AC/DC Drive
for industrial applications

TPD500

Instruction manual

Language: English

Information about this manual

Firmware version
This manual refers to the following firmware version: **TPD500 1.0.0**

General information

NOTE!

The terms "Inverter," "Converter," and "Drive" are sometimes used interchangeably in the industry. In this document, the term "Drive" will be used.

Thank you for choosing this WEG product.
Before using the product, carefully read **Chapter 1 – SAFETY INSTRUCTIONS**.
Throughout the product's operational life, make sure this manual is always accessible to technical personnel.

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1. SAFETY INSTRUCTIONS

This chapter contains the safety regulations to be followed during the installation, use, and maintenance of **TPD500** series drive. Failure to comply with these regulations may endanger human safety, posing a risk of death, or may damage the drive, the motor, or the driven equipment.

The safety instructions must be read carefully before working on the equipment.

Drives are electrical devices used in high-current applications. During operation, certain parts of the drives are live. Therefore, electrical installation and access to the interior of the equipment are permitted only for qualified personnel. Improper motor installation may damage the drive and cause personal injury or material damage.

Refer to the instructions provided in this manual and comply with local and national safety regulations.

The equipment must be installed in compliance with the following standards, as applicable:
- Canadian Electrical Code, Part I (CSA C22.1);
- National Electrical Code (ANSI/NFPA 70);
- European standards of the IEC 60364 series.

1.1 Symbols used in the manual

 WARNING!	Indicates a procedure or operating condition which, if not observed, may result in death or personal injury.
 CAUTION!	Indicates a procedure or operating condition which, if not observed, may cause damage to or destruction of the equipment.
 IMPORTANT!	Indicates a procedure or operating condition which, if followed, may optimize the application.
NOTE!	Draws attention to specific procedures and operating conditions.

1.2 General safety instructions

Qualified personnel
The installation, operation, and maintenance of the TPD500 drive must be carried out exclusively by qualified, trained, and authorized personnel who are capable of identifying and handling risks associated with electrical components.

Personal protective equipment (PPE)
During all operations, it is mandatory to wear appropriate Personal protective equipment (PPE), such as insulating gloves, safety glasses, and antistatic clothing, to prevent injuries from electric shock or contact with overheated surfaces.

Risk of personal injury
Transporting and lifting the equipment using improper methods may result in serious or fatal injury. The equipment must be lifted using appropriate tools and by trained personnel.

Functional safety
The TPD500 drive is not a device designed to ensure functional safety, but rather a component that can be integrated into a machine. The responsibility for risk assessment and the implementation of appropriate risk reduction measures lies with the machine manufacturer.

Documentation and compliance
The equipment is classified as **Open Type** (*Type 1*) and requires the implementation of appropriate technical measures to ensure compliance with current Electromagnetic Compatibility (EMC) regulations.
It is strongly recommended to carefully follow all instructions provided in the technical documentation to ensure adherence to these directives. Additionally, proper installation precautions must be taken to comply with Pollution Degree 2 (PD II) and the specified ambient temperature limits.

1.3 Safety measures during installation

Installation preparation
Before starting any work, ensure that the drive is completely disconnected from the power supply and that no residual voltage is present on any components. Additionally:
- inform all personnel involved about the ongoing operations;
- isolate the drive from the power supply and secure it against accidental power-up.

Safety condition check
Before starting the installation, check for the absence of voltage at the power terminals. Verify that all auxiliary circuits are de-energized and that the motors cannot rotate unintentionally.

Grounding
Ensure that the drive is properly grounded to prevent the risk of electric shock and electromagnetic interference. Grounding must be carried out in accordance with applicable regulations, using appropriately sized, non-interruptible conductors.

Power supplies
Do not connect supply voltages that exceed the allowable voltage range. Applying excessive voltages to the drive will damage internal components.

Fire and explosion hazard
Installing a drive in areas where flammable substances, fuel vapors, or dust are present can lead to fire or explosion risks. Drives should be installed away from such hazardous environments, even when used with motors designed for these conditions.

Installation environments
Do not install the drive in environments where the temperature exceeds the limits specified. Ambient temperature has a significant impact on the device's lifespan and reliability.

Mounting
The equipment must be mounted on a wall made of heat-resistant materials. During operation, the temperature of the cooling heatsinks can reach 90°C.

1.4 Protection during operation

Protection against electrostatic discharge (ESD)
When handling electronic components, take precautions against electrostatic discharge (ESD) to prevent damage to the equipment:
- use conductive surfaces;
- wear antistatic wrist straps and footwear;
- handle components only with appropriate tools.

Electromagnetic interference (EMC)
Drives generate electromagnetic fields that may interfere with medical devices such as pacemakers. It is essential to assess the specific risk and implement protective measures for individuals with active implantable devices.

Response to alarm conditions
When the drive indicates an alarm condition, refer to **Chapter 8 - FAULT REPORTING** and resume operation only after resolving the cause. Do not reset the alarm automatically via an external sequence.

1.5 Accident prevention

Ventilation spaces
Ensure that ventilation spaces are clear and unobstructed to prevent overheating of components, which could lead to fires. Install the equipment in enclosures designed to prevent the spread of flames.

Unexpected machine movements
When the drive is off but still connected to the power supply, accidental movement of the motor shaft cannot be ruled out. Ensure that all safety functions of the system are operational and correctly configured to prevent unexpected machine movements that could lead to accidents.

Handling the equipment

- Never open the equipment when it is connected to the power supply.
- Handle the equipment without touching or damaging any parts. Do not alter the insulation distances, nor remove insulating materials or covers.
- Do not apply voltage to the drive output (terminals C/D, C1/D1), and do not parallel the outputs of multiple drives.
- Do not connect capacitive loads to the drive output (terminals C/D), such as power factor correction capacitors.
- Even though the drive, when properly wired, can detect motor overheating, it is not designed to provide motor thermal protection.
- Avoid unauthorized modifications to the drive firmware to prevent risky operating states. Keep the firmware updated and implement security measures to protect the system from viruses and malware.

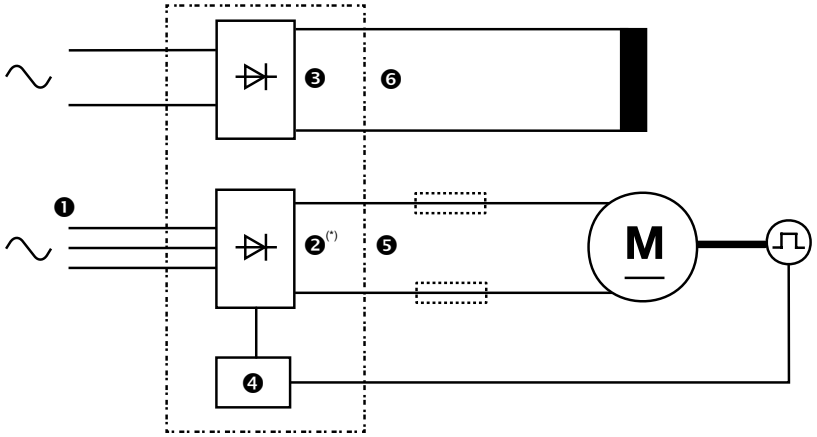
Reinstalling covers

Ensure that all covers are properly reinstalled before applying power to the equipment. Failure to follow this warning could result in death or serious injury.

2. COMPONENT IDENTIFICATION AND SPECIFICATIONS

2.1 General description

An AC/DC drive converts the AC voltage from a three-phase supply into a variable DC voltage, allowing the speed and/or torque of a separately excited DC motor to be controlled.



(*) Not present on **TPD500-CU-...**, which is the stand-alone solution for controlling external power bridges. Contact WEG for further information and details.

Figure 2-1: Schematic diagram of a AC/DC drive

❶ Three-phase supply voltage

❷ Armature circuit: three-phase controlled bridge (dual bridge for TPD500-...-4B-...)

❸ Field circuit: single-phase semi-controlled bridge

❹ Drive programmable control board

❺ Armature output DC voltage

❻ Field output DC voltage

The **TPD500** series drives are available in two variants:

TPD500-...-2B-...	for biquadrant operation
TPD500-...-4B-...	for tetraquadrant operation

Each variant is available in two subseries, which differ in the maximum supply voltage:

TPD500-500-...	supply voltage up to 3 x 500 Vac
TPD500-690-...	supply voltage up to 3 x 690 Vac, limited to 600 Vac for the North American market (cULus)

2.1.1 Functions and general features

The **TPD500** series devices have been developed as DC/AC drives featuring excellent control performance and a wide range of available functions.

General features

- Integrated field converter.
- Galvanic isolation between the power section and the control section.
- Galvanic isolation between the control section and the digital command and signal terminals.

Easy operation of the equipment

- Through the removable programming keypad with backlit display (KB-TPD500), provided as standard equipment.
- Via standard PC software **WEG_DriveLabs**, with Ethernet connection (Modbus TCP) or RS485 serial line (Modbus RTU).
- Through a fieldbus connection (optional): PROFIBUS, PROFINET, EtherNet/IP.

- Advanced programming interface, Wi-Fi module (optional, Wi-Fi Drive Link), and USB type-A connector.
- STARTUP WIZARD to facilitate commissioning.

Functional features

- Selectable adjustment of speed and torque.
- Adaptive speed controller type.
- Predictive current controller with automatic adaptation.
- Automatic self-calibration of the current controller.
- Automatic switching to armature feedback in case of loss of speed feedback signal, both in constant torque operation and during deceleration.
- Assignment of references and display of feedback values in engineering units.
- Overload protection.
- Three freely configurable differential analog inputs, as standard.
- Expansion of digital inputs and outputs, both digital and analog, via optional board (TBO-32).
- Integrated motor potentiometer function.
- Pulse operation control (JOG function).
- 9 internal speed references (including multi-speed function).
- 5 internal ramps, linear or S-shaped (including multi-ramp function).
- Internal signal conditioning (gain, min/max limits, offset).
- Alarm logging for the last 30 interventions with timestamp indication.
- For each alarm signal, if non-blocking, the drive behavior can be configured separately.
- Possibility of programming sequences and user functions via the development environment based on IEC 61131 standards (**WEG_DriveLogic** PC software).

NOTE! The essential technical data of the drive are documented in the model code and on the product identification nameplate.

NOTE! Contact WEG for further information and details regarding **WEG_DriveLogic**.

2.1.2 Selection of the equipment

The **TPD500** series drives can operate with a three-phase supply voltage ranging from 230 Vac to 690 Vac. Within this voltage range, the selection of the drive is based on the rated current required by the motor.
It is essential that the rated current of the drive is equal to or higher than the rated current of the motor.

The indicated current rating of the drive refers to continuous use. For applications where overloads are expected at the output, it is important to follow the overload management guidelines provided in **Chapter 6.18.8 - Overload**.

NOTE! In the case of use in high temperatures and for installations above 1000 m above sea level, the derating factor must also be taken into account. Refer to **Chapter 2.2.1 – Environmental Conditions**.
For the North American market (cULus mark), the installation is limited to a maximum altitude of **2000 m**.

2.1.3 Model identification

The following explains how to determine the main characteristics of the drive through the nomenclature used for identifying each model.

TPD500 -### -##### -## -# -####

-####	If present = options installed (any alphanumeric character) If not present = no options installed
-#	Construction type: **-A** = Frame A **-B** = Frame B **-C** = Frame C
-##	Operating quadrants: **-2B** = biquadrant **-4B** = tetraquadrant
###	Rated output current [A]
#####	Input voltage [Vca]: **-500** = up to 500 Vca **-690** = up to 600 Vca (cULus) / 690 Vca
TPD500	Drive model

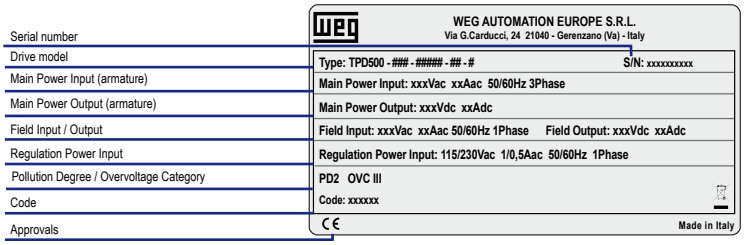
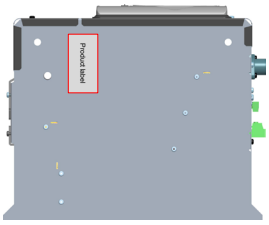
Side label	Positioning on the drive	
		**FRAME A** Left side of the drive
		**FRAME B** Right side of the drive
		**FRAME C** Right side of the drive

Figure 2-2: Product label and its positioning on the drive

The available sizes are listed in the following tables:

Table 2-1: Drive sizes

SIZE	QUADRANTS		CONSTRUCTION TYPE	ARMATURE CIRCUIT								FIELD CIRCUIT		CONTROL BOARD
				AC supply voltage		Nominal DC output voltage[Vdc]				Nominal DC output current [A]	DC output current overload	AC supply voltage	Nominal DC output current @40°C [A]	AC supply voltage
	2B	4B		TPD500-500	TPD500-690	TPD500-500		TPD500-690						
				230 … 500 Vca ±10% 3ph, 50/60 Hz ±5%	350 … 690 Vca ±10% 3ph, 50/60 Hz ±5%	2B	4B	2B	4B					
00020	•	•	A1	•		580	525			20	Programmable up to 150%	230 ... 500 Vca ±10% 1-phase, 50/60 Hz ±5%	6,25	115 Vac ±10% o 230 Vca ±10%, 1-fase, 50/60 Hz ±5%
00040	•	•	A1	•						40			8,33	
00070	•	•	A2	•						70			8,33	
00110	•	•	A3	•						110			12,5	
00140	•	•	A3	•						140			12,5	
00185	•	•	A3	•						184			12,5	
00280	•	•	B1	•						280			20	
00350	•	•	B1	•						350			20	
00420	•	•	B1	•						420			20	
00500	•	•	B1	•						500			20	
00650	•	•	B2	•						650			20	
00770	•	•	C	•						770			25	
01000	•		C	•						1000			25	
01050		•	C	•						1050			25	
00560	•	•	C		•			800	725	560			25	
00700	•	•	C		•					700			25	
00900	•	•	C		•					900			25	

Example of drive selection for a 15 kW motor
Supply voltage: 3 x 400 Vac

1. Biquadrant operation

Motor nameplate data	Rated power	P	15 kW
	Armature voltage	U_{DN}	470 V
	Armature current	I_{DN}	37,6 A
	Field voltage	U_{FN}	310 V
	Field current	I_{FN}	0,8 A
Selection criteria	Input voltage	U_{LN}	3 x 400 V < 500 V
	Closest available armature current value to the motor's required value	I_{DN}	37,6 A < 40 A
	Closest available field current value to the motor's required value	I_{FN}	0,8 A < 6,33 A
Selected drive	**TPD500-500-00040-2B-A**		
For use with overload cycles, refer to **Chapter 6.18.8 - Overload**.			

2. Tetraquadrant operation

Motor nameplate data	Rated power	P	15 kW
	Armature voltage	U_{DN}	420 V
	Armature current	I_{DN}	42 A
	Field voltage	U_{FN}	310 V
	Field current	I_{FN}	0,8 A
Selection criteria	Input voltage	U_{LN}	3 x 400 V < 500 V
	Closest available armature current value to the motor's required value	I_{DN}	42 A < 70 A
	Closest available field current value to the motor's required value	I_{FN}	0,8 A < 10 A
Selected drive	**TPD500-500-00070-4B-A**		
For use with overload cycles, refer to **Chapter 6.18.8 - Overload**.			

