	0		
Pad A bit 8	0		
Pad A bit 9	0		
Pad A bit 10	1	$= 2^{10}$	$= 1024$
Pad A bit 11	0		
Pad A bit 12	1	$= 2^{12}$	$= 4096$
Pad A bit 13	0		
Pad A bit 14	0		
Pad A bit 15	0		

Bitword pad A = 2 + 32 + 64 + 1024 + 4096 = 5218

Pad A (B) bit 0...15 Bit variables. The single Bits can be read or written. With the **Bitword pad A (B)** it is possible to process a Word. See the example. From the Pad A it is possible to read the Bits 0.....7 of a digital input. On a digital output it is possible to write all the Bit.

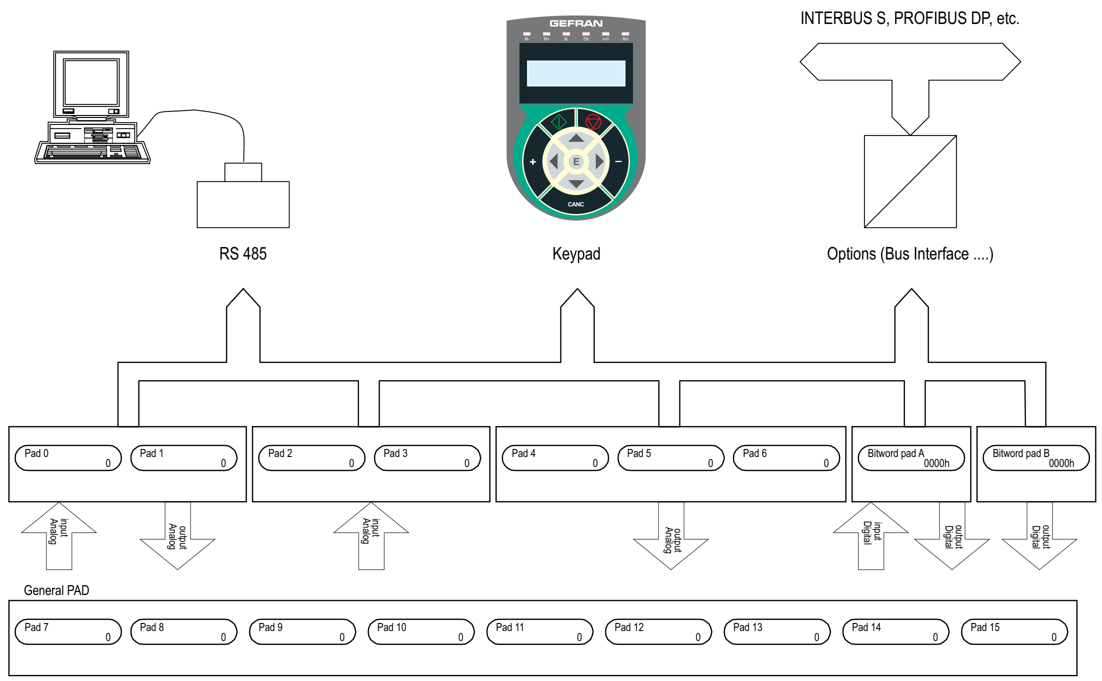


Figure 6.15.5.1: Bus pads

NOTE When setting the PADs bit to digital I/O the following rules have to be aplied:

1. Assigning PAD A/B bit to a Digital Output will cause the state of the digital output (n) coming from PAD A/B bit (n-1)

2. Relay 2 can be driven by means of PAD A/B bit 14.

6.16 OPTIONS

6.16.1 Option 1

OPTIONS			
	Option 1		
			Menu

Through this menu the assignement of Drive parameters to the virtual digital I/O (MONITOR\Virtual digital Inp-Out menu) and to the process data channels (PDC) of the field bus can be carried out.

If the bus card is not present you will be prompted (inside the menu) by the message **OPT1 not present**.

If the used bus card is not up-to-date for this management, you will be prompted (inside the menu) by the message **OPT1 old version**.

For further and detailed information, refer to the bus interface instruction book.

NOTE! Starting with FW version 10.08 (10.25/10.26 for TPD32-EV-FC), internal communication between drive and installed field bus board (Profibus, CANopen, DeviceNet) is set at 2ms. The scan time for data sent by an external master is 5 to 6ms.

For communication with Profibus board, the updated SBI-PDP32 board with firmware 2.400 is required.

6.16.2 Option 2

OPTIONS			
	Option 2		
			Menu
		[425]	Enable OPT2

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Menu						
Enable OPT2 Enabled (1) Disabled (0)	425	0	1	Disable	Disable	

This menu allows the user access to the parameter set of the APC300 option card.

Menu The menu is active only if the OPT2 card is present (e.g. a APC300 card). If the user tries to enter in the Option 2 menu and the card is not mounted on the device the message "Not present" is displayed.

For further and detailed information see the instruction book of the optional board.

Enable OPT2

Enabled: When the converter is switched on, the presence of the APC300 card is checked. If the card is present, the "Menu" parameters are started and the APC300 parameters can be reached.

Disabled: When the converter is switched on, the presence of the APC300 card is not checked. Therefore, the option parameters are not taken into consideration even though the card is present.

Default configuration = Disabled.

To change the configuration:
1 - set the new value of **Enable OPT2** parameter
2 - store via the **Save parameters** (BASIC MENU)
3 - switch-off and switch-on the drive

If Enabled and the APC300 card is not present, will be generated the error:
OPT2 failure code 100-98 or OPT2 failure code 100-96.

Note When using the APC300 card (Option 2), all parameters listed in the "Opt2-A/PDC" column of Parameter List (section 10.1 and 10.2) can be accessed through the automatic asynchronous communication. Parameters listed in the High Priority Parameter List (section 10.2) can be accessed by means of the automatic synchronous communication. (See APC300 manual for more details.)

If the software has detected the presence of the APC300 the parameter set of the optional card is accessible. In this case see the APC300 user manual for detailed information.

6.16.3 PID Function

OPTIONS

PID

[769]	Enable PI PID
[770]	Enable PD PID

PID source

[786]	PID source
[787]	PID source gain
[758]	Feed-fwd PID

PID references

[759]	PID error
[763]	PID feed-back
[762]	PID offs. Sel
[760]	PID offset 0
[761]	PID offset 1
[1046]	PID acc time
[1047]	PID dec time
[757]	PID clamp

PI controls

[765]	PI P gain PID
[764]	PI I gain PID
[695]	PI steady thr
[731]	PI steady delay
[793]	P init gain PID
[734]	I init gain PID
[779]	PI central v sel
[776]	PI central v1
[777]	PI central v2
[778]	PI central v3
[784]	PI top lim
[785]	PI bottom lim
[783]	PI integr freeze
[771]	PI output PID
[418]	Real FF PID

PD control

[768]	PD P gain 1 PID [%]
[766]	PD D gain 1 PID [%]
[788]	PD P gain 2 PID [%]
[789]	PD D gain 2 PID [%]
[790]	PD P gain 3 PID [%]
[791]	PD D gain 3 PID[%]
[767]	PD D filter PID [ms]
[421]	PD output PID
[772]	PID out sign PID
[774]	PID output

PID target

[782]	PID target
[773]	PID out scale

Diameter calc

[794]	Diameter calc
[795]	Positioning spd [rpm]
[796]	Max deviation
[797]	Gear box ratio
[798]	Dancer constant [mm]
[799]	Minimum diameter [cm]

6.16.3.1 General

The PID function has been developed for general uses which can include nip-roll, winders, unwinders, pressure control of pumps and extruders.

A dancer or a load cell can be used as position/tension transducer.

The inputs (with the exception of those concerning the transducers) and the outputs can be configured, they can be associated to various converter parameters. E.g. the PID output can be sent to the speed or to current regulator.

The analog inputs/outputs will be sampled/updated to 2ms.

The digital inputs/outputs will be sampled/updated to 8ms.

NOTE! PID function in the firmware can not be used when the APC300 card is present.

6.16.3.2 Inputs / Outputs

Regulation Inputs/outputs

PID source	Sample parameter of Feed-forward normally programmed on analog input.
PID feed-back	Analog input of position / tension transducer (dancer/load cell). PID feed-back must be programmed on the analog input 1 (terminals 1-2) because of the input filter provided.
PID offset 0	Offset analog input added to **PID feed-back**. Used for the adjustement of the dancer position.
PID target	Parameter associated with the regulator output. Normally, it will be programmed on the speed reference of the drive.
PID output	Analog output of the regulator. Used to carry on a reference cascade in multidrives systems.
PI central v3 PID	Initial value setting of the integral component of the regulator (corresponds to initial diameter). It can be programmed on an analog input. E.g. to an ultrasonic transducer used for the diameter measure of a winder/unwinder.

Input Command (programmable on digital inputs)

Enable PI PID	Enable of the PI (proportional - integral) of the regulator.
Enable PD PID	Enable of the PD (proportional - derivative) of the regulator.
PI integral freeze:	Freezing of the actual value of the integral component of the regulator.
PID offset sel	Offset select, in addition to **PID feed-back**: L = **PID offset 0**, H = **PID offset 1**.
PI central v S0	Used with **PI central v S1** to select one of four values for the initial integral level (corresponding to initial diameter). Through binary seletion.
PI central v S1	Used with **PI central v S0** to select one of four values for the initial integral level (corresponding to initial diameter). Through binary seletion.
Diameter calc	Enable of the initial diameter calculation.
Diameter calc st	State of the initial diameter calculation (digital output).

6.16.3.3 Feed - Forward

PID source		
	[786]	PID source
	[787]	PID source gain
	[758]	Feed-fwd PID

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
PID source	786	0	65535	0	0	
PID source gain	787	-100.000	+100.00	1.000	1.000	
Feed-fwd PID	758	-10000	+10000	0	0	*

* This parameter can be set on an analog programmable input..

When used, the feed-forward signal represents the main reference of the regulator. Inside the regulator it will be attenuated or amplified by the PID function and sent to the output as reference signal for the drive.

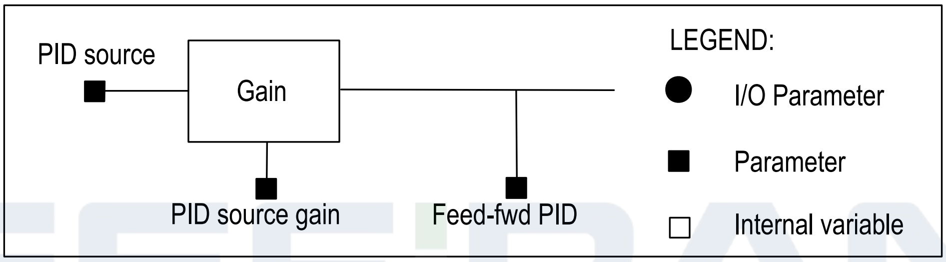


Figure 6.16.3.1: Feed-forward block description

PID source Address of the parameter (Feed-forward value) containing the value which will be used as PID source.
Number +2000H (8192 decimal) must be added to the parameter.

PID source gain Multiplier of the input value to PID source.

Feed-fwd PID Value of feed-forward

Through the parameter **PID source,** it is possible to select which point in the drive the feed-forward signal may be sent. The selectable parameters are those indicated in the paragraph 10.2. "List of the high-priority parameters". The measure units are those indicated in the notes at the end of this paragraph.

1. Programming example of the ramp output block (Parameter Ramp out) on PID source:

Menu OPTION
————> PID
————> PID source
————> PID source = 8305

The **PID source** must be set to the parameter number to which it will be associated, choosing it from paragraph 10.2. "List of high-priority parameters" (**Ramp out** has the decimal number 113).

To obtain the value, it must be added to the decimal value 8192 (fixed offset):

8192 + 113 = 8305.

If you need to set the feed-forward on analog input, given that they are not directly inserted in the 'high-priority parameters', it is necessary to pass through a **PAD 0.....PAD 15** parameter.

2. Programming example of the analog input 2 on PID source:

a) Input programming on a PAD parameter
Menu I/O CONFIG
————> Analog input
————> Analog input 2
————> Select input 2 = PAD 0

b) Setting of the **PAD 0** as feed-forward input:
Menu OPTION
————> PID
————> PID source
————> PID source = 8695

The **PID source** must be set to the parameter number to which it will be associated, choosing it from paragraph 10.2 “List of high-priority parameters’ (**PAD 0** has the decimal number 503).

To obtain the value must be added the decimal value 8192 (fixed offset):

8192 + 503 = 8695.

The full-scale of the feed-forward is limited to the value +/- 10000, which depends on the parameter set on **PID source**. It will be necessary the calibration through **PID gain source**.

The measure units are those indicated in the notes at the end of the paragraph 10.2. “List of the high-priority parameters”.

The feed-forward value can be read through the parameter **Feed-fwd PID** via keypad or serial line.

Referring to the above examples:

1. Programming example of the ramp output block (**Parameter Ramp out**) on **PID source**:
   Speeds will be converted inside the drive into RPM x 4.
   The ramp input references take as maximum set value what set in **Speed base value**.

   Feed - fwd PID = Speed base value x 4 x PID source gain

   If, with max. ramp reference and **Speed base value** = 3000rpm, to have
   Feed - fwd PID = 10000, it is necessary to set:
   PID source gain = 10000 / (3000 x 4) = 0.833

2. Programming for example analog input 2 on **PID source**:
   When an analog input will be set on a **PAD** parameter, this will have a max. value of + / - 2047.
   With max. analog reference, for having **Feed - fwd PID** = 10000, it is necessary to set:
   PID source gain = 10000 / 2047 = 4.885.

Note! Using the regulator as “generic PID” without the feed -forward function, **Feed - fwd PID** must be at its max. value.
To do this, it is necessary to set **PID source** on a **PAD** parameter and program it = 10000.

6.16.3.4 PID function

The PID function is divided in three blocks:

- Feed-back input "**PID reference**"
- Proportional-integral control block "**PI controls**"
- Proportional-derivative control block "**PD controls**".

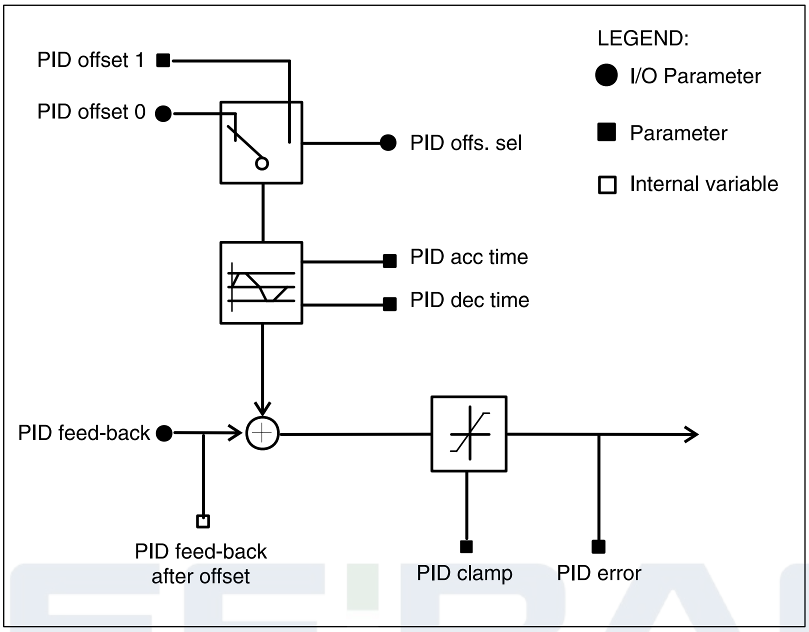


Figure 6.16.3.2: PID blocks description

PID references

[759]	PID error
[763]	PID feed-back
[762]	PID offs. Sel
[760]	PID offset 0
[761]	PID offset 1
[1046]	PID acc time
[1047]	PID dec time
[757]	PID clamp

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
PID error	759	-10000	+10000	0	0	
PID feed-back	763	-10000	+10000	0	0	**
PID offs. Sel Offset 0 (0) Offset 1 (1)	762	0	1	0	0	*
PID offset 0	760	-10000	+10000	0	0	**
PID offset 1	761	-10000	+10000	0	0	
PID acc time	1046	0.0	900.0	0.0	0.0	
PID dec time	1047	0.0	900.0	0.0	0.0	
PID clamp	757	-10000	+10000	10000	10000	

* This function can be set on a digital programmable input.
** This parameter can be set on an analog programmable input.

PID error Error reading in the input of the function PID (**PID clamp** block output).

PID feed-back Reading of feed-back value from the transducer position (dancer) or tension (load cell).

PID offs. sel Offset selector added to **PID feed-back**. This parameter can be set on a digital programmable input.

0 = **PID offset 0** 1 = **PID offset 1**

PID offset 0 Offset 0 added to **PID feed-back**. This parameter can be set on analog input , E.g. for the tension setting when a load cell has to be used as feed-back.

PID offset 1 Offset 1 added to **PID feed-back**.

PID acc time Acceleration ramp time value in seconds after the PID offset block.

PID dec time Deceleration ramp time value in seconds after the PID offset block.

PID clamp The clamp allows a smooth tension setting of a controlled system winder/unwinder, when the “calculation of the initial diameter” function cannot be used.

When the drive is enabled, the dancer is at its lower full scale, with **PID error** at its maximum value. The motor could accelerate to fast in taking the dancer in its central position of work.

Setting **PID clamp** at a value sufficiently low e.g = 1000, at the drive enabling and at the enabling of **Enable PD PID**, the value of **PID error** is limited to 1000 until the signal coming from the dancer (**PID feed-back**) does not reach this value. Now **PID clamp** is automatically take back at its maximum value corresponding to 10000. The clamp is kept at 10000 till the next disabling of the drive or of **Enable PD PID**.

The feed - back input is provided for the analog transducers connection like dancer, with relative potentiometer or load cell. Nevertheless, it is possible to use this input block as comparison point between two different analog signals + / - 10V.

Connection to a dancer with potentiometer connected between - 10 and + 10V.

The wiper of the potentiometer can be connected to one of the analog inputs of the drive. Normally it should be used the analog input 1 (terminals 1 and 2) because it is provided with filter.

The input choosen for that connection must be programmed in the menu I/O CONFIG as **PID feed - back**. Its value can be read in the **PID feed - back** parameter in the **PID REFERENCE** submenu.

Through **PID offset 1** (or PID offset 0), it is possible to carry on the adjustement of the dancer position.

Connection to a load cell with full range + 10V.

The output of the load cell can be connected to one of the drive analog inputs. Normally the analog input 1 (terminals 1 and 2) should be used because of the filter provided.

The input choosen for the connection must be programmed in the menu I/O CONFIG as **PID feed - back.** Its value can be read in the **PID feed - back** parameter of the **PID REFERENCE** submenu.

The tension setting can be sent, with value 0...-10V, to one of the remaining programmable analog inputs in the **I/O CONFIG** menu as **PID offset 0.**

6.16.3.5 Proportional - integral block

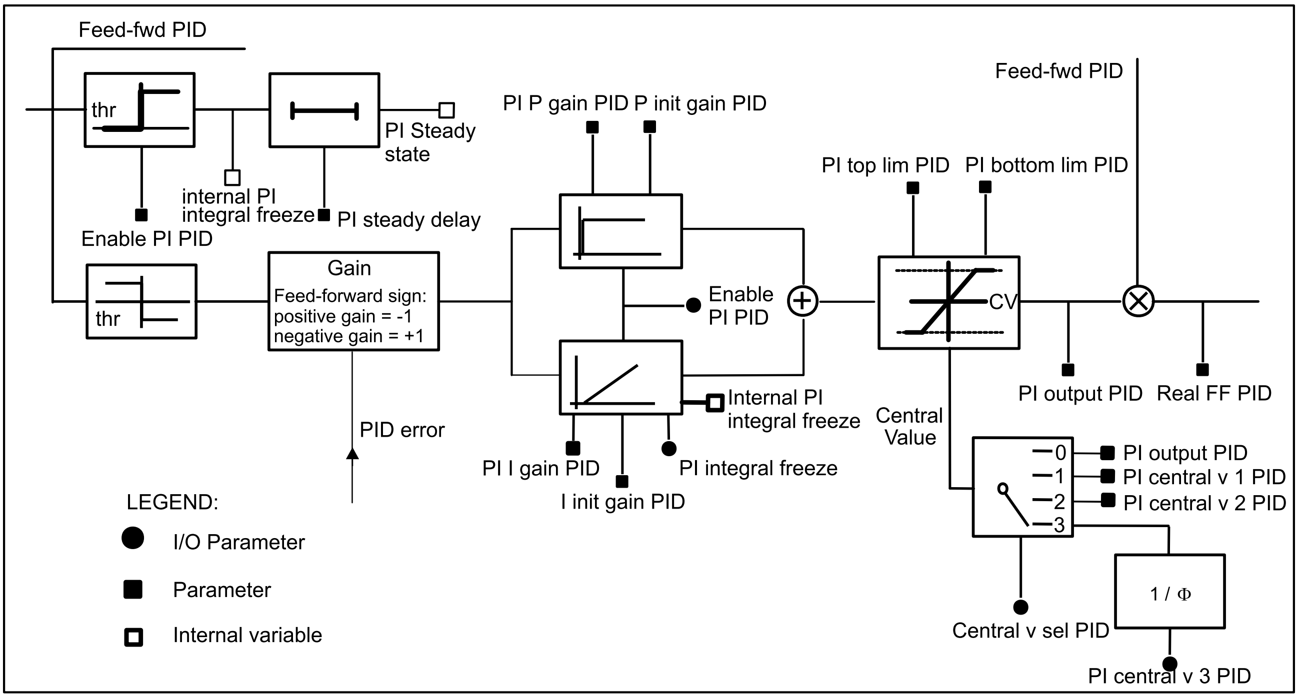


Figure 6.16.3.3: PI block description

The PI block receives its input from the **PID error** parameter, which represents the error that must be corrected by the regulator. The PI block carries on a proportional-integral regulation, its output **PI output PID** after having been appropriately adapted, according to the system which it has to control, it will be used as multiplier factor of the feed-forward (**Feed-fwd PID**) obtaining the correct value of the speed reference for the drive (**Real FF PID**).

The PI block will be enabled setting **Enable PI PID** = Enable. If **Enable PI PID** has been programmed on a digital input, this must be set to a high logic level (+24V).

PID		
	[769]	Enable PI PID

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Menu						
Enable PI PID Enabled (1) / Disabled (0)	769	0	1	Disable	Disable	*

* This function can be set on a digital programmable input.

Enable PI PID	Enabled	Enable of the proportional-integral block
	Disabled	Disabling of the proportional-integral blc.

PI controls		
	[765]	PI P gain PID
	[764]	PI I gain PID

[695]	PI steady thr
[731]	PI steady delay
[793]	P init gain PID
[734]	I init gain PID
[779]	PI central v sel
[776]	PI central v1
[777]	PI central v2
[778]	PI central v3
[784]	PI top lim
[785]	PI bottom lim
[783]	PI integr freeze
[771]	PI output PID
[418]	Real FF PID

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
PI P gain PID	765	0.00	100.00	10.00	10.00	
PI I gain PID	764	0.00	100.00	10.00	10.00	
PI steady thr	695	0	10000	0	0	
PI steady delay	731	0	60000	0	0	
P init gain PID	793	0.00	100.00	10.00	10.00	
I init gain PID	734	0.00	100.00	10.00	10.00	
PI central v sel	779	0	3	1	1	*
PI central v1	776	PI bottom lim	PI top lim	1.00	1.00	
PI central v2	777	PI bottom lim	PI top Lim	1.00	1.00	
PI central v3	778	PI bottom lim	PI top Lim	1.00	1.00	**
PI top lim	784	PI bottom lim	10.00	10.00	10.00	
PI bottom lim	785	-10.00	PI top lim	0.0	0.0	
PI integr freeze OFF (0) / ON (1)	783	0	1	0	0	*
PI output PID	771	0	1000 x PI top limit	1000	1000	
Real FF PID	418	-10000	+10000	0	0	

* This function can be set on a digital programmable input

** This parameter can be set on an analog programmable input

PI P gain PID Proportional gain of PI block

PI I gain PID Integral gain of PI block

PI steady thr Threshold feed-forward survey. If **Feed-fwd PID** is less than **PI steady thr** the integral regulation will be frozen, the proportional gain assumes the value set in **P init gain PID**.

When **Feed-fwd PID** overcomes the threshold, the integral regulation with the gain set in **I init gain PID** will be enabled. The PI block will mantain the gains **P init gain PID** and **I init gain PID** for the time preset through **PI steady delay**. Once this delay is over, they will be brought automatically to **PI P gain PID** and **PI I gain PID**.

PI steady delay Time for which the gains **P init gain PID** and **I init gain PID** have been kept operative after overcoming the feed-forward **PI steady thr** threshold.

The delay time **PI steady delay** and the resulting function of initial gains changing also, operate on the transition L to H of the **Enable PI PID** parameter.

P init gain PID Initial proportional gain. **P init gain PID** operates when feed-forward is less than **PI steady thr** and at its overcoming, for the time set in **PI steady delay** or on the transition L to H of **Enable PI PID** for the same time.

I init gain PID Initial integral gain. **I init gain PID** operates after the threshold **PI steady thr** has been overcome or on the transition L to H of **Enable PI PID** for the time set in **PI steady delay**.

PI central v sel Output selector of the starting PI block. **PI central v sel** (0...3) selects between the 4 possible settings of the initial value of the regulator integral component (corresponding to initial diameter).

PI central v sel can be set directly from keypad, serial line or through two digital inputs set respectively as **PI central v S0 and PI central v S1**.

Selecting **PI central v sel = 0**, when PI block is disabled (**Enable PI PID** = Disable), the last value of the integral component calculated (corresponding to roll diameter) is stored. This value is displayed in **PI output PID**. When enabled again, the regulation restarts again from that value. The same functionality is used when switching off the drive . This kind of operation can be used when controlling a winder and it is necessary to stop the machine and disable the drives or even remove AC incoming power from the electrical cabinet.

Selecting **PI central v sel** = 1-2-3, when PI block has been disabled, the value of **PI output PID** will be set at what is programmed in the correspondent parameter (x1000). When the drive is restarted after a power off, the precalculated value will be automatically set only if, when powering up the drive, the digital input programmed as **Enable PI PID** is already set at a high level.

PI central v 1 Setting of the first initial value of the regulator's integral component (corresponding to initial diameter 1). The **PI central v 1** value must be included in the limits set in **PI top lim PID** and **PI bottom lim PID**.

PI central v 1 will be selected by setting **PI central v sel** = 1.

PI central v 2 Setting of the second initial value of the regulator's integral component (corresponding to initial diameter 2). The **PI central v 2** value must be included in the limits set in

PI top lim PID and **PI bottom lim PID**.

PI central v 2 will be selected by setting **PI central v sel** = 2.

PI central v 3 Setting of the third initial value of the regulator's integral component (correspondent to initial diameter 3). The **PI central v 3** value must be included in the limits given by **PI top lim PID** and **PI bottom lim PID**.

PI central v 3 will be selected by setting **PI central v sel** = 3.

PI top lim It defines the higher limit of the adapting block of the PI correction.

PI bottom lim It defines the lower limit of the adapting block of the PI correction.

The output of the PI block represents the multiplier factor of feed-forward, whose value must be adapted from the regulator in the max. limits included between +10000 and -10000 and defined by **PI top lim** and **PI bottom lim**. The value of these parameters will be defined according to the system that has to be controlled. For a better understanding please refer to the paragraph "Examples of application".

PI integral freeze Freezing of the present condition of regulator integral component.

PI output PID Output of PI block, adapted to the values included between **PI top limit** and **PI bottom**

limit. At the power up of the drive, **PI output PID** acquires automatically the selected value with **PI central v sel** multiplied by 1000.

Example: If **PI central v 2** = 0.5 is selected, at the start **PI output PID** acquires value = 500.

When **Enable PI PID** has been enabled, the output **PI output PID** is, independently on the input error able to integrate its value up to the limits set with **PI top limit** or **PI bottom limit** multiplied by 1000.

Example: **PI top limit** = 2, **PI output PID** max = 2000.

The PI block output will be further limited from the parameter saturation **Real FF PID** (see corresponding parameter).

As previously described, **PI output PID** is used as a multiplier factor of the feed-forward in order to obtain the angular speed reference of the motor. If the PID function is used to control a winder/ unwinder system, its value is inversely proportional to the roll diameter. When winding with a constant peripheral speed, the following is valid:

$$\omega_0\Phi_1=\omega_1\Phi_1$$

where:

ω_0 = angular speed at minimum diameter

Φ_0 = minimum diameter

ω_1 = angular speed at actual diameter

Φ_1 = actual diameter

$\omega_1 = \omega_0 \text{ x } (\Phi_0/\Phi_1)$

If the drive is set correctly, and ω_0 is equivalent to the maximum value of the feed-forward, then **PI output PID** depends on (Φ_0/Φ_1).

Taking into consideration the internal coefficients of the firmware, it can be written:

PI output PID = (Φ_0/Φ_1) x 1000

This formula can be used to verify the accuracy of the setting when the system is on working or during the procedure for the calculation of the initial diameter.

Real FF PID Represents the feed-forward value which has been recalculated according to the PI correction. It will be calculated with the following formula:

Real FF PID = (**Feed-fwd PID** / 1000) x **PI output PID**

The max. value of **Real FF PID** is +/- 10.000.If this limit had been reached during operation, in order to avoid dangerous levels of regulator saturation, further increases of **PI output PID** will be blocked.

Example: Feed-fwd = + 8000, the positive limit of PI output PID will be automatically set at 10000 / (8000 / 1000) = 1250.

6.16.3.6 Proportional - Derivative control block

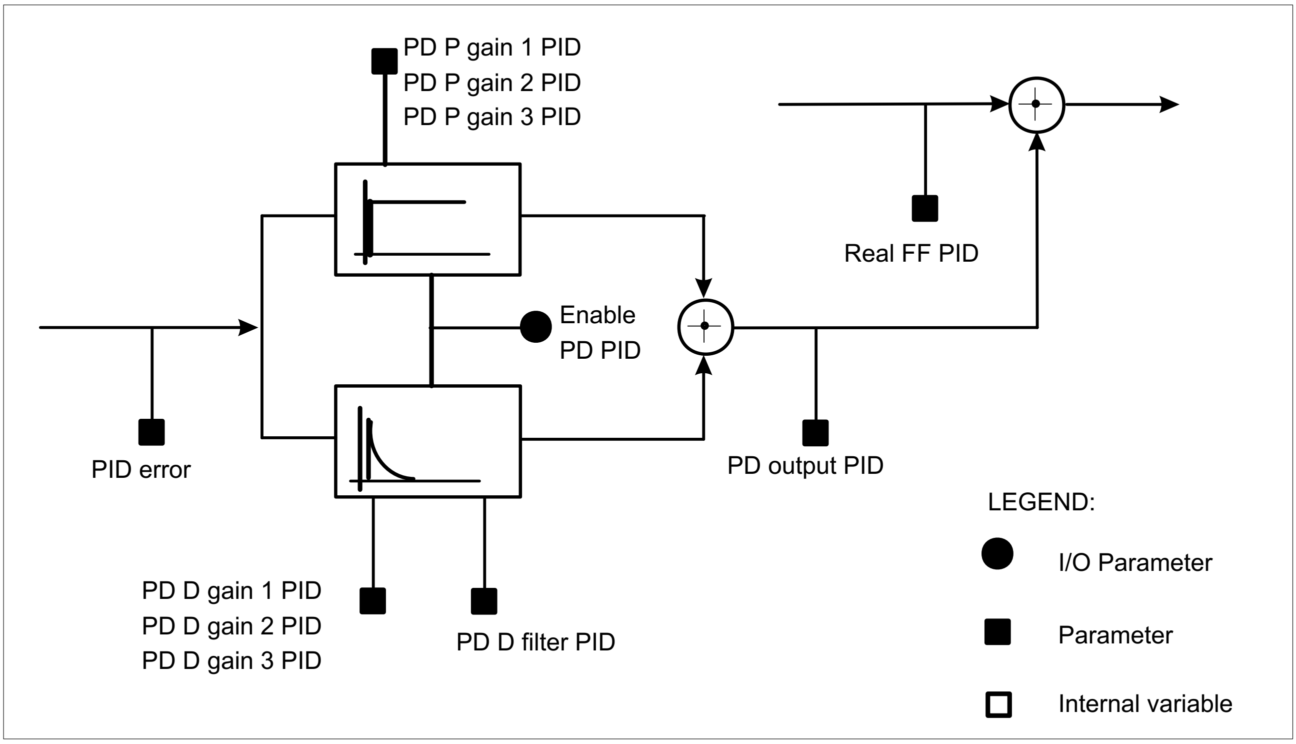


Figure 6.16.3.4: PD block description

The PD block receives the values **PID error** at its input, which represents the error that must be corrected by the regulator. The PD block carries out proportional-derivative regulation and its output **PD output PID** will be added to **Real FF PID**.

The PD block is enabled by setting **Enable PD PID** = Enable. If **Enable PD PID** has been programmed on a digital input, this must be set to a high logical level.

PID		
	[770]	Enable PD PID

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Menu						
Enable PD PID Enabled (1) / Disabled (0)	770	0	1	Disable	Disable	*

* This function can be set on a digital programmable input.

Enable PD PID	Enabled	Enabling of the block proportional-derivative
	Disabled	Disabling of the block proportional-derivatve

PD control

[768]	PD P gain 1 PID [%]
[766]	PD D gain 1 PID [%]
[788]	PD P gain 2 PID [%]
[789]	PD D gain 2 PID [%]
[790]	PD P gain 3 PID [%]
[791]	PD D gain 3 PID[%]
[767]	PD D filter PID [ms]
[421]	PD output PID

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
PD P gain 1 PID [%]	768	0.00	100.00	10.00	10.00	
PD D gain 1 PID [%]	766	0.00	100.00	1.00	1.00	
PD P gain 2 PID [%]	788	0.00	100.00	10.00	10.00	
PD D gain 2 PID [%]	789	0.00	100.00	1.00	1.00	
PD P gain 3 PID [%]	790	0.00	100.00	10.00	10.00	
PD D gain 3 PID[%]	791	0.00	100.00	1.00	1.00	
PD D filter PID [ms]	767	0	1000	0	0	
PD output PID	421	-10000	+10000	0	0	

The gains of the block can remain fixed and programmed in this case through the parameters **PD P gain 1 PID** and **PD I gain 1 PID**, or changed depending on machine parameters, through the function Adap spd reg. In this case the gains come from **PD P gain 1-2-3 PID** and **PD I gain 1-2-3 PID**.

For example, it is possible to modify, dynamically, the gains of PD block according to the speed, to a regulation parameter internal to the drive, or to an analog input proportional to the unit related to the machine. The behaviour of the regulator can be so configured to meet the needs of the machine.

Note: When **Adap Spd reg** has been enabled (paragraph 6.13.2. of the manual), it operates both on the PID function and on the gains of the speed regulator. So it is necessary to appropriately program all relative parameters. If one wishes to modify only the gains of the speed regulator and keep fixed the gains of the PID function, it is necessary set the three proportional gains and integral gains of the PD block at the same value. The same is valid in case the PID gains have to be modified and the speed regulator gains must remain fixed.

PD P gain 1 Proportional gain 1 of the block PD (its selection depends on the eventual enabling of the function **Adap Spd reg** and its configuration).

PD D gain 1 Derivative gain 1 of block PD (its selection depends on the eventual enabling of the function **Adap Spd reg** and its configuration).

PD P gain 2 Proportional gain 2 of the block PD (its selection depends on the eventual enabling of the function **Adap Spd reg** and its configuration).

PD D gain 2 Derivative gain 2 of block PD (its selection depends on the eventual enabling of the function **Adap Spd reg** and its configuration).

PD P gain 3 Proportional gain 3 of the block PD (its selection depends on the eventual enabling of the function **Adap Spd reg** and its configuration).

PD D gain 3 Derivative gain 3 of block PD (its selection depends on the eventual enabling of the function **Adap Spd reg** and its configuration).

PD D filter PID Time constant of the filter from the derivative side.

PD output PID PD block output.

6.16.3.7 Output reference

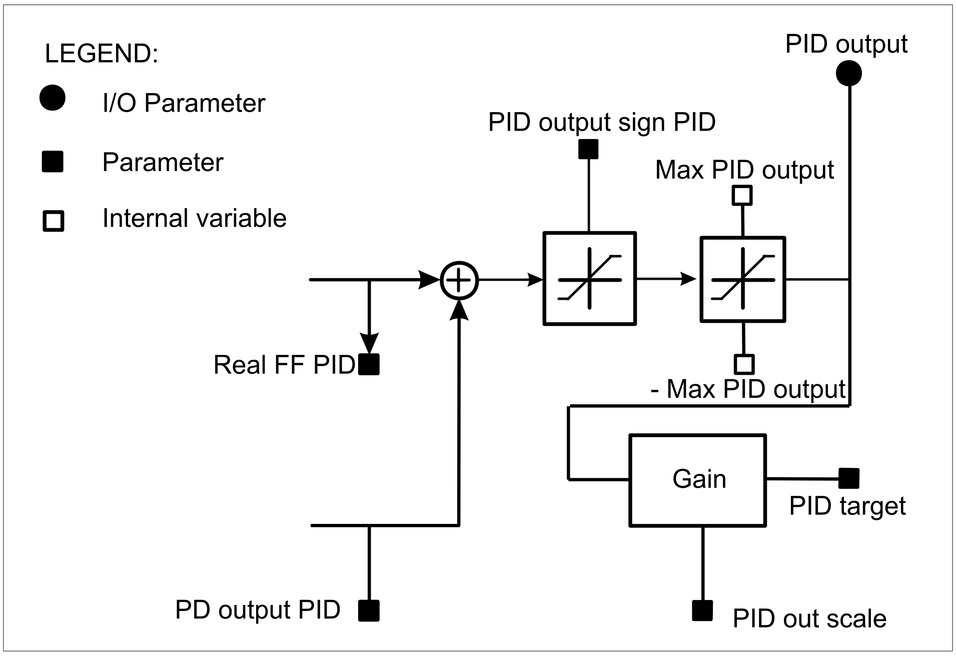


Figure 6.16.3.5: Output reference block description

PD control

[772]	PID out sign PID
[774]	PID output

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
PID out sign PID Positive (0) Bipolar (1)	772	0	1	1	1	
PID output	774	-10000	+10000	0	0	*

* This parameter can be set on an analogue programmable output.

PID out. sign PID Through this parameter it is possible to set the output of the regulator to be either bipolar or simply positive (clamp of negative side).

PID output Display of regulator output. It is possible to program this parameter to an analog output, in order to perform a reference cascade in multidrive systems.

PID target

[782]	PID target
[773]	PID out scale

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
PID target	782	0	65535	0	0	
PID out scale	773	-100.000	-100.000	1.000	1.000	

PID target Address of the parameter which contains the value to be used as PID target. To obtain the real settable value, it is necessary to add +2000H (8192 decimal) to the parameter number.

PID out scale Matching factor of **PID output**. Its value depends on the parameter to which the regulator output is addressed.

Through the parameter **PID target** it is possible to select which point of the drive will be addressed for output signal of the regulation. The selectable parameters are those assigned as writing parameters (W or R/W) indicated in the paraghraph 10.2. "*List of high-priority parameters*'". The units are those indicated in the notes at the end of the paragraph.

Programming example of the speed reference 1 (parameter **Speed ref 1**) on **PID target**:

Menu OPTION

————> PID

————> PID target

————> PID target = 8234

PID target must be set according to the number of the parameter to which it will be associated, choosing it from the paragraph 10.2. "List of high-priority parameters'" (**Speed ref 1** has the decimal number 42). To obtain the value it must be added the decimal number 8192 (fixed offset):

8192 + 42 = 8234.

Note: When the ramp function has been enabled, Speed ref 1 will be automatically programmed on its output. To have it available it is necessary to set parameter Enable ramp = disable.

Speed ref 1 will be set in RPM x 4, considering that **PID output** assumes values included between 0....10000, it is necessary to set appropriately the calibration through **PID out scale**.

Calculation of **PID out scale**:

If it is necessary that **PID output**, at its max. value = 10000, corresponds at speed reference = 2000rpm it is necessary to set:

PID out scale = (2000 x 4) / 10000 = 0.8

It is possible to read the set value of **Speed ref 1** in the appropriate parameter of the menu **INPUT VARIABLES / Speed ref**.

Note: The value of PID out scale will be defined according to the system which is being controlled. For a better understanding, please refer to the paragraph "Application examples".

6.16.3.8 Function of calculation for Initial diameter

This function performs a preliminary calculation of the diameter of an unwinder/winder before starting the line. This allows better control of the system avoiding unwanted balancing of the dancer.

The calculation is based on the measure of the movement of the dancer from the position of lower fullrange to its central position of work, and on the measure of angular movement of the roll during the initial phase.

NOTE: The function of initial diameter calculation can be carried out only when the winder/unwinder are controlled through dancer (no load cell) and the speed feed-back is carried out through encoder.

The result of the calculation is assigned to the parameter **PI output PID**, and so it represents the multiplier factor of the feed-forward, in order to obtain the angular speed reference of the motor.

Its value is universely proportional to the roll diameter.

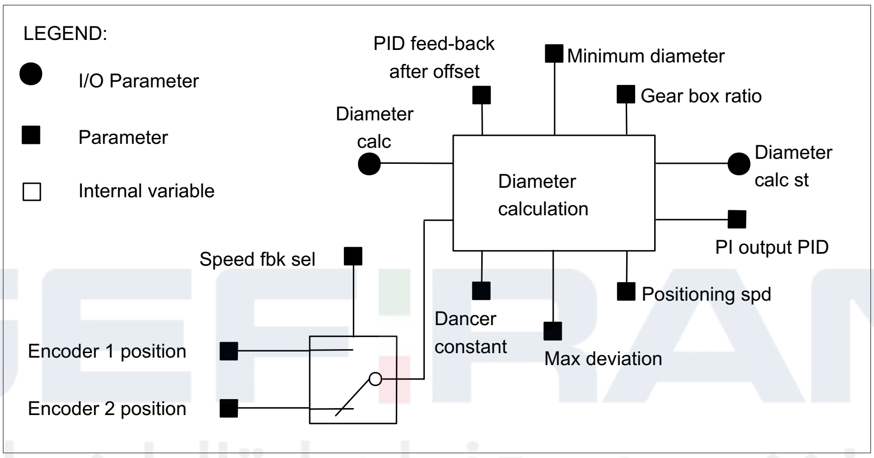


Figure 6.16.3.6: Diameter calculation block description

Diameter calc

[794]	Diameter calc
[795]	Positioning spd [rpm]
[796]	Max deviation
[797]	Gear box ratio
[798]	Dancer constant [mm]
[799]	Minimum diameter [cm]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Diameter calc Enabled (1) Disabled (0)	794	0	1	0	0	
Positioning spd [rpm]	795	-100	+100	0	0	
Max deviation	796	0	+10000	8000	8000	
Gear box ratio	797	0.001	1.000	1.000	1.000	
Dancer constant [mm]	798	1	10000	1	1	
Minimum diameter [cm]	799	1	2000	1	1	

* This function can be set on a digital programmable input.

Diameter calc Enabling of the initial function of diameter calculation.

The calculation will be enabled by setting **Diameter calc** = Enable.

If **Diameter calc** has been programmed on a digital input, this must be brought to a high logic level.

Positioning spd Motor speed at which the dancer is at its central working position, during the calculation phase of the initial diameter.

Max deviation Value expressed in count of D/A which corresponds to the maximum shift allowed by the dancer. This value will be associated with the starting measurement of the dancer movement during the calculation of the initial diameter.

During the preliminary phase of the commissioning, it is necessary to carry out the self-calibration of the analog inputs, so at the fullrange position of the dancer they will correspond, whatever was the value of the analog input, at 10000 counts. The parameter **Max deviation**, in order to guarantee a precise calculation of the movement, must be set at a value slightly lower. (standard **Max deviation** = 8000).

Gear box ratio Ratio reduction between the motor and the roll (< = 1).

Dancer constant It expresses the measure in mm, the total bunching of material in the dancer.

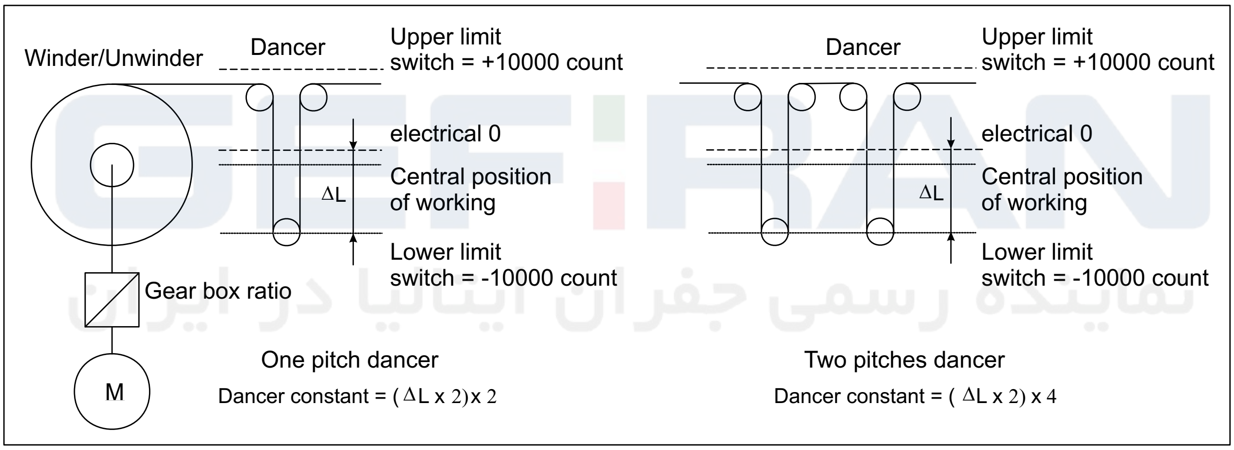


Figure 6.16.3.7: Diameter calculation

Measurement of **Dancer constant**:

With dancer in lower fullrange position, perform the self-calibration of the analog input programmed as **PID feed-back**.

Set the keypad of the drive on the parameter **PID feed-back**.

Measure and multiply by 2, the distance in mm between the lower mechanical fullrange and the position of the dancer that, on the parameter **PID feed-back,** will display 0 (position of electrical 0).

Multiply the above calculated value by 2 if the dancer has only one pitch, by 4 if the dancer has two pitches and so on, as per the figure above.

Minimum diameter Min. value of core diameter expressed in cm.

6.16.3.9 Procedure of calculation for initial diameter

The calculation is based on the measurement of the dancer movement from the lower fullrange position to its central working position, and on the measurent of the angular movement of the coil during the drawing phase. For that reason, during this period, make sure that the gear mantaining the material blocked. For this reason it is necessary to enable the regulation of the nip-roll drive with speed reference = 0.

If line nip-rolls are controlled by dancers or load cells, it is necessary to carry out the diameter calculation of the winders/unwinders first, then the gear.

The parameter **PI central v sel** must be set at 0 to avoid **PI output PID** being set automatically at a predefined value.

Bringing the digital input programmed as **Diameter calc** to a high logic level (+24V) , if the drive is enabled, will start the procedures. During this phase, the parameters **Enable PI PID** and **Enable PD PID** are automatically disabled.

The regulation verifies the signal coming from the dancer potentiometer. If this is higher than what is already set in **Max deviation**, the motor begins following the speed reference set in **Positioning speed** in order to wind the material and bring the dancer to its central position of working.

The polarity of the reference assigned to **Positioning speed** will be winder / unwinder equal to the one working as a winder.

If the initial regulation verifies that the signal coming from the potentiometer of the dancer is lower than what already set in **Max deviation**, the motor starts running with speed reference set in **Positioning speed** in order to unwind the material and bring the dancer on the point identified by **Max deviation**, at this point the reference will be inverted to bring the dancer to its central position.

When the dancer has reached the central position, the parameter **PI output PID** will be set at a value inversely proportional to the diameter and the digital output **Diameter calc st**, that indicates the end of diameter calculation, will be brought to high logical level .

At this point, if **Enable PI PID** and/or **Enable PD PID** are enabled, the system passes automatically in regulation. For this reason generally the digital inputs programmed as **Diameter calc** and **Enable PI PID** and/or **Enable PD PID** will be brought to high logic level at the same time.

The output signal Diameter calc st can be used to reset the command **Diameter calc** (this command will be activated on the rising edge of the digital input). For that reason, it must be brought to high logical level after the supply of the regulation part of the drive and reset once the initial calculation phase has finished.

The value of **PI output PID** will be calculated with the following formula:

PI output PID = (**Min diameter x PI top lim**) / Value of the calculated diameter

The parameters **PI top limit** and **PI bottom limit** in the menu **PI controls** have to be set according to the max. and min. diameter of the roll. For better explanation, please refer to paragraph 6.16.3.10 “Application examples”.

6.16.3.10 Examples of application

Nip-roll control with dancer

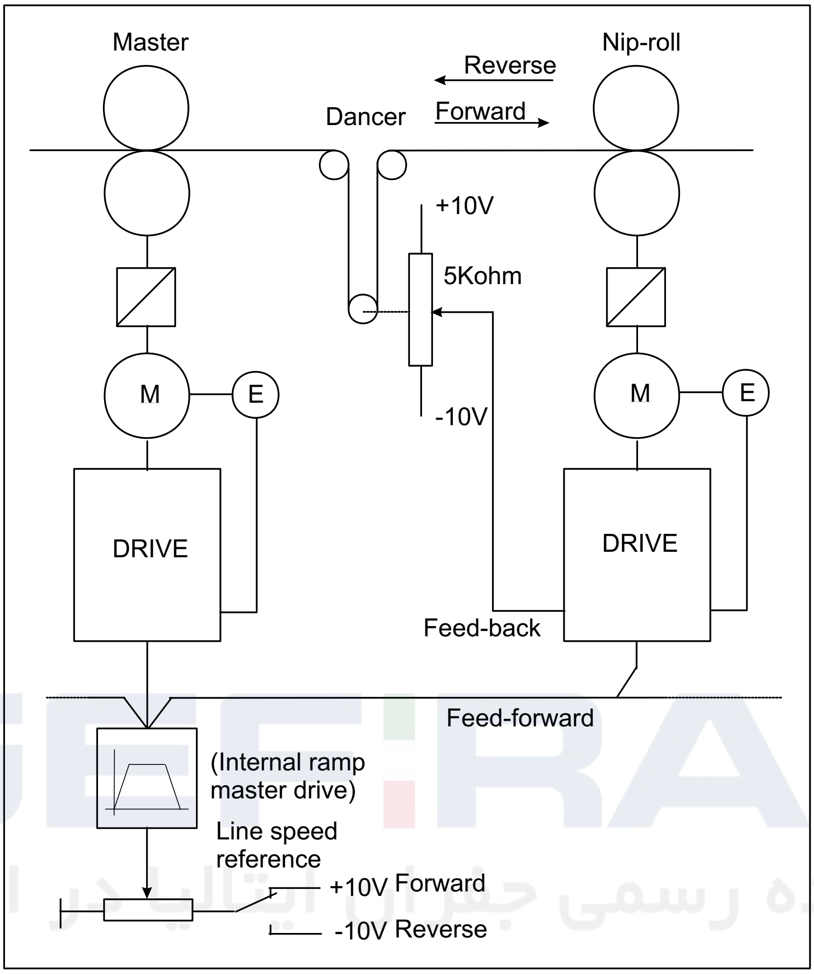


Figure 6.16.3.8: Nip-roll control with dancer

Machine data:

Rated speed of slave motor Vn = 3000rpm
Slave motors speed correspondent to the max. line speed = 85% Vn = 2550rpm
Max. correction of the dancer = +/- 15% of the line speed = +/- 382.5rpm

The slave drive must be sent the analog signals regarding line speed and the position of the dancer (whose potentiometer will be supplied between terminals -10V... +10V) and the digital commands regarding the enabling of the PID control.
The regulator output will be sent to speed reference 1.

Drive setting: (below parameters regarding only the PID function)

Input/output

Set **Analog input 1** as input for the wiper of the dancer potentiometer.
Analog input 1 / Select input 1= PID Feed-back
Set **Analog input 2** as line speed input (feed- forward).

To set the feed-forward on analog input, seeing that this one is not directly accessible in the list of high-priority parameters, it is necessary to pass through a supporting parameter **PAD 0.....PAD 15**.

Analog input 2 / Select input 2 = PAD 0

Set **Digital input 1** as enabling input of PI block of the PID
Digital input 1 = Enable PI PID

Set **Digital input 2** as enabling input of PD block of the PID
Digital input 2 = Enable PD PID

Parameters

Set **Speed base value** equal to the rated speed of the motor.
Speed base value = 3000rpm

Set **PID source** as **PAD 0**.
(**PAD 0** has been used as supporting parameter for the feed-forward reading on **Analog input 2**)
For PID source, set the parameter number to which it will be associated, choosing it from the list of paragraph 10.2. "*List of high-priority parameters*' (**PAD 0** has the decimal number 503).
To obtain the correct value it must be added to the decimal number 8192 (fixed offset):
PID source = (8192 + 503) = 8695

Set **PID source Gain** so that **Feed-fwd PID** reaches, along with the max. analog value on Analog input 2, 85% of its max. value = 10000 x 85%.
When an analog input is set on a PAD parameter, this will have a max. value +/- 2047.

So:
PID source Gain = (max **Feed-fwd PID** x 85%) / max **PAD 0** = (10000 x 0.85) / 2047 = 4.153

Set **PID target** as **Speed ref 1**.

Note: When the ramp function is enabled, **Speed ref 1** is not available. In order to keep it available, it is necessary to set the parameter **Enable ramp** = Disable.

PID target must be set to the parameter number to which it will be associated, choosing it from the list of paragraph 10.2, "*List of high-priority parameters*" (**Speed ref 1** has the decimal number 42).
To obtain the correct value it must be added the decimal number 8192 (fixed offset)
PID target = 8192 + 42 = 8234

Set **PID out scale** so that , the max. analog value on **Analog input 2** (**Feed-fwd PID** = 8500) and **Enable PI PID** and **Enable PD PID** = Disable, **Speed ref 1** is the same at 2550rpm.

The parameter **Speed ref 1** will set in RPM x 4, so:

PID out scale = (2550 x 4) / 8500 = 1.2

Set **PI central v sel** = 1.

Set **PI central v 1** = 1

In absence of a correction performed by the PI block of the regulator, the line speed reference (Feed-forward) must be multiplied by 1 and sent directly to the speed regulator of the drive.

In this application, the regulator carries out a mono type proportional control. The correction will be indicated in percentage, according to the line speed, from 0 to the maximum.

Set **PI top limit** and **PI bottom limit** so that, with max. of the dancer (max.value of the analog input 1 = **PID Feed-back**) and setting the proportional gain of the PI block at 15%, it will correspond to an equal proportional correction of feed-forward. For this reason set:

PI top limit = 10

PI bottom limit = 0.1

Set **PI P gain PID** = 15%

Set **PI I gain PID** = 0%

With this configuration, having a correction proportional to the line speed, the PI block is not able to position the dancer at speed = 0. In order to do the drawing in stop conditions, it is necessary to use the PD block.

Set **PD P gain PID** to a value that allows positioning of the dancer without large dynamic variations.

For example:

PD P gain PID = 1%

If necessary, use the derivative component as damping component of the system, setting for example:

PD D gain PID = 5%

PD D filter PID = 20ms

If not necessary, keep these parameters = 0.

If it is necessary to carry out a reference cascade for another drive, set **PID output** on an analog output, for example:

Analog output 1 / Select output 1= PID output

(with **Real FF PID** = 10000 count, **Analog output 1** = 10V).

Nip-rolls control with load cell

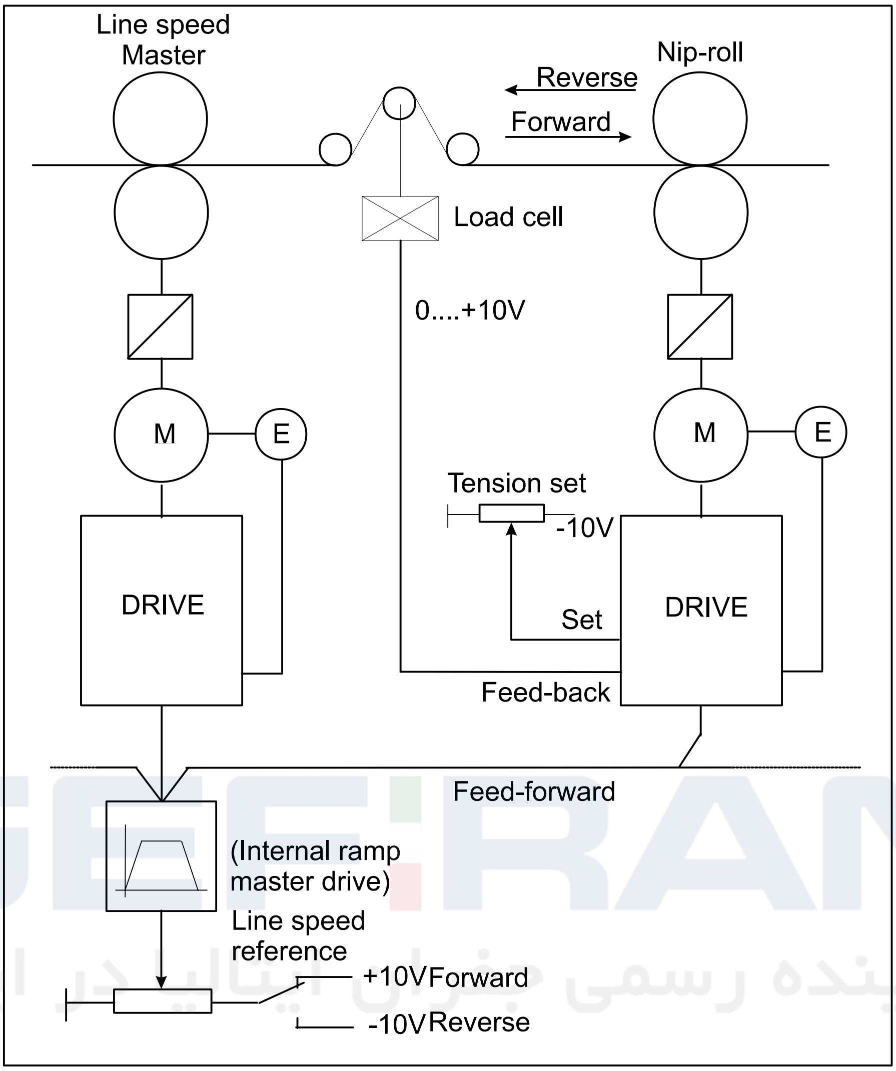


Figure 6.16.3.9: Nip-rolls control with load cell

Machine data:

Rated speed of slave motor Vn = 3000rpm
Slave motors speed corresponding to the max. line speed = 85% Vn = 2550rpm
Max. correction of the dancer = +/- 20% of the line speed = +/-510rpm

To the slave drive must be sent the analog signals regarding the line speed and the position of the load cell signal (0... +10V) and the tension set (0... +10V), and the digital commands regarding the enabling of the PID control. The regulator output will be sent to the speed reference 1.

Drive setting: (below are parameters regarding only the PID function)

Input/output

Set **Analog input 1** as input for the load cell signal.

Analog input 1 / Select input 1= PID Feed-back

Set **Analog input 2** as line speed input (feed- forward).

Setting the feed-forward on analog input, seeing it is not directly inserted in the list of high-priority parameters, it is necessary to pass through a supporting parameter **PAD 0.....PAD 15**.

Analog input 2 / Select input 2 = PAD 0

Set **Analog input 3** as input for the tension set (**PID offset 0**).

Analog input 3 / Select input 3 / PID offset 0

Set **Digital input 1** as enabling input of the PI block of the PID

Digital input 1 = Enable PI PID

Set **Digital input 2** as enabling input of the PD block of the PID

Digital input 2 = Enable PD PID

Parameters

Program **Speed base value** equal to the rated speed of the motor.

Speed base value = 3000rpm

Program **PID source** as **PAD 0**.

(**PAD 0** has been used as supporting parameter of the feed-forward reading on **Analog input 2**)

For **PID source** set the parameter number to which it will be associated, choosing it from the list of paragraph 10.2. "*List of high-priority parameters*' (**PAD 0** has the decimal number 503).

To obtain the correct value it must be added the decimal number 8192 (fixed offset):

PID source = (8192 + 503) = 8695

Set **PID source Gain** so that **Feed-fwd PID** reaches, along with the max. analog value on **Analog input 2**, 85% of its max. value = 10000 x 85%.

When an analog input is set on a PAD parameter , this will have a max. value +/- 2047.

So:

PID source Gain = (max **Feed-fwd PID** x 85%) / max **PAD 0** = (10000 x 0.85) / 2047 = 4.153

Set **PID target** as **Speed ref 1**.

Note: When the ramp function is enabled, **Speed ref 1** is not available. In order to have it available, it is necessary to set the parameter **Enable ramp** = Disable.

For **PID target** set the parameter number to which it will be associated, choosing it from the list of paragraph 10.2 "*List of high-priority parameters*' (**Speed ref 1** has the decimal number 42).

To obtain the correct value it must be added the decimal number 8192 (fixed offset)

PID target = 8192 + 42 = 8234

Set **PID out scale** so that, along with the max. analog value on **Analog input 2** (**Feed-fwd PID** = 8500) and with **Enable PI PID** e **Enable PD PID** = disable, **Speed ref 1** is the same at 2550rpm.

Speed ref 1 will be set in *RPM* x 4, so:

PID out scale = (2550 x 4) / 8500 = 1.2

Set **PI central v sel** = 1.

Set **PI central v 1** = 1

In the absence of a correction carried out from the PI block of the regulator, the line speed reference (Feed-forward) must be multiplied by 1 and sent directly to the speed regulator of the drive.

This application operates by using proportional control. The correction will be indicated in percentage according to the line speed, from 0 to the maximum.

Program **PI top limit** and **PI bottom limit** so that the max. correction of PI block corresponds at 20% of line speed.

PI top limit and **PI bottom limit** parameters are the maximum and minimum multiplier factor of Feed forward value.

At the max. line speed it will correspond 2550rpm of the motor (max. feed-forward).

Max. correction = 2550 x 20% = 510rpm

2550 + 510 = 3060rpm ——> **PI top limit** = 3060 / 2550 = 1.2

2550 - 510 = 2040rpm ——> **PI bottom limit** = 2040 / 2550 = 0.80

which will to multiply the setting of **PI central v 1** (= 1) by + 20% (1.2) and - 20% (0.80).

With this configuration, having a correction proportional to the line speed, the PI block is not able to apply tension at speed = 0. In order to apply tension in stop conditions, it is necessary to use on the PD block.

The gains of the single components have to be set with loaded machine; it is possible to start tests with values below indicated (default values):

Set **PI P gain PID** = 10%

Set **PI I gain PID** = 10%

Set **PD P gain PID** = 10%

In case use the derivative component for forcing the regulator output during velocity changes of the system, programming for example:

PD D gain PID = 5%

PD D filter PID = 20ms

If not necessary, keep these parameters = 0.

In case it is necessary to carry out a references cascade for another drive, set **PID output** on an analog output, for example:

Analog output 1 / Select output 1= PID output

(with **Real FF PID** = 10000 count, **Analog output 1** = 10V).

Note: If it is necessary, a system with the integral regulation enabled, with feed-forward = 0, and the need to apply tension of the system with null error also when the machine is stopped, please refer to the paragraph “Generic PID”.

Winder/Unwinder control with dancer

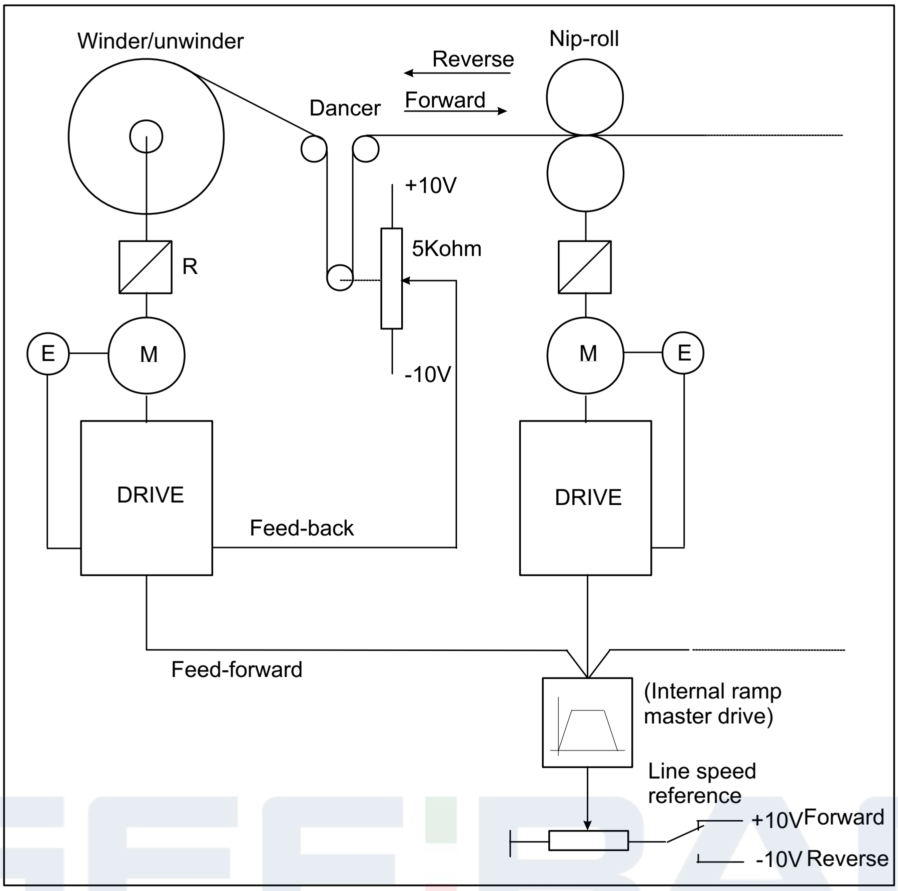


Figure 6.16.3.10: Winder/Unwinder control with dancer

Machine data:

Max. line speed =400m/min
Rated speed of the motor winder/unwinder Vn = 3000rpm
Max. diameter of the winder/unwinder = 700mm
Min. diameter of the winder/unwinder = 100mm
Reduction ratio motor-coil = 0.5
One pitch dancer
Dancer stroke from the lower limit switch to the position of electric 0 = 160mm
The drive of the winder/unwinder must be sent the analog signals regarding line speed and the position of the dancer (whose potentiometer will be supplied between the terminals -10V... +10V) and the digital commands regarding the enabling of the PID control.
The regulator output will be sent to the speed reference 1.
Drive setting: (below are only the parameters regarding the PID function)

Input/output

Set **Analog input 1** as input for the wiper of the dancer.
Analog input 1 / Select input 1= PID Feed-back

Set **Analog input 2** as line speed input (feed- forward).
To set the feed-forward on an analog input, seeing that this one is not directly accesible in the list of high-priority parameters, it is necessary to pass through a supporting parameter **PAD 0.....PAD 15**.

Analog input 2 / Select input 2 = PAD 0

Set **Digital input 1** as enabling input of the PI block of the PID
Digital input 1 = Enable PI PID

Set **Digital input 2** as enabling input of the PI block of the PID
Digital input 2 = Enable PD PID

Set **Digital input 3** as enabling input of the calculation function of initial diameter.
Digital input 3 = Diameter calc

Set **Digital output 1** as signalling " phase of calculation of starting diameter ".
Digital output 1 = Diameter calc st

Parameters

Set **Speed base value** equal to the rated speed of the motor.
Speed base value = 3000rpm

Set **PID source** as **PAD 0**.
(**PAD 0** has been used as supporting parameter of the feed-forward reading on **Analog input 2**)
For **PID source,** set the parameter number to which it will be associated, choosing it from the list of the paragraph 10.2. "*List of high-priority parameters*" (**PAD 0** had the decimal number 503). To obtain the correct value it must be added the decimal number 8192 (fixed offset):
PID source = (8192 + 503) = 8695

Set **Gain source** and **PID out scale** so that, the max. analog value on **Analog input 2** and without the PID correction (**Enable PI PID** e **Enable PD PID** = Disable), the peripheral speed of the roll in conditions of minimum diameter (core) is the same of the max. line speed.

Calculation of the motor speed in the condition above mentionned:

$$Vp = \pi \times \Phi min \times \omega \times R$$

where:
Vp = peripheral speed of the coil = line speed
Φ_{min} = min. diameter of the coil [m]
ω = angular speed of the motor [rpm]
R = reduction ratio motor-coil

$$\omega = Vp / \pi \times \Phi_{min} \times R = 400 / (\pi \times 0.1 \times 0.5) = 2546rpm = about\ 2550rpm$$

Mantaining a 15% margin as to the saturation limit of the regulator (10000 count), it is necessary to set **PID source Gain** so that **Feed-fwd PID** reaches, along with the max. analog value on **Analog input 2**, 85% of its max. value.
When an analog input is set on a PAD parameter , this will have a max. value +/- 2047.

So:

PID source Gain = (max **Feed-fwd PID** x 85%) / max **PAD 0** = (10000 x 0.85) / 2047 = 4.153

The speed reference of the motor is set in *RPM* x 4, so program as follows:

PID out scale = (2550 x 4) / (10000 x 0.85) = 1.2

Set **PID target** as 1 **Speed ref 1**.

Note: When the ramp function has been enabled, **Speed ref 1** is not available. To keep it available it is necessary to set the parameter **Enable ramp** = Disable.

For **PID target** set the parameter number to which it will be associated, choosing it from the list of paragraph 10.2. "*List of high-priority parameters*" (**Speed ref 1** has the decimal number 42).

To obtain the correct value it must be added the decimal number 8192 (fixed offset):

PID source = (8192 + 42) = 8234

Set **PI central v sel** = 0.

With this configuration, having a correction proportional to the line speed, the PI block is not able to position the dancer at speed = 0. In order to do the drawing in stop conditions, it is necessary to use the PD block.

As previously stated, the procedure determines the theorical multiplier factor (**PI output PID**) of feed-forward as relation of the diameter calculated. In order to send to the drive the correct speed angular value.

Note: When **PI central v sel** = 0 has been selected and the the PI block has been disabled, the system keeps in memory, or reset automatically in case of switching off, the last value calculated for **PI output PID**. If it would be necessary to set the value in order to have at the output an incorrect reference and so equal to the feed-forward, it is possible to configure a digital input as correction reset.

So configure:

Digital input 4 = PI central v S0

PI central v 1 = 1.00

Bringing the digital input to logical high level, the **PI output PID** will be reset.

Set **PI top lim** and **PI bottom lim** according to the ratio diameters coil.

Parameters **PI top lim** and **PI bottom lim** can be considered as multiplier factors, respectively max. and min. of the feed-forward.

Considering that the angular speed of the motor and the corresponding reference, change inversely to the unwinder/winder diameter;

Set: **PI top lim** = 1 **PI bottom lim** = Φ_{min} / Φ_{max} = 100 / 700 = 0.14

Below is an explanation of above settings.

Calculation of the angular speed of the motor:

ω max. = Vl / (π x Φ_{min} x R) and ω_{min} = Vl / (π x Φ_{max}. x R)

where:

ω_{max} = angular speed of the motor in conditions of min. diameter [rpm]

ω_{min} = angular speed of the motor in conditions of max. diameter [rpm]

Vl = line speed

Φ_{min} = min. diameter of the core[m]

Φ_{max} = max. diameter of the core[m]

R = gear reduction ratio motor-winder/unwinder

So: $\omega_{max} / \omega_{min} = \Phi_{max} / \Phi_{min}$

from which

$\omega_{min} = (\Phi_{min} / \Phi_{max}) \times \omega_{max}$

Considering that the parameters **PI top lim** and **PI bottom lim** can be seen as multiplier factors of min. and max. of the feed-forward.

Multiplying the feed-forward by **PI top lim** = 1, gives the max. speed reference concerning the minimum diameter.

Multiplying the feed-forward by **PI bottom lim** = 0.14, gives the min. speed reference concerning the max. diameter.

This application operates by using the proportional-integral regulation.

The gains of a single component will be experimentally set with a loaded machine. It is possible to begin the tests with the values below:

Set **PI P gain PID** = 15%

Set **PI I gain PID** = 8%

Set **PD P gain PID** = 5%

In this case, use the derivative component for forcing the regulator output during velocity changes of the system. Programming for example:

PD D gain PID = 20%

PD D filter PID = 20ms

In case it is necessaryto carry out a reference cascade for another drive, program **PID output** on an analog output, for example:

Analog output 1 / Select output 1= PID output

(with **Real FF PID** = 10000 count, **Analog output 1** = 10V).

Parameters regarding the calculation function of the initial diameter

This function is always necessary when one has to control an unwinder or when the starting diameter is unknown.

Set **Positioning spd** at the value in rpm with which the initial positionning of the dancer has to be done. For example:

Positioning spd = 15rpm

The polarity of the reference assigned to **Positioning speed** will be anyway (winder/unwinder) equal to the one functioning as a winder.

If for example one has to control an unwinder and the speed reference in standard functioning is positive, assign to **Positioning spd** a negative value.

Set **Max deviation** at a value slightly lower than the one correspondent to the position of max. mechanical travel allowed by the dancer.

During commissioning, it is always necessary to carry out the self calibration of the analog inputs of the drive. In particular the one regarding analog input 1, with dancer in its position of lower fullrange, This position is automatically assigned to the value 10000. So in order to guarantee a precise calculation it might be assigned:

Max deviation = 8000 (Default value)

Set **Gear box ratio** equal to the reduction ratio between the motor and the winder/unwinder:

Gear box ratio = 0.5

Set **Dancer constant** to the value in mm correspondent to the total accumulation of material in the dancer:

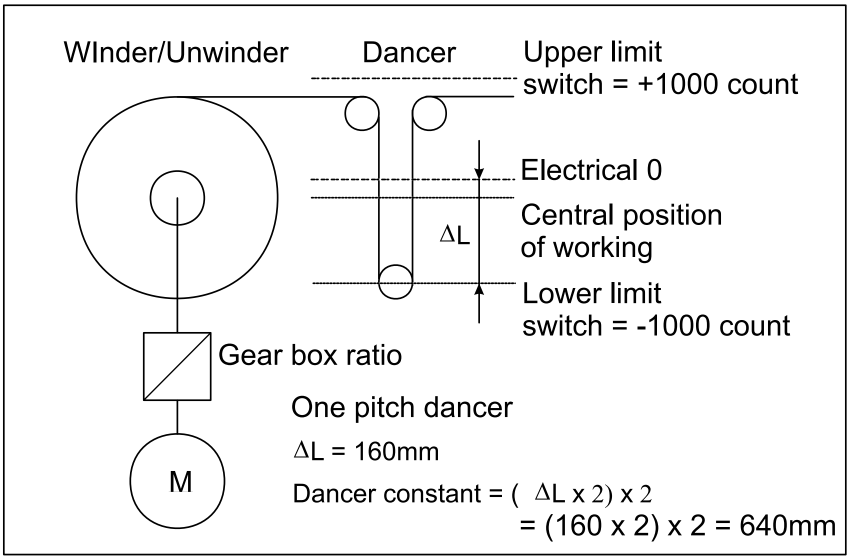


Figure 6.16.3.11: Diameter calculation

Measure of **Dancer constant**:

Set the keypad of the drive on the parameter **PID feed-back**.

Measure and multiply by 2, the distance between the lower mechanical fullrange and the position of the dancer so that in the parameter **PID feed-back** will display 0 (position of 0 electric).

As the dancer has only one pitch, multiply the above calculated value by 2.

In this case set:

Dancer constant = 640mm

Programm **Minimum diameter** equal to the minimum value of the core diameter [cm]:

Minimum diameter = 10cm

Use of the diameter sensor

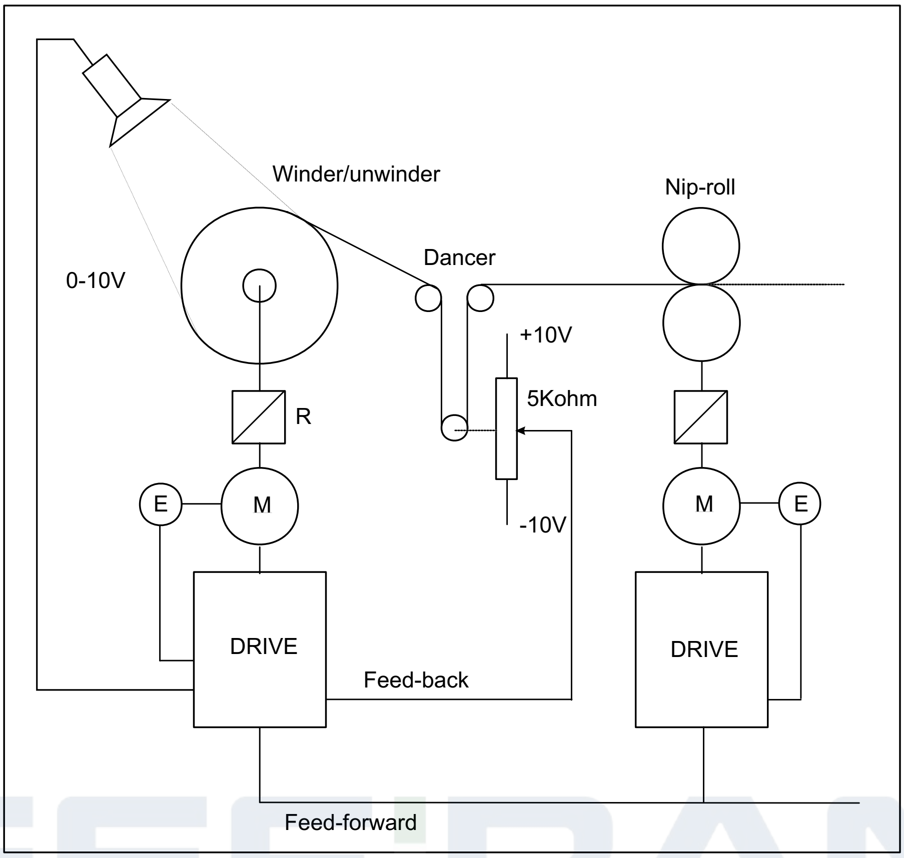


Figure 6.16.3.12: Winder/unwinder control with sensor diameter

The diameter sensor can be used in case of unwinder system with automatic gear.
In these cases, it is necessary to know the value of the starting diameter, in order to calculate the reference of the angular speed of the motor, before the insertion of the new core.
The transducer must set in order to supply a voltage signal proportional to the roll diameter.

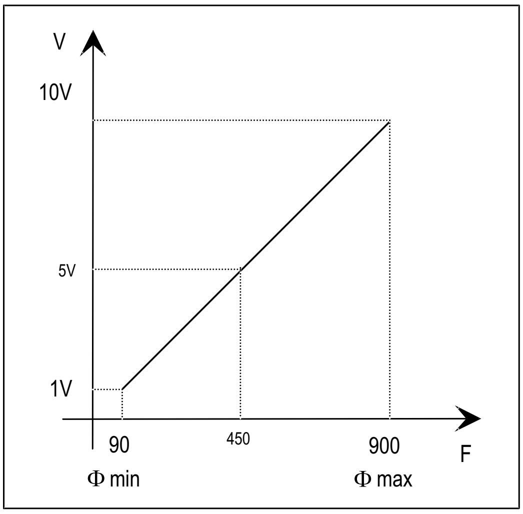


Figure 6.16.3.13: Relation between transducer signal and coil signal

Example:

Φ_{min}	= 90 mm	transducer output = 1V
Φ_{max}	= 900 mm	transducer output = 10V
Φ	= 450 mm	transducer output = 5V

The analog input to which the sensor is connected, must be programmed as **PI central V3**.

The parameter **PI central v sel**, must be set = 3.

When **Enable PI PID** = disable, the value of **PI central V3** is written in **PI output PID** and used as multiplier factor of the feed-forward.

As previously described in the instruction book, the setting of PI output PID depends on the diameters ratio, so the voltage signal proportional to the diameter will be automatically recalculated with the formula:

PI central V3 = (Φ_0 / Φ_1)

Where: Φ_0 = minimum winder diameter

Φ_1 = actual diameter

Setting resolution = 3 digits after the comma (also if in **PI central V3** are displayed only 2 digits after the comma).

NOTE ! During commissioning, it is necessary to verify that the signal coming from the sensor as proportional to the diameter and that its maximum value is corresponding to 10V (carry out the autotune of the analog input).