2.2 Technical data

2.2.1 Environmental conditions

Degree of protection: **IP20** - for Frame A, B and C
Type: **Open Type** with Typo 1 enclosure (UL)
Pollution degree: **2**
Altitude: **North America (cULus)**
Up to 2000 m with the following precautions:
- Up to 1000 m above sea level – no derating.
- Above this altitude – reduce the current by 1.2% for every 100 m of increase.

Rest of the world
Up to 4000 m with the following precautions:
- Up to 1000 m above sea level – no derating.
- Above this altitude – reduce the current by 1.2% for every 100 m of increase.
- From 2000 m to 4000 m – use with voltage derating (1.1% reduction of the nominal value for every 100 meters of increase).

OPERATING
Temperature: Ta = 0 ... 55°C
When the maximum ambient air temperature is between 40°C and 55°C, apply a derating of the output current of 1.25%/°C (down to 81% at 55°C).
Air humidity: 5% to 85%, 1 g/m³ to 25 g/m³, without condensation or ice formation.

NOTE! The derating factors to be applied are detailed in the following chapter.

TRANSPORT AND STORAGE
Storage temperature: Ta = -20 ... +55°C
Transport temperature: Ta = -20 ... +60°C
Air humidity: 5% up to 95%, 1 g/m³ up to 29 g/m³
Vibration: Sinusoidal profile 1 g_{rms} 10-57 Hz

2.2.1.1 Derating

Three derating factors, K_T, K_I and K_U, must be considered, as they affect the drive's performance when used under conditions different from the design specifications, particularly in the following cases:
- Operating temperature above 40°C;
- Installation altitude above 1000 m above sea level.

Derating due to operating temperature
For operation above 40°C, a derating of **1.25%** of the rated armature current per degree of temperature increase must be applied, up to the maximum operating ambient temperature of 55°C.

The following graph shows the derating coefficient K_T as a function of the operating temperature.
The graph also displays the compensation coefficient K_{TC} which can be used for compensation in certain cases (see the next section "Derating due to altitude").

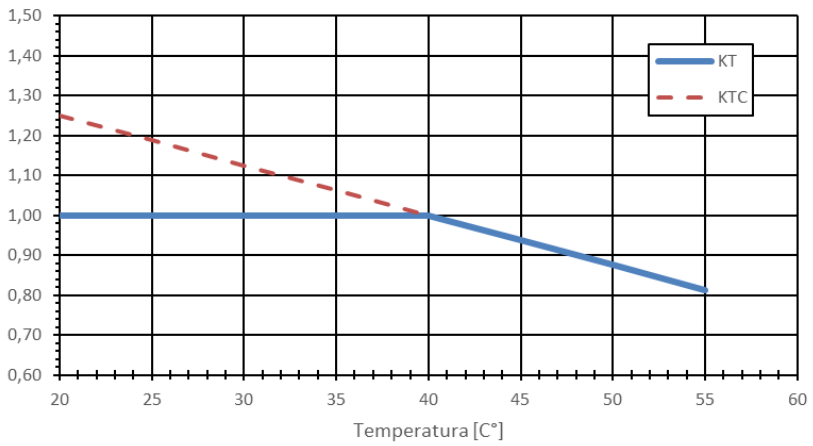


Figure 2-3: Temperature derating factor

Derating due to altitude
For operation in installations above 1000 m above sea level, the armature output current must be reduced by **1.2%** for every 100 meters of increase, up to a maximum altitude of 4000 m. This derating is included in the coefficient $\mathbf{K_I}$.
Additionally, the supply voltage $\mathbf{U_{LN}}$ must be reduced for installations above 2000 m above sea level, by **1.1%** for every 100 meters. This derating is defined by the coefficient $\mathbf{K_U}$.
The following graph shows the values of $\mathbf{K_I}$ and $\mathbf{K_U}$ as a function of altitude.

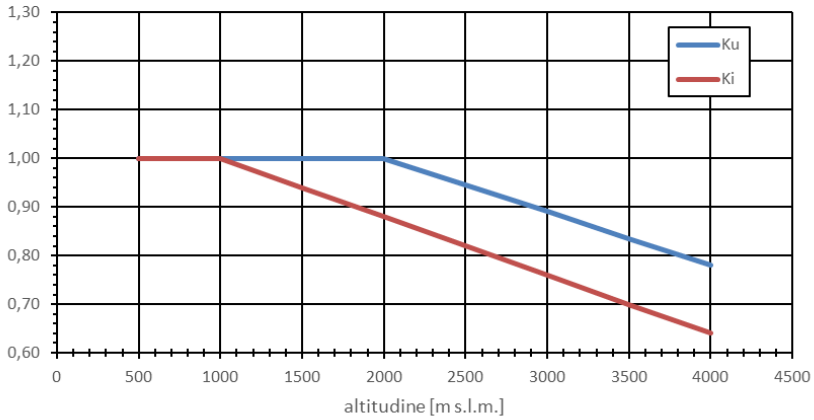


Figure 2-4: Altitude derating factor

CAUTION!

For North American compliance marking (cULus), the maximum installation altitude must not exceed 2000 m.

The three coefficients $\mathbf{K_I}$, $\mathbf{K_U}$ and $\mathbf{K_T}$ contribute together to the definition of the overall derating. For temperatures below 40°C, the overall derating on the current can be compensated using the coefficient $\mathbf{K_{TC}}$. However, the final result cannot exceed the design rated current.

NOTE!

The values of the rated voltage and current must never exceed those specified in the technical specifications.

$$I_{\mathrm{ND}} = I_N \cdot K_T \cdot K_I \cdot K_{\mathrm{TC}}$$

$$U_{\mathrm{LND}} = U_{\mathrm{LN}} \cdot K_U$$

Example 1
Vn = 500 V
In = 1000 A

Operating conditions:
- Temperature = 50°C
- Altitude = 2500 m ASL

K_T = 0.88; K_I= 0.82; K_U= 0.95; K_{TC}= Not applicable

I_{ND} = 1000 x 0.88 x 0.82 = 721.6 A
U_{LND} = 500 x 0.95 = 475 V

Example 2
Operating conditions:
- Temperature = 25°C
- Altitude: 2500 m ASL

K_T = 1.0; K_I = 0.82; K_U = 0.95; K_{TC} = 1.19

I_{ND} = 1000 x 1.0 x 1.19 x 0.82 = 975.8 A
U_{LND} = 500 x 0.95 = 475 V

Example 3
Operating conditions:
- Temperature = 25°C
- Altitude: 2000 m ASL

K_T = 1.0; K_I= 0.88; K_U= 0.96; K_{TC}= 1.19

I_{ND} = 1000 x 1.0 x 1.19 x 0.88 = 1004.72 → 1000 A
U_{LND} = 500 x 0.96 = 480 V

2.2.2 Standards

General standards: EN 61800-1, EN 60146-1-1
Electrical safety: EN 61800-5-1, UL 61800.5.1
Electromagnetic compatibility: EN 61800-3
Category C3
Operating conditions: Environment II
Degree of protection: EN 60529
IP20 - for frame A, B and C

Approvals:

CONSTRUCTION TYPE	APPROVED MARKS	PENDING
A	CE cULus*	EAC UKCA
B	CE	cULus EAC UKCA
C	CE	cULus EAC UKCA

* except for TPD500-500-00020-xB-A.

NOTE!

The cULus certification for the TPD500 series drive is currently in progress at the time of writing this manual. Please refer to the updated product documentation for this information or contact customer service.

For products already received, verify the presence of the **compliance mark** on the product label.

2.2.3 Connection to the power supply

The equipment must be used with a power supply up to the value indicated on the label.
During the drive commissioning, the undervoltage threshold for the power section can be set using the parameter IPA 5018-**Undervolt thr** (default 230 V).

NOTE!

For the operation of the TPD500 series drives, network inductors and possible interference filters are required. Refer to the guidelines in **Chapter 4.11 – Inductors/Filters**. Drives with a rating above 770 A and network filters have high leakage currents to ground.

Installation regulations require a fixed, non-interruptible ground connection.

2.3 Electrical data

North America (cULus)	3 x 230...500 Vac, 50/60 Hz (230 Vac minimum operating voltage) 3 x 350...600 Vac, 50/60 Hz (350 Vac minimum operating voltage)
Rest of the world	3 x 230...500 Vac, 50/60 Hz (230 Vac minimum operating voltage) 3 x 350...690 Vac, 50/60 Hz (350 Vac minimum operating voltage)
Overload	Category III
Short Circuit Current (SCCR)	Frame A e B = 50 kA Frame C = 100 kA

The **general tolerances** for the nominal supply voltages and nominal network frequencies indicated are:
- Voltage = ± 10%
- Frequency = ± 5%

2.3.1 Input circuit

Table 2-2: Input currents for Frame A, B, C

DRIVE		U/V/W MAIN INPUT (armature)			U1/V1 INPUT (field circuit)			U2/V2 INPUT (control board)		
Model	Construction type	Voltage [Vac]	Frequency [Hz]	Continuous current [Aac]	Voltage [Vac]	Frequency [Hz]	Current [A]	Voltage [Vac]	Frequency [Hz]	Current [A]
TPD500-500-00020-2B-A	A	230 ... 500	50/60	17	230 ... 500	50/60	6,25	115 230	50/60	1 A @115 V 0.5 A @230 V
TPD500-500-00040-2B-A				34			8,33			
TPD500-500-00070-2B-A				60			8,33			
TPD500-500-00110-2B-A				95			12,5			
TPD500-500-00140-2B-A				120			12,5			
TPD500-500-00185-2B-A				158			12,5			
TPD500-500-00020-4B-A				17			6,25			
TPD500-500-00040-4B-A				34			8,33			
TPD500-500-00070-4B-A				60			8,33			
TPD500-500-00110-4B-A				95			12,5			
TPD500-500-00140-4B-A				120			12,5			
TPD500-500-00185-4B-A				158			12,5			
TPD500-500-00280-2B-B	B	230 ... 500	50/60	241	230 ... 500	50/60	20	115 230	50/60	1 A @115 V 0.5 A @230 V
TPD500-500-00350-2B-B				301						
TPD500-500-00420-2B-B				361						
TPD500-500-00500-2B-B				430						
TPD500-500-00650-2B-B				559						
TPD500-500-00280-4B-B				241						
TPD500-500-00350-4B-B				301						
TPD500-500-00420-4B-B				361						
TPD500-500-00500-4B-B				430						
TPD500-500-00650-4B-B				559						
TPD500-500-00770-2B-C	C	230 ... 500	50/60	663	500	50/60	25	115 230	50/60	1 A @115 V 0.5 A @230 V
TPD500-500-01000-2B-C				860						
TPD500-690-00560-2B-C		350 ... 690 [1]		482						
TPD500-690-00700-2B-C				603						
TPD500-690-00900-2B-C				775						
TPD500-500-00770-4B-C		230 ... 500		663						
TPD500-500-01050-4B-C				904						
TPD500-690-00560-4B-C		350 ... 690 [1]		482						
TPD500-690-00700-4B-C				603						
TPD500-690-00900-4B-C				775						

[1] Up to 600 Vac for the North American market (cULus)

NOTA!

If the U2/V2 terminals of Frame B and C are powered at 115 V, connect the SA/SB terminals located at the top of the drive using an AWG 18 cable with an insulation voltage rating of at least 300 Vac.

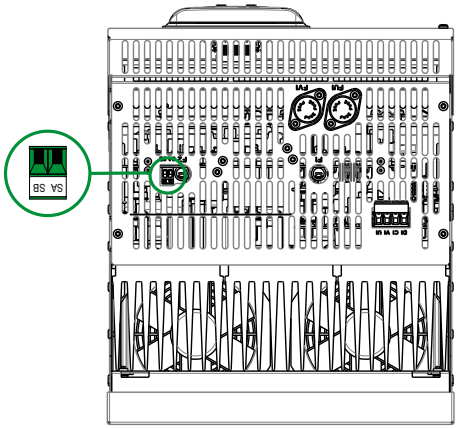


Figure 2-5: Position of SA/SB terminals for Frame B and C

2.3.2 Output circuit

The considered output voltages account for a network undervoltage within the specified tolerance limits and a voltage drop of 4% due to the network inductors used. This value corresponds to the recommended nominal armature voltage for the connected motor.

WARNING!

It is not allowed to connect an external voltage to the drive's output terminals! It is also not allowed to disconnect the motor from the device's output while the drive is operating.

Under normal conditions, a smoothing inductor is not required. However, it may be necessary depending on the type of motor used (refer to the motor documentation). In this case, insert the prescribed inductor by connecting it in series with the armature. The specified currents refer to continuous operation with an ambient temperature of 40°C.

Table 2-3: Output currents for Frame A, B, C

DRIVE		USCITA PRINCIPALE - ARMATURA		USCITA CAMPO		
Model	Construction type	Voltage [Vdc]	Continuous current [Adc]	Voltage [Vdc]	Frequency [Hz]	Current [Adc]
TPD500-500-00020-2B-A	A	580	20	390	50/60	12.5
TPD500-500-00040-2B-A			40			
TPD500-500-00070-2B-A			70			
TPD500-500-00110-2B-A			110			
TPD500-500-00140-2B-A			140			
TPD500-500-00185-2B-A			184			
TPD500-500-00020-4B-A		525	20			
TPD500-500-00040-4B-A			40			
TPD500-500-00070-4B-A			70			
TPD500-500-00110-4B-A			110			
TPD500-500-00140-4B-A			140			
TPD500-500-00185-4B-A			184			

TPD500-500-00280-2B-B	B	580	280	390	50/60	20
TPD500-500-00350-2B-B			350			
TPD500-500-00420-2B-B			420			
TPD500-500-00500-2B-B			500			
TPD500-500-00650-2B-B			650			
TPD500-500-00280-4B-B		525	280			
TPD500-500-00350-4B-B			350			
TPD500-500-00420-4B-B			420			
TPD500-500-00500-4B-B			500			
TPD500-500-00650-4B-B			650			
TPD500-500-00770-2B-C	C	580	770	390	50/60	25
TPD500-500-01000-2B-C			1000			
TPD500-690-00560-2B-C		800	560			
TPD500-690-00700-2B-C			700			
TPD500-690-00900-2B-C			900			
TPD500-500-00770-4B-C		525	770			
TPD500-500-01050-4B-C			1050			
TPD500-690-00560-4B-C		725	560			
TPD500-690-00700-4B-C			700			
TPD500-690-00900-4B-C			900			

2.3.3 Field circuit calibration

The field current reading is performed by inserting resistors that determine the maximum readable scale. These resistors can be selected via **dip-switch S14** (refer to the following tables). The drive, by default, is set to the maximum current managed by the internal circuitry.
Configure the dip-switches so that the set current scale is greater than or equal to the motor's field current.

If you want to maximize reading accuracy, you can insert your own resistor, properly calculated according to the formula described in the following tables, through terminals LA and LB. In this case, set all the dip-switches to zero (OFF) to disconnect the internal resistors.
Remember to set the parameter IPA 304-**Drive field current** to the chosen value.

Example:
- Motor field current = 2.5 A
- Select the dip-switches corresponding to 3 A
- Set IPA 304-**Drive field current** = 3 A

NOTE! Calibration is not necessary when the field control of the motor is managed by an external system, rather than the internal field converter of the TPD500.

1) For sizes TPD500-500-00020-..-A to TPD500-500-00185-..-A

NOTE! For improved readability of the following tables, the OFF state of the dip-switches is indicated by "-" (dash).

Table 2-4: PFC1-6 board mounted on TPD500-500-00020-xB-A

PFC1-6 board mounted on TPD500-500-00020-xB-A										**Factory setting**
Dip-switch	**S14-1**	**S14-2**	**S14-3**	**S14-4**	**S14-5**	**S14-6**	**S14-7**	**S14-8**	**Equivalent resistance [Ω]**	
Resistive value [Ω]	168.5	333.3	182	36.4	845	1668	3333	-		
Rated field current [A]	Equivalent resistance = 416.7 / field current									
6.25	ON	ON	ON	-	-	ON	-	-	66.5	•
6	ON	ON	ON	-	-	-	-	-	69.3	
5	ON	-	ON	-	-	ON	-	-	83.1	
4	ON	ON	-	-	-	ON	-	-	104.9	
3	-	-	ON	-	ON	ON	-	-	137.4	
2	-	ON	-	-	ON	ON	-	-	208.9	
1.5	-	ON	-	-	-	ON	-	-	277.6	

Table 2-5: PFC1-8 board mounted on TPD500-500-00040-xB-A and TPD500-500-00070-xB-A

PFC1-8 board mounted on TPD500-500-00040-xB-A and TPD500-500-00070-xB-A										Factory setting
Dip-switch	**S14-1**	**S14-2**	**S14-3**	**S14-4**	**S14-5**	**S14-6**	**S14-7**	**S14-8**	**Equivalent resistance [Ω]**	
Resistive value [Ω]	168.5	333.3	182	36,4	845	1668	3333	-		
Rated field current [A]	Equivalent resistance = 555.5 / field current									
8.33	ON	ON	ON	-	-	ON	-	-	66.5	•
8	ON	ON	ON	-	-	-	-	-	69.3	
7	ON	-	ON	-	ON	-	-	-	79.3	
6	ON	ON	-	-	ON	ON	-	-	93.3	
5	ON	ON	-	-	-	-	-	-	111.9	
4	-	-	ON	-	ON	ON	-	-	137.4	
3	-	-	ON	-	-	-	-	-	182	
2	-	ON	-	-	-	ON	-	-	277.6	
1	-	-	-	-	ON	ON	-	-	560.9	

Table 2-6: PFC1-12 board mounted on TPD500-500-00110-xB-A and TPD500-500-00185-xB-A

PFC1-12 board mounted on TPD500-500-00110-xB-A and TPD500-500-00185-xB-A										Factory setting
Dip-switch	**S14-1**	**S14-2**	**S14-3**	**S14-4**	**S14-5**	**S14-6**	**S14-7**	**S14-8**	**Equivalent resistance [Ω]**	
Resistive value [Ω]	168.5	333.3	182	36.4	845	1668	3333	-		
Rated field current [A]	Equivalent resistance = 833.3 / field current									
12.5	ON	ON	ON	-	-	ON	-	-	66.5	•
12	ON	ON	ON	-	-	-	-	-	69.3	
10	ON	-	ON	-	-	ON	-	-	83.1	
8	ON	ON	-	-	-	ON	-	-	104.9	
7	-	ON	ON	-	-	-	-	-	117.7	
6	-	-	ON	-	ON	ON	-	-	137.4	
5	ON	-	-	-	-	-	-	-	168.5	
4	-	ON	-	-	ON	ON	-	-	208.9	
3	-	ON	-	-	-	ON	-	-	277.6	
2.5	-	ON	-	-	-	-	-	-	333.3	
1.5	-	-	-	-	ON	ON	-	-	560.9	
1	-	-	-	-	ON	-	-	-	845	

2) Per sizes above TPD500-500-00280-..-B up to TPD500-500-01050-..-C

Table 2-7: PFCS2A-31 and PFC3 boards mounted on TPD500-500-00280-xB-B up to TPD500-500-01050-xB-C

PFCS2A-31 and PFC3 boards mounted on TPD500-500-00280-xB-B up to TPD500-500-01050-xB-C										Factory setting
Dip-switch	**S14-1**	**S14-2**	**S14-3**	**S14-4**	**S14-5**	**S14-6**	**S14-7**	**S14-8**	**Equivalent resistance [Ω]**	
Resistive value [Ω]	168.5	333	182	36.4	845	1668	3333.3	-		
Rated field current [A]	Equivalent resistance = 1667 / field current									
25.1	ON	ON	ON	-	-	ON	-	-	66.5	•
24.1	ON	ON	ON	-	-	-	-	-	69.3	
20	ON	-	ON	-	-	ON	-	-	83.1	
17.1	-	ON	ON	-	ON	ON	-	-	97.3	
14.2	-	ON	ON	-	-	-	-	-	117.7	
12.9	ON	-	-	-	ON	ON	-	-	129.6	
9,9	ON	-	-	-	-	-	-	-	168.5	
5	-	ON	-	-	-	-	-	-	333.3	
3	-	-	-	-	ON	ON	-	-	560.9	
2	-	-	-	-	ON	-	-	-	845	
1	-	-	-	-	-	ON	-	-	1668	

2.3.4 Control and regulation section

Below are the technical specifications of the digital and analog inputs and outputs of the **R-TPD500** control board, along with the system's power supply and control parameters. Tolerances and operating values are provided to ensure stable and reliable operation, including detailed information on voltages, currents, and encoder signals.

Interlocks (enabling signals):		0 / 15 ... 30 V	3.2 ... 6.5 mA (approx. 5 mA at 24 V)	
Analog inputs:	configurable	0 ... ±10 V 0 ... 20 mA 4 ... 20 mA	0.25 mA max 10 V max 10 V max	
Analog outputs:		0... ±10 V5 mA max per output		
Digital inputs:		0 / 15 ... 30 V	3.2 ... 6.5 mA (approx. 5 mA at 24 V)	
Digital outputs:	power supply signals	+15 ... 30 V +15 ... 30 V	 50 mA max per output	
Incremental digital encoder inputs:	voltage current pulses max frequency cable	5 V TTL / 15...24 V HTL (High level) 4.5 mA / 6.8 ... 10.9 mA per channel when logic level is High min 150 - max 16382 150 kHz shielded, 150 m (0.75 mm^2) / 125 m (0.5 mm^2) / 55 m (0.22 mm^2)		
Tachogenerator input:	voltage current cable	22.7 / 45.4 / 90.7 / 181.6 / 302.9 [1] V max it depends on the configuration set using **dip-switch S4** 8 mA at full scale shielded; max length depends on installation - typically 150 m		
Internal power supply voltage:	max load	+5 V encoder	300 mA max 150 mA each	connectors XE1/XE2, PIN 7/9
		+24 V encoder	300 mA max 150 mA each	connectors XE1/XE2, PIN 2/7
		+10 V	10 mA	terminal 7
		-10 V	10 mA	terminal 8
		+24 V	150 mA	terminal 19
	tolerance	+5 V encoder	± 10%	internal power supply
		+24 V encoder	± 10%	internal power supply
	+10 V	± 3 % [2]		
		-10 V	± 3 % [2]	
		+24 V	+ 20 ... 30 V	unregulated

[1] Max 300 V only for North America (cULus).

[2] The +10 V and -10 V voltage values are identical in absolute terms. The indicated tolerance refers to the voltage amplitude.

2.4 Dimensions and weights

2.4.1 Frame A1

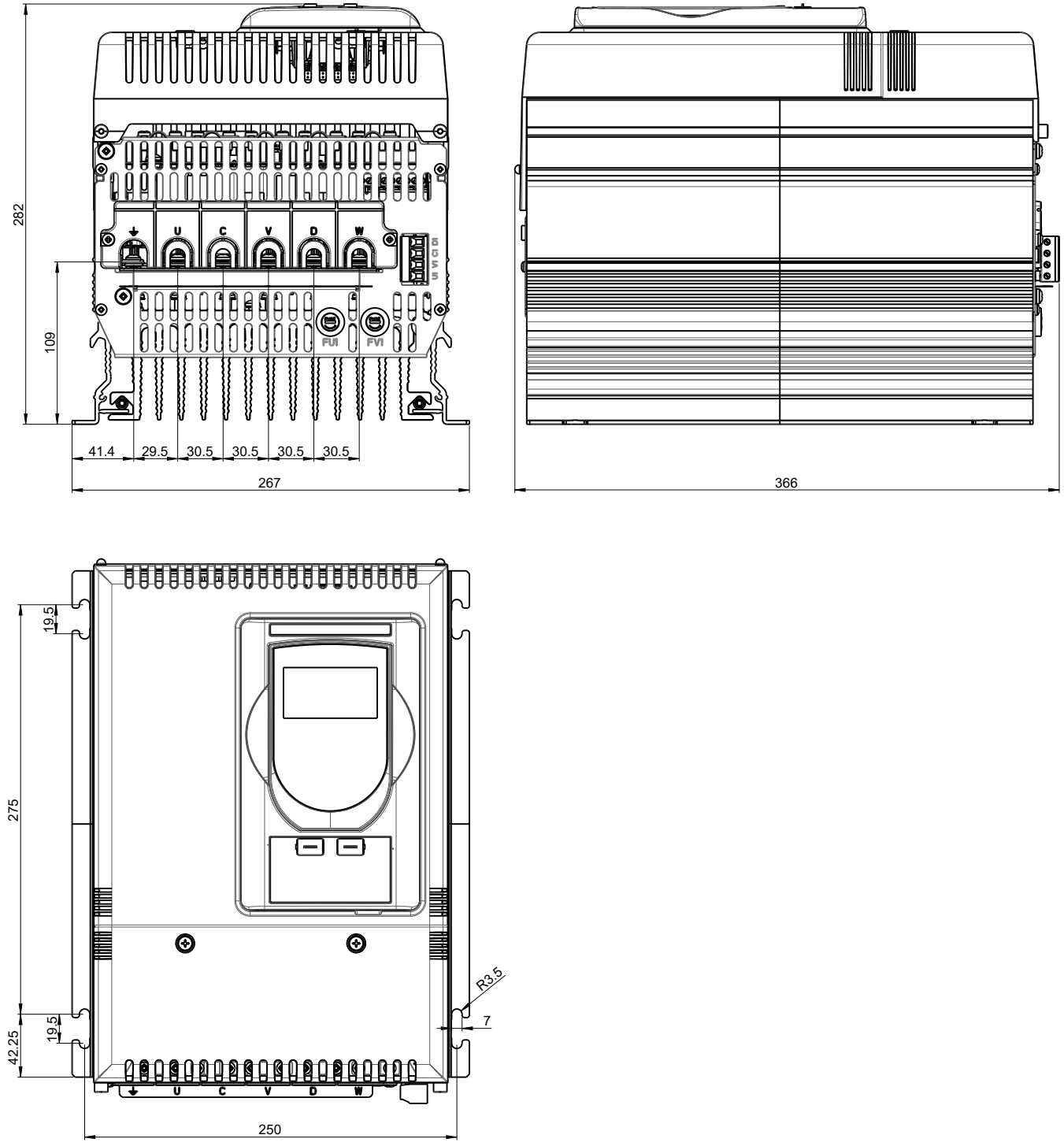


Figure 2-5: Overall dimensions Frame A1

Table 2-8: Dimensions Frame A1

DRIVE	DIMENSIONS W x H x d		WEIGHT	
	[mm]	[inches]	[kg]	[lb]
TPD500-...-00020-...-A	282 x 366 x 267	11.1 x 14.41 x 10.51	11	24.3
TPD500-...-00040-...-A				

2.4.2 Frame A2

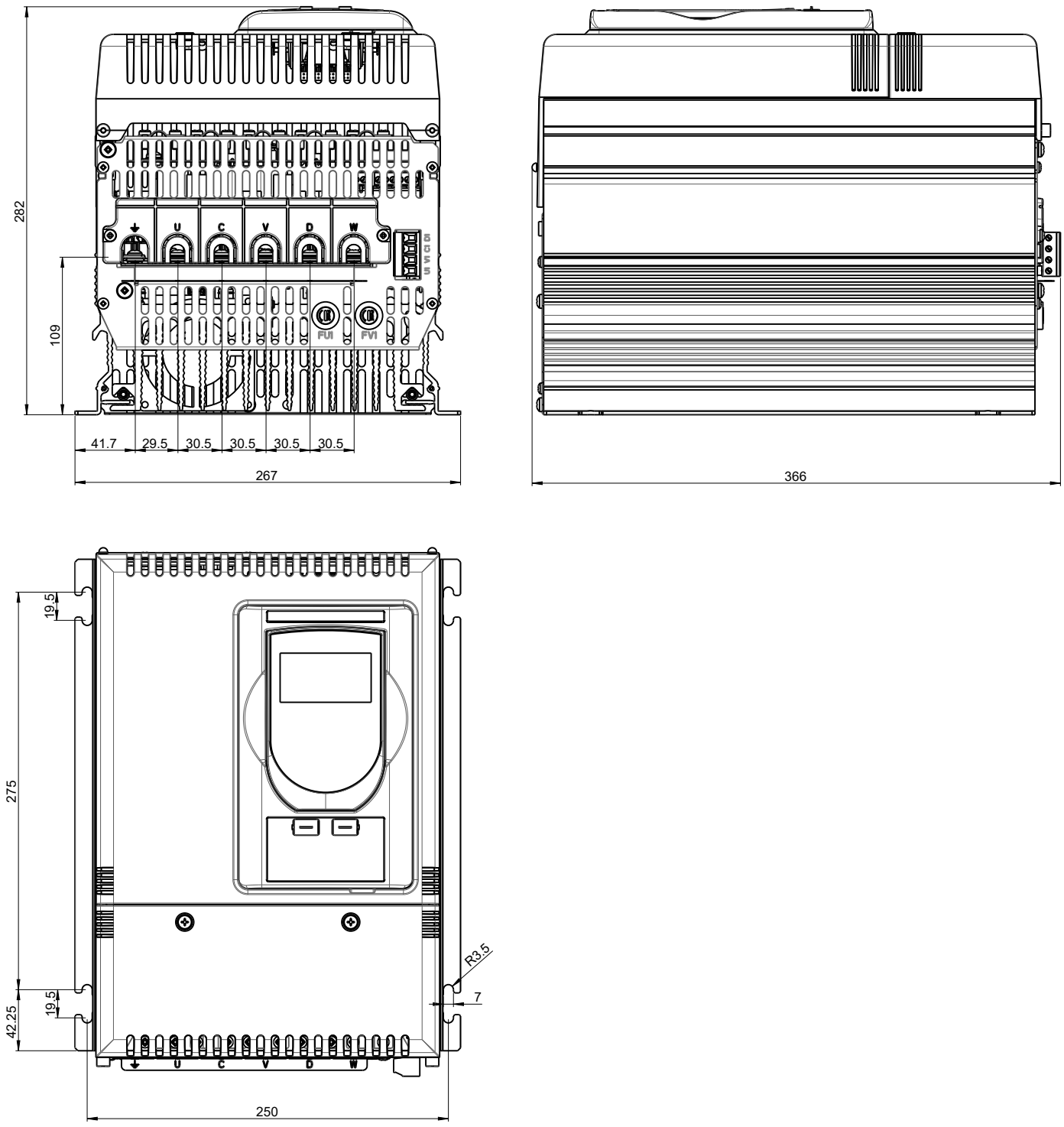


Figure 2-6: Overall dimensions Frame A2

Table 2-9: Dimensions Frame A2

DRIVE	DIMENSIONS W x H x d		WEIGHT	
	[mm]	[inches]	[kg]	[lb]
TPD500-...-00070-...-A	282 x 366 x 267	11.1 x 14.41 x 10.51	11.5	25.4