It is necessary to verify that **PI top lim** and **PI bottom lim** had been programmed

Pressure control for pumps and extruders

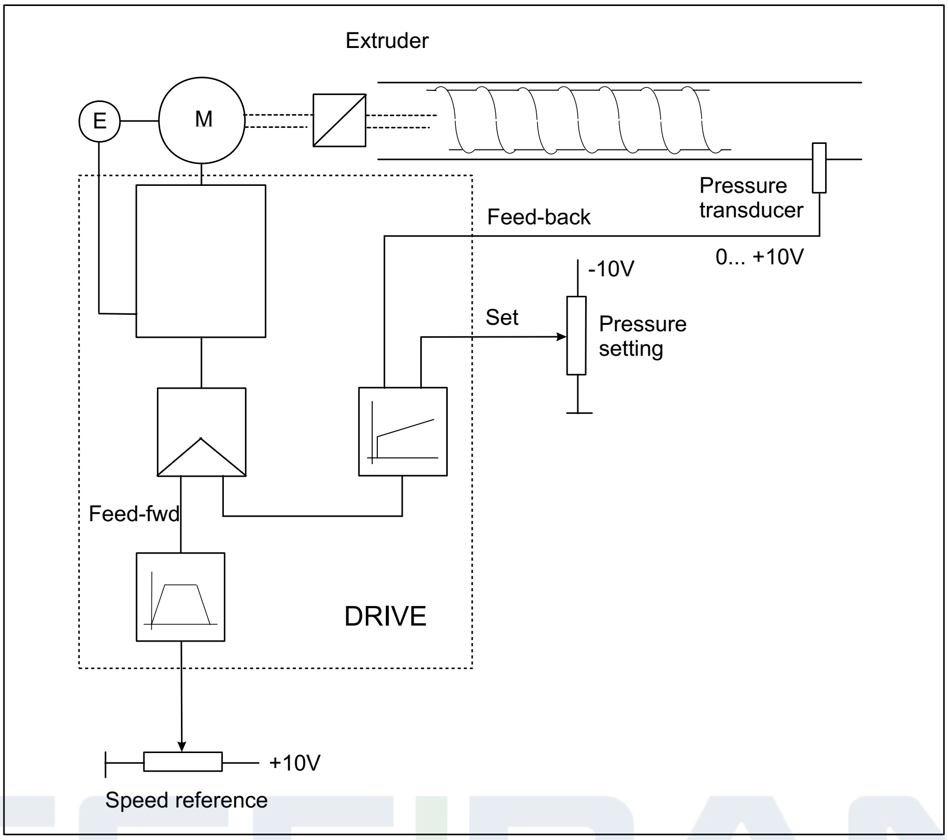


Figure 6.16.3.14: Pressure control for pumps and extruder

Machine Data:

Nominal speed of the extruder motor Vn = 3000rpm

Pressure transducer 0... +10V

The extruder slave drive must be sent analog signals concerning speed reference, the pressure transducer, the setting of potentiometer for pressure (supplied between 0V... -10V) and the digital commands concerning the enabling of the PID control.

The regulator output must be sent to the speed reference 1.

Setting of the drive: (below are only the parameters regarding the PID function)

Input/output

Set **Analog input 1** as input for the pressure transducer.

Analog input 1 / Select input 1= PID Feed-back

Set **Analog input 2** as input for the ramp block. The output of the ramp block must be used as speed reference. (feed- forward).

Analog input 2 / Select input 2 = Ramp ref 1

Set **Analog input 3** as input for the pressure setting (**PID offset 0**).

Analog input 3 / Select input 3 / PID offset 0

Set **Digital input 1** as enabling input for the PI block of the PID

Digital input 1 = Enable PI PID

Set **Digital input 2** as enabling input for the PD block of the PID

Digital input 2 = Enable PD PID

Parameters

Set **Speed base value** equal to the motor nominal speed .

Speed base value = 3000rpm

Set **PID source** as **Ramp output**.

For **PID source** set the parameter number to which it will be associated, choosing it from the list of section 10.2. "*List of high priority parameters*" (**Ramp output** has the decimal number113).

To obtain the correct value it must be added the decimal value 8192 (fixed offset):

PID source = (8192 + 113) = 8305

Set **PID source Gain** so that **Feed-fwd PID,** along with the maximum value of **Ramp output** (corresponding to the maximum value of the analog input 2), reaches 100% of its value = 10000.

The ramp reference and its output automatically acquire their maximum value from the setting of **Speed base value**. Therefore it must be taken into consideration that each writing or reading of any parameter concerning the speed is defined as *RPM* x 4.

So: **PID source Gain** = max **Feed-fwd PID** / (**Speed base value** x 4) = 10000 / (3000 x 4) = 0.833

Set **PID target** as **Speed ref 1**.

Note: When the ramp function is enabled, **Speed ref 1** is not available. In order to make it available it is necessary to set the parameter **Enable ramp** = Disable. (This setting allows the working of the ramp block, but disconnects its output from the speed reference 1).

For **PID target,** set the parameter number to which it will be associated, choosing it from the list of the section 10.2. "*List of high priority parameters*" (**Speed ref 1** has the decimal number 42). To obtain the correct value it must be added the decimal value 8192 (fixed offset):

PID target = 8192 + 42 = 8234

Set **PID out scale** so that the maximum analog value on **Analog input 2** (**Feed-fwd PID** = 10000) and with **Enable PI PID** and **Enable PD PID** = Disable, **Speed ref 1** were equal to 3000rpm.

The **Speed ref 1** must be set as RPM x 4, then:

PID out scale = (3000 x 4) / 10000 = 1.2

Set **PI central v sel** = 1.

Set **PI central v 1** = 1

In absence of correction performed by the PI block of the regulator, the line reference speed (Feed-forward) must be multiplied x 1 and sent directly to the speed regulator of the drive.

In this application, the regulator makes a proportional-integral control.

Set **PI top limit** and **PI bottom limit** in order to obtain maximum correction of the PI block equal to the 100% of the speed reference.

The parameters, **PI top limit** and **PI bottom limit** could be considered as the multiplier factor respectively maximum and minimum of the feed-forward.

PI top limit = 1

PI bottom limit = 0

In this application the regulator uses a proportional-integral type of control.

The gains of the various components must be set with the load on the machine. A reference, it is possible to start the test with the values below (default values):

Set **PI P gain PID** = 10%

Set **PI I gain PID** = 20%

Set **PD P gain PID** = 10%

If necessary, use the derivative component for forcing the regulator output during velocity changes of the system, setting for example:

PD D gain PID = 5%

PD D filter PID = 20ms

If not necessary, keep these parameters = 0.

6.16.3.11 Generic PID

Drive settings: (here below are reported only the ones concering the PID function)

Input/output

Set **Analog input 1** as input of the variable which has to be regulated (Feed-back).
Analog input 1 / Select input 1= PID Feed-back

Set **Analog input 2** as input of the offset signal (**PID offset 0**).
Analog input 2 / Select input 2 / PID offset 0

Set **Digital input 1** as input for the enabling of the PI block of the PID
Digital input 1 = Enable PI PID

Set **Digital input 2** as input for the enabling of the PD block of the PID
Digital input 2 = Enable PD PID

Parameters

In case it necessary to use the regulator as "Generic PID", independent from the feed-forward function, the parameter **Feed-fwd PID** must be set at its maximum value. In order to do this it is necessary to go through a PAD parameter.

Set **PID source** come **PAD 0**.
On **PID source** it must be set the parameter number which has to be associated, choosing it from the list of the section 10.2. "*List of high priority parameters*" (**PAD 0** has the decimal number 503).
To obtain the value, it must be added to the decimal value 8192 (fixed offset):
PID source = (8192 + 503) = 8695

Set **PAD 0** = 10000
(The parameter **PAD 0** is situated in the menu' "Special Function").

Note: Setting PAD 0 = -10000, the output regulator polarity will be overturned.

Set **PID source Gain** = 1

Set **PID target** with the parameter number that has to be addressed to the output regulator.
To obtain the value it must be added the decimal value 8192.
The parameters that can be addressed are the ones described in the list of the section 10.2. "*List of high priority parameters*".

Set **PID out scale** according to the parameter to which the regulator output has been addressed.
From the section 10.2. "*List of high priority parameters*" comes out that:

The parameters concerning the speed are expressed as [*SPD*].

For all the drive sizes, the rated current will be 2000 [CURR], so:
PID out scale = 2000/ max. output PID = 2000/ 10000 = 0.2

NOTE: In case it would be necessary to use the drive with a provisory current higher than the rated current of the drive, it is possible to increase the above described value of PID out scale. For example, if one wants to obtain 1.5 times the size, one has to set:

PID out scale = 0.2 x 1.5 = 0.3

In this case it is necessary to enable the function of overload control "**Overload contr**" setting correctly the values **Overload current**, **Overload time**, **Base current** and **Pause Time**.

The firmware of the drive does not perform a control on the polarity of the value sent, for this reason, if it is not necessary to address the regulator output on parameters "Unsigned", then set the PID output so that it can be positive.

PID out. sign PID = Only positive

The parameters "Unsigned", for example the current limits **T current lim +** and **T current lim -**, are indicated in the "*List of high priority parameters* " with the symbol "U16".

Set **PI central v sel** = 1.

Set **PI central v 1** = 0

In this configuration, when executing the transition Off / On of the parameters for the enabling of the PID function, the regulator output starts from 0.

If it is necessary to retain the last value calculated also when the machine is disabled, it necessary to use a digital input programmed as:

Digital input xx = PI central v S0

PI central v 1 = 0

When the digital input is at a low logic level (L), the last value calculated is stored. Applying a high logic level (H) will reset the value.

Set **PI top lim** and **PI bottom lim** in order to obtain a correction of the PID block equal to 100% of its maximum value.

PI top lim = 1

PI bottom lim = -1

In this configuration the PID block output will be either positive and negative.

Setting **PI top lim** = 0, the positive part is blocked.

Setting **PI bottom lim** = 0, the negative part is blocked.

The gains of the various components must be set experimentally with the machine loaded.

It is possible to start the test with the following values:

Set **PI P gain PID** = 10%

Set **PI I gain PID** = 4%

Set **PD P gain PID** = 10%

Use the derivative component as damping component of the system, setting for example:

PD D gain PID = 5%

PD D filter PID = 20ms

If not necessary maintain these parameters = 0.

6.16.3.12 Application note

Dynamic modification of the integral gain of the PI block

In standard dancer applications, where there is not a build up of material, the PI gains are set to a constant value. Where dancers are used in conjuction with material winding, the gains are compromise between low gain setting at large diameter, and high gain settings at a small diameter. Using the drawing as an example, it can be seen that with a large diameter roll, the amount of material to move the dancer requires only a fraction of a turn. At a small diameter, or empty roll, the center of the roll must rotate a whole turn to move the same amount of material. Since the PI regulator is used to provide the correction in rpm to maintain the dancer position, having the gain set by a single value is inadequate when used with a winder.

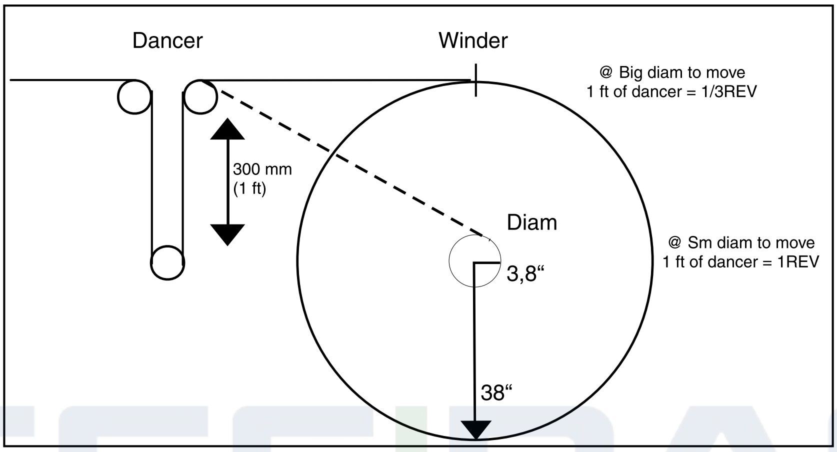


Figure 6.16.3.15: Example with small and large diameter

Better dancer control is realized if the gain of the PI is modified dynamically based on diameter. This can be accomplished using LINKS function.

In case of higher ratio diameters, **PI I gain PID** could be dynamically changed according to the actual diameter. At the moment this functionality has not been implemented as specific function.

For example to control a winder having a diameters ratio of 1/10.

The function LINK 1 is used to get a connection between the diameter and the value of the integral component of the PI block.

The integral component of the regulator must have a behaviour inversely proportional to the diameter.

The value of the parameter **PI output PID** already follows this behaviour. Infact, it changes according to the relation Φ_0 / Φ_{act}.

Where: Φ_0 = minimum roll diameter
Φ_{act} = actual roll diameter

The operation to carry out through the LINK parameter is:

PI output PID x KI = **PI I gain PID**

Where KI corresponds to the value of the integral component on minimum diameter condition.

For example, if at min diameter, the maximum speed with steady dancer in electric zero position with **PI I gain PID** = 40%.

The LINK source must be associated to **PI output PID** [n⁰ 771]:

Source link 1 = 8192 + 771 = 8963

The LINK destination must be associated to the value of the integral component= parameter **PI I gain PID** [n⁰ 764]:

Destination *link 1* = 8192 + 764 = 8956

The multiplier factor must be set to the value defined by the functioning tests above mentioned.

Mul gain *link 1* = 40

It will be necessary to set:

Div gain *link 1* = 1000 *
Input max *link 1* = 1000 *
Input min *link 1* = 100 **
Input offset *link 1* = 0
Output offset *link 1* = 0
Input absolute *link 1* = OFF

* The value 1000 is defined by **PI top lim** which will be in this case = 1 (correspondent to a maximum value of **PI output PID** = 1000).

** The value 100 is defined by **PI bottom lim** which will be in this case = 0.1 (correspondent to a minimum value of **PI output PID** = 100).

With this configuration at minimum diameter it will correspond an integral gain = 40% and at maximum diameter it will correspond to an integral gain = 4%, between the two setpoints the gain will change with an hyperbolic characteristic.

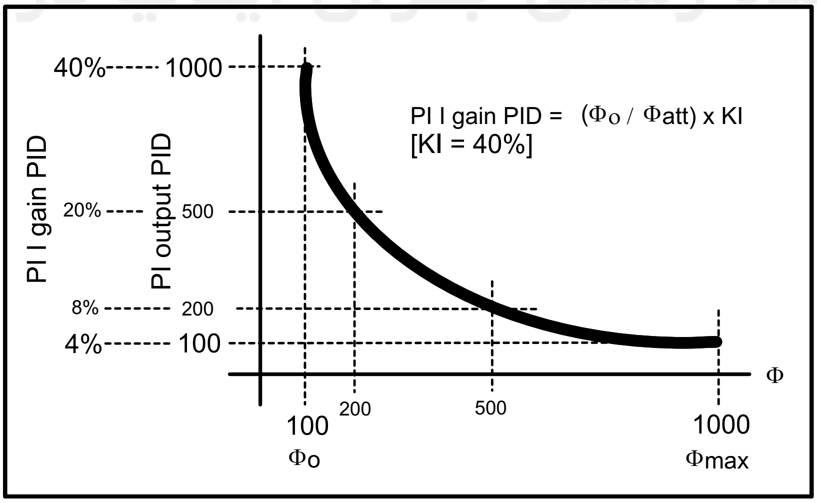


Figure 6.16.3.16: Relation between PI I gain PID and PI I output PID

The value of **PI I gain PID** will be displayed in the relative parameter of the submenu **PI controls**.

If necessary, using the LINK 2, it is possible to modify, dynamically, the proportional gain **P gain PID**.

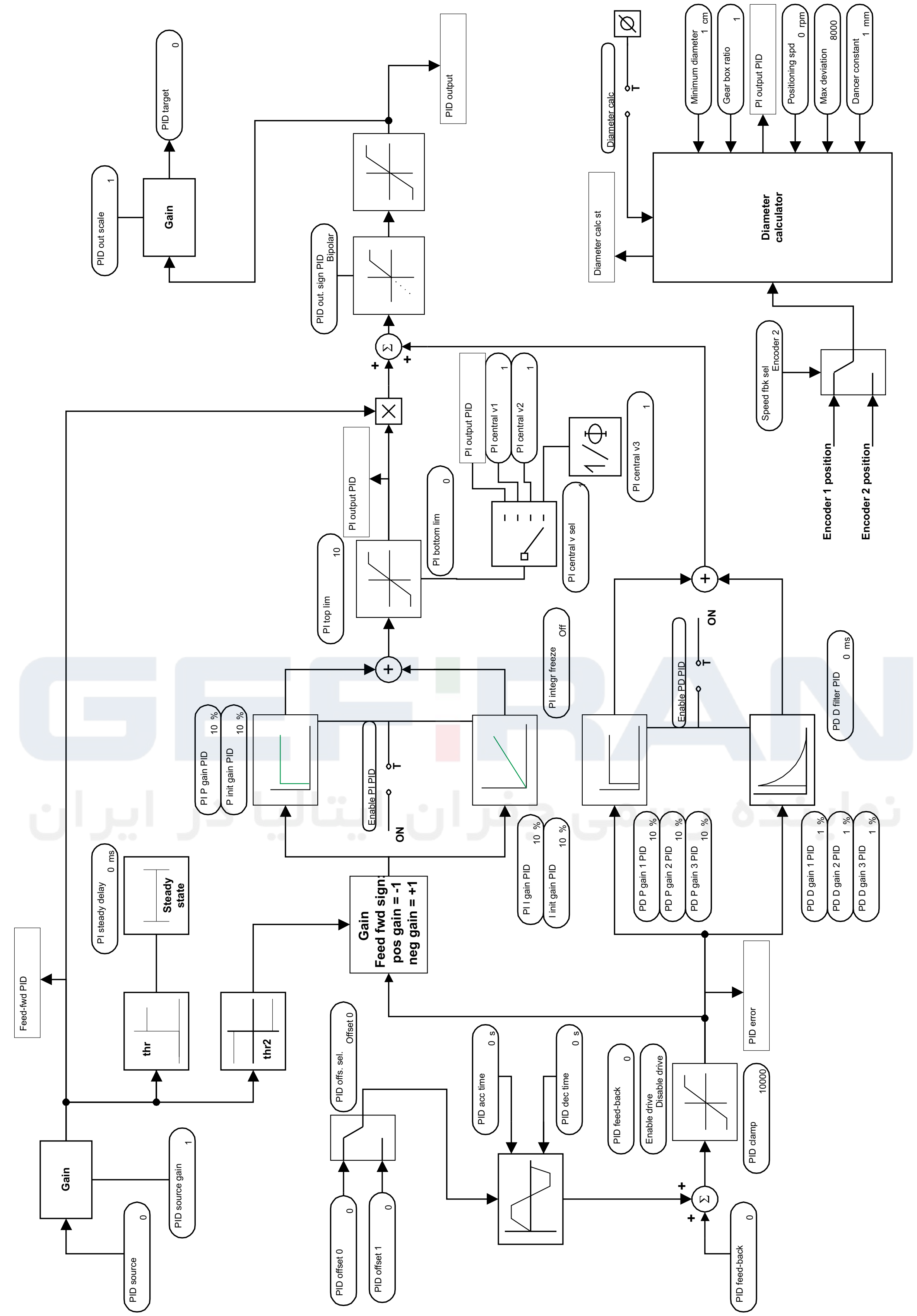


Figure 6.16.3.17: General description of the PID blocks

6.17 TORQUE WINDER FUNCTION

The center wind function inside the TPD32-EV converters is used to control winders and unwinders whose tension regulation is carried out via an open or closed loop control.

Apart from calculation functions for torque, diameter, compensation and Taper tension, the system foresees the calculation of the motor speed reference. Such function allows to use the drive on the four regulation quadrants controlling both winders and unwinders, and to control the motor with a peripheral speed proportional to the diameter in case of a break of the wound material.

The torque is adjusted according to the motor flux, thus meaning that the system is suitable to control motors with a constant torque-power ratio.

The closed loop regulation foresees an analog input for the loading cell 0…10V, 0…20mA, 4…20mA.

The output of the center wind function is sent directly to the current limits; the specific parameters T current lim +/- and the limits set by the programmable overload function are anyway active in order to protect both the inverter and the motor; among the three possible settings the one with the lowest value is always the most important.

Input / Output

Line spd source Line speed sampling parameter. It is used exclusively for the diameter calculation. The speed threshold, **Ref speed thr**, under which the calculation procedure is blocked, refers to **Ref line speed**. It can be programmed as analog input or encoder input.

Ref spd source Line reference sampling parameter. It is used exclusively for the calculation of:

- the inertia compensations
- the line speed reference.

It can be programmed as analog input or encoder input.

Analog inputs

Tension ref Per cent tension reference; 10V (20mA) = 100%.

Tension red Per cent decrease in the Taper tension; 10V (20mA) = 100%.

Diam preset 3 Setting of the starting diameter; 10V (20mA) = max. diameter.

Analog outputs

Roll diameter Present diameter; 10V = max. diameter.

Act tension ref Tension reference decreased by the Taper percentage; 10V = 100% Tension ref.

Torque current Request for torque current; 5V = drive size.

W reference Reference for angular speed, 10V = 100% Base omega.

Actual comp Active compensation monitor (it sums up static, dynamic and inertial frictions); 5V = drive size.

Digital inputs

Torque winder En Enabling of the center wind function.

Diam calc Dis Enabling of the diameter calculation.

Diam inc/dec En If enabled and if winder, the calculated diameter can never decrease; if unwinder the calculated diameter can never increase. It is used to improve the system stability.

Wind/unwind Winder/unwinder selection: 0 = winder, 1 = unwinder.

Winder side Selection of the winding/unwinding side: 0 = up, 1 = down

Diam preset sel 0 LSD digital input; preselection of the starting diameter.

Diam preset sel 1 MSD digital input; preselection of the starting diameter.

Diam reset Reset of the calculated diameter.

Taper Enable Enabling of the Taper function.

Speed match Coil “launching” phase command for automatic switching.

Line acc status Active acceleration.

Line dec status Active deceleration.

Line fstp status Fast deceleration.

The last three parameters are inputs sending to the drive the status of the line speed: they are used when the internal calculation procedure for the line acceleration is disabled.

Speed demand En Enabling of the speed reference calculation.

Closed loop En Enabling of the closed loop control.

Digital outputs

Diameter reached Indication: the diameter threshold has been overcome.

Spd match compl Indication: the “launching” speed has been reached.

6.17.1 Diameter calculation

OPTIONS

Torque winder

Diam Calculatio

[1154]	Roll diameter [m]
[1160]	Line speed [%]
[1286]	Ref line speed [%]
[1161]	Diam calc Dis
[1205]	Diam inc/dec En
[1187]	Wind/unwind
[799]	Minimum diameter [mm]
[1153]	Maximum diameter [m]
[1204]	Line spd source
[1284]	Ref spd source
[1156]	Line speed gain
[1285]	Ref speed gain
[1163]	Base omega [rpm]
[1155]	Ref speed thr [%]
[1162]	Diam filter [ms]
[1206]	Diam init filter [ms]
[1207]	Diam stdy delay [ms]
[1157]	Diam reset
[1158]	Diam thr [%]
[1159]	Diam reached
[1168]	Diam preset sel
[1164]	Diam preset 0 [m]
[1165]	Diam preset 1 [m]
[1166]	Diam preset 2 [m]
[1167]	Diam preset 3 [m]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Roll diameter [m]	1154	0.000	32.000			****
Line speed [%]	1160	0.00	200.00			
Ref line speed [%]	1286	0.00	200.00			
Diam calc Dis ON (1) / OFF (0)	1161	0	1	ON (1)	ON (1)	*
Diam inc/dec En Enabled (1) / Disabled (0)	1205	0	1	Enabled (0)	Enabled (0)	*
Wind/unwind Unwinder (1) / Winder (0)	1187	0	1	Winder (0)	Winder (0)	*
Minimum diameter [mm]	799	1	2000	100	100	
Maximum diameter [m]	1153	0.000	32.000	1.000	1.000	
Line spd source	1204	0	65535	0	0	
Ref spd source	1284	0	65535	0	0	
Line speed gain	1156	0	32767	0	0	
Ref speed gain	1285	0	32767	0	0	
Base omega [rpm]	1163	0	8191	1500	1500	
Ref speed thr [%]	1155	0	150.00	5	5	
Diam filter [ms]	1162	0	5000	100	100	
Diam init filter [ms]	1206	0	5000	100	100	
Diam stdy delay [ms]	1207	0	60000	0	0	
Diam reset	1157	0	1	0	0	*
Diam thr [%]	1158	0	150.00	10	10	
Diam reached	1159	0	1			**
Diam preset sel	1168	0	3	0	0	*
Diam preset 0 [m]	1164	0.000	32.000	0	0	
Diam preset 1 [m]	1165	0.000	32.000	0	0	
Diam preset 2 [m]	1166	0.000	32.000	0	0	
Diam preset 3 [m]	1167	0.000	32.000	0	0	***

* This parameter can be set on a programmable digital input.
** This parameter can be set on a programmable digital output.
*** This parameter can be set on a programmable analog input.
**** This parameter can be set on a programmable analog output.

The inputs received by the diameter calculator are the angular speed of the controlled motor and the line speed. The latter can be measured through an analog input or an encoder.

The value of the calculated diameter can be sent to an analog output; via a digital output it is also possible to state the overcoming of a programmable threshold.

It is possible to select four values of the starting diameters; one value can derive from an analog input.

Roll diameter Monitor of the calculated diameter in [m].

Line speed Monitor of the line speed in [%].

Ref line speed Reference monitor for the line speed in [%].

Diam calc Dis Disabling of the diameter calculation (see also par. **Ref speed thr**). In case such function is temporarily disabled during the functioning period, the system stores the last calculated value.

Diam inc/dec En If enabled and if winder, the calculated diameter can never decrease; if unwinder the calculated diameter can never increase. It is used to improve the system stability.

Wind/unwind Winder/unwinder selection. If the selection is carried out via a digital input: 0V = winder, +24V = unwinder.

Minimum diameter Value of the minimum diameter in [mm].

Maximum diameter Value of the maximum diameter in [m].

Line spd source Number of the sampling parameter for the line speed. In order to obtain the real number to be set, it is necessary to add +2000H (8192 decimal) to the parameter number.

Programming example for the encoder 1 (connector XE1) on **Line speed source**:

OPTION Menu
————> Torque winder
————> Diam calculation
————> Line speed source = 8619

Paragraph 10.2. *"List of the high priority parameters"* shows that **Enc 1 speed** has the decimal number 427. In order to obtain the value to be entered it is necessary to add 8192 decimal (fixed offset): 8192 + 427 = 8619

Programming example for the analog input 2 on **Line speed source**:

a) input programming on a PAD parameter

I/O CONFIG Menu
————> Analog input
————> Analog input 2
————> Select input 2 = PAD 0

b) setting of **PAD 0** as a line speed input:

OPTION Menu
————> Torque winder
————> Diam calculation
————> Line speed source = 8695

Paragraph 10.2. *"List of the high priority parameters"* shows that **PAD 0** has the decimal number 503. In order to obtain the value to be entered it is necessary to add 8192 decimal (fixed offset): 8192 + 503 = 8695

Line speed gain Calibration value for the line speed.

Its setting depends on the sampling parameter of the line speed; it is used to obtain "Line speed" = 100% at its maximum value

The calculation of **Line speed gain** must be carried out with the formula:

[32768 x 16384 / (maximum value of the sampling parameter x 8)] -1

Programming example for the encoder 1 (connector XE1) on **Line speed source**:

If the encoder has an unknown rotation speed, the input value of the encoder 1 can be read in the

MONITOR Menu
————> Measurements
————> Speed
————> Speed in rpm
————> **Enc 1 speed**

Remember that the drive internally converts the speed in *RPM x 4*, therefore assuming to have maximum **Enc 1 speed** = 1500rpm:

Line speed gain = [32768 x 16384 / (1500 x 4 x 8) – 1] = 11184

Programming example for the analog input 2 on **Line speed source**:

When an analog input is set on a PAD parameter, its maximum value is + / - 2048, therefore in order to have **Line speed** = 100%:

Line speed gain = [32768 x 16384 / (2048 x 8) – 1] = 32767

(In order to obtain a fine tuning it is necessary to carry out the self tuning procedure of the analog input).

Ref spd source

Ref speed gain Their functions are similar to **Line speed source** and **Line speed gain**. They can set the signal used for the calculation of the inertia compensations and of the speed reference. With the exception of particular conditions, for example a difference between the line speed and the speed reference due to the presence of a loop on the material, such values are set on the same source with the same gains.

Base omega Value in [rpm] corresponding to the maximum angular speed of the winder/unwinder (motor shaft side).

Line speed thr Line speed detecting threshold in %.

When "Ref line speed" is lower than "Ref speed thr" the diameter calculation is stopped. The diameter is kept at a constant value. When "Ref line speed" overcomes the threshold, the diameter calculation is enabled with an initial filter corresponding to **Diam init filter** for the time set in **Diam stdy delay.** At the end of this time the filter will be set to **Diam filter**.

Diam filter Filter on the diameter calculation in [ms].

Diam init filter Initial filter on the diameter calculation in [ms].

Diam stdy delay Time in [ms] during which the value of **Diam init filter** is kept active after **Line speed thr** has been overcome.

Diam reset Diameter reset. When this parameter is enabled, the diameter gets a starting value selected with **Diam preset sel**.

Diam thr Programmable diameter threshold as a percentage of **Maximum diameter**. The threshold overcoming is detected by **Diam reached** and it can be sent to a digital output.

Diam reached Indication for the overcoming of the diameter threshold.

Diam preset sel Selector of the starting diameter [0…3]. **Diam preset sel** can be set directly via the keypad or serial line or via two digital inputs programmed as **Diam preset sel 0** and **Diam preset sel 1**, the selection in this case is carried out with a binary logic.

Diam preset 0 0 starting diameter in [m]. The setting of this value must be included between **Minimum diameter** and **Maximum diameter**.

Diam preset 1 1 starting diameter in [m]. The setting of this value must be included between **Minimum diameter** and **Maximum diameter**.

Diam preset 2 2 starting diameter in [m]. The setting of this value must be included between **Minimum diameter** and **Maximum diameter**.

Diam preset 3 3 starting diameter in [m]. The setting of this value must be included between **Minimum diameter** and **Maximum diameter**.

It can be assigned to an analog input, in this case 10V correspond to **Maximum diameter** and the voltage referring to the minimum diameter is = 10 x (**Minimum diameter / Maximum diameter**).

6.17.2 Torque calculation

The torque calculator is made of three blocks:

1. Torque calculation according to the winder/unwinder ray and to the set tension: C = T x r
2. Calculation of the static, dynamic and inertial compensations
3. If the Taper function is enabled, the calculation of the tension curve is made according to the ray.

The tension and Taper reduction references can be sent via an analog input, serial line or field bus. The calculation of the angular acceleration, necessary to the inertial compensations, can be carried out through asuitable internal function or by stating via three digital inputs the acceleration, deceleration and fast deceleration conditions.

The connection to the PID function belongs to the compensation block. Such connection is necessary when a closed loop tension control with loading cell is carried out.

The calculation result is sent directly to the drive current limits and can be monitored in the parameters **In use Tcur lim +** and **In use Tcur lim –** of the LIMITS menu.

The standard parameters **T current lim +/-** and the limits set by the programmable overload function are anyway active in order to protect both the inverter and the motor; the setting with the lowest value is always the most important. It is also possible to set a specific current limit for the coil “launching” function during an automatic switching. The outcoming tension value and that of the calculated torque current can be monitored on the analog outputs.

OPTIONS
Torque winder
Torque calculat

[1180]	Tension ref [%]
[1181]	Tension scale [%]
[1194]	Act tension ref [%]
[1193]	Torque current [%]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Tension ref [%]	1180	0.00	199.99	0	0	*
Tension scale [%]	1181	0	200	100	100	
Act tension ref [%]	1194	0.00	199.99			
Torque current [%]	1193	0.00	200.00			**

* This parameter can be set on a programmable analog input.
** This parameter can be set on a programmable analog output.

Tension ref Per cent tension reference.

Tension scale Scale factor of the torque current in %.

This parameter is used when the value of the maximum winding torque has to be limited or when a closed loop control is used in order to adjust the torque current value to the real tension on the material measured by the loading cell.

As for tuning refer to paragraph *Application example.*

Act tension ref Monitor of the % tension reference less the Taper percentage set via **Tension red**; if the Taper function is not enabled, it corresponds to **Tension ref**.

Torque current Monitor for the requirement of the torque current in %.

6.17.2.1 Compensations and closing of the tension loop

OPTIONS → **Torque winder** → **Torque calculat** → **Comp calculat**

[1183]	Int acc calc En
[1182]	Time acc/dec min [s]
[1212]	Acc/dec filter [ms]
[1184]	Line acc [%]
[1185]	Line dec [%]
[1186]	Line fast stop [%]
[1188]	Line acc status
[1189]	Line dec status
[1190]	Line fstp status
[1171]	Variable J comp [%]
[1172]	Constant J comp [%]
[1192]	Act var J comp [%]
[1191]	Act const J comp [%]
[1173]	Mat width [%]
[1174]	Static f [%]
[1175]	Dinamic f [%]
[1287]	Static f Zero
[1213]	Actual comp [%]
[1214]	Closed loop En
[1208]	Close loop comp

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Int acc calc En Enabled (1) / Disabled (0)	1183	0	1	Enabled (1)	Enabled (1)	*
Time acc/dec min [s]	1182	0.15	300.00	9.01	9.01	
Acc/dec filter [ms]	1212	0	5000	30	30	
Line acc [%]	1184	0.00	100.00	100	100	
Line dec [%]	1185	0.00	100.00	100	100	
Line fast stop [%]	1186	0.00	100.00	100	100	
Line acc status	1188	0	1	OFF	OFF	*
Line dec status	1189	0	1	OFF	OFF	*
Line fstp status	1190	0	1	OFF	OFF	*
Variable J comp [%]	1171	0.00	199.99	0	0	
Constant J comp [%]	1172	-100.00	+100.00	0	0	
Act var J comp [%]	1192	-	200.00	0	0	
Act const J comp [%]	1191	-	200.00	0	0	
Mat width [%]	1173	0.00	100.00	100	100	
Static f [%]	1174	0.00	199.99	0	0	
Dinamic f [%]	1175	0.00	199.99	0	0	
Static f Zero Enabled (1) / Disabled (0)	1287	0	1	Disabled (0)	Disabled (0)	
Actual comp [%]	1213	-200	+200			**
Closed loop En Enabled (1) / Disabled (0)	1214	0	1	Disabled (0)	Disabled (0)	
Close loop comp	1208	-32767	+32767			

* This parameter can be set on a programmable digital input.
** This parameter can be set on a programmable digital output.

Int acc calc En Enabling of the calculation of the coil acceleration.

If enabled this function carries out the calculation of the angular acceleration inside the drive. In this case it is necessary to set just the value of **Time acc/dec min**. If disabled, it is necessary to set the parameters **Line acc %, Line dec % , Fast stop %** and **Time acc/dec min** and to supply the corresponding status indication to the digital inputs.

Time acc/dec min Time in [s] corresponding to the lower acceleration, deceleration and fast deceleration time.

Acc/dec filter Filter in [ms] on the calculation of the acceleration inside the drive.

Line acc % Acceleration time as a percentage of **Time acc/dec min**.

Ex: Acceleration = line deceleration = 10s
Fast deceleration (fast stop) = 5s
Time acc/dec min = 5s
Line acc % = (5 / 10) x 100 = 50%

Line dec % Deceleration time as a percentage of **Time Acc/dec min**.

Ex: Acceleration = line deceleration = 10s
Fast deceleration (fast stop) = 5s
Time acc/dec min = 5s
Line dec % = (5 / 10) x 100 = 50%

Line fast stop % Fast deceleration time as a percentage of **Time Acc/dec min**.

Ex: Acceleration = line deceleration = 10s
Fast deceleration (fast stop) = 5s
Time acc/dec min = 5s
Line fast stop % = (5 / 5) x 100 = 100%

Line acc status Acceleration stating input.

Line dec status Deceleration stating input.

These two indications are combined with the drive digital outputs **Acc state** and **Dec state** (see fig. 6.17.1).

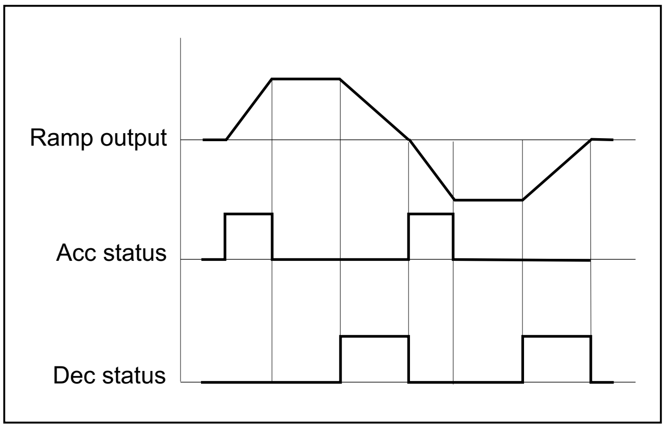


Figure 6.17.1: Acceleration and deceleration indication

Line fstp status Indication of a fast deceleration.

Variable J comp Torque compensation due to the wound material as a percentage of the drive rated current. As for tuning see the paragraph *Application example.*

Constant J comp Compensation of the fixed section (motor, reducer,pin) as a percentage of the drive rated current. As for tuning see the paragraph *Application example.*

Act var J comp Monitor for the active compensation of the variable section as a percentage of the drive rated current.

Act const J comp Monitor for the active compensation of the fixed section as a percentage of the drive rated current.

Mat width Width of the wound material as a percentage of the maximum width.

Static f Compensation of the static frictions as a percentage of the drive rated current. As for tuning see the paragraph *Application example.*

Dinamic f Compensation of the dynamic frictions as a percentage of the drive rated current. As for tuning see the paragraph *Application examples.*

Static f Zero By setting the parameter on “Enabled”, the friction compensation is completely inserted for all speed values. When it set as “Disabled”, the static friction compensation is completely inserted with Ref line speed = 1.5%.

Act comp Monitor for the active compensations (it sums up the static, dynamic and inertial frictions) as a percentage of the drive rated current.

Closed loop En Enabling of the tension loop closing (to be used with a loading cell).

Closed loop comp Monitor for the active compensation, output of the PID regulator used for the loop closing.

6.17.2.2 Taper function

OPTIONS → **Torque winder** → **Torque calculat** → **Taper function**

[1176]	Taper enable
[1177]	Init diameter [m]
[1178]	Final diameter [m]
[1180]	Tension ref [%]
[1179]	Tension red [%]
[1194]	Act tension ref [%]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Taper enable Enabled (1) / Disabled (0)	1176	0	1	Disabled (0)	Disabled (0)	*
Init diameter [m]	1177	0.000	32.000	0.1	0.1	
Final diameter [m]	1178	0.000	32.000	1	1	
Tension ref [%]	1180	0.00	199.99	0	0	**
Tension red [%]	1179	0.00	199.99	0	0	**
Act tension ref [%]	1194	0.00	200.00	0	0	***

* This parameter can be set on a programmable digital input.
** This parameter can be set on a programmable analog input.
*** This parameter can be set on a programmable analog output.

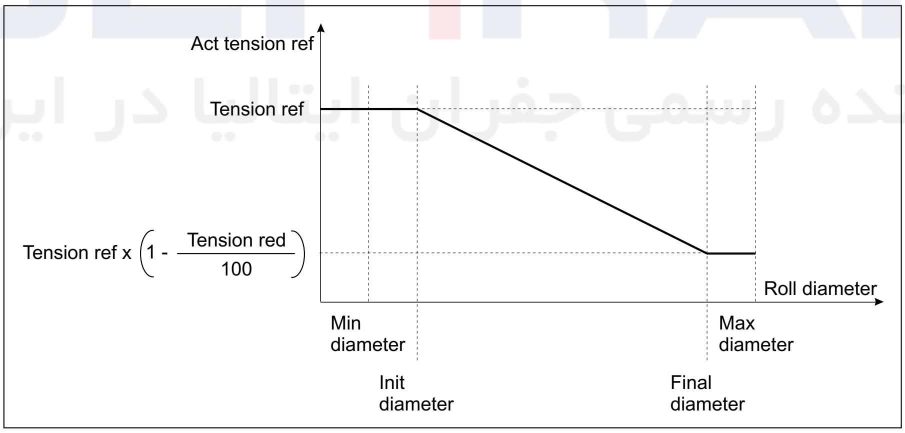


Figure 6.17.2: Relation among the Taper function parameters

Taper enable Enabling of Taper function.

Init diameter Diameter for the starting of the taper tension reduction in meters.

Final diameter Diameter for the ending of the taper tension reduction in meters.

Tension ref Tension reference in %.

Tension red Taper tension reduction as a percentage of **Tension ref**.

Act tension ref Monitor for the active tension reference as a percentage of **Tension ref.**

6.17.3 Calculation of the speed reference

OPTIONS
Torque winder
Speed demand

[1215]	Speed demand En
[1201]	Winder side
[1202]	W gain [%]
[1195]	Speed match
[1200]	Spd match gain [%]
[1196]	Spd match acc [s]
[1197]	Spd match dec [s]
[1203]	Spd match compl
[1216]	Spd match torque [%]
[1199]	W offset [rpm]
[1198]	Offset acc time [s]
[1210]	W target
[1217]	W reference [rpm]
[1256]	Jog TW enable
[1255]	Jog TW speed [%]

The calculation and control of the reference for the motor angular speed allow to use the drive on the four regulation quadrants both with a winder and unwinder control and to control the motor with a peripheral speed proportional to the diameter in case the wound material breaks down.

Such program block contains also the control of the coil "launching" reference during the initial and automatic switching phases with a stopped line.

The calculator output can be addressed to one of the four possible speed references of the drive or on an analog output.

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Speed demand En Enabled (1) / Disabled (0)	1215	0	1	Disabled (0)	Disabled (0)	
Winder side Down (1) / Up (0)	1201	0	1	Up (0)	Up (0)	
W gain [%]	1202	0	100	0	0	
Speed match ON (1) / OFF (0)	1195	0	1	OFF (0)	OFF (0)	
Spd match gain [%]	1200	0	150	100	100	
Spd match acc [s]	1196	0.30	300.00	83.88	83.88	
Spd match dec [s]	1197	0.30	300.00	83.88	83.88	
Spd match compl	1203	0	1			
Spd match torque [%]	1216	0	200	100	100	
W offset [rpm]	1199	0	1000	0	0	
Offset acc time [s]	1198	0.30	950.00	83.88	83.88	
W target	1210	0	65535	0	0	
W reference [rpm]	1217	-8192	+8192			
Jog TW enable Enabled (1) / Disabled (0)	1256	0	1	Disabled (0)	Disabled (0)	
Jog TW speed [%]	1255	0	100	0	0	

* This parameter can be set on a programmable digital input.
** This parameter can be set on a programmable digital output.
*** This parameter can be set on a programmable analog output.

Speed demand En Speed reference calculation enabled.

Winder side Selection of the winding/unwinding side: 0 = up, 1 = down

W gain Setting of the speed reference gain used to saturate the loop. Parameter as a percentage of the increasing/decreasing value of the angular speed reference.

Speed match Command of the coil "launching" phase for an automatic switching.

Spd match gain Setting of the speed reference gain during the launching phase, 100% corresponds to a peripheral speed equal to the line speed.

Spd match acc Motor acceleration time during the launching phase, in [s].

Spd match dec Motor deceleration time in [s] if during the launching phase a stop command is given.

Spd match compl Indication of a completed launching ramp, if it is programmed on a digital output it can be used to state that the coil can be changed.

Spd match torque Setting of the torque current during the launching and change phase. The parameter is given as a percentage of the drive rated current.

W offset Offset setting on the speed reference for the initial phase of the winder/unwinder when the line is stopped. The parameter is given in [rpm].

Offset acc time Setting of the ramp for the initial phase when the machine is stopped. The parameter is given in [s]. It refers to **Speed base value**.

W target Parameter number where the speed reference has to be addressed to. In order to obtain the real number to be set, it is necessary to add +2000H (8192 decimal) to the parameter number.

1. Addressing example on the speed reference 2:

OPTION Menu
————> Torque winder
————> Speed demand
————> W target = 8235

Paragraph 10.2. *"List of the high priority parameters'* shows that **Speed ref 2** has the decimal number 43. In order to obtain the value to be entered, it is necessary to add 8192 decimal (fixed offset): 8192 + 427 = 8235

W reference Monitor for the speed reference.

Jog TW enable Jog function enabled.

Jog TW speed Reference setting for Jog function. The parameter is given as a % of **Line speed.**

Control of the speed reference

In order to calculate the speed reference during the different functioning phases of the machine, a status logic has been developed. The status sequence and the operativeness is described in the figure 6.17.3.

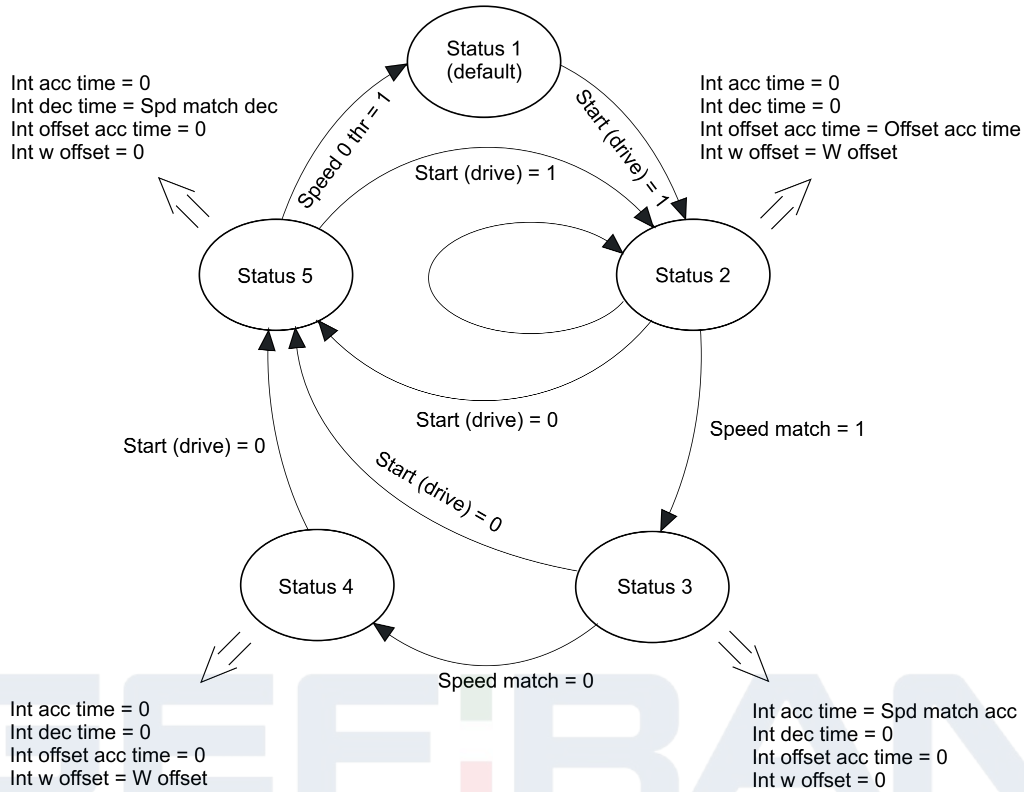


Figure 6.17.3: Operative sequence of the functioning status

Status 1:

Default status, this system condition is given when the drive is in a Stop condition. The speed reference is zero.

Status 2:

The system reaches this status when the Start command is given.
When the line is stopped, the initial phase reference **W offset** is assigned with the ramp time **Offset acc time**.
When the line is started, the motor speed reference follows its profile with a value corresponding to:
W reference = ± Line speed x (Minimum diameter ÷ Roll diameter) ± (W gain % + W offset)
the sign of:
± Line speed x (Minumum diameter ÷ Roll diameter)
is positive if **Wind/unwind** = winder
is negative if **Wind/unwind** = unwinder
the sign of:
± (W gain % + W offset)
is usually positive, it could be changed only if during the acceleration or deceleration phases a torque inversion is required.
The polarity of **W reference** will be further inverted if **Winder side** = 1 (winding/unwinding down).
If during a Status 1functioning period the system receives a Stop command (Start drive = 0), the Status 5 is forced.

Status 3:

The system reaches this status if the command **Speed match** = 1 and the Start command are given.

Starting from a Stop condition, if these commands are given, the motor speed reference is set with: ***W reference = [± Line speed x (Min dia ÷ Roll dia) ± (W gain % * W offset)] x Spd match gain***

where **W offset** is forced to 0 with a ramp time set to **Spd match acc**.

If during a Status 3 functioning period the command **Speed match** is set at zero, the Status 4 is forced.

If during a Status 3 functioning period the system receives a Stop command (Start drive = 0), the Status 5 is forced.

Status 4:

The system reaches this status if starting from the Status 3 the command **Speed match** is set at zero.

It usually happens simultaneously with the cutting and coil change command.

In this status the motor speed reference is set to:

W reference = ± Line speed x (Minimum diameter ÷ Roll diameter) ± (W gain % + W offset)

all the internal ramp times for the reference calculation are set at zero.

If during a Status 4 functioning period the system receives a Stop command (Start drive = 0), the Status 5 is set at zero.

Status 5:

The system reaches this status through the Status 2, 3, and 4 if it receives a Stop command (Start drive = 0).

It usually happens:

a) after an automatic switching in order to stop the rotating coil.
   The speed reference is set at zero with a ramp time set to **Spd match dec**.
   The parameter **W offset** is immediately set at zero in order to slow down the coil starting from the present speed
b) After the line stop if the tension has to be removed (in this case the drive has to be disabled).

Anyway, when the speed = 0 has been reached, the system switches automatically to the Status 1.

Status 6:

The system reaches this status when the parameter **Jog TW enable** is enabled and the Start command has been given. The Jog command is used on unwinders in order to bring the coil material till the first nip roll. See figure 6.17.4.

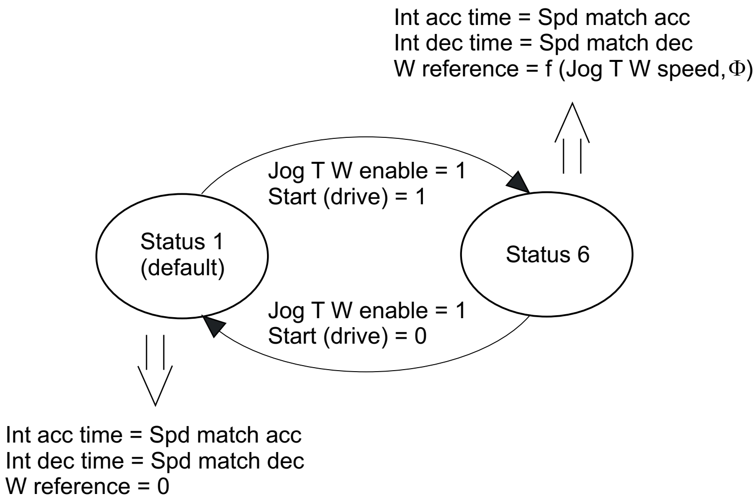


Figure 6.17.4: Functioning with Jog TW enable

Jog TW enable prepares the system for a particular functioning condition; in order to enable the coil rotation it is necessary to give the Start command, a following Stop will force the speed reference to 0 (see paragraph *Control logic*).

In the Status 6 the motor speed reference is set to:

W reference = Jog TW speed x Minimum diameter ÷ Roll diameter

It is possible to change the Jog speed sign by using the command **Winder side**.

If starting from the Status 6, **Jog TW enable** is disabled by keeping the Start command, the system switches to the Status 2.

6.17.4 Typical connection diagrams

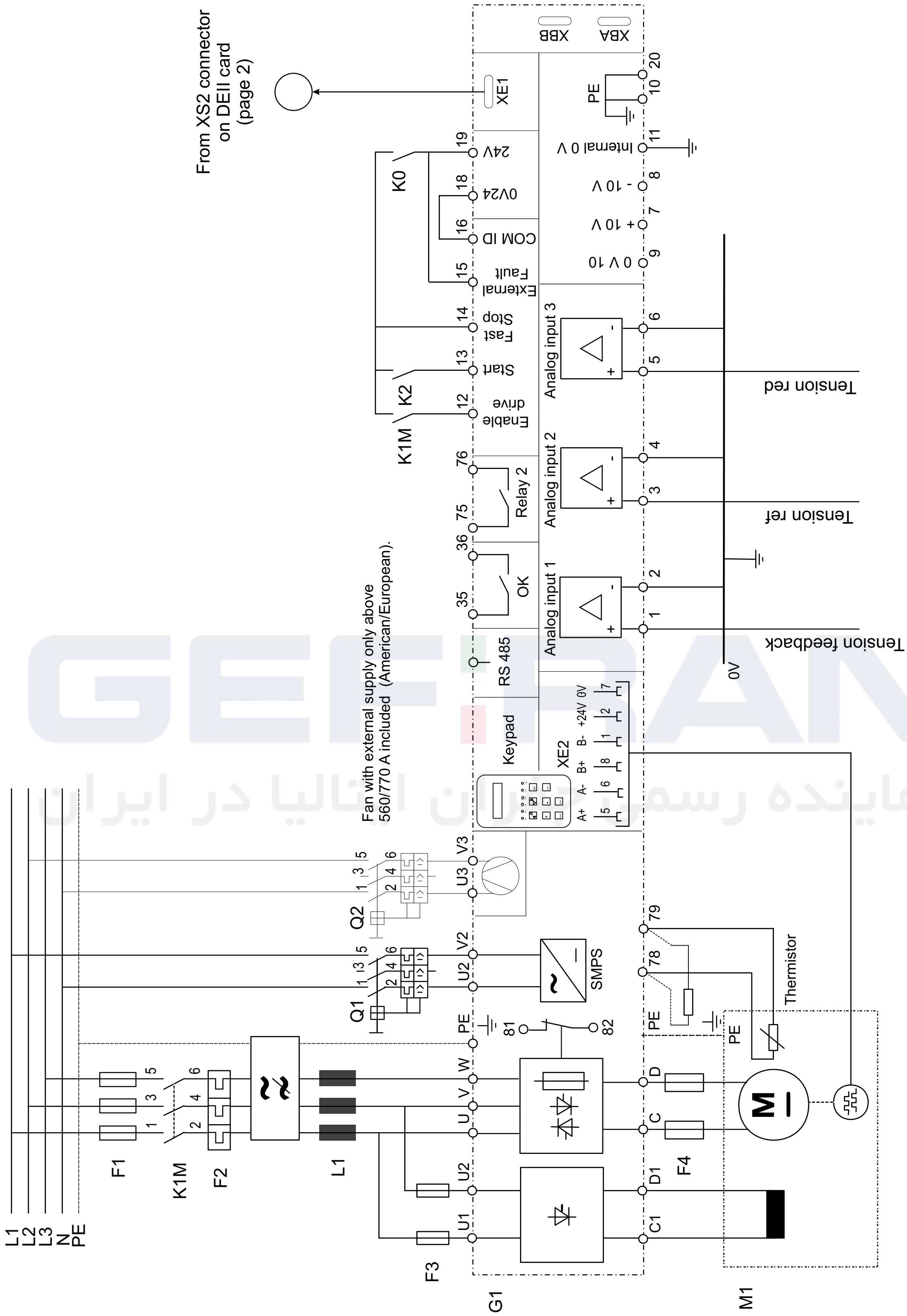


Figure 6.17.5: Winder with an automatic switch and a closed loop tension regulation

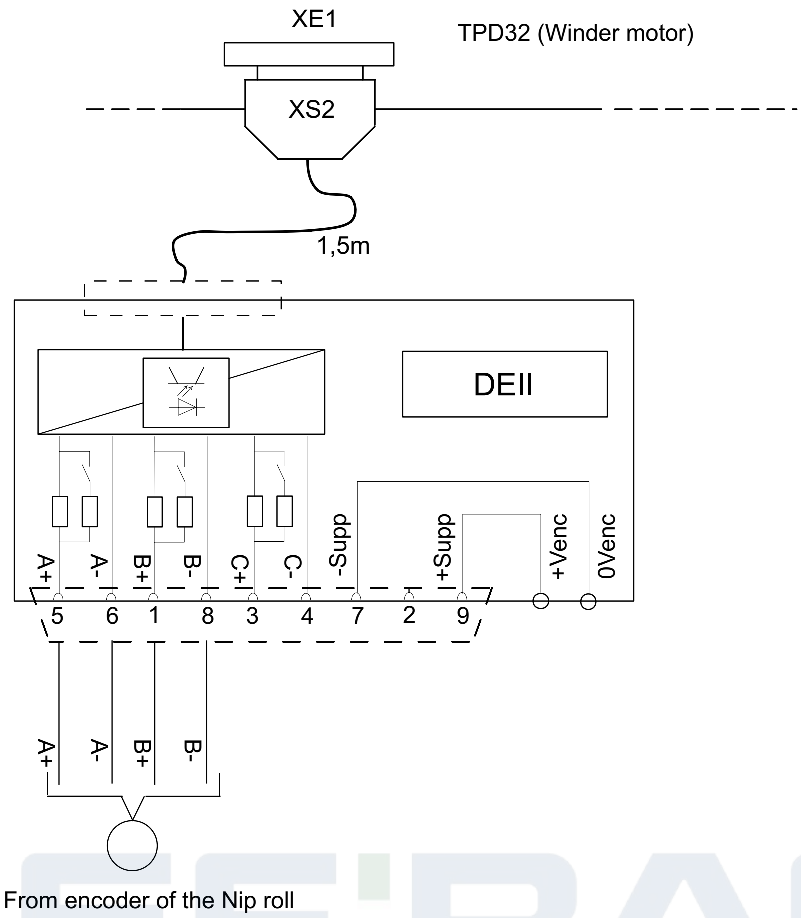


Figure 6.17.6: Winder with an automatic switch and a closed loop tension regulation

(Interface card of the second encoder)

I/O expansion card on TPD32-EV winder motor (connector XBA)

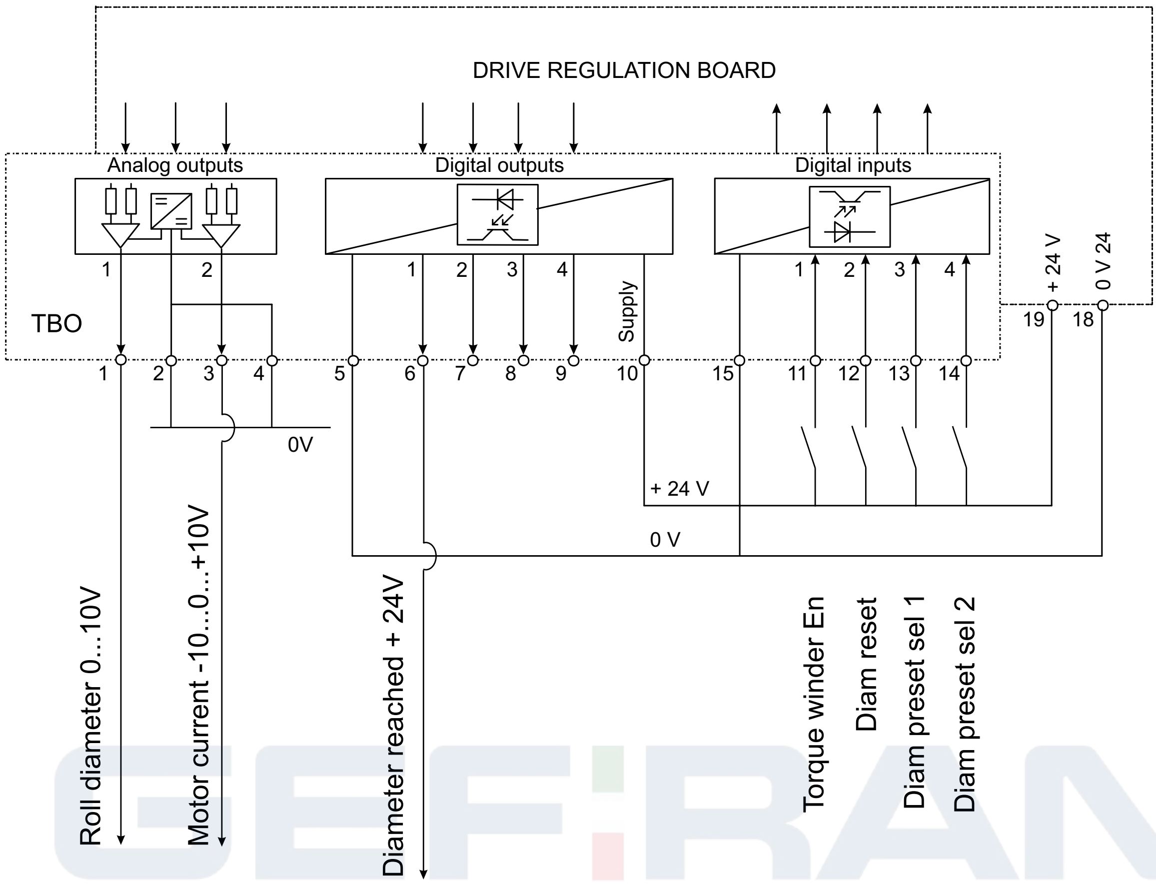


Figure 6.17.7: Winder with an automatic switch and a closed loop tension regulation

(I/O expansion card)

I/O expansion card on TPD32-EV winder motor (connector XBB)

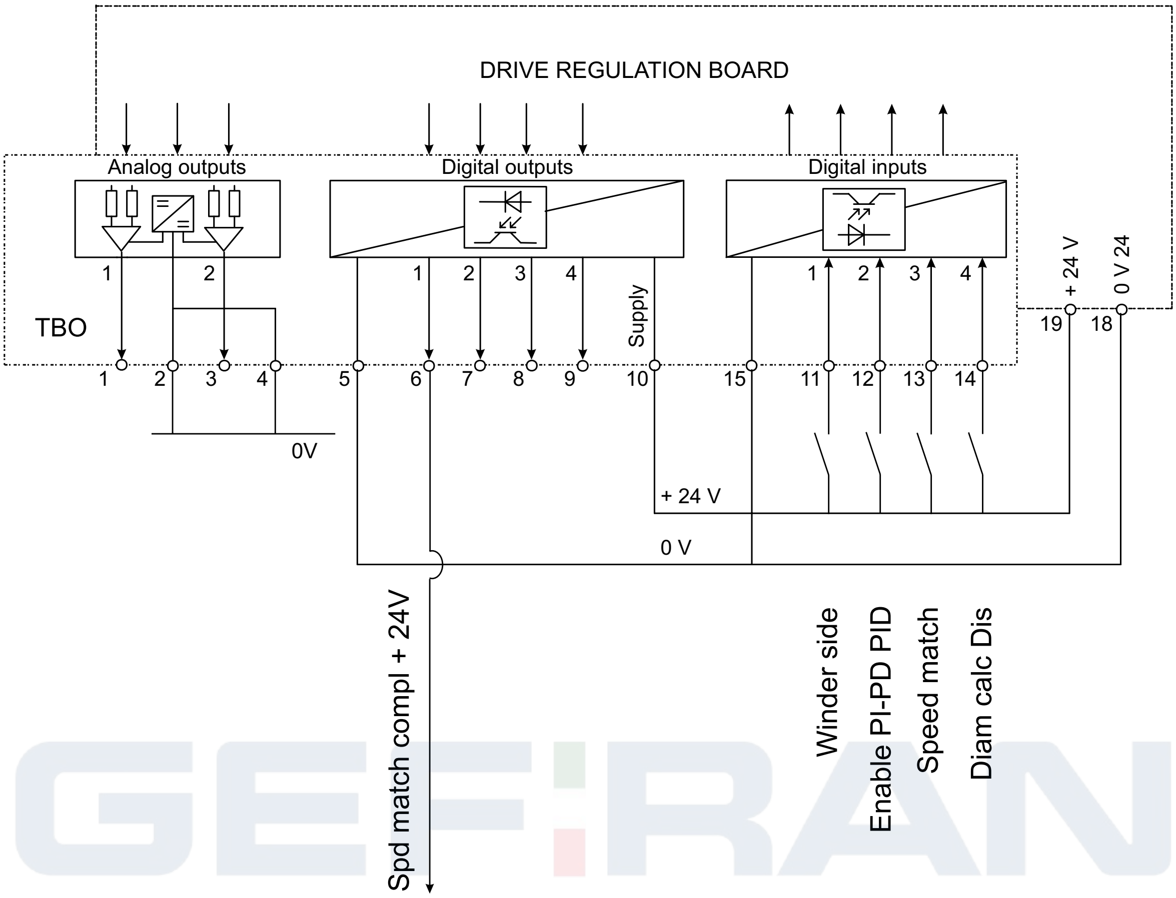


Figure 6.17.8: Winder with an automatic switch and a closed loop tension regulation

(I/O expansion card)

6.17.5 Control logic

This chapter describes the most common logic sequences:

1. Diameter initialization
2. Initial phase
3. Automatic switch
4. Coil stop
5. Jog function

Diameter initialization

This sequence is carried out before the starting of a winder/unwinder both with a coil initial phase when the line is stopped and during an automatic switching.

The diameter value set in **Roll diameter** depends on the parameters **Diam preset 0**, **1**, **2**, **3** and on **Diam preset sel**.

If 2-4 different values of the starting diameter have been set, the selection has to be carried out via some programmed digital inputs such as **Diam preset sel 0** and **Diam preset sel 1**, or via the parameter **Diam preset sel**.

If the value of the starting diameter is set via an analog input, set **Diam preset sel** = 3.

Enable the parameter **Diam reset** for a time longer than 20ms.

Reset the digital input status before the start.

Initial phase

This sequence is carried out in order to start the initial phase with a stopped line.

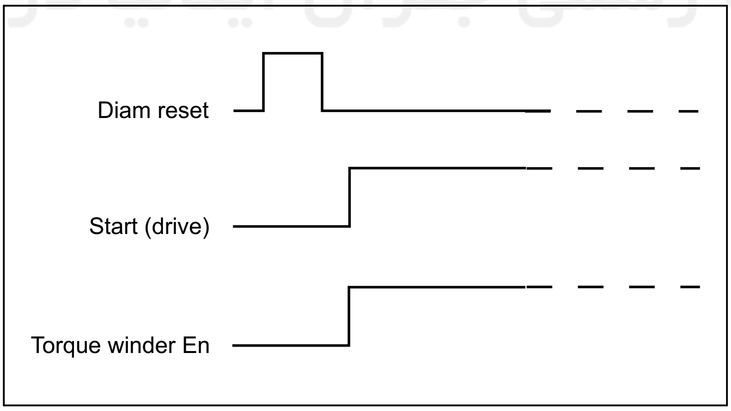


Figure 6.17.9: Initial phase with a stopped line

Initialize the diameter value as stated above.

Enable the tension control and give the start command to the drive.

If the speed reference calculation is carried out inside the drive (**Speed demand en** = Enable) the initial phase is started with the reference set to **W offset** and with a ramp time **Offset acc time**.

Now the line can be started.

Automatic switching

This sequence carries out an automatic switching between two coils during a winding/unwinding period.

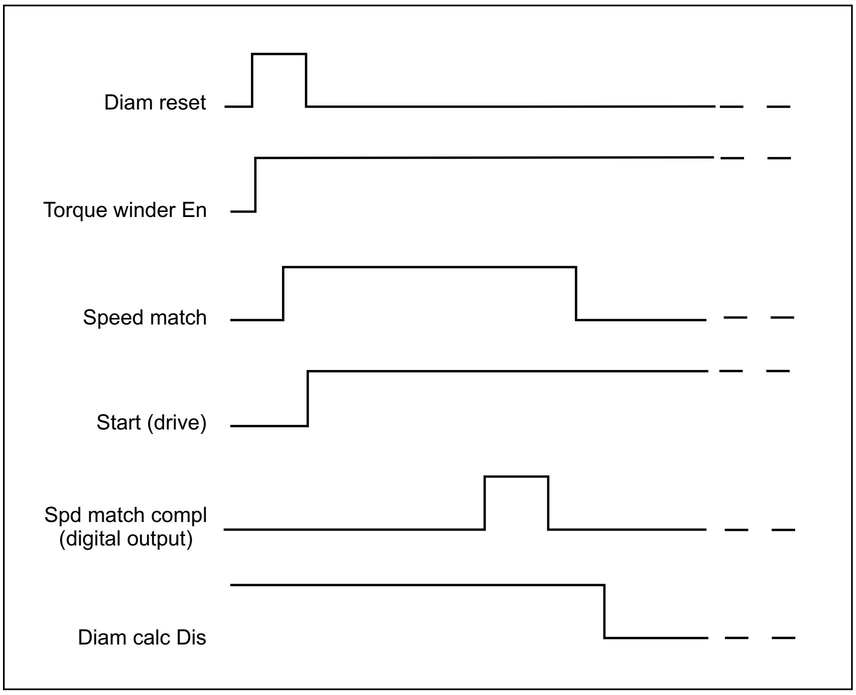


Figure 6.17.10: Automatic switching between two coils during a winding/unwinding period

a) Commands referring to the old coil:

During the star rotation phase it is advisable to disable the diameter calculation of the coil functioning as **Diam calc dis** = 1 in order to avoid errors in the diameter calculation.

b) Commands referring to the new coil:

Initialize the diameter value as stated above.

Enable the command **Speed match**, **Torque winder en** and give the start command to the drive. The motor will increase the coil speed till a peripheral speed has been reached which corresponds to the line speed for **Spd match gain** with the ramp set to **Spd match acc**. After reaching such speed, the drive indicates the end of the launching phase with the parameter **Spd match compl**.

Disable the command **Spd match** simultaneously to the switching between the two coils.

Enable the diameter calculation: **Diam calc dis** = 0.

Reel stop

This sequence is used to stop the ended reel after carrying out the automatic switching.

Disabled the diameter calculation **Diam calc Dis** = 1 and Start command. The reel will decrease up to zero speed with the time set on **Spd match dec** .

At speed = 0 disabled **Torque winder en**.

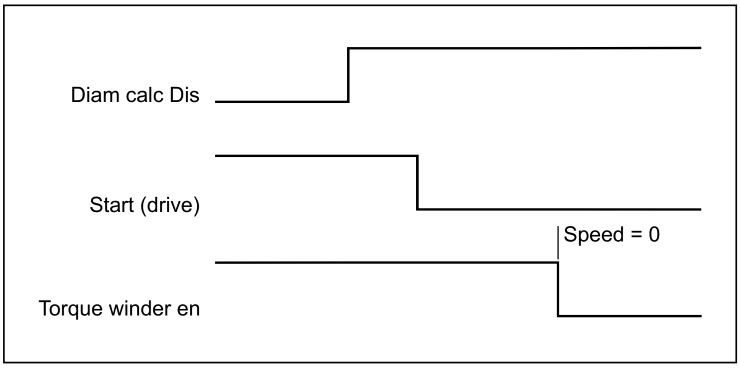


Figure 6.17.11: Coil stop after the automatic switching

Jog function

This sequence is used in particular on unwinders in order to bring the coil material till the first nip roll.

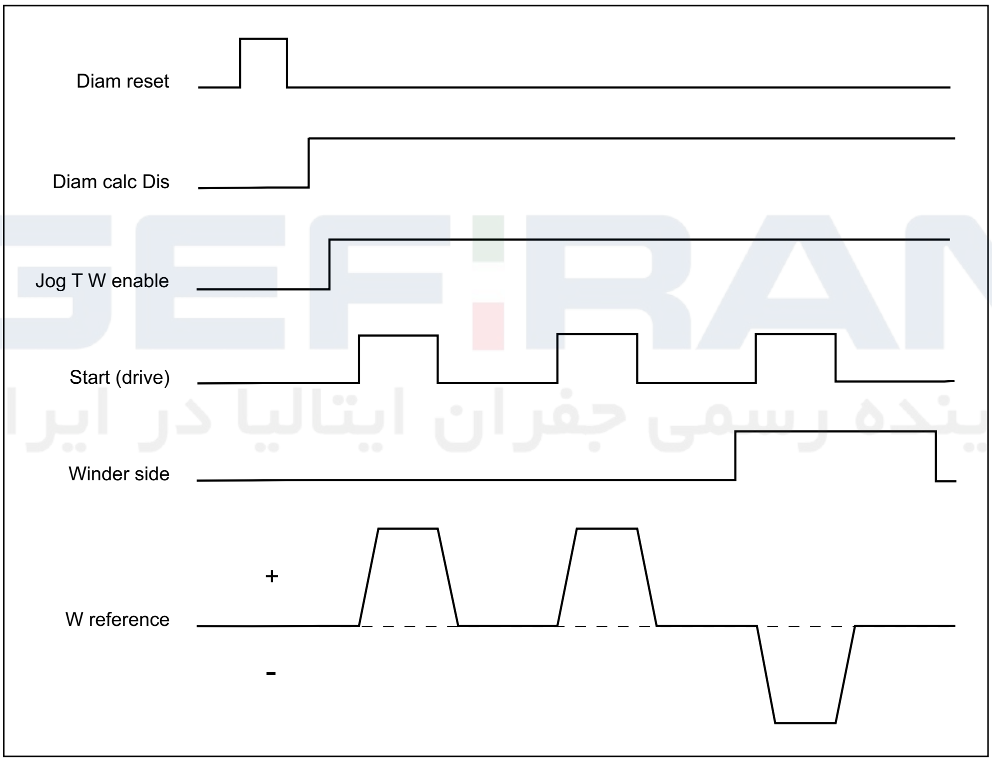


Figure 6.17.12: Jog function to prepare the machine

Initialize the diameter value as stated above.

Disable the diameter calculation. Enable **Jog TW enable.**

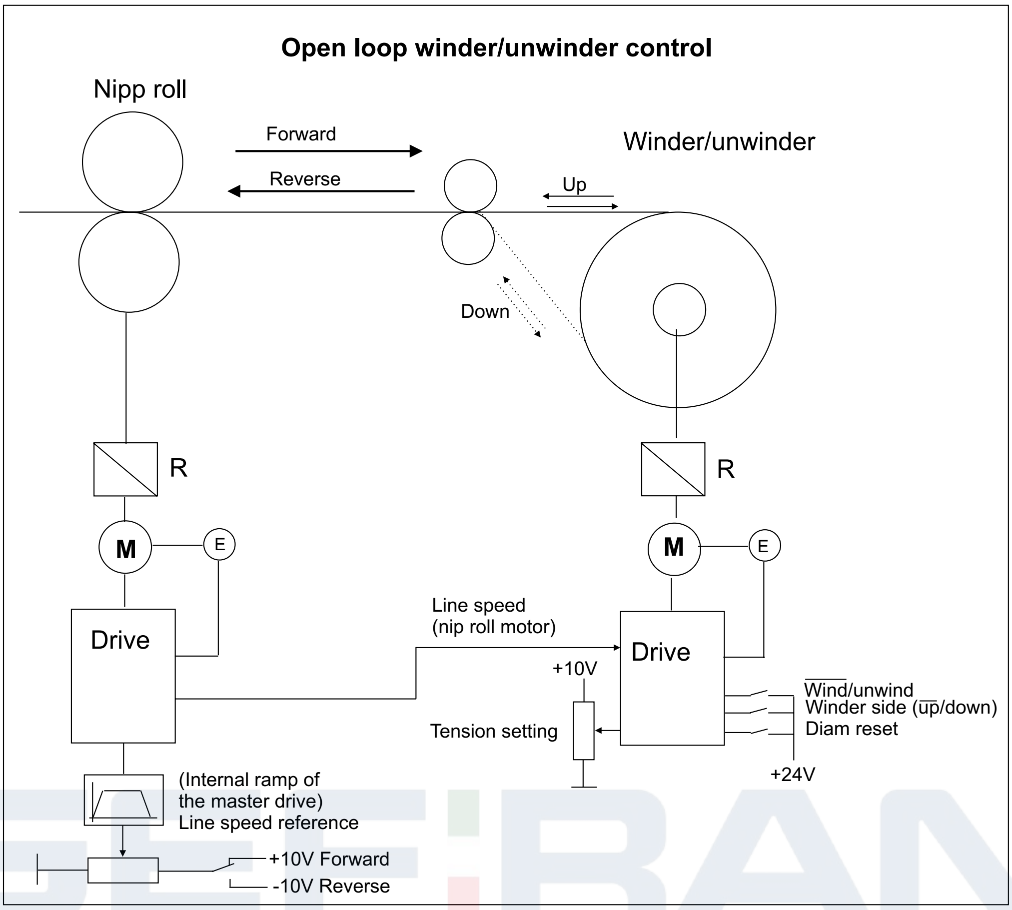
Use the Start/stop command to carry out the Jog function.

With the Start the motor increases the coil speed till reaching the peripheral speed set in **Jog TW speed** with the ramp time **Spd match acc**.

With the Stop the motor decreases its speed till reaching the 0 speed with the ramp time **Spd match dec**.

In order to change the rotation direction use the command **Winder side**.

6.17.6 Application example



Machine data:

Maximum line speed=400m/min
Rated speed of the winder motor Vn=3000rpm
Winder maximum diameter=0.7m
Winder minimum diameter=100mm
Motor - winder reduction ratio=0.5
Line speed reference 0-10V from nip roll motor.
Line acceleration/deceleration time =30sec.
Fast deceleration time fast/stop=15 sec.
Winder/unwinder selection via a digital input.
Winding side selection (up/down) via a digital input.
Tension setting via the analog input.

The winder/unwinder drive receives the analog signals referring to the line speed, to the tension setting, to the digital commands for the winder/unwinder selection, winding side (up/down), and to the diameter reset.
Drive settings:(only the settings referring to the function Torque Winder are described)

PROGRAMMING OF ANALOG INPUTS

ANALOG INPUT 1

Tension ref Tension reference in %;10V (20mA)=100%

I/O CONFIG Menu

————> Analog input

————> Analog input 1

————> Select input 1 **Tension ref**:

ANALOG INPUT 2 If the parameter **Line spd source** has to be set on an analog input, as this parameter is not listed among the high priority parameters, it is necessary to pass through a support parameter PAD0…PAD15.

Line spd source: 10V (20mA)=100%

Programming of the analog input 2 on **PAD 0:**

I/O CONFIG Menu

————> Analog input

————> Analog input 2

————> Select input 2 = PAD 0

ANALOG INPUT 3 If the parameter **Ref spd source** has to be set on an analog input, as this parameter is not listed among the high priority parameters, it is necessary to pass through a support parameter PAD0…PAD15.

Ref spd source: 10V (20mA)=100%

Programming of the analog input 2 on **PAD 1:**

I/O CONFIG Menu

————> Analog input

————> Analog input 3

————> Select input 3 = PAD 1

PROGRAMMING OF DIGITAL INPUTS

DIGITAL INPUT 1

Diam calc Dis: Disabling of the diameter calculation (see also par. **Line speed thr**). In case during the functioning period it is temporarily disabled, the system stores the last calculated value. This function has to be enabled only if the application requires it.

I/O CONFIG Menu

————> digital input

————> digital input 1: **Diam calc Dis**:

DIGITAL INPUT 2

Wind/unwind Winder/unwinder selection. In case the selection is carried out via the digital input: 0V =Winder, +24V = Unwinder.

DIGITAL INPUT 3

Winder side Selection of the winding/unwinding side: in case the selection is carried out via a digital input: 0 =UP, 1 = Down

DIGITAL INPUT 4

Diam reset Diameter reset. When this parameter is enabled, the diameter gets the starting value selected with **Diam preset sel**.

If 2-4 different values of the starting diameter have been set, the selection has to be carried out via some programmed digital inputs such as: **Diam preset sel 0- Diam preset sel 0**

If the value of the starting diameter is set via an analog input, set **Diam preset sel** = 3.
In case of a winder control, it is necessary to give a reset command every time a coil change is performed by setting the minimum diameter value (winder empty diam.)

In case of an unwinder control, it is necessary to give a reset command every time a coil change is performed by setting the maximum diameter value(winder maximum diam.).

Enable the parameter **Diam reset** for a time longer than 20ms.

Reset the digital input status before the start

DIGITAL INPUT 5

Diam preset sel 0

DIGITAL INPUT 6

Diam preset sel 1 In case of a system with a winder or unwinder control, it is possible to set in **Diam preset 0** the value of the starting diameter; for the winder control a minimum diameter, for the unwinder control a maximum diameter. Set **Diam preset sel =0** (do not set any digital input as diam preset sel 0-diam preset 1). By starting the command of **Diam reset** the value of diam preset 0 is entered in **Roll diameter.**

OPTION Menu

————> Torque winder

Torque winder En ; set **Enable** to enable the center wind function.

If the system requires it, it is possible to set this function (enable/disable)also via a digital input.

Setting of the parameters in the DIAMETER CALCULATION menu

PARAMETERS

OPTION Menu

————> Torque winder

————> Diam calculation

Wind/unwind Winder/unwinder selection. Selection to be carried out only if the digital inputs are not set.

Minimum diameter Minimum diameter value in [mm]. Set 100mm

Maximum diameter Maximum diameter value in [m]. Set 0.7m

Line spd source Number of the sampling parameter of the line speed. In order to get the real number to be set it is necessary to add +2000H (8192 decimal) to the parameter number.

Setting of **PAD 0** as a line speed input:

OPTION Menu

——————> Torque winder

——————> Diam calculation

——————> Line speed source = 8695

Line speed gain Calibration value of the line speed.

Its programming depends on the sampling parameter of the line speed; it is used to get "Line speed" = 100% of its maximum value.

The calculation of **Line speed gain** must be carried out with the formula:

[32768 x 16384 / (maximum value of the sampling parameter x 8)] -1

When this analog input is set on a PAD parameter, its maximum value is + / - 2048, therefore to have **Line speed** = 100%:

Line speed gain = [32768 x 16384 / (2048 x 8) – 1] = 32767

(A fine tuning can be obtained by carrying out the self tuning procedure of the analog input).