2.4.3 Frame A3

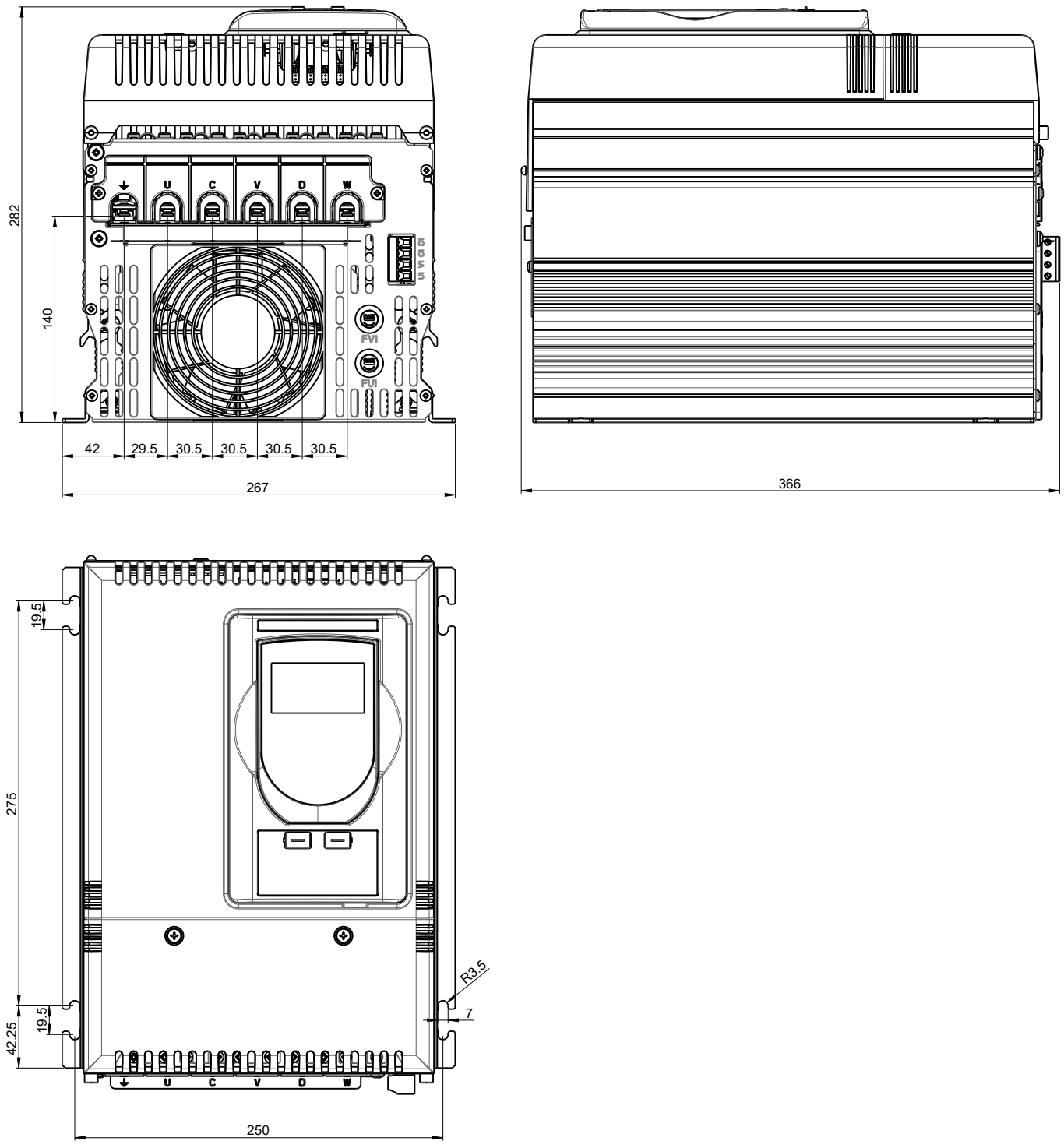


Figure 2-7: Overall dimensions Frame A3

Table 2-10: Dimensions Frame A3

DRIVE	DIMENSIONS W x H x d		WEIGHT	
	[mm]	[inches]	[kg]	[lb]
TPD500-...-00110-...-A	282 x 366 x 267	11.1 x 14.41 x 10.51	12	26.5
TPD500-...-00140-...-A				
TPD500-...-00185-...-A				

2.4.4 Frame B1

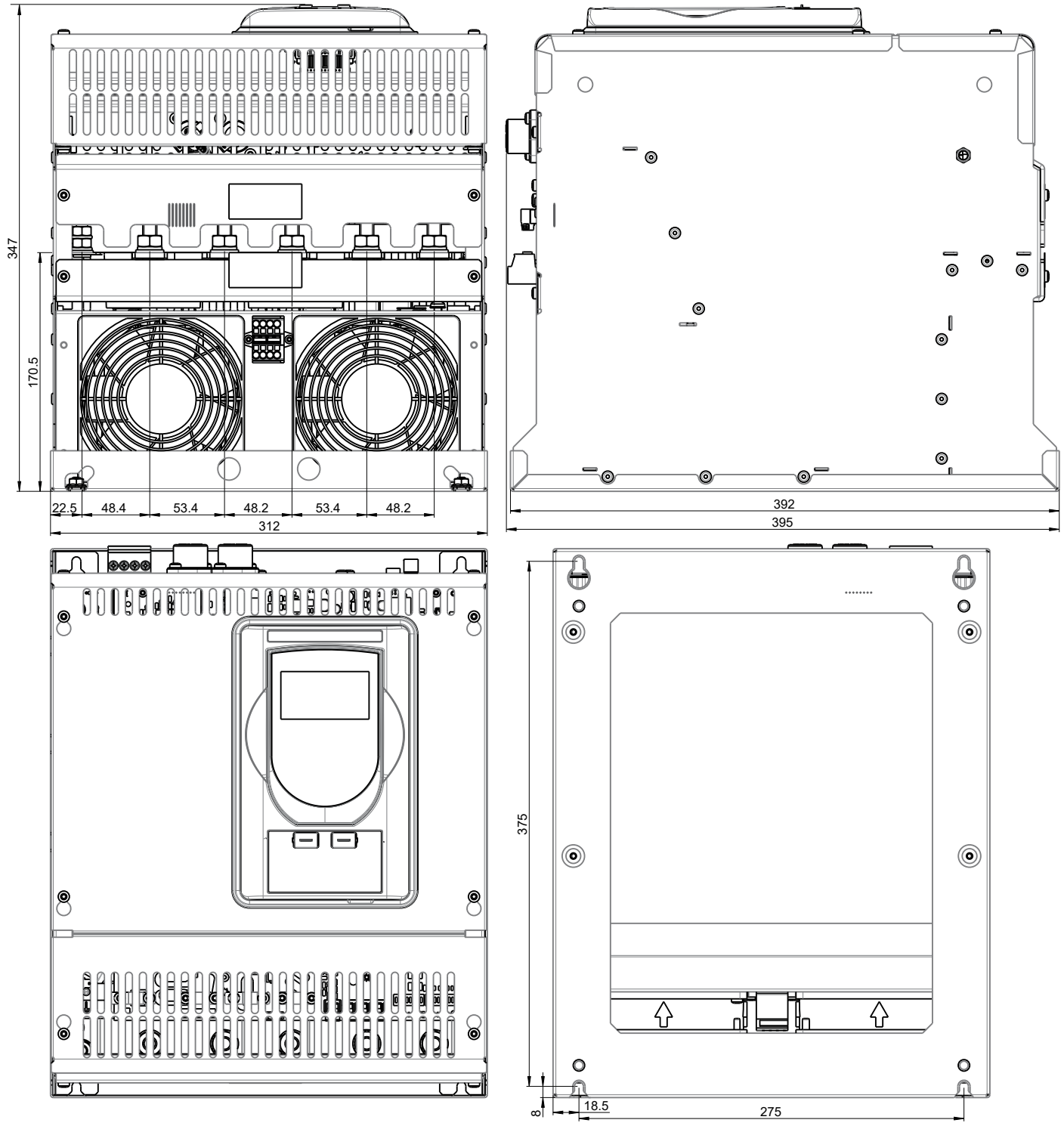


Figure 2-8: Overall dimensions Frame B1

Table 2-11: Dimensions Frame B1

DRIVE	DIMENSIONS W x H x d		WEIGHT	
	[mm]	[inches]	[kg]	[lb]
TPD500-...-00280-...-B	312 x 395 x 347	12.28 x 15.55 x 13.66	26	57.3
TPD500-...-00350-...-B				
TPD500-...-00420-...-B				
TPD500-...-00500-...-B				

2.4.5 Frame B2

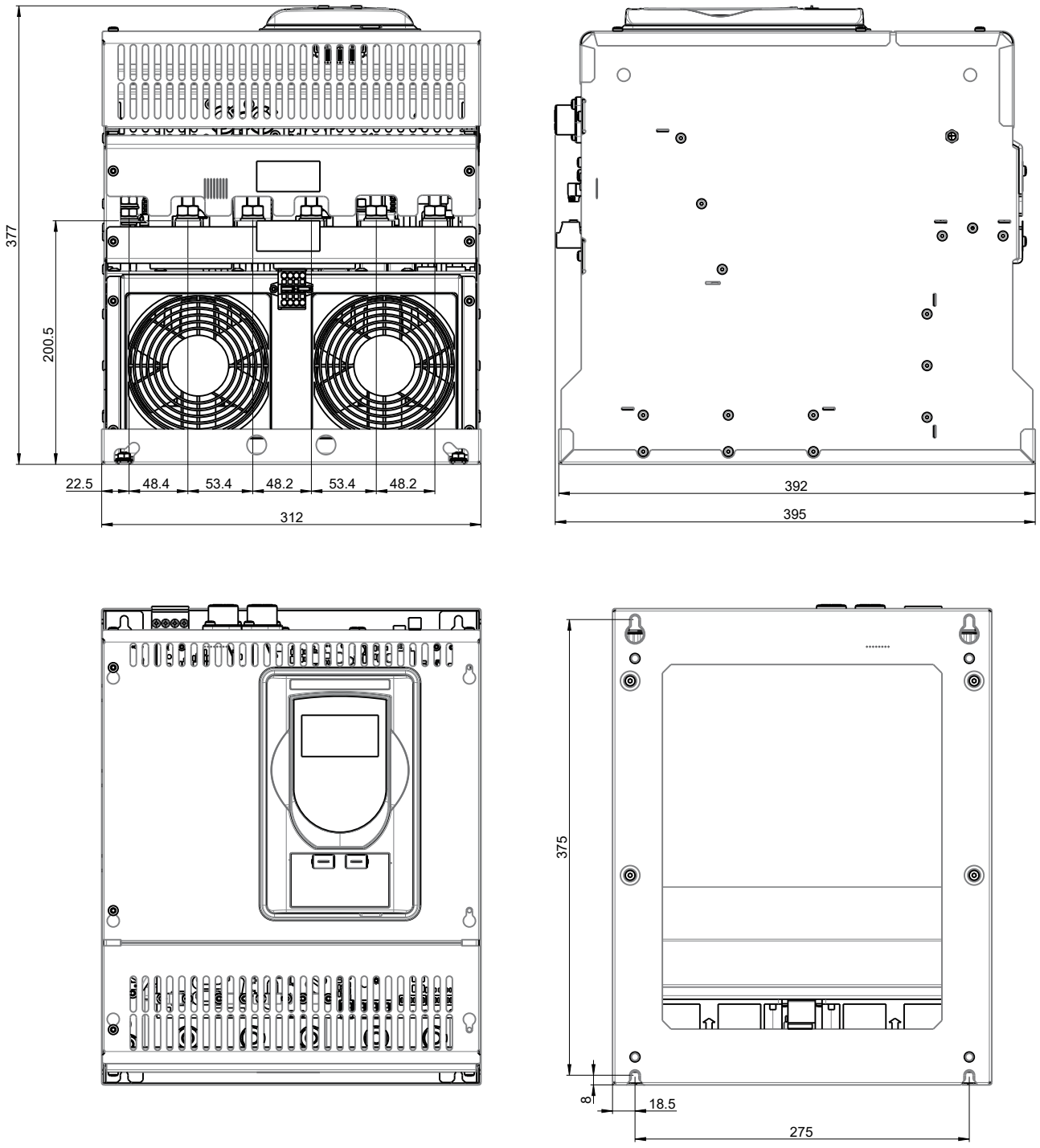


Figure 2-9: Overall dimensions Frame B2

Table 2-12: Dimensions Frame B2

DRIVE	DIMENSIONS W x H x d		WEIGHT	
	[mm]	[inches]	[kg]	[lb]
TPD500-...-00650-...-B	312 x 395 x 377	12.28 x 15.55 x 14.84	32	70.6

2.4.6 Frame C

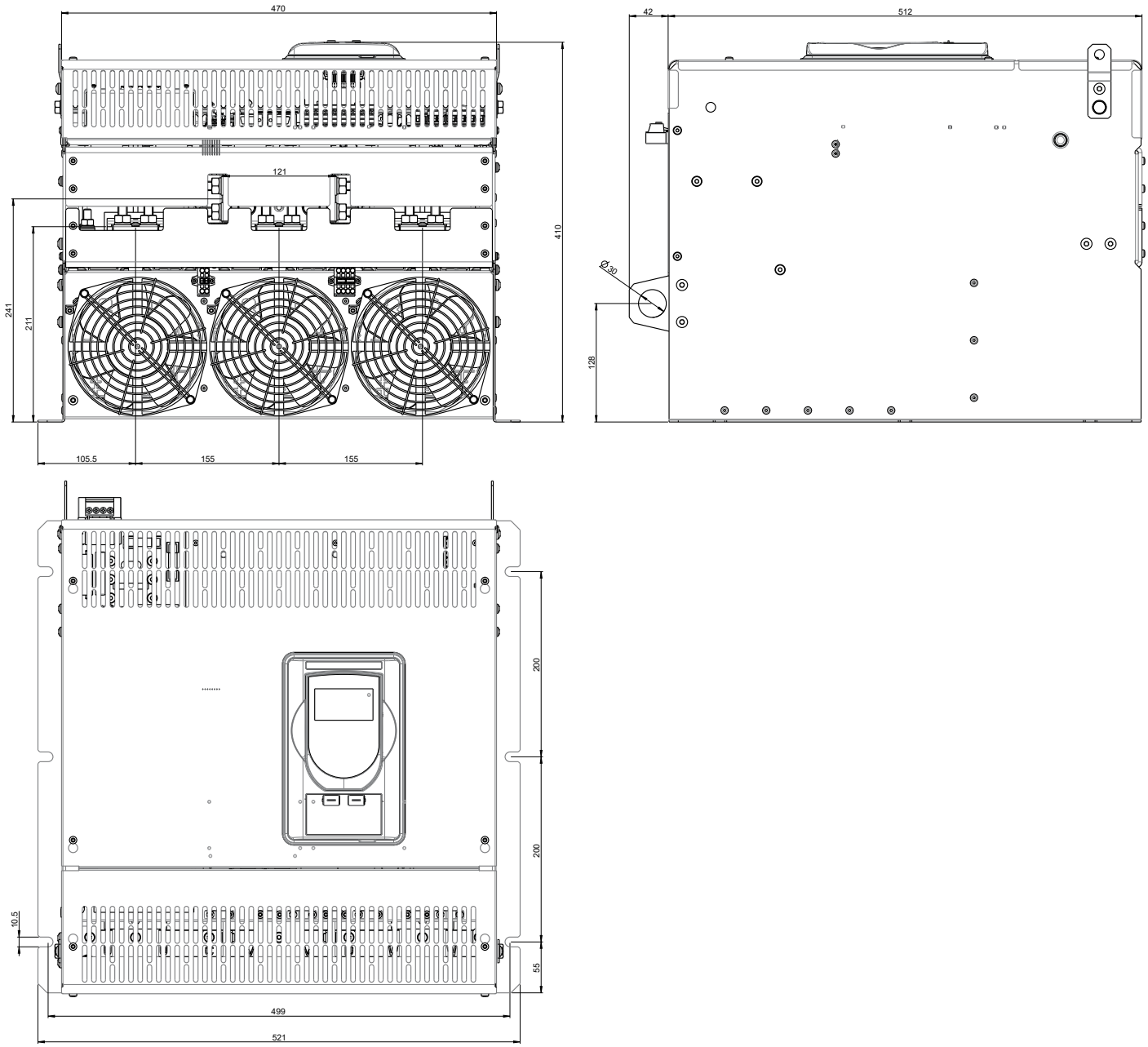


Figure 2-10: Overall dimensions Frame C

Table 2-13: Dimensions Frame C

DRIVE	DIMENSIONS W x H x d		WEIGHT	
	[mm]	[inches]	[kg]	[lbs]
TPD500-...-00560-...-C	521 x 512 x 410	20.51 x 20.16 x 16.14	61	134.5
TPD500-...-00700-...-C				
TPD500-...-00770-...-C				
TPD500-...-00900-...-C			65	143.3
TPD500-...-01000-...-C			72	158.7
TPD500-...-01050-...-C				

2.5 Power dissipation and internal fans

The power dissipated by the drive mainly depends on the output current. The power dissipation values shown in the following table refer to operation at nominal current.