Ref spd source Sampling parameter number relating to the line speed reference. In order to get the real number to be set it is necessary to add +2000H (8192 decimal) to the parameter number.

Setting of **PAD 0** as a line speed input:

OPTION Menu

——————> Torque winder

——————> Diam calculation

——————> Ref speed source = 8695

Ref speed gain Gauging value of the line speed reference.

The relative setting depends on the sampling parameter of the line speed reference and is used to obtain "Line speed" = 100% at its peak.

The calculation of **Ref speed gain** must be carried out with the formula:

[32768 x 16384 / (maximum value of the sampling parameter x 8)] -1

When this analog input is set on a PAD parameter, its maximum value is + / - 2048, therefore to have **Ref line spd** = 100%:

Ref speed gain = [32768 x 16384 / (2048 x 8) – 1] = 32767

(A fine tuning can be obtained by carrying out the self tuning procedure of the analog input).

Line speed Monitor of the line speed in [%]. After programming line speed source and line speed gain it is possible to control the tuning by checking that with a line speed at its maximum value the parameter line speed =100%.

Ref line speed Line reference Monitor.

Base omega Value in [rpm] corresponding to the maximum angular speed of the winder/unwinder (motor shaft side).

$Vp=\pi \times \Phi min \times \omega \times R$

where :

Vp= peripheral speed

Φmin=winder minimum diameter (mm)

ω = motor angular speed

R =reduction ratio

$\omega=Vp/ \pi \times \Phi min \times R=400/(3.14 \times 0.1 \times 0.5)=2547rpm$

Base omega =set 2547rpm.

Ref speed thr Line speed detecting threshold in %.

When “Line speed” is lower than “Line speed thr” the diameter calculation is disabled. When “Line speed” is higher than the threshold, the diameter calculation is enabled with an initial filter corresponding to **Diam init filter** for the time set in **Diam stdy delay**. At the end of this time the filter is set to **Diam filter**.

Maximum line speed =400m/min . Line speed thr=5% (the diameter calculation is automatically enabled at 20m/min).

Setting of the parameters in the SPEED DEMAND menu

PARAMETERS

OPTION Menu

————> Torque winder

————> Speed demand

Speed demand En Enabling of the speed reference calculation; set **Enable**

Winder side Selection of the winding/unwinding side. Selection to be carried out only if the digital inputs are not set. 0 =up, 1 =down

W gain Setting of the speed reference gain used for the loop saturation. Parameter given as a percentage of the increase/decrease of the angular speed reference.

W gain=30% (set this starting value)

W offset Offset setting on the speed reference for the winder/unwinder initial phase with a stopped line. Parameter in [rpm].

W offset=50rpm (check with the material)

Offset acc time Setting of the initial phase ramp with a stopped machine. Parameter in [s]. The acc time refers to the parameter **speed base value**

W target Parameter number which the speed reference has to be addressed to. In order to obtain the real number to be set it is necessary to add +2000H (8192 decimal) to the parameter number.

W target : set 2 as a speed reference:

OPTION Menu

————> Torque winder

————> Speed demand

————> W target = 8235

Paragraph 10.2. *“List of the high priority parameters’* shows that **Speed ref 2** has the decimal number 43. In order to obtain the value to be entered add 8192 decimal (fixed offset): 8192 + 427 = 8235

W reference: It is possible to use it as a monitor for the speed reference.

Setting of the parameters in the COMP CALCULATION menu

OPTION Menu
——————> Torque winder
——————> torque calculation
——————> comp calculation

Static f: Compensation of the static frictions as a percentage of the drive rated current

- Check that the parameters **Static f and Dinamic f**=0
- Set the tension (tension ref)=0
- The diameter calculation function is blocked (enable the programmed digital input as Dis diam calc)
- Operations to be carried out without line reference, jog function and materials on the machine (the compensation of the static frictions is completely entered only when the line speed is higher than 1.5%).
- Stopped winder/unwinder motor within the current limit (In use t curr lim+/-=0)
- Gradually increase the value of **Static f**. The motor will start rotating. Set a suitable value so that the winder/unwinder can rotate with a speed near to the zero (it must always be within the current limit. The led Ilim on the keypad is lighted)

Dynamic f: Compensation of the dynamic frictions as a percentage of the drive rated current

- Set the maximum line speed reference, check that the minimum diameter has been set in **roll diameter** (if not carry out a **Diam reset** on the minimum diameter)
- Set temporarily the parameter **Static f**: with a value of 10-20%. The motor speed will increase reaching the speed **Base omega** (the converter in this phase has to overcome the current limit) .
- When the motor reaches its rated speed, set the parameter **Static f** with its previously tuned value. The speed will start decreasing.
- Increase gradually the parameter **Dynamic f** till the speed ends its decreasing phase and the motor rotates at a constant speed.
- Increase the speed by increasing temporarily the parameter **Static f**. Reset the parameter **Static f** with its right value. The motor must keep the reached speed.
- In a negative case, reset the parameter **Dynamic f** and repeat the tests till the required conditions have been reached.

Static f Zero By setting the parameter on "Enabled", the friction compensation is completely inserted for all speed values. When it set as "Disabled", the static friction compensation is completely inserted with Ref line speed = 1.5%.

Int acc calc En Enabling of the calculation for the coil acceleration.

If enabled, this function calculates the angular acceleration inside the drive. In this case it is necessary to set just the value of **Time acc/dec min**. If disabled, the parameters **Line acc % - dec % - fast stop %** and **Time acc/dec min** have to be set and the digital inputs have to be supplied with the suitable indications.

Time acc/dec min Set the time in [s] corresponding to the lowest acceleration, deceleration and fast deceleration time.

Set time acc/dec min =15sec (time required for a fast deceleration)

Acc/dec filter Filter in [ms] on the acceleration calculation inside the drive

Set =30 msec

Mat width Width of the wound material as a percentage of the maximum width. Set =100%

Constant J comp Compensation of the fixed section (motor, reducer,core) as a percentage of the drive rated current. Increase the value till the motor can increase the speed following the line reference. During this phase the converter has always to be within the current limit.

- Diameter calculation function disabled (enable the programmed digital input as **Dis diam calc)**
- Operations to be carried out without material on the machine,
- Install the empty winder (check that the parameter **Roll diameter**= min. diam). Check that the parameters **Constant J comp- Variable J comp**=0
- Set the tension (**tension ref**)=0
- Minimum jog function and line reference
- Carry out some changes on the line reference.
- Increase gradually the value of the parameter **Constant J comp** till the winder/unwinder is able to follow the line speed reference.

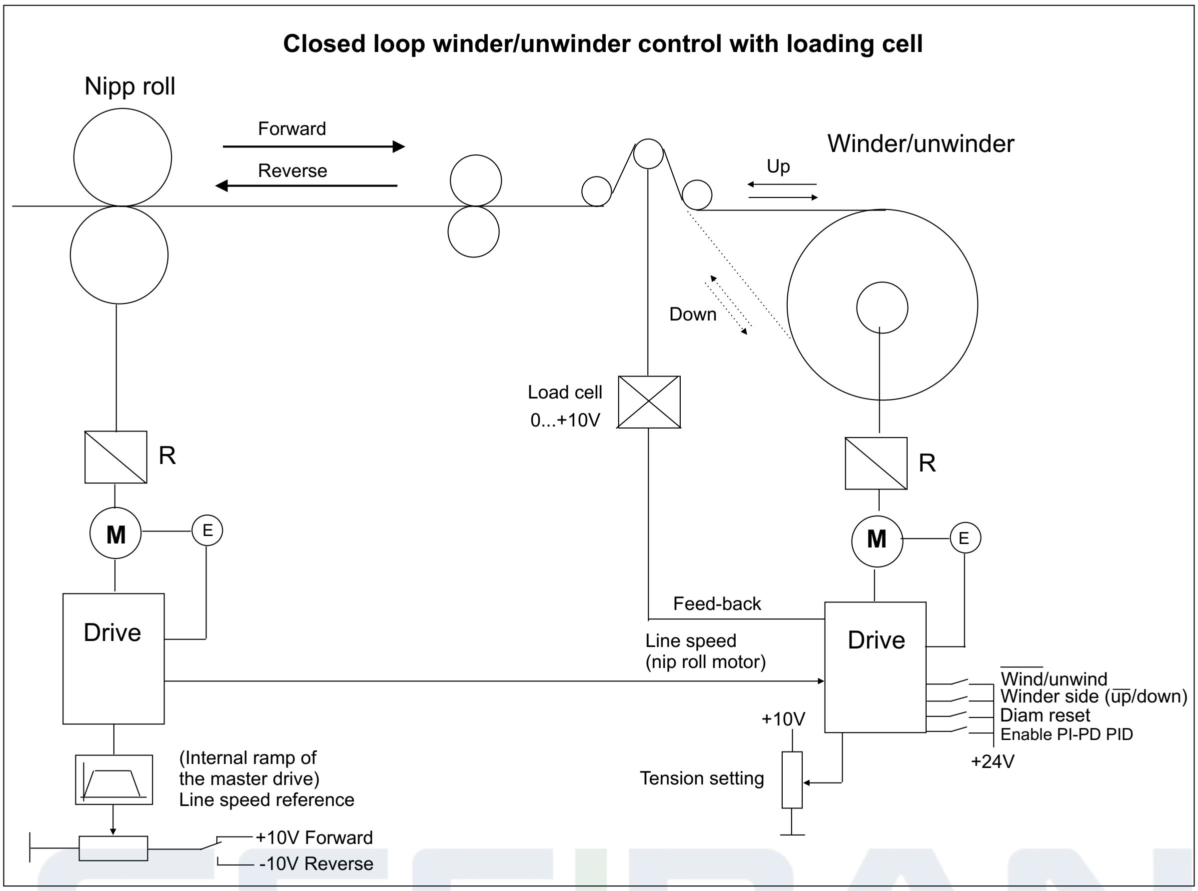
Variable J comp Torque compensation due to the wound material as a percentage of the drive rated current.

- Operation to be carried out without material on the machine
- Install a full coil on the winder (check that the parameter **Roll diameter**= max. diam).
- Follow the same procedure as the one carried out for the tuning of **Constant J comp**

Act var J comp Monitor for the compensation of the variable section as a percentage of the drive rated current.

Act const J comp Monitor for the compensation of the fixed section as a percentage of the drive rated current.

Act comp Monitor for the compensations (it sums up static, dynamic and inertial frictions) as a percentage of the drive rated current.



Machine data

Maximum line speed=400m/min

Rated speed of the winder motorVn=3000rpm

Winder maximum diameter=0.7m

Winder minimum diameter=100mm

Motor-winder reduction ratio=0.5

Line speed reference 0-10V from nip roll motor.

Line acceleration/deceleration time =30sec.

Fast deceleration time fast/stop=15 sec.

Winder/unwinder selection via a digital input.

Winding side selection (up/down) via a digital input.

Tension setting via the analog input.

Set all the parameters as stated in the previous example. After testing the machine with an open loop material, carry out such settings for the tuning with a loading cell.

ANALOG INPUT 3

Pid feed back Input of the loading cell;10V (20mA)=100%
I/O CONFIG Menu
———> Analog input
———> Analog input 3 **Pid feed back**

Closed loop En Closing of the tension loop enabled (to be used with a loading cell).
Set the parameter **Closed loop En**=enable

Closed loop comp Monitor for the present compensation on the output of the PID regulator used for the loop closing.

DIGITAL INPUT
Programming of a digital input to enable the PID function
I/O CONFIG Menu
———> digital input
———> digital input 7:**enable PI-PD PID**

<u>Setting of Pid parameters</u>

Set **Pid Source** as **PAD 1.**
Pid source=(8192+504)=8696
PARAMETERS
OPTION Menu
———> PID
———> Pid source
———> Pid source=8695

Set **PAD 1** =10000
(Pad 1 is in the "Special function" menu)

Set **Pid source gain** =1

Set **PID target** as the parameter **Closed loop comp**
The parameter Closed loop comp has the decimal number 1208
In order to obtain the value to be entered add 8192 decimal (fixed offset)
PID target=8192+1208=9400

Set **Pid out scale**
Pid out scale=(max .value of closed loop comp)/max oPID output
Pid out scale=10000/10000=1
Set **PI top lim** and **Pi bottom lim** in order to have a 100% correction of its maximum value.
PI top lim=1
Pi bottom lim=-1
With this configuration the regulator output is positive and negative.
The gains of the several components have to be set experimentally with a loaded machine.

It is possible to start the tests with the values below :

set **PI P gain PID**=10%

set **PI I gain PID**=4%

set **PD P gain PID**=5%

set **PD D gain PID**=0%

PD D filter PID=20msec

Set **PI central vsel**=1

Set **PI central v 1**=0

With this configuration, when the switching ON/OFF of the parameters enabling the PID function is carried out, the regulator output starts from 0.

Before enabling the PID regulator and the loop closing it is necessary to check the matching between the set tension and the tension measured by the loading cell.

The loading cell has to be tuned in order to have an analog output =10V connected to the maximum tension on the required material.

With a loaded machine start the winder/unwinder by setting a tension of 50%.

Check the values of the parameters **Act tension ref** (0 ¸ 100%, tension set in the Torque winder menu) and **Pid feedback** (0 ¸ 10000, loading cell feedback in the PID menu). The two values must be the same.

If not, act on the parameter **Tension scale** till the two parameters reach the same values.

After this parameterization has been carried out, it is possible to start the tests with the material.

Improve the system stability via the different components of the blocks PI and PD PID.

Provisions

In order to make the commissioning procedure easier and uniform, the system contains a clause referring to the speed and torque directions to be respected:

As a general rule the winder speed and the torque direction are considered positive with a upper winding side.

All the possible system configurations stated in the examples below refer to this clause.

Note! The polarity of the line speed reference is not important, because the system states the output reference polarity only according to the parameters **Wind/unwind** and **Winder side**.

1. Drive used as a winder – winding side = up

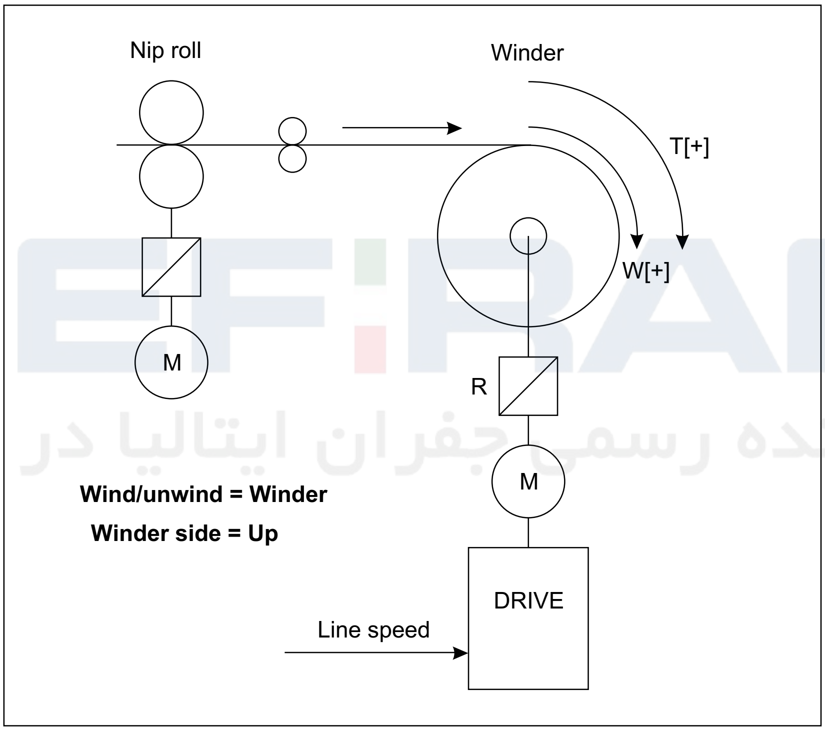


Figure 6.17.13: Drive used as a winder – winding side = up

If the speed demand function is used, the system creates a positive speed reference; it is therefore necessary to connect the motor so that, with this polarity, the coil winds the material starting from the upper side. The winding torque is positive.

2. Drive used as a winder – winding side = down

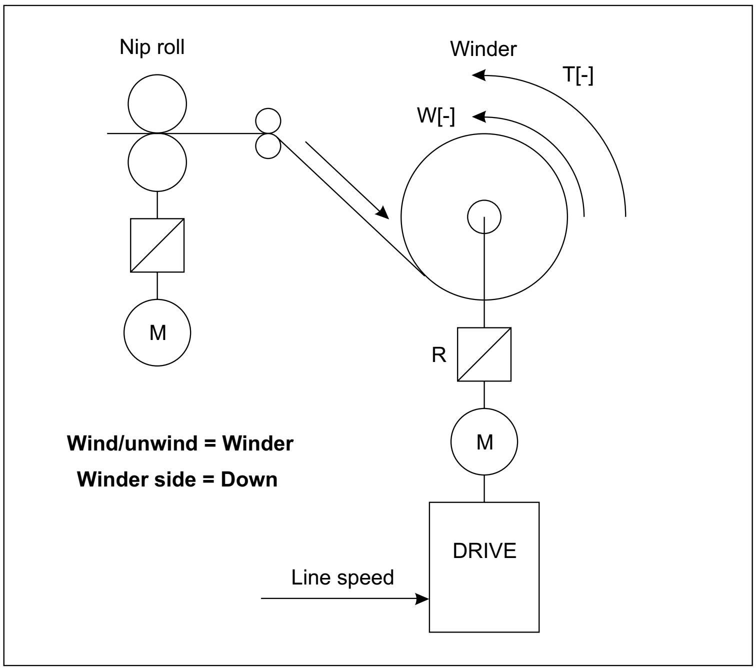


Figure 6.17.14: Drive used as a winder – winding side = down

If the speed demand function is used, the system creates a negative speed reference; it is therefore necessary to connect the motor so that, with this polarity, the coil winds the material starting from the lower side. The winding torque is negative.

3. Drive used as an unwinder – unwinding side = up

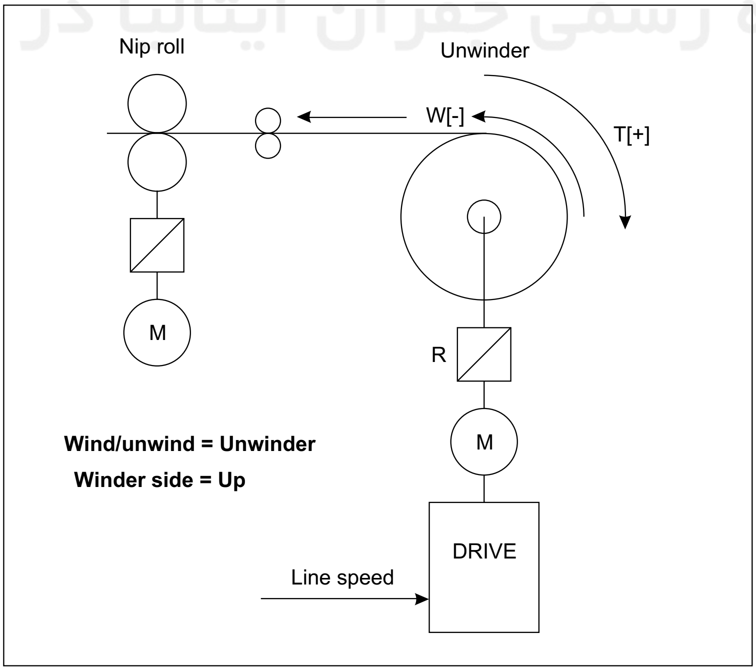


Figure 6.17.15: Drive used as an unwinder – unwinding side = up

If the speed demand function is used, the system creates a negative speed reference; it is therefore necessary to connect the motor so that, with this polarity, the coil unwinds the material starting from the upper side. The unwinding torque is positive.

4. Drive used as an unwinder – unwinding side = down

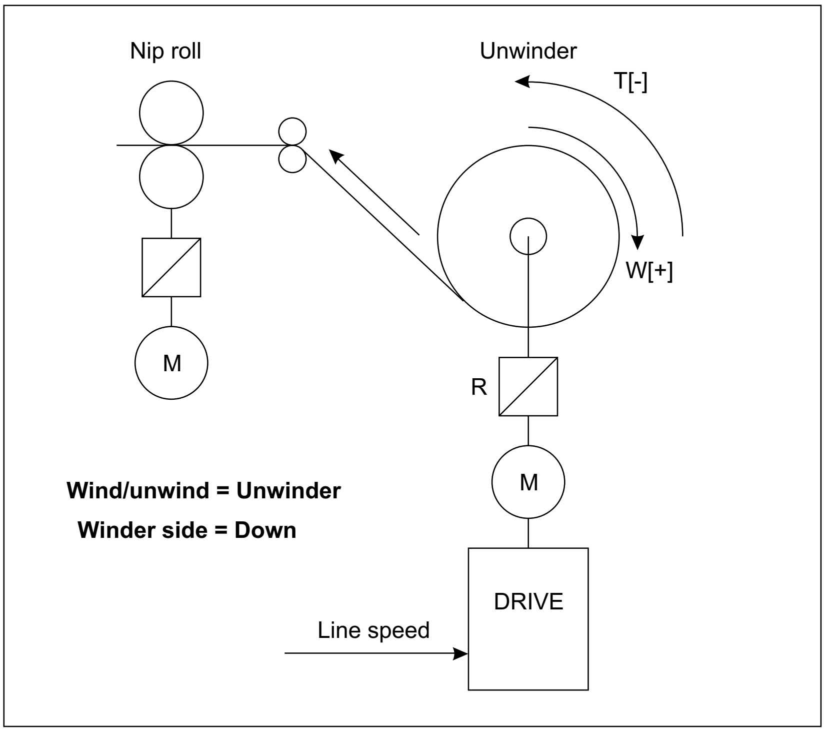
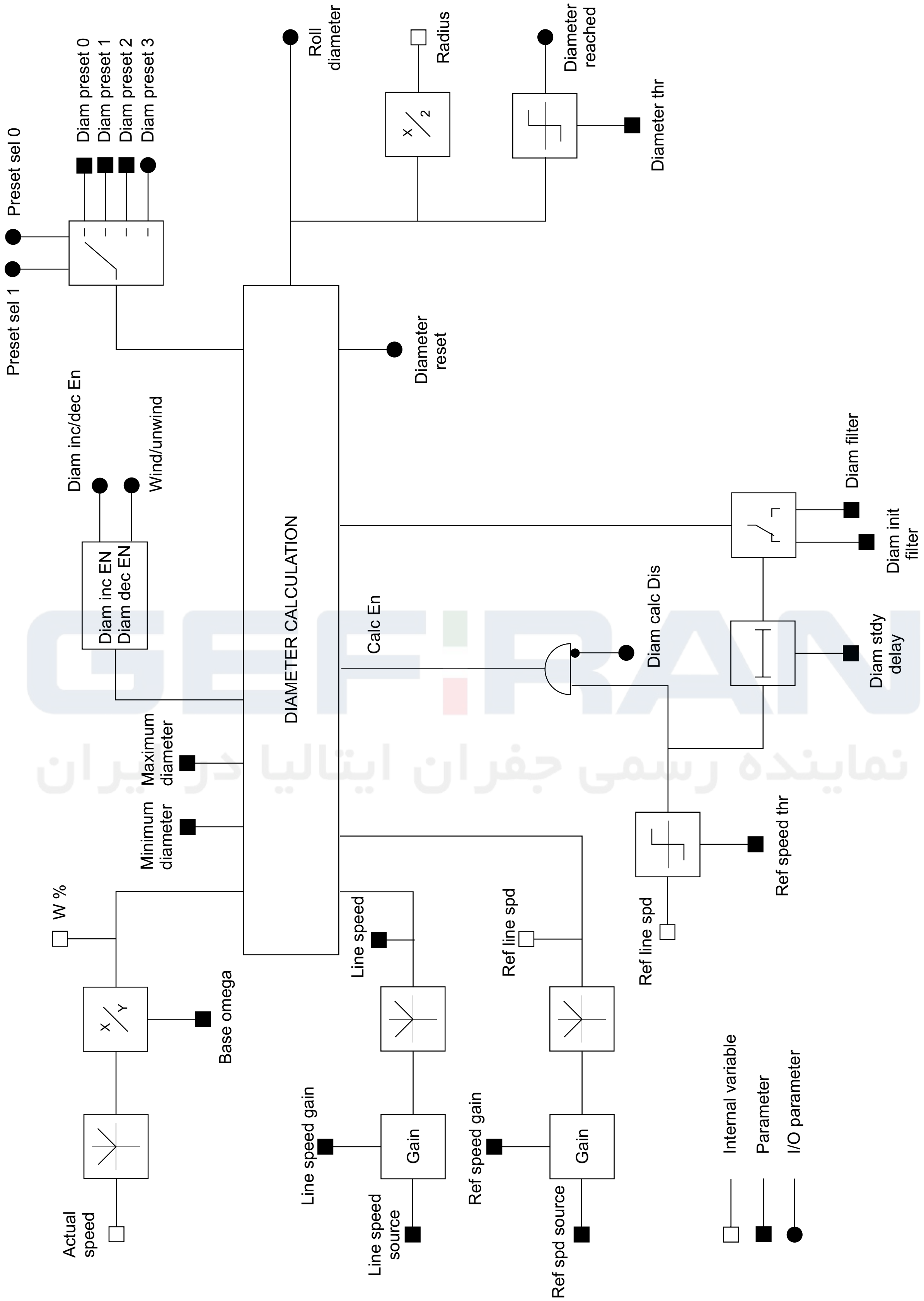
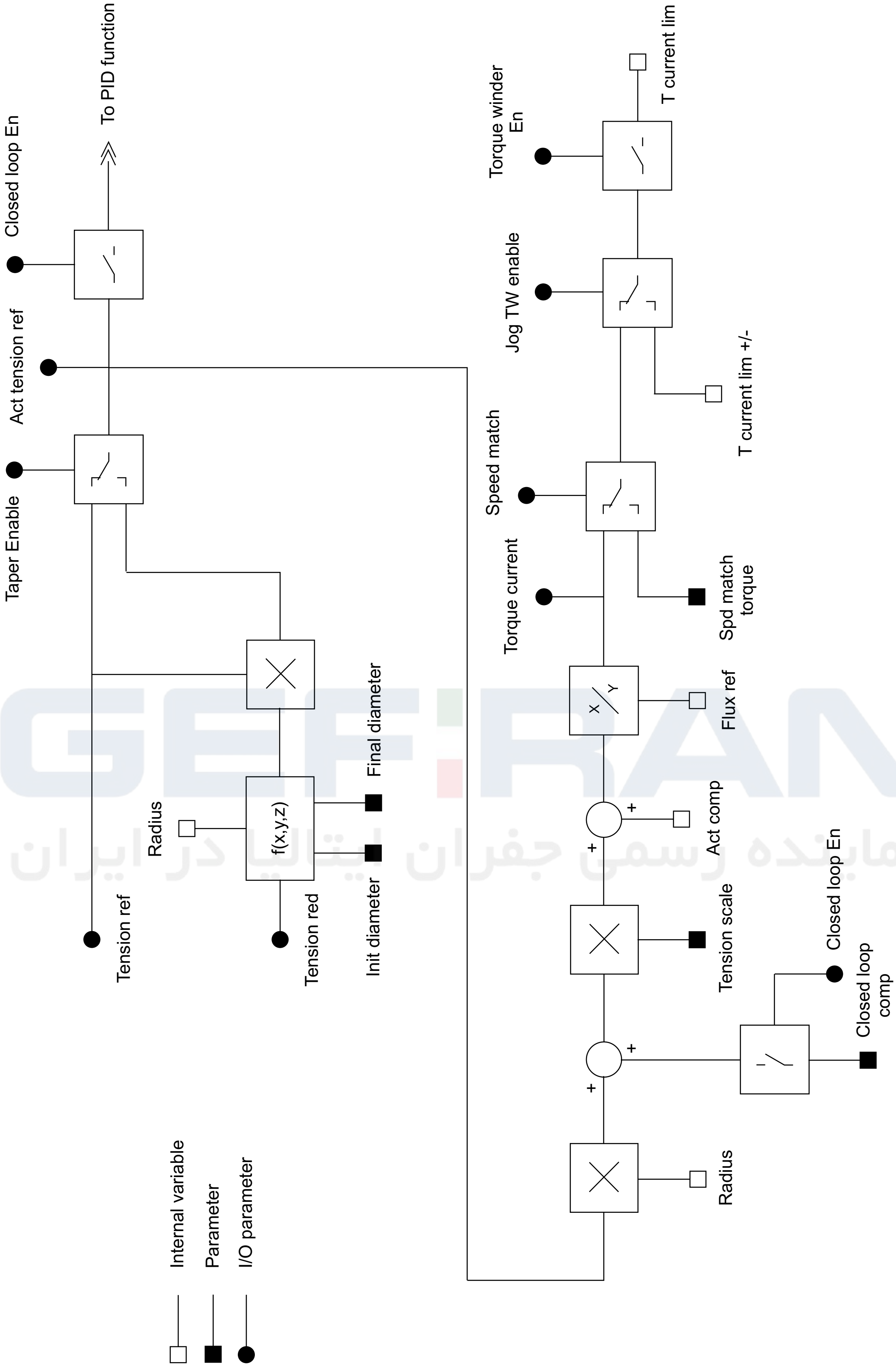


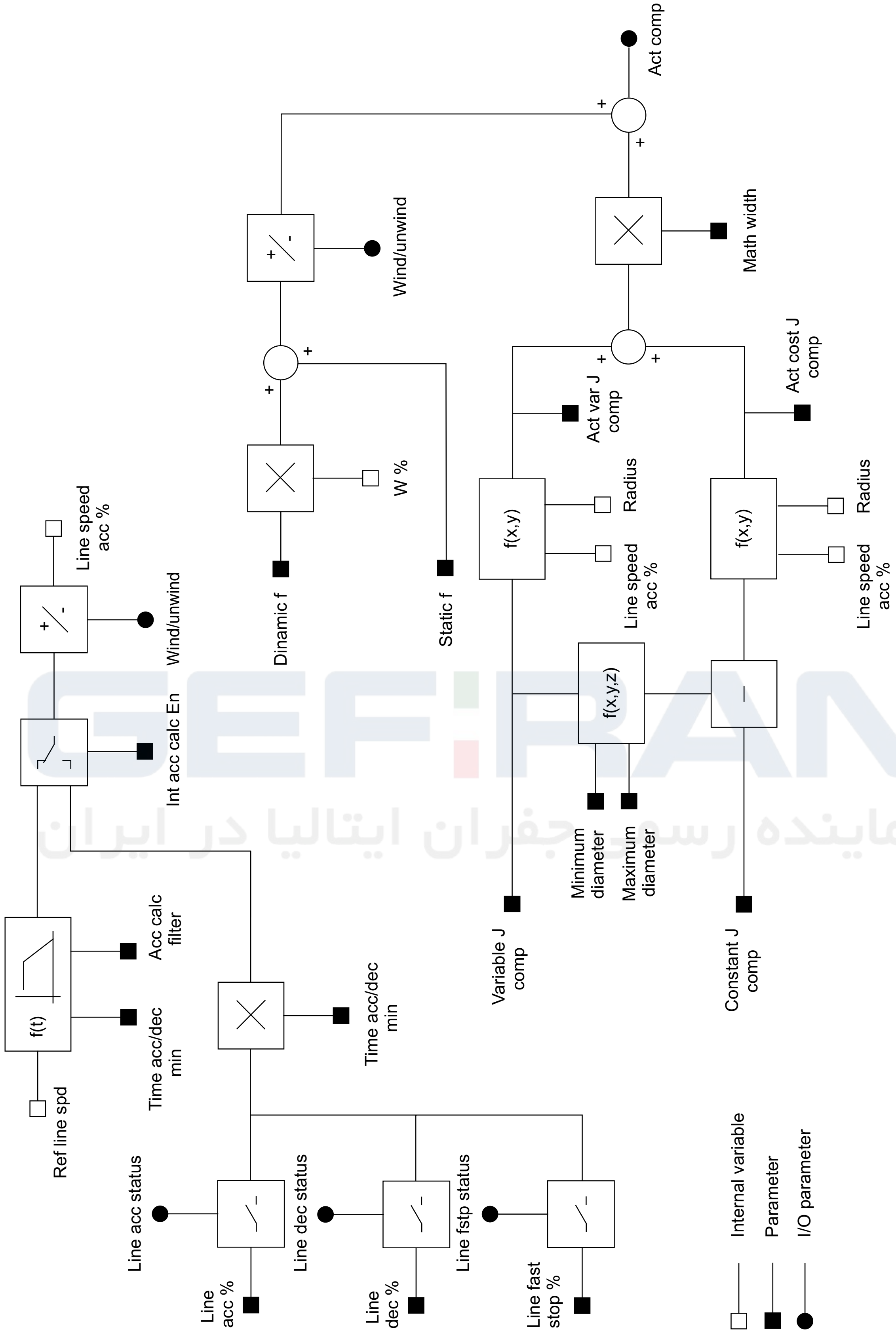
Figure 6.17.16: Drive used as an unwinder – unwinding side = down

If the speed demand function is used, the system creates a positive speed reference; it is therefore necessary to connect the motor so that, with this polarity, the coil unwinds the material starting from the lower side. The unwinding torque is negative.

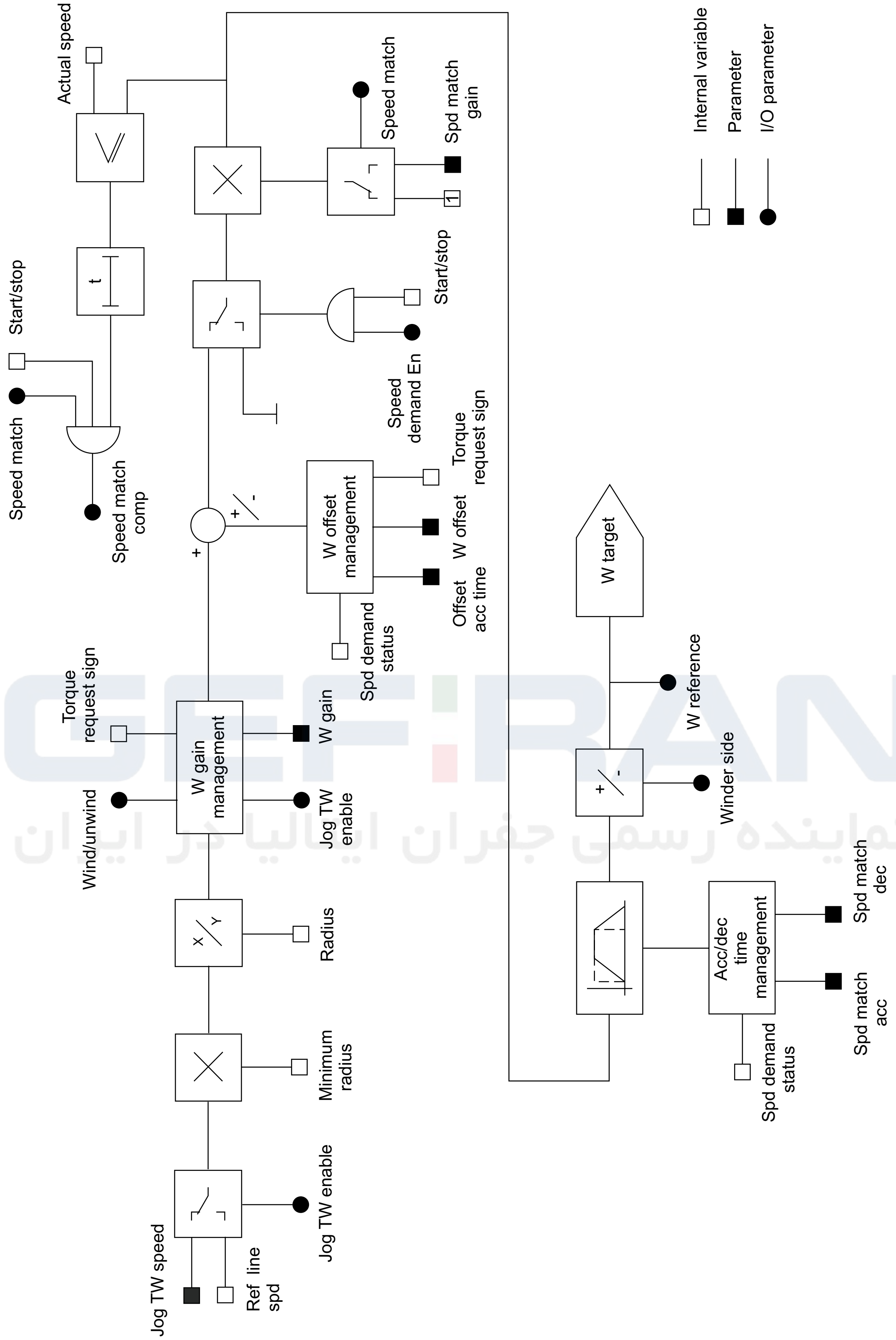
6.17.7 Block diagram




Closed loop En
To PID function
Act tension ref
Taper Enable
Tension ref
Radius
f(x,y,z)
Tension red
Init diameter
Final diameter
Torque winder En
T current lim
Jog TW enable
T current lim +/-
Speed match
Torque current
Spd match torque
Flux ref
Act comp
Tension scale
Closed loop En
Closed loop comp
Radius
Internal variable
Parameter
I/O parameter



Act comp
Wind/unwind
Math width
Act cost J comp
Act var J comp
W %
Radius
Line speed acc %
Radius
Line speed acc %
Dinamic f
Static f
f(x,y)
f(x,y)
f(x,y,z)
Line speed acc %
Wind/unwind
Int acc calc En
Minimum diameter
Maximum diameter
Variable J comp
Constant J comp
Acc calc filter
Time acc/dec min
f(t)
Ref line spd
Time acc/dec min
Line acc status
Line dec status
Line fstp status
Line acc %
Line dec %
Line fast stop %
Internal variable
Parameter
I/O parameter



Actual speed
Start/stop
Speed match
Speed match comp
Speed match
Spd match gain
Start/stop
Speed demand En
Torque request sign
W offset management
W offset
Offset acc time
Spd demand status
Torque request sign
W gain management
W gain
Wind/unwind
Jog TW enable
Radius
Minimum radius
Jog TW enable
Jog TW speed
Ref line spd
W target
W reference
Winder side
Acc/dec time management
Spd match dec
Spd match acc
Spd demand status
Internal variable
Parameter
I/O parameter

6.18 DRIVECOM

The DRIVECOM profile #21 “Power transmission,” defines the behavior of the drive if this is operated via the INTERBUS-S field bus. The DRIVECOM menu of the TPD32-EV converter provides functions that were defined in the above standards and which are required to operate a motor with the converter.

The TPD32-EV converters, however, have a considerably greater range of functions than is defined here. Apart from a few exceptions the parameters provided in this menu are described somewhere else in detail. We will therefore restrict this description to the Parameters function. See section 10, “Parameter list” and the above standard for further information on the parameters. When operating from a Bus, the parameters in the Drivecom group can also be accessed using the format and index specified in the above standard.

6.18.1 Control word, status word, malfunction code

DRIVECOM

[57]	Malfunction code
[55]	Control word
[56]	Status word

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Malfunction code	57					
Control word	55	0	65535			
Status word	56	0	65535			

Malfunction code Malfunction code according to DRIVECOM specification (Mandatory functions)

The code displayed indicates a particular failure. The meaning of the individual failures concerned is described in the section Programmable Alarms.

1001h	**Unknown alarm**	**7510h**	**Hw opt 1 failure**
2300h	**Overcurrent**	**7400h**	**Hw opt 2 failure**
4210h	**Heatsink overtemperature**	**3120h**	**Undervoltage**
5000h	**Hardware**	**3310h**	**Overvoltage**
5100h	**Failure supply**	**9009h**	**Enable seq err**
5211h	**Ud measurement**	**9090h**	**Brake error**
6110h	**DSP error**	**7120h**	**I2t motor overload error**
6120h	**Interrupt error**	**3320h**	**Over Speed error**
7301h	**Speed feedback loss**	**3140h**	**Mains frequency error**
9000h	**External fault**	**2310h**	**I2t drive overload error**
4310h	**Motor overtemperature**	**8100h**	**SSC Error**
3330h	**Field loss**	**8101h**	**Shorted SCR**
8110h	**Bus loss**	**8102h**	**Open SCR**

The code and the alarm are displayed in plain text in the event of a failure. The code is given in hexadecimal format.

Control word Control word according to DRIVECOM specification (Mandatory functions)

Status word Status word according to DRIVECOM specification (Mandatory functions).

New function, starting from: Firmware Standard=10.08A (TPD32-EV), Firmware FC-200V =10.25A and Firmware FC-500V=10.26A (TPD32-EV-FC).

		BIT							
		7	6	5	4	3	2	1	0
Status no.1	Drive disabled	0	1	0	0	0	0	0	0
Status no.2	Drive enabled & start; No Alarms active	0	0	1	1	0	1	1	1
Status no.3	Drive enabled & start; Warning active	1	0	0	1	1	1	1	1
Status no.4	Drive disabled; Warning active; start not possible	1	0	0	0	1	0	0	0
Status no.5	Drive disabled; Warning active; start possible	1	1	0	0	0	0	0	0
Status no.6	Drive disabled; Fault active (alarm set as activity > Warning)	0	0	0	0	1	0	0	0
Status no.7	Drive enabled & start; Fault active (alarm set as activity > Warning that cause drive stop) with no previous Warning condition	0	0	0	1	1	0	0	0
Status no.8	Drive enabled & start; Fault active (alarm set as activity > Warning that cause drive stop) with previous Warning condition	1	0	0	1	1	0	0	0

Nota! **Bit 0, 1, 2 of Status no.7 and Status no.8:** when the motor is running (drive enabled) the value of bits 1,2,3 is 1 (one). Whenever a fault occours (that disables the drive), the motor will stop. When the motor speed is 0 (zero) the 3 bits change from 1 to 0.

BITs Description

BIT	Description
0,1,2	Motor regulation Active (Drive enabled and start, No fault)
3	Malfunctioning Active (Fault or/and warning) Except when the drive is disabled and/or Alarm activity set to warning which does not prevent activation of motor
4	Drive enabled and start (is set to 0 (zero) if enable=0 and start=0. If a drive fault is shown it remains to 1 (one) until Enable command and Start is not removed (set to = 0 (zero))
5	Drive enabled and NO Malfunctioning situation
6	Drive disabled and no fault
7	Warning active Note : this bit is set to 1 (one) also when command RL Search is selected. Both when drive is disabled and during autotuning procedure)

6.18.2 Speed

DRIVECOM

[44]	Speed input var [FF]
[115]	Speed ref var [FF]
[119]	Act speed value [FF]
[45]	Speed base value [FF]
[46]	Speed input perc [%]
[116]	Percent ref var [%]
[120]	Act percentage [%]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Speed input var [FF]	44	-2 P45	+2 P45	0	0	*
Speed ref var [FF]	115	-32768	+32767	-	-	**
Act speed value [FF]	119	-32768	+32767	-	-	***
Speed base value [FF]	45	1	16383	1500	1500	
Speed input perc [%]	46	-32768	+32767	0	0	*
Percent ref var [%]	116	-32768	+32767			**
Act percentage [%]	120	-32768	+32767			***

* Factory set as Ramp ref and connected to analog input 1 (terminal 1 and 2). See reference values.
** Factory set as Speed ref and connected to the ramp output. See reference values.
*** Factory set as Motor speed and connected to analog output 1. See BASIC MENU.

Speed input var 1st ramp reference value. The value to be entered is based on the factor function

Speed ref var 1st speed reference value. The value to be entered is based on the factor function

Act speed value Speed actual value in the unit specified in the factor function.

Speed base value The **Speed base value** is given in the unit specified in the factor function. It is the base value for all speed values given as a percentage (reference values, adaptive speed regulation ...). A change in this parameter is only possible when the drive is disabled. (**Enable drive** = Disabled).

Speed input perc 1st ramp reference value. Defined as a percentage of the **Speed base value**

Percent ref var 1st speed reference value. Defined as a percentage of the **Speed base value**

Act percentage Speed actual value as a percentage of the **Speed base value**

6.18.3 Speed limitation

DRIVECOM

- **Speed amount**
  - [1] Speed min amount [FF]
  - [2] Speed max amount [FF]
- **Speed min/max**
  - [5] Speed min pos [FF]
  - [3] Speed max pos [FF]
  - [6] Speed min neg [FF]
  - [4] Speed max neg [FF]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Speed min amount [FF]	1	0	2^{32}-1	0	0	-
Speed max amount [FF]	2	0	2^{32}-1	5000	5000	-
Speed min pos [FF]	5	0	2^{32}-1	0	0	-
Speed max pos [FF]	3	0	2^{32}-1	5000	5000	-
Speed min neg [FF]	6	0	2^{32}-1	0	0	-
Speed max neg [FF]	4	0	2^{32}-1	5000	5000	-

Speed min amount Defines the minimum speed for both rotation directions (with TPD32-EV...4B...).

A lower value than the defined value is not possible, regardless of the reference value set. It has an effect on the input of the ramp. If the **Speed min amount** parameter is changed, the **Speed min pos** and **Speed min neg** parameters are set to the same value. If one of these two parameters is changed later, the last change is valid. The current value for positive rotation (clockwise) is shown in the display of the keypad. The value to be entered is based on the factor function.

Speed max amount Defines the maximum speed for both rotation directions (with TPD32-EV...4B...).

The function has an effect on the input of the speed regulator and therefore takes into account the reference value that comes from the ramp as well as the directly defined values (see Figure 6.4.2.1). If the Speed max amount is changed, the **Speed max pos** and **Speed max neg** parameters are set to the same value. If one of these two parameters is changed later, the last change is valid. The current value for positive rotation (clockwise) is shown in the display of the keypad. The value to be entered is based on the factor function.

Speed min pos Defines the minimum speed for the clockwise rotation of the motor. A lower value than the defined value is not possible, regardless of the reference value. The function has an effect on the input of the ramp (see Figure 6.4.1.1). The value to be entered is based on the factor function.

Speed max pos Defines the maximum speed for the clockwise rotation of the motor. The function has an effect on the input of the speed regulator, and therefore takes into consideration the reference value that comes from the ramp as well as those that are entered directly (see Figure 6.4.2.1). The value to be entered is based on the factor function.

Speed min neg Defines the minimum speed for the anti-clockwise rotation of the motor (with TPD32-EV...4B...). A lower value than the defined value is not possible, regardless of the reference value. The function has an effect on the input of the ramp (see Figure 6.4.1.1). The value to be entered is based on the factor function.

Speed max neg Defines the maximum speed for the anti-clockwise rotation of the motor (with TPD32-EV...4B...). The function has an effect on the input of the speed regulator, and therefore takes into consideration the reference value that comes from the ramp as well as the those that are entered directly (see Figure 6.4.2.1). The value to be entered is based on the factor function.

6.18.4 Acceleration / Deceleration

DRIVECOM

Acceleration

[21]	Acc delta speed [FF]
[22]	Acc delta time [s]

Deceleration

[29]	Dec delta speed [FF]
[30]	Dec delta time [s]

Quick stop

[37]	QStp delta speed [FF]
[38]	QStp delta time [s]

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Acc delta speed [FF]	21	0	2^{32}-1	100	100	
Acc delta time [s]	22	0	65535	1	1	
Dec delta speed [FF]	29	0	2^{32}-1	100	100	
Dec delta time [s]	30	0	65535	1	1	
QStp delta speed [FF]	37	0	2^{32}-1	1000	1000	
QStp delta time [s]	38	0	65535	1	1	
Quick stop Quick stop (0) No Quick stop (1)	343	0	1	No Quick stop	No Quick stop	

Acc delta speed Has the same unit as the ramp reference value and is based on the factor function.

Acc delta time Is defined in seconds. The ramp output follows the reference value directly if “0 s” is entered.

Dec delta speed Has the same unit as the ramp reference value and is based on the factor function.

Dec delta time Is defined in seconds. If “0 s” is entered, the ramp output follows the reference value directly.

Qstp delta speed Has the same unit as the ramp reference value and is based on the factor function.

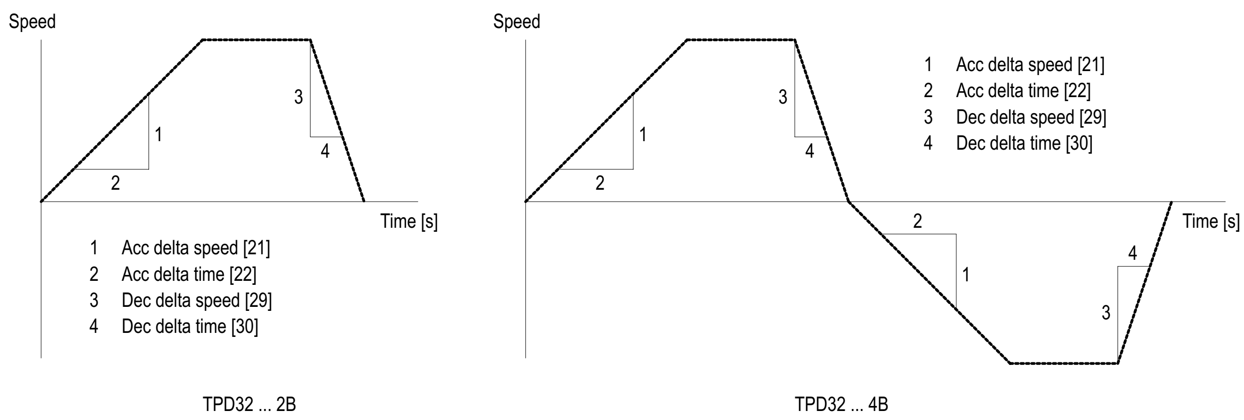


Figure 6.17.4.1: Acceleration and deceleration

Qstp delta time Is defined in seconds. If “0 s” is entered, the ramp output follows the reference value directly.

Quick stop Activates the Quick stop ramp to stop the Drive.

The acceleration of the drive is defined as a quotient of the **Acc delta speed** and **Acc delta time** parameters. It is the same for both rotation directions of the motor.

The deceleration of the drive is defined as a quotient of the **Dec delta speed** and **Dec delta time** parameters. It is the same for both rotation directions of the motor.

The Quick stop function provides a second deceleration ramp for braking the drive to halt in the event of an emergency. The deceleration of the drive using the Quick stop function is defined as a quotient of the Qstp delta speed and Qstp delta time. It is the same for both rotation directions of the motor. This function is only available via the serial interface or BUS.

6.18.5 Factor function

DRIVECOM			
	Face value fact		
		[54]	Face value num
		[53]	Face value den
	Dimension fact		
		[50]	Dim factor num
		[51]	Dim factor den
		[52]	Dim factor text

The factor function contains two factors, the Dimension factor and Face value factor. They are both expressed as fraction numbers.

The dimension factor enables the drive speed to be defined in a machine-related dimension, e.g. kg/h or m/min.

Further information and examples are given in the section on the Configuration menu.

Parameter description	No.	Value				Standard Configuration
		min	max	Factory American	Factory Standard	
Face value num	54	1	32767	1	1	
Face value den	53	1	32767	1	1	
Dim factor num	50	1	65535	1	1	
Dim factor den	51	1	2^{31}-1	1	1	
Dim factor text	52			rpm	rpm	

Dim factor num Numerator of the dimension factor

Dim factor den Denomiator of the dimension factor

Dim factor text Unit of the dimension factor. This text is shown in the display of the keypad when the reference value is shown.
Possible characters: / % & + , - . 0..9 : < = > ? A...Z [ ] a...z

Face value num Numerator of the reference value factor.

Face value den Denominator of the reference value factor.

See example in section 6.11.7, “Dimension factor, Face value factor”, on how to make the calculation.

6.19 SERVICE

The SERVICE menu is only accessible for the service personnel of the manufacturer.

7- MAINTENANCE

7.1 CARE

The TPD32-EV converters must be installed according to the relevant installation regulations. They do not require any particular care. They should not be cleaned with a wet or moist cloth. The power supply must be switched off before cleaning.

7.2 SERVICE

The screws of all terminals on the device should be tightened two weeks after initial commissioning. This should be repeated once a year.

7.3 REPAIRS

Repairs on the device should be made by your supplier's trained personnel.

If you carry out a repair of your own, observe the following points:

- When ordering spare parts, do not only state the device type but also the device number (nameplate). It is also useful to state the type of regulator card and the software version of the operating system (data plate attached to the EEPROM of the R-TPD32 regulation card).
- When exchanging cards, ensure that the positions of switches and jumpers are observed. This particularly applies to switch SW15 on the regulator card. This sets the rated current of the converter.

Note! The manufacturer does not accept any liability for any device parts that are destroyed due to the incorrect position of switch SW15.

7.4 CUSTOMER SERVICE

For customer service, please contact your Gefran office.

8 - TROUBLESHOOTING

The following describes possible faults and their causes.

Failure alarms in the keypad display

FAILURE ALARM	POSSIBLE CAUSES
Bus loss	Failure in the Bus connection (only with interface Bus option card) • Check the Bus connection • EMC compatibility problems • Try a RESET. If you are still unsuccessful: probable internal fault. Contact your sales office.
Brake fault	Error in the brake opening or closing sequence after the **Brake control** has been enabled. • Refer to chapter **6.14.8** and check that wiring, parameters and sequences of signals are correct.
Delta frequency	Excessive difference between the frequency of the three-phase power supply input and the value measured the instant this is guaranteed. • **Delta freq thres** parameter set too low. • Check that the frequency of the three-phase power supply remains constant or in any case within the threshold limit throughout drive operation.
Drive I2t ovrld	Excessive drive overload. • Wait until the accumulator (**Drive I2t accum**) is zeroed before resetting the alarm and then enable the drive. No data can be configured for this alarm; however, reference should be made to chapter **6.14.6** for further information about calculating thresholds.
Enable seq err	Drive is powered up or Reset with Enable input connected to 24 V (picked up) and the Drive is configured to run from the terminals. Refer to CONFIGURATION/Main commands.
External fault	External failure, reported on terminal 15. • External failure, reported on terminal 15 • If the "External fault" message is not used: connection missing between terminals 16 and 18 (reference point) and/or 15 and 19. • The signal on terminal 15 is missing (15...30V to terminal 16). With external voltage supply: reference points must be connected with each other!
Failure supply	Fault in voltage supply = the voltages are below the permitted value CAUTION: switch off voltage before removing terminal strips. • In most cases the cause is in the external wiring. Pull out the plug-in terminal strips of the regulator card and enter the Reset command. If no other failures are reported, check your wiring for a short-circuit, in some cases with the cable shielding. • If this has not rectified the fault: remove the terminal strips of the I/O option card (if present) and try RESET once more. • If you are still unsuccessful: probably an internal fault. Contact your sales office
Field loss	Too low field current • The field regulation is blocked • The conductors in the field circuit are interrupted • Field fuses are active
Heatsink	Heatsink temperature too high • Ambient temperature too high • Failure of device fan [with devices > 88 A (American), 110 A (Standard)] • Dirty heatsink.
Hw opt1 failure	Failure on the option card 1 • Try a RESET. If you are still unsuccessful: probable internal fault. Contact your sales office.
Motor I2t ovrld	Excessive motor overload. • Refer to chapters **6.14.6** and **6.11.7** (**Motor I2t ovrld** alarm) and check the exactness of the data that have been entered. If these are correct, wait until the accumulator (**Motor I2t accum**) is zeroed before resetting the alarm and then enable the drive.
Opt2 failure	Failure on the option card 2 • Try a RESET. If you are still unsuccessful: probable internal fault. Contact your sales office.

FAILURE ALARM	POSSIBLE CAUSES
Overcurrent	Overcurrent in the motor circuit • Short-circuit or ground fault at the output of the converter • Current regulator optimized incorrectly • **Overcurrent thr** parameter too low
Overspeed	Excessive motor speed in the feedback circuit. • **Overspeed thr** parameter set too low. • Check that the **Speed fbk sel** parameter has been selected consistently with the feedback used (Encoder 1, Encoder 2, Tacho, Armature). • If an encoder or tacho generator feedback circuit is used, check the relative wiring.

Overtemp Motor	Motor overtemperature (signaled by the thermistor to the terminals 78/79)
	• the motor is not provided with a thermistor: no jumper between the terminals 78 and 79
	• Cable between thermistor connection on motor and terminals 78 and 79 interrupted.
	• Overheating of motor:
	  • Load cycle too extreme
	  • Ambient temperature at site of motor too high
	  • Motor has an external fan: fan failed
	  • Motor does not have an external fan: too large a load at low speeds. The cooling effect of the fan on the motor shaft is too low for this load cycle. Change cycle or fit external fan.

Overvoltage	Overvoltage of the armature circuit • **Max out voltage** parameter set too low. • The drive does not operate with a field weakening, even though the set speed can be reached only with a field weakening. Check the **Flux reg mode** parameter
Speed fbk loss	No speed feedback signal • The conductors of the feedback signal are interrupted • One or several encoder channels are missing (conductor interruption, no encoder power supply)

SSC Error	Non-configurable alarm that disables the drive if:
	• no serial communication is received from the slave, because:
	  • Slave disconnected
	  • Slave not configured correctly (En ext digit FC parameter disabled)
	  • no signals on optical fibre cables (cable HW problems or optical fibres not connected properly)
	• data are exchanged but regarded as incorrect (checksum not valid)
	  • The alarm can be programmed on a digital output (see "6.12.3 Digital Outputs" on page 216, selezione 79).

Undervoltage	Undervoltage on the power circuit
	• Undervolt thr parameter set incorrectly (possibly 400 V set, although the device is run on 230 V). Remedy: set parameter correctly and then acknowledge the failure via RESET.
	• The incoming voltage to the terminals U/V/W of the device is too low due to:
	  • too low an AC input voltage
	  • poor cable connections (e.g. terminals on contactor, choke, filter ... not properly fixed). Remedy: check connections.
	• Intervention of the line fuses
	• AC input voltage dips, or high distortion of the supply voltage
	• The converter has been enabled when the supply voltage is not present.

Short <SCR> **Open F <SCR>**	• SCR in Short or Open. • For details, see chapter "6.11.8 Programmable alarms" on page 196.

Other faults

FAILURE	POSSIBLE CAUSES
The motor is not turning	• Failure alarm is displayed: see table above • Once the error has been rectified give the RESET command • Keypad display is dark: voltage supply to terminals U2/V2 missing or internal fuse blown or missing • Enable and/or start command missing • Converter not accepting commands: incorrect or wrongly selected operating mode • Protective device of the power supply has tripped: protective device incorrectly sized or fault on the thyristor bridge • The analog input used for the reference value was not assigned or assigned differently • Negative reference with TPD32-EV...2B. The reference for the biquadrant converters must always be positive!
The motor is turning in a wrong way	• Wrong polarity of the reference sign (with TPD32-EV...4B) • The motor is connected in a wrong way. ATTENTION: when the motor turns in a wrong way but the rotation direction can be changed, remember to change **both** the armature or field conductors and the two encoder connections (A+ with A- **or** B+ with B-). Using a tachometer change the conductor polarity.

The motor does not reach the rated speed	• Drive is within speed limitation. Remedy: check **Speed max amount, Speed max pos** and **Speed max neg** parameters
	• Drive working at current limit (LED ILimit lit) Possible causes:
	  • Motor overloaded
	  • Converter sized too small
	  • Flux reduction selected via **Torque reduct.**
	• The entered value for the number of encoder pulses is too high. Remedy: check the parameters concerned (**Encoder 1 pulses** when using plug connector XE1 or **Encoder 2 pulses** with plug connector XE2) and set correct value.
	• Wrong adaptation of the tachometer voltage. Check the voltage field choice (jumpers to the terminals A/B/C). Check the **Tacho scale** parameter.
	• A correction value reduces the main reference value. Remedy: check the configuration
	• The factor function is set incorrectly.

The motor reaches the maximum speed immediately	• Reference value set via terminals: Check whether the value varies from min. to max. value. Potentiometer used for reference value setting: is there a 0V connection present?
	• Encoder/tachometer not connected, or incorrectly connected or not supplied:
	• Preset the **Actual spd** parameter in the DRIVE STATUS menu.
	  • With the regulator disabled turn the motor clockwise (viewed from the front of the shaft). The value indicated must be positive.
	  • If the indicated value does not change or if inexplicable values are shown, check the power supply and the cabling of the encoder/tachometer.
	  • If the indicated value is negative, reverse the encoder connections. Exchange channel A+ and A- or B+ and B-. Using a tachometer change the conductor polarity.

The motor accelerates too slowly	• Ramp set incorrectly
	• Motor running at max. current
	  • Motor overloaded
	  • Converter too small

The motor decelerates too slowly	• Ramp values and times incorrectly set • Braking current too low • With two quadrant drives: moment of inertia too high.

The motor turns slowly even though the reference value = zero	• Minimum speed selected
	• Interference due to unused analog input. Remedy: set unused analog inputs to OFF
	• Disconnect reference value on used analog input.
	  • If drive now stands still, the effect is due to the cable resistance of the 0V cable.
	  • If the drive is still turning: check if the speed reference is zero. If it is not zero set **Offset input xx** parameter so that the drive stands still. If it is zero set Spd offset parameter.

The motor thermic is active	• Overloaded motor • Motor thermic protection relay incorrectly scaled

The motor is not supplying the max torque and the max power	• Drive working at current limit
	  • Check whether the value for **Full load curr** in the CONFIGURATION menu is set correctly
	  • Check the value for the current limitation

FAILURE	POSSIBLE CAUSES
The speed during acceleration with max. current is not linear	• Reduce the **Speed I** and **Speed P** proportionally. If this does not lead to an improvement, optimize the regulator (see chapter 5.3.6).
Speed oscillating	• Check **Speed P** and **Speed I** parameter • If the operating point is in the field weak range, check the **Fld reg P gain** and **Fld reg I gain** parameters and eventually **Voltage P** and **Voltage I** parameters. • Remedy: Optimize the regulator as previously described
Drive not reacting to adaptive speed regulation	• Adaptive speed regulation not enabled. **Enable spd adap** = Enabled
Motor potentiometer function not executed	• Function not enabled. **Enable motor pot** = Enabled • With operation via the terminal strip: **Motor pot up** and/or **Motor pot down** were not assigned to a digital input
Jog operation not possible	• A start command is still present • Function not enabled. **Enable jog** = Enabled • With operation via terminal strip: **Jog +** and/or **Jog -** were not assigned to a digital input.
Internal speed reference values not carried out	• Function not enabled. **Enab multi spd** = Enabled • With operation via terminal strip: **Speed sel 0, Speed sel 1** and **Speed sel 2** were not assigned to a digital input.
Multi-Ramp function not reacting	• Function not enabled. **Enab multi rmp** = Enabled • With operation via terminal strip: **Ramp sel 0** and **Ramp sel 1** were not assigned to a digital input
Overload not possible	• Function not enabled. **Enable overload** = Enabled
The Current regulator selftune procedure never finishes and continues over and over again.	• Because of the motor inductance value, the routine is executing an endless loop. The inductance value is cycling between two values without an evolution of the algorithm. • Solution procedure: 1) verify the two displayed inductance values 2) insert the average value as motor inductance during the autotuning. If the procedure does not end, repeat step 1) and 2).

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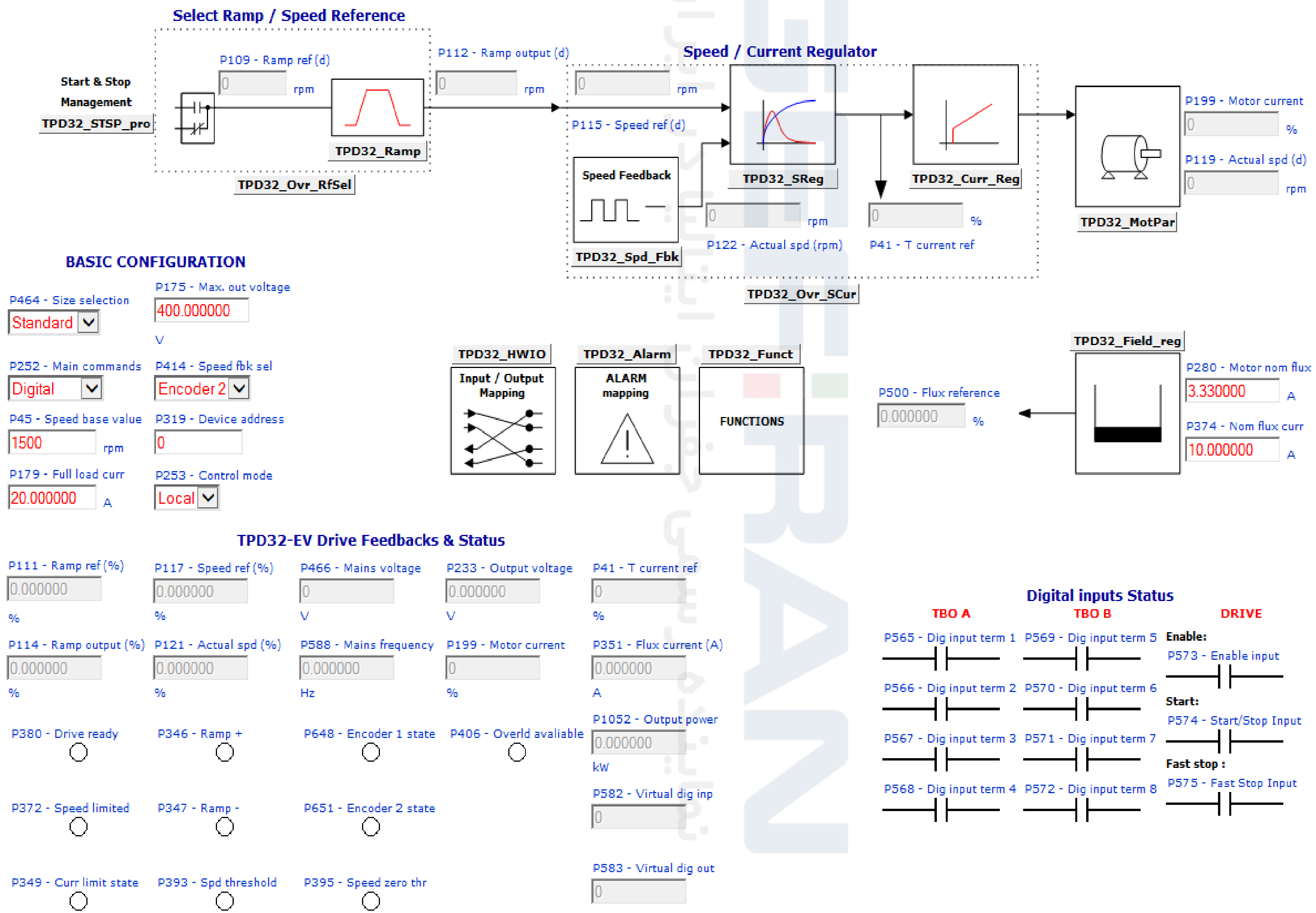
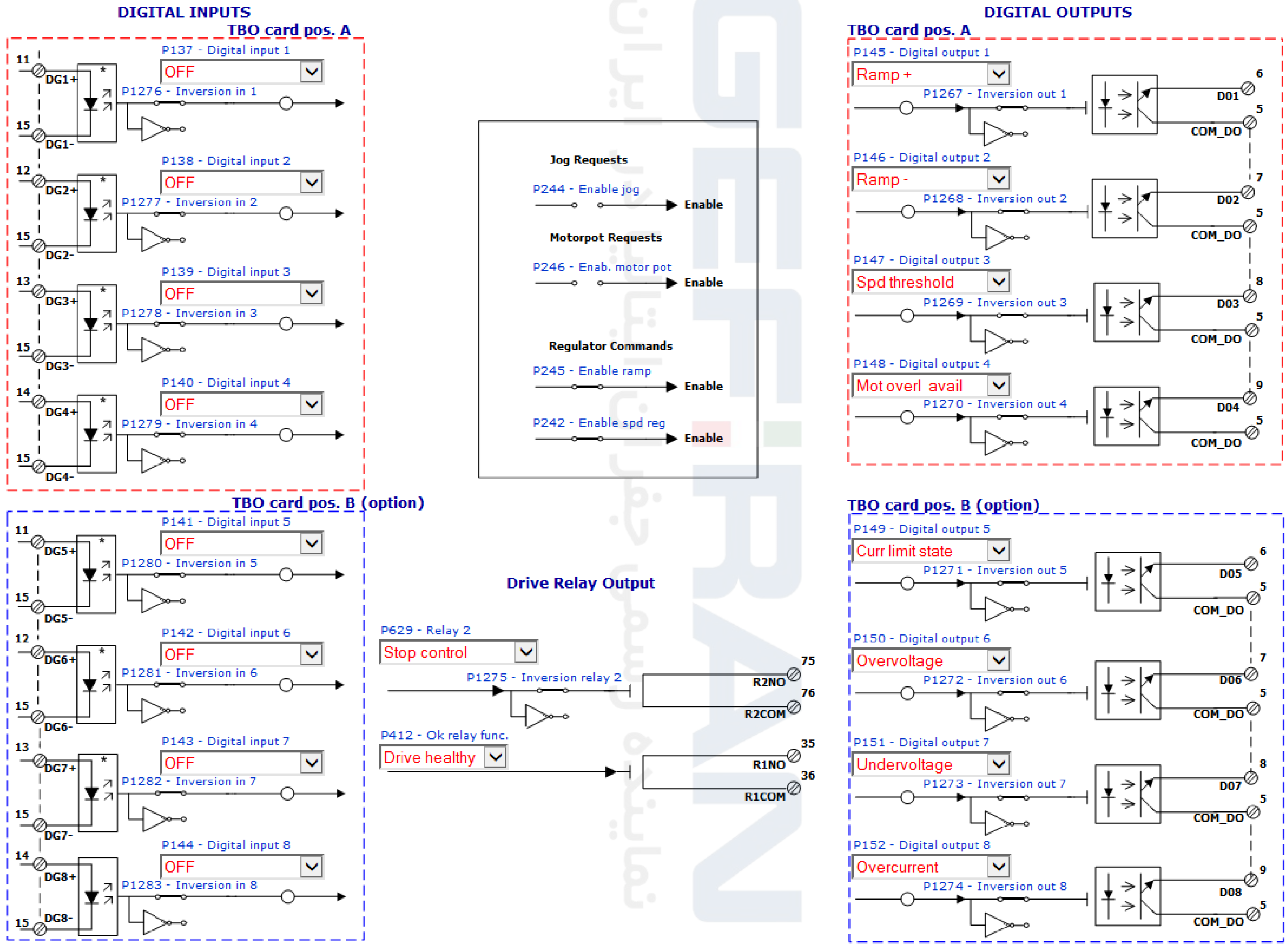
9 - BLOCK DIAGRAM

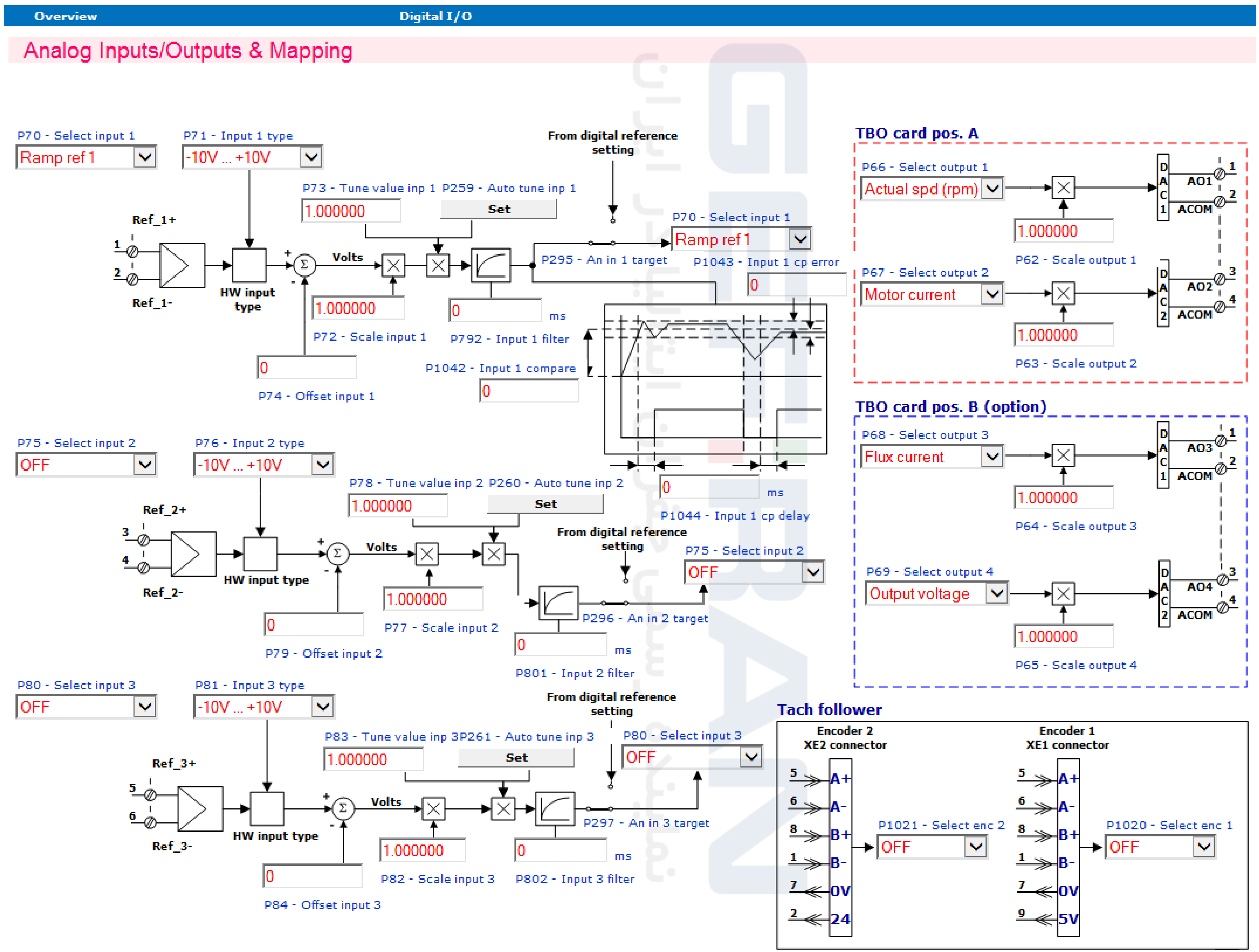
9.1 CONTROL BLOCK DIAGRAMS

TPD32-EV Converter Overview

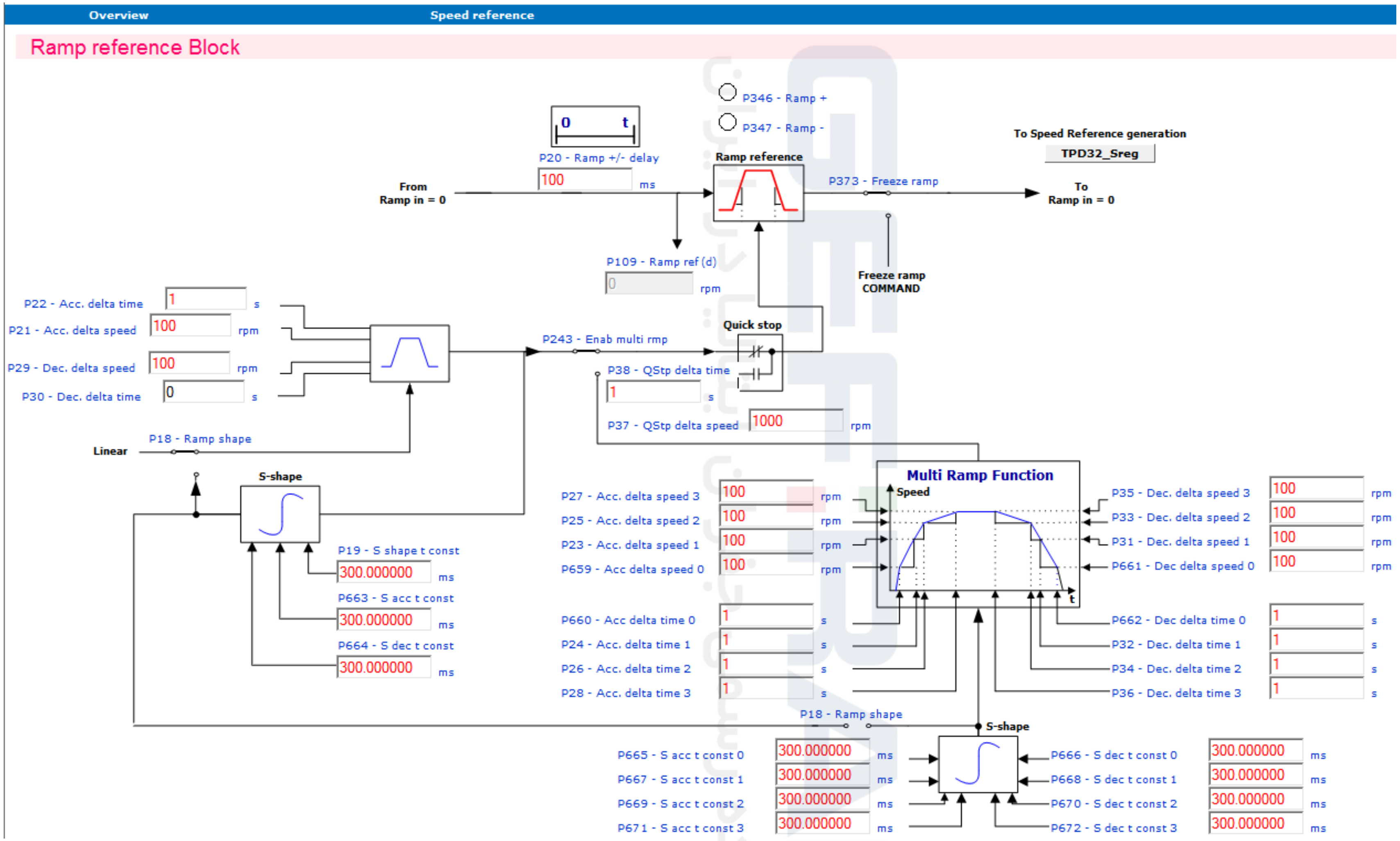


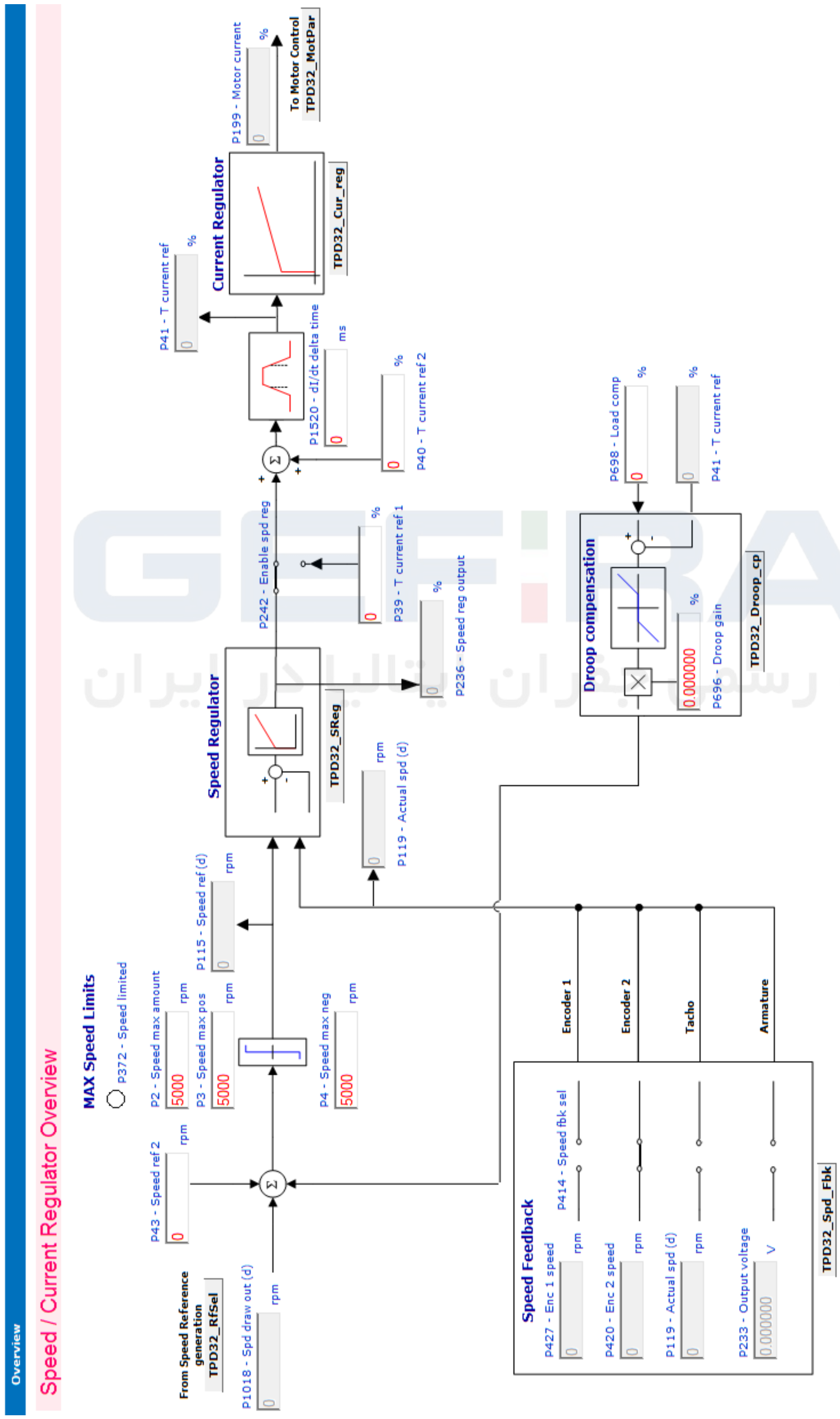
Digital Inputs/Outputs & Mapping - Standard and TBO cards