NOTE! Installation must allow for a free space of at least 150 mm above and below the unit to ensure proper air circulation.

Fans with external power supply must be powered with a single-phase voltage of 230 V, 50/60 Hz (terminals U3/V3).

Table 2-14: Power dissipation – TPD500 Series

Code	Power dissipation P_v [W]	Fans		
		Voltage [V]	Rated current [A]	Airflow rate [m^3/h]
TPD500-...-00020-...-A	131	-	-	-
TPD500-...-00040-...-A	186	-	-	-
TPD500-...-00070-...-A	254	Internal power supply	Internal power supply	80
TPD500-...-00110-...-A	408	Internal power supply	Internal power supply	160
TPD500-...-00140-...-A	476	Internal power supply	Internal power supply	160
TPD500-...-00185-...-A	553	Internal power supply	Internal power supply	160
TPD500-...-00280-...-B	781	Internal power supply	Internal power supply	320
TPD500-...-00350-...-B	939	Internal power supply	Internal power supply	320
TPD500-...-00420-...-B	1038	Internal power supply	Internal power supply	320
TPD500-...-00500-...-B	1248	Internal power supply	Internal power supply	320
TPD500-...-00650-...-B	1693	Internal power supply	Internal power supply	680
TPD500-...-00560-...-C	2372	1ph 230	1	1050
TPD500-...-00700-...-C	3085	1ph 230	1	1050
TPD500-...-00770-...-C	2143	1ph 230	1	1050
TPD500-...-00900-...-C	3384	1ph 230	1	1050
TPD500-...-01000-...-C	2986	1ph 230	1	1050
TPD500-...-01050-...-C	3103	1ph 230	1	1050

2.6 DC motor drive operation

Separately excited DC motors require careful consideration of their electrical and mechanical characteristics, which are specific to a given operating range. The key points listed below must be taken into account to ensure proper operation and protection of these motors.

Essential data for connecting a motor to the drive

Before connecting the motor to the drive, the following nameplate data must be clearly known:
- Armature nominal voltage
- Armature nominal current
- Field nominal current
- Motor nominal speed

These parameters are essential for proper system sizing and correct drive configuration.

2.6.1 Overload

The drive is designed to supply the nominal current continuously (continuous duty).
In some applications, it may be necessary, for a few seconds, to exceed the nominal current, before returning to operating conditions below the nominal value.

This operating mode can be enabled by setting parameter IPA 4300-**Overload mode** = I2T_Drive (see the parameter description in section **6.18.8 Overload**).
Once this mode is active, the current-related parameters, normally limited to 100%, can accept values up to 150%.

The following table shows, for each drive size, the allowable overload currents and durations in this mode.

Table 2-15: Nominal overload currents

Code	I2T Drive		
	I_n [A]	I_{ovl} [A]	T_{ovl} [s]
TPD500-500-00020-2B-A	20	30	30
TPD500-500-00020-4B-A	20	30	30
TPD500-500-00040-2B-A	40	60	35
TPD500-500-00040-4B-A	40	60	35
TPD500-500-00070-2B-A	70	105	21
TPD500-500-00070-4B-A	70	105	21
TPD500-500-00110-2B-A	110	165	21
TPD500-500-00110-4B-A	110	165	21
TPD500-500-00140-2B-A	140	210	21
TPD500-500-00140-4B-A	140	210	21
TPD500-500-00185-2B-A	184	276	22
TPD500-500-00185-4B-A	184	276	22
TPD500-500-00280-2B-B	280	420	21
TPD500-500-00280-4B-B	280	420	21
TPD500-500-00350-2B-B	350	525	21
TPD500-500-00350-4B-B	350	525	21
TPD500-500-00420-2B-B	420	630	21
TPD500-500-00420-4B-B	420	630	21
TPD500-500-00500-2B-B	500	750	21
TPD500-500-00500-4B-B	500	750	21
TPD500-500-00650-2B-B	650	975	4
TPD500-500-00650-4B-B	650	975	4
TPD500-500-00770-2B-C	770	1155	9
TPD500-500-00770-4B-C	770	1155	9
TPD500-500-01000-2B-C	1000	1500	21
TPD500-500-01050-4B-C	1050	1575	23
TPD500-690-00560-2B-C	560	Not available	
TPD500-690-00560-4B-C	560		
TPD500-690-00700-2B-C	700	1050	5
TPD500-690-00700-4B-C	700	1050	5
TPD500-690-00900-2B-C	900	1350	8
TPD500-690-00900-4B-C	900	1350	8

If an overload cycle of 60 seconds every 10 minutes is to be considered, a derating of the nominal current must be applied for each drive size, as indicated in the following table.

Table 2-16: Nominal overload currents – 60 s every 10 min cycle

Code	I_n [A]	I_{nd} [A]	I_{ovl_60s} [A]
TPD500-500-00020-2B-A	20	17	25,5
TPD500-500-00020-4B-A	20	17	25,5
TPD500-500-00040-2B-A	40	35	52,5
TPD500-500-00040-4B-A	40	35	52,5
TPD500-500-00070-2B-A	70	56	84
TPD500-500-00070-4B-A	70	56	84
TPD500-500-00110-2B-A	110	88	132
TPD500-500-00110-4B-A	110	88	132
TPD500-500-00140-2B-A	140	112	168
TPD500-500-00140-4B-A	140	112	168
TPD500-500-00185-2B-A	184	148	222

TPD500-500-00185-4B-A	184	148	222
TPD500-500-00280-2B-B	280	224	336
TPD500-500-00280-4B-B	280	224	336
TPD500-500-00350-2B-B	350	280	420
TPD500-500-00350-4B-B	350	280	420
TPD500-500-00420-2B-B	420	336	504
TPD500-500-00420-4B-B	420	336	504
TPD500-500-00500-2B-B	500	400	600
TPD500-500-00500-4B-B	500	400	600
TPD500-500-00650-2B-B	650	450	675
TPD500-500-00650-4B-B	650	450	675
TPD500-500-00770-2B-C	770	560	840
TPD500-500-00770-4B-C	770	560	840
TPD500-500-01000-2B-C	1000	800	1200
TPD500-500-01050-4B-C	1050	850	1275
TPD500-690-00560-2B-C	560	360	540
TPD500-690-00560-4B-C	560	360	540
TPD500-690-00700-2B-C	700	490	735
TPD500-690-00700-4B-C	700	490	735
TPD500-690-00900-2B-C	900	650	975
TPD500-690-00900-4B-C	900	650	975

2.6.2 Motor protection

To protect the motor from overloads and malfunctions, it is essential to consider the following protection devices.

Motor thermal relay

The thermal overload relay must be installed upstream of the drive and sized correctly using the formula:

$$I_{DN} \cdot 0{,}82 \cdot 1{,}05$$

The relay contact can:
- block the drive directly via the control system;
- signal an external fault to the drive via terminal 15 (External Fault).

NOTE!

Please note that with a thermal relay, only motor heating due to overload can be controlled, but not that due to insufficient ventilation. For low-speed operation of the motor, we recommend the use of PTC thermistors or the insertion of thermal pads in the motor windings.

Thermistors and thermal pads

Thermistors or thermal pads can be connected to terminals 78 and 79 to monitor motor overheating. In the absence of a temperature sensor, an external 1 kΩ resistor must be connected to the terminals. It is essential to follow the connection instructions below.

- **Thermistors (PTC)**

  PTC thermistors, which comply with DIN 44081 or 44082, can be connected directly to terminals 78 and 79 of the converter. In this case, the 1 kΩ resistor between the terminals must be removed.

- **Thermal pad contacts (Klixon®)**

  The contacts of the Klixon® thermal pads integrated in the motor windings can:
  - block the drive via the auxiliary control circuits;
  - signal an alarm via terminals 78 and 79.

  In this case, the 1 kΩ resistor must be connected in series with the thermal pad contact.

Drive current limitation

The drive current limitation function is a crucial element in protecting the motor from inadmissible overloads. The current limit and overload control must be configured so that the current remains within acceptable values for the motor, thus ensuring safe and durable operation.

3. TRANSPORT, UNPACKING AND INSTALLATION

During handling, unpacking and installation of the device, follow the safety instructions provided in **Chapter 1 - SAFETY INSTRUCTIONS**.

NOTE!

During installation, the dimensions and weights specified in this manual must be taken into account. Appropriate handling equipment and tools must be used (such as hoists or cranes for heavy loads). Improper handling or the use of unsuitable tools may cause damage to the device and injury to personnel.

3.1 Transport and unpacking

TPD500 series drives are carefully packaged to ensure safe shipment. Transportation must be carried out using suitable equipment (refer to **Chapter 2.4 - Dimensions and weights**). These instructions also apply to devices that have been removed from their packaging for installation in control cabinets.

Upon delivery, immediately check the following:
- that the packaging is not visibly damaged;
- that the information on the delivery note matches the order placed.

CAUTION!

When removing the packaging, pay special attention to ensure that the desiccant bags do not remain stuck inside the unit. They may get caught in the fans or block the cooling openings, potentially causing the drive to overheat.

In case of damage, missing items, or incorrect delivery, promptly notify the relevant sales office.

Storage must take place exclusively in dry locations and within the temperature limits specified in this manual (refer to **Chapter 2.2.1 - Environmental conditions**).

NOTE!

Temperature fluctuations may cause condensation to form inside the device. This is acceptable under certain conditions (refer to **Chapter 2.2.1 – Environmental conditions**), but condensation is not permitted during operation. Therefore, always ensure that the device is completely free of condensation before applying power!

3.2 Installation

The device is an **Open Type** unit with IP20 protection rating, classified as UL Type 1, and does not provide protection against airborne contaminants. It is designed to operate in clean, dry environments (PD II classification – refer to **Chapter 2.2.1 - Environmental conditions**). Contaminants such as oils, corrosive vapors, or abrasive particles must not enter the installation cabinets.

The maximum allowable tilt during installation is 30° on all axes.

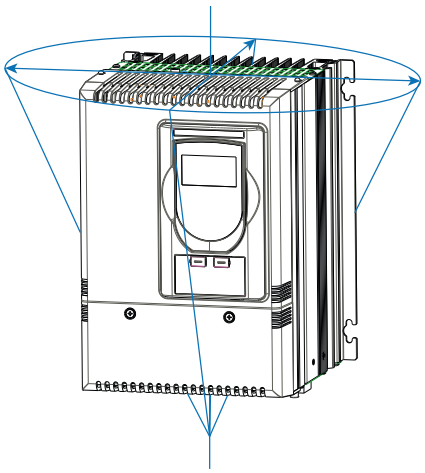


Figure 3-1: Maximum installation tilt

Drives must be installed in a way that ensures proper airflow around the units.
A minimum clearance of 150 mm must be maintained above and below the device, with at least 50 mm of free space at the front. On the sides, a minimum distance of 10 mm must be kept.
In addition, the drives must not be installed near equipment that generates heat.

NOTE! After a few days of operation, check the tightness of the terminal screws.

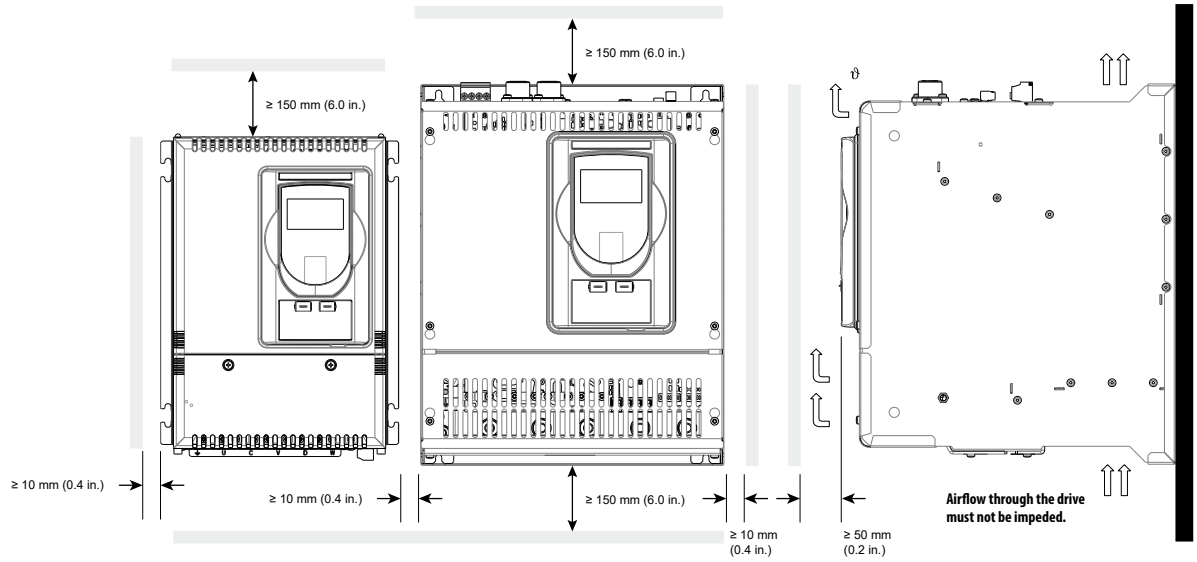


Figure 3-2: Mounting clearances

During installation and positioning of the equipment, it is recommended to consider not only the space required for proper heat dissipation, as shown in the figure, but also the space needed to ensure easy access to the device for installation, adjustment, and maintenance.
The equipment is mounted to the panel or wall using the screws specified in the following table.

FCONSTRUCTION TYPE	SCREWS
A, B	M6
C	M10

3.2.1 Disassembling the unit

This section provides detailed instructions for disassembling the device, allowing access to internal components for making the necessary connections (refer to **Chapter 4 - ELECTRICAL CONNECTION**), performing maintenance operations (refer to **Chapter 7 - MAINTENANCE**), and installing optional boards. It is essential to follow the instructions carefully to ensure proper and safe installation while preserving the integrity of the device.

WARNING! Follow the safety instructions provided in this manual. The devices can be opened without the use of force. Use only the tools specified.

3.2.1.1 Drive Frame A

On Frame A drives, both the lower protective cover and the power terminal cover must be removed to access the power terminals.

Removal of the power terminal cover

- Remove the two screws as shown, then slide the cover downward until it detaches from the frame.

TOOL	TIGHTENING TORQUE
PH2 screwdriver	1 Nm (8.9 lb·in)

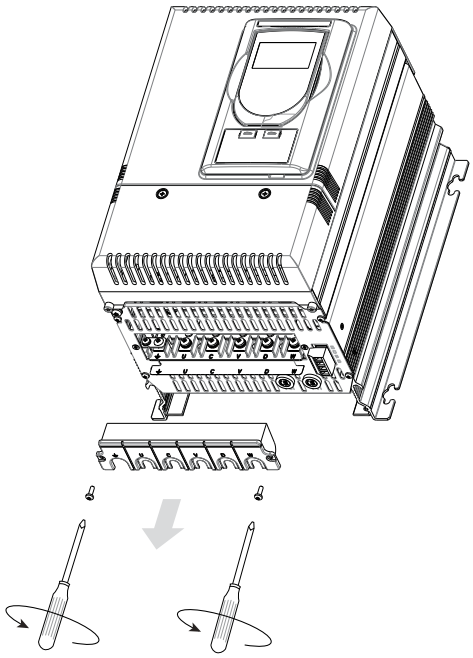


Figure 3-3: Removal of the power terminal protective cover – Frame A

Removal of the lower protective cover

- Remove the two screws as shown and, gently lifting along the upper edge, slide the cover downward until it detaches from the frame.