Overview
Digital I/O
Analog Inputs/Outputs & Mapping
P70 - Select input 1
Ramp ref 1
P71 - Input 1 type
-10V ... +10V
From digital reference setting
P73 - Tune value inp 1
P259 - Auto tune inp 1
1.000000
Set
Ref_1+
Ref_1-
HW input type
Volts
P295 - An in 1 target
P1043 - Input 1 cp error
P72 - Scale input 1
P792 - Input 1 filter
ms
P1042 - Input 1 compare
P74 - Offset input 1
P1044 - Input 1 cp delay
P75 - Select input 2
OFF
P76 - Input 2 type
P78 - Tune value inp 2
P260 - Auto tune inp 2
Ref_2+
Ref_2-
P296 - An in 2 target
P77 - Scale input 2
P79 - Offset input 2
P801 - Input 2 filter
P80 - Select input 3
P81 - Input 3 type
P83 - Tune value inp 3
P261 - Auto tune inp 3
Ref_3+
Ref_3-
P297 - An in 3 target
P82 - Scale input 3
P802 - Input 3 filter
P84 - Offset input 3
TBO card pos. A
P66 - Select output 1
Actual spd (rpm)
AO1
ACOM
P62 - Scale output 1
P67 - Select output 2
Motor current
AO2
P63 - Scale output 2
TBO card pos. B (option)
P68 - Select output 3
Flux current
AO3
P64 - Scale output 3
P69 - Select output 4
Output voltage
AO4
P65 - Scale output 4
Tach follower
Encoder 2
XE2 connector
Encoder 1
XE1 connector
A+
A-
B+
B-
0V
24
5V
P1021 - Select enc 2
P1020 - Select enc 1

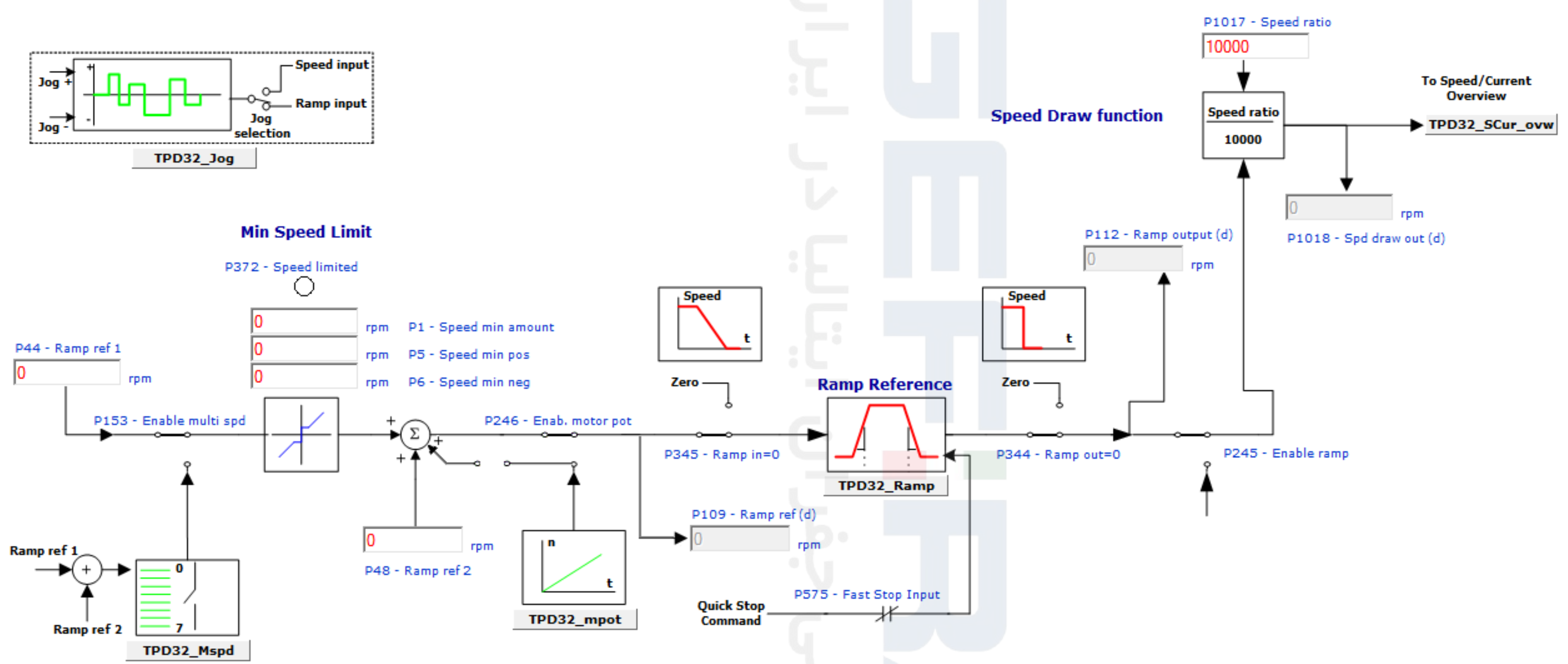

Overview
Speed Reference Generation
Speed input
Ramp input
Jog selection
Jog +
Jog -
TPD32_Jog
Min Speed Limit
P372 - Speed limited
P1 - Speed min amount
P5 - Speed min pos
P6 - Speed min neg
rpm
P44 - Ramp ref 1
P153 - Enable multi spd
0
7
TPD32_Mspd
Ramp ref 1
Ramp ref 2
P48 - Ramp ref 2
P246 - Enab. motor pot
n
t
TPD32_mpot
P109 - Ramp ref (d)
P345 - Ramp in=0
Zero
Speed
Ramp Reference
TPD32_Ramp
P575 - Fast Stop Input
Quick Stop Command
P344 - Ramp out=0
P112 - Ramp output (d)
P245 - Enable ramp
Speed Draw function
P1017 - Speed ratio
10000
Speed ratio
P1018 - Spd draw out (d)
To Speed/Current Overview
TPD32_SCur_ovw


Overview
Speed reference
Ramp reference Block
P20 - Ramp +/- delay
100
ms
From
Ramp in = 0
P346 - Ramp +
P347 - Ramp -
Ramp reference
P373 - Freeze ramp
To Speed Reference generation
TPD32_Sreg
To
Ramp in = 0
P109 - Ramp ref (d)
0
rpm
Freeze ramp
COMMAND
P22 - Acc. delta time
1
s
P21 - Acc. delta speed
100
rpm
P29 - Dec. delta speed
100
rpm
P30 - Dec. delta time
0
s
P243 - Enab multi rmp
Quick stop
P38 - QStp delta time
1
s
P37 - QStp delta speed
1000
rpm
Linear
P18 - Ramp shape
S-shape
P19 - S shape t const
300.000000
ms
P663 - S acc t const
300.000000
ms
P664 - S dec t const
300.000000
ms
Multi Ramp Function
Speed
t
P27 - Acc. delta speed 3
100
rpm
P25 - Acc. delta speed 2
100
rpm
P23 - Acc. delta speed 1
100
rpm
P659 - Acc delta speed 0
100
rpm
P35 - Dec. delta speed 3
100
rpm
P33 - Dec. delta speed 2
100
rpm
P31 - Dec. delta speed 1
100
rpm
P661 - Dec delta speed 0
100
rpm
P660 - Acc delta time 0
1
s
P24 - Acc. delta time 1
1
s
P26 - Acc. delta time 2
1
s
P28 - Acc. delta time 3
1
s
P662 - Dec delta time 0
1
s
P32 - Dec. delta time 1
1
s
P34 - Dec. delta time 2
1
s
P36 - Dec. delta time 3
1
s
P18 - Ramp shape
S-shape
P665 - S acc t const 0
300.000000
ms
P667 - S acc t const 1
300.000000
ms
P669 - S acc t const 2
300.000000
ms
P671 - S acc t const 3
300.000000
ms
P666 - S dec t const 0
300.000000
ms
P668 - S dec t const 1
300.000000
ms
P670 - S dec t const 2
300.000000
ms
P672 - S dec t const 3
300.000000
ms

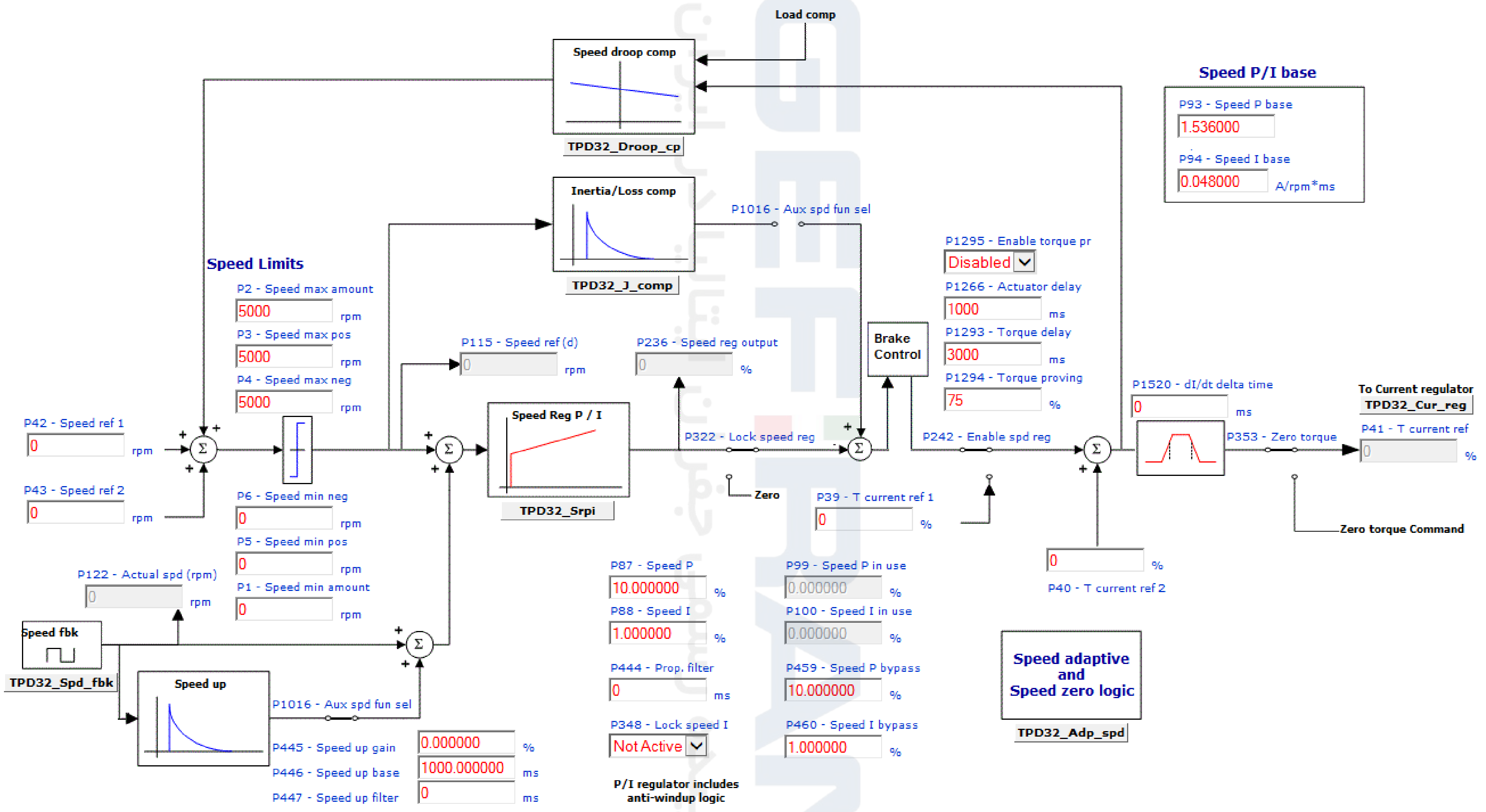

Overview
Speed / Current Regulator Overview
MAX Speed Limits
P372 - Speed limited
P2 - Speed max amount
5000
rpm
P3 - Speed max pos
5000
rpm
P4 - Speed max neg
5000
rpm
From Speed Reference generation
TPD32_RfSel
P1018 - Spd draw out (d)
0
rpm
P43 - Speed ref 2
0
rpm
P115 - Speed ref (d)
0
rpm
Speed Regulator
TPD32_SReg
P119 - Actual spd (d)
0
rpm
P236 - Speed reg output
0
%
P242 - Enable spd reg
P39 - T current ref 1
0
%
P40 - T current ref 2
0
%
P1520 - dI/dt delta time
0
ms
P41 - T current ref
0
%
Current Regulator
TPD32_Cur_reg
P199 - Motor current
0
%
To Motor Control
TPD32_MotPar
Droop compensation
TPD32_Droop_cp
P698 - Load comp
0
%
P41 - T current ref
0
%
P696 - Droop gain
0.000000
%
Speed Feedback
TPD32_Spd_Fbk
P427 - Enc 1 speed
0
rpm
P420 - Enc 2 speed
0
rpm
P119 - Actual spd (d)
0
rpm
P233 - Output voltage
0.000000
V
P414 - Speed fbk sel
Encoder 1
Encoder 2
Tacho
Armature

Overview

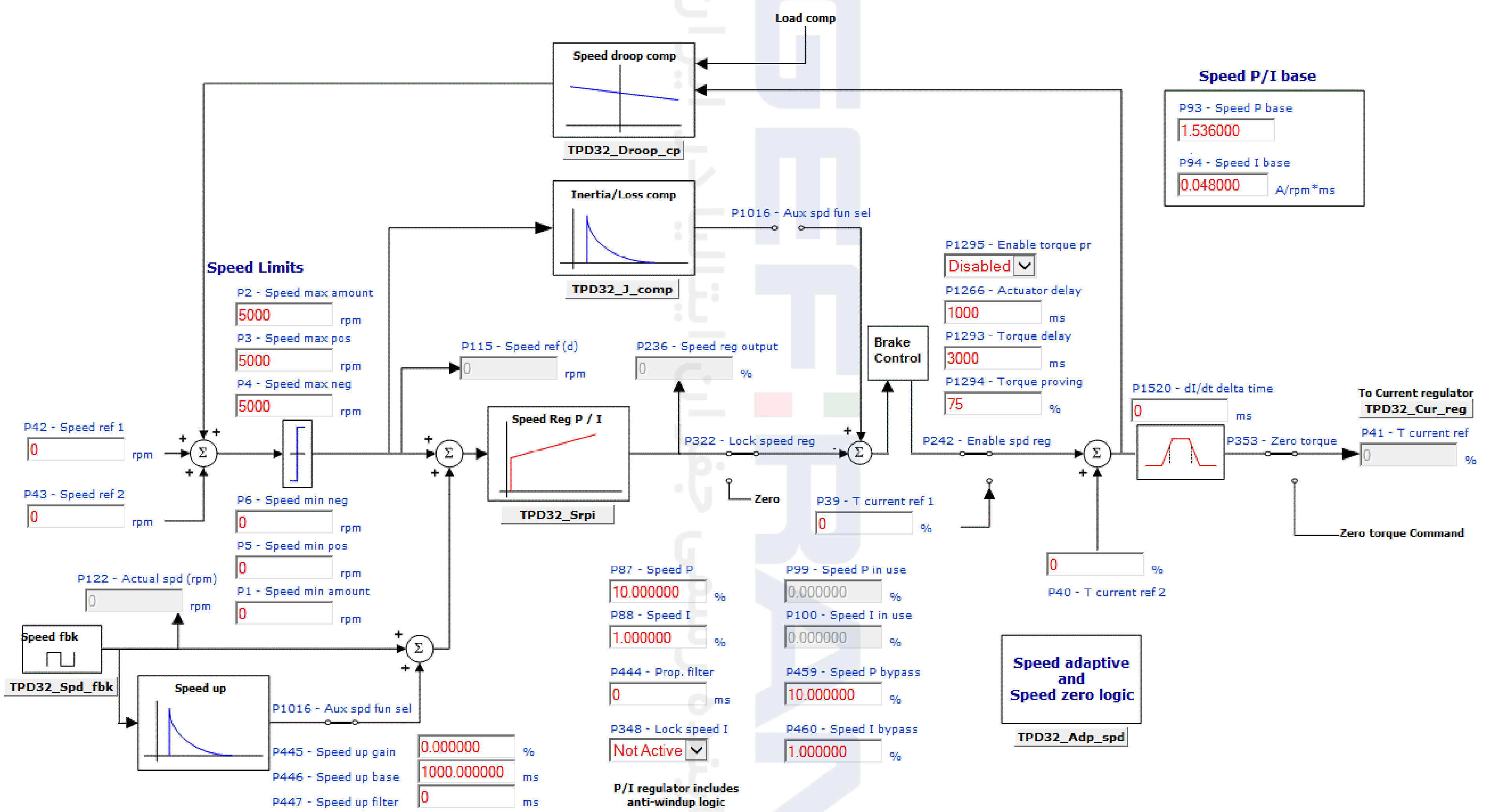
Speed Reference Generation



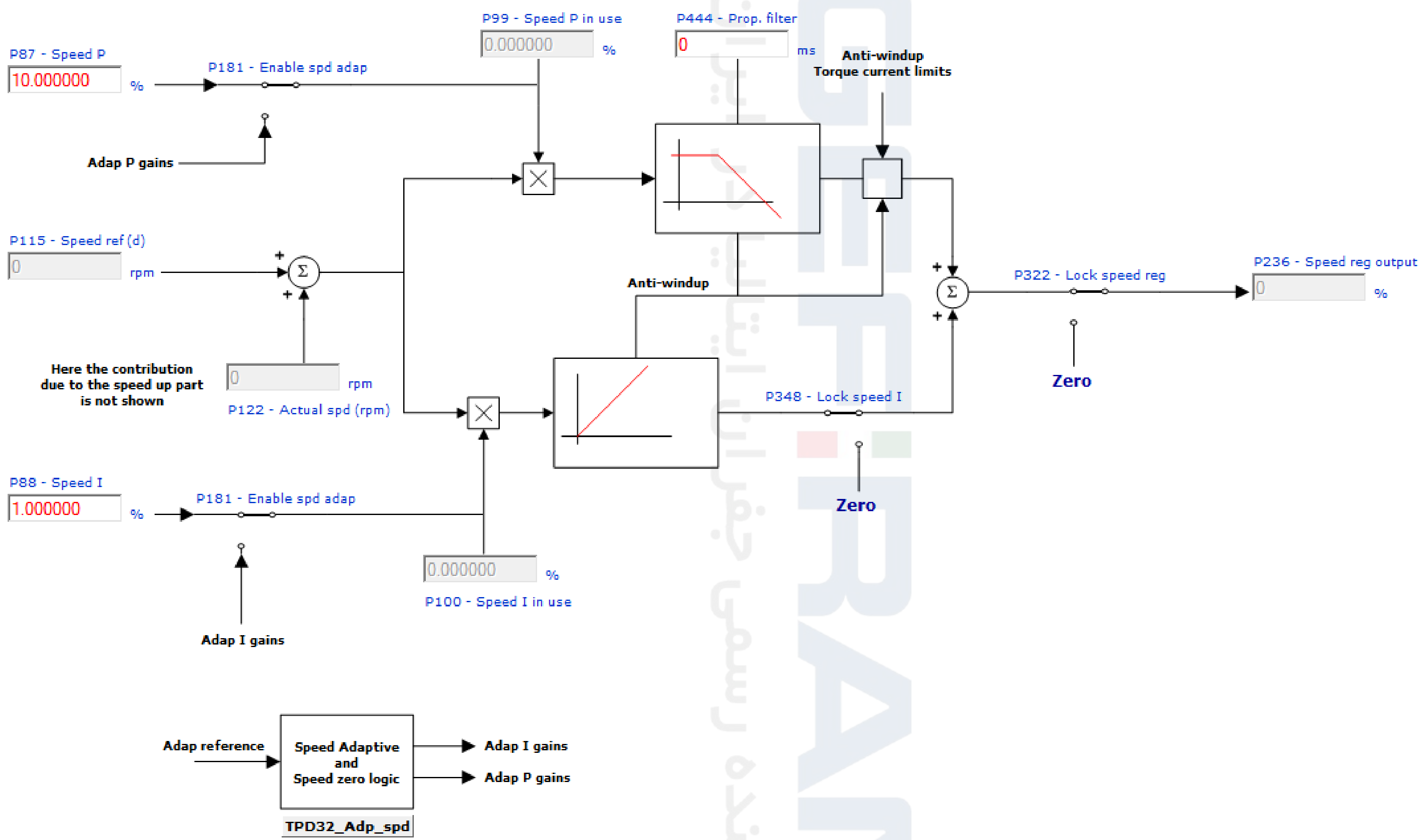
Speed regulator

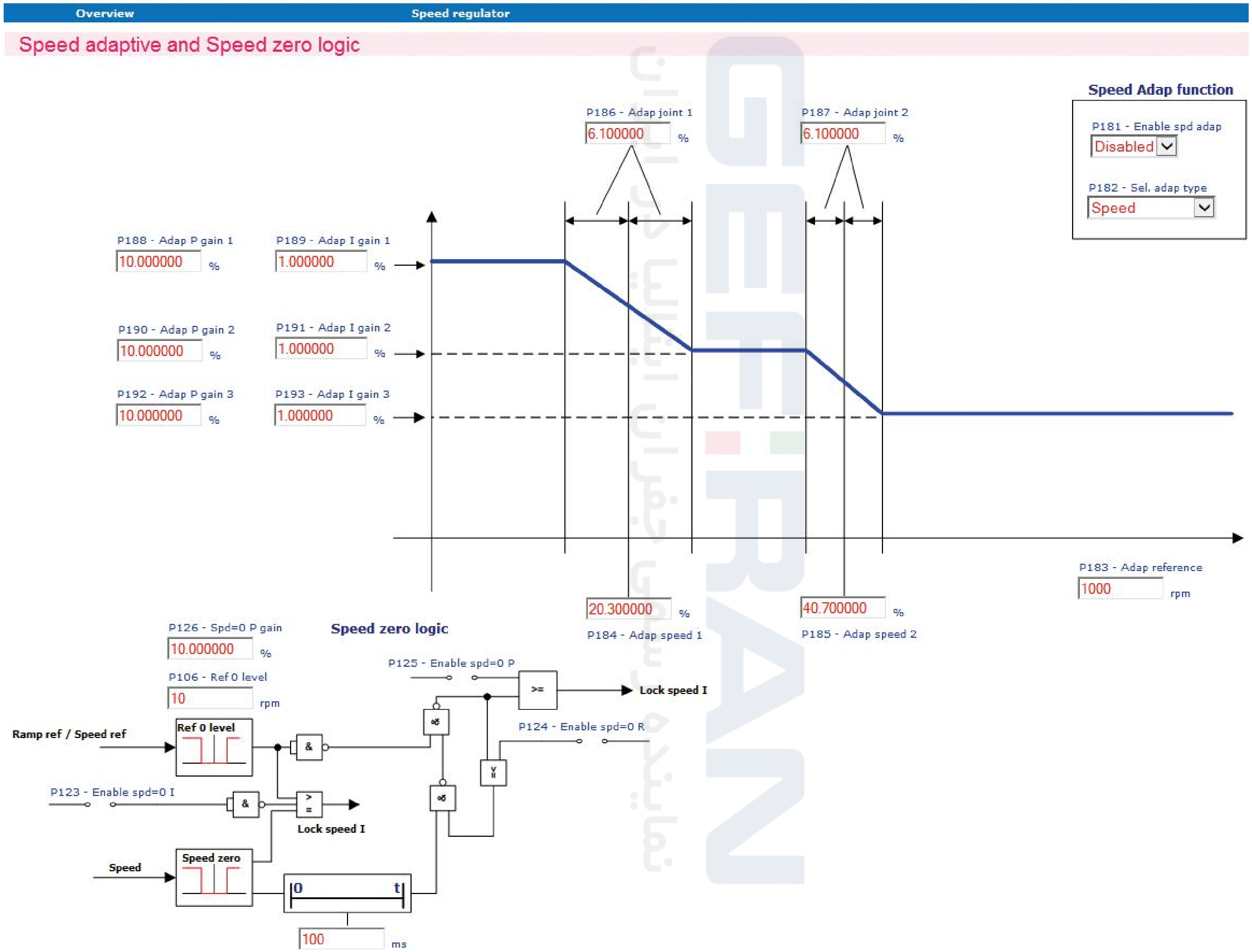


Speed regulator



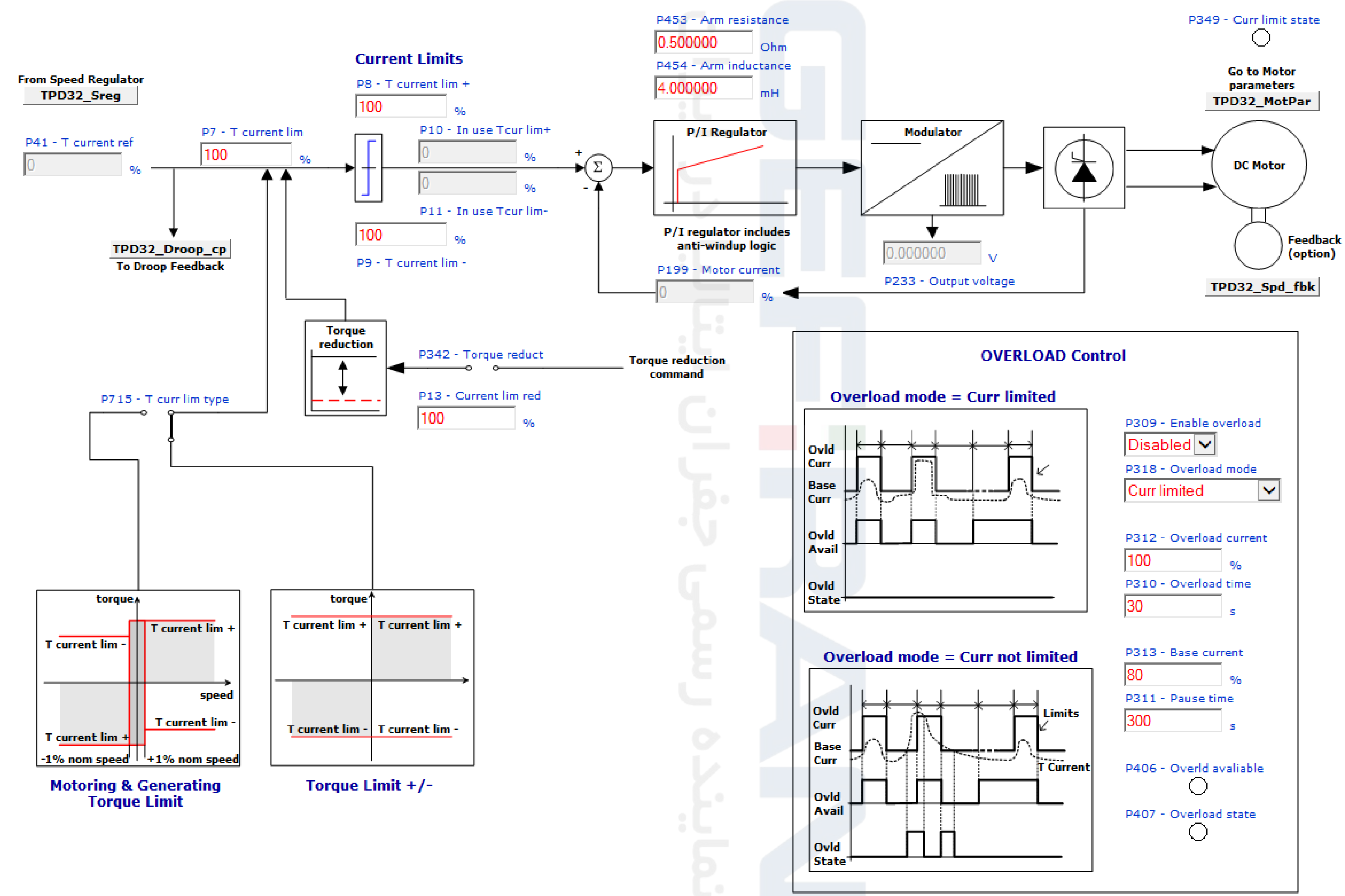
Speed regulator PI part




Overview
Speed regulator
Speed adaptive and Speed zero logic
Speed Adap function
P181 - Enable spd adap
Disabled
P182 - Sel. adap type
Speed
P186 - Adap joint 1
6.100000 %
P187 - Adap joint 2
6.100000 %
P188 - Adap P gain 1
10.000000 %
P189 - Adap I gain 1
1.000000 %
P190 - Adap P gain 2
10.000000 %
P191 - Adap I gain 2
1.000000 %
P192 - Adap P gain 3
10.000000 %
P193 - Adap I gain 3
1.000000 %
20.300000 %
P184 - Adap speed 1
40.700000 %
P185 - Adap speed 2
P183 - Adap reference
1000 rpm
Speed zero logic
P126 - Spd=0 P gain
10.000000 %
P106 - Ref 0 level
10 rpm
Ramp ref / Speed ref
Ref 0 level
P123 - Enable spd=0 I
Speed
Speed zero
0
t
100 ms
Lock speed I
P125 - Enable spd=0 P
>=
Lock speed I
P124 - Enable spd=0 R

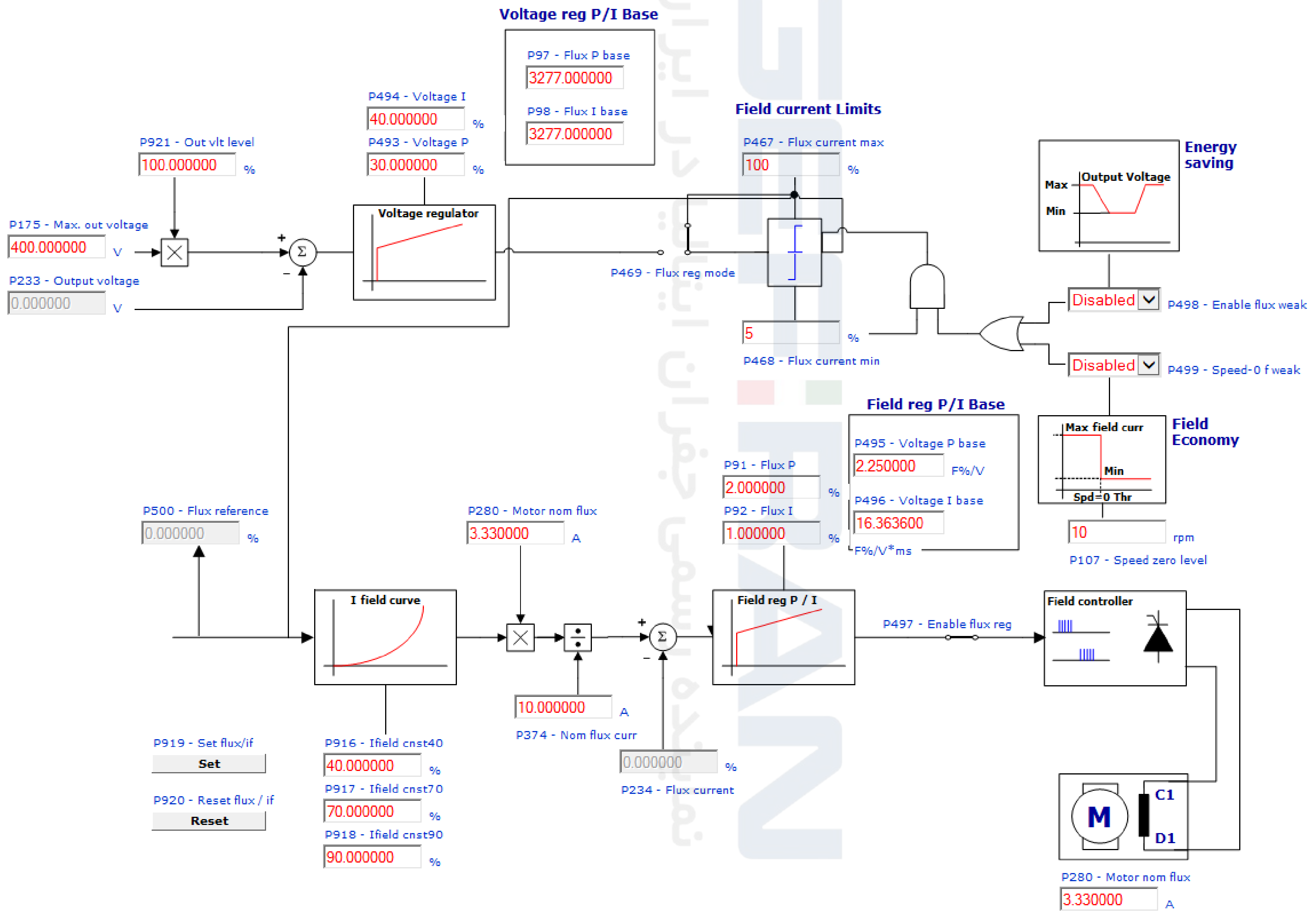
Overview | Regulation overview | Field regulator

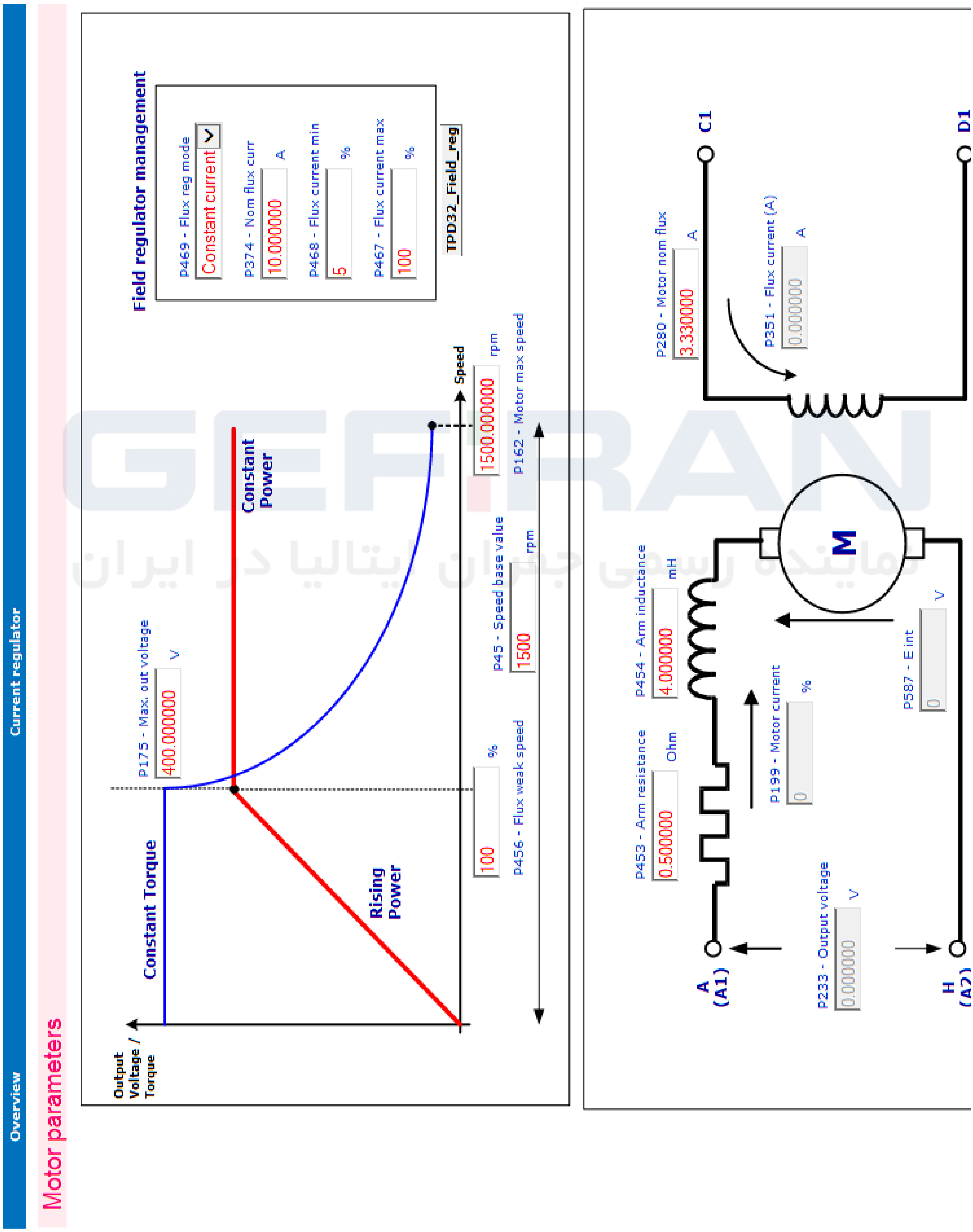
Current regulator



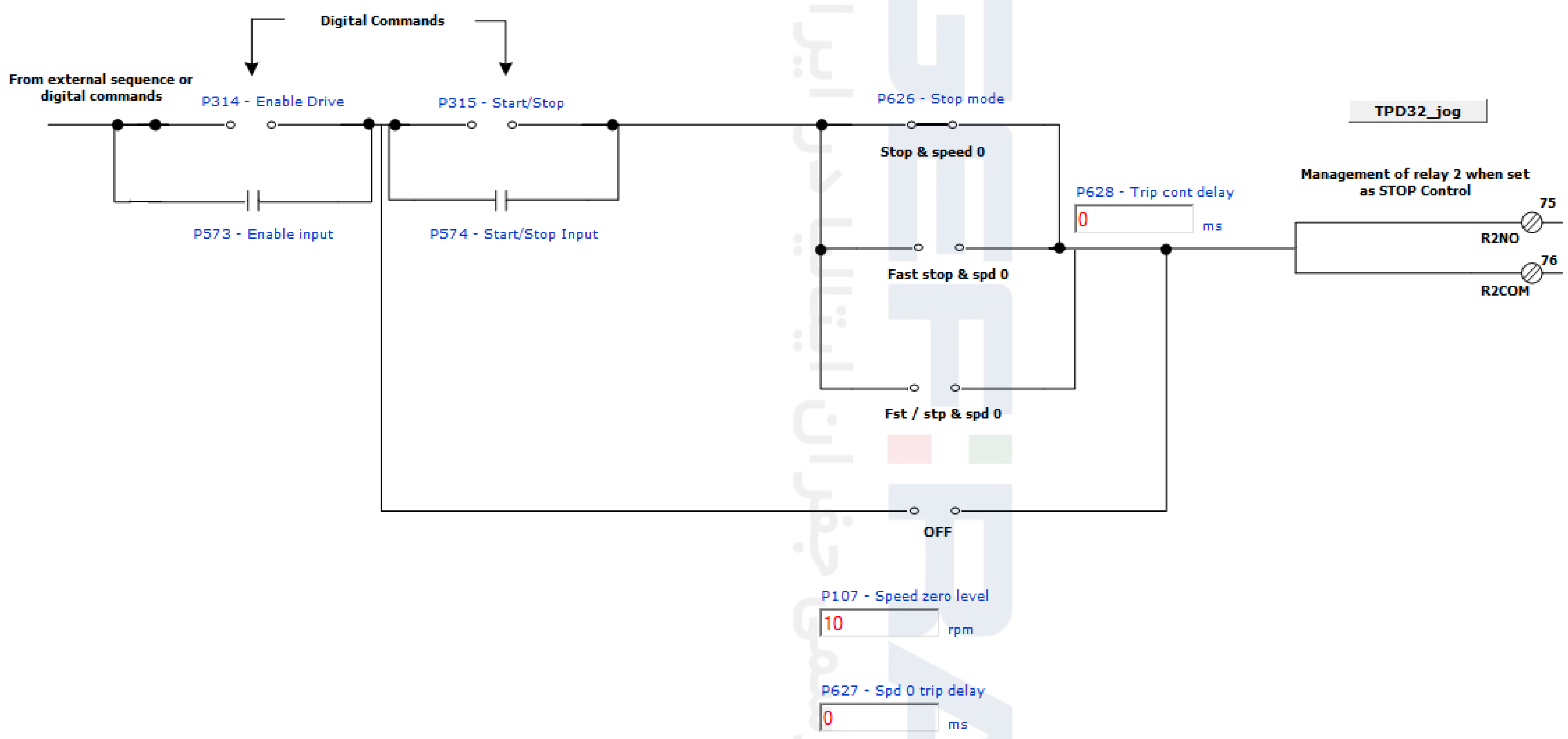
Overview | Current regulator

Field current regulator

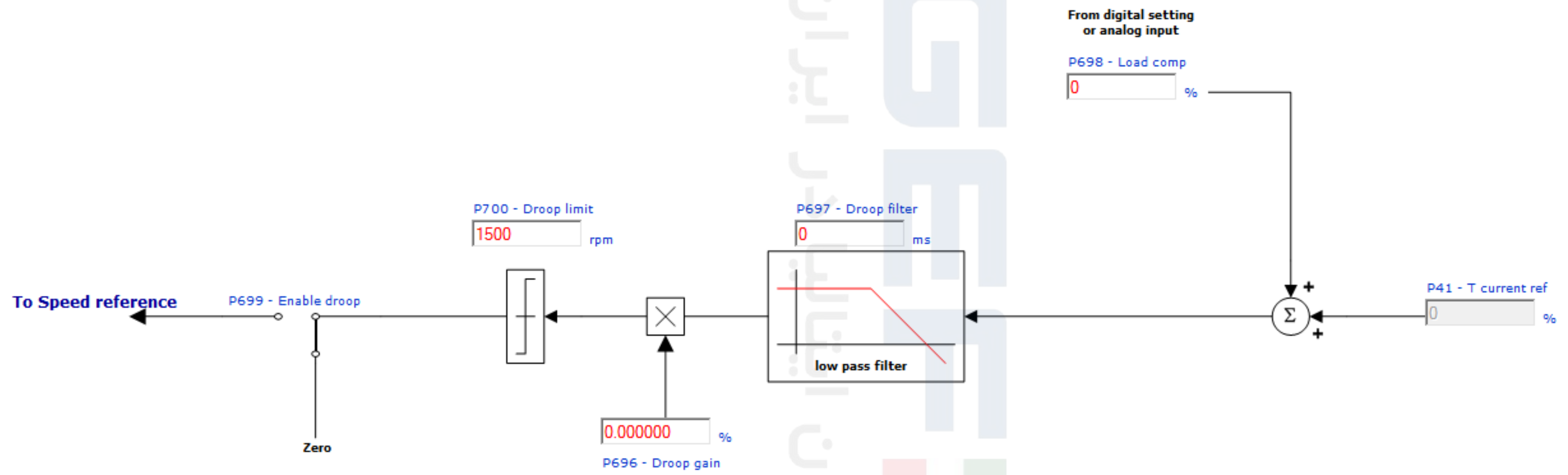



Overview
Current regulator
Motor parameters
Field regulator management
P469 - Flux reg mode
Constant current
P374 - Nom flux curr
10.000000
A
P468 - Flux current min
5
%
P467 - Flux current max
100
%
TPD32_Field_reg
Output Voltage / Torque
Constant Torque
P175 - Max. out voltage
400.000000
V
Rising Power
Constant Power
Speed
1500.000000
rpm
P162 - Motor max speed
P45 - Speed base value
1500
rpm
100
%
P456 - Flux weak speed
C1
D1
P280 - Motor nom flux
3.330000
A
P351 - Flux current (A)
0.000000
A
M
P454 - Arm inductance
4.000000
mH
P453 - Arm resistance
0.500000
Ohm
P199 - Motor current
0
%
P587 - E int
0
V
A (A1)
H (A2)
P233 - Output voltage
0.000000
V

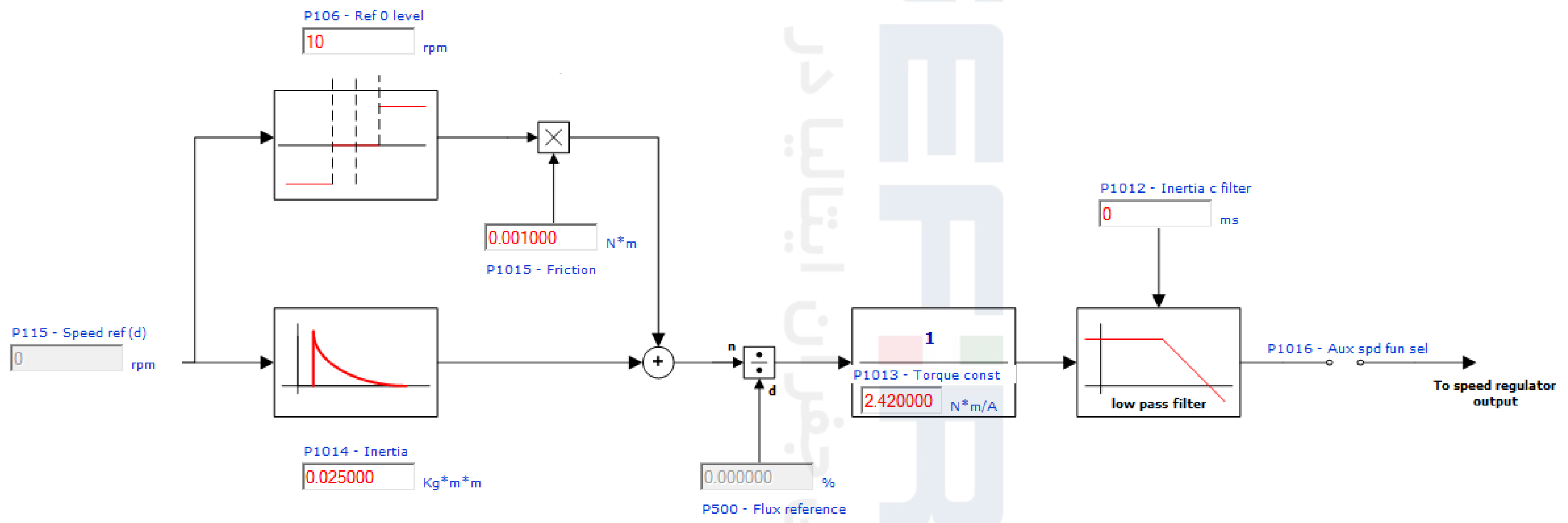
Start and Stop management



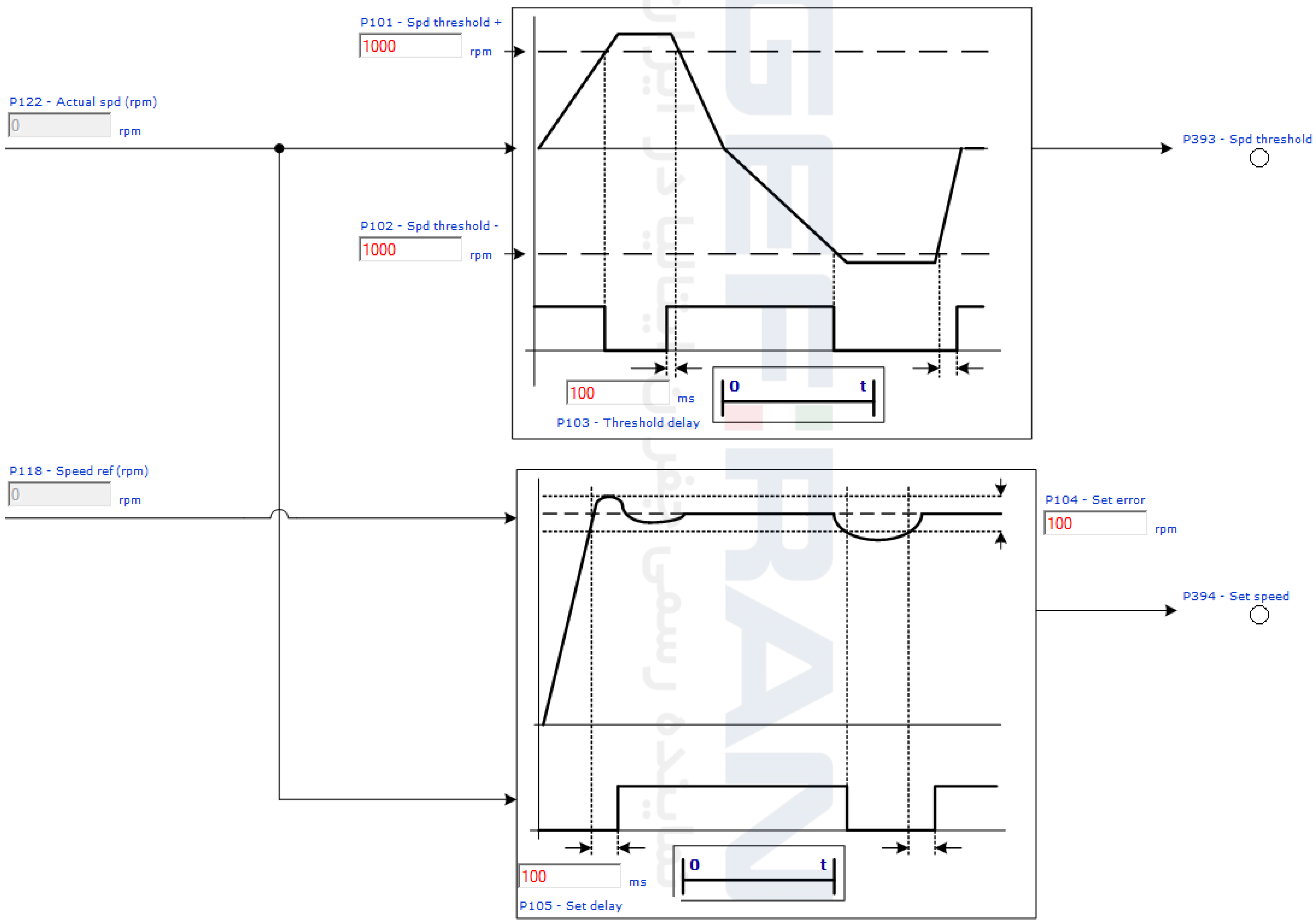
Droop compensation



Inertia/Loss compensation



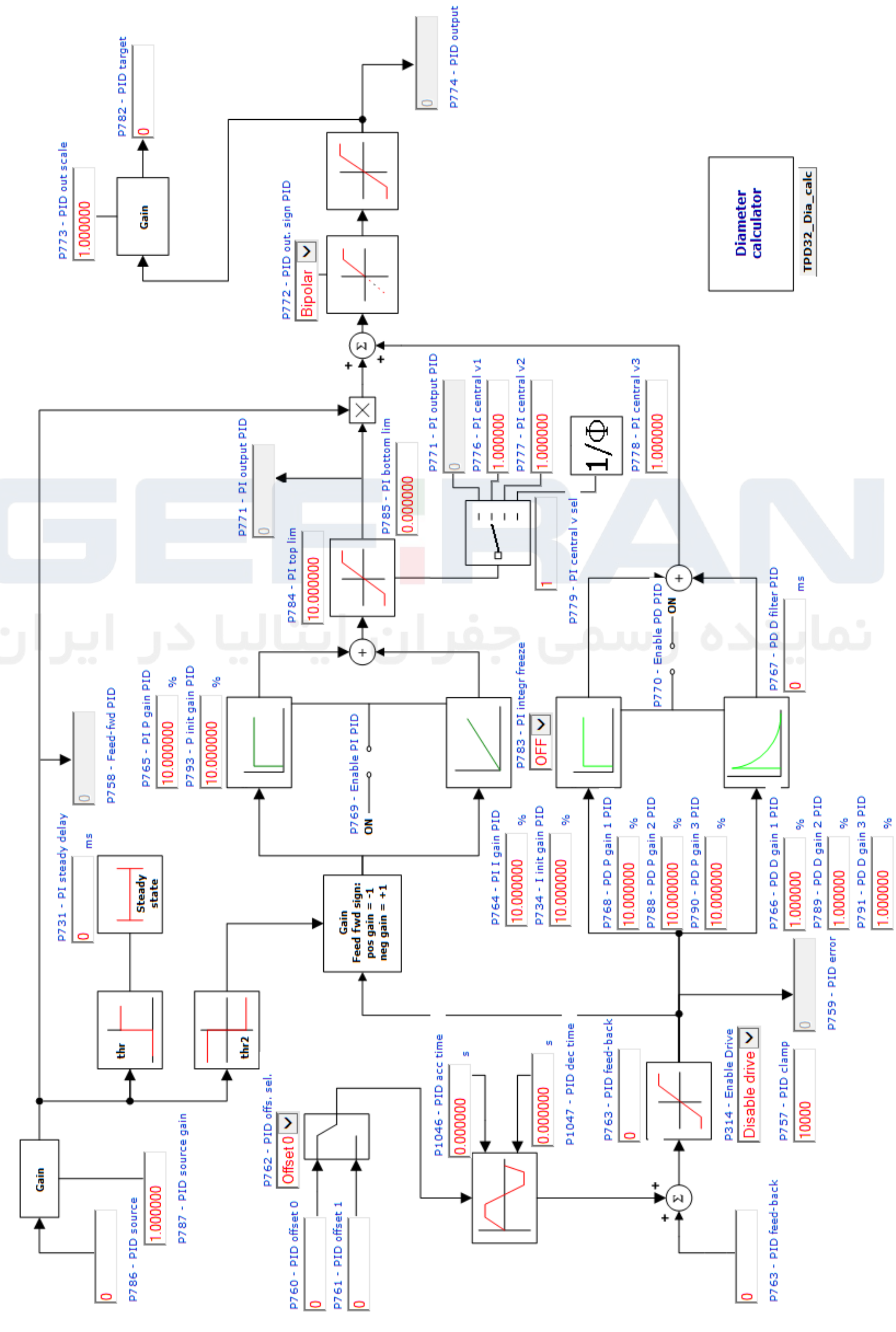
Speed threshold - Speed control



Overview

Go to functions

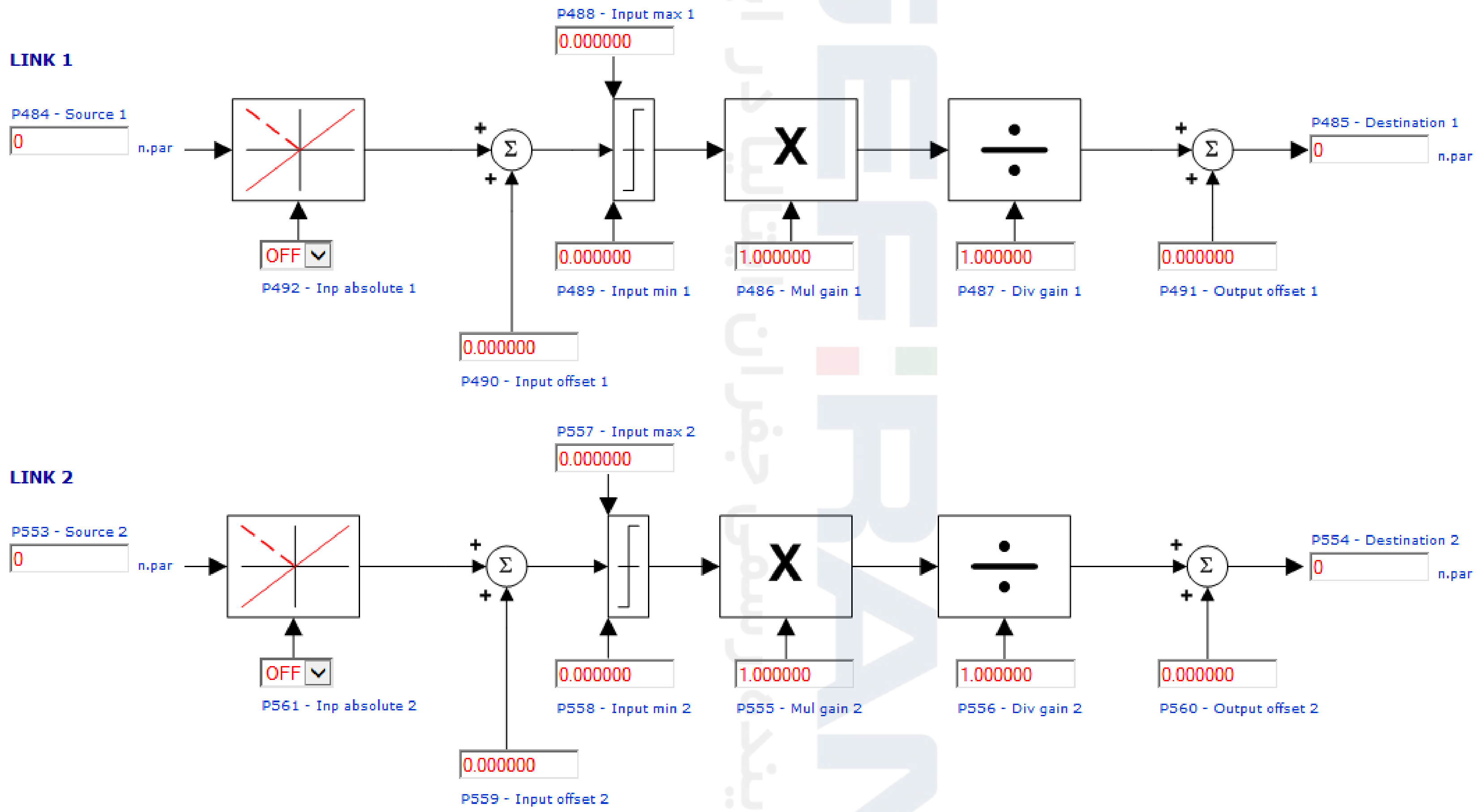
PID function



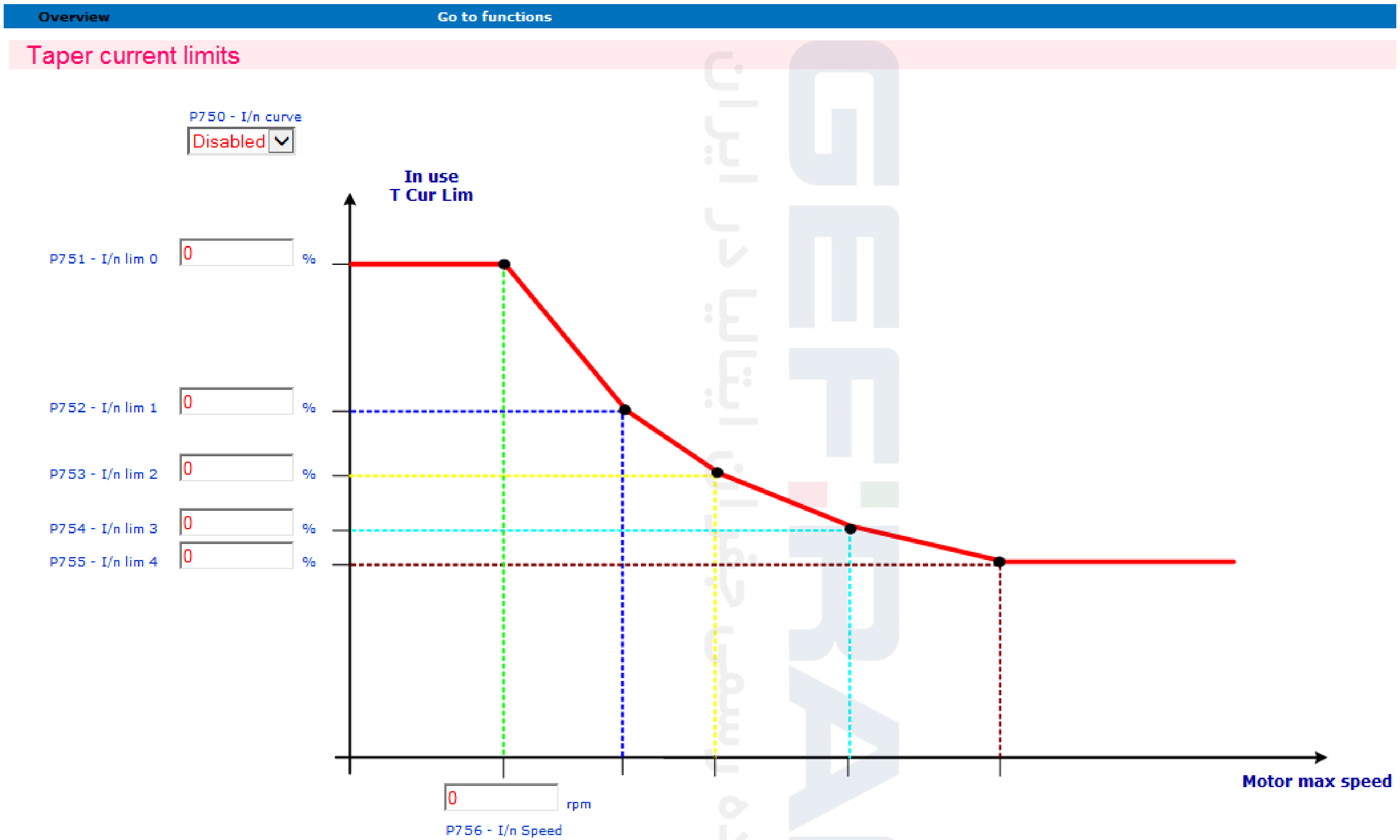
Functions

LINKS	TPD32_Links	PAD Parameters	TPD32_PAD	Taper Current Limits	TPD32_Taper_lim
Test Generator	TPD32_Test_gen	JOG function	TPD32_jog	Multispeed	TPD32_mspd
PID function	TPD32_PID	Start - Stop Programming	TPD32_STSP_pro	Tach follower	TPD32_HWIOAN
Dimension factor Face value factor	TPD32_fctfct	Motor potentiometer	TPD32_mpot	SCR Test	TPD32_SCRTest

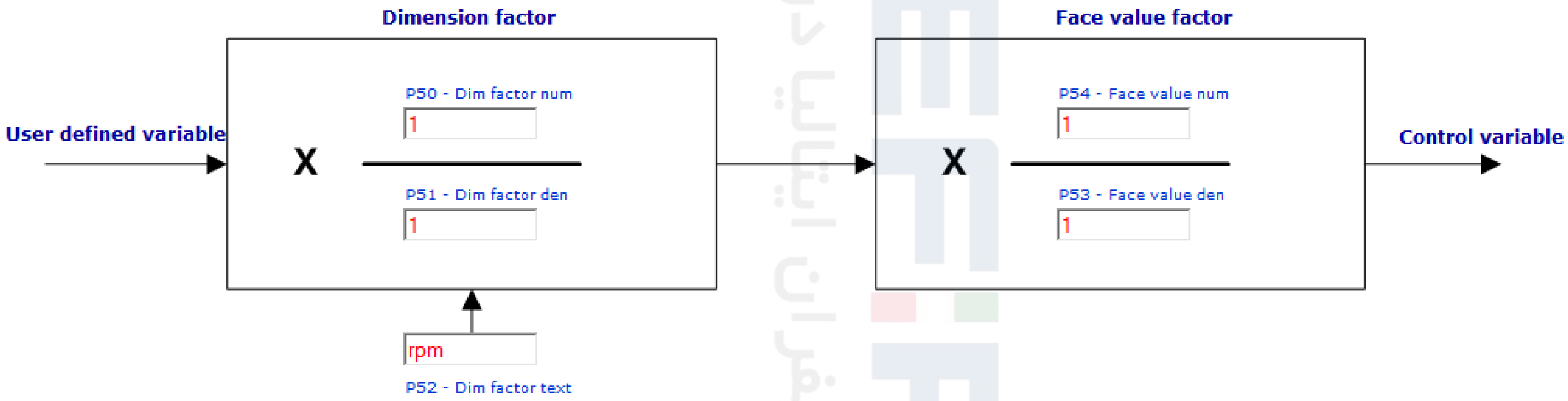
LINKS Function




Overview
Go to functions
PAD parameters
P503 - Pad 0
0
P504 - Pad 1
0
P505 - Pad 2
0
P506 - Pad 3
0
P507 - Pad 4
0
P508 - Pad 5
0
P509 - Pad 6
0
P519 - Bitword Pad A
0000
P536 - Bitword Pad B
0000
Analog input
Analog output
Analog input
Analog output
Analog input
Analog output
Analog output
P510 - Pad 7
0
P511 - Pad 8
0
P512 - Pad 9
0
P513 - Pad 10
0
P514 - Pad 11
0
P515 - Pad 12
0
P516 - Pad 13
0
P517 - Pad 14
0
P518 - Pad 15
0

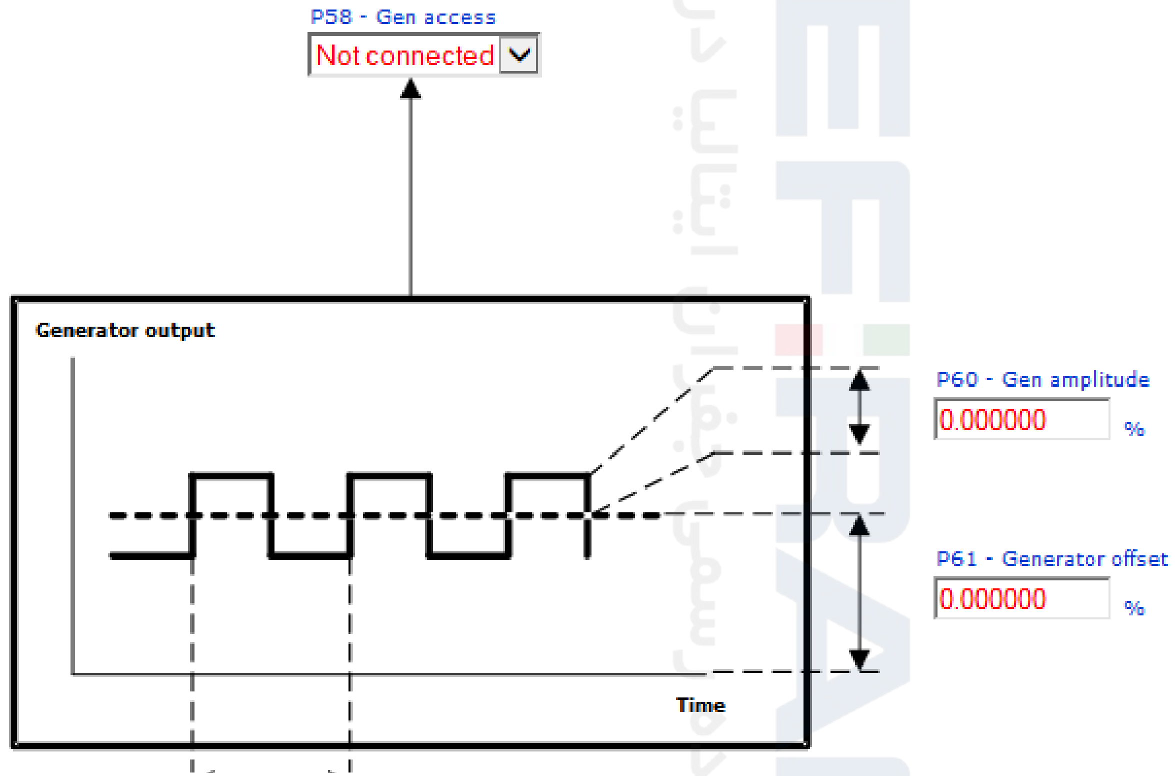

Overview
Go to functions
Taper current limits
P750 - I/n curve
Disabled
In use
T Cur Lim
P751 - I/n lim 0
0
%
P752 - I/n lim 1
0
%
P753 - I/n lim 2
0
%
P754 - I/n lim 3
0
%
P755 - I/n lim 4
0
%
0
rpm
P756 - I/n Speed
Motor max speed

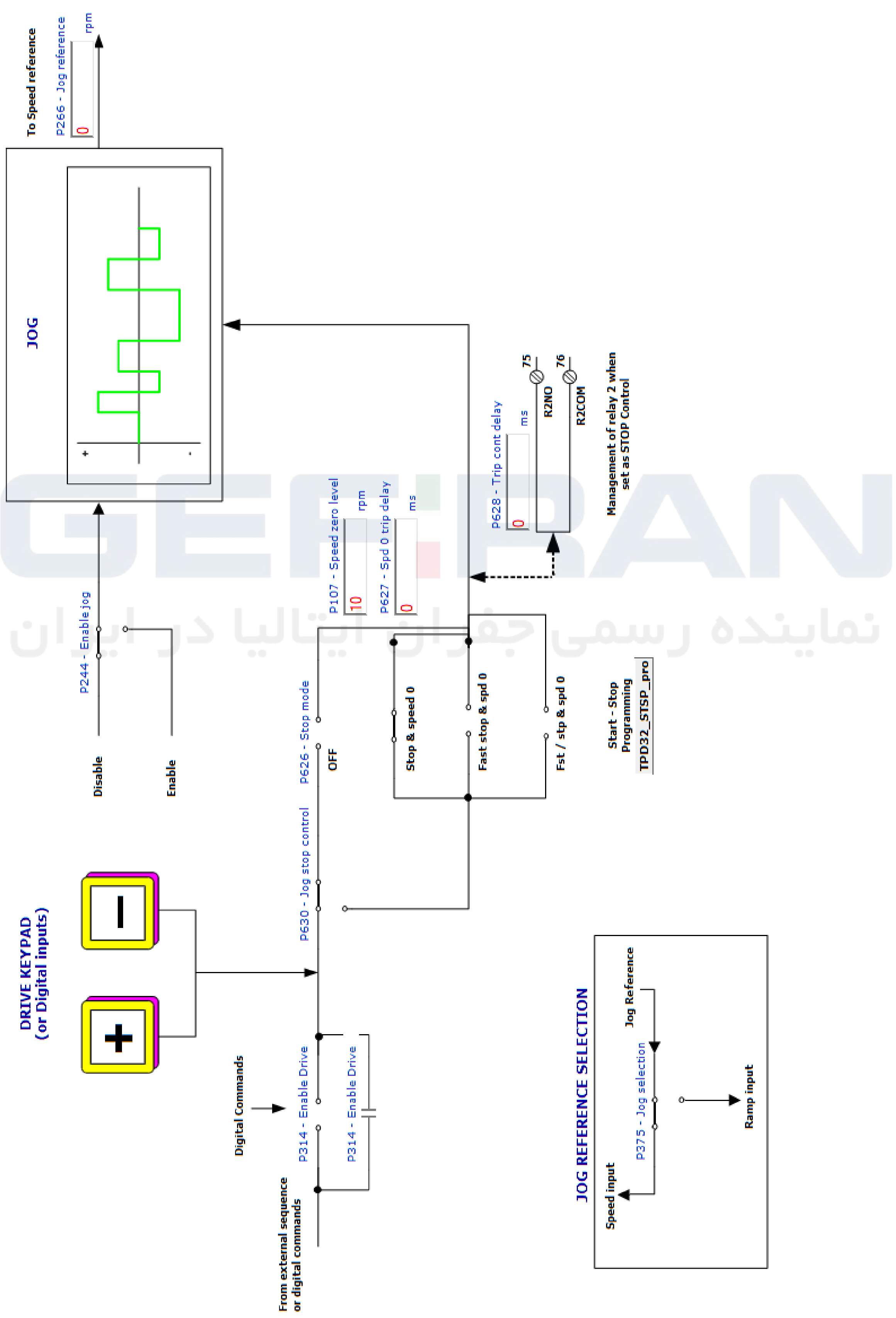
Dimension factor - Face value factor



Overview | Go to functions

Test generator




To Speed reference
P266 - Jog reference
rpm
0
JOG
P244 - Enable jog
Disable
Enable
DRIVE KEYPAD
(or Digital inputs)
P630 - Jog stop control
P626 - Stop mode
OFF
Stop & speed 0
Fast stop & spd 0
Fst / stp & spd 0
P107 - Speed zero level
rpm
10
P627 - Spd 0 trip delay
ms
0
P628 - Trip cont delay
ms
0
75
76
R2NO
R2COM
Management of relay 2 when
set as STOP Control
Start - Stop
Programming
TPD32_STSP_pro
Digital Commands
P314 - Enable Drive
P314 - Enable Drive
From external sequence
or digital commands
JOG REFERENCE SELECTION
Speed input
P375 - Jog selection
Jog Reference
Ramp input

Overview Go to functions

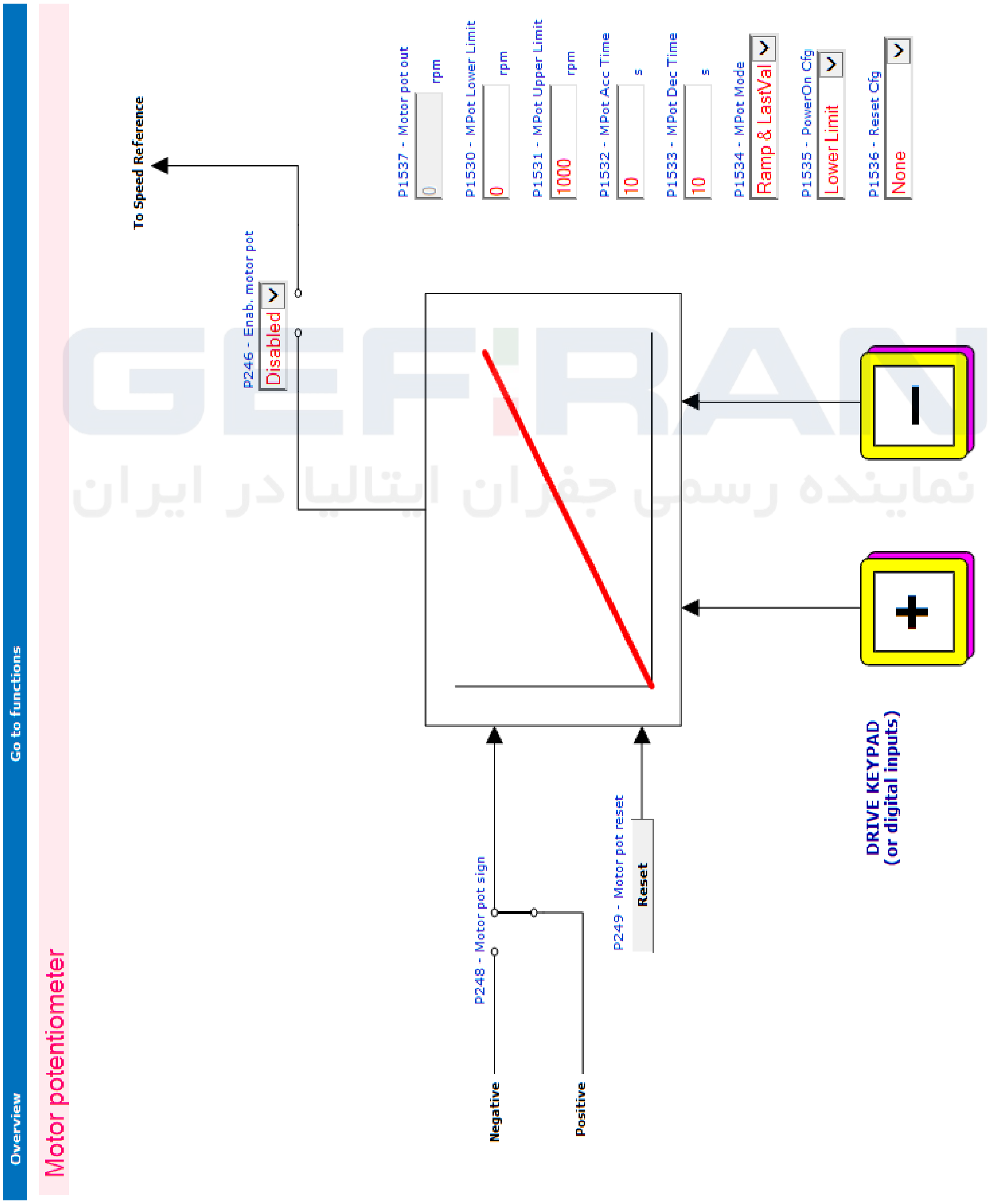
Multi speed

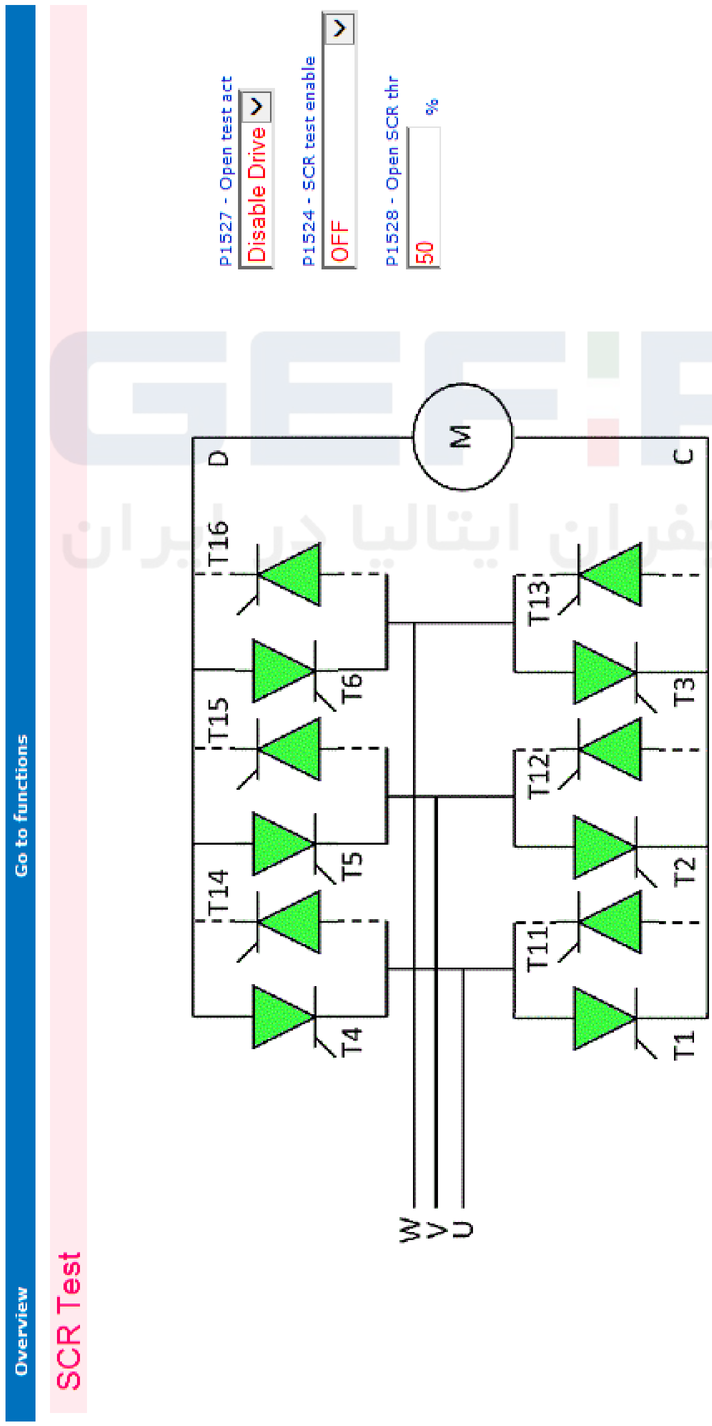
P153 - Enable multi spd: Disabled

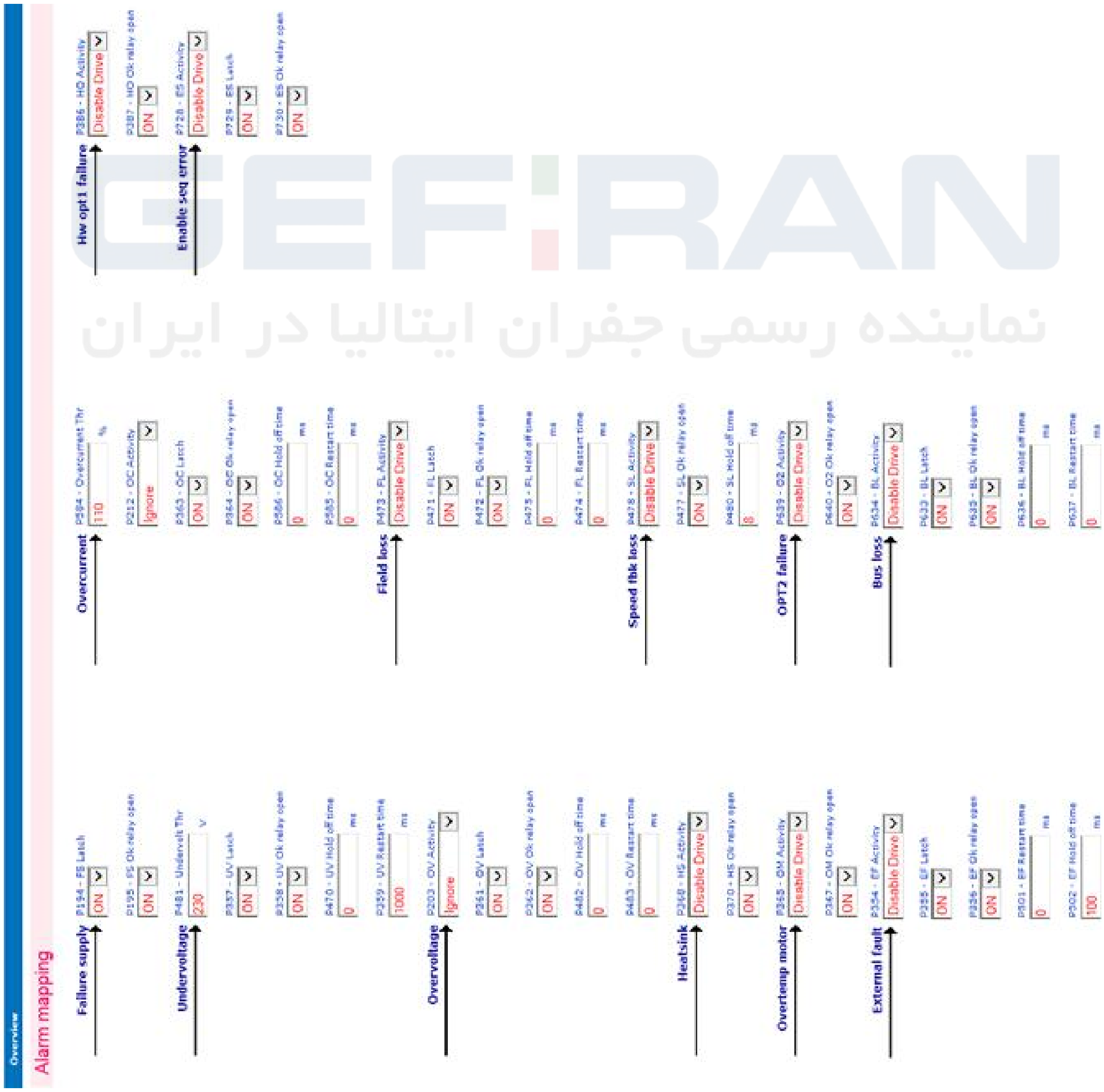
P208 - Multi speed sel.: 0

P109 - Ramp ref (d): 0 rpm

P400 - Speed sel 0: Bit 0 Not Selected	P401 - Speed sel 1: Bit 1 Not Selected	P402 - Speed sel 2: Bit 2 Not Selected	REFERENCE
0	0	0	P44 - Ramp ref 1: 0 rpm + P48 - Ramp ref 2: 0 rpm
1	0	0	P154 - Multi speed 1: 0 rpm
0	1	0	P155 - Multi speed 2: 0 rpm
1	1	0	P156 - Multi speed 3: 0 rpm
0	0	1	P157 - Multi speed 4: 0 rpm
1	0	1	P158 - Multi speed 5: 0 rpm
0	1	1	P159 - Multi speed 6: 0 rpm
1	1	1	P160 - Multi speed 7: 0 rpm


Overview
Go to functions
Motor potentiometer
To Speed Reference
P246 - Enab. motor pot
Disabled
P1537 - Motor pot out
0
rpm
P1530 - MPot Lower Limit
0
rpm
P1531 - MPot Upper Limit
1000
rpm
P1532 - MPot Acc Time
10
s
P1533 - MPot Dec Time
10
s
P1534 - MPot Mode
Ramp & LastVal
P1535 - PowerOn Cfg
Lower Limit
P1536 - Reset Cfg
None
P248 - Motor pot sign
Negative
Positive
P249 - Motor pot reset
Reset
+
DRIVE KEYPAD
(or digital inputs)


Overview
Go to functions
SCR Test
P1527 - Open test act
Disable Drive
P1524 - SCR test enable
OFF
P1528 - Open SCR thr
50
%
M
D
C
T16
T6
T15
T5
T14
T4
T13
T3
T12
T2
T11
T1
W
V
U


Overview
Alarm mapping
Failure supply
Undervoltage
Overvoltage
Heatsink
Overtemp motor
External fault
Overcurrent
Field loss
Speed fbk loss
OPT2 failure
Bus loss
Hw opt1 failure
Enable seq error

9.2 POWER CIRCUIT BLOCK DIAGRAMS

Figure 9.2.1: ESE5911 TPD32-EV-500 ...-20 ...185-4B (Construction type A)

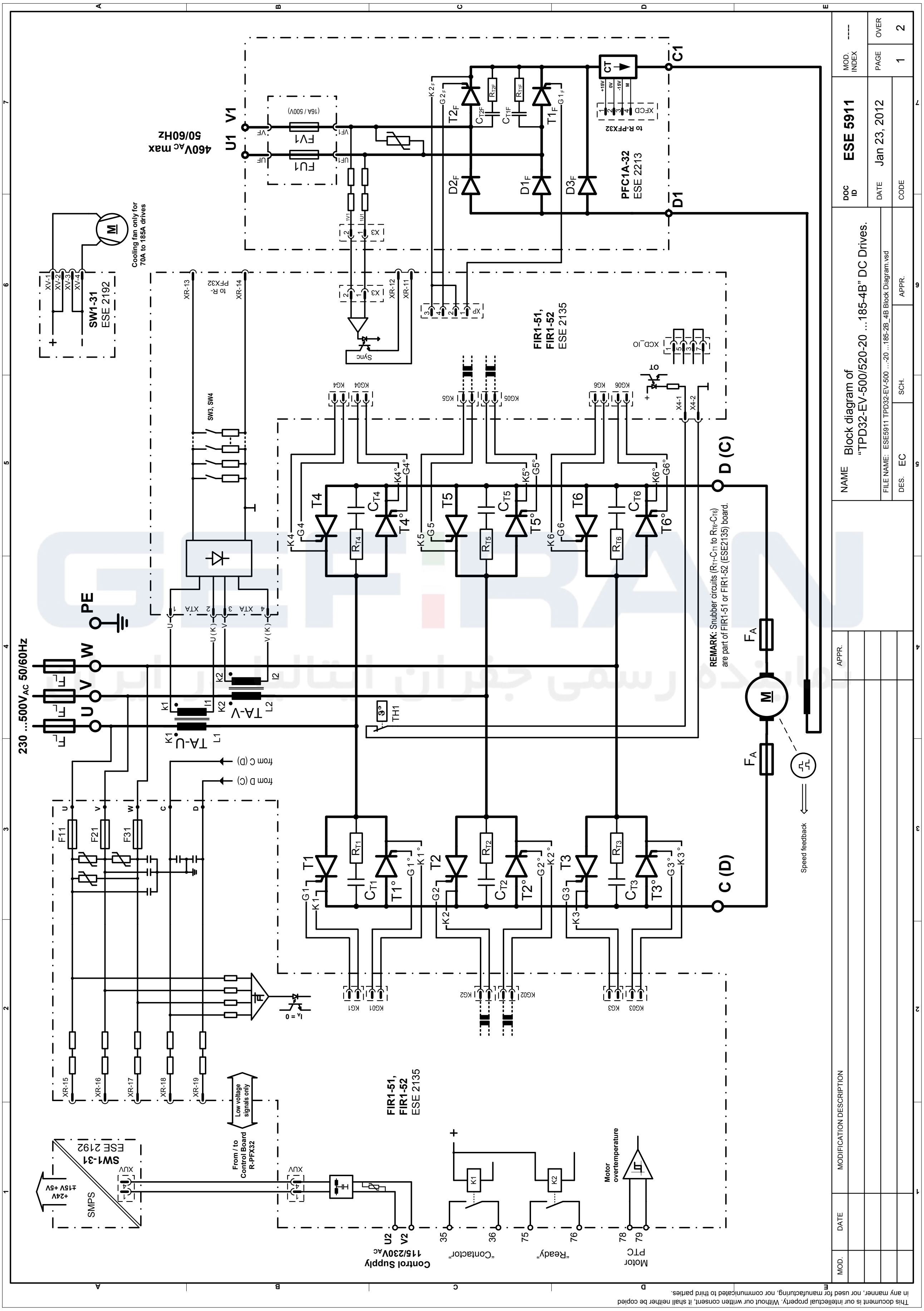


Figure 9.2.2: ESE5911 TPD32-EV-500 ...-20 ...185-2B (Construction type A)

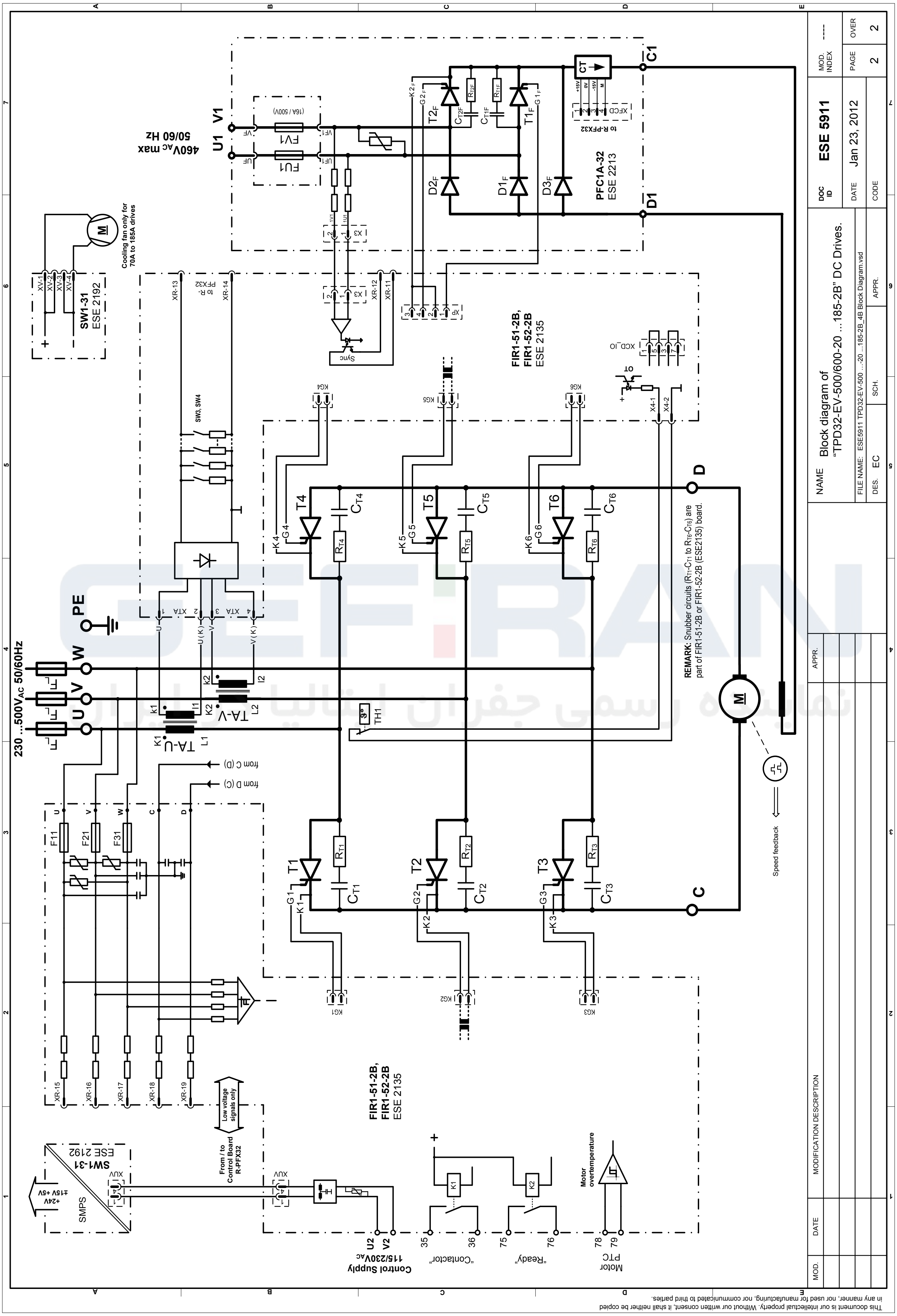


Figure 9.2.3: ESE5912 TPD32-EV-500 ...-280 ...650-4B (Construction type B)

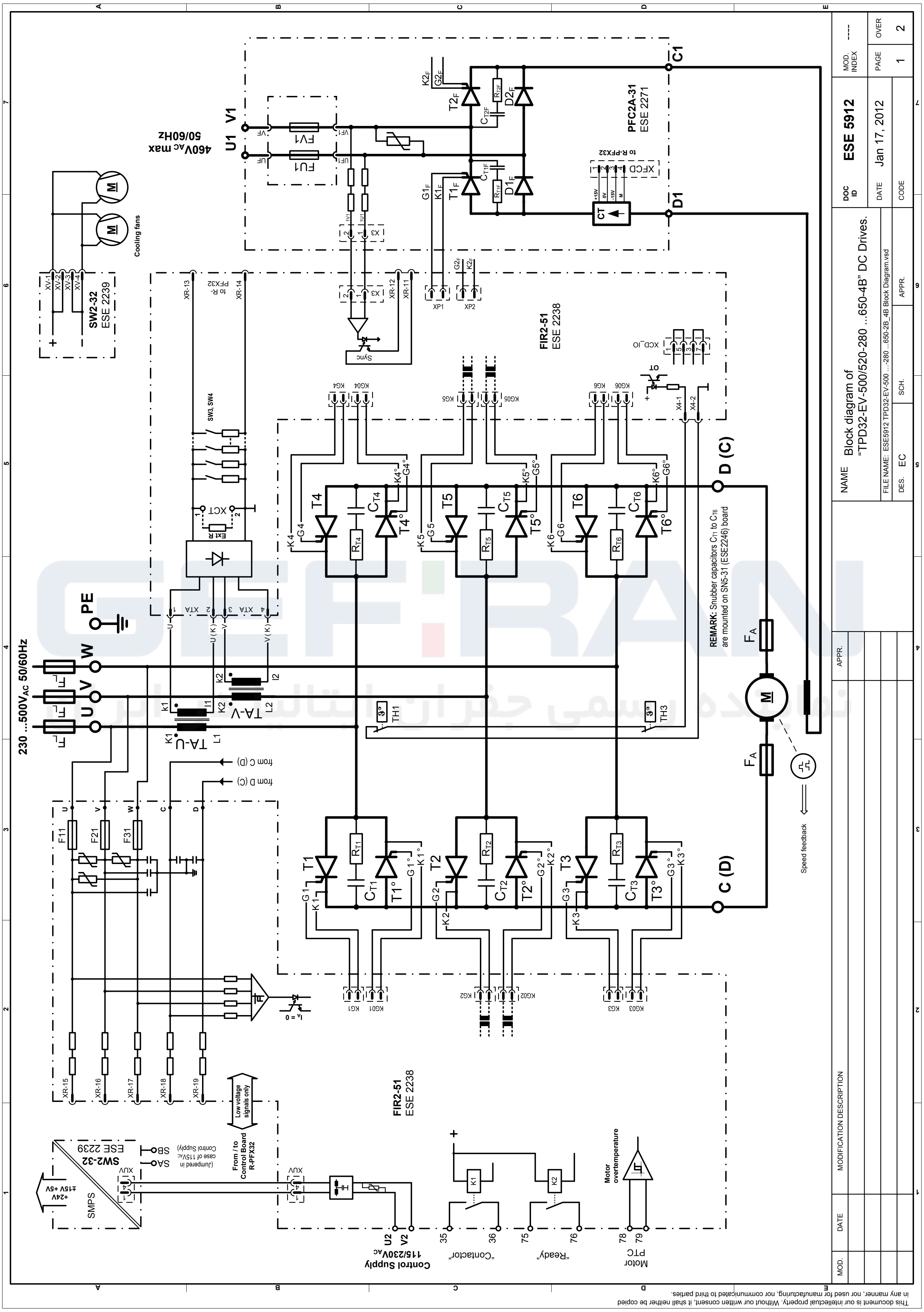


Figure 9.2.4: ESE5912 TPD32-EV-500 ...-280 ...650-2B (Construction type B)

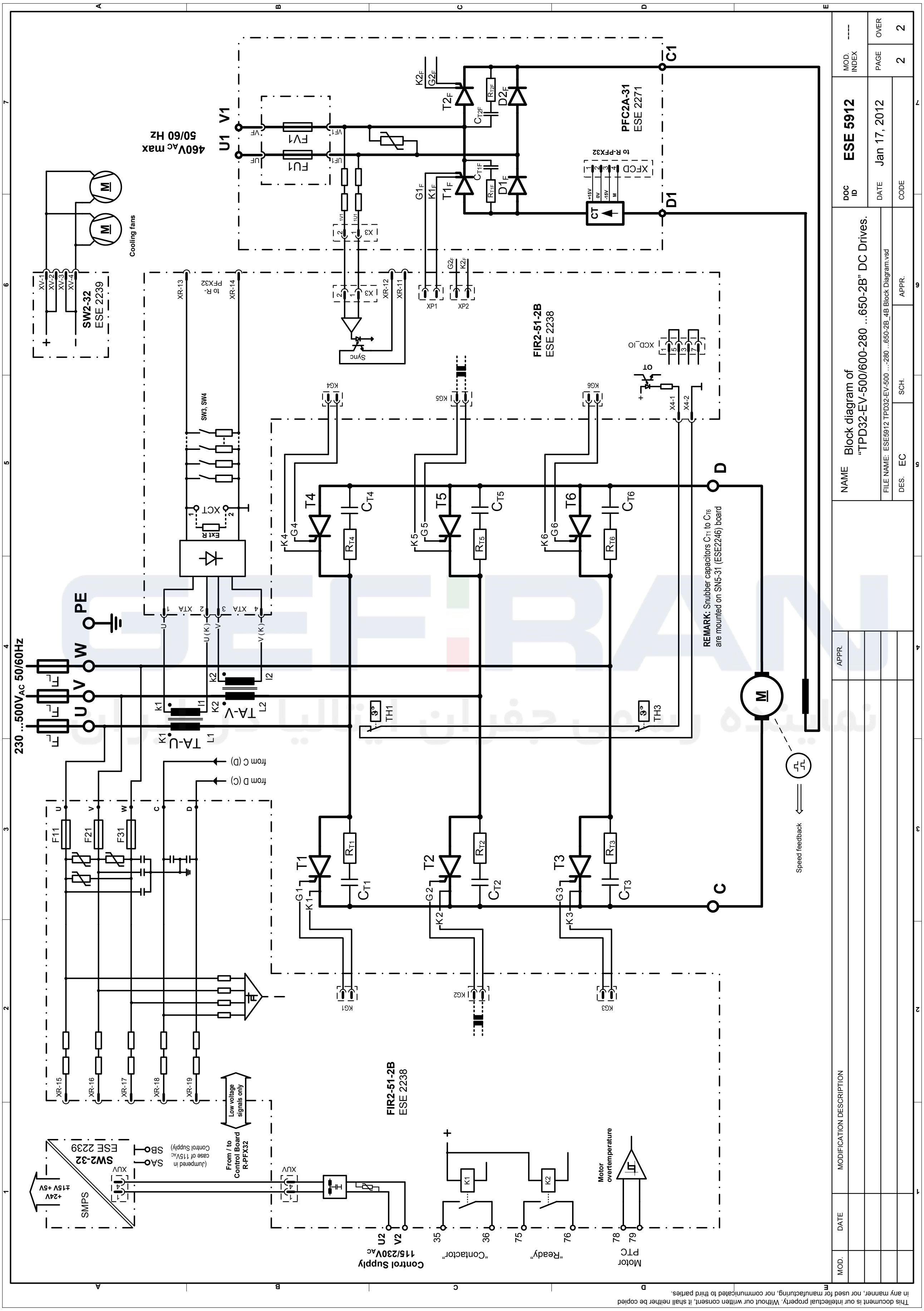


Figure 9.2.5: ESE5913 TPD32-EV-500 ...-770 ...1050-4B (Construction type C)

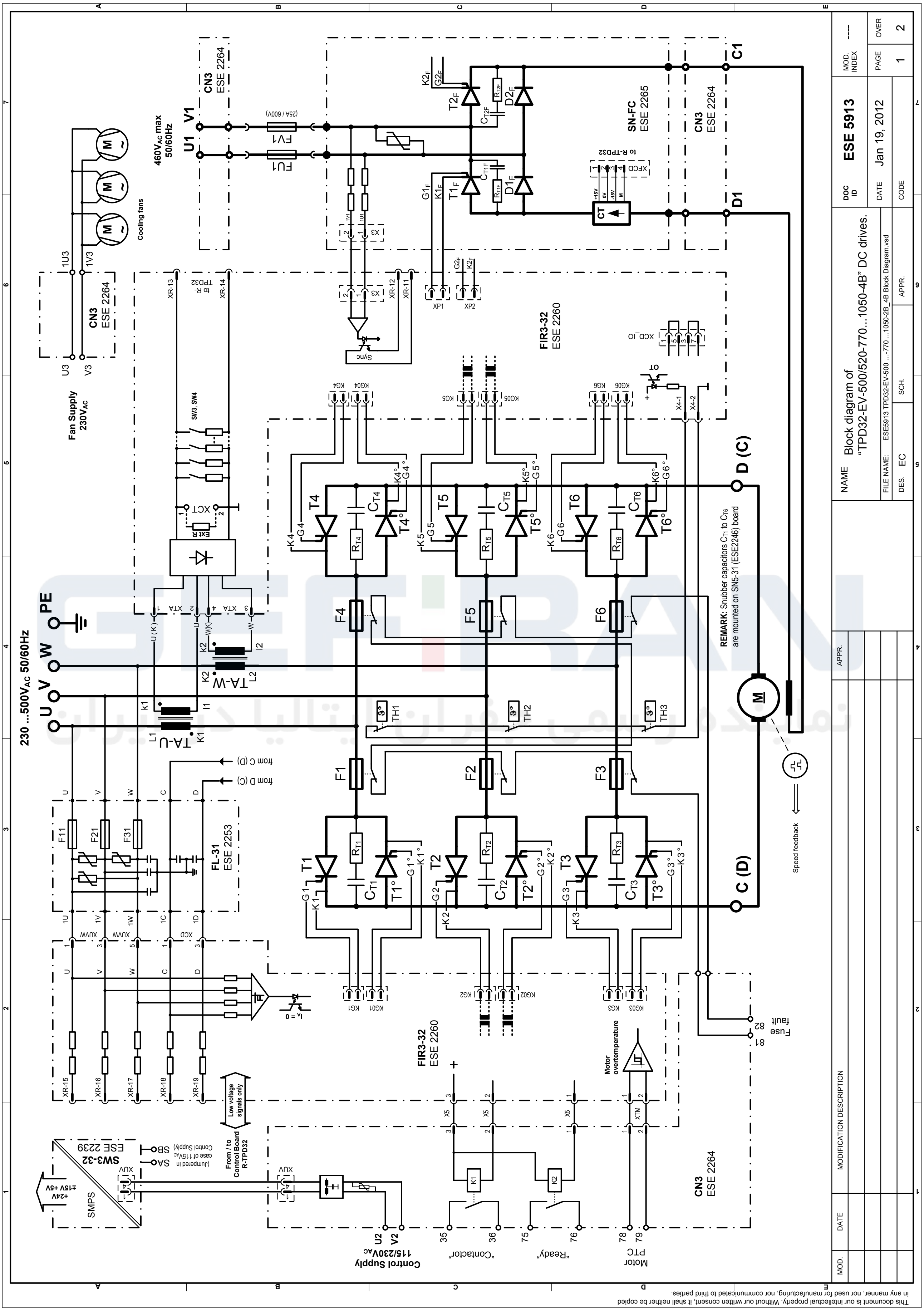


Figure 9.2.6: ESE5913 TPD32-EV-500 ...-770 ...1050-2B (Construction type C)

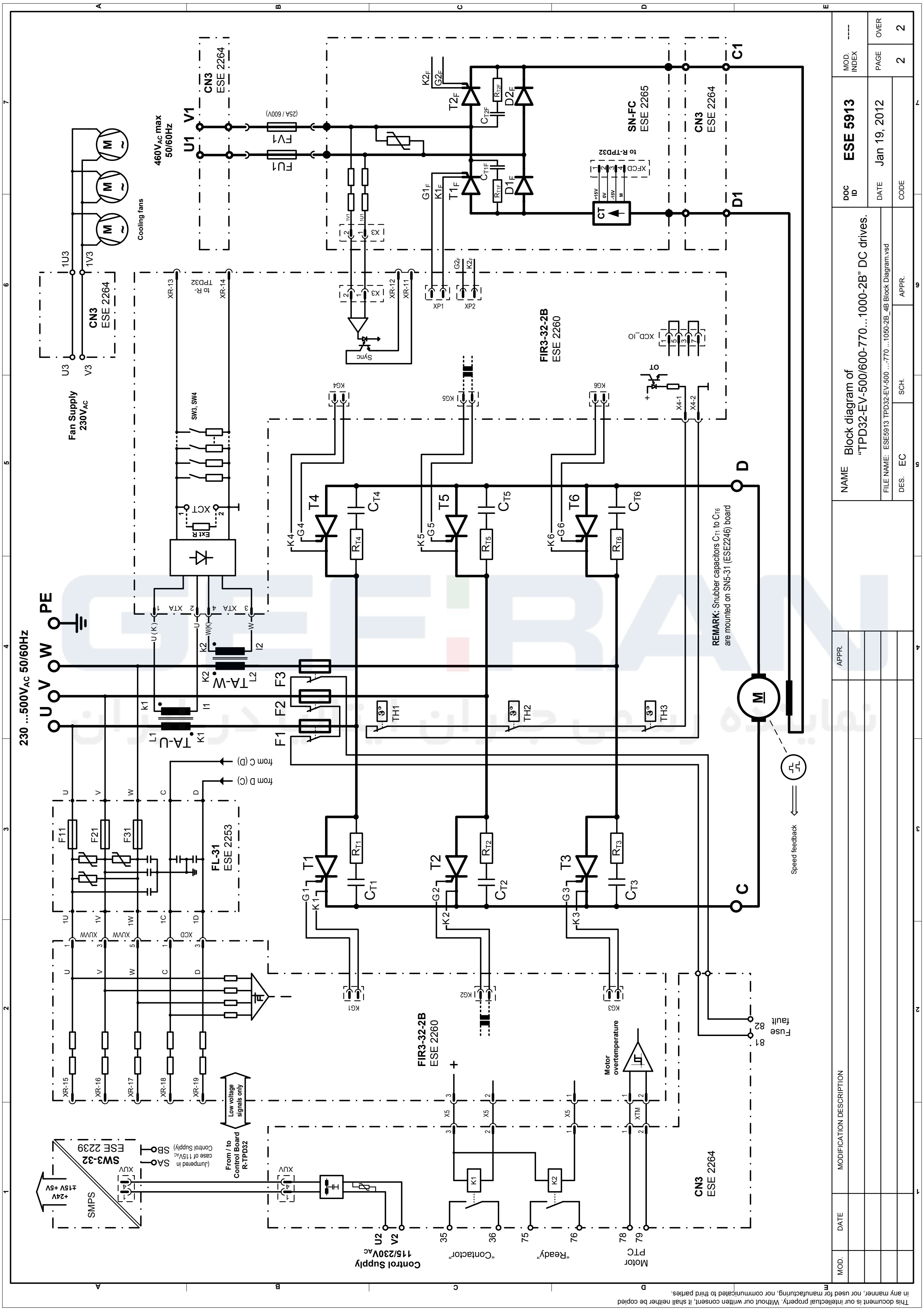


Figure 9.2.7: ESE5858 TPD32-EV-500_520-1500 ...3300-4B (Construction type E)

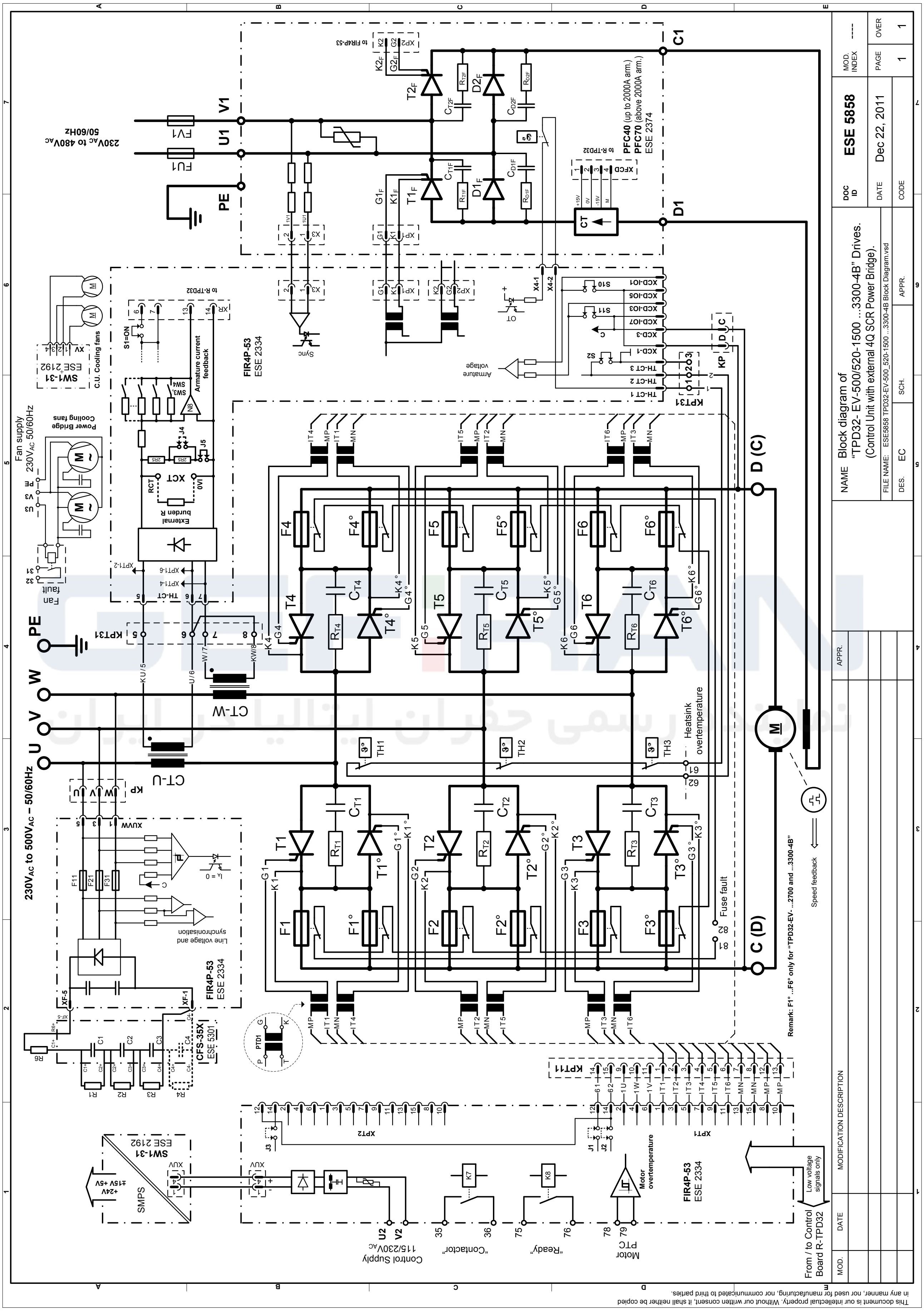


Figure 9.2.8: ESE5856 TPD32-EV-500_600-1200 ...3300-2B (Construction type E)

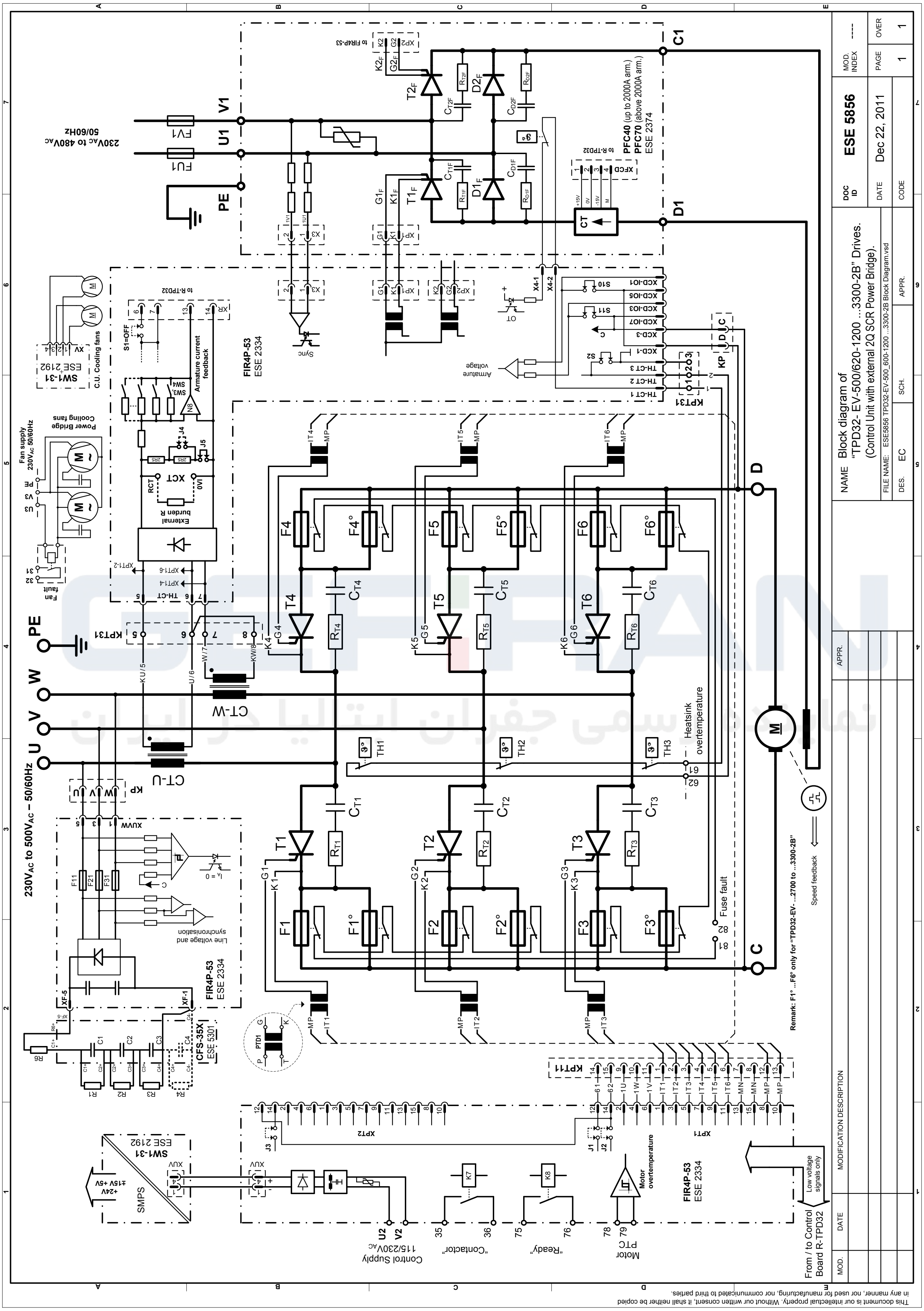


Figure 9.2.9: ESE5770 TPD32-EV-500 ...690 ...-1300 ...2400-4B (Construction type D)

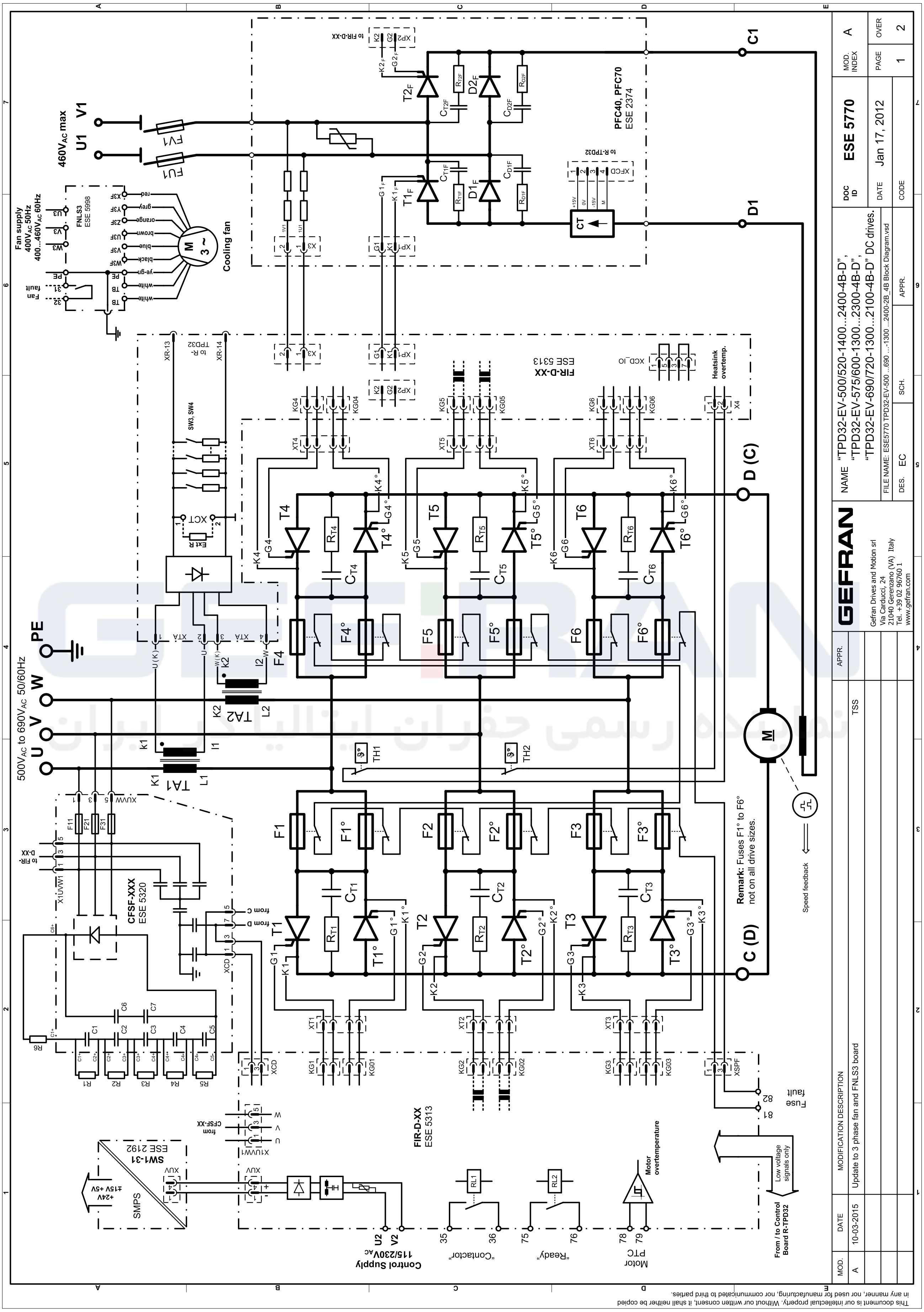


Figure 9.2.10: ESE5770 TPD32-EV-500 ...690 ...-1300 ...2400-2B (Construction type D)

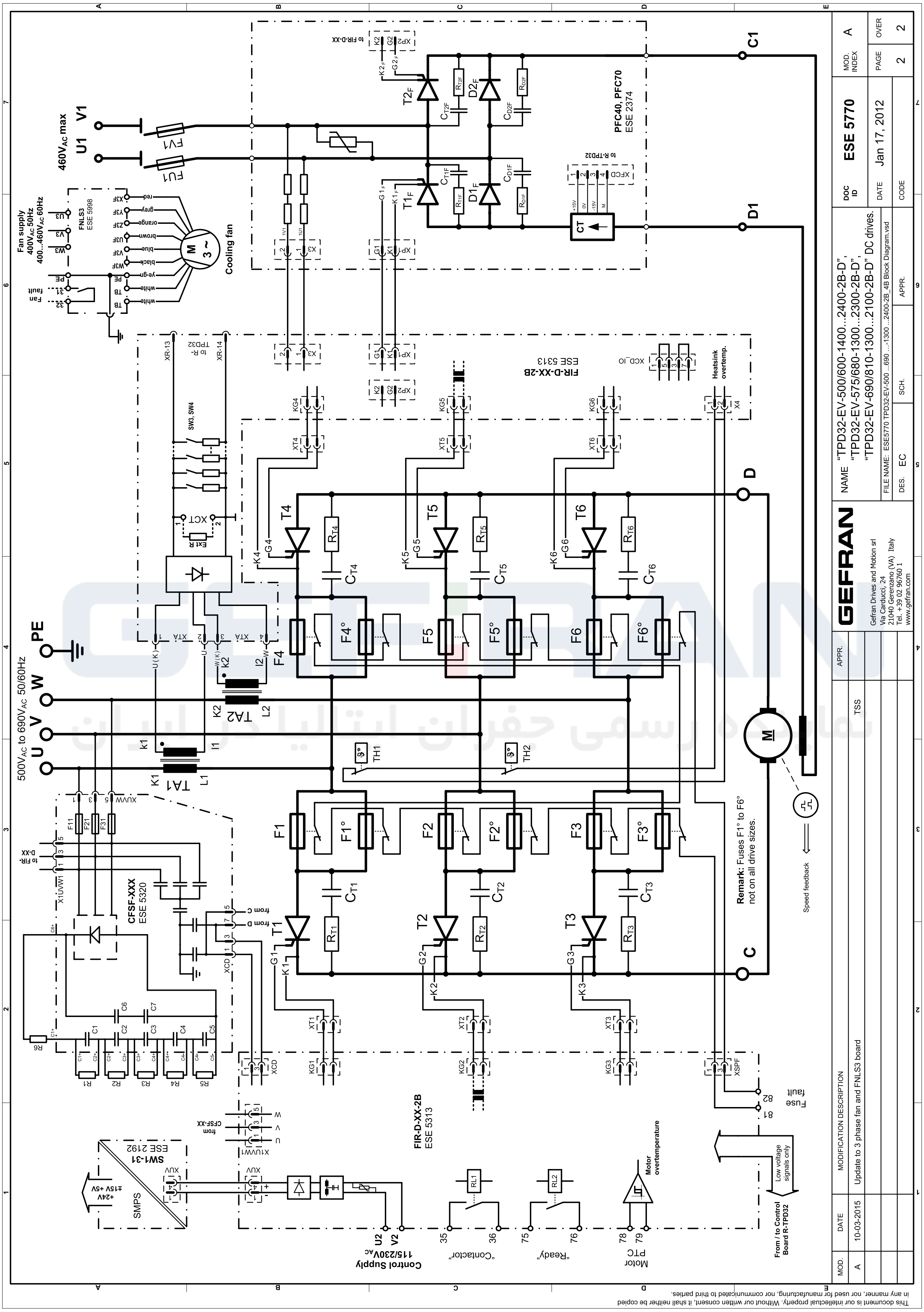


Figure 9.2.11: ESE5804 TPD32-EV-575 ...-280 ...650-4B (Construction type B)

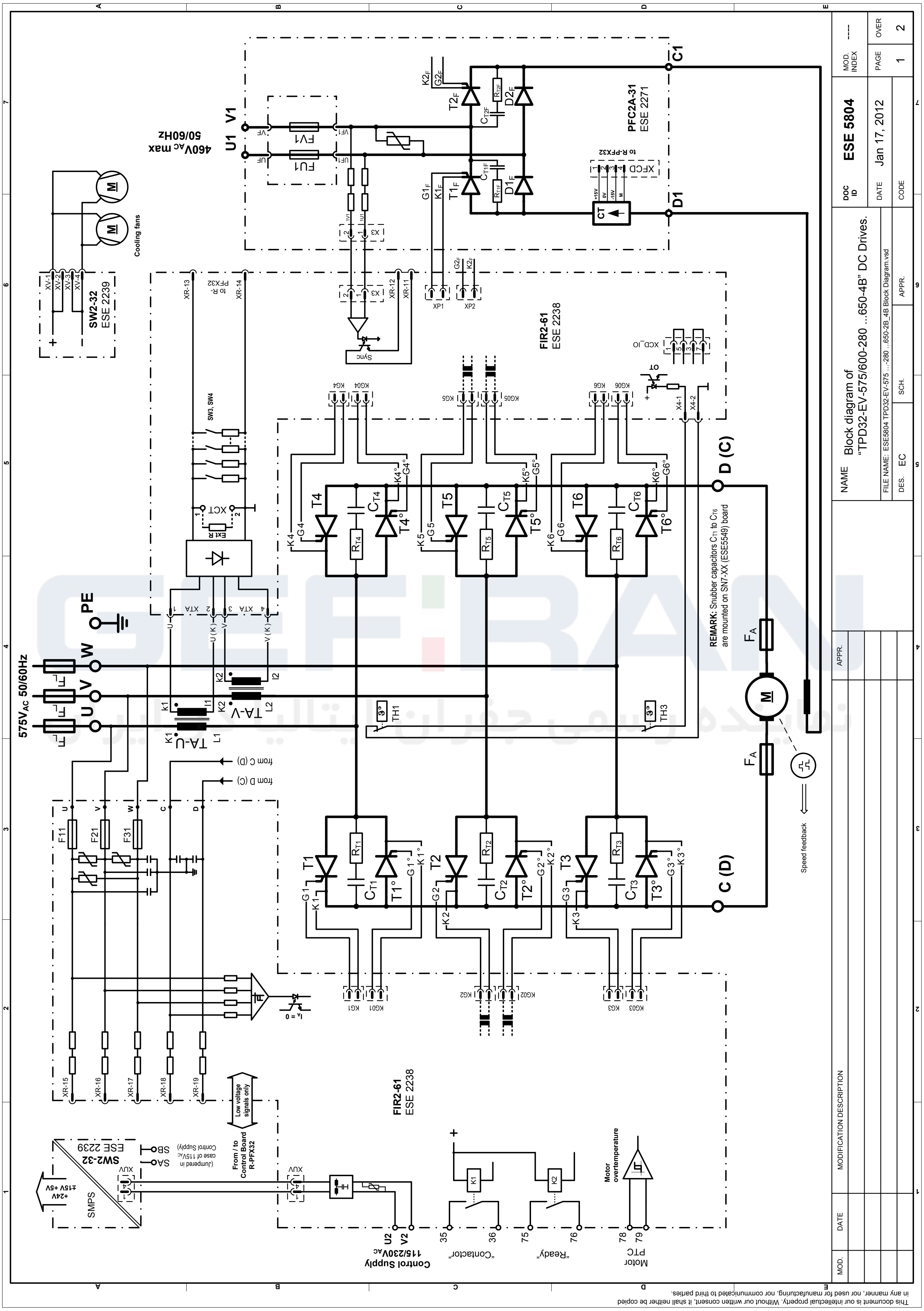


Figure 9.2.12: ESE5804 TPD32-EV-575 ...-280 ...650-2B (Construction type B)

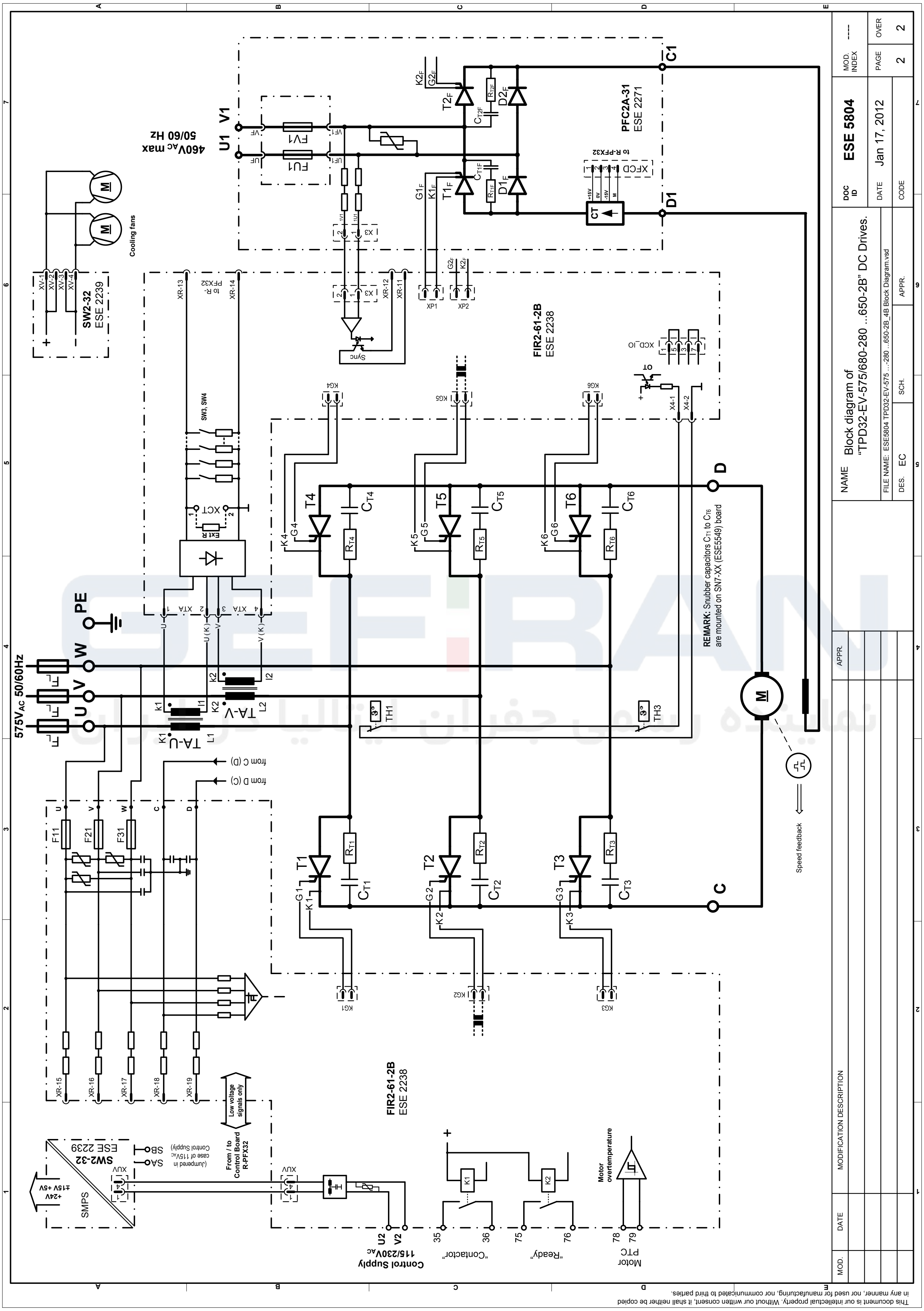


Figure 9.2.13:ESE5803 TPD32-EV-575_690 ...-560 ...1000-4B (Construction type C)

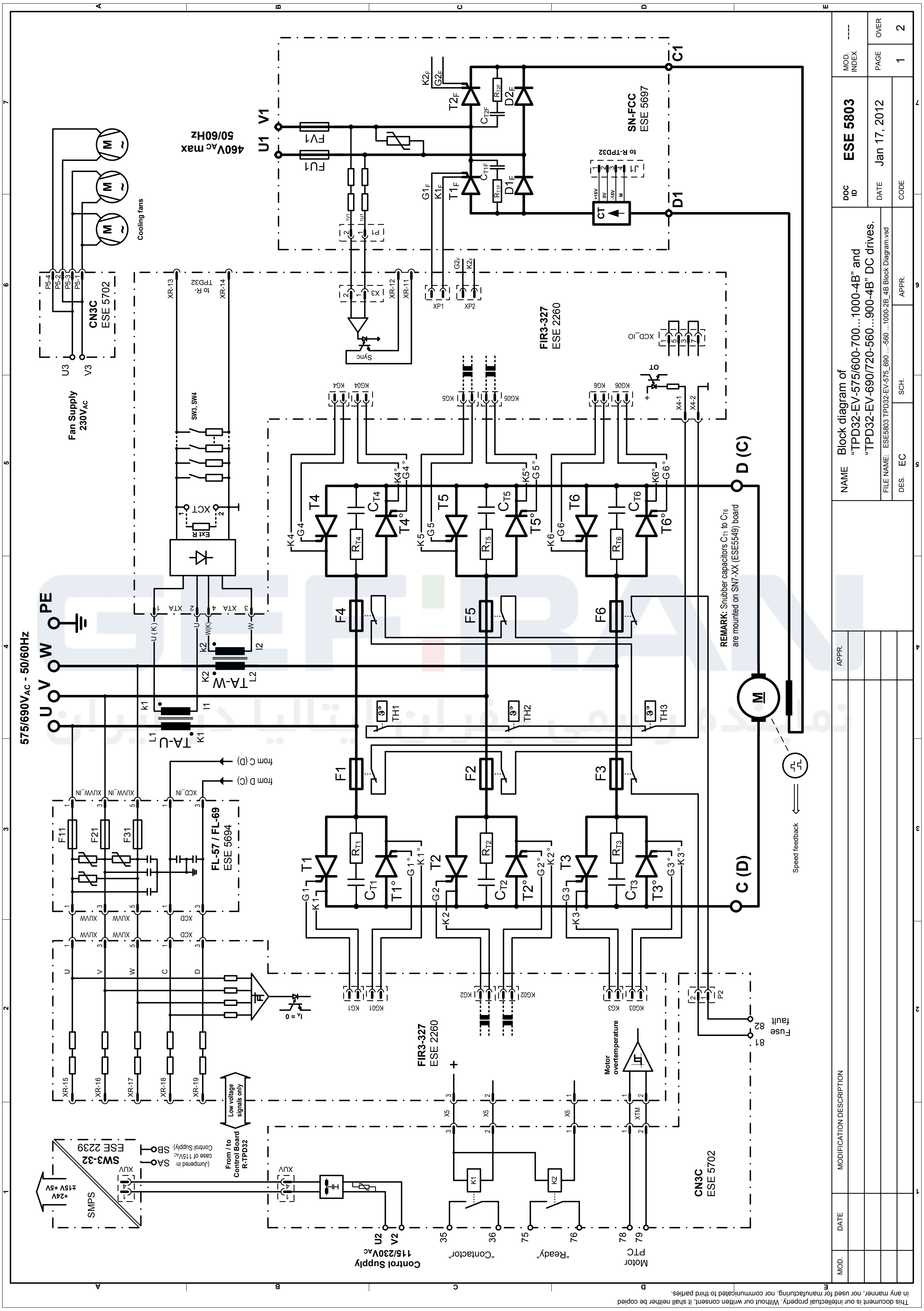


Figure 9.2.14: ESE5803 TPD32-EV-575_690 ...-560 ...1000-2B (Construction type C)

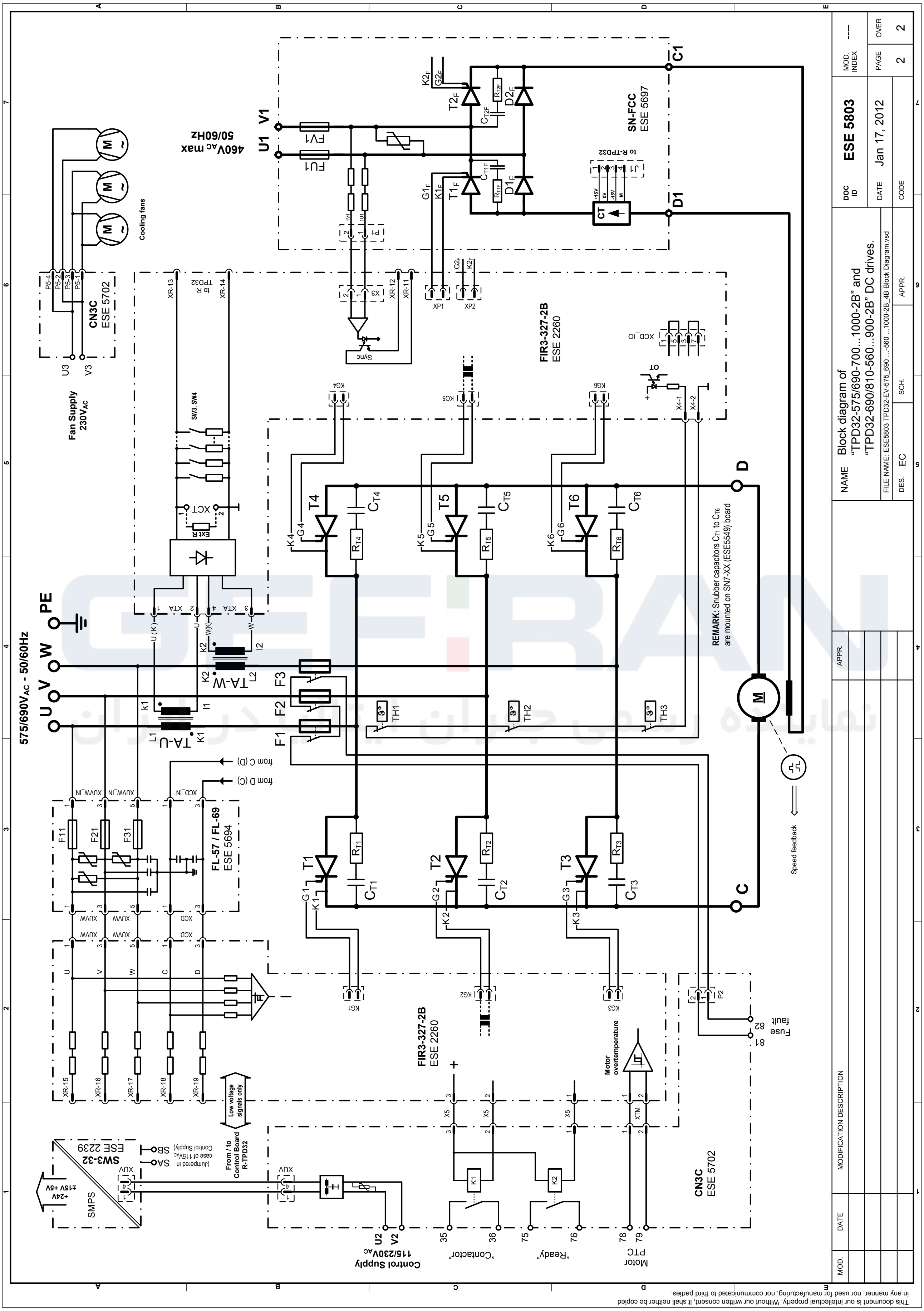


Figure 9.2.15: ESE5859 TPD32-EV-690_720-1010 ...3300-4B (Construction type E)

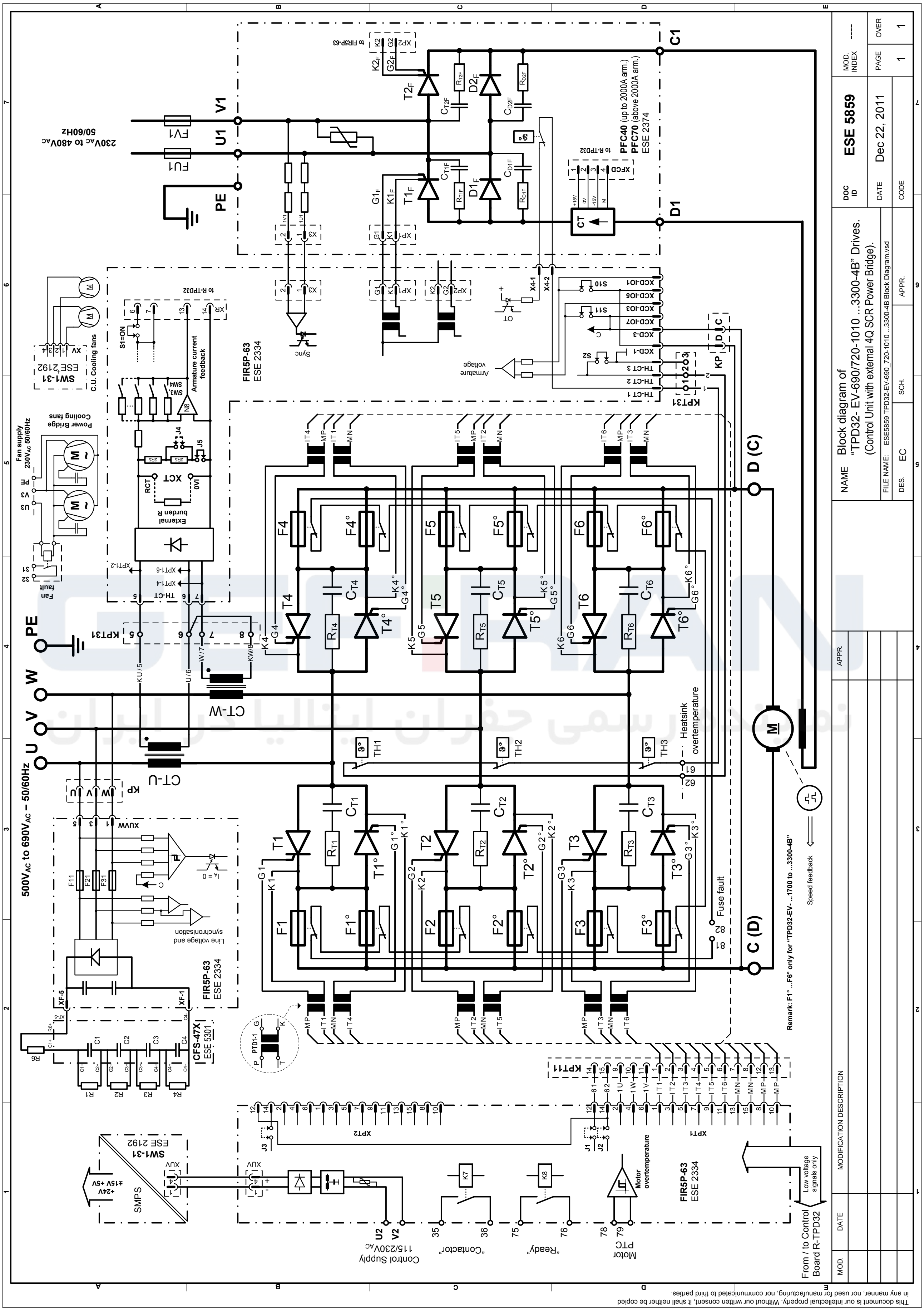
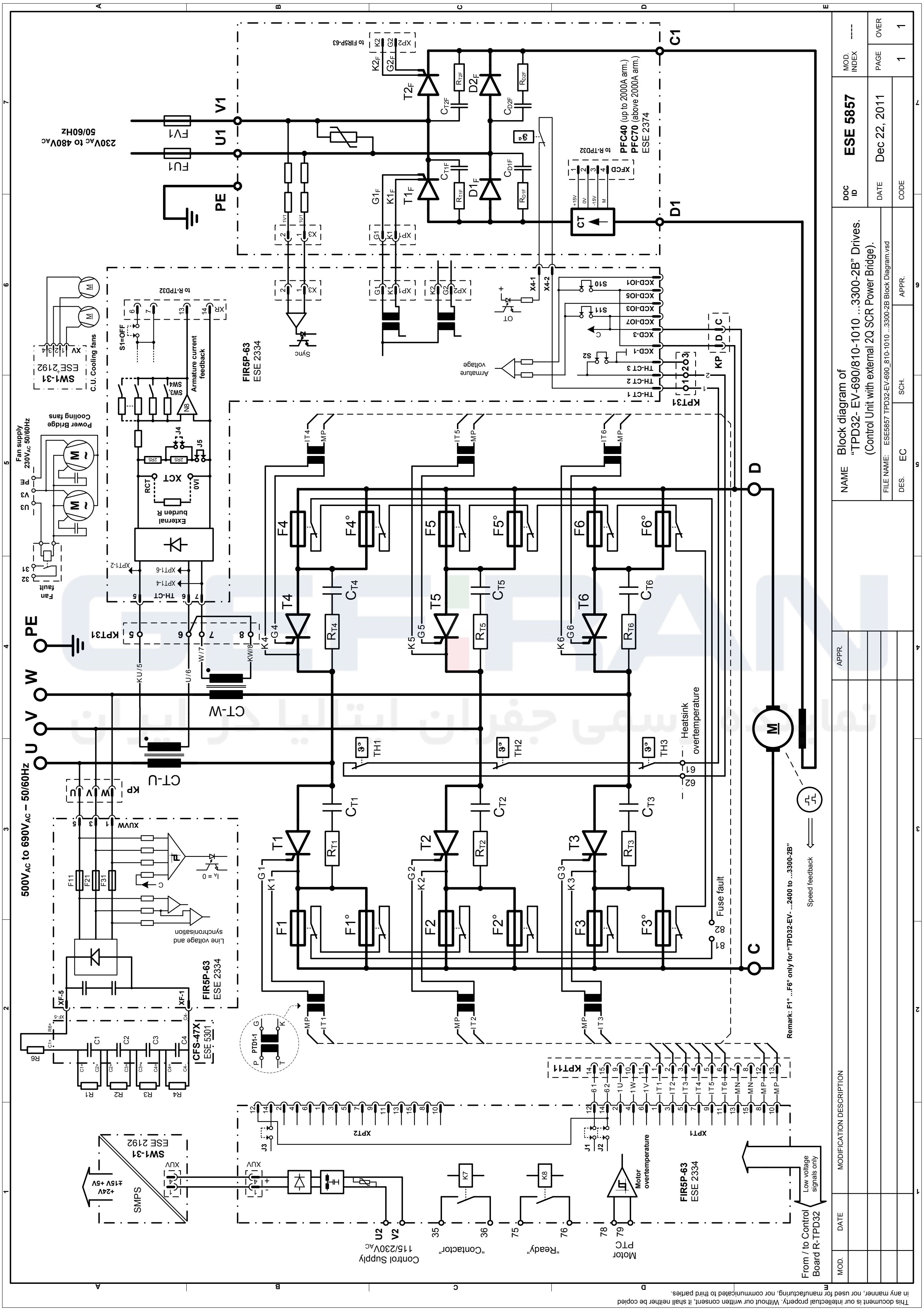
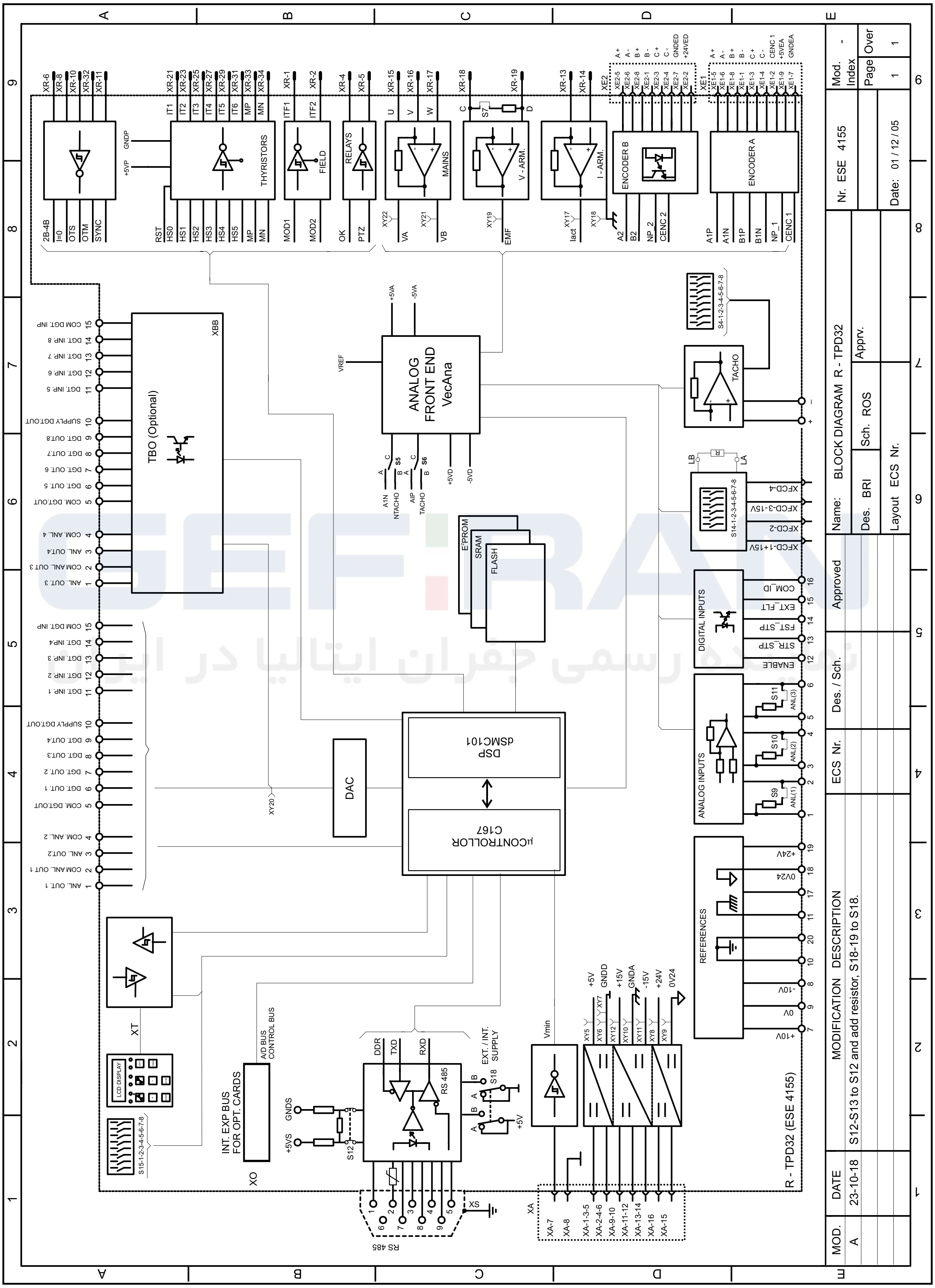


Figure 9.2.16: ESE5857 TPD32-EV-690_810-1010 ...3300-2B (Construction type E)