TOOL	TIGHTENING TORQUE
PH2 screwdriver	1.5 Nm (13 lb·in)

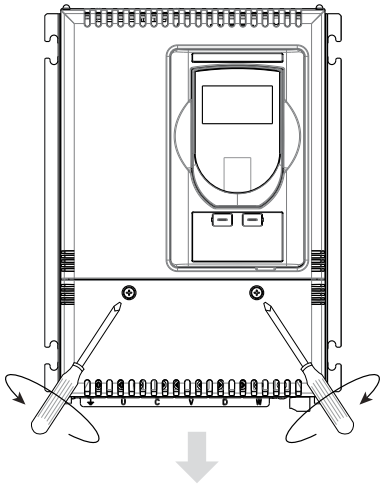


Figure 3-4: Removal of the lower protective cover – Frame A

3.2.1.2 Drive Frame B and C

- Loosen, but do not remove, the two screws securing the lower cover.
- Slide the cover downward until the screw heads align with the keyhole slots, then lift the cover to remove it from the frame.

TOOL	TIGHTENING TORQUE
Torx® T20 screwdriver	1.5 Nm (13 lb·in)

® Registered trademark of Camcar LLC, Acument Global Technologies

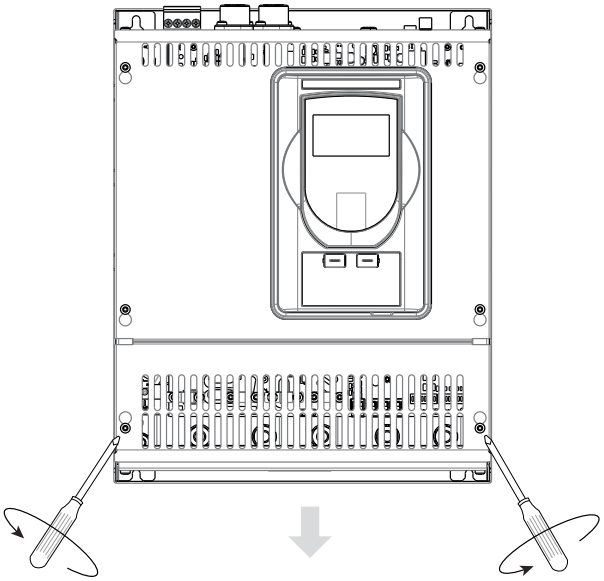


Figure 3-5: Removal of the lower protective cover – Frames B and C

4. ELECTRICAL CONNECTION

4.1 General information

TPD500 series drives are **Open Type** devices and offer no protection against environmental conditions. During installation, all necessary measures must be taken to protect the device from unsuitable environmental conditions (temperature, humidity, shock, etc.).

Electrical commissioning must be performed only by qualified personnel, who are also responsible for ensuring proper grounding and a protected power supply in compliance with local and national regulations.

WEG cannot assume responsibility for compliance with any national, local, or other codes regarding the correct installation of these devices or any associated equipment.
Failure to comply with applicable codes during installation may result in personal injury and equipment damage.

4.1.1 Electrical connection warnings

TPD500 series drives are designed to be powered by standard three-phase networks that are electrically symmetrical with respect to ground (TN or TT systems).
When supplied by IT networks, the use of a delta/star isolation transformer with the secondary neutral grounded is strictly required, in order to ensure proper operation and system insulation.

An example of the wiring is illustrated in the figure below.

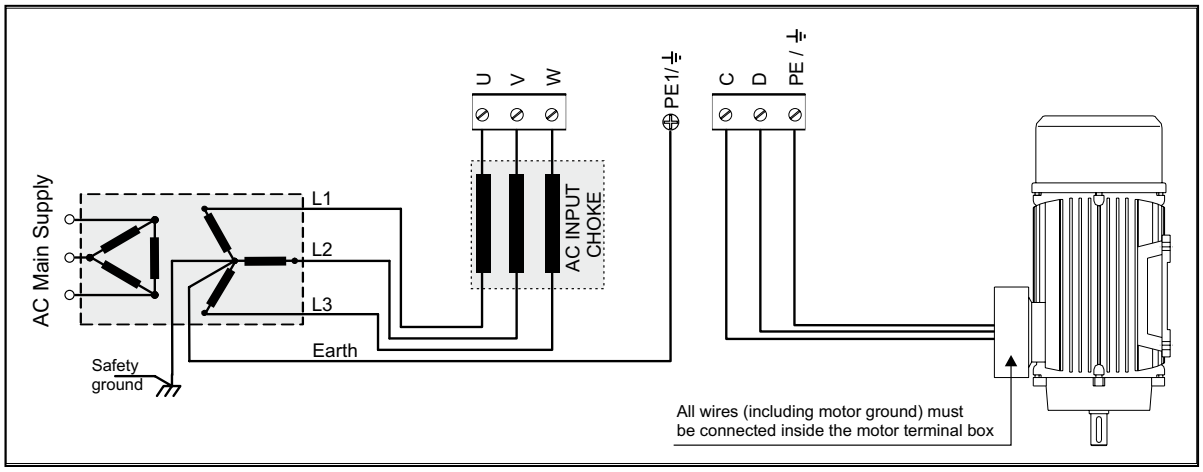


Figure 4-1: Wiring example

For IT networks, do not install an external EMI filter on the drive. The capacitors inside the standard EMI filter may become damaged and/or cause safety issues.

The power supply required for the control circuits, connected to terminals U2/V2, must come from an independent source, typically with one terminal grounded (PE).

Always connect the drive to protective earth (PE), using a properly sized cable in accordance with the applicable standards. Only permanent connections using cable rated for at least 75°C and compliant with the standards in force in the country of installation are allowed for system grounding.

TPD500 series drives and EMC filters have a leakage current to ground greater than 3.5 mA. If a residual current device (RCD) is required, use a Type B RCD.
Three-phase powered machines equipped with EMC filters must not be connected to the supply through an ELCB (Earth Leakage Circuit Breaker).

4.2 Device connection

The device must be connected according to the wiring diagrams shown below.

Control section potentials
The potentials of the control section are galvanically isolated from the power section.
As shown in **Figure 4-2: Control section potentials**, the connection between these sections can be visualized.

- The analog inputs are differential.
- The enable signals are isolated from the control section by optoisolators. Terminals 12 to 15 share terminal 16 as a common reference potential.
- The digital inputs are isolated from the control section by optoisolators. Terminals 31 to 34 share terminal 37 as a common reference potential.
- Terminal 11 is connected to the internal 0V potential, while terminal 10 is connected to ground.
- The analog outputs are isolated from the internal potential and share the same potential. When the optional TBO board is used, the potentials of the optional analog outputs are isolated from those of the standard outputs.
- The digital outputs share the same potential and are isolated via optoisolators. To operate them, a power supply must be connected to terminals 30 and 25.
- With the optional TBO board, the potentials of the optional digital outputs are separated from those of the standard outputs. In this case as well, a power supply must be connected to terminals 5 and 10.

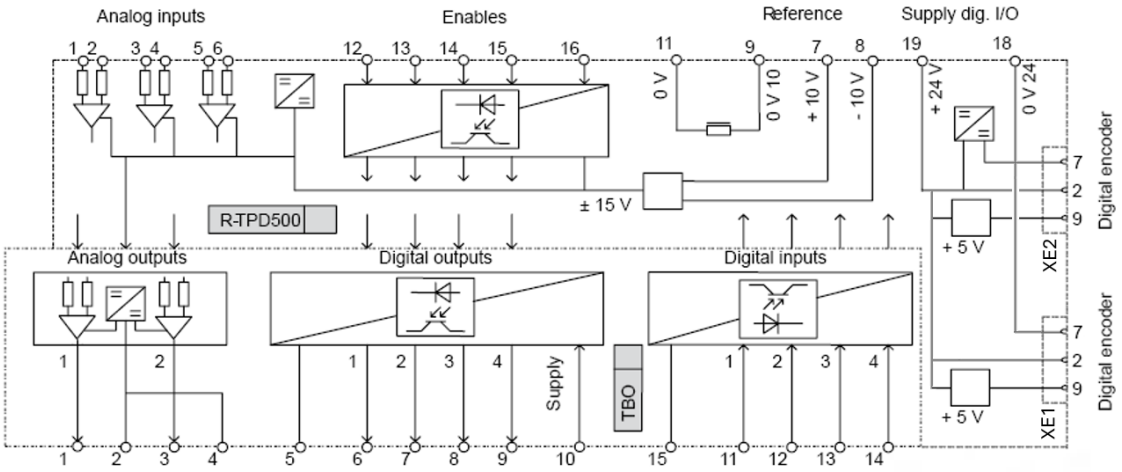


Figure 4-2: Control section potentials

External devices
For the installation of contactors, protection devices, inductors, filters, and other external components, refer to the drive connection diagrams provided in this manual, as well as to the specifications and instructions supplied by the respective component manufacturers.

Encoder wiring precautions
Encoder cables must be connected directly to the device, avoiding the use of intermediate terminal blocks.

Signal conductor shields should generally be grounded at both ends. However, for analog signals and digital signals with very long cable runs (outside the electrical cabinet), it is preferable to ground only the converter side to prevent interference caused by ground loop currents.
In specific cases, it may be necessary to ground the shield at both ends, ensuring equipotential bonding between the grounding points using appropriate bonding cables.

The encoder cable must consist of twisted pairs with an overall shield connected to ground. It is recommended to avoid grounding the shield at the motor-side connector.
In extreme cases (e.g., cable lengths exceeding 100 meters or the presence of strong electromagnetic interference), it may be necessary to use a cable with individual shields for each pair, connected to the power supply ground.

4.2.1 Typical wiring diagram

A typical two-button wiring diagram (Start – S2 and Stop – S11) is shown below, based on the factory configuration (IPA 500-**Main commands** = Terminals).

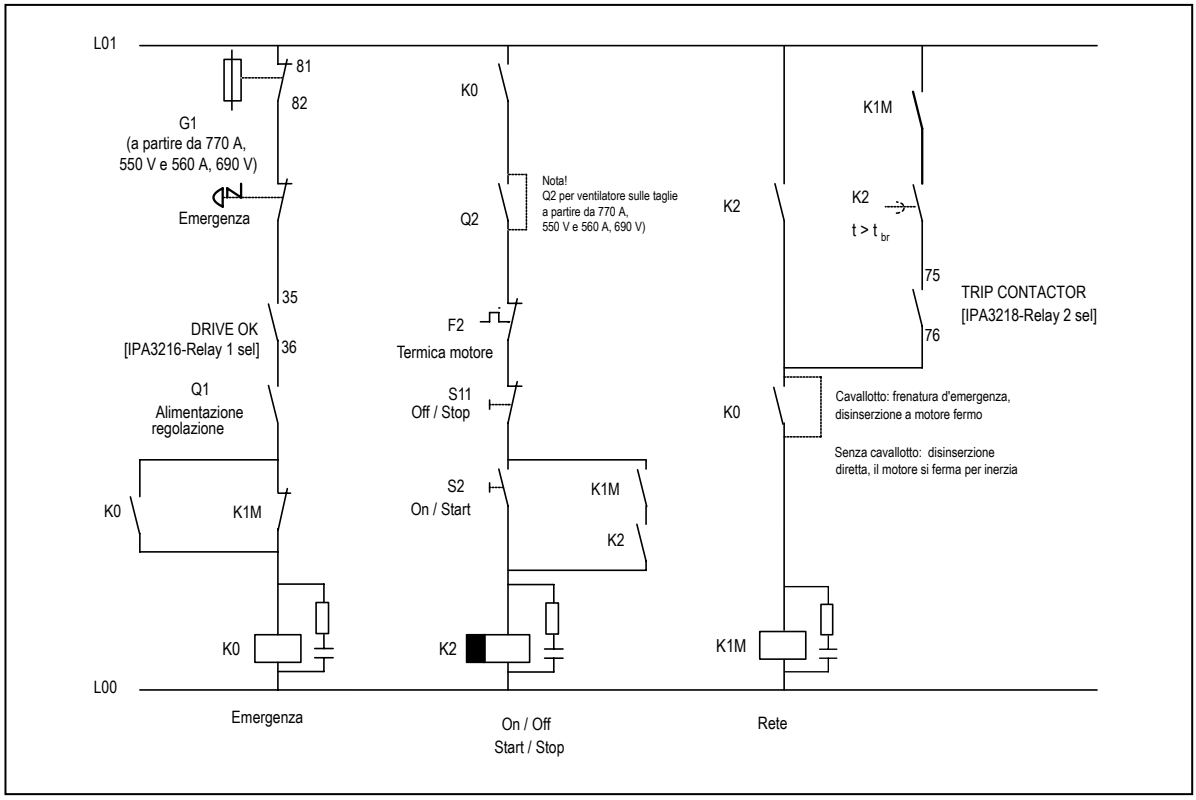


Figure 4-3: Command sequence

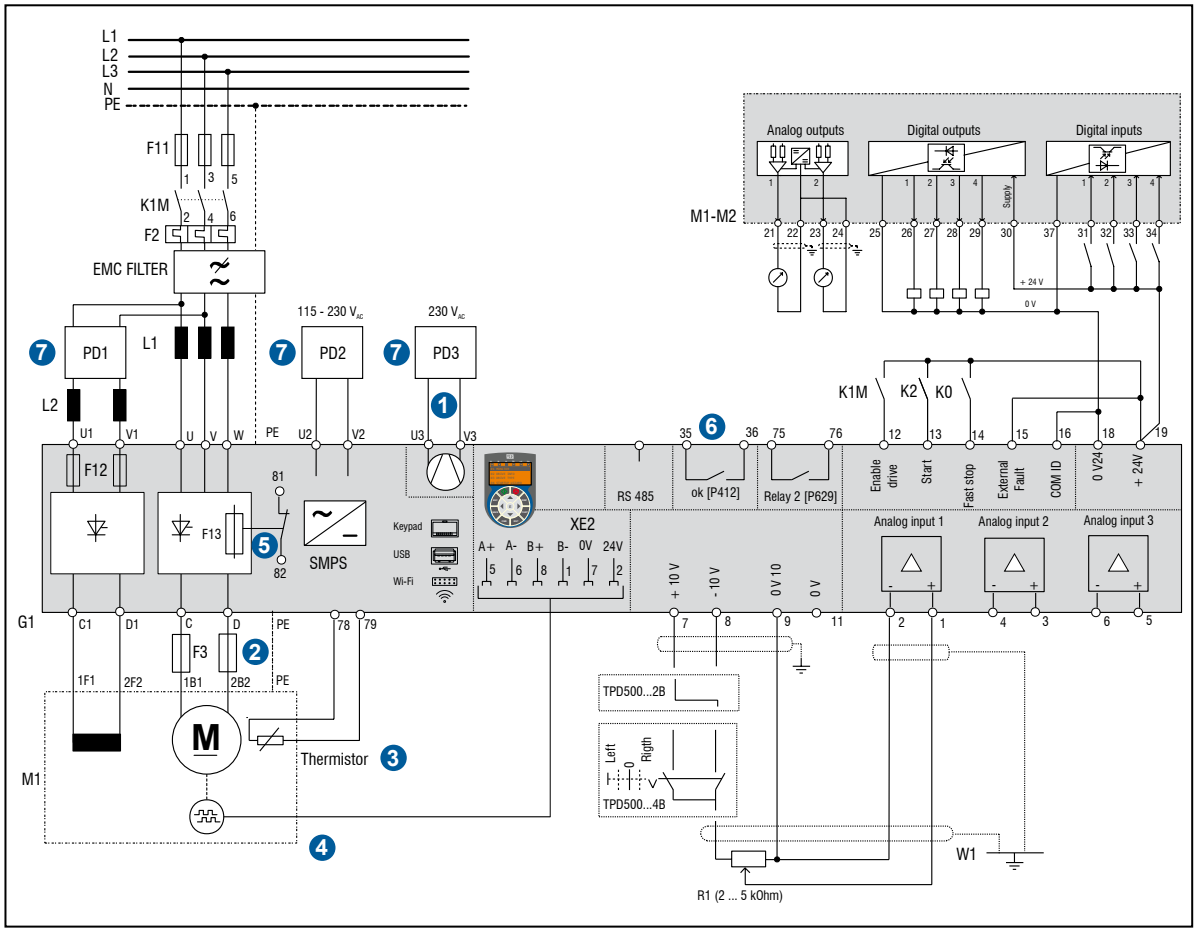


Figure 4-4: Typical wiring diagram

[1] Ventilation units powered externally only for Frame C.
[2] Fuses required only for TPD500-...-4B-... drives, Frame A and B.
[3] A 1 kΩ resistor must be connected when the thermistor is not present.
[4] The connections shown refer to the 24 V digital encoder XE2. For more information on encoder configuration, refer to **Chapter 4.4 - Regulation and control section**.
[5] Only for Frame C.
[6] On the FIR power board...
[7] PDx is a generic line protection device (circuit breaker, fuses, etc.) that must be selected in compliance with local regulations applicable in the country of installation. For North America (cULus), refer to **Chapter 4.10 - Protections**.