9.3 REGULATION CARD



9.4 CONNECTION OF EXTERNAL POWER BRIDGES

Figure 9.4.1: ESE5855 TPD32-EV-....-1010....3300-4B-E

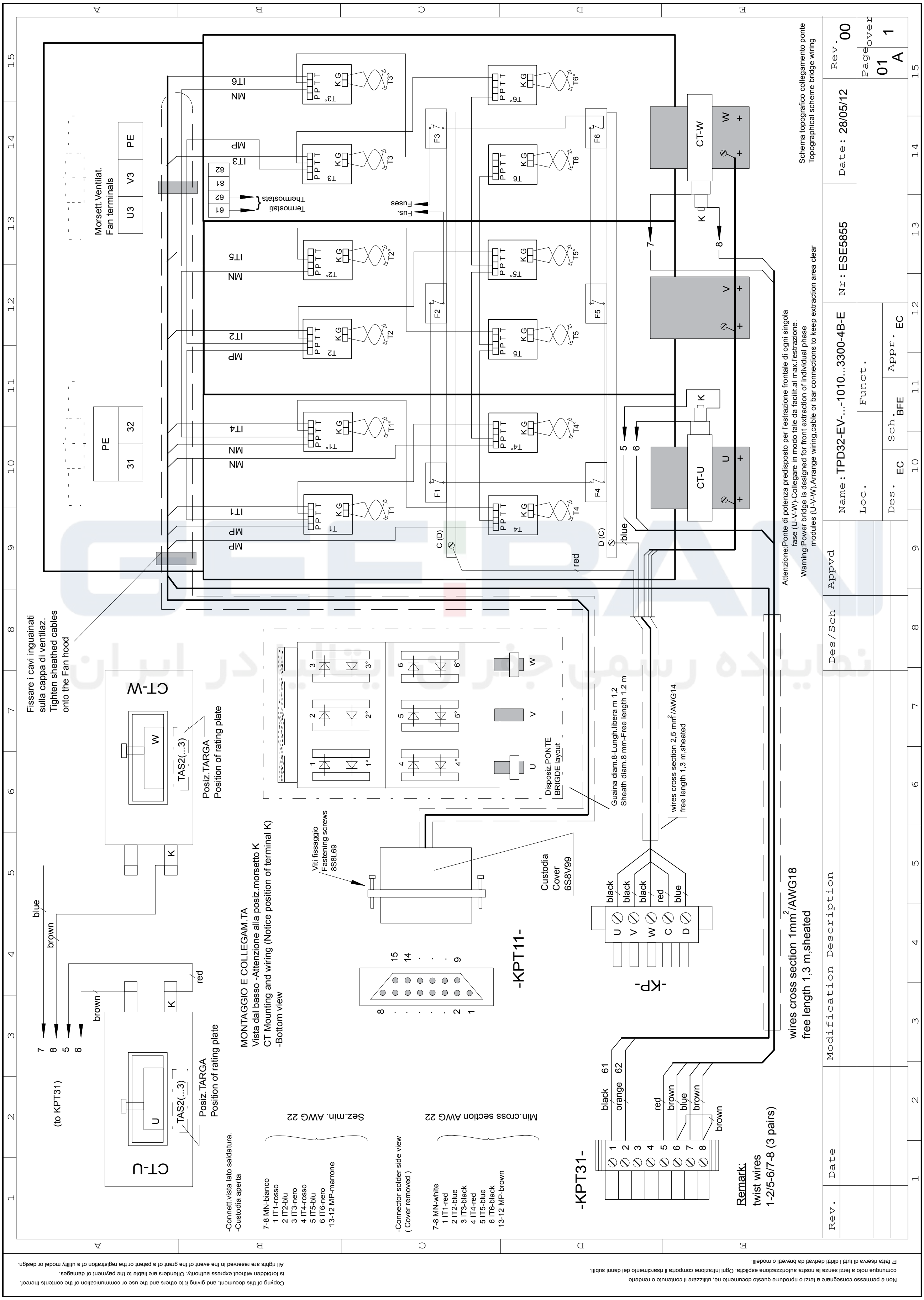


Figure 9.4.2: ESE5854 TPD32-EV-....-1010....3300-2B-E

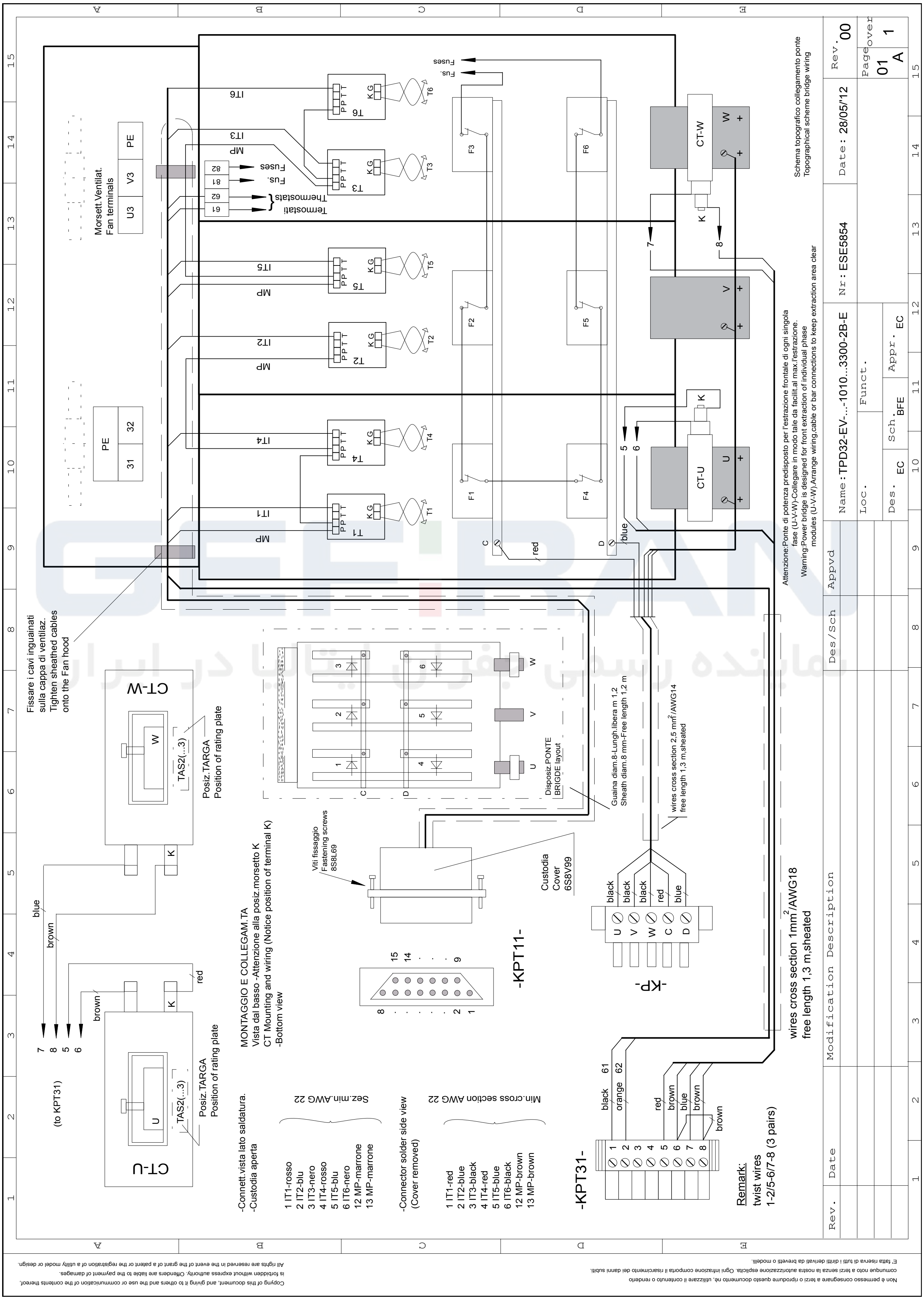


Figure 9.4.3-A: ESE5799 (1/3) - TPD32-EV-CU-

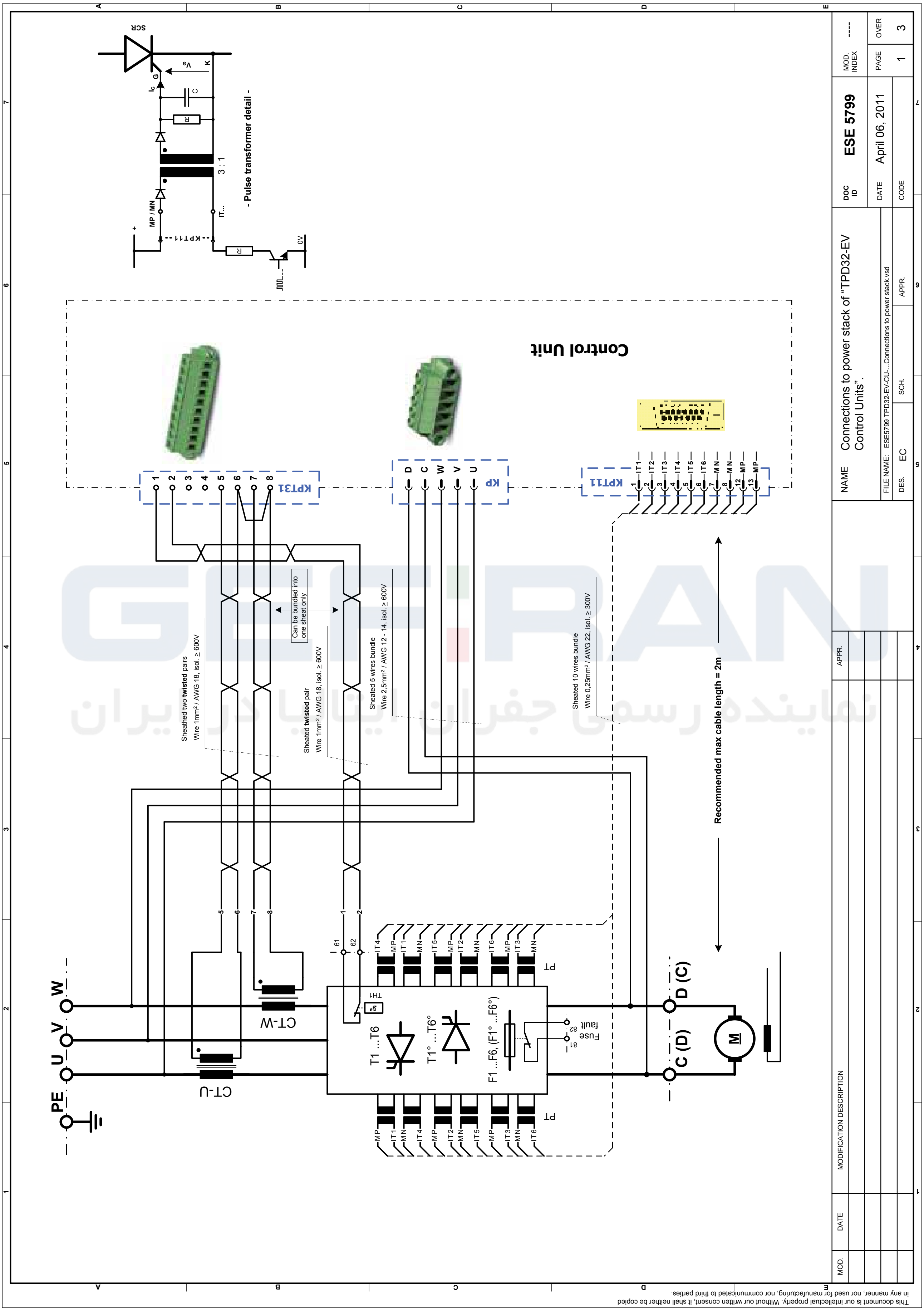


Figure 9.4.3-B: ESE5799 (2/3) - TPD32-EV-CU-

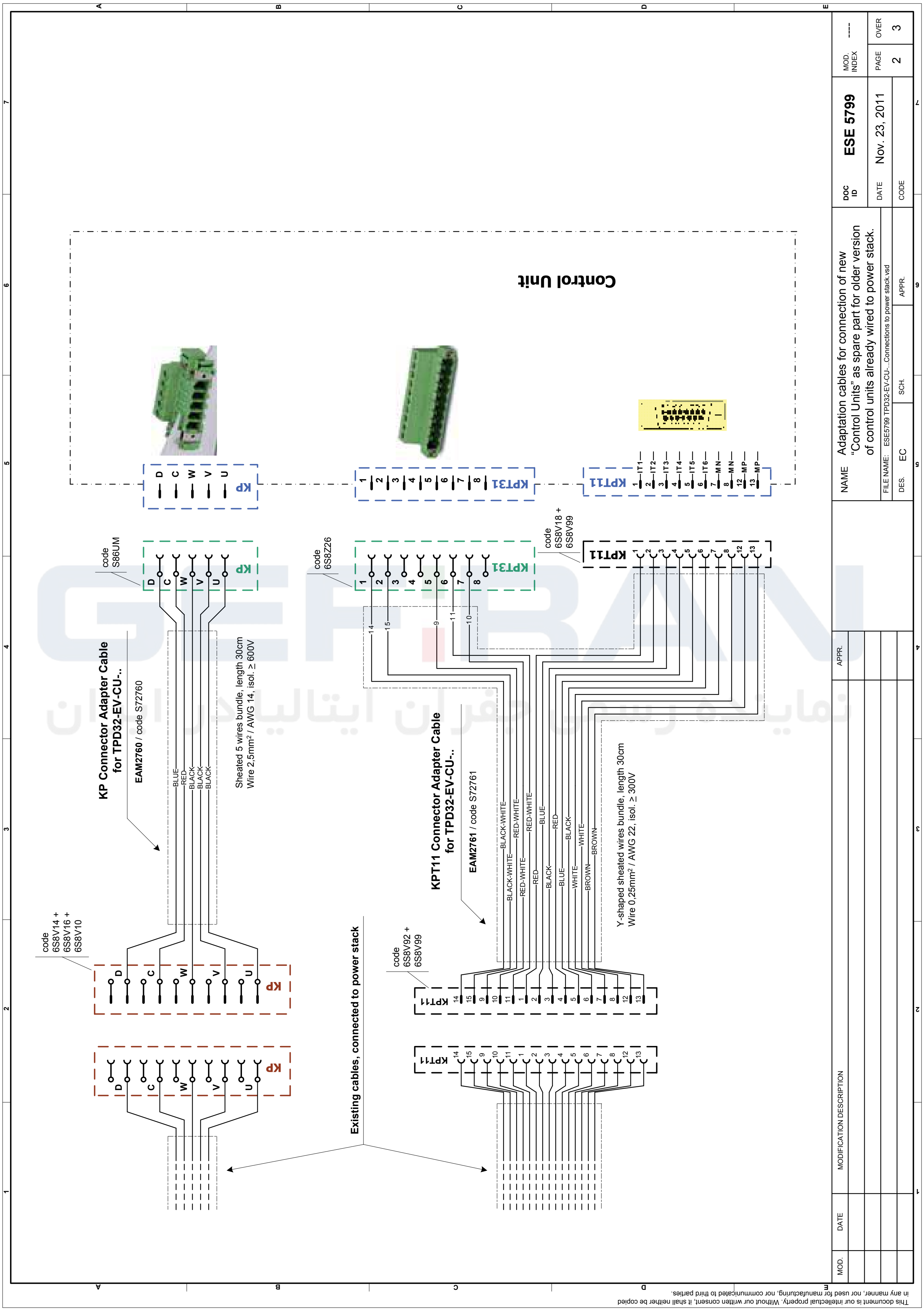


Figure 9.4.3-C: ESE5799 (3/3) - TPD32-EV-CU-

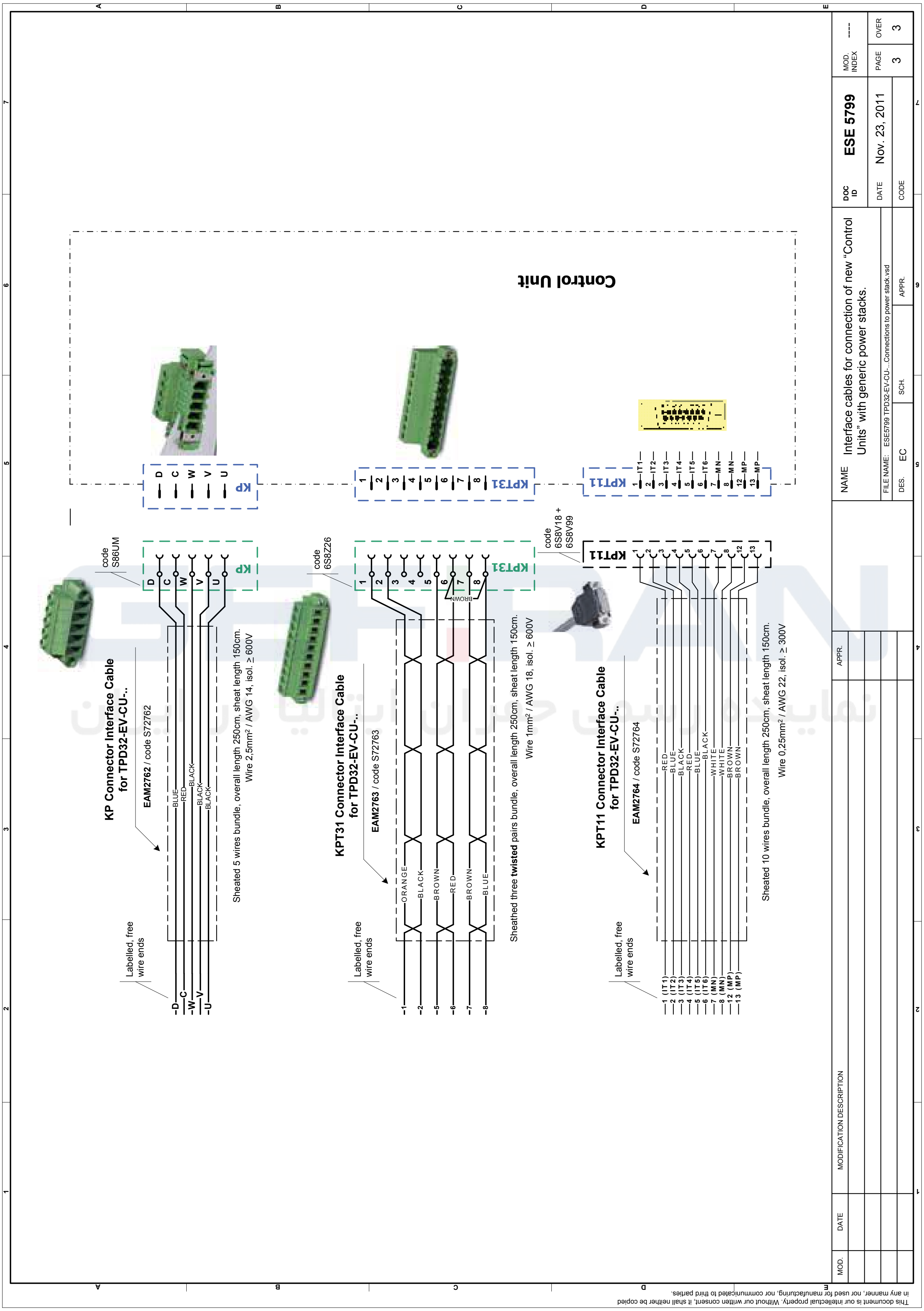


Figure 9.4.4: ESE5771 TPD32-EV-CU-230...690-THY1-XX_1

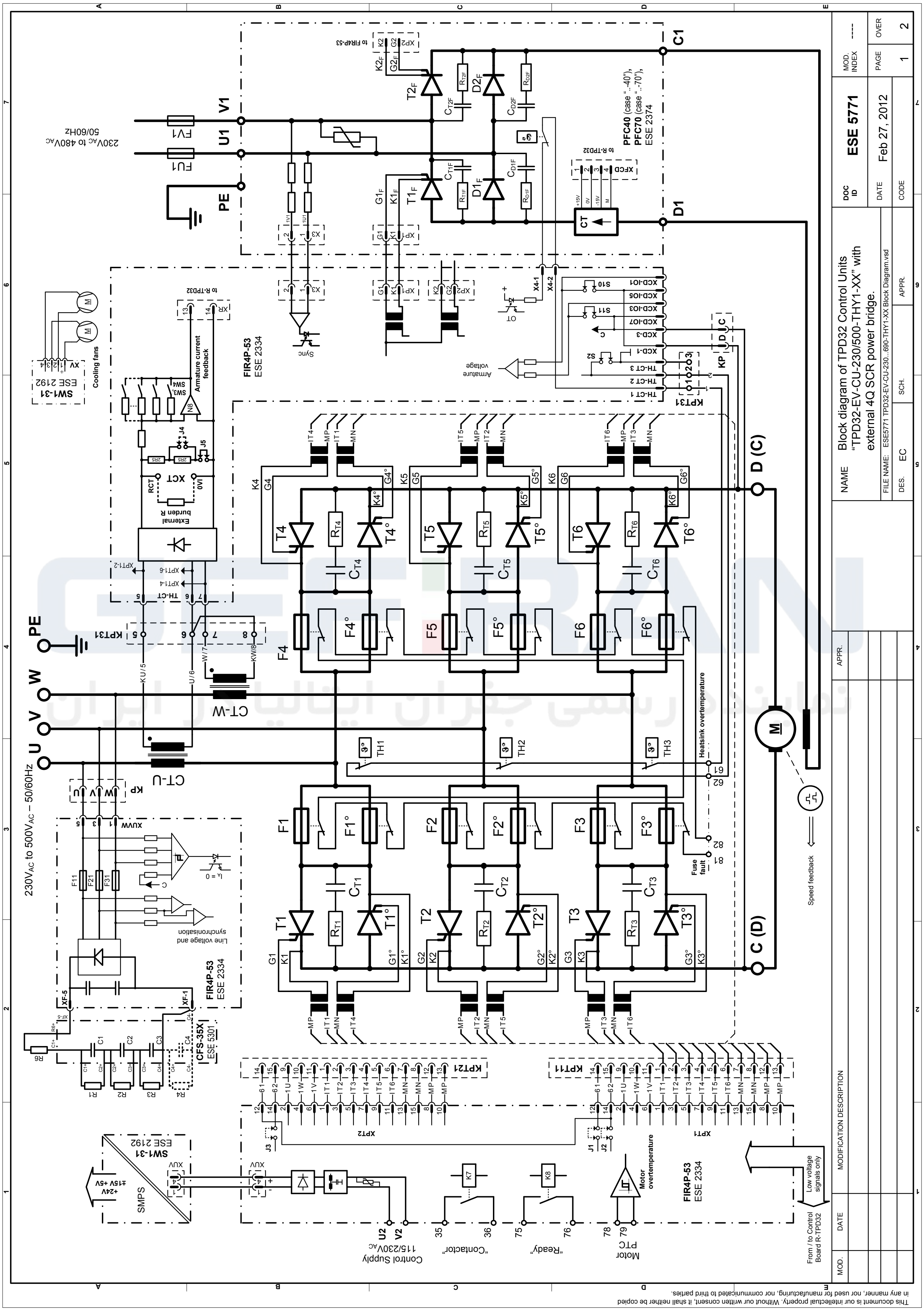
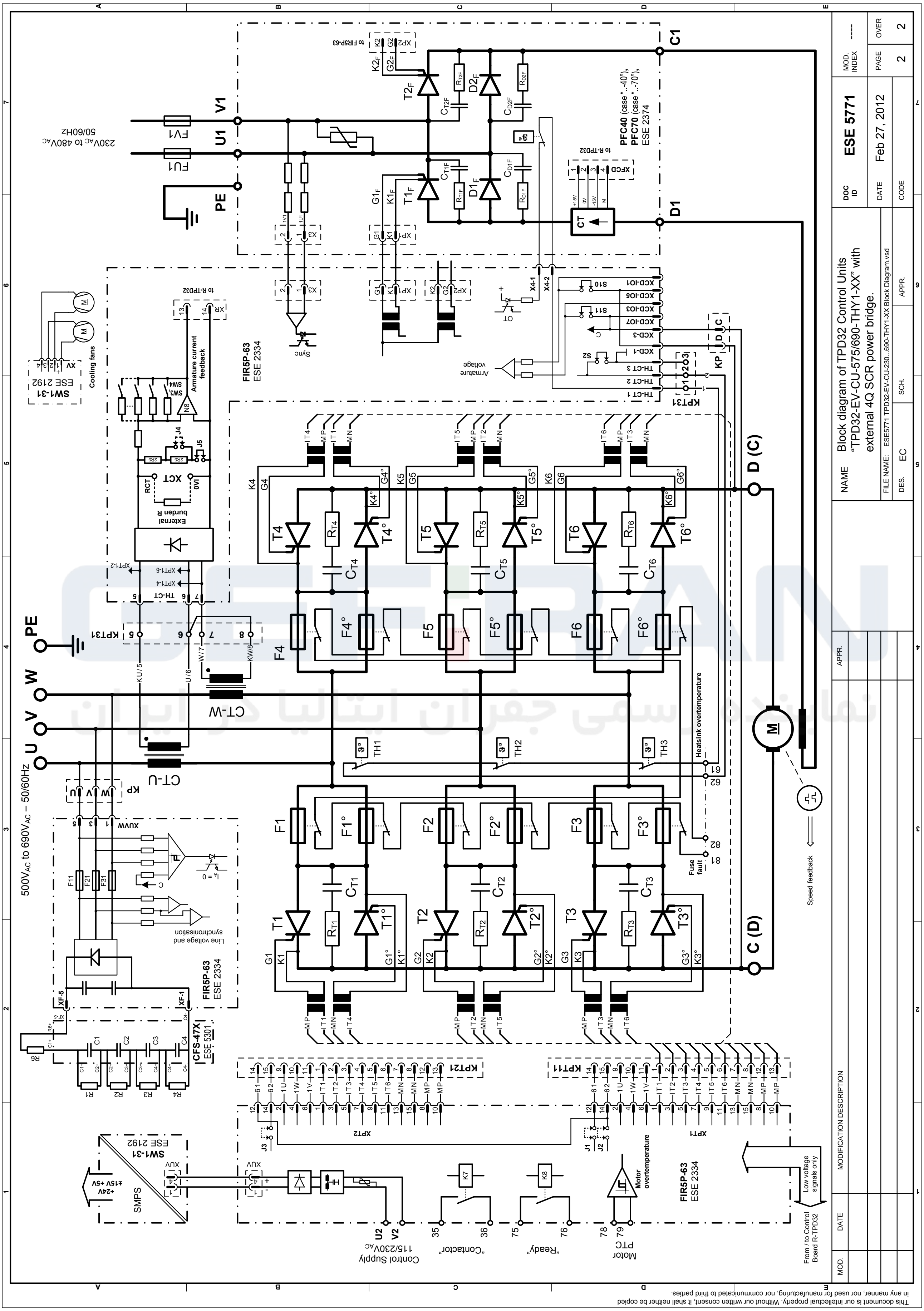


Figure 9.4.5: ESE5771 TPD32-EV-CU-230...690-THY1-XX_2



10 - PARAMETER LISTS

10.1 COMPLETE MAIN MENU LIST

Explanation of tables:

White text on black background	Menu/submenu
White text on black background in brackets	Function not accessible via keypad. The status of the corresponding parameter is only displayed.
[FF] in the Parameter column	Dimension based on the factor function
"No." column	**Parameter number (decimal). The value 2000H (= decimal 8192) must be added to the number given in the "No." column in order to obtain the index to access the parameter via Bus , RS485 or Opt2. The parameters in the Drivecom group can be accessed using the format and index specified in the DRIVECOM power transmission profile (#21).**
"Format" column	Internal parameter format: I= Integer (Example: I16 = Integer 16 bit) U = Unsigned (Example: U32 = unsigned 32 bit) Float = Floating point
"Value" column	Minimum, maximum and factory parameter values. If "S" the value is depending on the size of the device.
"Keypad" column"	✓ = Parameter available via keypad
"RS485/BUS/Opt2-M" column (low priority)	Parameter available via RS485, field Bus or via the APC300 manual communication (see the APC300 user manual) The numbers indicate what has to be sent via interface line in order to set the single parameters.
"Term." column	Parameter addressable to one of the analog or digital input/output terminals.

"Opt2-A/"(Low priority) "PDC" (High priority)	Parameter available via APC300 asynchronous communication (see the APC300 user manual) and/or the Process Data Channel (PDC). When using a field bus interface, parameters whose range is [min=0; max=1] can be assigned to either Virtual digital inputs (if W access code exists) and/or Virtual digital outputs (if R access code exists). The numbers indicate what has to be sent via interface line in order to set the single parameters. Letter in brackets in the "Term." columnAnalog level to be applied to the terminal in order to start the single function.
IA, QA, ID, QD in the "Term." column	The function can be accessed via a freely programmable analog or digital input or output. IA = analog input QA = analog output ID = digital input QD = digital output. The eventually present number is the one by which the terminal is called.
H, L in the "Term." column	Level of the terminal signals (H=high, L=low) which enables the single function.
R/W/Z/C	Access possibilities via the serial interface, Bus or Opt2 manual or asynchronous communication : R = Read, W = Write, Z = Write only when drive disabled, C=Command parameter (the writing of any value causes the execution of a command).
X · Pyy	The value of this parameter can correspond to min/max X times the value of the yy parameter.

Note! The parameter number here indicated has to be intended as an offset value, that the user has always to add to the base value 2000H (= decimal 8192), in order to address parameters when a serial line/bus or the APC300 card are used. It also possible to accede to the DRIVECOM parameter with the DRIVECOM standard indexes.

* When the parameter is accessed by Opt2-A/PDC the format is U16.

** When the parameter is accessed by Opt2-A/PDC the format is I16.

*** When the parameter is accessed by Opt2-A/PDC the lower word of the parameter is considered.

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
Drive ready Drive ready Drive not ready	380	U16	0	1	-	-	-	R 1 0	QD H L	R 1 0
Quick stop Quick stop No Quick stop	343	U16	0	1	No Quick stop	No Quick stop	-	R/W 0 1	-	-
Start/Stop Start Stop	315	U16	0	1	Stop (0)	Stop (0)		R/W 1 0	13 H L	R/W 1 0
Fast stop Fast Stop No Fast Stop	316	U16	0	1	No Fast Stop	No Fast Stop	-	R/W 0 1	14 L H	R/W 0 1
DRIVE STATUS										
Ramp ref 1 [FF]	44	I16	-2 P45	+2 P45	0	0	✓	R/W	IA, QA	R/W
Enable drive Enabled Disabled	314	U16	0	1	Disabled	Disabled	✓	R/W 1 0	12 H L	R/W 1 0
Start/Stop Start Stop	315	U16	0	1	Stop (0)	Stop (0)	✓	R/W 1 0	13 H L	R/W 1 0
Output voltage [V]	233	Float **	0	999	-	-	✓	R	QA	R
Motor current [%]	199	I16	-250	250	-	-	✓	R	QA	R
Actual spd (rpm)	122	I16	-8192	+8192	-	-	✓	R	QA	R
Speed ref (rpm)	118	I16	-32768	+32767	-	-	✓	R	QA	R
Output power [kW]	1052	Float	0.01	9999.99	-	-	✓	R	-	-
Flux current (A)	351	Float	0.1	99.9	S	S	✓	R	-	-
Mains voltage [V]	466	U16	0	999	-	-	✓	R	-	-
Digital I/Q					-	-	✓	-	-	-

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
START UP										
Speed base value [FF]	45	U32***	1	16383	1500	1500	✓	R/Z	-	R
Nom flux curr [A] (Field curr scale [A])	374	Float	0.5	70.0	S	S	✓	R/Z	-	-
Speed-0 f weak ON (Enabled) OFF (Disabled)	499	U16	0	1	0	0	✓	R/W 1 0	-	-
Acc delta speed [FF]	21	U32	0	2^{32}-1	100	100	✓	R/W	-	-
Acc delta time [s]	22	U16	0	65535	1	1	✓	R/W	-	-
Dec delta speed [FF]	29	U32	0	2^{32}-1	100	100	✓	R/W	-	-
Dec delta time [s]	30	U16	0	65535	1	1	✓	R/W	-	-
START UP \ Motor data										
Motor nom flux (Motor field curr [A])	280	Float	0.0	P374	P374	P374	✓	R/Z	-	-
Flux reg mode Constant current Voltage control External control (OFF) Ext digital FC Ext wired FC Ext digital FC Const Ext wired FC Cons	469	U16	0	6	Const. current (0)	Const. current (0)	✓	R/Z 0 1 2 3 4 5 6	-	-
Full load curr [A]	179	Float	0.1	IdAN	IdAN	IdAN	✓	R/Z	-	-
Motor max speed [rpm]	162	Float *	0	6553	1500	1500	✓	R/Z	-	R
Max out voltage [V]	175	Float	20	999	400	400	✓	R/Z	-	-
Flux weak speed [%]	456	U16	0	100	100	100	✓	R/Z	-	R
START UP \ Limits										
T current lim [%]	7	U16	0	200	150	150	✓	R/W	IA	R/W
Flux current min [%]	468	U16	0	P467	5	5	✓	R/W	-	----
Flux current max [%]	467	U16	P468	100	100	100	✓	R/W	-	R/W
Speed min amount [FF]	1	U32	0	2^{32}-1	0	0	✓	R/Z	-	-
Speed max amount [FF]	2	U32	0	2^{32}-1	5000	5000	✓	R/Z	-	-
START UP \ Speed feedback										
Speed fbk sel Encoder 1 Encoder 2 Tacho Armature	414	U16	0	3	1	1	✓	R/Z 0 1 2 3	-	R
Tacho scale	562	Float	0.90	3.00	1.00	1.00	✓	R/W	-	-
Speed offset	563	Float	-20.00	+20.00	0.00	0.00	✓	R/W	-	-
Encoder 2 pulses	169	Float *	600	9999	1024	1024	✓	R/Z	-	R
Enable fbk contr Enabled Disabled	457	U16	0	1	Enabled (1)	Enabled (1)	✓	R/Z 1 0	-	-
Refresh enc 2 Enabled Disabled	652	U16	0	1	0	0	✓	R/W 1 0	-	-
Volt Enc 1 [V] 5.2V 5.6V 6.1V 6.5V	1602	U16	0	3	5.2V (0)	5.2V (0)	✓	R/W 0 1 2 3	-	-
Volt Enc 2 [V] 5.2V 5.6V 6.1V 6.5V	1603	U16	0	3	5.2V (0)	5.2V (0)	✓	R/W 0 1 2 3	-	-
START UP \ Alarms										
Warning Cfg No Stop/No start Stop/No start No Stop/Start	9287	U16	0	4	Stop/No start (1)	Stop/No start (1)	✓	R/W 0 1 4	-	-

Parameter	No.	Format	Value: min	Value: max	Value: Factory American	Value: Factory European	Access via: Keyp.	Access via: RS485/ BUS/ Opt2-M	Access via: Term.	Access via: Opt2-A/ PDC
Undervolt thr [V]	481	U16	0	1000	230	230	✓	R/W	-	-
Overcurrent thr [%]	584	U16	0	200	160	160	✓	R/W	-	-
START UP \ Overload contr										
Enable overload Enabled Disabled	309	I16	0	1	Enabled	Disabled	✓	R/Z 1 0	-	-
Overload mode Curr limited Curr not limited I2t Motor I2t Drive I2t Motor & Drv	318	U16	0	4	I2t Motor	Curr limited	✓	R/W 0 1 2 3 4	-	-
Overload current [%]	312	U16	P313	200	150	100	✓	R/W	-	-
Base current [%]	313	U16	0	P312 < 100	100	80	✓	R/W	-	-
Overload time [s]	310	U16	0	65535	60	30	✓	R/W	-	-
Ventil. Type SERVO AUTO	914	U16	0	1	Servo	Servo 0 1	✓	R/Z	-	-
Derating factor [%]	915	U16	0	100	50	50	✓	R/Z	-	-
Motor ovrld preal.	1289	U16	0	1	-	-	✓	R	-	-
Motor I2t accum	655	Float	0.00	100.00	-	-	✓	R	-	-
Drive ovrld preal.	1438	U16	0	1	-	-	✓	R	-	-
Drive I2t accum	1439	FLOAT	0.00	100.00	-	-	✓	R	-	-
Pause time [s]	311	U16	0	65535	540	300	✓	R/W	-	-
Overld available Overload not possible Overload possible	406	U16	0	1	-	-	-	R 0 1	QD L H	R 0 1
Overload state Current limit value Current > limit value	407	U16	0	1	-	-	-	R 0 1	QD L H	R 0 1
START UP \ Analog inputs \ Analog input 1										
Select input 1 OFF Jog reference Speed ref 1 Speed ref 2 Ramp ref 1 Ramp ref 2 T current ref 1 T current ref 2 Adap reference T current limit T current lim + T current lim - Pad 0 Pad 1 Pad 2 Pad 3 Load comp PID offset 0 PI central v3 PID feed-back Flux current max Out vlt level Speed ratio Tension red Tension ref Preset 3 Brake Ref	70	U16	0	32	Ramp ref 1 (4)	Ramp ref 1 (4)	✓	R/Z 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 19 21 22 23 25 26 28 29 30 31 32	-	-
Scale input 1	72	Float	-10000	10.000	1.000	1.000	✓	R/W	-	-
Auto tune inp 1 Auto tune	259	U16					✓	C/W 1	-	-

Parameter	No.	Format	Value: min	Value: max	Value: Factory American	Value: Factory European	Access via: Keyp.	Access via: RS485/ BUS/ Opt2-M	Access via: Term.	Access via: Opt2-A/ PDC
Offset input 1	74	I16	-32768	+32767	0	0	✓	R/W	-	-
START UP \ Analog inputs \ Analog input 2										
Select input 2 (Select like Input 1)	75	U16	0	32	OFF (0)	OFF (0)	✓	R/Z	-	-
Scale input 2	77	Float	-10.000	10.000	1.000	1.000	✓	R/W	-	-
Auto tune inp 2 Auto tune	260	U16					✓	C/W 1	-	-
Offset input 2	79	I16	-32768	+32767	0	0	✓	R/W	-	-
START UP \ Analog inputs \ Analog input 3										
Select input 3 (Select like Input 1)	80	U16	0	32	OFF (0)	OFF (0)	✓	R/Z	-	-
Scale input 3	82	Float	-10.000	10.000	1.000	1.000	✓	R/W	-	-
Auto tune inp 3 Auto tune	261	U16					✓	C/W 1	-	-
Offset input 3	84	I16	-32768	+32767	0	0	✓	R/W	-	-
START UP										
R&L Search OFF ON	452	U16	0	1	OFF	OFF	✓	R/Z 0 1	-	-
Enable drive Enabled Disabled	314	U16	0	1	Disabled	Disabled	✓	R/W 1 0	12 H L	R/W 1 0
Start/Stop Start Stop	315	U16	0	1	Stop (0)	Stop (0)	✓	R/W 1 0	13 H L	R/W 1 0
START UP \ Speed self tune										
Fwd-Rev spd tune Fwd direction Rev direction	1029	U16	1	2	Fwd Direction (1)	Fwd Direction (1)	✓	R/Z 1 2	-	-
Test T curr lim [%]	1048	U16	0	S	20	20	✓	R/Z	-	-
Start	1027	U16	0	65535	-	-	✓	C	-	-
Inertia [kg*m*m*]	1014	Float	0.001	999.999	S	S	✓	R/W	-	-
Inertia Nw [kg*m*m*]	1030	Float	0.001	999.999	-	-	✓	R	-	-
Friction [N*m]	1015	Float	0.000	99.999	S	S	✓	R/W	-	-
Friction Nw [N*m]	1031	Float	0.000	99.99	-	-	✓	R	-	-
Speed P [%]	87	Float	0.00	100.00	S	S	✓	R/W	-	-
Speed P Nw [%]	1032	Float	0.00	100.00	-	-	✓	R	-	-
Speed I [%]	88	Float	0.00	100.00	S	S	✓	R/W	-	-
Speed I Nw [%]	1033	Float	0.00	100.00	-	-	✓	R	-	-
Take val	1028	U16	0	65535	-	-	✓	Z/C	-	-
START UP										
Main commands Terminals Digitals	252	U16	0	1	Term (0)	Term (0)	✓	R/Z 0 1	-	-
Control mode Local Bus	253	U16	0	1	Local (0)	Local (0)	✓	R/Z 0 1	-	-
Save parameters	256	U16					✓	C/W (1)	-	-

Parameter	No.	Format	Value min	Value max	Value Factory American	Value Factory European	Access via Keyp.	Access via RS485/ BUS/ Opt2-M	Access via Term.	Access via Opt2-A/ PDC
TUNING										
R&L Search OFF ON	452	U16	0	1	OFF	OFF	✓	R/Z 0 1	-	-
Enable drive Enabled Disabled	314	U16	0	1	Disabled	Disabled	✓	R/W 1 0	12 H L	R/W 1 0
Start/Stop Start Stop	315	U16	0	1	Stop (0)	Stop (0)	✓	R/W 1 0	13 H L	R/W 1 0
TUNING \ Speed self tune										
Fwd-Rev spd tune Fwd direction Rev direction	1029	U16	1	2	Fwd Direction -1	Fwd Direction -1	✓	R/Z 1 2	-	-
Test T curr lim [%]	1048	U16	0	S	20	20	✓	R/Z	-	-
Start	1027	U16	0	65535	-	-	✓	C	-	-
Inertia [kg*m*m*]	1014	Float	0.001	999.999	S	S	✓	R/W	-	-
Inertia Nw [kg*m*m*]	1030	Float	0.001	999.999	-	-	✓	R	-	-
Friction [N*m]	1015	Float	0.000	99.999	S	S	✓	R/W	-	-
Friction Nw [N*m]	1031	Float	0.00	99.99	-	-	✓	R	-	-
Speed P [%]	87	Float	0.00	100.00	S	S	✓	R/W	-	-
Speed P Nw [%]	1032	Float	0.00	100.00	-	-	✓	R	-	-
Speed I [%]	88	Float	0.00	100.00	S	S	✓	R/W	-	-
Speed I Nw [%]	1033	Float	0.00	100.00	-	-	✓	R	-	-
Take val	1028	U16	0	65535	-	-	✓	Z/C	-	-
TUNING										
Speed P [%]	87	Float	0.00	100.00	S	S	✓	R/W	-	-
Speed I [%]	88	Float	0.00	100.00	S	S	✓	R/W	-	-
Prop filter [ms]	444	U16	0	1000	0	0	✓	R/W	-	-
Flux P [%]	91	Float	0.00	100.00	2.00	2.00	✓	R/W	-	-
Flux I [%]	92	Float	0.00	100.00	1.00	1.00	✓	R/W	-	-
Voltage P [%]	493	Float	0.00	100.00	30.00	30.00	✓	R/W	-	-
Voltage I [%]	494	Float	0.00	100.00	40.00	40.00	✓	R/W	-	-
Save parameters	256	U16					✓	C/W (1)	-	-

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
MONITOR										
Enable drive Enabled Disabled	314	U16	0	1	Disabled	Disabled	✓	R/W 1 0	12 H L	R/W 1 0
Start/Stop Start Stop	315	U16	0	1	Stop (0)	Stop (0)	✓	R/W 1 0	13 H L	R/W 1 0
MONITOR \ Measurements \ Speed \ Speed in DRC [ ]										
Ramp ref (d) [FF]	109	I16	-32768	+32767	-	-	✓	R	-	R
Ramp output (d) [FF]	112	I16	-32768	+32767	-	-	✓	R	-	R
Speed ref (d) [FF]	115	I16	-32768	+32767	-	-	✓	R	-	R
Actual spd (d) [FF]	119	I16	-32768	+32767	-	-	✓	R	-	R
F act spd (d) [FF]	925	I16	-32768	+32767	-	-	✓	R	-	R
Act spd filter [s]	923	Float	0.001	1.000	0.100	0.100	✓	R/W	-	-
MONITOR \ Measurements \ Speed \ Speed in rpm										
Ramp ref (rpm)	110	I16	-32768	+32767	-	-	✓	R	QA	R
Ramp outp (rpm)	113	I16	-32768	+32767	-	-	✓	R	QA	R
Speed ref (rpm)	118	I16	-32768	+32767	-	-	✓	R	QA	R
Actual spd (rpm)	122	I16	-8192	+8192	-	-	✓	R	QA	R
Enc 1 speed (rpm)	427	I16	-8192	+8192	-	-	✓	R		R
Enc 2 speed (rpm)	420	I16	-8192	+8192	-	-	✓	R		R
F act spd (rpm)	924	I16	-32768	+32767	-	-	✓	R	QA	R
Act spd filter [s]	923	Float	0.001	1.000	0.100	0.100	✓	R/W	-	-
MONITOR \ Measurements \ Speed \ Speed in %										
Ramp ref (%)	111	Float	-200.0	+200.0	-	-	✓	R	-	-
Ramp output (%)	114	Float	-200.0	+200.0	-	-	✓	R	-	-
Speed ref (%)	117	Float	-200.0	+200.0	-	-	✓	R	-	-
Actual spd (%)	121	Float	-200.0	+200.0	-	-	✓	R	-	-
MONITOR \ Measurements										
Mains voltage [V]	466	U16	0	999	-	-	✓	R	-	-
Mains frequency [Hz]	588	Float	0.0	70.0	-	-	✓	R	-	-
Output power [Kw]	1052	Float	0.01	9999.99	-	-	✓	R	-	-
Output voltage [V]	233	Float **	0	999	-	-	✓	R	QA	R
Motor current [%]	199	I16	-250	250	-	-	✓	R	QA	R
F T curr (%)	928	I16	-500	+500	-	-	✓	R	QA	R
T curr filter [s]	926	Float	0.001	0.250	0.100	0.100	✓	R/W	-	-
T current ref [%]	41	I16	-200	+200	-	-	✓	R	QA	R
Flux reference [%]	500	Float*	0.0	100.0	-	-	✓	R	QA	-
Flux current [%]	234	Float *	0.0	100.0	-	-	✓	R	QA	-
Flux current (A)	351	Float	0.1	99.9	S	S	✓	R	-	-
MONITOR \ I/O										
Digital I/Q					-	-	✓	-	-	-
Dig input term	564	U16	0	65535	-	-	-	R	-	R
Dig input term 1	565	U16	0	1	-	-	-	R	-	R
Dig input term 2	566	U16	0	1	-	-	-	R	-	R
Dig input term 3	567	U16	0	1	-	-	-	R	-	R
Dig input term 4	568	U16	0	1	-	-	-	R	-	R
Dig input term 5	569	U16	0	1	-	-	-	R	-	R
Dig input term 6	570	U16	0	1	-	-	-	R	-	R
Dig input term 7	571	U16	0	1	-	-	-	R	-	R
Dig input term 8	572	U16	0	1	-	-	-	R	-	R
Dig input term 9	573	U16	0	1	-	-	-	R	-	R
Dig input term 10	574	U16	0	1	-	-	-	R	-	R
Dig input term 11	575	U16	0	1	-	-	-	R	-	R

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
Dig input term 12	576	U16	0	1	-	-	-	R	-	R
Dig input term 15	579	U16	0	1	-	-	-	R	-	R
Dig input term 16	580	U16	0	1	-	-	-	R	-	R
Dig output term	581	U16	0	65535	-	-		R	-	R
Virtual dig inp	582	U16	0	65535	-	-	✓	R	-	-
Virtual dig out	583	U16	0	65535	-	-	✓	R	-	-

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
INPUT VARIABLES \ Ramp ref \ Ramp ref 1										
Ramp ref 1 [FF]	44	I16	-2 P45	+2 P45	0	0	✓	R/W	IA, QA	R/W
Ramp ref 1 (%)	47	Float	-200.0	+200.0	0.0	0.0	✓	R/W	-	-
INPUT VARIABLES \ Ramp ref \ Ramp ref 2										
Ramp ref 2 [FF]	48	I16	-2 P45	+2 P45	0	0	✓	R/W	IA, QA	R/W
Ramp ref 2 (%)	49	Float	-200.0	+200.0	0.0	0.0	✓	R/W	-	-
INPUT VARIABLES \ Speed ref \ Speed ref 1										
Speed ref 1 [FF]	42	I16	-2 P45	+2 P45	0	0	✓	R/W	IA, QA	R/W
Speed ref 1 (%)	378	Float	-200.0	+200.0	0	0	✓	R/W	-	-
INPUT VARIABLES \ Speed ref \ Speed ref 2										
Speed ref 2 [FF]	43	I16	-2 P45	+2 P45	0	0	✓	R/W	IA, QA	R/W
Speed Ref 2 (%)	379	Float	-200.0	+200.0	0	0	✓	R/W	-	-
INPUT VARIABLES \ T current ref										
T current ref 1 [%]	39	I16	-200	+200 see 6.4.3	0	0	✓	R/W	IA, QA	R/W
T current ref 2 [%]	40	I16	-200	+200	0.00	0.00	✓	R/W	IA, QA	-

Parameter	No.	Format	Value min	Value max	Value Factory American	Value Factory European	Access via Keyp.	Access via RS485/ BUS/ Opt2-M	Access via Term.	Access via Opt2-A/ PDC
LIMITS \ Speed limits \ Speed amount										
Speed min amount [FF]	1	U32	0	2^{32}-1	0	0	✓	R/Z	-	-
Speed max amount [FF]	2	U32	0	2^{32}-1	5000	5000	✓	R/Z	-	-
LIMITS \ Speed limits \ Speed min/max										
Speed min pos [FF]	5	U32	0	2^{32}-1	0	0	✓	R/Z	-	-
Speed max pos [FF]	3	U32	0	2^{32}-1	5000	5000	✓	R/Z	-	-
Speed min neg [FF]	6	U32	0	2^{32}-1	0	0	✓	R/Z	-	-
Speed max neg [FF]	4	U32	0	2^{32}-1	5000	5000	✓	R/Z	-	-
Speed limited Speed not limited Speed limited	372	U16	0	1			-	R 0 1	QD L H	R 0 1
LIMITS \ Current limits										
T current lim type T lim +/- T lim mot gen	715	U16	0	1	0	0	✓	R/Z 0 1	-	-
T current lim [%]	7	U16	0	200	150	150	✓	R/W	IA	R/W
T current lim + [%]	8	U16	0	200	150	150	✓	R/W	IA	R/W
T current lim - [%]	9	U16	0	200	150	150	✓	R/W	IA	R/W
Curr limit state Curr. limit not reached Curr. limit reached	349	U16	0	1			-	R 0 1	QD L H	R 0 1
In use Tcur lim+ [%]	10	U16	0	200			✓	R	-	R
In use Tcur lim- [%]	11	U16	0	200			✓	R	-	R
Current lim red [%]	13	U16	0	200	100	100	✓	R/W	-	R/W
Torque reduct Not active Active	342	U16	0	1	Not active (0)	Not active (0)	✓	R/W 0 1	ID L H	R/W 0 1
LIMITS \ Flux limits (Fld curr limits)										
Flux current max [%] (Max field curr [%])	467	U16	P468	100	100	100	✓	R/W	-	R/W
Flux current min [%]	468	U16	0	P467	5	5	✓	R/W	-	----

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
RAMP \ Acceleration										
Acc delta speed [FF]	21	U32	0	2^{32}-1	100	100	✓	R/W	-	-
Acc delta time [s]	22	U16	0	65535	1	1	✓	R/W	-	-
RAMP \ Deceleration										
Dec delta speed [FF]	29	U32	0	2^{32}-1	100	100	✓	R/W	-	-
Dec delta time [s]	30	U16	0	65535	1	1	✓	R/W	-	-
RAMP \ Quick stop										
QStp delta speed [FF]	37	U32	0	2^{32}-1	1000	1000	✓	R/W	-	-
QStp delta time [s]	38	U16	0	65535	1	1	✓	R/W	-	-
RAMP										
Ramp shape Linear S-Shaped	18	U16	0	1	Linear (0)	Linear (0)	✓	R/Z 0 1	-	-
S shape t const [ms]	19	Float	0	15000	300	300	✓	R/W	-	-
S acc t const [ms]	663	Float	0	15000	300	300	✓	R/W	-	-
S dec t const [ms]	664	Float	0	15000	300	300	✓	R/W	-	-
Ramp +/- delay [ms]	20	U16	0	65535	100	100	✓	R/W	-	-
Fwd-Rev No direction Fwd direction Rev direction No direction	673	U16	0	3	1	1	✓	R/W 0 1 2 3	ID	R/W 0 1 2 3
Forward sign	293	U16	0	1	0	0	-	R/W	ID	R/W
Reverse sign	294	U16	0	1	0	0	-	R/W	ID	R/W
Enable ramp Enabled Disabled	245	I16	0	1	Enabled (1)	Enabled (1)	✓	R/Z 1 0	-	-
Ramp out = 0 Active Not active	344	U16	0	1	Not active (1)	Not active (1)	✓	R/W 0 1	ID L H	R/W 0 1
Ramp in = 0 Active Not active	345	U16	0	1	Not active (1)	Not active (1)	✓	R/W 0 1	ID L H	R/W
Freeze ramp Active Not active	373	U16	0	1	Not active (1)	Not active (1)	✓	R/W 0 1	ID H L	R/W 1 0
Ramp + Acc.CW + Dec. anti-CW Other states	346	U16	0	1	-	-	-	R 1 0	QD H L	R 1 0
Ramp - Acc.anti-CW + Dec. CW Other states	347	U16	0	1	-	-	-	R 1 0	QD H L	R 1 0

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
SPEED REGULAT										
Speed ref [rpm]	118	I16	-32768	+32767	-	-	✓	R	QA	R
Speed reg output [%]	236	I16	-200	+200 see 6.7.1	-	-	✓	R	QA	R
Lock speed reg ON OFF	322	U16	0	1	OFF	OFF	✓	R/W 1 0	ID L H	R/W 1 0
Enable spd reg Enable Disable	242	I16	0	1	Enabled	Enabled	✓	R/W 1 0	-	-
Lock speed I Active Not active	348	U16	0	1	Not active (1)	Not active (1)	✓	R/W 0 1	ID L H	R/W 0 1
Aux spd fun sel Speed up Inertia-loss cp	1016	U16	0	1	Speed up (0)	Speed up (0)	✓	R/Z 0 1	-	-
Prop filter [ms]	444	U16	0	1000	0	0	✓	R/W	-	-
SPEED REGULAT. \ Self tuning										
Fwd-Rev spd tune Fwd direction Rev direction	1029	U16	1	2	Fwd Direction (1)	Fwd Direction (1)	✓	R/Z 1 2	-	-
Test T curr lim [%]	1048	U16	0	S	20	20	✓	R/Z	-	-
Start	1027	U16	0	65535	-	-	✓	C	-	-
Inertia [kg*m*m*]	1014	Float	0.001	999.999	S	S	✓	R/W	-	-
Inertia Nw [kg*m*m*]	1030	Float	0.001	999.999	-	-	✓	R	-	-
Friction [N*m]	1015	Float	0.000	99.999	S	S	✓	R/W	-	-
Friction Nw [N*m]	1031	Float	0.00	99.99	-	-	✓	R	-	-
Speed P [%]	87	Float	0.00	100.00	S	S	✓	R/W	-	-
Speed P Nw [%]	1032	Float	0.00	100.00	-	-	✓	R	-	-
Speed I [%]	88	Float	0.00	100.00	S	S	✓	R/W	-	-
Speed I Nw [%]	1033	Float	0.00	100.00	-	-	✓	R	-	-
Take val	1028	U16	0	65535	-	-	✓	Z/C	-	-
SPEED REGULAT \ Spd zero logic										
Enable spd=0 I Enabled Disabled	123	U16	0	1	Disabled	Disabled	✓	R/Z 1 0	-	-
Enable spd=0 R Enabled Disabled	124	U16	0	1	Disabled	Disabled	✓	R/Z 1 0	-	-
Enable spd=0 P Enabled Disabled	125	U16	0	1	Disabled	Disabled	✓	R/Z 1 0	-	-
Spd=0 P gain [%]	126	Float	0.00	100.00	10.00	10.00	✓	R/W	-	-
Ref 0 level [FF]	106	U16	1	32767	10	10	✓	R/W	-	-
SPEED REGULAT \ Speed up										
Speed up gain [%]	445	Float	0.00	100.00	0.00	0.00	✓	R/W	-	-
Speed up base [ms]	446	Float	0	16000	1000	1000	✓	R/W	-	-
Speed up filter [ms]	447	U16	0	1000	0	0	✓	R/W	-	-
SPEED REGULAT \ Droop function										
Droop gain [%]	696	Float	0.00	100.00	0.00	0.00	✓	R/W	-	-
Droop filter [ms]	697	U16	0	1000	0	0	✓	R/W	-	-
Load comp [%]	698	I16	-200	+200	0	0	✓	R/W	IA	R/W
Droop limit [FF]	700	U16	0	2*P45	1500	1500	✓	R/W	-	-
Enable droop Enabled Disabled	699	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W 1 0	ID	R/W 1 0

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
SPEED REGULAT \ Inertia/loss cp										
Inertia [kg*m*m]	1014	Float	0.001	999.999	S	S	✓	R/W	-	-
Friction [N*m]	1015	Float	0.000	99.999	S	S	✓	R/W	-	-
Torque const [N*m/A]	1013	Float	0.01	99.99	S	S	✓	R	-	-
Inertia c filter [ms]	1012	U16	0	1000	0	0	✓	R/W	-	-

Parameter	No.	Format	Value: min	Value: max	Value: Factory American	Value: Factory European	Access via: Keyp.	Access via: RS485/ BUS/ Opt2-M	Access via: Term.	Access via: Opt2-A/ PDC
CURRENT REGULAT										
T current ref [%]	41	I16	-200	+200	-	-	✓	R	QA	R
Motor current [%]	199	I16	-250	250	-	-	✓	R	QA	R
Mot cur threshld [%]	1430	U16	0	200	100	100	✓	R/W	-	-
Mot cur th delay [ms]	1431	U16	0	65535	1000	1000	✓	R/W	-	-
dI/dt delta time	1520	U16	0	100	0	0	✓	R/W	-	-
Arm resistance [ohm]	453	Float	S	S	0.500	0.500	✓	R/W	-	-
Arm inductance [mH]	454	Float	S	S	4.00	4.00	✓	R/W	-	-
E int [V]	587	I16	-80	+80	-	-	✓	R	QA	-
R&L Search	452	U16	0	1	OFF	OFF	✓	R/Z	-	-
OFF								0		
ON								1		
Zero torque	353	U16	0	1	Not active (1)	Not active (1)	✓	R/W	ID	R/W
Active								0	L	
Not active								1	H	

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
FLUX REGULATION (FIELD CURRENT REGULATION)										
Enable flux reg ON (Enabled) OFF (Disabled)	497	U16	0	1	Enabled	Enabled	✓	R/W 1 0	ID H L	-
Flux reg mode Constant current Voltage control External control (OFF) Ext digital FC Ext wired FC Ext digital FC Const Ext wired FC Const	469	U16	0	6	Const. current (0)	Const. current (0)	✓	R/Z 0 1 2 3 4 5 6	-	-
Enable flux weak ON (Enabled) OFF (Disabled)	498	U16	0	1	1	1	✓	R/W 1 0	ID H L	-
Speed-0 f weak ON (Enabled) OFF (Disabled)	499	U16	0	1	0	0	✓	R/W 1 0	-	-
Flux reference [%]	500	Float*	0.0	100.0	0.0	0.0	✓	R	QA	-
Flux current [%]	234	Float*	0.0	100.0	-	-	✓	R	QA	-
Out vlt level	921	Float*	0.00	100.0	100.0	100.0	✓	R/W	IA, QA	R/W
FC cur ref hyst	1522	U16	1	100	5	5	✓	R/W	-	-
FC limit ramp Disabled (0) Enabled (1)	411	U16	-	-	Disabled	Disabled	✓	R/W	-	-
FC lmt ramp time [ms]	888	U16	200	10000	800	800	✓	R/W	-	-
FLUX REGULATION (FIELD CURRENT REGULATION) \ Flux \ if curve										
I field cnst 40	916	Float	0.0	100.0	40.0	40.0	✓	R/Z		-
I field cnst 70	917	Float	0.0	100.0	70.0	70.0	✓	R/Z		-
I field cnst 90	918	Float	0.0	100.0	90.0	90.0	✓	R/Z		-
Set flux / if	919	U16	0	1	0	0	✓	Z/C		-
Reset flux / if	920	U16	0	1	0	0	✓	Z/C		-
Nom flux curr [A]	374	Float	0.5	70.0	S	S	✓	R/Z	-	-
Motor nom flux	280	Float	0.00	P374	P374	P374	✓	R/Z	-	-

Parameter	No.	Format	Value: min	Value: max	Value: Factory American	Value: Factory European	Access via: Keyp.	Access via: RS485/ BUS/ Opt2-M	Access via: Term.	Access via: Opt2-A/ PDC
REG PARAMETERS \ Percent values \ Speed regulator										
Speed P [%]	87	Float	0.00	100.00	10.00	10.00	✓	R/W	-	-
Speed I [%]	88	Float	0.00	100.00	1.00	1.00	✓	R/W	-	-
Speed P bypass [%]	459	Float	0.00	100.00	10.00	10.00	✓	R/W	-	-
Speed I bypass [%]	460	Float	0.00	100.00	1.00	1.00	✓	R/W	-	-
REG PARAMETERS \ Percent values \ Flux regulator (Field regulator)										
Flux P [%]	91	Float	0.00	100.00	2.00	2.00	✓	R/W	-	-
Flux I [%]	92	Float	0.00	100.00	1.00	1.00	✓	R/W	-	-
REG PARAMETERS \ Percent values \ Voltage reg										
Voltage P [%]	493	Float	0.00	100.00	30.00	30.00	✓	R/W	-	-
Voltage I [%]	494	Float	0.00	100.00	40.00	40.00	✓	R/W	-	-
REG PARAMETERS \ Base values \ Speed regulator										
Speed P base [A/rpm]	93	Float	000.1	S	0.3 x P93max P93max	0.3 x P93max P93max	✓	R/Z	-	-
Speed I base [A/rpm·ms]	94	Float	0.001	S	0.3 P94max	0.3 P94max	✓	R/Z	-	-
REG PARAMETERS \ Base values \ Flux regulator (Field regulator)										
Flux P base	97	Float	1	32767	3277	3277	✓	R/Z	-	-
Flux I base	98	Float	1	32767	3277	3277	✓	R/Z	-	-
REG PARAMETERS \ Base values \ Voltage reg										
Voltage P base [f%/V]	495	Float	0.0100	S	S	S	✓	R/Z	-	-
Voltage I base [f%/V·ms]	496	Float	0.01	S	S	S	✓	R/Z	-	-
REG PARAMETERS \ In use values										
Speed P in use [%]	99	Float	0.00	100.00	S	S	✓	R	-	-
Speed I in use [%]	100	Float	0.00	100.00	S	S	✓	R	-	-

Parameter	No.	Format	Value: min	Value: max	Value: Factory American	Value: Factory European	Access via: Keyp.	Access via: RS485/ BUS/ Opt2-M	Access via: Term.	Access via: Opt2-A/ PDC
CONFIGURATION										
Main commands Terminals Digital	252	U16	0	1	Term.(0)	Term.(0)	✓	R/Z 0 1	-	-
Control mode Local Bus	253	U16	0	1	Local (0)	Local (0)	✓	R/Z 0 1	-	-
Speed base value [FF]	45	U32***	1	16383	1500	1500	✓	R/Z	-	R
Full load curr [A]	179	Float	0.1	P465	P465	P465	✓	R/Z	-	-
Max out voltage [V]	175	Float	20	999	400	400	✓	R/Z	-	-
Ok relay funct Drive healthy Ready to Start	412	I16	0	1	0	0	✓	R/Z 0 1	-	-
En Tcurr HiRes	1521	I16	0	1	0	0	✓	R/Z	-	-
Encoder Spd Res	1550	U16	1	20	1	1	✓	R/Z	-	-
Speed res 1/4 1/8 1/16 1/32 1/64	1429	U16	0	4	1/4 (0)	1/4 (0)	✓	R/Z 0 1 2 3 4	-	-
CONFIGURATION \ Speed fbk										
Motor max speed [rpm]	162	Float *	0	6553	1500	1500	✓	R/Z	-	R
Speed fbk sel Encoder 1 Encoder 2 Tacho Armature	414	U16	0	3	1	1	✓	R/Z 0 1 2 3	-	R
Encoder 1 state Encoder Fault Encoder ok	648	U16	0	1			-	R 0 1	QD	R 0 1
Enable fbk contr Enabled Disabled	457	U16	0	1	Enabled (1)	Enabled (1)	✓	R/Z 1 0	-	-
Enable fbk bypas Enabled Disabled	458	U16	0	1	0	0	✓	R/Z 1 0	-	-
Flux weak speed [%]	456	U16	0	100	100	100	✓	R/Z	-	R
Speed fbk error [%]	455	U16	0	100	22	22	✓	R/Z	-	-
Tacho scale	562	Float	0.90	3.00	1.00	1.00	✓	R/W	-	-
Speed offset	563	Float	-20.00	+20.00	0.00	0.00	✓	R/W	-	-
Encoder 1 pulses	416	Float *	600	9999	1024	1024	✓	R/Z	-	R
Encoder 2 pulses	169	Float *	150	9999	1000	1000	✓	R/Z	-	R
Refresh enc 1 Enabled Disabled	649	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W 1 0	-	-
Encoder 2 state Encoder Fault Encoder ok	651	U16	0	1			-	R 0 1	QD	R 0 1
Refresh enc 2 Enabled Disabled	652	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W 1 0	-	-
Enable ind store Enabled Disabled	911	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W 1 0	-	R/W
Ind store ctrl	912	U16	0	65535	0	0	-	R/W	-	R/W
Index storing	913	U32	0	$+2^{32}-1$	0	0	-	R	-	R
CONFIGURATION \ Drive type										
Drive size [A]	465	U16	0	S	S	S	✓	R	-	R
2B + E ON (Off) OFF (On)	201	U16	0	1	0	0	✓	R/Z 0 1		-

Parameter	No.	Format	Value: min	Value: max	Value: Factory American	Value: Factory European	Access via: Keyp.	Access via: RS485/ BUS/ Opt2-M	Access via: Term.	Access via: Opt2-A/ PDC
Size selection Standard American	464	U16	0	1	1	1	✓	R/Z 0 1	-	-
Software version	331	Text					✓	R	-	-
Drive type TPD32-EV-...-2B TPD32-EV-...-4B	300	U16	10	11	S	S	-	R 10 11	-	R 10 11
CONFIGURATION \ Dimension fact										
Dim factor num	50	I32***	1	65535	1	1	✓	R/Z	-	R
Dim factor den	51	I32***	1	$+2^{31}$ -1	1	1	ü	R/Z	-	R
Dim factor text	52	Text			rpm	rpm	✓	R/Z	-	-
CONFIGURATION \ Face value fact										
Face value num	54	I16	1	+32767	1	1	✓	R/Z	-	R
Face value den	53	I16	1	+32767	1	1	✓	R/Z	-	R
CONFIGURATION \ Prog alarms \ Failure supply										
FS Latch ON OFF	194	U16	0	1	ON	ON	✓	R/Z 1 0	-	-
FS Ok relay open ON OFF	195	I16	0	1	ON	ON	✓	R/W 1 0	-	-
CONFIGURATION \ Prog alarms \ Undervoltage										
Undervolt thr [V]	481	U16	0	1000	230	230	✓	R/W	-	-
UV Latch ON OFF	357	U16	0	1	ON	ON	✓	R/Z 1 0	-	-
UV Ok relay open ON OFF	358	I16	0	1	ON	ON	✓	R/W 1 0	-	-
UV Hold off time [ms]	470	U16	0	100	0	0	✓	R/W	-	-
UV Restart time [ms]	359	U16	0	65535	1000	1000	✓	R/W	-	-
CONFIGURATION \ Prog alarms \ Overvoltage										
OV Activity Ignore Warning Disable drive	203	U16	0	2	Ignore	Ignore	✓	R/Z 0 1 2	-	-
OV Latch ON OFF	361	U16	0	1	ON	ON	✓	R/Z 1 0	-	-
OVk relay open ON OFF	362	I16	0	1	ON	ON	✓	R/W 1 0	-	-
OV Hold off time [ms]	482	U16	0	10000	0	0	✓	R/W	-	-
OV Restart time [ms]	483	U16	0	10000	0	0	✓	R/W	-	-
CONFIGURATION \ Prog alarms \ Overspeed										
Overspeed thr [rpm]	1426	U16	0	32767	4000	4000	✓	R/W	-	-
OS Activity Ignore Warning Disable drive Quick stop Normal stop Curr lim stop	1422	U16	0	2	Ignore	Ignore	✓	R/Z 0 1 2 3 4 5	-	-
OS Latch ON OFF	1421	U16	0	1	ON	ON	✓	R/Z 1 0	-	-
OS Ok relay open ON OFF	1423	I16	0	1	ON	ON	✓	R/W 1 0	-	-
OS Hold off time [ms]	1424	U16	0	10000	0	0	✓	R/W	-	-
OS Restart time [ms]	1425	U16	0	10000	0	0	✓	R/W	-	-
CONFIGURATION \ Prog alarms \ Heatsink										

Parameter	No.	Format	Value min	Value max	Value Factory American	Value Factory European	Access via Keyp.	Access via RS485/ BUS/ Opt2-M	Access via Term.	Access via Opt2-A/ PDC
HS Activity Warning Disable drive Quick stop Normal stop Curr lim stop	368	U16	1	5	Disable drive	Disable drive	✓	R/Z 1 2 3 4 5	-	-
HS Ok relay open ON OFF	370	I16	0	1	ON	ON	✓	R/W 1 0	-	-
CONFIGURATION \ Prog alarms \ Overtemp motor										
OM Activity Ignore Warning Disable drive Quick stop Normal stop Curr lim stop	365	U16			Disable dive	Disable dive	✓	R/Z 0 1 2 3 4 5	-	-
OM Ok relay open ON OFF	367	I16			ON	ON	✓	R/W 1 0	-	-
CONFIGURATION \ Prog alarms \ External fault										
EF Activity Warning Disable drive Quick stop Normal stop Curr lim stop	354	U16	1	5	Disable drive	Disable drive	✓	R/Z 1 2 3 4 5	-	-
EF Latch ON OFF	355	U16	0	1	ON	ON	✓	R/Z 1 0	-	-
EF Ok relay open ON OFF	356	I16	0	1	ON	ON	✓	R/W 1 0	-	-
EF Hold off time [ms]	502	U16	0	10000	0	0	✓	R/W	-	-
EF Restart time [ms]	501	U16	0	10000	0	0	✓	R/W	-	-
CONFIGURATION \ Prog alarms \ Brake fault										
BF Activity Ignore Warning Disable drive Quick stop Normal stop Curr lim stop	1296	U16	0	5	Disable drive	Disable drive	✓	R/Z 0 1 2 3 4 5	-	-
BF Ok relay open ON OFF	1297	I16	0	1	ON	ON	✓	R/W 0 1	-	-
CONFIGURATION \ Prog alarms \ Motor I2t ovrld										
Motor I2t Activity Ignore Warning Disable drive	1419	U16	0	2	Disable drive	Disable drive	✓	R/Z 0 1 2	-	-
Motor I2t Latch ON OFF	1442	U16	0	1	ON	ON	✓	R/Z 0 1	-	-
Motor I2t Ok relay open ON OFF	1420	I16	0	1	ON	ON	✓	R/W 0 1	-	-
CONFIGURATION \ Prog alarms \ Drive I2t ovrld										
Drive I2t Ok relay open ON OFF	1441	I16	0	1	ON	ON	✓	R/W 0 1	-	-
CONFIGURATION \ Prog alarms \ Overcurrent										

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
Overcurrent thr [%]	584	U16	0	200	160	160	✓	R/W	-	-
OC Activity Ignore Warning Disable drive	212	U16	0	2	Ignore	Ignore	✓	R/Z 0 1 2	-	-
OC Latch ON OFF	363	U16	0	1	ON	ON	✓	R/Z 1 0	-	-
OC Ok relay open ON OFF	364	I16	0	1	ON	ON	✓	R/W 1 0	-	-
OC Hold off time [ms]	586	U16	0	10000	0	0	✓	R/W	-	-
OC Restart time [ms]	585	U16	0	10000	0	0	✓	R/W	-	-
CONFIGURATION \ Prog alarms \ Field loss										
FL Activity Ignore Warning Disable drive	473	U16	0	2	Disable drive	Disable drive	✓	R/Z 0 1 2	-	-
FL Latch ON OFF	471	U16	0	1	ON	ON	✓	R/Z 1 0	-	-
FL Ok relay open ON OFF	472	I16	0	1	ON	ON	✓	R/W 1 0	-	-
FL Hold off time [ms]	475	U16	0	10000	0	0	✓	R/W	-	-
FL Restart time [ms]	474	U16	0	10000	0	0	✓	R/W	-	-
CONFIGURATION \ Prog alarms \ Delta frequency										
Delta freq thres [%]	1437	Float	1	15	5	5	✓	R/Z	-	-
DF Activity Ignore Warning Disable drive	1432	U16	0	2	Ignore	Ignore	✓	R/Z 0 1 2	-	-
DF Latch ON OFF	1433	U16	0	1	ON	ON	✓	R/Z 0 1	-	-
DF Ok relay open ON OFF	1434	I16	0	1	ON	ON	✓	R/W 0 1	-	-
DF Hold off time [ms]	1435	U16	0	10000	0	0	✓	R/W	-	-
DF Restart time [ms]	1436	U16	0	10000	0	0	✓	R/W	-	-
CONFIGURATION \ Prog alarms \ SSC Error										
Threshold	8601	U16	0	250	50	50	✓	R/W	-	-
CONFIGURATION \ Prog alarms \ Speed fbk loss										
SL Activity Warning Disable drive	478	U16	1	2	Disable drive	Disable drive	✓	R/Z 1 2	-	-
SL Ok relay open ON OFF	477	I16	0	1	ON	ON	✓	R/W 1 0	-	-
SL Hold off time [ms]	480	U16	0	10000	8	8	✓	R/W	-	-
CONFIGURATION \ Prog alarms \ Opt2 failure										
O2 Activity Disable drive Quick stop Normal stop Curr lim stop	639	U16	0	5	Disable drive	Disable drive	✓	R/Z 2 3 4 5	-	-
O2 Ok relay open ON OFF	640	I16	0	1	ON	ON	✓	R/W 1 0	-	-

Parameter	No.	Format	Value min	Value max	Value Factory American	Value Factory European	Access via Keyp.	Access via RS485/ BUS/ Opt2-M	Access via Term.	Access via Opt2-A/ PDC
CONFIGURATION \ Prog alarms \ Bus loss										
BL Activity Ignore Warning Disable drive Quick stop Normal stop Curr lim stop	634	U16	0	5	Disable drive	Disable drive	✓	R/Z 0 1 2 3 4 5	-	-
BL Latch ON OFF	633	U16	0	1	ON	ON	✓	R/Z 1 0	-	-
BL Ok relay open ON OFF	635	I16	0	1	ON	ON	✓	R/W 1 0	-	-
BL Hold off time [ms]	636	U16	0	10000	0	0	✓	R/W	-	-
BL Restart time [ms]	637	U16	0	10000	0	0	✓	R/W	-	-
CONFIGURATION \ Prog alarms \ SCR test										
Open test act Ignore Warning Disable Drive	1527	U16	1	5	Disable drive	Disable drive	✓	R/Z 0 1 2	-	-
SCR test enable OFF OPEN SCR TEST SHORT SCR TEST OPEN/SHORT TEST	1524	I16	0	1	OFF	OFF	✓	R/Z 0 1 2 3	-	-
SCR diag status	1525	U16	-	-	-	-	✓	R	-	-
Open SCR thr [%]	1528	U16	0	100	50	50	✓	R/W	-	-
CONFIGURATION \ Prog alarms \ Hw opt1 failure										
HO Activity Warning Disable drive Quick stop Normal stop Curr lim stop	386	U16	1	5	Disable drive	Disable drive	✓	R/Z 1 2 3 4 5	-	-
HO Ok relay open ON OFF	387	I16	0	1	ON	ON	✓	R/W 1 0	-	-
CONFIGURATION \ Prog alarms \ Enable seq err										
ES Activity Ignore Disable drive	728	U16	0	2	Disable drive	Disable drive	✓	R/Z 0 2	-	-
ES Latch ON OFF	729	U16	0	1	ON	ON	✓	R/Z 1 0	-	-
ES Ok relay open ON OFF	730	U16	0	1	ON	ON	✓	R/W 1 0	-	-
CONFIGURATION \ Set serial comm										
Device address	319	U16	0	127	0	0	✓	R/Z	-	-
Ser answer delay	408	U16	0	900	0	0	✓	R/W	--	---
Ser protocol sel SLINK3 MODBUS RTU JBUS	323	U16	0	2	SLINK3 (0)	SLINK3 (0)	✓	R/W 0 1 2	--	---
Ser baudrate sel 19200 9600 4800 2400 1200	326	U16	0	4	9600 (1)	9600 (1)	✓	R/W 0 1 2 3 4	--	---
CONFIGURATION										
Pword 1	85	I32	0	99999	0	0	✓	W	-	-

Parameter	No.	Format	Value: min	Value: max	Value: Factory American	Value: Factory European	Access via: Keyp.	Access via: RS485/ BUS/ Opt2-M	Access via: Term.	Access via: Opt2-A/ PDC
I/O CONFIG \ Analog outputs \ Analog output 1										
Select output 1	66	U16	0	96	Actual speed (8)	Actual speed (8)	✓	R/Z	-	-
OFF								0		
Speed ref 1								1		
Speed ref 2								2		
Ramp ref 1								3		
Ramp ref 2								4		
Ramp ref								5		
Speed ref								6		
Ramp out								7		
Actual speed								8		
T current ref 1								9		
T current ref 2								10		
T current ref								11		
Speed reg out								15		
Motor current								16		
Output voltage								20		
Analog input 1								24		
Analog input 2								25		
Analog input 3								26		
Flux current								27		
Pad 0								31		
Pad 1								32		
Pad 4								33		
Pad 5								34		
Flux reference								35		
Pad 6								38		
PID output								39		
Out vlt level								79		
Flux current max								80		
F act spd								81		
F T curr								82		
Speed draw out								84		
Output power								88		
Roll diameter								89		
Act tension ref								90		
Torque current								91		
W reference								92		
Actual comp								93		
Brake current								94		
Field cur ref								95		
Motor Pot Out								96		
Scale output 1	62	Float	-10.000	+10.000	0.000	0.000	✓	R/W	-	
I/O CONFIG \ Analog outputs \ Analog output 2										
Select output 2 (Select like output 1)	67	U16	0	94	Motor current (16)	Motor current (16)	✓	R/Z	-	-
Scale output 2	63	Float	-10.000	+10000	0.000	0.000	✓	R/W	-	-
I/O CONFIG \ Analog outputs \ Analog output 3										
Select output 3 (Select like output 1)	68	U16	0	94	Flux -27	Flux -27	✓	R/Z	-	-
Scale output 3	64	Float	-10.000	+10000	0.000	0.000	✓	R/W	-	-
I/O CONFIG \ Analog outputs \ Analog output 4										
Select output 4 (Select like output 1)	69	U16	0	94	Output voltage (20)	Output voltage (20)	✓	R/Z	-	-
Scale output 4	65	Float	-10.000	+10000	0.000	0.000	✓	R/W	-	-

Parameter	No.	Format	Value: min	Value: max	Value: Factory American	Value: Factory European	Access via: Keyp.	Access via: RS485/BUS/Opt2-M	Access via: Term.	Access via: Opt2-A/PDC
I/O CONFIG \ Analog inputs \ Analog input 1										
Select input 1	70	U16	0	32	Ramp ref 1 (4)	Ramp ref 1 (4)	✓	R/Z	-	-
OFF								0		
Jog reference								1		
Speed ref 1								2		
Speed ref 2								3		
Ramp ref 1								4		
Ramp ref 2								5		
T current ref 1								6		
T current ref 2								7		
Adap reference								8		
T current limit								9		
T current lim +								10		
T current lim -								11		
Pad 0								12		
Pad 1								13		
Pad 2								14		
Pad 3								15		
Load comp								19		
PID offset 0								21		
PI central v3								22		
PID feed-back								23		
Flux current max								25		
Out vlt level								26		
Speed ratio								28		
Tension red								29		
Tension ref								30		
Preset 3								31		
Brake Ref								32		
An in 1 target	295	U16	0	1	0	0	✓	R/W	ID	R/W
Assigned								0	L	0
Not assigned								1	H	1
Input 1 type	71	U16	0	2	± 10 V	± 10 V	✓	R/Z	-	-
-10V ... + 10 V								0		
0...20 mA, 0...10 V								1		
4...20 mA								2		
Input 1 sign	389	U16	0	1	1	1	✓	R/W	-	R/W
Positive								1		1
Negative								0		0
Scale input 1	72	Float	-10000	+10000	1.000	1.000	✓	R/W	-	-
Tune value inp 1	73	Float	0.100	10.000	1.000	1.000	✓	R/W	-	-
Auto tune inp 1	259	U16					✓	C/W	-	-
Auto tune								1		
Input 1 filter [ms]	792	U16	0	1000	0	0	✓	R/W	-	R/W
Input 1 compare	1042	I16	-10000	+10000	0	0	✓	R/W	-	-
Input 1 cp error	1043	U16	0	10000	0	0	✓	R/W	-	-
Input 1 cp delay	1044	U16	0	65000	0	0	✓	R/W	-	-
Input 1 cp match	1045	U16	0	1	-	-	-	R	QD	R
Input 1 not thr.val.								0	L	
Input 1=thr.val								1	H	
Offset input 1	74	I16	-32768	+32767	0	0	✓	R/W	-	-
I/O CONFIG \ Analog inputs \ Analog input 2										
Select input 2 (Select like Input 1)	75	U16	0	32	OFF (0)	OFF (0)	✓	R/Z	-	-
An in 2 target	296	U16	0	1	0	0	✓	R/W	ID	R/W
Assigned								0	L	0
Not assigned								1	H	1
Input 2 type	76	U16	0	2	± 10 V	± 10 V	✓	R/Z	-	-
-10V ... + 10 V								0		
0...20 mA, 0...10 V								1		
4...20 mA								2		
Input 2 sign	390	U16	0	1	1	1	✓	R/W	-	R/W
Positive								1		1
Negative								0		0
Scale input 2	77	Float	-10.000	+10000	1.000	1.000	✓	R/W	-	-
Tune value inp 2	78	Float	0.100	10.000	1.000	1.000	✓	R/W	-	-

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
Auto tune inp 2 Auto tune	260	U16					✓	C/W 1	-	-
Input 2 filter [ms]	801	U16	0	1000	0	0	✓	R/W	-	R/W
Offset input 2	79	I16	-32768	+32767	0	0	✓	R/W	-	-
I/O CONFIG \ Analog inputs \ Analog input 3										
Select input 3 (Select like Input 1)	80	U16	0	32	OFF (0)	OFF (0)	✓	R/Z	-	-
An in 3 target Assigned Not assigned	297	U16	0	1	0	0	✓	R/W 0 1	ID L H	R/W 0 1
Input 3 type -10V ... + 10 V 0...20 mA, 0...10 V 4...20 mA	81	U16	0	2	± 10 V	± 10 V	✓	R/Z 0 1 2	-	-
Input 3 sign Positive Negative	391	U16	0	1	1	1	✓	R/W 1 0	-	R/W 1 0
Scale input 3	82	Float	-10.000	+10000	1.000	1.000	✓	R/W	-	-
Tune value inp 3	83	Float	0.100	10.000	1.000	1.000	✓	R/W	-	-
Auto tune inp 3 Auto tune	261	U16					✓	C/W 1	-	-
Input 3 filter [ms]	802	U16	0	1000	0	0	✓	R/W	-	R/W
Offset input 3	84	I16	-32768	+32767	0	0	✓	R/W	-	-

Parameter	No.	Format	Value min	Value max	Value Factory American	Value Factory European	Access via Keyp.	Access via RS485/ BUS/ Opt2-M	Access via Term.	Access via Opt2-A/ PDC
I/O CONFIG \ Digital outputs										
Digital output 1	145	U16	0	79	Ramp + (8)	Ramp + (8)	✓	R/Z	-	-
OFF								0		
Speed zero thr								1		
Spd threshold								2		
Set speed								3		
Curr limit state								4		
Drive ready								5		
Mot ovrld avail								6		
Overload state								7		
Ramp +								8		
Ramp -								9		
Speed limited								10		
Undervoltage								11		
Overvoltage								12		
Heatsink								13		
Overcurrent								14		
Overtemp motor								15		
External fault								16		
Failure supply								17		
Pad A bit								18		
Pad B bit								19		
Virt dig input								20		
Torque sign								21		
Stop control								23		
Field loss								24		
Speed fbk loss								25		
Bus loss								26		
Hw opt1 failure								28		
Opt2 failure								29		
Encoder 1 state								30		
Encoder 2 state								31		
Enable seq err								35		
Diameter calc st								38		
Drive healthy								42		
Input 1 cp match								49		
Diam reached								58		
Spd match compl								59		
Acc state								60		
Dec state								61		
Brake comand								62		
Brake failure								63		
Mot ovrld preal								65		
Dvr ovrld preal								66		
Dvr ovrld avail								67		
I2t mot ovrld fail								68		
I2t drv ovrld fail								69		
Mot cur threshld								70		
Overspeed								71		
Delta frequency								72		
Drv rdy to start								76		
BUS control mode								77		
SSC Error								79		
Firing								80		
Cont Current								81		
Inversion out 1	1267	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W	-	-
Enabled								1		
Disabled								0		
Digital output 2 (Select like output 1)	146	U16	0	77	Ramp - (9)	Ramp - (9)	✓	R/Z	-	-
Inversion out 2	1268	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W	-	-
Enabled								1		
Disabled								0		
Digital output 3 (Select like output 1)	147	U16	0	77	Spd thr. (2)	Spd thr. (2)	✓	R/Z	-	-
Inversion out 3	1269	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W	-	-
Enabled								1		
Disabled								0		

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
Digital output 4 (Select like output 1)	148	U16	0	77	Overld avail. (6)	Overld avail. (6)	✓	R/Z	-	-
Inversion out 4	1270	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W	-	-
Enabled								1		
Disabled								0		
Digital output 5 (Select like output 1)	149	U16	0	77	Curr lim. state (4)	Curr lim. state (4)	✓	R/Z	-	-
Inversion out 5	1271	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W	-	-
Enabled								1		
Disabled								0		
Digital output 6 (Select like output 1)	150	U16	0	77	Over-voltage (12)	Over-voltage (12)	✓	R/Z	-	-
Inversion out 6	1272	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W	-	-
Enabled								1		
Disabled								0		
Digital output 7 (Select like output 1)	151	U16	0	77	Under-voltage (11)	Under-voltage (11)	✓	R/Z	-	-
Inversion out 7	1273	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W	-	-
Enabled								1		
Disabled								0		
Digital output 8 (Select like output 1)	152	U16	0	77	Over-current (14)	Over-current (14)	✓	R/Z	-	-
Inversion out 8	1274	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W	-	-
Enabled								1		
Disabled								0		
Relay 2 (Select like output 1)	629	U16	0	77	Stop ctrl (23)	Stop ctrl (23)	✓	R/Z	-	-
Inversion relay 2	1275	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W	-	-
Enabled								1		
Disabled								0		

Parameter	No.	Format	Value min	Value max	Value Factory American	Value Factory European	Access via Keyp.	Access via RS485/ BUS/ Opt2-M	Access via Term.	Access via Opt2-A/ PDC
I/O CONFIG \ Digital inputs										
Digital input 1	137	U16	0	90	OFF (0)	OFF (0)		R/Z	-	-
OFF								0		
Motor pot reset								1		
Motor pot up								2		
Motor pot down								3		
Motor pot sign +								4		
Motor pot sign -								5		
Jog +								6		
Jog -								7		
Failure reset								8		
Torque reduct								9		
Ramp out = 0								10		
Ramp in = 0								11		
Freeze ramp								12		
Lock speed reg								13		
Lock speed I								14		
Auto capture								15		
Input 1 sign +								16		
Input 1 sign -								17		
Input 2 sign +								18		
Input 2 sign -								19		
Input 3 sign +								20		
Input 3 sign -								21		
Zero torque								22		
Speed sel 0								23		
Speed sel 1								24		
Speed sel 2								25		
Ramp sel 0								26		
Ramp sel 1								27		
Field loss								29		
Enable flux reg								30		
Enable flux weak								31		
Pad A bit 0								32		
Pad A bit 1								33		
Pad A bit 2								34		
Pad A bit 3								35		
Pad A bit 4								36		
Pad A bit 5								37		
Pad A bit 6								38		
Pad A bit 7								39		
Forward sign								44		
Reverse sign								45		
An in 1 target								46		
An in 2 target								47		
An in 3 target								48		
Enable droop								49		
Enable PI PID								52		
Enable PD PID								53		
PI integral freeze								54		
PID offs. Sel								55		
PI central vs0								56		
PI central vs1								57		
Diameter calc								58		
Diam reset								68		
Diam calc Dis								69		
Torque winder EN								70		
Line acc status								71		
Line dec status								72		
Line fstp status								73		
Speed match								74		
Diam inc/dec En								75		
Wind/unwind								76		
Diam preset sel0								77		
Diam preset sel1								78		
Taper enable								79		
Speed demand En								80		
Winder side								81		
Enable PI-PD PID								82		
Jog TW enable								83		
Brake fbk								84		
Adapt Sel 1								86		
Adapt Sel 2								87		
Wired FC EN								88		
Wired FC Inv Seq								89		
Wired FC Act Brg								90		
Inversion in 1	1276	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W	-	-
Enabled								1		
Disabled								0		
Digital input 2 (Select like input 1)	138	U16	0	87	OFF (0)	OFF (0)	✓	R/Z	-	-

Parameter	No.	Format	Value min	Value max	Value Factory American	Value Factory European	Access via Keyp.	Access via RS485/ BUS/ Opt2-M	Access via Term.	Access via Opt2-A/ PDC
Inversion in 2 Enabled Disabled	1277	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W 1 0	-	-
Digital input 3 (Select like input 1)	139	U16	0	87	OFF (0)	OFF (0)	✓	R/Z	-	-
Inversion in 3 Enabled Disabled	1278	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W 1 0	-	-
Digital input 4 (Select like input 1)	140	U16	0	87	OFF (0)	OFF (0)	✓	R/Z	-	-
Inversion in 4 Enabled Disabled	1279	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W 1 0	-	-
Digital input 5 (Select like input 1)	141	U16	0	87	OFF (0)	OFF (0)	✓	R/Z	-	-
Inversion in 5 Enabled Disabled	1280	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W 1 0	-	-
Digital input 6 (Select like input 1)	142	U16	0	87	OFF (0)	OFF (0)	✓	R/Z	-	-
Inversion in 6 Enabled Disabled	1281	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W 1 0	-	-
Digital input 7 (Select like input 1)	143	U16	0	87	OFF (0)	OFF (0)	✓	R/Z	-	-
Inversion in 7 Enabled Disabled	1282	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W 1 0	-	-
Digital input 8 (Select like input 1)	144	U16	0	87	OFF (0)	OFF (0)	✓	R/Z	-	-
Inversion in 8 Enabled Disabled	1283	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W 1 0	-	-
I/O CONFIG \ Encoder inputs										
Select enc 1 OFF Speed ref 1 Speed ref 2 Ramp ref 1 Ramp ref 2	1020	U16	0	5	OFF (0) see 6.12.05	OFF (0) see 6.12.05	✓	R/Z 0 2 3 4 5	-	-
Select enc 2 OFF Speed ref 1 Speed ref 2 Ramp ref 1 Ramp ref 2	1021	U16	0	5	OFF (0) see 6.12.05	OFF (0) see 6.12.05	✓	R/Z 0 2 3 4 5	-	-
Encoder 1 pulses	416	Float*	600	9999	1024	1024	✓	R/Z	-	R
Encoder 2 pulses	169	Float*	150	9999	1024	1024	✓	R/Z	-	R
Refresh enc 1 Enabled Disabled	649	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W 1 0	-	-
Refresh enc 2 Enabled Disabled	652	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W 1 0	-	-

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
ADD SPEED FUNCT										
Auto capture ON OFF	388	U16			OFF (0)	OFF (0)	✓	R/W 1 0	ID H L	-
ADD SPEED FUNCT \ Adaptive spd reg										
Enable spd adap Enabled Disabled	181	U16	0	1	Disabled	Disabled	✓	R/Z 1 0	-	-
Select adap type Speed Adap reference Parameter	182	U16	0	2	Speed	Speed	✓	R/Z 0 1 2	-	-
Adap reference [FF]	183	I16	-32768	+32767	1000	1000	✓	R/W	IA	R/W
Adap selector	1464	U16	0	3	0	0	✓	R/W	-	-
Adap speed 1 [%]	184	Float	0.0	200.0	20.3	20.3	✓	R/W	-	-
Adap speed 2 [%]	185	Float	0.0	200.0	40.7	40.7	✓	R/W	-	-
Adap joint 1 [%]	186	Float	0.0	200.0	6.1	6.1	✓	R/W	-	-
Adap joint 2 [%]	187	Float	0.0	200.0	6.1	6.1	✓	R/W	-	-
Adap P gain 1 [%]	188	Float	0.00	100.00	10.00	10.00	✓	R/W	-	-
Adap I gain 1 [%]	189	Float	0.00	100.00	1.00	1.00	✓	R/W	-	-
Adap P gain 2 [%]	190	Float	0.00	100.00	10.00	10.00	✓	R/W	-	-
Adap I gain 2 [%]	191	Float	0.00	100.00	1.00	1.00	✓	R/W	-	-
Adap P gain 3 [%]	192	Float	0.00	100.00	10.00	10.00	✓	R/W	-	-
Adap I gain 3 [%]	193	Float	0.00	100.00	1.00	1.00	✓	R/W	-	-
Adap P gain 4 [%]	1462	Float	0.00	100.00	10.00	10.00	✓	R/W	-	-
Adap I gain 4 [%]	1463	Float	0.00	100.00	1.00	1.00	✓	R/W	-	-
ADD SPEED FUNCT \ Speed control										
Spd threshold + [FF]	101	U16	1	32767	1000	1000	✓	R/W	-	-
Spd threshold - [FF]	102	U16	1	32767	1000	1000	✓	R/W	-	-
Threshold delay [ms]	103	U16	0	65535	100	100	✓	R/W	-	-
Spd threshold Speed exceeded Speed not exceeded	393	U16	0	1			-	R 0 1	QD L H	R 0 1
Set error [FF]	104	U16	1	32767	100	100	✓	R/W	-	-
Set delay [ms]	105	U16	1	65535	100	100	✓	R/W	-	-
Set speed Speed not ref. val. Speed = ref. val.	394	U16	0	1			-	R 0 1	QD L H	R 0 1
ADD SPEED FUNCT \ Speed zero										
Speed zero level [FF]	107	U16	1	32767	10	10	✓	R/W	-	-
Speed zero delay [ms]	108	U16	0	65535	100	100	✓	R/W	-	-
Speed zero thr Drive not rotating Drive rotating	395	U16	0	1			-	R 0 1	QD L H	R 0 1

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
FUNCTIONS \ Motor pot										
Enable motor pot Disabled Config1 Config2	246	I16	0	1	Disabled	Disabled	✓	R/Z 0 1 2	-	-
Motor pot oper	247						✓	-	-	-
MPot Lower Limit [rpm]	1530	U16	0	8000	0	0	✓	-	-	-
MPot Upper Limit [rpm]	1531	U16	0	8000	1000	1000	✓	-	-	-
MPot Acc Time [s]	1532	U16	0	65535	10	10	✓	-	-	-
MPot Dec Time [s]	1533	U16	0	65535	10	10	✓	-	-	-
MPot Mode Ramp & LastVal Ramp & Follow Fine & LastVal Fine & Follow	1534	U16	-	-	-	-	✓	R/W 0 1 2 3	-	-
PowerOn Cfg Last Power Off Zero Lower Limit Upper Limit	1535	U16	-	-	-	-	✓	R/W 0 1 2 3	-	-
Reset Cfg None Inp Zero Inp Low Limit Inp Ref Zero Inp Ref Low Lim Out Zero Out Low Limit Out Ref Zero Out Ref Low Lim Inp Up Limit Inp Ref Up Lim Inp Freeze	1536	U16	-	-	-	-	✓	R/W 0 1 2 3 4 5 6 7 8 9 10 11	-	-
Motor pot out [rpm]	1537	I16	-	-	-	-		R	-	-
Motor pot sign Positive Negative	248	I16	0	1	Positive	Positive	✓	R/W 1 0	ID	-
Motor pot reset	249	U16					✓	Z/C(1)	ID (H)	-
Motor pot up No acceleration Acceleration	396	U16	0	1				R/W 0 1	ID L H	R/W 0 1
Motor pot down No deceleration Deceleration	397	U16	0	1				R/W 0 1	ID L H	R/W 0 1
FUNCTIONS \ Jog function										
Enable jog Enabled Disabled	244	I16	0	1	Disabled	Disabled	✓	R/Z 1 0	-	-
Jog operation	265	-	-	-	-	-	✓	-	-	-
Jog selection Speed input Ramp input	375	U16	0	1	0	0	✓	R/Z 0 1	-	-
Jog reference [FF]	266	I16	0	32767	0	0	✓	R/W	IA	-
Jog + No jog forwards Forwards jog	398	U16	0	1				R/W 0 1	ID L H	R/W 0 1
Jog - No backwards jog Backwards jog	399	U16	0	1				R/W 0 1	ID L H	R/W 0 1
FUNCTIONS \ Multi speed fct										
Enab multi spd Enabled Disabled	153	I16	0	1	Disabled	Disabled	✓	R/Z 1 0	-	-
Multi speed 1 [FF]	154	I16	-32768	+32767	0	0	✓	R/W	-	-
Multi speed 2 [FF]	155	I16	-32768	+32767	0	0	✓	R/W	-	-

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
Multi speed 3 [FF]	156	I16	-32768	+32767	0	0	✓	R/W	-	-
Multi speed 4 [FF]	157	I16	-32768	+32767	0	0	✓	R/W	-	-
Multi speed 5 [FF]	158	I16	-32768	+32767	0	0	✓	R/W	-	-
Multi speed 6 [FF]	159	I16	-32768	+32767	0	0	✓	R/W	-	-
Multi speed 7 [FF]	160	I16	-32768	+32767	0	0	✓	R/W	-	-
Speed sel 0 Value 2^0 not selected Value 2^0 selected	400	U16	0	1	0	0	-	R/W 0 1	ID L H	R/W 0 1
Speed sel 1 Value 2^1 not selected Value 2^1 selected	401	U16	0	1	0	0	-	R/W 0 1	ID L H	R/W 0 1
Speed sel 2 Value 2^2 not selected Value 2^2 selected	402	U16	0	1	0	0	-	R/W 0 1	ID L H	R/W 0 1
Multispeed sel	208	U16	0	7	0	0	✓	R/W	ID	R/W
FUNCTIONS \ Multi ramp fct										
Enab multi rmp Enabled Disabled	243	I16	0	1	Disabled	Disabled	✓	R/Z 1 0	-	-
Ramp selector	202	U16	0	3	0	0	✓	R/W	ID	R/W
FUNCTIONS \ Multi ramp fct \ Ramp 0 \ Acceleration 0										
Acc delta speed0 [FF]	659	U32	0	2^{32}-1	100	100	✓	R/W	-	-
Acc delta time 0 [s]	660	U16	0	65535	1	1	✓	R/W	-	-
S acc t const 0 [ms]	665	Float	0	15000	300	300	✓	R/W	-	-
FUNCTIONS \ Multi ramp fct \ Ramp 0 \ Deceleration 0										
Dec delta speed0 [FF]	661	U32	0	2^{32}-1	100	100	✓	R/W	-	-
Dec delta time 0 [s]	662	U16	0	65535	1	1	✓	R/W	-	-
S dec t const 0 [ms]	666	Float	0	15000	300	300	✓	R/W	-	-
FUNCTIONS \ Multi ramp fct \ Ramp 1 \ Acceleration 1										
Acc delta speed1 [FF]	23	U32	0	2^{32}-1	100	100	✓	R/W	-	-
Acc delta time 1 [s]	24	U16	0	65535	1	1	✓	R/W	-	-
S acc t const 1 [ms]	667	Float	0	15000	300	300	✓	R/W	-	-
FUNCTIONS \ Multi ramp fct \ Ramp 1 \ Deceleration 1										
Dec delta speed1 [FF]	31	U32	0	2^{32}-1	100	100	✓	R/W	-	-
Dec delta time 1 [s]	32	U16	0	65535	1	1	✓	R/W	-	-
S dec t const 1 [ms]	668	Float	0	15000	300	300	✓	R/W	-	-
FUNCTIONS \ Multi ramp fct \ Ramp 2 \ Acceleration 2										
Acc delta speed2 [FF]	25	U32	0	2^{32}-1	100	100	✓	R/W	-	-
Acc delta time 2 [s]	26	U16	0	65535	1	1	✓	R/W	-	-
S acc t const 2 [ms]	669	Float	0	15000	300	300	✓	R/W	-	-
FUNCTIONS \ Multi ramp fct \ Ramp 2 \ Deceleration 2										
Dec delta speed2 [FF]	33	U32	0	2^{32}-1	100	100	✓	R/W	-	-
Dec delta time 2 [s]	34	U16	0	65535	1	1	✓	R/W	-	-
S dec t const 2 [ms]	670	Float	0	15000	300	300	✓	R/W	-	-
FUNCTIONS \ Multi ramp fct \ Ramp 3 \ Acceleration 3										
Acc delta speed3 [FF]	27	U32	0	2^{32}-1	100	100	✓	R/W	-	-
Acc delta time 3 [s]	28	U16	0	65535	1	1	✓	R/W	-	-
S acc t const 3 [ms]	671	Float	0	15000	300	300	✓	R/W	-	-
FUNCTIONS \ Multi ramp fct \ Ramp 3 \ Deceleration 3										
Dec delta speed3 [FF]	35	U32	0	2^{32}-1	100	100	✓	R/W	-	-
Dec delta time 3 [s]	36	U16	0	65535	1	1	✓	R/W	-	-
S dec t const 3 [ms]	672	Float	0	15000	300	300	✓	R/W	-	-
Ramp sel 0 Value 2^0 not selected Value 2^0 selected	403	U16	0	1	0	0	-	R/W 0 1	ID L H	R/W 0 1
Ramp sel 1 Value 2^1 not selected Value 2^1 selected	404	U16	0	1	0	0	-	R/W 0 1	ID L H	R/W 0 1

Parameter	No.	Format	Value: min	Value: max	Value: Factory American	Value: Factory European	Access via: Keyp.	Access via: RS485/ BUS/ Opt2-M	Access via: Term.	Access via: Opt2-A/ PDC
FUNCTIONS \ Speed draw										
Speed ratio	1017	I16	0	+32767	+10000	+10000	✓	R/W	IA	R/W
Speed draw out (d)	1018	I16	-32768	+32767	-	-	✓	R	QA	R/W
Speed draw out (%)	1019	Float	-200.0	+200.0	-	-	✓	R	-	-
FUNCTIONS \ Overload contr										
Enable overload Enabled Disabled	309	I16	0	1	Enabled	Disabled	✓	R/Z 1 0	-	-
Overload mode Curr limited Curr not limited I2t Motor I2t Drive I2t Motor & Drv	318	U16	0	4	I^2t Motor	Curr limited	✓	R/W 0 1 2 3 4	-	-
Overload current [%]	312	U16	P313	200	150	100	✓	R/W	-	-
Base current [%]	313	U16	0	P312 < 100	100	80	✓	R/W	-	-
Overload time [s]	310	U16	0	65535	60	30	✓	R/W	-	-
Ventil. Type SERVO AUTO	914	U16	0	1	Servo	Servo 0 1	✓	R/Z	-	-
Derating factor [%]	915	U16	0	100	50	50	✓	R/Z	-	-
Motor ovrld preal.	1289	U16	0	1	-	-	✓	R	-	-
Motor I2t accum	655	Float	0.00	100.00	-	-	✓	R	-	-
Drive ovrld preal.	1438	U16	0	1	-	-	✓	R	-	-
Drive I2t accum	1439	FLOAT	0.00	100.00	-	-	✓	R	-	-
Pause time [s]	311	U16	0	65535	540	300	✓	R/W	-	-
Overld available Overload not possible Overload possible	406	U16	0	1	-	-	-	R 0 1	QD L H	R 0 1
Overload state Current limit value Current > limit value	407	U16	0	1	-	-	-	R 0 1	QD L H	R 0 1
FUNCTIONS \ Stop control										
Stop mode OFF Stop & speed 0 Fast stp & spd 0 Fst / stp & spd 0	626	U16	0	3	Stop & Speed 0	Stop & Speed 0	✓	R/Z 0 1 2 3	-	-
Spd 0 trip delay [ms]	627	U16	0	40000	0	0	✓	R/W	-	-
Trip cont delay [ms]	628	U16	0	40000	0	0	✓	R/W	-	-
Jog stop control OFF ON	630	U16	0	1	OFF	OFF	✓	R/Z 0 1	-	-
FUNCTIONS \Brake control										
Enable Torque pr	1295	I16	0	1	Disabled	Disabled	✓	R/W	-	-
Closing speed [rpm]	1262	U16	0	200	30	30	✓	R/W	-	-
Torque delay [ms]	1293	I16	0	30000	3000	3000	✓	R/W	-	-
Torque proving [%]	1294	I16	0	200	75	75	✓	R/W	-	-
Actuator delay [ms]	1266	U16	0	30000	1000	1000	✓	R/W	-	-
FUNCTIONS \ I/n curve (Taper curr lim)										
I/n curve Enabled Disabled	750	U16	0	1	0	0	✓	R/Z 1 0	-	-
I/n lim 0 [%]	751	U16	0	200	0	0	✓	R/Z	-	-
I/n lim 1 [%]	752	U16	0	200	0	0	✓	R/Z	-	-
I/n lim 2 [%]	753	U16	0	200	0	0	✓	R/Z	-	-
I/n lim 3 [%]	754	U16	0	200	0	0	✓	R/Z	-	-
I/n lim 4 [%]	755	U16	0	200	0	0	✓	R/Z	-	-
I/n speed [rpm]	756	U16	0	P162	0	0	✓	R/Z	-	-

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
SPEC FUNCTIONS \ Test generator										
Generator access Not connected T current ref Flux ref Ramp ref Speed ref	58	U16	0	5	Not conn.	Not conn.	✓	R/Z 0 2 3 4 5	-	-
Gen frequency [Hz]	59	Float	0.1	62.5	0.1	0.1	✓	R/W	-	-
Gen amplitude [%]	60	Float	0	200.00	0	0	✓	R/W	-	-
Generator offset [%]	61	Float	-200.00	+200.00	0	0	✓	R/W	-	-
SPEC FUNCTIONS										
Save parameters	256	U16					✓	C/W(1)	-	-
Load default	258	U16					✓	Z/C(1)	-	-
Life time [h.min]	235	Float	0.00	65535.00			✓	R	-	-
Failure register	330	U16	1	10	10	10	✓	R/W	-	-
Failure text	327	Text					-	R	-	-
Failure hour	328	U16	0	65535				R	-	-
Failure minute	329	U16	0	59				R	-	-
Failure code Failure supply Undervoltage Overvoltage Overcurrent Heatsink Hardware DSP error Interrupt error Speed fbk External fault Overtemp motor Field loss Bus loss Hw opt 1 failure Opt2 Unknown Enable seq err	417	U16	0	65535				R 5100h 3120h 3310h 2300h 4210h 5000h 6110h 6120h 7301h 9000h 4310h 3330h 8110h 7510h 7400h 1001h 9009h	-	-
Failure reset	262	U16					✓	Z/C (1)	ID (H)	W
Failure reg del	263	U16					✓	C	-	-
SPEC FUNCTIONS \ Links \ Link 1										
Source	484	U16	0	65535	0	0	✓	R/W	-	-
Destination	485	U16	0	65535	0	0	✓	R/W	-	-
Mul gain	486	Float	-10000	+10000	1	1	✓	R/W	-	-
Div gain	487	Float	-10000	+10000	1	1	✓	R/W	-	-
Input max	488	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Input min	489	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Input offset	490	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Output offset	491	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Inp absolute OFF ON	492	U16	0	1	OFF	OFF	✓	R/W 0 1	-	-
SPEC FUNCTIONS \ Links \ Link 2										
Source	553	U16	0	65535	0	0	✓	R/W	-	-
Destination	554	U16	0	65535	0	0	✓	R/W	-	-
Mul gain	555	Float	-10000	+10000	1	1	✓	R/W	-	-
Div gain	556	Float	-10000	+10000	1	1	✓	R/W	-	-
Input max	557	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Input min	558	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Input offset	559	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Output offset	560	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-

Parameter	No.	Format	Value: min	Value: max	Value: Factory American	Value: Factory European	Access via: Keyp.	Access via: RS485/ BUS/ Opt2-M	Access via: Term.	Access via: Opt2-A/ PDC
Inp absolute OFF ON	561	U16	0	1	OFF	OFF	✓	R/W 0 1	-	-
SPEC FUNCTIONS \ Links \ Link 3										
Source	1218	U16	0	65535	0	0	✓	R/W	-	-
Destination	1219	U16	0	65535	0	0	✓	R/W	-	-
Mul gain	1220	Float	-10000	+10000	1	1	✓	R/W	-	-
Div gain	1221	Float	-10000	+10000	1	1	✓	R/W	-	-
Input max	1222	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Input min	1223	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Input offset	1224	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Output offset	1225	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Inp absolute ON OFF	1226	U16	0	1	OFF 0	OFF 0	✓	R/W 1 0	-	-
SPEC FUNCTIONS \ Links \ Link 4										
Source	1227	U16	0	65535	0	0	✓	R/W	-	-
Destination	1228	U16	0	65535	0	0	✓	R/W	-	-
Mul gain	1229	Float	-10000	+10000	1	1	✓	R/W	-	-
Div gain	1230	Float	-10000	+10000	1	1	✓	R/W	-	-
Input max	1231	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Input min	1232	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Input offset	1233	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Output offset	1234	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Inp absolute ON OFF	1235	U16	0	1	OFF 0	OFF 0	✓	R/W 1 0	-	-
SPEC FUNCTIONS \ Links \ Link 5										
Source	1236	U16	0	65535	0	0	✓	R/W	-	-
Destination	1237	U16	0	65535	0	0	✓	R/W	-	-
Mul gain	1238	Float	-10000	+10000	1	1	✓	R/W	-	-
Div gain	1239	Float	-10000	+10000	1	1	✓	R/W	-	-
Input max	1240	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Input min	1241	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Input offset	1242	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Output offset	1243	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Inp absolute ON OFF	1244	U16	0	1	OFF 0	OFF 0	✓	R/W 1 0	-	-
SPEC FUNCTIONS \ Links \ Link 6										
Source	1245	U16	0	65535	0	0	✓	R/W	-	-
Destination	1246	U16	0	65535	0	0	✓	R/W	-	-
Mul gain	1247	Float	-10000	+10000	1	1	✓	R/W	-	-
Div gain	1248	Float	-10000	+10000	1	1	✓	R/W	-	-
Input max	1249	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Input min	1250	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Input offset	1251	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Output offset	1252	Float	-2^{31}	$2^{31}-1$	0	0	✓	R/W	-	-
Inp absolute ON OFF	1253	U16	0	1	OFF 0	OFF 0	✓	R/W 1 0	-	-
SPEC FUNCTIONS \ Pad Parameters										
Pad 0	503	I16	-32768	+32767	0	0	✓	R/W	IA, QA	R/W

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
Pad 1	504	I16	-32768	+32767	0	0	✓	R/W	IA, QA	R/W
Pad 2	505	I16	-32768	+32767	0	0	✓	R/W	IA	R/W
Pad 3	506	I16	-32768	+32767	0	0	✓	R/W	IA	R/W
Pad 4	507	I16	-32768	+32767	0	0	✓	R/W	QA	R/W
Pad 5	508	I16	-32768	+32767	0	0	✓	R/W	QA	R/W
Pad 6	509	I16	-32768	+32767	0	0	✓	R/W	QA	R/W
Pad 7	510	I16	-32768	+32767	0	0	✓	R/W	-	R/W
Pad 8	511	I16	-32768	+32767	0	0	✓	R/W	-	R/W
Pad 9	512	I16	-32768	+32767	0	0	✓	R/W	-	R/W
Pad 10	513	I16	-32768	+32767	0	0	✓	R/W	-	R/W
Pad 11	514	I16	-32768	+32767	0	0	✓	R/W	-	R/W
Pad 12	515	I16	-32768	+32767	0	0	✓	R/W	-	R/W
Pad 13	516	I16	-32768	+32767	0	0	✓	R/W	-	R/W
Pad 14	517	I16	-32768	+32767	0	0	✓	R/W	-	R/W
Pad 15	518	I16	-32768	+32767	0	0	✓	R/W	-	R/W
Bitword pad A	519	U16	0	65535	0	0	✓	R/W	ID*, QD*	R/W
Pad A Bit 0	520	U16	0	1	0	0	-	R/W	ID, QD	R/W
Pad A Bit 1	521	U16	0	1	0	0	-	R/W	ID, QD	R/W
Pad A Bit 2	522	U16	0	1	0	0	-	R/W	ID, QD	R/W
Pad A Bit 3	523	U16	0	1	0	0	-	R/W	ID, QD	R/W
Pad A Bit 4	524	U16	0	1	0	0	-	R/W	ID, QD	R/W
Pad A Bit 5	525	U16	0	1	0	0	-	R/W	ID, QD	R/W
Pad A Bit 6	526	U16	0	1	0	0	-	R/W	ID, QD	R/W
Pad A Bit 7	527	U16	0	1	0	0	-	R/W	ID, QD	R/W
Pad A Bit 8	528	U16	0	1	0	0	-	R/W	QD*	-
Pad A Bit 9	529	U16	0	1	0	0	-	R/W	QD*	-
Pad A Bit 10	530	U16	0	1	0	0	-	R/W	QD*	-
Pad A Bit 11	531	U16	0	1	0	0	-	R/W	QD*	-
Pad A Bit 12	532	U16	0	1	0	0	-	R/W	QD*	-
Pad A Bit 13	533	U16	0	1	0	0	-	R/W	QD*	-
Pad A Bit 14	534	U16	0	1	0	0	-	R/W	QD*	-
Pad A Bit 15	535	U16	0	1	0	0	-	R/W	QD*	-
Bitword pad B	536	U16	0	65535	0	0	✓	R/W	QD*	R/W
Pad B Bit 0	537	U16	0	1	0	0	-	R/W	QD	R
Pad B Bit 1	538	U16	0	1	0	0	-	R/W	QD	R
Pad B Bit 2	539	U16	0	1	0	0	-	R/W	QD	R
Pad B Bit 3	540	U16	0	1	0	0	-	R/W	QD	R
Pad B Bit 4	541	U16	0	1	0	0	-	R/W	QD	R
Pad B Bit 5	542	U16	0	1	0	0	-	R/W	QD	R
Pad B Bit 6	543	U16	0	1	0	0	-	R/W	QD	R
Pad B Bit 7	544	U16	0	1	0	0	-	R/W	QD	R
Pad B Bit 8	545	U16	0	1	0	0	-	R/W	QD*	-
Pad B Bit 9	546	U16	0	1	0	0	-	R/W	QD*	-
Pad B Bit 10	547	U16	0	1	0	0	-	R/W	QD*	-
Pad B Bit 11	548	U16	0	1	0	0	-	R/W	QD*	-
Pad B Bit 12	549	U16	0	1	0	0	-	R/W	QD*	-
Pad B Bit 13	550	U16	0	1	0	0	-	R/W	QD*	-
Pad B Bit 14	551	U16	0	1	0	0	-	R/W	QD*	-
Pad B Bit 15	552	U16	0	1	0	0	-	R/W	QD*	-

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
OPTIONS \ Option 1										
Accessible only with optional Field Bus card (see Bus card user manual)										
OPTIONS \ Option 2										
Menu	Accessible only with optional APC300 card (see APC300 card user manual)									
Enable OPT2 Enabled Disabled	425	U16	0	1	Disable	Disable	✓	R/Z 1 0	-	-
OPTIONS \ PID										
Enable PI PID Enabled Disabled	769	U16	0	1	Disable	Disable	✓	R/W 1 0	ID	R/W
Enable PD PID Enabled Disabled	770	U16	0	1	Disable	Disable	✓	R/W 1 0	ID	R/W
Enable PI-PD PID Enabled Disabled	1258	U16	0	1	Disabled 0	Disabled 0	-	R/W 1 0	ID	R/W
OPTIONS \ PID \ PID source										
PID source	786	U16	0	65535	0	0	✓	R/W	-	-
PID source gain	787	Float	-100.000	+100.00	1.000	1.000	✓	R/W	-	-
Feed-fwd PID	758	I16	-10000	+10000	0	0	✓	R	IA	R
OPTIONS \ PID \ PID references										
PID error	759	I16	-10000	+10000	0	0	✓	R	-	R
PID feed-back	763	I16	-10000	+10000	0	0	✓	R/W	IA	R/W
PID offs. Sel Offset 0 Offset 1	762	U16	0	1	0	0	✓	R/W 0 1	ID	R/W
PID offset 0	760	I16	-10000	+10000	0	0	✓	R/W	IA	R/W
PID offset 1	761	I16	-10000	+10000	0	0	✓	R/W	-	-
PID acc time	1046	Float	0.0	900.0	0.0	0.0	✓	R/W	-	-
PID dec time	1047	Float	0.0	900.0	0.0	0.0	✓	R/W	-	-
PID clamp	757	I16	-10000	+10000	10000	10000	✓	R/W	-	-
OPTIONS \ PID \ PI controls										
PI P gain PID	765	Float	0.00	100.00	10.00	10.00	✓	R/W	-	-
PI I gain PID	764	Float	0.00	100.00	10.00	10.00	✓	R/W	-	-
PI steady thr	695	I16	0	10000	0	0	✓	R/W	-	-
PI steady delay	731	U16	0	60000	0	0	✓	R/W	-	-
P init gain PID	793	Float	0.00	100.00	10.00	10.00	✓	R/W	-	-
I init gain PID	734	Float	0.00	100.00	10.00	10.00	✓	R/W	-	-
PI central v sel	779	U16	0	3	1	1	✓	R/W	ID	R/W
PI central v1	776	Float	PI bot-tom lim	PI top lim	1.00	1.00	✓	R/W	-	-
PI central v2	777	Float	PI bot-tom lim	PI top Lim	1.00	1.00	✓	R/W	-	-
PI central v3	778	Float	PI bot-tom lim	PI top Lim	1.00	1.00	✓	R/W	IA	-
PI top lim	784	Float	PI bot-tom lim	10.00	10.00	10.00	✓	R/W	-	-
PI bottom lim	785	Float	-10.00	PI top lim	0.0	0.0	✓	R/W	-	-
PI integr freeze OFF ON	783	U16	0	1	0	0	✓	R/W 0 1	ID	R/W
PI output PID	771	I16	0	1000 x PI top limit	1000	1000	✓	R	-	R
Real FF PID	418	I16	-10000	+10000	0	0	✓	R/W	-	R
OPTIONS \ PID \ PD control										
PD P gain 1 PID [%]	768	Float	0.00	100.00	10.00	10.00	✓	R/W	-	-
PD D gain 1 PID [%]	766	Float	0.00	100.00	1.00	1.00	✓	R/W	-	-

Parameter	No.	Format	Value: min	Value: max	Value: Factory American	Value: Factory European	Access via: Keyp.	Access via: RS485/ BUS/ Opt2-M	Access via: Term.	Access via: Opt2-A/ PDC
PD P gain 2 PID [%]	788	Float	0.00	100.00	10.00	10.00	✓	R/W	-	-
PD D gain 2 PID [%]	789	Float	0.00	100.00	1.00	1.00	✓	R/W	-	-
PD P gain 3 PID [%]	790	Float	0.00	100.00	10.00	10.00	✓	R/W	-	-
PD D gain 3 PID[%]	791	Float	0.00	100.00	1.00	1.00	✓	R/W	-	-
PD D filter PID [ms]	767	U16	0	1000	0	0	✓	R/W	-	-
PD output PID	421	I16	-10000	+10000	0	0	✓	R	-	-
PID out sign PID Positive Bipolar	772	U16	0	1	1	1	✓	R/W 0 1	-	-
PID output	774	I16	-10000	+10000	0	0	✓	R	QA	R
OPTIONS \ PID \ PID target										
PID target	782	U16	0	65535	0	0	✓	R/W	-	-
PID out scale	773	Float	-100.000	-100.000	1.000	1.000	✓	R/W	-	-
OPTIONS \ PID \ Diameter calc										
Diameter calc Enabled Disabled	794	U16	0	1	0	0	✓	Z/R 1 0	ID	R/W
Positioning spd [rpm]	795	I16	-100	+100	0	0	✓	R/W	-	-
Max deviation	796	I16	0	+10000	8000	8000	✓	R/W	-	-
Gear box ratio	797	Float	0.001	1.000	1.000	1.000	✓	R/W	-	-
Dancer constant [mm]	798	U16	1	10000	1	1	✓	R/W	-	-
Minimum diameter [cm]	799	U16	1	2000	1	1	✓	R/W	-	-
OPTIONS \ PID										
PI central vs0	780	U16	0	1	1	1	-	R/W	ID	R/W
PI central vs1	781	U16	0	1	0	0	-	R/W	ID	R/W
Diameter calc st	800	U16	0	1	0	0	-	R	QD	R
OPTIONS \ TORQUE WINDER										
Torque winder En Enabled Disabled	1209	U16	0	1	Disabled 0	Disabled 0	✓	R/W 1 0	ID	R/W
OPTIONS \ TORQUE WINDER \ Diam Calculatio										
Roll diameter [m]	1154	Float	0.000	32.000			✓	R	QA	-
Line speed [%]	1160	Float	0.00	200.00			✓	R	-	-
Ref line speed [%]	1286	Float	0.00	200.00			✓	R	-	-
Diam calc Dis ON OFF	1161	U16	0	1	ON (1)	ON (1)	✓	R/W 1 0	ID	R/W
Diam inc/dec En Enabled Disabled	1205	U16	0	1	Enabled (0)	Enabled (0)	✓	R/W 1 0	ID	R/W
Wind/unwind Unwinder Winder	1187	U16	0	1	Winder (0)	Winder (0)	✓	R/W 1 0	ID	R/W
Minimum diameter [mm]	799	U16	1	2000	100	100	✓	R/Z	-	-
Maximum diameter [m]	1153	Float	0.000	32.000	1.000	1.000	✓	R/Z	-	-
Line spd source	1204	U16	0	65535	0	0	✓	R/Z	-	-
Ref spd source	1284	U16	0	65535	0	0	✓	R/Z	-	-
Line speed gain	1156	I16	0	32767	0	0	✓	R/W	-	-
Ref speed gain	1285	I16	0	32767	0	0	✓	R/W	-	-
Base omega [rpm]	1163	U16	0	8191	1500	1500	✓	R/W	-	-
Ref speed thr [%]	1155	Float	0	150.00	5	5	✓	R/W	-	-
Diam filter [ms]	1162	U16	0	5000	100	100	✓	R/W	-	-
Diam init filter [ms]	1206	U16	0	5000	100	100	✓	R/W	-	-
Diam stdy delay [ms]	1207	U16	0	60000	0	0	✓	R/W	-	-

Parameter	No.	Format	Value min	Value max	Value Factory American	Value Factory European	Access via Keyp.	Access via RS485/ BUS/ Opt2-M	Access via Term.	Access via Opt2-A/ PDC
Diam reset	1157	U16	0	1	0	0	✓	R/W	ID	R/W
Diam thr [%]	1158	Float	0	150.00	10	10	✓	R/W	-	-
Diam reached	1159	U16	0	1			✓	R	QD	R
Diam preset sel	1168	U16	0	3	0	0	✓	R/W	ID	-
Diam preset 0 [m]	1164	Float	0.000	32.000	0	0	✓	R/W	-	-
Diam preset 1 [m]	1165	Float	0.000	32.000	0	0	✓	R/W	-	-
Diam preset 2 [m]	1166	Float	0.000	32.000	0	0	✓	R/W	-	-
Diam preset 3 [m]	1167	Float	0.000	32.000	0	0	✓	R/W	IA	-
OPTIONS \ TORQUE WINDER \ Torque calculat										
Tension ref [%]	1180	Float	0.00	199.99	0	0	✓	R/W	IA	-
Tension scale [%]	1181	I16	0	200	100	100	✓	R/W	-	-
Act tension ref [%]	1194	Float	0.00	199.99			✓	R	-	-
Torque current [%]	1193	Float	0.00	200.00			✓	R	QA	-
OPTIONS \ TORQUE WINDER \ Torque calculat \ Comp calculat										
Int acc calc En Enabled Disabled	1183	U16	0	1	Enabled (1)	Enabled (1)	✓	R/Z 1 0	-	-
Time acc/dec min [s]	1182	Float	0.15	300.00	9.01	9.01	✓	R/W	-	-
Acc/dec filter [ms]	1212	U16	0	5000	30	30	✓	R/W	-	-
Line acc [%]	1184	Float	0.00	100.00	100	100	✓	R/W	-	-
Line dec [%]	1185	Float	0.00	100.00	100	100	✓	R/W	-	-
Line fast stop [%]	1186	Float	0.00	100.00	100	100	✓	R/W	-	-
Line acc status	1188	U16	0	1	OFF	OFF	✓	R/W	ID	R/W
Line dec status	1189	U16	0	1	OFF	OFF	✓	R/W	ID	R/W
Line fstp status	1190	U16	0	1	OFF	OFF	✓	R/W	ID	R/W
Variable J comp [%]	1171	Float	0.00	199.99	0	0	✓	R/W	-	-
Constant J comp [%]	1172	Float	-100.00	+100.00	0	0	✓	R/W	-	-
Act var J comp [%]	1192	Float	-	200.00	0	0	✓	R	-	-
Act const J comp [%]	1191	Float	-	200.00	0	0	✓	R	-	-
Mat width [%]	1173	Float	0.00	100.00	100	100	✓	R/W	-	-
Static f [%]	1174	Float	0.00	199.99	0	0	✓	R/W	-	-
Dinamic f [%]	1175	Float	0.00	199.99	0	0	✓	R/W	-	-
Static f Zero Enabled Disabled	1287	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W 1 0	-	-
Actual comp [%]	1213	I16	-200	+200			✓	R	QD	-
Closed loop En Enabled Disabled	1214	U16	0	1	Disabled (0)	Disabled (0)	✓	R/Z 1 0	-	R/Z
Close loop comp	1208	I16	-32767	+32767			✓	R	-	-
OPTIONS \ TORQUE WINDER \ Torque calculat \ Taper function										
Taper enable Enabled Disabled	1176	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W 1 0	ID	R/W
Init diameter [m]	1177	Float	0.000	32.000	0.1	0.1	✓	R/W	-	-
Final diameter [m]	1178	Float	0.000	32.000	1	1	✓	R/W	-	-
Tension ref [%]	1180	Float	0.00	199.99	0	0	✓	R/W	IA	-
Tension red [%]	1179	Float	0.00	199.99	0	0	✓	R/W	IA	-
Act tension ref [%]	1194	Float	0.00	200.00	0	0	✓	R	QA	-
OPTIONS \ TORQUE WINDER \ Speed demand										
Speed demand En Enabled Disabled	1215	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W 1 0	-	R/W

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
Winder side Down Up	1201	U16	0	1	Up (0)	Up (0)	✓	R/W 1 0	ID	R/W
W gain [%]	1202	U16	0	100	0	0	✓	R/W	-	-
Speed match ON OFF	1195	U16	0	1	OFF (0)	OFF (0)	✓	R/W 1 0	ID	R/W
Spd match gain [%]	1200	U16	0	150	100	100	✓	R/W	-	-
Spd match acc [s]	1196	Float	0.30	300.00	83.88	83.88	✓	R/W	-	-
Spd match dec [s]	1197	Float	0.30	300.00	83.88	83.88	✓	R/W	-	-
Spd match compl	1203	U16	0	1			✓	R	QD	R
Spd match torque [%]	1216	U16	0	200	100	100	✓	R/W	-	-
W offset [rpm]	1199	I16	0	1000	0	0	✓	R/W	-	-
Offset acc time [s]	1198	Float	0.30	950.00	83.88	83.88	✓	R/W	-	-
W target	1210	U16	0	65535	0	0	✓	R/Z	-	-
W reference [rpm]	1217	I16	-8192	+8192			✓	R	QA	-
Jog TW enable Enabled Disabled	1256	U16	0	1	Disabled (0)	Disabled (0)	✓	R/W 1 0	ID	R/W
Jog TW speed [%]	1255	I16	0	100	0	0	✓	R/W	-	-

Parameter	No.	Format	Value: min	Value: max	Value: Factory American	Value: Factory European	Access via: Keyp.	Access via: RS485/ BUS/ Opt2-M	Access via: Term.	Access via: Opt2-A/ PDC
DRIVECOM										
Malfunction code Failure supply Undervoltage Overvoltage Overcurrent Heatsink Hardware DSP error Interrupt error Speed fbk loss External fault Overtemp motor Field loss Bus loss Hw opt 1 failure Opt2 Unknown Enable seq err SSC Error Slave Error (1) Diff Current (1) *(1) TPD32-EV- ... 12P/12S only.*	57	I16					✓ 5100h 3120h 3310h 2300h 4210h 5000h 6110h 6120h 7301h 9000h 4310h 3330h 8110h 7510h 7400h 1001h 9009h 8100h 2600h 2200h	R 5100h 3120h 3310h 2300h 4210h 5000h 6110h 6120h 7301h 9000h 4310h 3330h 8110h 7510h 7400h 1001h 9009h 8100h 2600h 2200h	-	-
Control word	55	U16	0	65535			✓	R/W	-	R/W
Status word	56	U16	0	65535			✓	R	-	R
Speed input var [FF]	44	I16	-2 P45	+2 P45	0	0	✓	R/W	IA, QA	R/W
Speed ref var [FF]	115	I16	-32768	+32767	-	-	✓	R	-	R
Act speed value [FF]	119	I16	-32768	+32767	-	-	✓	R	-	R
DRIVECOM \ Speed amount										
Speed min amount [FF]	1	U32	0	$2^{32}-1$	0	0	✓	R/Z	-	-
Speed max amount [FF]	2	U32	0	$2^{32}-1$	5000	5000	✓	R/Z	-	-
DRIVECOM \ Speed min/max										
Speed min pos [FF]	5	U32	0	$2^{32}-1$	0	0	✓	R/Z	-	-
Speed max pos [FF]	3	U32	0	$2^{32}-1$	5000	5000	✓	R/Z	-	-
Speed min neg [FF]	6	U32	0	$2^{32}-1$	0	0	✓	R/Z	-	-
Speed max neg [FF]	4	U32	0	$2^{32}-1$	5000	5000	✓	R/Z	-	-
DRIVECOM \ Acceleration										
Acc delta speed [FF]	21	U32	0	$2^{32}-1$	100	100	✓	R/W	-	-
Acc delta time [s]	22	U16	0	65535	1	1	✓	R/W	-	-
DRIVECOM \ Deceleration										
Dec delta speed [FF]	29	U32	0	$2^{32}-1$	100	100	✓	R/W	-	-
Dec delta time [s]	30	U16	0	65535	1	1	✓	R/W	-	-
DRIVECOM \ Quick stop										
QStp delta speed [FF]	37	U32	0	$2^{32}-1$	1000	1000	✓	R/W	-	-
QStp delta time [s]	38	U16	0	65535	1	1	✓	R/W	-	-
Quick stop Quick stop No Quick stop	343	U16	0	1	No Quick stop	No Quick stop	-	R/W 0 1	-	-
DRIVECOM \ Face value fact										
Face value num	54	I16	1	32767	1	1	✓	R/Z	-	R
Face value den	53	I16	1	32767	1	1	✓	R/Z	-	R
DRIVECOM \ Dimension fact										
Dim factor num	50	I32***	1	65535	1	1	✓	R/Z	-	R
Dim factor den	51	I32***	1	$2^{31}-1$	1	1	✓	R/Z	-	R
Dim factor text	52	Text			rpm	rpm	✓	R/Z	-	-
DRIVECOM										
Speed base value [FF]	45	U32***	1	16383	1500	1500	✓	R/Z	-	R
Speed input perc [%]	46	I16	-32768	+32767	0	0	✓	R/W	-	R/W
Percent ref var [%]	116	I16	-32768	+32767			✓	R	-	R
Act percentage [%]	120	I16	-32768	+32767			✓	R	-	R

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
SERVICE										
Password 2										

* When the parameter is accessed by Opt2-A/PDC the format is U16

** When the parameter is accessed by Opt2-A/PDC the format is I16

*** When the parameter is accessed by Opt2-A/PDC the lower word of the parameter is considered

10.2 LIST OF HIGH PRIORITY PARAMETERS

When a APC300 cards is used a subset of the TPD32-EV parameters can be exchanged with the optional card through the automatic synchronous communication. For more details see the APC300 technical documentation.

Parameter	No.	Format	Value			Read/ Write
			min	max	factory	
T current lim + [CURR]	8	U16	0	2 * TOP_CURR	TOP_CURR	R/W
T current lim - [CURR]	9	U16	0	2 * TOP_CURR	TOP_CURR	R/W
In use Tcur lim+ [CURR]	10	U16	0	2 * TOP_CURR	-	R
In use Tcur lim- [CURR]	11	U16	0	2 * TOP_CURR	-	R
Current lim red [CURR]	13	U16	0	2 * TOP_CURR	TOP_CURR	R
T current ref 1 [CURR]	39	I16	-2 * TOP_CURR	+2 * TOP_CURR	0	R/W
T current ref 2 [CURR]	40	I16	-2 * TOP_CURR	+2 * TOP_CURR	0	R/W
T current ref [CURR]	41	I16	-2 * TOP_CURR	+2 * TOP_CURR	-	R
Speed ref 1 [SPD]	42	I16	-32767	32767	0	R/W
Speed ref 2 [SPD]	43	I16	-32767	32767	0	R/W
Ramp ref 1 [SPD]	44	I16	-32767	32767	0	R/W
Ramp ref 2 [SPD]	48	I16	-32767	32767	0	R/W
Control word	55	U16				R/W
Status word	56	U16				R
Ramp ref [SPD]	110	I16	-32767	32767	-	R
Ramp outp [SPD]	113	I16	-32767	32767	-	R
Speed ref [SPD]	118	I16	-32767	32767	-	R
Actual spd [SPD]	122	I16	-32767	32767	-	R
Adap reference [SPD]	183	I16	-32767	32767	4000	R/W
Enc 1 position [ENC_PLS] *	197	I16	-32767	32767	-	R
Enc 2 position [ENC_PLS] *	198	I16	-32767	32767	-	R
Enc 1 last time [ENC_TIM] *	204	U32	0	2^{32}-1	-	R
Enc 1 last time high [ENC_TIM] *	205	U16	0	65535	-	R
Enc 2 last time {ENC_TIM] *	206	U32	0	2^{32}-1	-	R
Enc 2 last time high {ENC_TIM] *	207	U16	0	65535	-	R
Speed reg output [CURR]	236	I16	-2 * TOP_CURR	+2 * TOP_CURR	-	R
Lock speed reg	322	U16	0	1	0	R/W
Enc 2 speed [SPD] *	420	I16	-37767	32767	-	R
Enc 1 speed [SPD] *	427	I16	-37767	32767	-	R
Flux current max	467	U16	819	16384	16384	R/W
Flux reference	500	U16	0	16384	16384	R
Pad 0	503	I16	-32768	32767	0	R/W
Pad 1	504	I16	-32768	32767	0	R/W
Pad 2	505	I16	-32768	32767	0	R/W
Pad 3	506	I16	-32768	32767	0	R/W
Pad 4	507	I16	-32768	32767	0	R/W
Pad 5	508	I16	-32768	32767	0	R/W
Pad 6	509	I16	-32768	32767	0	R/W
Pad 7	510	I16	-32768	32767	0	R/W
Pad 8	511	I16	-32768	32767	0	R/W
Pad 9	512	I16	-32768	32767	0	R/W
Pad 10	513	I16	-32768	32767	0	R/W
Pad 11	514	I16	-32768	32767	0	R/W
Pad 12	515	I16	-32768	32767	0	R/W
Pad 13	516	I16	-32768	32767	0	R/W
Pad 14	517	I16	-32768	32767	0	R/W
Pad 15	518	I16	-32768	32767	0	R/W
Bitword pad A	519	U16	0	65535	0	R/W
Bitword pad B	536	U16	0	65535	0	R/W
Dig input term	564	U16	0	65535	0	R
Dig output term	581	U16	0	65535	0	R

Load comp [CURR]	698	I16	-2 * TOP_CURR	+2 * TOP_CURR	-	R
Ind store ctrl	912	U16	0	65535	0	R/W
Index storing	913	U16	0	$+2^{32}$-1	-	R
Out vlt level	921	U16	0	16384	16384	R/W
F act speed (rpm) [spd]	924	I16	-32768	32767	-	R
F act speed (d) [spd]	925	I16	-32768	32767	-	R
F T curr % [curr]	928	I16	-2 * TOP_CURR	+2 * TOP_CURR	-	R
Speed ratio	1017	I16	0	32767	+10000	R/W
Spd draw out (d) [SPD]	1018	I16	-32768	32767	-	R

NOTE !

1) [**SPD**] = Speed settings are xpressed in *RPM * 4*

2) [**CURR**] = Current settings are expressed in European Drive rated current / 2000 = Motor Amps (2000 is **TOP_CURR**)

3) [**ENC_PLS**] = Encoders positions are expressed in *pulses * 4*

4) [**ENC_TIM**] = Encoders **last time** (s) are expressed in *50ns units* (1=50nS)

5) Encoder 2 parameters (marked with "*" in the table) can be read by the APC300 only if the parameter **Speed fbk sel** = encoder 2

6) Encoder 1 parameters (marked with "*" in the table) can be read by the APC300 only if
   - the parameter **Speed fbk sel** = encoder 2 and
   - a digital encoder is used as encoder 1 (interfacing with the converter by means of the DEII card)

7) **Speed reg output [%]** contains valid information even if the speed regulator is disabled (Enable speed reg = Disabled). If Speed reg output is enabled, it contains the sum of actual speed regulator output and **T current ref 2**.

11 - REPLACEMENT PARTS

11.1 HARDWARE CONFIGURATION

The functionality and use of the TPD32-EV converter are the same for the whole device range. Different power and control cards are mounted depending on the output rated current. The following table indicates the card range for each converter type.

Function	Type	Drawing	Converter construction type						
			CU	A1 A2	A3	B	C	D	E
Regulation	R-TPD32-EV	ESE 4155	X	X	X	X	X	X	X
Power / Control	FIR1-.. (-2B/4B)	ESE 2135	-	X	X	-	-	-	-
	FIR1-..-FC (-2B/4B)	ESE 4188	-	X	X				
	FIR2-.. (-2B/4B)	ESE 2238	-	-	-	X	-	-	-
	FIR2-..-FC (-2B) FIR2-..-FC (-4B)	ESE 4823 ESE 4351	-	-	-	X	-	-	-
	FIR3-32 (-2B/4B)	ESE 2260	-	-	-	-	X	-	-
	FIR-D-.. (-2B/4B)	ESE 5313	-	-	-	-	-	X	-
	FIR-.P-..	ESE 5534	X	-	-	-	-	-	X
	PBB (-2B/-4B)	ESE 2275	-	X	-	-	-	-	-
Supply	SW1-31	ESE 2192	X	X	X	-	-	X	X
	SW2-32	ESE 2239	-	-	-	X	-	-	-
	SW3-32	ESE 2239	-	-	-	-	X	-	-
Field	PFC1A-32	ESE 2213	-	X	X	-	-	-	-
	PFC2-31	ESE 2271	-	-	-	X	-	-	-
	SN-FCC	ESE 5697	-	-	-	-	X (*)	-	-
	PFC40/70	ESE 2374	X	-	-	-	-	X	X
	SN-FC	ESE 2265	-	-	-	-	X (**)	-	-
Filter	FL-31	ESE 2253	-	-	-	-	X (**)	-	-
	FL-57 FL-69	ESE 5694	-	-	-	-	X (*)	-	-
	CFS-..	ESE 5301	X	-	-	-	-	-	X
	CFSF-..	ESE 5320	-	-	-	-	-	X	-
Snubber	SN.-31	ESE 2246	-	-	-	X (**)	X (**)	-	-
	SN7-3.	ESE 5549	-	-	-	X (*)	X (*)	-	-
Fan control	FNLS3	ESE 5998	-	-	-	-	-	X	-

(*): TPD32-EV-575/...-... , TPD32-EV-690/...-...
(**): TPD32-EV-500/...-...

Important note: When the FIR card is replaced, **switches S3 and S4 must be set according to the size of the converter**, see the following pages.

Figure 11.3.1: FIR1-... power/driver cards

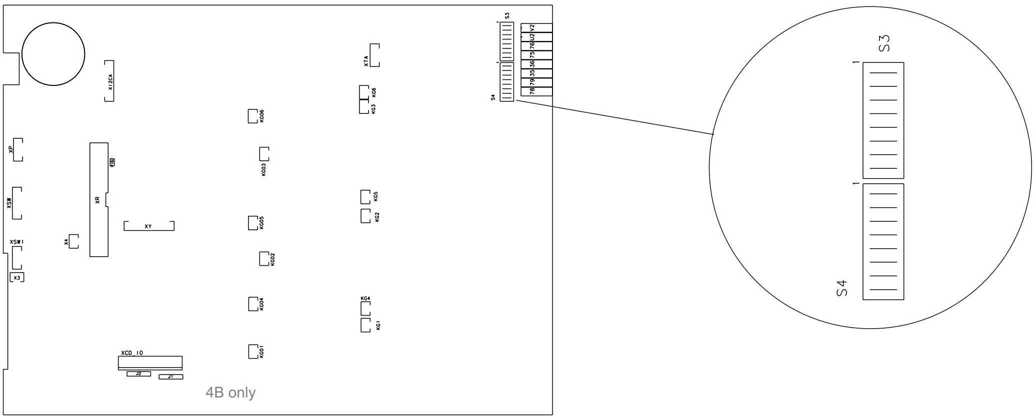


Table 11.3.1-A: Selection of dip-switches "S3-XX" and "S4-XX" for FIR1-… and FIR1-…-FC (≥ rev. H) cards

TPD32-EV-		Dip-switch								Dip-switch							
Standard	**American**	**S3-1**	**S3-2**	**S3-3**	**S3-4**	**S3-5**	**S3-6**	**S3-7**	**S3-8**	**S4-1**	**S4-2**	**S4-3**	**S4-4**	**S4-5**	**S4-6**	**S4-7**	**S4-8**
20	**17**	ON	ON		ON												
40	**35**				ON	ON	ON	ON									
70	**56**	ON			ON			ON					ON				
110	**88**				ON			ON					ON	ON			
140	**112**				ON						ON				ON		
185	**148**				ON						ON		ON		ON		

Table 11.3.1-B: Selection of dip-switches "S3-XX" and "S4-XX" for FIR1-…-FC cards (< rev. H)

TPD32-EV-FC-A	Dip-switch								Dip-switch				TA
	S3-1	**S3-2**	**S3-3**	**S3-4**	**S3-5**	**S3-6**	**S3-7**	**S3-8**	**S4-1**	**S4-2**	**S4-3**	**S4-4**	
20	ON												200/0.1 (ETI1188)
40	ON	ON											
70					ON	ON							
110						ON	ON	ON					
140			ON	ON					ON				
185						ON	ON				ON		

Figure 11.3.2: FIR2-... power/driver card

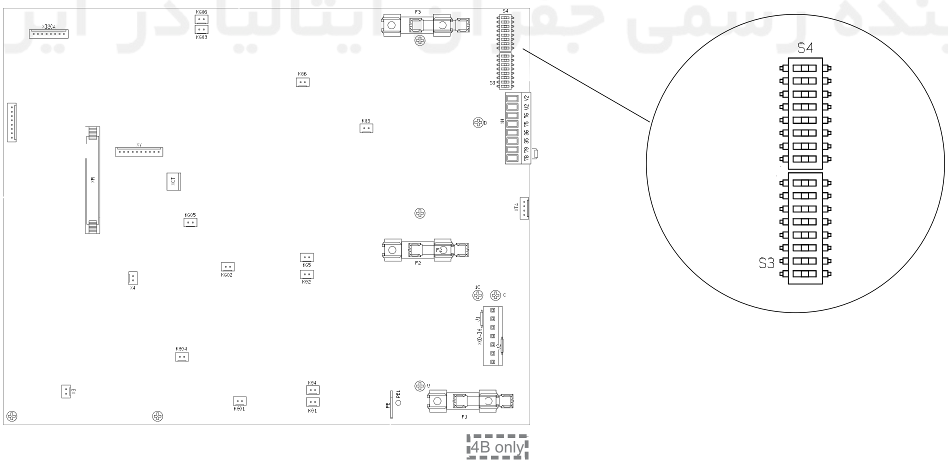


Table 11.3.2-A: Selection of dip-switches "S3-XX" and "S4-XX" for FIR2-X-… and FIR2-…-FC (≥ rev. H) cards

TPD32-EV-		Dip-switch								Dip-switch							
Standard	**American**	**S3-1**	**S3-2**	**S3-3**	**S3-4**	**S3-5**	**S3-6**	**S3-7**	**S3-8**	**S4-1**	**S4-2**	**S4-3**	**S4-4**	**S4-5**	**S4-6**	**S4-7**	**S4-8**
280	224					ON					ON		ON		ON		
350	280										ON					ON	
420	336								ON		ON	ON				ON	
500	400								ON	ON					ON	ON	
650	450							ON	ON							ON	ON

Table 11.3.2-B: Selection of TPD32-EV-FC for FIR2-X-…-FC cards (< rev. H)

TPD32-EV-FC-B	Resistors					T/A
	R1	**R2**	**R3**	**R4**	**R5**	
280	Not mounted	CUT	5R36	5R36	5R36	1:3000
350		CUT	5R36	5R36	5R36	
420		CUT	5R36	5R36	5R36	
500		CUT	5R36	5R36	5R36	
650		5R36	CUT	5R36	5R36	

Figure 11.3.3: FIR3-32 power/driver card

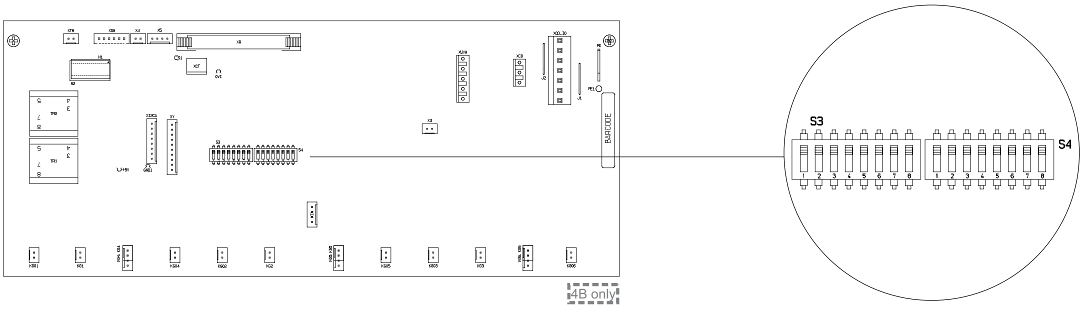


Table 11.3.3: Selection of dip-switches "S3-XX" and "S4-XX" for FIR3-32- cards.

TPD32-EV-		Dip-switch								Dip-switch							
Standard	American	S3-1	S3-2	S3-3	S3-4	S3-5	S3-6	S3-7	S3-8	S4-1	S4-2	S4-3	S4-4	S4-5	S4-6	S4-7	S4-8
560	360					ON					ON	ON				ON	
700	490	ON				ON					ON						ON
770	560	ON									ON		ON				ON
900	650								ON		ON				ON		ON
1000	750		ON										ON	ON	ON		ON
1050	850	ON						ON								ON	ON

Figure 11.3.4: FIR3-D power/driver card.

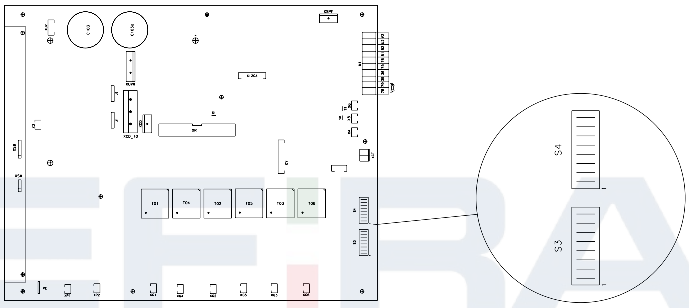


Table 11.3.4: Selection of dip-switches "S3-XX" and "S4-XX" for FIR3-D- cards.

TPD32-EV-		Dip-switch								Dip-switch							
Standard	American	S3-1	S3-2	S3-3	S3-4	S3-5	S3-6	S3-7	S3-8	S4-1	S4-2	S4-3	S4-4	S4-5	S4-6	S4-7	S4-8
1300	**920/980**			ON				ON	ON		ON						
1400	**1000**						ON		ON		ON	ON					
1600	**1200**					ON			ON				ON		ON		
1900	**1450**								ON		ON	ON		ON			
2000	**1500**	ON				ON		ON			ON			ON			
2100	**1650**						ON						ON	ON	ON		
2300	**1800**							ON	ON		ON		ON	ON			
2400	**1850**						ON		ON		ON		ON		ON		

Figure 11.3.5: FIR4/5P-XX power/driver card

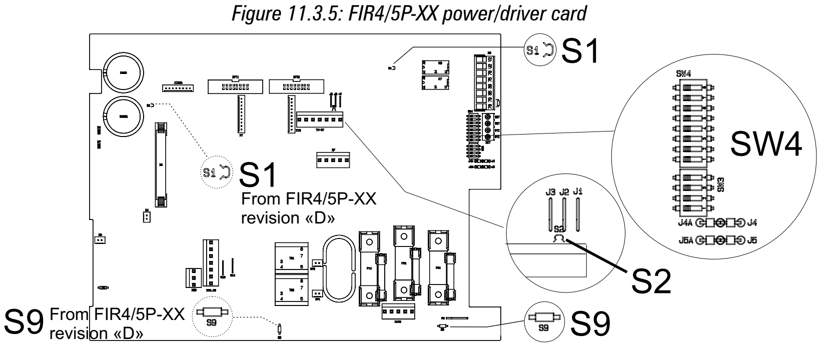


Table 11.3.5: Selection of Dip-switch "S2" (FIR4/5P-XX)

	One CU controlling one external bridge	One CU controlling two external bridges
State of S2	Closed (default)	Cut

Table 11.3.6: Selection of dip-switches "S3-XX" and "S4-XX" for FIR4/5P-XX cards.

Drive 500VAC 2 quadrants	On board FIR4P-53															On board R-TPD32-EV																IPA 464
	Jumper			Dip-switch				Dip-switch								Dip-switch								Dip-switch								
	S1	J4	J5	SW3-1	SW3-2	SW3-3	SW3-4	SW4-1	SW4-2	SW4-3	SW4-4	SW4-5	SW4-6	SW4-7	SW4-8	S14-1	S14-2	S14-3	S14-4	S14-5	S14-6	S14-7	S14-8	S15-1	S15-2	S15-3	S15-4	S15-5	S15-6	S15-7	S15-8	set to
TPD32-EV-500/600-1200-2B-E			ON						ON	ON	ON	ON	ON		ON	ON		ON			ON			ON		ON	ON			ON		EU
TPD32-EV-500/600-1000-2B-E-NA			ON						ON	ON	ON	ON	ON		ON	ON		ON			ON			ON		ON	ON			ON		AM
TPD32-EV-500/600-1500-2B-E			ON					ON			ON	ON	ON			ON		ON			ON			ON				ON		ON		EU
TPD32-EV-500/600-1300-2B-E-NA			ON					ON			ON	ON	ON			ON		ON			ON			ON				ON		ON		AM
TPD32-EV-500/600-1800-2B-E			ON					ON		ON	ON	ON	ON			ON		ON			ON			ON	ON			ON		ON		EU
TPD32-EV-500/600-1400-2B-E-NA			ON					ON		ON	ON	ON	ON			ON		ON			ON			ON	ON			ON		ON		AM
TPD32-EV-500/600-2000-2B-E			ON					ON		ON		ON	ON	ON		ON		ON			ON					ON		ON		ON		EU
TPD32-EV-500/600-1500-2B-E-NA			ON					ON		ON		ON	ON	ON		ON		ON			ON					ON		ON		ON		AM
TPD32-EV-500/600-2400-2B-E			ON					ON	ON		ON				ON	ON	ON	ON	ON					ON		ON		ON		ON		EU
TPD32-EV-500/600-1800-2B-E-NA			ON					ON	ON		ON				ON	ON	ON	ON	ON					ON		ON		ON		ON		AM
TPD32-EV-500/600-2700-2B-E			ON					ON	ON	ON		ON		ON	ON	ON	ON	ON	ON						ON	ON		ON		ON		EU
TPD32-EV-500/600-2000-2B-E-NA			ON					ON	ON	ON		ON		ON	ON	ON	ON	ON	ON						ON	ON		ON		ON		AM
TPD32-EV-500/600-2900-2B-E			ON					ON			ON		ON	ON	ON	ON	ON	ON	ON					ON	ON	ON		ON		ON		EU
TPD32-EV-500/600-2200-2B-E-NA			ON					ON			ON		ON	ON	ON	ON	ON	ON	ON					ON	ON	ON		ON		ON		AM
TPD32-EV-500/600-3300-2B-E			ON					ON		ON		ON	ON			ON	ON	ON	ON								ON	ON		ON		EU
TPD32-EV-500/600-2350-2B-E-NA			ON					ON		ON		ON	ON			ON	ON	ON	ON								ON	ON		ON		AM

Drive 690VAC 2 quadrants	On board FIR5P-63															On board R-TPD32-EV																IPA 464
	Jumper			Dip-switch				Dip-switch								Dip-switch								Dip-switch								
	S1	J4	J5	SW3-1	SW3-2	SW3-3	SW3-4	SW4-1	SW4-2	SW4-3	SW4-4	SW4-5	SW4-6	SW4-7	SW4-8	S14-1	S14-2	S14-3	S14-4	S14-5	S14-6	S14-7	S14-8	S15-1	S15-2	S15-3	S15-4	S15-5	S15-6	S15-7	S15-8	set to
TPD32-EV-690/810-1010-2B-E			ON						ON	ON		ON			ON	ON		ON			ON			ON	ON	ON	ON				ON	EU
TPD32-EV-690/810-900-2B-E-NA			ON						ON	ON		ON			ON	ON		ON			ON			ON	ON	ON	ON				ON	AM
TPD32-EV-690/810-1400-2B-E			ON					ON			ON			ON		ON		ON			ON							ON			ON	EU
TPD32-EV-690/810-1150-2B-E-NA			ON					ON			ON			ON		ON		ON			ON							ON			ON	AM
TPD32-EV-690/810-1700-2B-E			ON					ON		ON	ON				ON	ON		ON			ON				ON			ON			ON	EU
TPD32-EV-690/810-1350-2B-E-NA			ON					ON		ON	ON				ON	ON		ON			ON				ON			ON			ON	AM
TPD32-EV-690/810-2000-2B-E			ON					ON		ON		ON	ON	ON		ON		ON			ON					ON		ON			ON	EU
TPD32-EV-690/810-1500-2B-E-NA			ON					ON		ON		ON	ON	ON		ON		ON			ON					ON		ON			ON	AM
TPD32-EV-690/810-2400-2B-E			ON					ON	ON		ON				ON	ON	ON	ON	ON					ON		ON		ON			ON	EU
TPD32-EV-690/810-1800-2B-E-NA			ON					ON	ON		ON				ON	ON	ON	ON	ON					ON		ON		ON			ON	AM
TPD32-EV-690/810-2700-2B-E			ON					ON	ON	ON		ON		ON	ON	ON	ON	ON	ON						ON	ON		ON			ON	EU
TPD32-EV-690/810-2000-2B-E-NA			ON					ON	ON	ON		ON		ON	ON	ON	ON	ON	ON						ON	ON		ON			ON	AM
TPD32-EV-690/810-3300-2B-E			ON					ON		ON		ON	ON			ON	ON	ON	ON								ON	ON			ON	EU
TPD32-EV-690/810-2350-2B-E-NA			ON					ON		ON		ON	ON			ON	ON	ON	ON								ON	ON			ON	AM

Drive 500VAC 4 quadrants	On board FIR4P-53															On board R-TPD32-EV																IPA 464
	Jumper			Dip-switch				Dip-switch								Dip-switch								Dip-switch								
	S1	J4	J5	SW3-1	SW3-2	SW3-3	SW3-4	SW4-1	SW4-2	SW4-3	SW4-4	SW4-5	SW4-6	SW4-7	SW4-8	S14-1	S14-2	S14-3	S14-4	S14-5	S14-6	S14-7	S14-8	S15-1	S15-2	S15-3	S15-4	S15-5	S15-6	S15-7	S15-8	set to
TPD32-EV-500/520-1500-4B-E	ON		ON					ON			ON	ON	ON			ON		ON			ON			ON	ON	ON	ON			ON		EU
TPD32-EV-500/520-1300-4B-E-NA	ON		ON					ON			ON	ON	ON			ON		ON			ON			ON	ON	ON	ON			ON		AM
TPD32-EV-500/520-1700-4B-E	ON		ON					ON		ON	ON				ON	ON		ON			ON							ON		ON		EU
TPD32-EV-500/520-1350-4B-E-NA	ON		ON					ON		ON	ON				ON	ON		ON			ON							ON		ON		AM
TPD32-EV-500/520-2000-4B-E	ON		ON					ON		ON		ON	ON	ON		ON		ON			ON			ON				ON		ON		EU
TPD32-EV-500/520-1500-4B-E-NA	ON		ON					ON		ON		ON	ON	ON		ON		ON			ON			ON				ON		ON		AM
TPD32-EV-500/520-2400-4B-E	ON		ON					ON	ON		ON				ON	ON	ON	ON	ON						ON			ON		ON		EU
TPD32-EV-500/520-1800-4B-E-NA	ON		ON					ON	ON		ON				ON	ON	ON	ON	ON						ON			ON		ON		AM
TPD32-EV-500/520-2700-4B-E	ON		ON					ON	ON	ON		ON		ON	ON	ON	ON	ON	ON					ON	ON			ON		ON		EU
TPD32-EV-500/520-2000-4B-E-NA	ON		ON					ON	ON	ON		ON		ON	ON	ON	ON	ON	ON					ON	ON			ON		ON		AM
TPD32-EV-500/520-3300-4B-E	ON		ON					ON		ON		ON	ON			ON	ON	ON	ON					ON		ON		ON		ON		EU
TPD32-EV-500/520-2350-4B-E-NA	ON		ON					ON		ON		ON	ON			ON	ON	ON	ON					ON		ON		ON		ON		AM

Drive 690VAC 4 quadrants	On board FIR5P-63															On board R-TPD32-EV																IPA 464
	Jumper			Dip-switch				Dip-switch								Dip-switch								Dip-switch								
	S1	J4	J5	SW3-1	SW3-2	SW3-3	SW3-4	SW4-1	SW4-2	SW4-3	SW4-4	SW4-5	SW4-6	SW4-7	SW4-8	S14-1	S14-2	S14-3	S14-4	S14-5	S14-6	S14-7	S14-8	S15-1	S15-2	S15-3	S15-4	S15-5	S15-6	S15-7	S15-8	set to
TPD32-EV-690/720-1010-4B-E	ON		ON						ON	ON		ON			ON	ON		ON			ON			ON		ON	ON				ON	EU
TPD32-EV-690/720-900-4B-E-NA	ON		ON						ON	ON		ON			ON	ON		ON			ON			ON		ON	ON				ON	AM
TPD32-EV-690/720-1400-4B-E	ON		ON					ON			ON			ON		ON		ON			ON				ON	ON	ON				ON	EU
TPD32-EV-690/720-1150-4B-E-NA	ON		ON					ON			ON			ON		ON		ON			ON				ON	ON	ON				ON	AM
TPD32-EV-690/720-1700-4B-E	ON		ON					ON		ON	ON				ON	ON		ON			ON							ON			ON	EU
TPD32-EV-690/720-1350-4B-E-NA	ON		ON					ON		ON	ON				ON	ON		ON			ON							ON			ON	AM
TPD32-EV-690/720-2000-4B-E	ON		ON					ON		ON		ON	ON	ON		ON		ON			ON			ON				ON			ON	EU
TPD32-EV-690/720-1500-4B-E-NA	ON		ON					ON		ON		ON	ON	ON		ON		ON			ON			ON				ON			ON	AM
TPD32-EV-690/720-2400-4B-E	ON		ON					ON	ON		ON				ON	ON	ON	ON	ON						ON			ON			ON	EU
TPD32-EV-690/720-1800-4B-E-NA	ON		ON					ON	ON		ON				ON	ON	ON	ON	ON						ON			ON			ON	AM
TPD32-EV-690/720-2700-4B-E	ON		ON					ON	ON	ON		ON		ON	ON	ON	ON	ON	ON					ON	ON			ON			ON	EU
TPD32-EV-690/720-2000-4B-E-NA	ON		ON					ON	ON	ON		ON		ON	ON	ON	ON	ON	ON					ON	ON			ON			ON	AM
TPD32-EV-690/720-3300-4B-E	ON		ON					ON		ON		ON	ON			ON	ON	ON	ON					ON		ON		ON			ON	EU
TPD32-EV-690/720-2350-4B-E-NA	ON		ON					ON		ON		ON	ON			ON	ON	ON	ON					ON		ON		ON			ON	AM

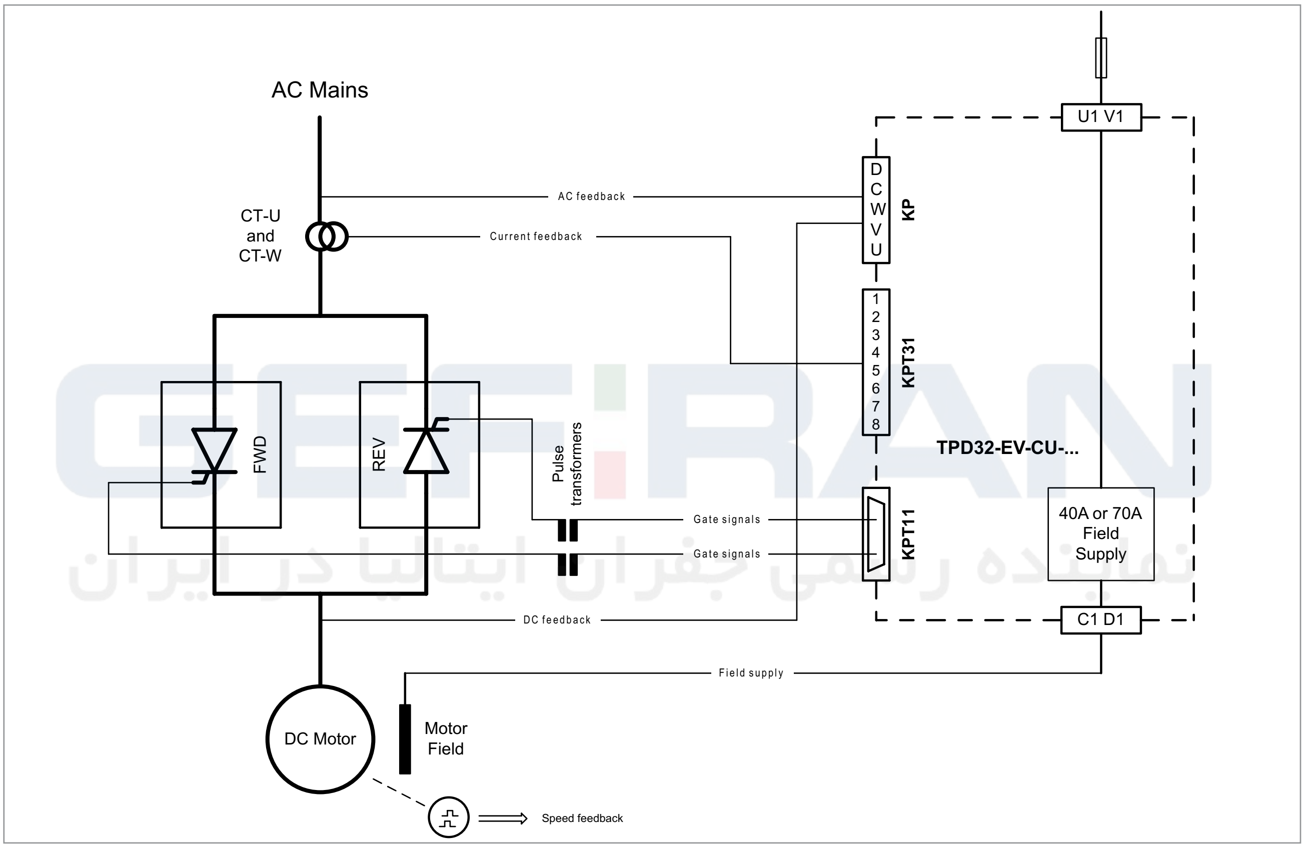
APPENDIX 1 - TPD32-EV-CU: CONTROL UNIT

General description

The TPD32-EV-CU-… is an electronic control unit designed for use with one or more six-pulse two or four-quadrant power bridge SCR AC/DC converters. It is supplied as a stand-alone unit for systems that already have a power bridge.

The control unit regulates the armature voltage and current, generates SCR gate command signals and also contains a 40 A or 70 A field power supply circuit. It is suitable for power bridges connected to a 230 VAC to 690 VAC 50/60 Hz three-phase voltage supply. It interfaces directly with the three-phase power line, the armature voltage and armature current, measured by two current transducers that must be included on the power bridge. It covers armature currents ranging from 4 ADC to 20,000 ADC.

Figure A1.1: Typical single-wire connection diagram



A1.1 Models available and main technical data

Model name	Armature				Field		
	Type of drive	Rated U_{LN}	Rated U_{dN}	Rated I_{dN}	Rated I_{FN}	Rated U_{LFN}	Rated U_{dFN}
		Mains input voltage	Motor output voltage	Motor output current	Motor field output current	Mains input voltage	Motor field output voltage
	[quadrants]	[VAC]	[VDC]	[ADC]	[ADC]	[VAC]	[VDC]
TPD32-EV-CU-230/500-THY1-40	2Q / 4Q	3 x 230 / 400 / 500	up to 600	Can be set to between 4 and 20,000 A	40	1 x 230 / 400 / 460	200 / 310 / 360
TPD32-EV-CU-230/500-THY2-40							
TPD32-EV-CU-230/500-THY1-70					70		
TPD32-EV-CU-230/500-THY2-70							
TPD32-EV-CU-575/690-THY1-40		3 x 575 / 690	up to 810		40		
TPD32-EV-CU-575/690-THY2-40							
TPD32-EV-CU-575/690-THY1-70					70		
TPD32-EV-CU-575/690-THY2-70							

NOTE ! …-THY1-… models are suitable for controlling pulse transformers with one secondary winding; …-THY2-… models for controlling pulse transformers with two secondary windings.

A1.2 Connection cables supplied

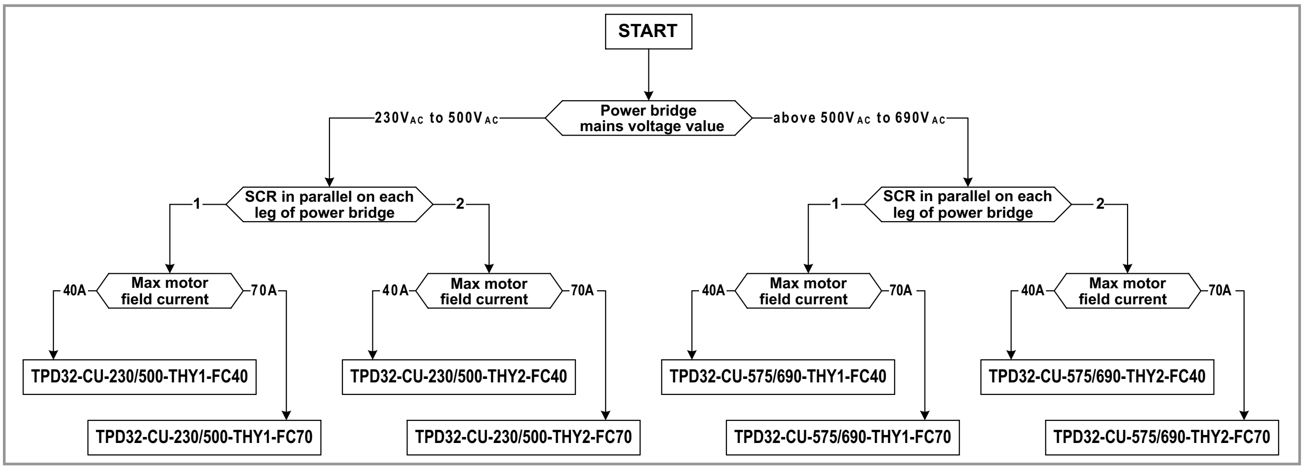
All the models listed above are supplied with three cables for connection to the power bridge in standard situations. However, additional cables may be necessary in certain conditions. These are described below. The flow chart and tables below will help you decide which control unit is the best for your particular application and whether you need any additional cables.

Table A.1.2.1: Connection cables for TPD32-EV-CU-….

Name	Description	Supplied as standard	Electrical diagram	Code
KP Connector Interface Cable for TPD32-EV-CU	Cable, 5-pin, AWG14, tot. length 2.5 m, sheathing for 1.5 m. Link between mains voltage and armature voltage. KP connector	yes	"Figure 9.4.3-C: ESE5799 (3/3) - TPD32-EV-CU-" on page 424	S72762
KPT31 Connector Interface Cable for TPD32-EV-CU	Cable, 3 twisted pairs, 6-pin, AWG18, tot. length 2.5 m, sheathing for 1.5 m. Link between current sensors (CT) and thermal contact on power bridge(s). KPT31 connector	yes		S72763
KPT11 Connector Interface Cable for TPD32-EV-CU	Cable, 10-pin, AWG22, tot. length 2.5 m, sheathing for 1.5 m. Link between pulse transformers. KPT11 15-pin D connector	yes		S72764
KP Connector Adapter Cable for TPD32-EV-CU	Cable, 5-pin, AWG14, tot. length 0.3 m with sheathing. The cable is an adapter to allow a new TPD32-EV-CU-.. control unit to be connected to replace an earlier version of the TPD32 control unit. For KP connector	upon request	"Figure 9.4.3-B: ESE5799 (2/3) - TPD32-EV-CU-" on page 423	S72760
KPT11 Connector Adapter Cable for TPD32-EV-CU	Y-cable, 15-pin, AWG22, tot. length 0.3 m with sheathing. The cable is an adapter to allow a new TPD32-EV-CU-.. control unit to be connected to replace an earlier version of the TPD32 control unit. Connector KPT11 and KPT31 on the TPD32-EV-CU-.. side, KPT11 on the TPD32 side	upon request		S72761

NOTE ! Refer to diagram ESE5799 on page 1/3 for wiring between the power bridge and control unit using the three cables supplied ("Figure 9.4.3-A: ESE5799 (1/3) - TPD32-EV-CU-" on page 422).

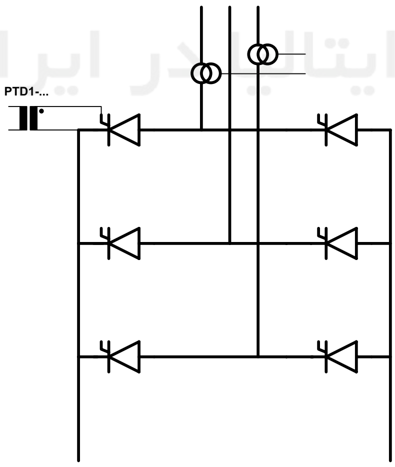
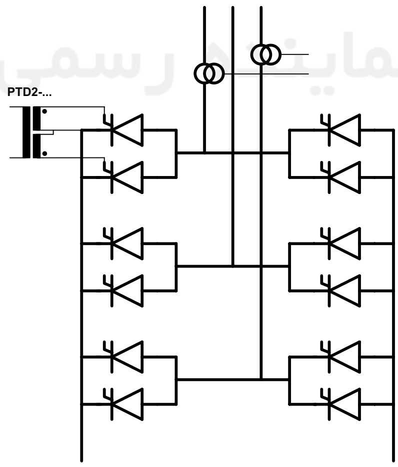
A1.3 Choosing the right model for your application



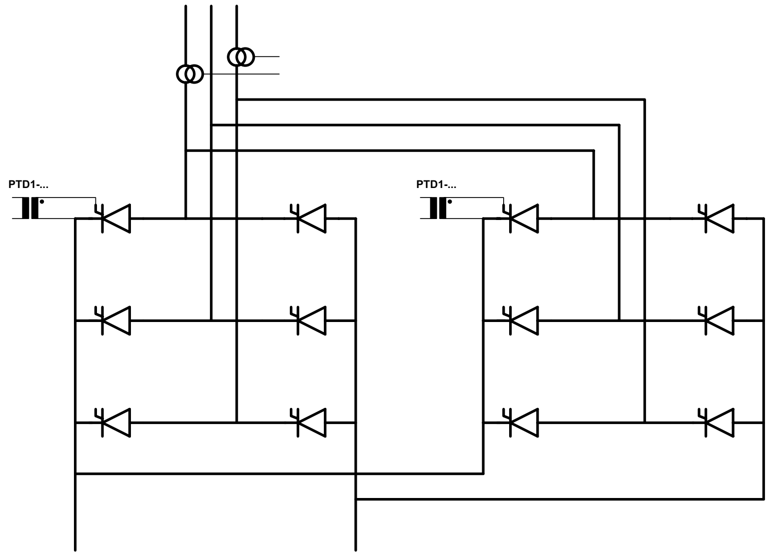
The flow chart illustrates the choice of unit, based on the rated supply voltage, the need to control pulse transformers with one or two secondary windings and the maximum field current requested.