NOTE! The connections for the digital encoder XE1 and the tachogenerator are shown separately.

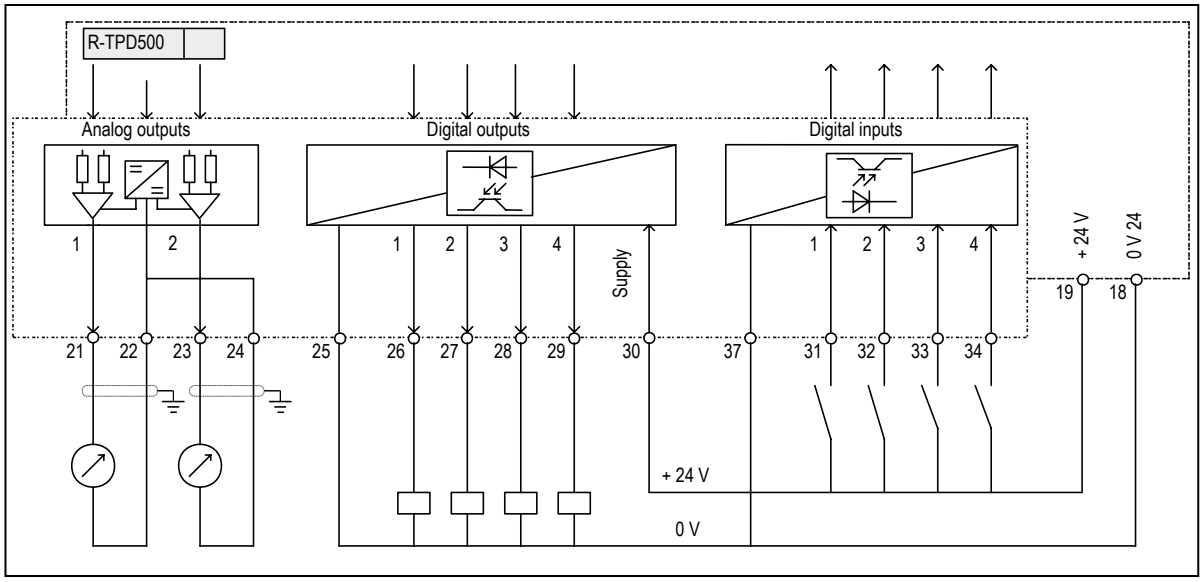


Figure 4-5: Relay and contact wiring with internal power supply

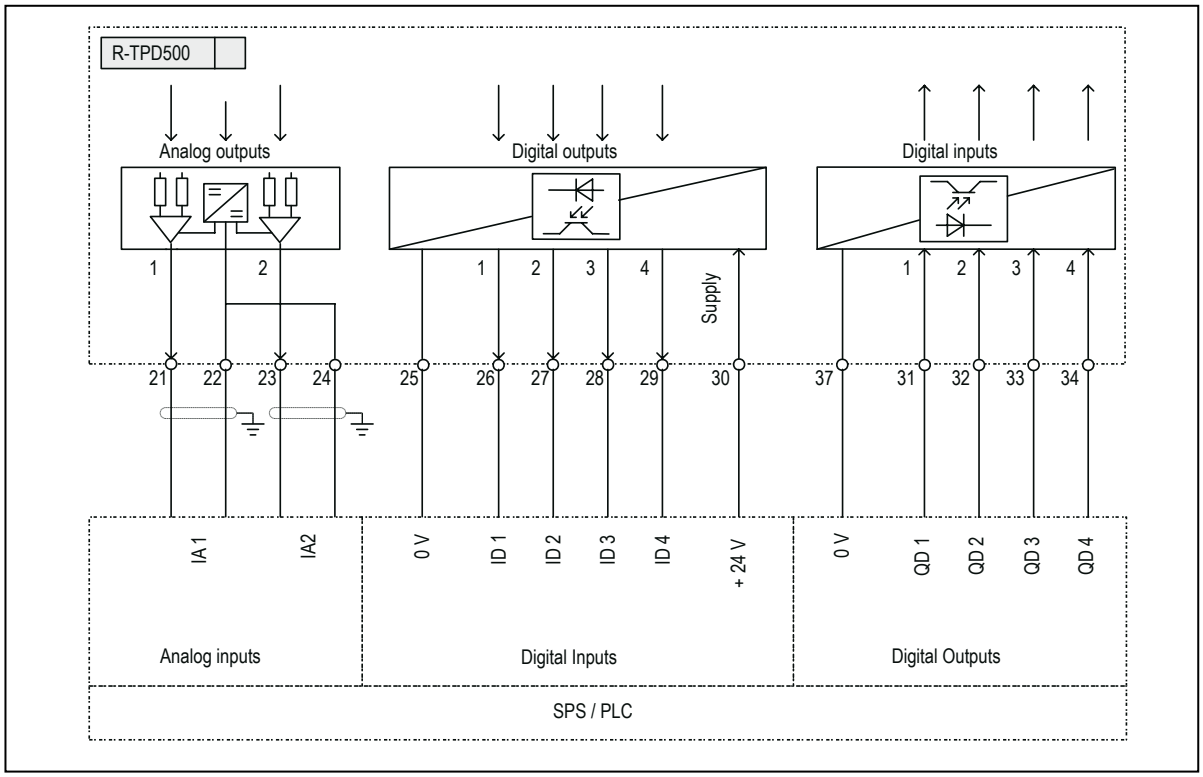


Figure 4-6: Relay and contact wiring with external power supply (PLC)

4.3 Power section

The indicated cable cross-sections, provided as a guideline for the installer, have been determined based on the following parameters, in accordance with UL61800-5-1 and EN61800-5-1 standards:

- definition of the machine's rated current;
- 125% oversizing of the considered current;
- selection of the equivalent cable cross-section rated for 75°C, according to the standard table, rounded up to the next size.

The resulting value represents the "nominal" cross-section to be considered, calculated in compliance with the drive's safety requirements. The installer is responsible for calculating the actual cable cross-sections during installation, in accordance with the regulations in force in the country of use.

NOTE! Only stranded copper conductors with a minimum temperature rating of 75°C are recommended.

Table 4-1: Terminal description

DESIGNATION	FUNCTION	I/O	MAX VOLTAGE	MAX CURRENT	MIN CURRENT (recommended)
U, V, W	Armature circuit mains connection	I	3 x 690 Vac ± 10%	**Chapter 2.3 – Electrical data**	-
C, D	Armature connection	O	**Chapter 2.3 – Electrical data**		-
U1, V1	Field circuit mains connection	I	1 x 500 Vac ± 10%		-
C1, D1	Field circuit connection	O	390 Vdc		-
U2, V2	Control board power supply	I	1 x 115 Vac ±10% 1 x 230 Vac ±10%	1 Aac 0,5 Aac	-
U3, V3	Internal fan connection (Frame C drives only)	I	1 x 230 Vac	**Chapter 2.5 – Power dissipation and internal fans**	-
35, 36 [1] [2]	Potential-free contact of relay 1 (DRIVE OK), configurable via IPA 3216-**Relay 1 sel**	O	250 Vac	1 A AC11	100 mA
75, 76 [1] [2]	Potential-free contact of relay 2 (TRIP CONTACTOR), configurable via IPA 3218-**Relay 2 sel**	O	250 Vac	1 A AC11	100 mA
78, 79	Connection for the thermistor	I	-	-	-
81, 82	Indication of internal ultrafast fuse tripping (Frame C drives only)	O	250 Vac	1 A AC11	50 mA

[1] To maintain reinforced insulation, the relay outputs and the fuse trip signal terminals must not be connected to a SELV (Safety Extra-Low Voltage) power supply or signal.
[2] For North America market (cULus) the relay outputs and the fuse trip signal terminals shall be connected to the same source as terminals U2 and V2. This source must be rated 115/230 Vac.

Table 4-2: Connection type and technical data

DRIVE	CONNECTION TYPES AND DIMENSIONS				WIRE STRIPPING	The maximum cable dimensions refer to the rated current with stranded copper wires at 75°C. If a load requiring a lower current is used, the installer must calculate the cable dimensions according to national codes.												
							U, V, W				C, D				PE			
TPD500		U, V, W	C, D	PE	[mm]	AWG min	Cable [AWG]	Tightening torque [Nm]	LUG (North America) ILSCO [1]	LUG (North America) BURNDY [1]	Cable [AWG]	Tightening torque [Nm]	LUG (North America) ILSCO [1]	LUG (North America) BURNDY [1]	Cable [AWG]	Tightening torque [Nm]	LUG (North America) ILSCO [1]	LUG (North America) BURNDY [1]
500-00020-xB-A	Screw	M5	M5	M5	-	-	10	3.5	BRBR-10-14-P50	YAV10T3BOX	10	3.5	BRBR-10-14-P50	YAV10T3BOX	10	3.5	BRBR-10-14-P50	YAV10T3BOX
500-00040-xB-A	Screw	M5	M5	M5	-	-	8	3.5	CSWS-8-14	YA8CL1BOX	8	3.5	CSWS-8-14	YA8CL1BOX	8	3.5	CSWS-8-14	YA8CL1BOX
500-00070-xB-A	Screw	M5	M5	M5	-	-	4	3.5	CSWS-4-14	YA4CLBOX	3	3.5	CSWS-3-14	-	6	3.5	CSWS-4-14	YA4CLBOX

500-00110-xB-A	Terminal block [2]	-	-	-	17	6	1/0	9	-	-	1/0	9	-	-	2	9	-	-
500-00140-xB-A	Terminal block [2]	-	-	-	17	6	2/0	9	-	-	2/0	9	-	-	2	9	-	-

DRIVE	**CONNECTION TYPES AND DIMENSIONS**				**WIRE STRIP-PING**	The maximum cable dimensions refer to the rated current with stranded copper wires at 75°C. If a load requiring a lower current is used, the installer must calculate the cable dimensions according to national codes.												
						U, V, W				**C, D**				**PE**				
TPD500		**U, V, W**	**C, D**	**PE**	**[mm]**	**AWG min**	**Cable [AWG]**	**Tightening torque [Nm]**	**LUG (North America) ILSCO [1]**	**LUG (North America) BURNDY [1]**	**Cable [AWG]**	**Tightening torque [Nm]**	**LUG (North America) ILSCO [1]**	**LUG (North America) BURNDY [1]**	**Cable [AWG]**	**Tightening torque [Nm]**	**LUG (North America) ILSCO [1]**	**LUG (North America) BURNDY [1]**
500-00280-xB-B	Bar (bolt / nut)	M10	M10	M8	-	-	2x1/00	25	CSWS-1/0-12	Y25L6	2x3/00	25	CSWS-3/0-12	YA27L BOX	1/0	15	CSWS-1/0-38	YA25L BOX
500-00350-xB-B	Bar (bolt / nut)	M10	M10	M8	-	-	2x3/00	25	CSWS-3/0-12	YA27L BOX	2x4/00	25	CSWS-4/0-12	YA28L BOX	3/0	15	CSWS-3/0-38	YA27L 4BOX
500-00420-xB-B	Bar (bolt / nut)	M10	M10	M8	-	-	2x4/00	25	CSWS-4/0-12	YA28L BOX	2x3/00	25	CSWS-300-12	YA30L	4/0	15	CSWS-4/0-38	YA28L 4BOX
500-00500-xB-B	Bar (bolt / nut)	M10	M10	M8	-	-	2x3/00	25	CSWS-300-12	YA30L	2x4/00	25	CSWS-400-12	YA32LN	300	15	CSWS-300-38	YA30L24
500-00650-xB-B	Bar (bolt / nut)	M10	M10	M8	-	-	2x4/00	25	CSWS-400-12	YA32LN	2x6/00	25	CSWS-600-12	YA36L11	400	15	CSWS-400-38	YA32L14
500-00770-xB-C	Bar (bolt / nut)	M10	M10	M8	-	-	4x2/50	25	CSWS-250-12	YA29L BOX	4x3/50	25	CSWS-350-12	YA31L	2x2/50	15	CSWS-250-38	YA29L4
500-01000-xB-C	Bar (bolt / nut)	M10	M10	M8	-	-	4x4/00	25	CSWS-3/0-12	YA32LN	4x6/00	25	CSWS-400-38	YA36L11	2x4/00	15	CSWS-3/0-38	YA32L14
690-00560-xB-C	Bar (bolt / nut)	M10	M10	M8	-	-	4x3/00	25	CSWS-3/0-12	YA27 BOX	4x4/00	25	CSWS-3/0-38	YA28L BOX	2x3/00	15	CSWS-4/0-38	YA27L 4BOX
690-00700-xB-C	Bar (bolt / nut)	M10	M10	M8	-	-	4x4/00	25	CSWS-4/0-12	YA28L BOX	4x3/00	25	CSWS-4/0-38	YA30L	2x4/00	15	CSWS-300-38	YA28L 4BOX
500-00900-xB-C	Bar (bolt / nut)	M10	M10	M8	-	-	4x3/50	25	CSWS-350-12	YA31L	4x5/00	25	CSWS-500-12	YA34L6	2x3/50	15	CSWS-350-38	YA31L11

[1] Crimping tool reference: ILSCO – https://www.ilsco.com/ and BURNDY – https://www.hubbell.com/burndy

[2] Terminal block with bare wire

NOTE!

TPD500 series drives comply with North American standards only when installed using the cable lugs specified in the table. These lugs must be tightened according to the parameters and using the tools specified in the documentation provided by the manufacturers.

For convenience, note [1] below Table **4-2: Connection types and technical data** includes a link to the manufacturer's website, where the technical specifications and required installation tools can be found.

If cables with a smaller cross-section than the nominal one are used, the wiring can be adapted to the actual required cross-section by calculating the new section according to the following table.