There is no need to make a distinction between two or four-quadrant drives; this is done by configuring jumper S1 on the FIRXP-XX power card. ON=4Q (default), OFF=2Q (see Figure 11.3.5).

The control unit is capable of controlling SCR power bridges with four possible configurations, which must also be taken into account when choosing the appropriate CU with the relative connection cables and pulse transformers. These four possible configurations, referring to two-quadrant bridges, are illustrated below (the same choices apply to four-quadrant bridges). Likewise, the mains voltage and max. field current are not considered..

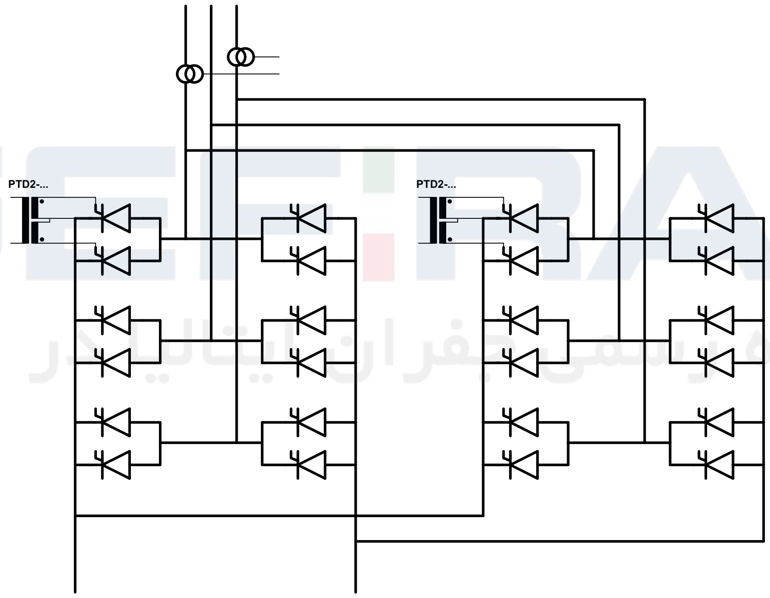
Configuration 1: Single bridge with 1 SCR per branch	Configuration 2: 1 single bridge with 1 SCR per branch in parallel
	
This is regarded as a standard configuration that can be achieved with a TPD32-EV-CU-XXX/XXX-THY1-XX control unit and the cables supplied with it.	This is achieved with the TPD32-EV-CU-XXX/XXX-THY2-XX control unit and the cables supplied with it

Configuration 3: 2 single bridges with 1 SCR per branch in parallel



This is achieved with a TPD32-EV-CU-XXX/XXX-THY1-XX control unit, the cables supplied with it, plus a second KPT11 connector interface cable for TPD32-EV-CU (EAM2764) that is connected to connector KPY21.

Configuration 4: 2 single bridges with 2 SCRs per branch in parallel



This is achieved with a TPD32-EV-CU-XXX/XXX-THY2-XX control unit, the cables supplied with it, plus a second KPT11 connector interface cable for TPD32-EV-CU (EAM2764) that is connected to connector KPT21.

To sum up:

	Power bridge(s)			
	Single bridge with 1 SCR per branch	**Single bridge with 2 SCRs per branch in parallel**	**2 single bridges with 1 SCR per branch in parallel**	**2 single bridges with 2 SCRs per branch in parallel**
Type	TPD32-EV-CU-XXX/XXX-**THY1**-XX	TPD32-EV-CU-XXX/XXX-**THY2**-XX	TPD32-EV-CU-XXX/XXX-**THY1**-XX	TPD32-EV-CU-XXX/XXX-**THY2**-XX
3 Standard cables	yes	yes	yes	yes
Additional cables	no	no	1 x cod. S72764 (EAM2764)	1 x cod. S72764 (EAM2764)
Pulse trans-formers (upon request)	Single bridge with 1 SCR per branch	Single bridge with 2 SCRs per branch in parallel	2 single bridges with 1 SCR per branch in parallel	2 single bridges with 2 SCRs per branch in parallel
State of S2 (*)	Closed (default)	Closed (default)	Cut	Cut

(*) If the Control Unit drives 2 single bridges, open jumper S2 on the FIR4/5P-XX card to correctly read the thermal protector on the second bridge to be connected to terminals 2 and 3 of connector KPT31.

NOTE ! If the NC thermal contact (bimetal thermostat) connected between terminals 1 and 2 is not used, these must be jumpered. Terminal 3 is already jumpered internally with terminal 2 via jumper S2 on the FIRXP-XX power card, as standard. Terminal 4 is not used.

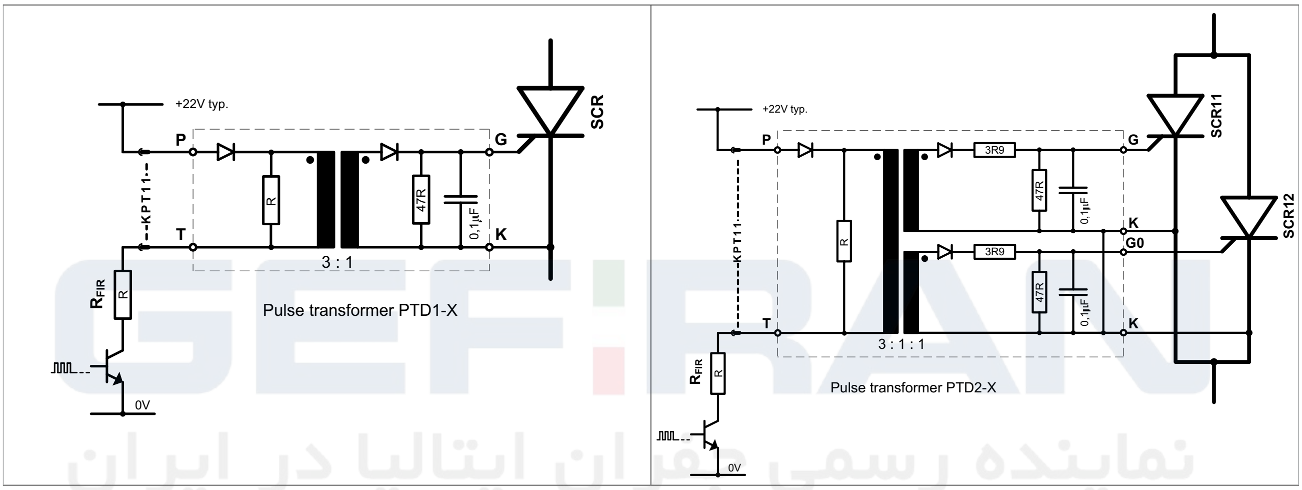
A1.4 Pulse transformers

Pulse transformers with the following characteristics are available upon request:

PULSE TRANS-FORMERS	Electrical diagram and code		Rated working voltage [V_{RMS}]	Imax secondary winding		Transformation ratio (P:S:S)
				[A]	[A_{RMS}]	
PTD1	ESE5948-1	S5C370	500	1.2 Peak	0.75	3 : 1
PTD2	ESE5948-2	S5C371	500	1.2 Peak	0.5	3 : 1 : 1
PTD1-1	ESE5948-3	S5C372	750	1.2 Peak	0.75	3 : 1
PTD2-1	ESE5948-4	S5C373	750	1.2 Peak	0.5	3 : 1 : 1
PTD1-1K	ESE5948-5	S5C374	1000	1.2 Peak	0.75	3 : 1
PTD2-1K	ESE5948-6	S5C375	1000	1.2 Peak	0.5	3 : 1 : 1

Start-up pulses are "pulse trains" with a total duration of 1 ms and frequency of approx. 12 kHz. RFIR resistors are dimensioned to have peak gate current values of between 600 mA and 900 mA..

Figure A1.4.1: Typical connection for PTDX-X transformers



A1.5 Current transducers (CT or TA)

The armature current of the motor is measured by two AC current transducers inserted on the line side of the power bridge; see, for example, ("Figure 9.4.4: ESE5771 TPD32-EV-CU-230...690-THY1-XX_1" on page 425).

Transducers with different primary/secondary current ratios are available on the market and can be used with the CU. The TPD32-.. series uses a CT with standard current values of 0.4 A or 0.5 A on the secondary winding.

We recommend the use of current transducers with a secondary current of not more than 1 A.

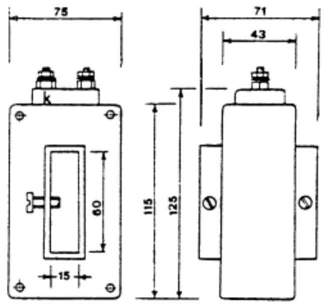
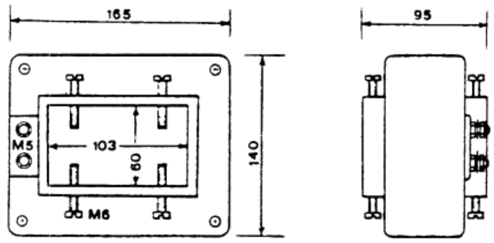
Some of the current transducers available upon request are listed below with the relative technical data:

TAS2-1600A/0.4A used for 1000A ≤ IdN ≤ 1800A (code S7H22)
TAS2-2400A/0.5A used for 2000A ≤ IdN ≤ 2700A (code S7H23)
TAS3-4000A/0.5A used for 2900A ≤ IdN ≤ 3300A (code S7H30)

Electrical data

Type	Rated voltage and frequency	Winding ratio	Rated primary current	Rated secondary current	Rated power	Maximum bar opening	Measurement accuracy class
TAS2-1600A/0.4A	700V_{RMS} 40 ... 60Hz	1:4000	1600A	0.4A	20VA	60mm x 15mm [2.36" x 0.59"]	1
TAS2-2400A/0.5A		1:4800	2400A	0.5A	20VA	60mm x 15mm [2.36" x 0.59"]	1
TAS3-4000A/0.5A		1:8000	4000A	0.5A	≥ 20VA	103mm x 60mm [4.05" x 2.36"]	1

Mechanical dimensions:

TAS2	TAS3
	

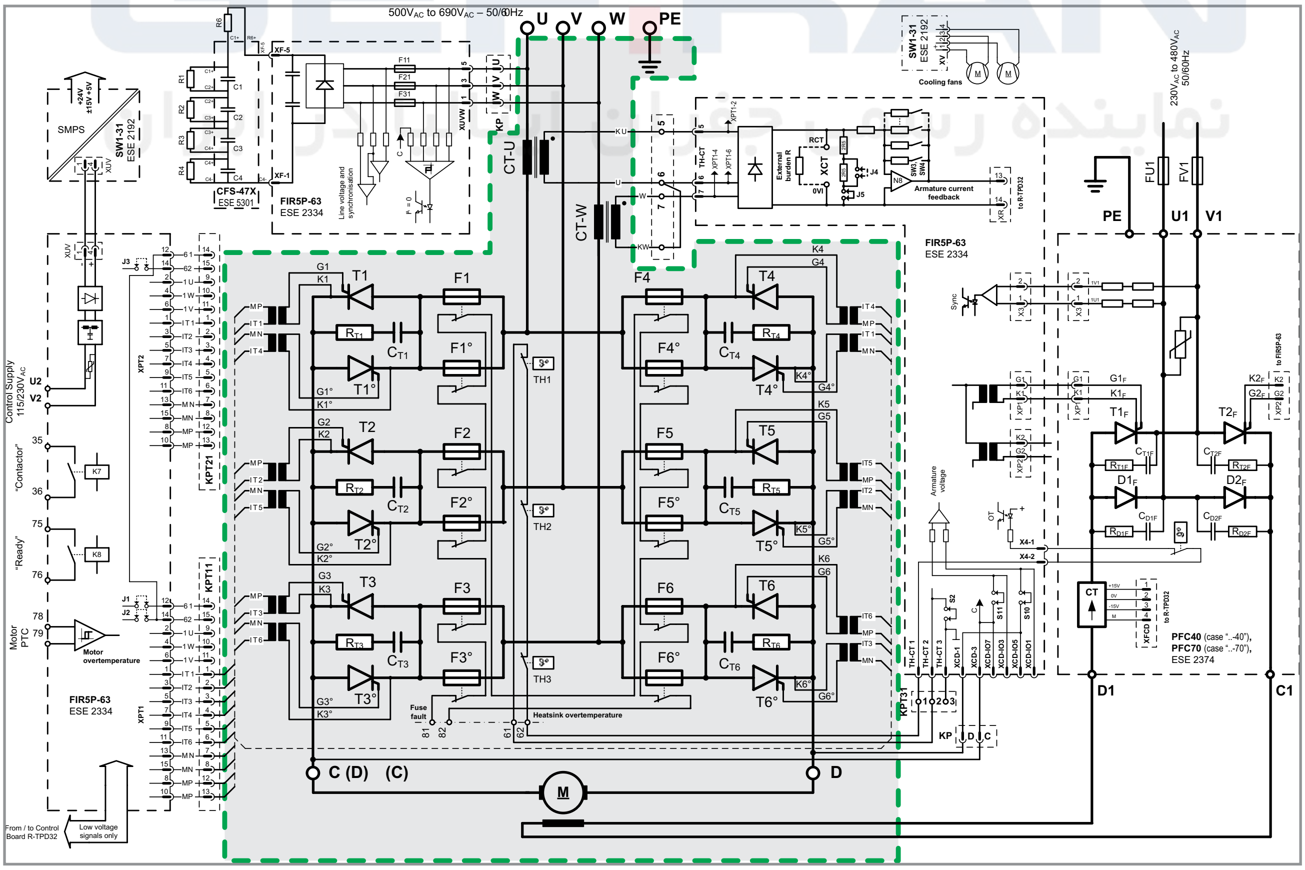
A1.6 Installation, connection and configuration

A1.6.1 Assembly

See chapter "3.3 Mounting the device" on page 61.

A1.6.2 Electrical connections

The block diagram below shows the typical connection of a CU with a 4Q SCR bridge. Parts shown inside the grey area are NOT part of the TPD32-EV-CU-….



For further details, see "Figure 9.4.4: ESE5771 TPD32-EV-CU-230...690-THY1-XX_1" on page 425 , "Figure 9.4.5: ESE5771 TPD32-EV-CU-230...690-THY1-XX_2" on page 426) , "Figure 9.4.3-A: ESE5799 (1/3) - TPD32-EV-CU-" on page 422.

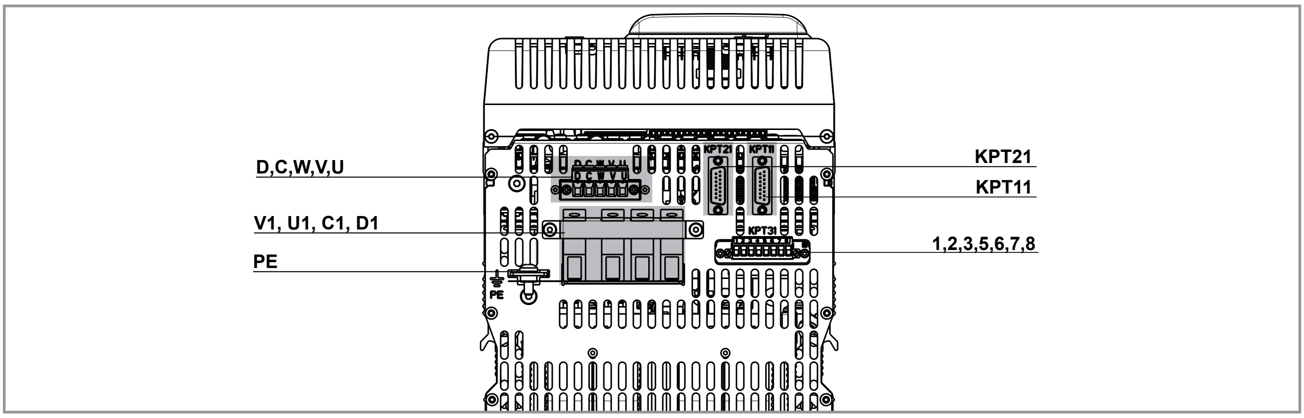
Field circuit and ground connection

The unit contains a semi-controlled single-phase motor field power supply circuit. As shown, the input and output connections are in the lower part.

We recommend the use of an adapter transformer for the input power supply to terminals U1-V1. The fuses listed in the table are mandatory.

Use dip-switches S14 on the regulation card to set the field current full scale value, see "Table 2.3.3.4-F: Field current resistors Sizes TPD32-EV-CU-..." on page 32

Figure A1.6.1: Position of terminals



Cable cross-sections and tightening torque

Terminal	Function	Min. cable cross-section	Max. cable cross section	Tightening torque
U1, V1	AC power input	10 mm^2 (10AWG)	25 mm^2 (2AWG)	4 …4.5 Nm
C1, D1	Motor field DC power output			
PE	Protective earth	10 mm^2 (8AWG)	16 mm^2 (6AWG)	6 …8 Nm

The protective earth PE connector must be connected to the system's ground circuit according to the laws in force.

Recommended field fuses (FU1, FV1) and fuse holders

Rated field current	Type of fuse (cylindrical, 22x58 mm)			
	Bussmann	Ferraz-Shawmut (Mersen)	Siba	Code
40A	FWP-50A22Fa	A70QS50-22F	5014006.50	F4M15
70A	FWP-100A22Fa	A70QS100-22F	5014006.100	F4M21
Fuse holders	Bussmann CH222D or Ferraz-Shawmut US222 (Ref. L227940)			S85B9

Interface with three-phase power supply (mains) and motor armature voltage

The CU requires a mains voltage and armature voltage feedback from the controlled power bridge. It is connected to terminals U V W and C D, respectively, of the KP connector. As mentioned previously, the CU is supplied with a specific cable already fitted with the relative KP connector at the CU end and free conductors at the other end ("KP connector interface cable for TPD32-EV-CU", EAM2762).

Terminal	Function	Min. cable cross-section	Max. cable cross section	Tightening torque
U, V, W	Mains voltage feedback	0.2 mm^2 (24AWG)	6 mm^2 (10AWG)	0.7 …0.8Nm
C, D	Armature voltage feedback	Recommended : 2.5 mm^2 (14 …12AWG)		

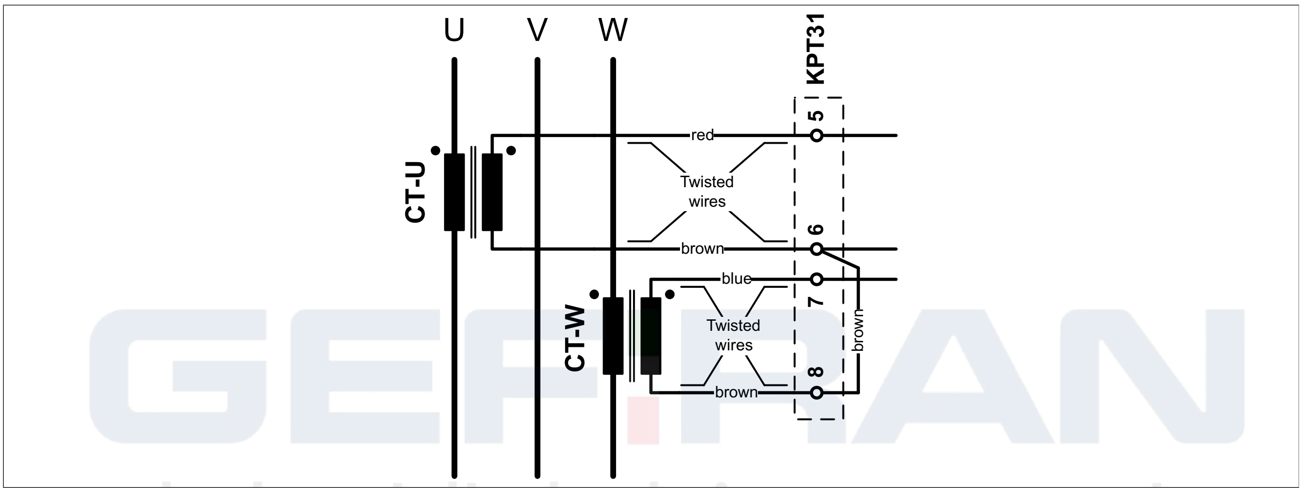
Connection of current transducers and thermal switch(es)

The secondary windings of the two AC current transducers and any thermal circuit breakers (bimetal thermostats) on the power bridges are connected to the KPT31 connector. A specific cable already fitted with the relative KPT31 connector at the CU end and free conductors at the other end is supplied ("KPT31 connector interface cable for TPD32-EV-CU", EAM2763).

Terminal	Function	Min. cable cross-section	Max. cable cross section	Tightening torque
1, 2, 3 *	Connection of bimetal thermostats	0.25 mm² (24AWG)	2.5 mm² (12AWG)	0.5 …0.6Nm
5, 6, 7, 8	CT connection	Recommended : 1 mm² (18AWG)		

NOTE ! If the NC thermal contact (bimetal thermostat) connected between terminals 1 and 2 is not used, these must be jumpered. Terminal 3 is already jumpered internally with terminal 2 via jumper S2 on the FIRXP-XX power card, as standard. Terminal 4 is not used.

Detail of connection of current transducers:



Connection of pulse transformers

The primary circuits of the pulse transformers are connected to connector KPT11 (and KPT21, where applicable) for switching the SCRs on. A specific cable already fitted with the relative KPT11 connector at the CU end and free conductors at the other end is supplied ("KP11 connector interface cable for TPD32-EV-CU", EAM2764). For details of wiring, see ESE5771 showing the connection of a 4Q bridge (reversible). With a 2Q bridge, the two conductors labelled "MN" are not used. Their free end must therefore not be connected but electrically isolated.

Regulation power supply

As for the entire TPD32-EV-… series, the regulation power supply is connected to terminals U2-V2 on the FIRXP-XX power card. To access this, remove the plastic cover at the bottom.

This card also contains terminals 35-36, 75-76 and 78-79 which have the same function on all units in the TPD32-EV-.. series and have already been described in chapter "4.4 Regulation Section" on page 69.

Cable cross-sections and tightening torque

Terminal	Function	Min. cable cross-section	Max. cable cross section	Tightening torque
U2, V2	Regulation power supply	0.25 mm² (24AWG)	2.5 mm² (12AWG)	0.5 …0.6 Nm
35, 36	Contact OK Relay			
75, 76	Relay 2 contact			
78, 79	Motor thermistor			

Electrical data for all of the terminals and connectors listed

Connector	Terminal	Function	IN/OUT	Voltage	Current
-	U1, V1	Motor field circuit AC power input	IN	1 x 230 …460A_{AC}, 50/60Hz	40 / 70A_{AC}
	C1, D1	Motor field DC power output	OUT	0 …360V_{DC}	40 / 70A_{DC}
KP	U, V, W	Mains voltage feedback	IN	3 x 230 …690A_{AC}, 50/60Hz	200mA
	C, D	Armature voltage feedback	IN	0 …810V_{DC}	10mA
KPT31	1, 2, 3	Connection of bimetal thermostats	IN	-----	4mA
	5, 6, 7, 8	CT connection	IN	-----	0 …5A_{AC}
KPT11, KPT21	15 poli Sub-D	Pulse transformer primary winding side circuits	OUT	-----	1A peak
XM	U2, V2	Regulation power supply	IN	1 x 115/230A_{AC}, 50/60Hz	1/0.5A_{AC}
	35, 36	Contact OK Relay	OUT	250A_{AC} max	1A AC11
	75, 76	Relay 2 contact	OUT	250A_{AC} max	1A AC11
	78, 79	Motor thermistor	IN	-----	-----
XCT	0VI, 0VI, RCT, RCT	Connection of external CT burden resistor with secondary current of >1 Aac (see "A1.6.3 Configuration of the armature current feedback circuit" on page 483)	OUT	-----	5A max

Dissipated power

See "Table 2.5.2: Dissipated power TPD32-EV-CU series" on page 57.

Regulation and control section

General information is provided in chapter "4.4 Regulation Section" on page 69.

R-TPD32 regulation card:

- Dip-switch S15, see "Table 4.4.2-B: Dip-switch S15 Adjustment of the TPD32-EV-CU-... series mains voltage regulation card" on page 71.
- Dip-switch S14, see "Table 2.3.3.4-F: Field current resistors Sizes TPD32-EV-CU-..." on page 32.

A1.6.3 Configuration of the armature current feedback circuit

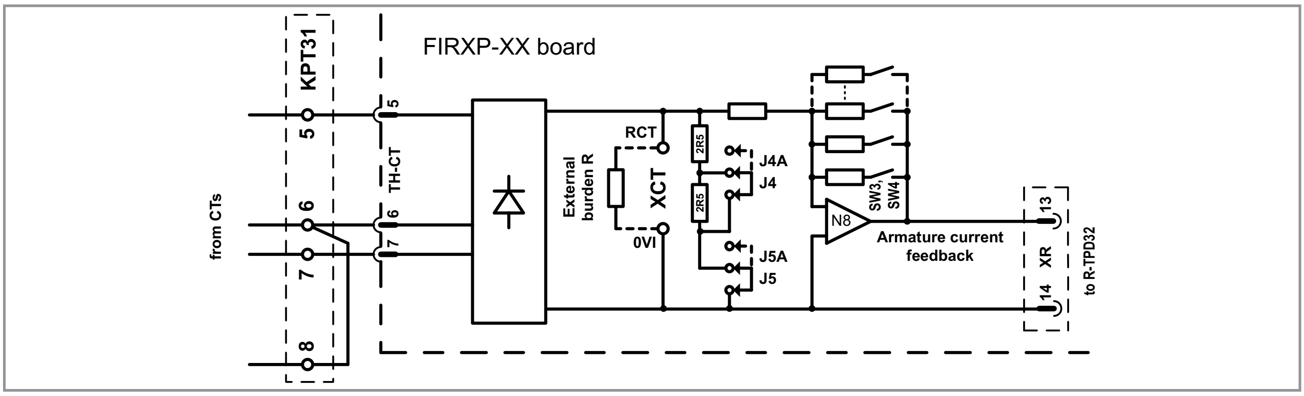
Overview

The current feedback signal is sent to the control unit by two current transducers (CT) inserted on phases U and W of the controlled power bridge. It is rectified on the FIRXP-XX card by a three-phase diode bridge and applied to a burden resistor that converts it into a voltage signal proportional to the DC motor current value. This is then applied to the armature current regulator which compares it with the reference value.

The standard FIRXP-XX card offers a choice of two burden resistor (RB) values, 2.5 Ohm or 5 Ohm, which are suitable in the majority of cases. Otherwise an external burden resistor can be used, connected between terminals RCT and 0VI.

In order to enable precise adjustment to the many possible rated current values (size of the controlled power bridge), a programmable gain amplifier (N8) is inserted between the burden resistor and the current regulator. The gain is set by means of a 12-bit binary number selected with dip-switches S3 and S4.

Figure A1.6.3.1: Detail of circuit



If the secondary current of the CTs installed is < 1 A, the 2.5 Ohm or 5 Ohm burden resistors already provided on the card can be used; for secondary currents of >1 A and < 5 A the burden resistor must be connected between terminals RCT and 0VI, excluding the internal resistors. In table form:

	CT secondary current		
	< 0.5A	**> 0.5A, < 1A**	**> 1A, < 5A**
Jumper J4	J4A (OFF)	J4 (ON)	irrelevant
Jumper J5	J5 (ON)	J5 (ON)	J5A (OFF)
Ext. resistor RCT	Not connected	Not connected	See example of calculation
R resulting load (Rb)	5 Ohm	2.5 Ohm	

Note: Sometimes, especially in revamping projects, current transducers with a 5 A secondary current may already be installed on the power bridges. It is still possible to use just the internal resistors: simply insert two more 5 A/1 A or 5 A/0.5 A current transducers, although this could affect the ultimate accuracy of current measurement.

- At 100% of the drive's rated current (IdN), the average reaction voltage, applied between pins XR-13/XR-14 (0 V) is **0.612 V**.
- Dip-switch S3-1 represents the most significant bit (MSB) and dip-switch S4-8 the least significant bit (LSB). A closed switch ("ON") means binary value 1, an open switch ("OFF") means 0. In graph form

SW3-1	SW3-2	SW3-3	SW3-4	SW4-1	SW4-2	SW4-3	SW4-4	SW4-5	SW4-6	SW4-7	SW4-8
bit 11 **MSB**	bit 10	bit 9	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0 **LSB**

- The maximum gain of the amplifier is 51.2 (in actual fact –51.2) and the minimum gain is 0.0125005 with possible values of 212 – 1.
- The binary configuration 00....000 (all S3 and S4 switches open), is not allowed!
- The relation between amplifier gain ("Gain_required") and binary number ("Binary_switch_setting") is given by:

$$\textit{Binary\_switch\_setting} = \frac{1}{\textit{Gain\_required}} \times 51.2 = \frac{51.2}{\textit{Gain\_required}}$$

Clearly, only the whole number of the result of the above equation is converted into a binary number.

The variables used in the following examples of calculation are:

- Id_N = drive armature rated current in A;
- CT = current transducer with a transformation ratio of: Iprim/Isec;
- Rb = burden resistor in Ohm;
- $Vf@Id_N$ = reaction voltage at armature rated current: 0.612 V;
- $Vb@Id_N$ = reaction voltage on the burden resistor at the rated armature current in V.

Valid formulas

Vb@IdN = (IdN / (Iprim / Isec)) x Rb and Gain_required = Vf@IdN / Vb@IdN.

Calculation example A

IdN = 2000A, CT = 2400A / 0.5A; Rb = 5 Ohm.

Vb@IdN = (IdN / (2400 / 0.5)) x Rb = (2000 / 4800) x 5 = 2.08333V;

Gain_required = Vf@IdN / Vb@IdN = 0.612 / 2.08333 = 0.29376; therefore

Binary_switch_setting = 51.2 / 0.29376 = 174.29 which is rounded off to 174 and converted into binary format as **000010101110**. i.e.:

SW3-1	SW3-2	SW3-3	SW3-4	SW4-1	SW4-2	SW4-3	SW4-4	SW4-5	SW4-6	SW4-7	SW4-8
OFF **MSB**	OFF	OFF	OFF	ON	OFF	ON	OFF	ON	ON	ON	OFF **LSB**

Calculation example B (extreme case)

IdN = 85A, CT = 2000A / 1A; Rb = 2.5Ohm.

Vb@IdN = (IdN / (2000 / 1)) x Rb = (85 / 2000) x 2.5 = 0.10625V;

Gain_required = Vf@IdN / Vb@IdN = 0.612 / 0.10625 = 5.76; therefore

Binary_switch_setting = 51.2 / 5.76 = 8.88888 rounded off to 9 and converted into binary format as **000000001001**.

Calculation example C

IdN = 16000A, CT = 20000A / 5A;

Using an internal 2.50-Ohm RB, inserting a second CT2 with a ratio of 5 A/1 A.

The new Iprim/Isec is the total of 20000 A / 1 A;

Vb@IdN = (IdN / (20000 / 1)) x Rb = (16000 / 20000) x 2.5 = 2V;

Gain_required = Vf@IdN / Vb@IdN = 0.612 / 2 = 0.306; therefore

Binary_switch_setting = 51.2 / 0.306 = 167.32 rounded off to 167 and converted into binary format as **000010100111**.

Calculation example D

Burden resistor connected to terminals XCT and CT with a 5 A secondary current. Applying the same criteria for the burden resistor, the ideal burden resistor value is 2.5 Ohm / 5 = 0.5 Ohm. The nearest value for the EIA E96 series is 0.499 Ohm ±1% but the more commonly used 47 Ohm ±1% can of course also be used.

IdN = 8000A, CT = 10000A / 5A, Rb = 0.47Ohm.

Vb@IdN = (IdN / (10000 / 5)) x Rb = (8000 / 2000) X 0.47 = 1.88V;

Gain_required = Vf@IdN / Vb@IdN = 0.612 / 1.88 = 0.3255319149; therefore

Binary_switch_setting = 51.2 / 0.3255319149 = 157.281; rounded off to 157 and converted into binary format as **000010011101**.

Note: When choosing the external burden resistor, bear in mind the possibility of substantial power dissipation. In this example, the power at the rated current is already approx. $(1.88)^2$ / 0.47 = 7.5 W without taking into account any overload conditions or the advisability of not using resistors at more than half of their rated power.

Table A.1.6.3.1: Calculation of the configuration of dip-switches SW3-1 to SW4-8 for standard TPD32-EV-.. drives with external bridge

Rated armature current [Adc]	CT transformer	Jumper J4 (on the FIRXP-XX card) (Rb=5Ω)	Jumper J5 (on the FIRXP-XX card)	Vb@IdN [Vdc]	Gain required	Binary switch setting	Binary number	SW3-1, ..SW3-4, SW4-1, ..SW4-8 (on the FIRXP-XX card) [MSB … LSB]
1000	1600/0.4	OFF	ON	1.250000	0.489600	105	1101000	**000001101000**
1010	1600/0.4	OFF	ON	1.262500	0.484752	106	1101001	**000001101001**
1200	1600/0.4	OFF	ON	1.500000	0.408000	125	1111101	**000001111101**

1400	1600/0.4	OFF	ON	1.750000	0.349714	146	10010010	**000010010010**
1500	1600/0.4	OFF	ON	1.875000	0.326400	157	10011100	**000010011100**
1700	1600/0.4	OFF	ON	2.125000	0.288000	178	10110001	**000010110001**
1800	1600/0.4	OFF	ON	2.250000	0.272000	188	10111100	**000010111100**
2000	2400/0.5	OFF	ON	2.083333	0.293760	174	10101110	**000010101110**
2400	2400/0.5	OFF	ON	2.500000	0.244800	209	11010001	**000011010001**
2700	2400/0.5	OFF	ON	2.812500	0.217600	235	11101011	**000011101011**
2900	4000/0.5	OFF	ON	1.812500	0.337655	152	10010111	**000010010111**
3300	4000/0.5	OFF	ON	2.062500	0.296727	173	10101100	**000010101100**

Position on the FIRXP-XX card: see "Figure 11.3.5: FIR4/5P-XX power/driver card" on page 473.

A1.6.4 Using the control unit as a replacement part

The TPD32-EV-CU-… can also be used as :

- a replacement part for TPD32-… “external bridge” control units previous series,
- a replacement part for TPD32-EV-...-E series.

Having identified the appropriate TPD32-EV-CU-… according to the mains voltage, field rated current, type of pulse transformer (for all standard drives up to 3300 A the correct type is “THY1”), configure the dip-switches as shown in tables "Table 11.3.6: Selection of dip-switches “S3-XX” and “S4-XX” for FIR4/5P-XX cards." on page 474 and "Table A.1.6.3.1: Calculation of the configuration of dip-switches SW3-1 to SW4-8 for standard TPD32-EV-.. drives with external bridge" on page 485 above.

Insert two EAM2760 and EAM2761 adapter cables between the two KP and KPT11 cables connected to the existing power bridge and the new TPD32-EV-CU-…. Connect these adapter cables to connectors KP, KPT31 and KPT11 on the new control unit as shown "Figure 9.4.3-B: ESE5799 (2/3) - TPD32-EV-CU-" on page 423.

A1.7 DC Converter size management

This function makes the CU universal and unrelated to the size of the external power bridge to be controlled.

Use this procedure to use a control unit with an external bridge not included in the Gefran catalogue.

1) Configure dip-switch S15 on the CU regulation card:

Standard	American	S15-8	S15-7	S15-6	S15-5	S15-4	S15-3	S15-2	S15-1
TPD32-EV-CU-230/500-....-....	**TPD32-EV-CU-230/500-....-....**	OFF	ON	ON	ON	ON	ON	ON	ON
TPD32-EV-CU-575/690-....-....	**TPD32-EV-CU-575/690-....-....**	ON	OFF	ON	ON	ON	ON	ON	ON

2) The default values of the following parameters are set automatically:

- Drive Size (IPA 465) = Full load curr (IPA 179) = 4
- Nom flux curr (IPA 374) = 1
- Inertia (IPA 1015) = 10
- Friction (IPA 1014) = 0.001

3) Modify the **Drive Size** parameter (IPA 465) to set the desired size directl.

IMPORTANT: In this configuration the max. I2t overload areas are always calculated as 150% of **Full load curr** x 60 seconds for motor overload and 150% of **Drive size** x 60 seconds for drive overload.

IMPORTANT: The **Size selection** parameter (IPA 464) cannot be set in this configuration.

Modifications to parameters with respect to chapters "6.11.6 “Standard / American” selection, Software Version" on page 193 and "10 - Parameter Lists" on page 427 :

Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
CONFIGURATION \ Drive type										
Drive size [A]	465	U16	4	20000	Disable	Disable	✓	R	-	R/Z

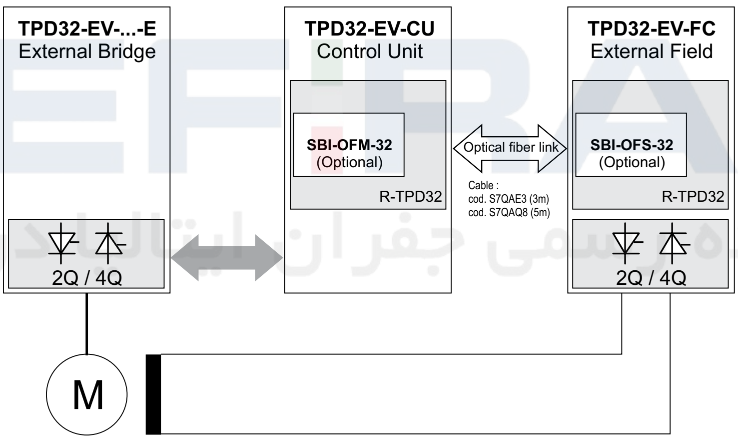
A1.8 External Three-phase Field Exciter Control by TPD32-EV-FC

If a higher than standard nominal value of motor field current is required, you can use the TPD32-EV-FC external field exciter.

With the TPD32-EV-FC field exciter, dynamic control of four-quadrant systems is also possible with a two-quadrant power and control circuit (in the 2B+e configuration) connected to the armature: this is done by inverting the polarity of the excitation circuit current connected to a four-quadrant bridge.

For details, see Appendix 2.

Figura A1.8.1: Block diagram of Field exciter control



APPENDIX 2 - TPD32-EV-FC: FIELD CONTROL UNIT

Compatibility of TPD32-EV firmware version combined with TPD32-EV -FC:

	TPD32-FC FW 10.26 and lower	TPD32-FC FW 11.20 and higher
TPD32EV FW 10.08 and lower	YES	YES
TPD32EV FW 11.00 and higher	NO	YES

Functions/parameters that differ from those of the standard version V. 11.0X (TPD32-EV):

Preliminary operation

NOTE: During the TPD32-EV -FC unit commissioning, the user has to set the parameter [162] **Motor max speed** (START UP / Motor Data menu) with the same numerical value of parameter [1175] **Max out voltage** (START UP / Motor Data menu).

A2.1 Current regulation (CURRENT REGULAT)

In the TPD32-EV-FC version there is a PI regulator instead of a predictive current regulator.

This section replaces that in chapter "6.8 Current regulation (Current regulat)" on page 174.

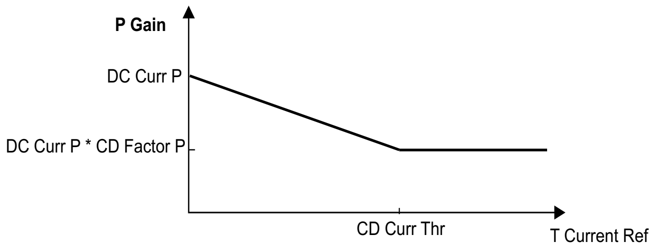
CURRENT REGULAT

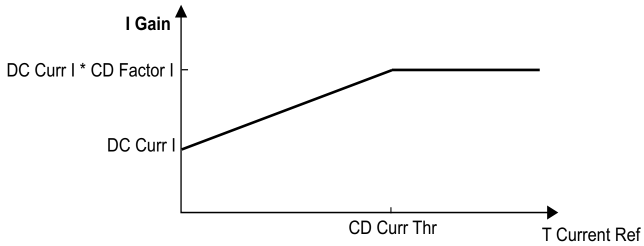
[1520]	dI/dt delta time
[453]	Arm resistance [ ]
[454]	Arm inductance [mH]
[838]	CD curr thr [%]
[839]	CD factor P
[840]	CD factor I
[915]	Autotune
[1526]	Autotune Status
[353]	Zero torque

Parameter	No.	Format	Value min	Value max	Value Factory	Access via Keyp.	Access via RS485/BUS/ Opt2-M	Access via Term.	Access via Opt2-A/ PDC
CURRENT REGULAT									
dI/dt delta time	1520	U16	0	100	0	✓	R	QA	R
Arm resistance [ohm]	453	Float	0	S	0.0	✓	R/W	-	-
Arm inductance [mH]	454	Float	S	S	0.41	✓	R/W	-	-
CD curr thr [%]	838	Int16	0	200	100	✓	R/W	-	-
CD factor P	839	Float	0.001	100 / DC Curr P (P847)	0.3	✓	R/W	-	-
CD factor I	840	Float	0	100 / DC Curr I (P848)	0.3	✓	R/W	-	-
Autotune	915	U16	0	65535		✓	C	-	-
Autotune Status Not executed (0) In progress (1) Success (2) Aborted (3) No current (4) Gain calc err (5) Drive Failure (6) Timeout (7)	1526	U16				✓	R	-	-
Zero torque Active Not active	353	U16	0	1	Not active (1)	✓	R/W 0 1	ID L H	R/W

NOTE: In the "FC" version the **Arm resistance** (IPA 453) and **Arm inductance** (IPA 454) parameters must not be modified.

CD curr thr	Reference value of current used as limit point on gain ramps, as indicated in the figures below.
CD factor P	Proportional gain multiplication factor for **T current ref > CD curr thr** (see figures below).
CD factor I	Integral gain multiplication factor for **T current ref > CD curr thr** (see figures below).
Autotune	Commands autotuning of the PI current regulator (see description of autotuning below)
Autotune Status	Indicates the autotuning status of the PI current regulator. The value “Not executed” indicates that autotuning has never been run (value parameter assumes at power on), the value “In progress” indicates that autotuning is running, the value “Success” indicates that the last time autotuning was run it ended successfully. The other values indicate that the last time autotuning was run it ended with an error (for the type of error corresponding to the various values, see the description of the autotuning procedure below).





A2.2 Regulator parameters (REG PARAMETERS)

This section modifies chapter "6.10 Reg Parameters" on page 180:

- addition of **DC Curr PI reg** menu (after the **Speed regulator** menu),
- addition of parameters to the **In use values** menu.

REG PARAMETERS

Percent values

Speed regulator

[...]	....

DC Curr PI reg

[847]	DC Curr P
[848]	DC Curr I
[849]	DC Curr P base
[850]	DC Curr I base

Flux regulator

[...]	...

Voltage reg

[...]	...

Base values

....

In use values

[...]	...
[845]	Curr P in use [%]
[846]	Curr I in use [%]

Parameter	No.	Format	Value			Access via			
			min	max	Factory	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
REG PARAMETERS \ Percent values \ DC Curr PI reg									
DC Curr P	847	Float	0	100 / CD factor P (P839)	0.5	✓	R/W	-	-
DC Curr I	848	Float	0.0	100 / CD factor I (P840)	30	✓	R/W	-	-
DC Curr P base	849	Float	0.001	Pmax	0.98 * Pmax (*)	✓	R/Z	-	-
DC Curr I base	850	Float	0.01	Imax	0.45 * Imax (*)	✓	R/Z	-	-

(*) For calculations performed internally by the configurator: Pmax = 360 * (2000 / IPA465) * (2^4 / 2^{15}); Imax = 360 * (2000 / IPA465) / 2^2 * f_vecon / 2^{15}). f_vecon = 24009.6.

DC curr P Proportional gain (as percentage of **DC Curr P base)** for **T current ref** = 0.

DC Curr I Integral gain (as percentage of **DC Curr I base**) for **T current ref** = 0.

DC curr P base Default proportional gain in physical units.

DC Curr I base Default integral gain in physical units.

Parameter	No.	Format	Value			Access via			
			min	max	Factory	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
REG PARAMETERS \ In use values									
Curr P in use [%]	845	Float	0.0	100.0	S	✓	R	-	-
Curr I in use [%]	846	Float	0.0	100.0	S	✓	R	-	-

Curr P in use Display of proportional gain of current regulator in use as a percentage of **DC Curr P base**.

Curr I in use Display of integral gain of current regulator in use as a percentage of **DC Curr I base**.

A2.3 Autotune function of PI current regulator

The autotune procedure for the current regulator calculates the best gain values for the PI regulator. The procedure can be used only when the drive is connected to a highly inductive load.

The autotune procedure can be launched from GF_eXpress (Parameter P915 **Autotune** on the CURRENT REGULATOR menu) or from the keypad via **Autotune** on the CURRENT REGULATOR menu. In order to run autotune, the control method must be set to **Digital – Local** and the **Enable** and **Start** contacts must be closed.

When the procedure is launched from the keypad, the message "Start?" is displayed first. Press **Enter** to start the procedure; press **CANC** to abort.

Whether the procedure is launched from the keypad or from GF_eXpress, when running its status is displayed on the keypad and via the P1526 **Autotune Status** parameter

During normal running of autotuning, the keypad displays the message "Curr reg tuning" and the value of P1526 is set to 1 (In progress). If everything goes well, when the procedure ends the keypad displays the messages "Ready" and "End curr tune" and parameter P1526 is set to 2 (Success).

The autotune procedure can be interrupted before it ends by pressing the **CANC** button on the keypad or from GF_eXpress by clicking the **Disable** button on the Control Panel.

If the autotune procedure does not end correctly (due either to error events during the procedure or to interruption commanded by the user) the PI parameters are reset to the values present before the procedure was started, otherwise they are overwritten with the new values calculated.

In addition to the messages shown above regarding cases in which the procedure begins and ends correctly, the keypad may also display the following messages:

"No current"	This message is displayed if, during the autotune procedure, the regulation cannot be activated or if current is not calculated (not even with a proportional gain value of 100%). This event may be caused by the following: - Field is physically disconnected from drive - **DC Curr P base** value too low - Enable and/or Start contacts open - Autotune procedure interrupted from GF_eXpress via **Disable** button on Control Panel - Failure causing disabling of drive Following these events, parameter P1526 is set to 4 (No current).
"Tuning aborted"	This message is displayed if the autotune procedure is interrupted by pressing the **CANC** key on the keypad. The message remains displayed for a few seconds, after which the message "End curr tune" is displayed. In addition, following this event, parameter P1526 is set to 3 (Aborted).
"Gains calc error"	This message is displayed if the autotune procedure encounters problems in reading the best gains, especially integral gain. This is typically due to an excessively high **DC Curr I base** value, so that in this case it is advisable to lower such value and repeat the autotune procedure. In addition, following this event, parameter P1526 is set to 5 (Gain calc err).
"Drive Failure"	This message is displayed if an alarm trips during the autotune procedure or is present before it is run. Following this event, parameter P1526 is set to 6 (Drive Failure).
"Time out"	This message is displayed if the autotune procedure does not end by the maximum allowed time (50 minutes). Following this event, parameter P1526 is set to 7 (Timeout).
"Set Main cmd=Dig"	This message is displayed if the autotune procedure is launched with parameter 252 **Main Commands** set to Terminals.
"Set Ctrl=Local"	This message is displayed if the autotune procedure is launched with parameter 253 **Control mode** set to **Bus**.

The autotune procedure tries to calculate the best values of parameters **CD factor P**, **CD factor I**, **DC Curr P** and **DC Curr I**, which allow a good compromise between fast current dynamics and limited overshoots. Parameter **CD curr thr** is set to 100. Parameter **DC Curr P base** and **DC Curr I base** are not changed.

Notes:

- If the nominal current of the connected field is significantly below the size of the drive, the values of **CD factor P** and **CD factor I** are set to 1.
- If the values of **DC Curr I** or **DC Curr I** * **CD factor I** are equal to or near 100 at the end of the procedure, you should raise the value of **DC Curr I base** (if not already at maximum) and repeat the procedure. On the other hand, if **DC Curr I** is low (below 10), you should lower the value of **DC Curr I base** and repeat the procedure.
- In some cases, especially if the nominal current of the field is less than half the size of the drive, there may be lengthy (or improvable) rise times starting from zero current for reference values below 100% with gains settings calculated by the autotune procedure. In this case, these times may be improved as follows:
    a. Increase the value of **DC Curr I** by changing **CD factor I** in order to keep the value of **DC Curr I** * **CD factor I** constant.
    b. Decrease the value of **DC Curr P** by changing **CD factor P** in order to keep the value of **DC Curr P** * **CD factor P** constant.

A2.4 Digital Outputs

This section modifies chapter "6.12.3 Digital Outputs" on page 216.

- Added selections needed for "**Ext wired FC**":

Digital output XX Selection of the parameter that is assigned to the digital output concerned. The following assignments are possible:

OFF	0	**Pad B bit**	19	**Brake comand** [2]	42
Speed zero thr	1	**Virt dig input**	20	**Brake failure** [3]	63
Spd threshold	2	**Torque sign**	21	**Mot ovrld preal** [4]	65
Set speed	3	**Stop control**	23	**Dvr ovrld preal** [5]	66
Curr limit state	4	**Field loss**	24	**Dvr ovrld avail** [7]	67
Drive ready	5	**Speed fbk loss**	25	**I2t mot ovrld fail** [8]	68
Mot ovrld avail [6]	6	**Bus loss**	26	**I2t drv ovrld fail** [9]	69
Overload state	7	**Hw opt1 failure**	28	**Mot cur threshld** [10]	70
Ramp +	8	**Opt2 failure**	29	**Overspeed** [11]	71
Ramp -	9	**Encoder 1 state**	30	**Delta frequency** [12]	72
Speed limited	10	**Encoder 2 state**	31	**Drv rdy to start** [14]	76
Undervoltage	11	**Enable seq err**	35	**BUS control mode** [15]	77
Overvoltage	12	**Diameter calc st** [1]	38	**SSC Error** [16]	
Heatsink	13	**Drive healthy** [13]	42	**Wired FC Enabled** [17]	80
Overcurrent	14	**Input 1 cp match**	49	**Wired FC Inv Seq** [18]	81
Overtemp motor	15	**Diam reached**	58	**Wired FC Act Brg** [19]	82
External fault	16	**Spd match compl**	59	**Firing**	83
Failure supply	17	**Acc state**	60	**Cont Current**	84
Pad A bit	18	**Dec state**	61		

17) Enables field control by TPD32-EV-FC via standard I/O.
18) Indication if field control is during inversion sequence
19) Indication of the actual active bridge (positive or negative) of the FC unit.

Note: For the operation of the FC unit by using external I/O signals, the three digital outputs of the FC unit, configured as indicated in section "A2.5.2 Connection between TPD32-EV-CU and TPD32-EV-FC units via external I/O" on page 495, must be connected to the digital inputs of the CU configured in the same way. In addition, the analog output of the CU configured as "**Field cur ref**" must be connected to an analog input unit configured as FC "**T current ref 1**."

A2.5 External Three-phase Field Exciter Control

CONFIGURATION		
	[...]	....
	[1522]	En ext digit FC
	[914]	CU EN Flux fact

Parameter	No.	Format	Value			Access via			
			min	max	Factory	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
CONFIGURATION									
En ext digit FC	1522	I16	0	1	0	✓	R/Z	-	-
CU EN Flux fact [%]	914	U16	10	100	50	✓	R/Z	-	-

En ext digit FC With this function, enabling **En ext digit FC** and the **Flux reg mode** (IPA 469) parameter can be set to **Ext digital FC** (or **Ext digital FC Const**) to use the drive in the "FC" configuration (via fiber optics) to control the excitation circuit of large DC motors.

CU EN Flux fact In order to avoid possible armature spikes current during bridge reversing, this value (in percentage of field current) defines a threshold for activating armature current during the reverse.

Communication between the TPD32-EV armature control drive (master) and the TPD32-EV-FC drive (slave) should be via optical fibre serial interface (PAR 469 **Flux reg mode** = [3] **Ext digital FC or [5] Ext digital FC Const** for field control without field weakening) or (from TPD32-EV FW11.XX, version) by standard external I/O terninal connection (PAR 469 **Flux reg mode** = [4] **Ext wired FC or [6] Ext wired FC Const** for field control without field weakening). In this operating mode, the -FC slave drive acts as an actuator of a current reference from the master control unit.

The master control unit provides the flux reference (voltage regulator output) which, appropriately scaled and sent to the current reference of the -FC slave drive, enables this to control the current of the three-phase bridge of the drive connected to the motor excitation circuit (in both the constant torque and constant power areas)

Dynamic control of four-quadrant systems is also possible with a two-quadrant power and control circuit (in the 2B+e configuration) connected to the armature: this is done by inverting the polarity of the excitation circuit current connected to a four-quadrant bridge.

In this configuration the slave drive works in torque regulation mode with the reference controlled by the master: the drive size and, above all, the value of **Full load current** (IPA 179) must therefore be selected according to the current required by the excitation circuit.

The sign of the master speed regulator output manages the polarity of the current reference sent to the slave: this is inverted when the value of the speed regulator output is higher than the symmetric hysteresis value set in [1522] **FC cur ref hyst**.

This parameter can be used to avoid continuous reversals of field current polarity when the motor is running with no load applied and thus with a **Speed reg output value** that is almost null.

If this configuration is enabled, the “Field loss” control indicating the absence of excitation is activated when:

- the master drive is enabled,
- the -FC slave drive is not powered or not enabled or in an alarm condition.

In this operating mode, there is no need to set the field circuit parameters, apart from those to configure any voltage regulator gains (**Voltage P** IPA 493 and **Voltage I** IPA 494).

Important: if this function is enabled with the 2B+e option, the drive cannot be used with the **Speed fbk**

sel parameter (IPA 414) set to **Armature**.

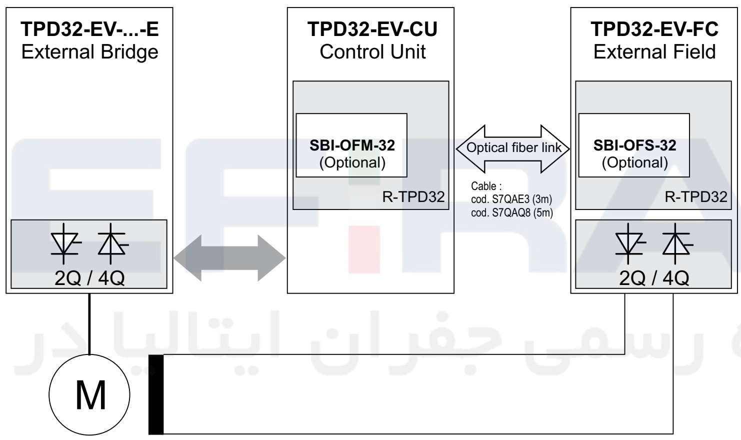
Accessories for connecting the TPD32-EV / TPD32-EV-CU control unit via fiber optics to the TPD32-EV-FC external exciter:

Code	Description	Remarks
S7QAE3 or S7QAQ8	M/S cable	Master/slave connection cable: 3 mt. = S7QAE3 5 mt. = S7QAQ8
S5H78	SBI-OFM-32	Master card
S5H83	SBI-OFS-32	Slave card

Note: The boards and the 3-meter cable are already included in the TPD32-EV 12 Pulse configuration. If requested, the TPD32-EV-FC must be used via a standard external I/O connection.

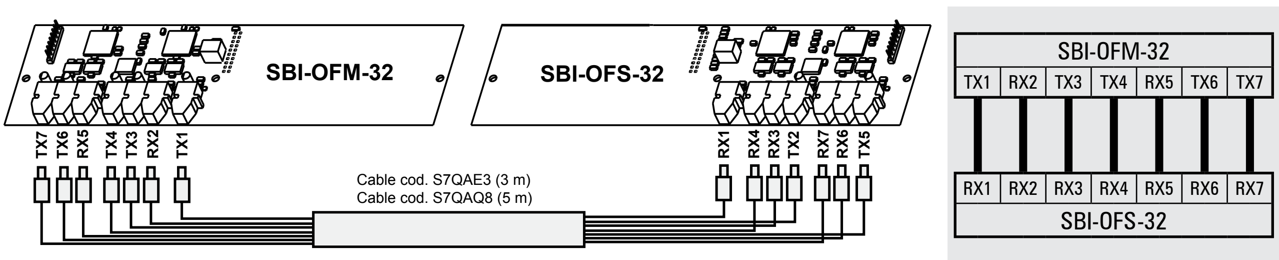
A2.5.1 Fiber optics connection of master board (in TPD32-EV-CU unit) to Slave board (in TPD32-EV-FC unit)

Figure A2.5.1: Block diagram of Field exciter control, fiber optics connection



External connections are made with connectors with different names if the board is a master (SBI-OFM-32) or a slave (SBI-OFS-32).

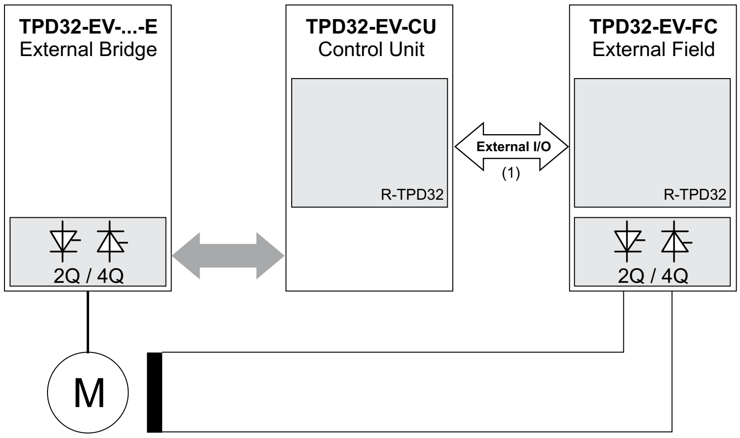
For the serial communication connection via fiber optics interface, you have to use the optional cable specified above (3m or 5m).



A2.5.2 Connection between TPD32-EV-CU and TPD32-EV-FC units via external I/O

In FW version 11.00 and higher for the TPD32-EV / TPD32-EV-CU, you can control a TPD32-EV-FC unit via external inputs and outputs (I/O) (without needing a fiber optics connection).

Figure A2.5.2: Block diagram of Field exciter control, connection via external I/Os



Parameter	No.	Format	Value				Access via			
			min	max	Factory American	Factory European	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
FLUX REGULATION (FIELD CURRENT REGULATION)										
Flux reg mode	469	U16	0	6	Const. current (0)	Const. current (0)	✓	R/Z	-	-
Constant current								0		
Voltage control								1		
External control								2		
Ext digital FC								3		
Ext wired FC								4		
Ext digital FC Const								5		
Ext wired FC Const								6		

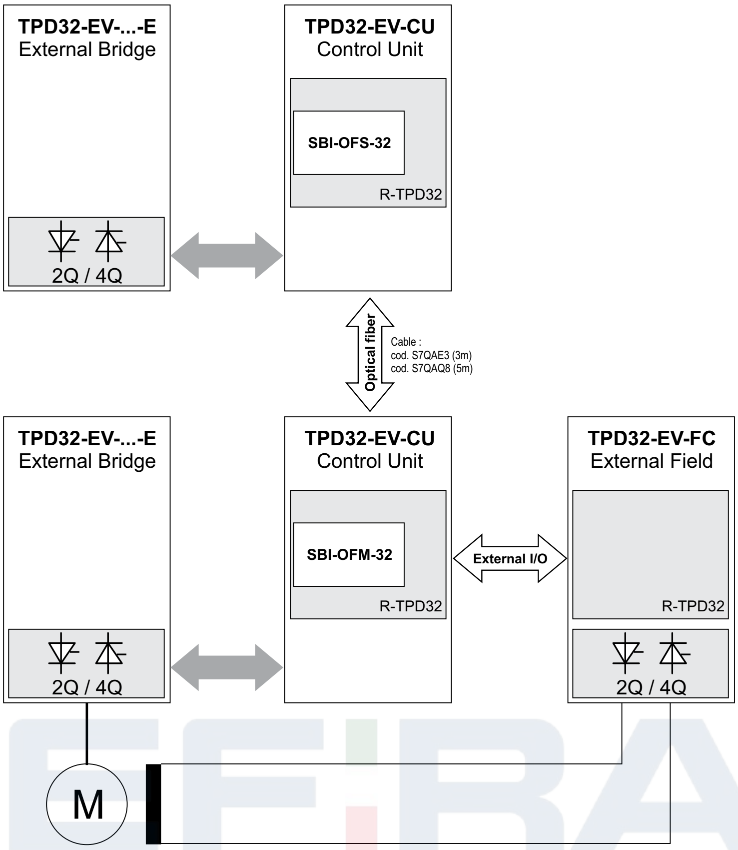
Set **Flux reg mode** = **Ext wired FC**
field control by TPD32-FC using external digital and analog I/Os.

(1) Recommended configuration for terminals

TPD32-EV / TPD32-EV-CU			
IPA 66 Select output 1	IPA 139 Digital Input 3	IPA 138 Digital Input 2	IPA 137 Digital Input 1
[95] **Field cur ref**	[90] **Wired FC Act Brg**	[89] **Wired FC Inv Seq**	[88] **Wired FC EN**
21	33	32	31
1	28	27	26
[6] **T current ref 1**	[82] **Wired FC Act Brg**	[81] **Wired FC Inv Seq**	[80] **Wired FC EN**
IPA 70 Select input 1	IPA 147 Digital Output 3	IPA 146 Digital Output 2	IPA 145 Digital Output 1
TPD32-EV-FC			

A2.5.3 12-pulse configuration of TPD32-EV with connection via external I/Os between TPD32-EV-CU and TPD32-EV-FC units

Figure A2.5.3: Block diagram of Field exciter control, connection via external I/Os



A2.5.4 Install an SCR Overvoltage Protection Device

When the “TPD32-EV FC” unit is used as a motor/generator field supply, should be need to install on the load an Overvoltage Protection Device (OVDP, i.e. crowbar) to prevent faults in the thyristors and / or varistors of the device

The purpose of the voltage clamp is to provide a means to let the DC output current to the load decay if the power is interrupted to the field controller while the device is adjusting the current on the load.

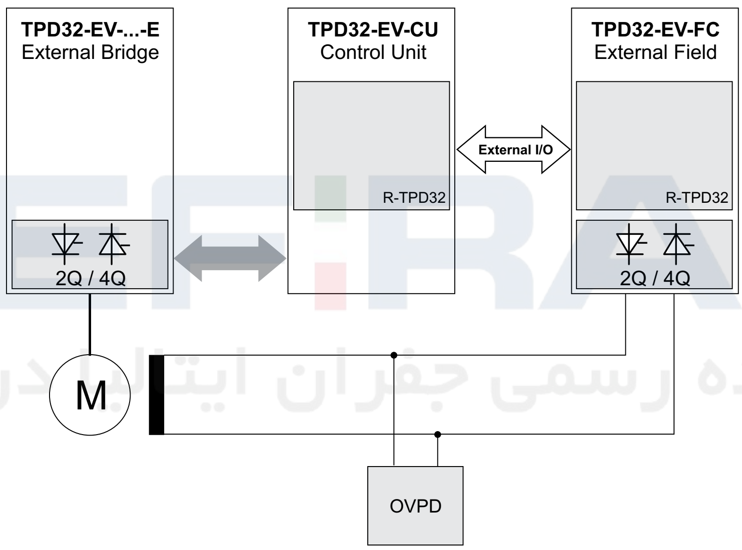
In these cases the load current decreases very rapidly generating voltages proportional to the rate at which the current decreases. These voltages can damage the field controller and/or the motor wire insulation.

The voltage clamp is connected directly across the DC output power connections to the load and during normal operation it appears as an open circuit.

Below the Block Diagram with the Overvoltage Protection Device.

Caution: Do not remove AC power until the field controller output current is zero. Equipment damage can occur.

Figure A2.5.4: Block diagram of Field exciter control + Overvoltage Protection Device



A2.6 Programmable alarms

CONFIGURATION
Prog alarms
SSC error
[9080] Hold off time [ms]

Parameter	No.	Format	Value min	Value max	Value Factory	Access via Keyp.	Access via RS485/ BUS/ Opt2-M	Access via Term.	Access via Opt2-A/ PDC
Hold off time [ms]	9080	U16	0	500	80	✓	R/W	-	-

Alarm	N.	Factory Activity	Factory Latch	Factory Open OK relay	Factory Hold off time [ms]	Factory Restart time [ms]	Standard
SSC error		Disable drive	-	-	80	-	

Alarm	Ignore	Warning	Disable drive	Quick stop	Normal stop	Curr lim stop
SSC error	-	-	X	-	-	-

SSC error

Functionality available starting from Firmware TPD32-EV-FC 10.25A (FC-200V) and 10.26A (FC-500V) .

Hold off time parameter**.**: It is needed to generate a SSC alarm if the drive does not receive in the timeframe set a valid data thru the optical fiber.

The alarm does not cause reaction of the drive. A warning message can be output via a digital output. When the drive is disabled, it will not restart until the failure has been cancelled.

If the failure is no more active, the drive can be reset without stopping the motor.

A2.7 Parameter changes

This section specifies only the differences between the version TPD32-EV-FC parameters list and the standard TPD32-EV version described in chapter 10.

Eliminated Menu:

Flux Regulation
Reg Parameters/Percent Values/Flux Regulation
Reg Parameters/Percent Values/Voltage Reg
Reg Parameters/Base Values/Flux Regulation
Reg Parameters/Base Values/Voltage Reg
Configuration/Prog Alarms/Field Loss
Configuration/Prog Alarms/Speed Fbk loss

Eliminated parameters:

Par 91 - Flux P
Par 92 - Flux I
Par 97 - Flux P base
Par 98 - Flux I base
Par 280 - Motor nom flux
Par 374 - Nom flux curr
Par 456 - Flux weak speed
Par 467 - Flux current max
Par 468 - Flux current min
Par 474 - FL restart time
Par 475 - FL Hold off time
Par 480 - SL Hold off time
Par 493 - Voltage P
Par 494 - Voltage I
Par 495 - Voltage P base
Par 496 - Voltage I base
Par 916 - Ifield cnst40
Par 917- Ifield cnst70
Par 918 - Ifield cnst90
Par 919 - Set flux/if
Par 921 - Out vlt level
Par 201 - 2B+E
Par 469 - Flux reg mode
Par 471 - FL Latch
Par 472 - FL Ok relay open
Par 473 - FL Activity
Par 477 - SL Ok relay open
Par 478 - SL Activity
Par 497 - Enable flux reg
Par 498 - Enable flux weak
Par 499 - Speed-0 f weak
Par 234 - Flux current
Par 351 - Flux current (A)
Par 500 - Flux reference
Par 452 - RL Search
Par 587 - E int

Renamed parameters / selections:

START UP \ MOTOR DATA

CONFIGURATION

Parameter	No.	Format	Value			Access via			
			min	max	Factory	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
Full field curr [A]	179	Float	0.1	S	S	✓	R/W	-	-

DRIVE STATUS

MONITOR \ MEASUREMENTS

CURRENT REGULAT

Parameter	No.	Format	Value			Access via			
			min	max	Factory	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
Field current [%]	199	I16			-	✓	R	-	-

I/O CONFIG \ ANALOG OUTPUTS \ ANALOG OUTPUT 1 ... 4

Parameter	No.	Format	Value			Access via			
			min	max	Factory	Keyp.	RS485/ BUS/ Opt2-M	Term.	Opt2-A/ PDC
Select output 1...4 **Field current**	66...69	U16	0	96	-	✓	R/Z **16**	-	-

OPTIONS \ OPTION 1 \ PDC CONFIG \ PDC INPUTS

Parameter	No.	Format	Value min	Value max	Value Factory	Access via Keyp.	Access via RS485/ BUS/ Opt2-M	Access via Term.	Access via Opt2-A/ PDC
Pdc in 0...5 **Field current**	1472 ... 1475	U16	0	65535	Unused	✓	R/Z **8391**	-	-

Different factory default:

Parameter	No.	Format	Value min	Value max	Value Factory	Access via Keyp.	Access via RS485/ BUS/ Opt2-M	Access via Term.	Access via Opt2-A/ PDC
SPEED REGULAT									
Enable spd reg Enable Disable	242	I16	0	1	**Disabled**	✓	R/W 1 0	-	-
START UP \ Speed feedback									
Speed fbk sel Encoder 1 Encoder 2 Tacho Armature	414	U16	0	3	Armature	✓	R/Z 0 1 2 3	-	R
CURRENT REGULAT									
CD curr thr	838	Int16	0	200	100	✓	R/W	-	-
CD factor P	839	Float	0.001	100 / DC Curr P (P847)	0.3	✓	R/W	-	-

In **SSC Error** menu**,** the parameter 888 replaces parameter 409 of **standard version TPD32-EV**:

~~Threshold~~	~~409~~	~~U16~~	~~0~~	~~250~~	~~50~~	~~✓~~	~~R/W~~	-	-
Hold off time [ms]	888	U16	0	500	80	✓	R/W	-	-

Eliminated selections from **Select output 1...4** parameters:

I/O CONFIG \ ANALOG OUTPUTS \ ANALOG OUTPUT 1 ... 4

[27] Flux current

[35] Flux reference

[79] Out vlt level

[80] Flux current max

Eliminated selections from **Select input 1...3** parameters:

I/O CONFIG \ ANALOG INPUTS \ ANALOG INPUT 1 ... 3

[25] Flux current max

[26] Out vlt level

Eliminated selections from **Digital Output 1...8** parameters:

I/O CONFIG \ DIGITAL OUTPUTS

[24] Field loss

[25] Speed fbk loss

Eliminated selections from **Digital Inputs** parameters:

I/O CONFIG \ DIGITAL INPUTS

[29] Field loss

[30] Enable flux reg

[31] Enable flux weak

Eliminated selections from **Pdc in 0 ... 5** parameters:

OPTIONS \ OPTION 1 \ PDC CONFIG \ PDC INPUTS

[8648] Flux weak speed

[8659] Flux current max

[8692] Flux reference

[9113] Out vlt level

Eliminated selections from **Pdc out 0 ... 5** parameters:

OPTIONS \ OPTION 1 \ PDC CONFIG \ PDC OUTPUTS

[8659] Flux current max

[9113] Out vlt level

Eliminated selections from **Virt dig in 0 ... 15** parameters:

OPTIONS \ OPTION 1 \ PDC CONFIG \ VIRT DIG IN

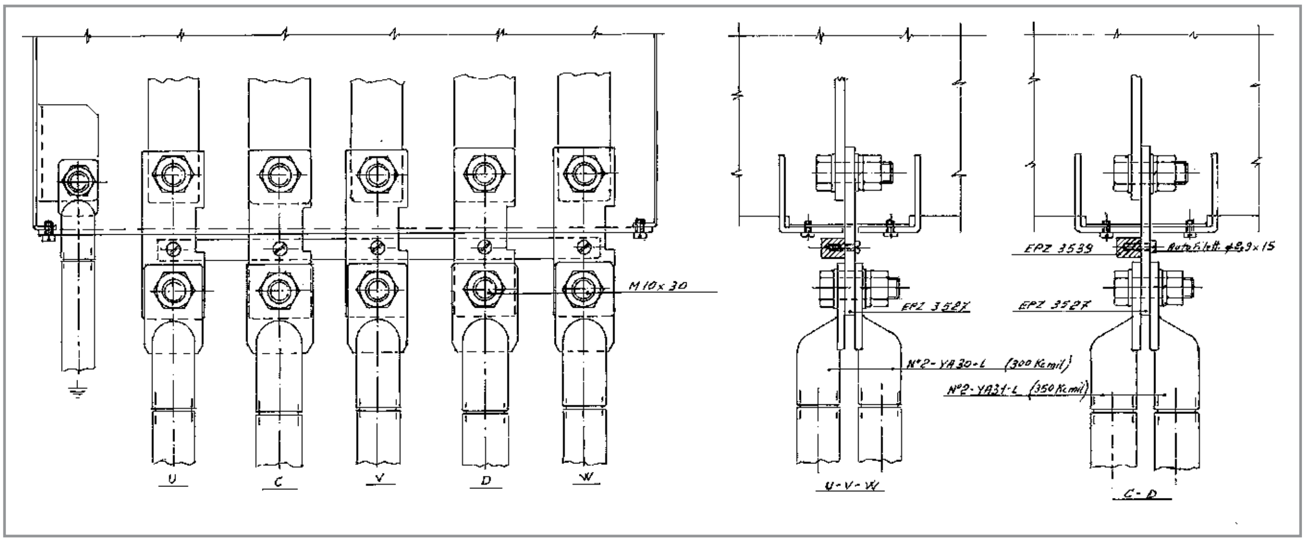
[8689] Enable flux reg

[8691] Speed-0 f weak

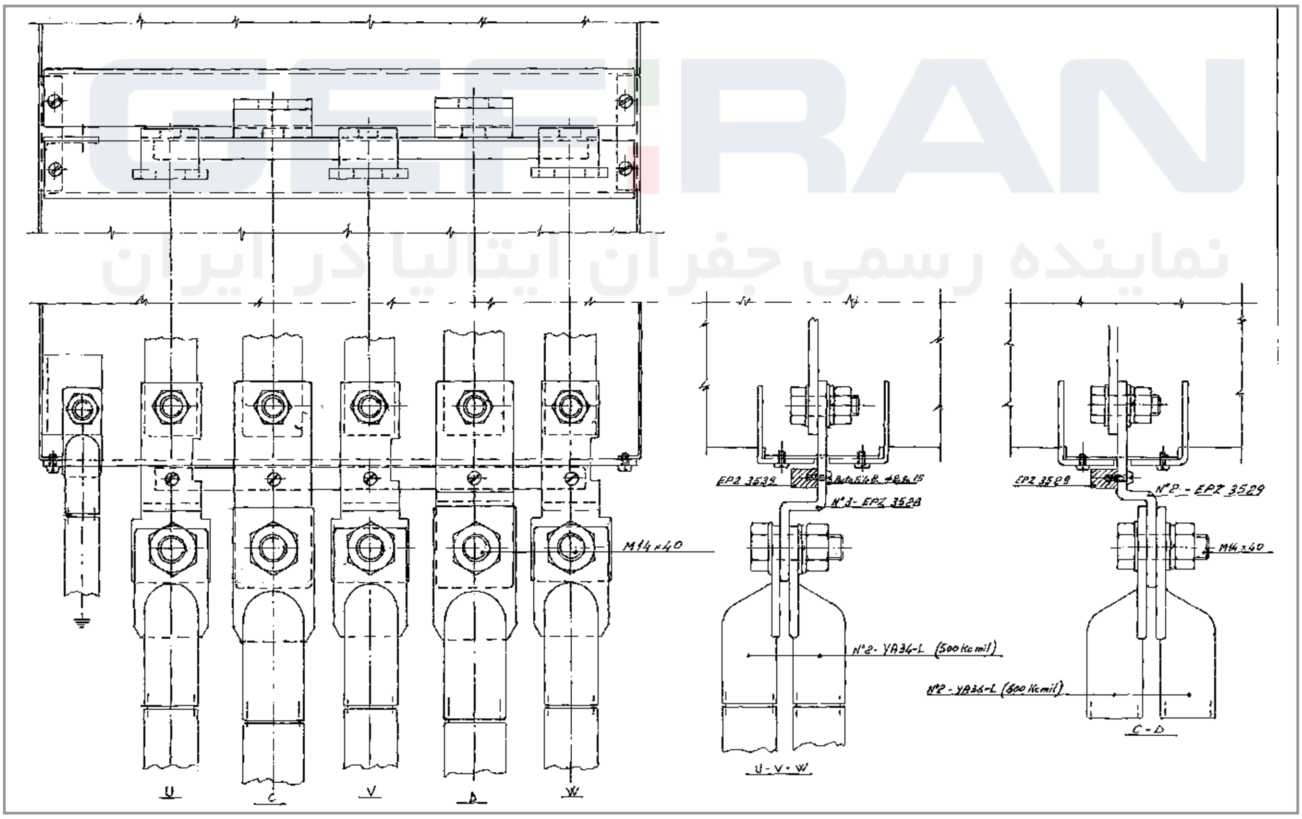
APPENDIX 3 - ACCESSORIES

A3.1 EAM Adapter Kit

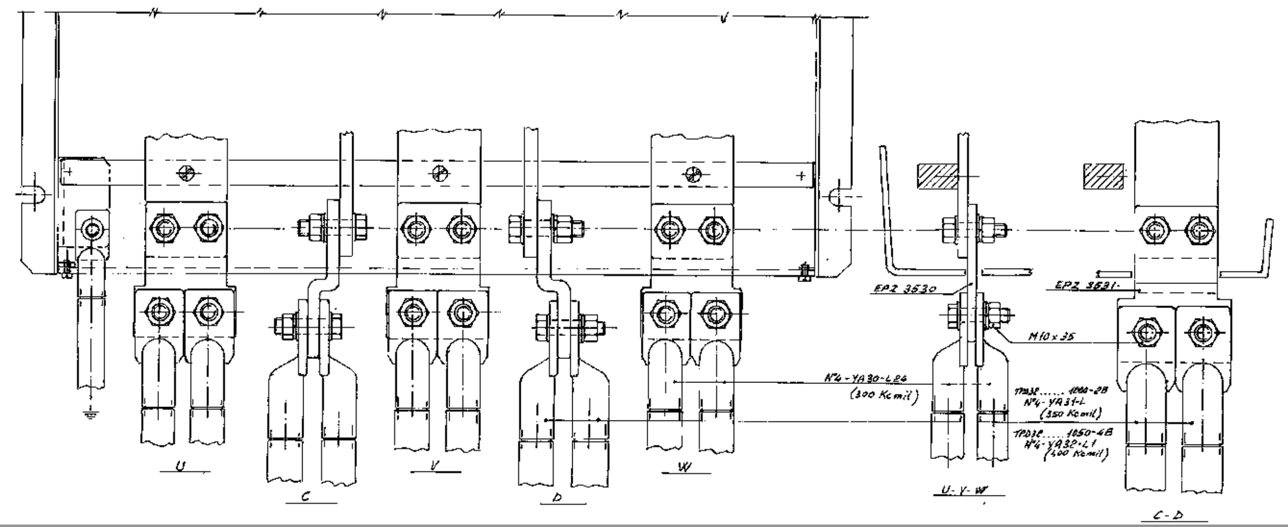
EAM1579



EAM1580



EAM1581



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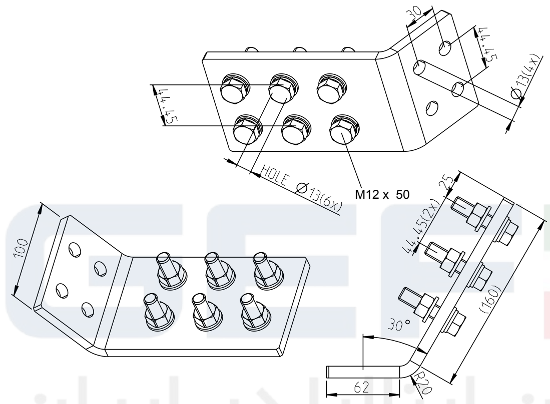
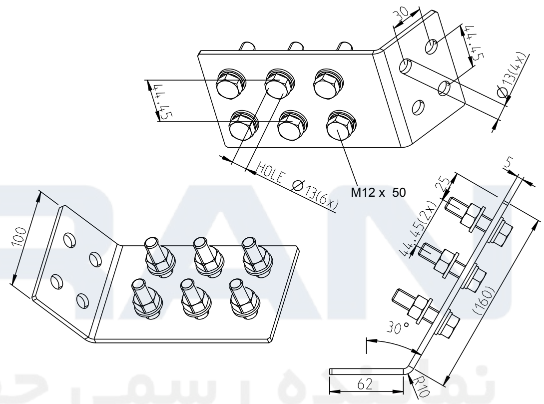
<tr><td>
</td><td>
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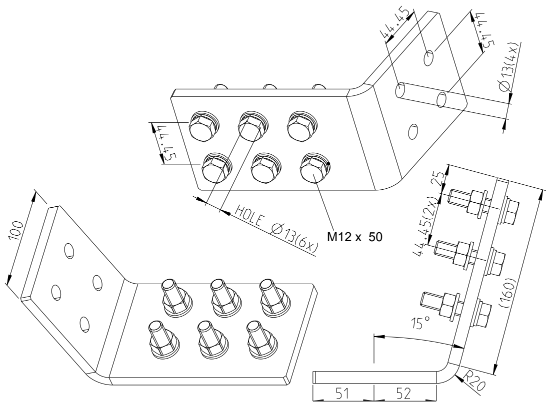
<tr><td>
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