Table 4-3: Cable sizing criteria

AWG CABLE	CABLE CROSS-SECTION [mm²]	75°C (167°F)
		AMPACITY [A] Copper [1]
24	0.2	-
22	0.3	-
20	0.5	-
18	0.8	-
16	1.3	-
14	2.1	15
12	3.3	20
10	5.3	30
8	8.4	50
6	13.3	65
4	21.2	85
3	26.7	100
2	33.6	115
1	42.4	130
1/0	53.4	150
2/0	67.4	175
3/0	85.0	200
4/0	107.2	230
250	127	255
300	152	285
350	177	310
400	203	335
500	253	380
600	304	420
700	355	460
750	380	475
800	405	490
900	456	520
1000	506	545
1250	633	590
1500	760	625
1750	887	650
2000	1013	665

[1] The listed values are the rated current multiplied by a factor of 1.25.

4.4 Control and regulation section

In the standard delivery configuration, only dip-switch **S15** is preset correctly. Dip-switches **S14** and **S4** must be configured according to the specific application (motor and tachogenerator data, if present).

NOTE! If the control board is supplied as a spare part, dip-switch **S15** must also be configured to select the appropriate drive size.

4.4.1 R-TPD500 control board

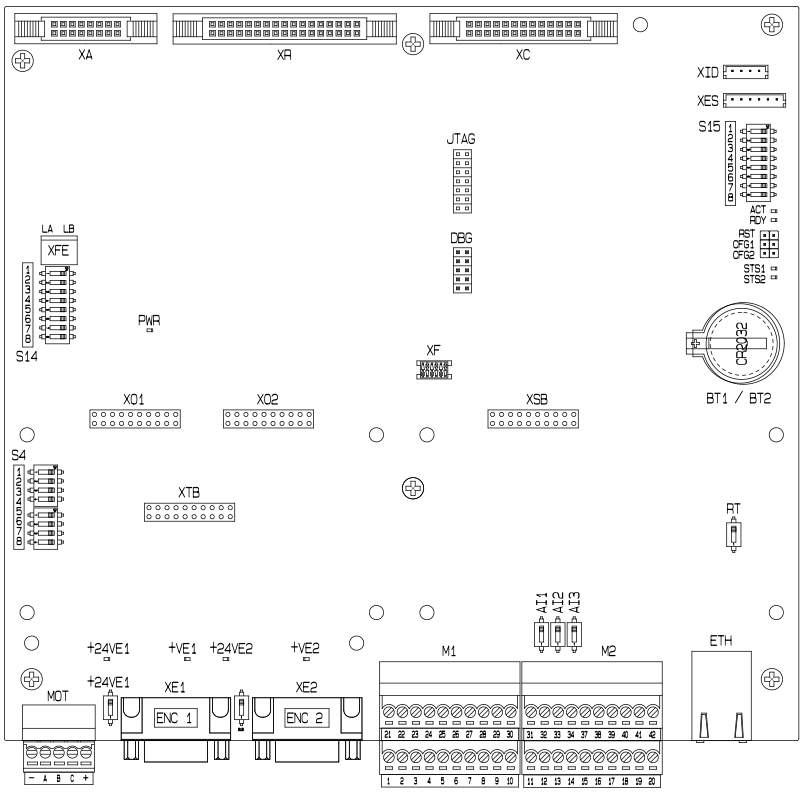


Figure 4-7: Topographic layout of components on the R-TPD500 control board (Rev. E)

Table 4-4: LEDs on the control board

REFERENCE	FUNCTION
PWR	**Control board power supply XA connection (+24V, ±15V, +5V)**
	OFF: Power supply not present or out of tolerance **ON**: Power supply not present or in tolerance
RDY	**Digital control board power supply (+3V3, RESET)**
	OFF: Power supply in tolerance, board in RESET mode **ON**: Power supply in tolerance, board in READY mode
ACT	**SCR Pilot Monitor**
	OFF: SCR control deactivated **ON**: SCR control active
STS1	**Status LED – uController Motion Control (DSP)**
	BOOT mode: 1s flash (asymmetrical) **NORMAL operation**: 1s flash (symmetrical) **R&D test**: uncoded flash (reserved)
STS2	**Status LED – uController Human Interface (HMI)**
	BOOT mode: 1s flash (asymmetrical) **NORMAL operation**: 1s flash (symmetrical) **R&D test**: uncoded flash (reserved)
+VE1 / +VE2	**Encoder power supply 1/2 (+5V)**
	OFF: Power output disabled **ON**: Power output enabled
+24VE1 / +24VE2	**Encoder power supply 1/2 (+24V)**
	OFF: Power output disabled **ON**: Power output enabled

Table 4-5: Jumpers and Dip-Switches on the control board

REFERENCE	FUNCTION	FACTORY SETTING
RST	**Regulation board hardware RESET**	**OPEN**
	Not used (only for R&D tests)	
CFG1	**Configuration Jumper – uController Motion Control (DSP)**	**OPEN**
	Not used (only for R&D tests)	
CFG2	**Configuration Jumper – uController Human Interface (HMI)**	**OPEN**
	Not used (only for R&D tests)	
AI1 (terminals1-2) **AI2 (terminals 3-4)** **AI3 (terminals 5-6)**	**Analogue input V/I selection**	**OFF**
	OFF: Voltage (0 ... 10V / -10 ... +10V) **ON**: Current (0 ... 20 mA / 4 ... 20 mA)	
+24VE1 / +24VE2	**Encoder power supply 1/2 (+24V)**	**ON**
	OFF: Power output disabled **ON**: Power output enabled	
RT	**Enabling RS485 serial interface termination resistor**	**ON**
	OFF: Resistance not switched on **ON:** Resistance switched on (120 Ω)	
S4	**Tachometer input voltage selection**	
	Refer to **Table 4-6: Dip-switch S4 - Tacho Response Input Voltage Adaptation**	
S14	**Rated field current selection**	
	See **Chapter 2.3.3 - Field Circuit Calibration**	
S15	**Selection/configuration of control board (drive size setting)**	
	See **Table 4-7: Dip-switch S15 - Factory setting of appliance size**	

NOTE! For improved readability in the following tables, the **OFF** state of the dip switches is denoted by the symbol "–".

Table 4-6: Dip-switch S4 - Tachogenerator feedback input voltage adjustment

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	-
90.7	ON	ON	-	-
181.6	ON	-	-	-
302.9	-	-	-	-

Table 4-7: Dip-switch S15 - Factory setting of the drive size

NOTE! **S15** configuration is factory-set. Do not modify.

Standard	S15-8	S15-7	S15-6	S15-5	S15-4	S15-3	S15-2	S15-1
TPD500-500-00020-...-A	-	ON	-	-	-	-	-	-
TPD500-500-00040-...-A	-	ON	-	-	-	-	-	ON
TPD500-500-00070-...-A	-	ON	-	-	-	-	ON	-
TPD500-500-00110-...-A	-	ON	-	-	-	-	ON	ON
TPD500-500-00140-...-A	-	ON	-	-	-	ON	-	-
TPD500-500-00185-...-A	-	ON	-	-	-	ON	-	ON
TPD500-500-00280-...-B	-	ON	-	-	-	ON	ON	-
TPD500-500-00350-...-B	-	ON	-	-	-	ON	ON	ON
TPD500-500-00420-...-B	-	ON	-	-	ON	-	-	-
TPD500-500-00500-...-B	-	ON	-	-	ON	-	-	ON
TPD500-500-00650-...-B	-	ON	-	-	ON	-	ON	-
TPD500-500-00770-...-C	-	ON	-	-	ON	-	ON	ON
TPD500-500-01000-2B-C	-	ON	-	-	ON	ON	-	-
TPD500-500-01050-4B-C	-	ON	-	-	ON	ON	-	-
TPD500-690-00560-2B-C	ON	-	-	ON	ON	-	ON	-
TPD500-690-00560-4B-C	ON	-	-	ON	-	ON	ON	-
TPD500-690-00700-2B-C	ON	-	-	ON	ON	-	ON	ON
TPD500-690-00700-4B-C	ON	-	-	ON	-	ON	ON	ON
TPD500-690-00900-2B-C	ON	-	-	ON	ON	ON	-	-
TPD500-690-00900-4B-C	ON	-	-	ON	ON	-	-	-

4.2 Terminal blocks

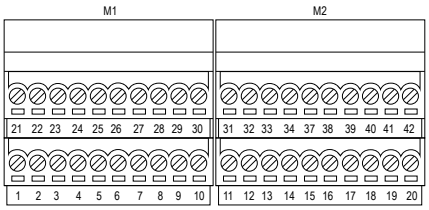


Figure 4-8: Layout of terminals 1 to 42

Table 4-8: Meaning of terminal block signals (terminals 1 to 20)

TERMINAL / DESCRIPTION	FUNCTION	I/O	MAX VOLTAGE	MAX CURRENT
1+2 Analog input 1	Configurable differential analogue input Signal: terminal 1 Reference: terminal 2 Factory-configured for **Ramp ref 1***	I	±10 V	0.25 mA - voltage reference 20 mA - current reference
3+4 Analog input 2	Configurable differential analogue input Signal: terminal 3 Reference: terminal 4 Not pre-configured at factory*	I	±10 V	0.25 mA - voltage reference 20 mA - current reference
5+6 Analog input 3	Configurable differential analogue input Signal: terminal 5 Reference: terminals 6 Not factory-configured*	I	±10 V	0.25 mA - voltage reference 20 mA - current reference
7 +10 V	Reference voltage +10 V Reference potential: terminal 9	O	+10 V	10 mA
8 -10 V	Reference voltage -10 V Reference potential: terminal 9	O	-10 V	10 mA
9 0 V 10	Reference for voltages at terminals 7 and 8	-	-	-
10	Screen connection (PE) (connected with metal housing)	-	-	-
11	0V internal	-	-	-
12 Enable drive	General converter unlock 0V Converter locked +15 ... +30 V Converter unlocked	I	+30 V	3.2 mA @15 V 5 mA @24 V 6.4 mA @30 V
13 Start	Start command 0V None Start +15 ... +30 V Start	I	+30 V	3.2 mA @15 V 5 mA @24 V 6.4 mA @30 V
14 Fast stop	Fast stop 0V Fast stop +15 ... +30 V No Fast stop	I	+30 V	3.2 mA @15 V 5 mA @24 V 6.4 mA @30 V
15 External fault	External alarm 0V External alarm present +15...30 V No external alarm present	I	+30 V	3.2 mA @15 V 5 mA @24 V 6.4 mA @30 V
16 COM ID	Common of digital inputs at terminals 12 to 15	-	-	-
18 0 V 24	24 V voltage reference at terminal 19	-	-	-
19 +24 V	Voltage +24 V Reference potential: terminal 18	0	+20 ... +30 V	200 mA**
20	Shield connection (PE) (connected with metal housing)	-	-	-

* The terminal block configuration and wiring can be adapted by the user to suit the specific application.
** Maximum current for digital I/O, including both the control board and the **TBO-32** option card (code S5V62).

Table 4-9: Meaning of terminal block signals (terminals 21 to 42)

TERMINAL / DESCRIPTION	FUNCTION	I/O	MAX VOLTAGE	MAX CURRENT
21 Analog output 1	Analogue output 1 Reference potential: terminal 22 Factory-configured for **Motor speed nofilt**	O	±10 V	5 mA
22 COM analog output 1	Reference potential for analogue output 1	-	-	-
23 Analog out 2	Analogue output 2 Reference potential: terminal 24 Factory-configured for **Arm curr nofilt**	O	±10 V	5 mA
24 COM analog output 2	Reference potential for analogue output 2	-	-	-
25 COM digital outputs	Common of the digital outputs of terminals 26 to 29	-	-	-
26 Digital output 1	Digital output 1 Common: terminal 25 Factory-configured for **Ramp +**	0	+30 V	50 mA
27 Digital output 2	Digital output 2 Common: terminal 25 Factory-configured for **Ramp -**	0	+30 V	50 mA
28 Digital output 3	Digital output 3 Common: terminal 25 Factory-configured for **Speed threshold**	0	+30 V	50 mA
29 Digital output 4	Digital output 4 Common: terminal 25 Factory-configured for **Motor overload free**	0	+30 V	50 mA
30 Supply digital output	Supply voltage for digital outputs	I	+30 V	Depends on load max 80 mA
31 Digital input 1	Digital input 1 Common: terminal 37 Not factory-configured	I	+30 V	15 V / 3.2 mA 24 V / 5 mA 30 V / 6.4 mA
32 Digital input 2	Digital input 2 Common: terminal 37 Not preset at factory	I	+30 V	15 V / 3.2 mA 24 V / 5 mA 30 V / 6.4 mA
33 Digital input 3	Digital input 3 Common: terminal 37 Not preset at factory	I	+30 V	15 V / 3.2 mA 24 V / 5 mA 30 V / 6.4 mA
34 Digital input 4	Digital input 4 Common: terminal 37 Not preset at factory	I	+30 V	15 V / 3.2 mA 24 V / 5 mA 30 V / 6.4 mA
37 COM digital inputs	Common of digital inputs at terminals 31 to 34	-	-	-
39-40-41-42	RS485 39 - RxA/TxA 40 - RxB/TxB 41 - GND 42 - PE (screen)	See **Chapter 4.6 - RS485 Serial Communication Modbus RTU**		
17-38	Not used	-	-	-

Table 4-10: Permissible cable cross-section for removable control terminal blocks

TERMINALS	MAXIMUM CABLE CROSS-SECTION			TIGHTENING TORQUE [Nm]
	FLEXIBLE [mm²]	SEMI-RIGID [mm²]	AWG	
1...20, +, -	0.14...1.5	0.14...1.5	26...16	0.4

In order to make the connections to the terminal blocks correctly, it is recommended to follow the instructions below:

- Use a flat-blade screwdriver with dimensions of 75 x 2.5 x 0.4 mm.
- Remove the cable insulation to a length of 6.5 mm.
- Only connect one cable per terminal; the cable must be untreated, i.e. without cable lugs.

Table 4-11: Terminal block for connecting an analog tachogenerator

DESIGNATION	FUNCTION	I/O	MAX VOLTAGE	MAX CURRENT
—	Tachymetric input refinement	I	—	—
+	Tachometer positive input Clockwise rotation: positive Counterclockwise rotation: negative	I	302.9 V (1) (2) 300 V (cULus)	8 mA

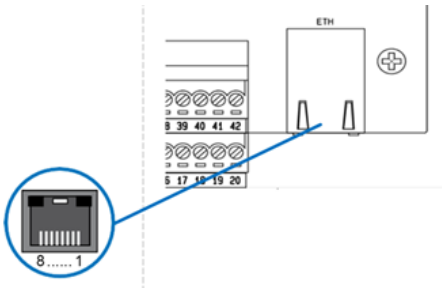
(1) Maximum voltage set via dip-switch **S4**
(2) 300 V as the maximum voltage for the North American market (cULus)

Table 4-12: Description of connectors XE1/XE2

DESIGNATION (1)	FUNCTION	I/O	MAX VOLTAGE	MAX CURRENT
PIN 1	Channel B-	I	30 Vpp (2)	17 mA pp
PIN 2	+24 V supply voltage for the encoder (4)	O	24 V	150 mA (3)
PIN 3	Channel C+(zero pulse)	I	30 Vpp (2)	17 mA pp
PIN 4	Channel C- (zero pulse)	I	30 Vpp (2)	17 mA pp
PIN 5	Channel A+	I	30 Vpp (2)	17 mA pp
PIN 6	Channel A-	I	30 Vpp (2)	17 mA pp
PIN 7	Reference for 5 V / 24 V	O	-	-
PIN 8	Channel B+	I	30 Vpp (2)	17 mA pp
PIN 9	+5 V supply voltage for the encoder (5)	O	6.5 V	150 mA

(1) 9-DSUB female connector mounted on the device. Connect/wire using a 9-DSUB male connector (DIN 41 652).
(2) The maximum input voltage for the encoder channels is 30 Vpp with HTL selection (default), and +5.5 Vpp with TTL selection.
(3) The maximum output current with HTL selection (+24 V) is 150 mA per encoder, 300 mA total.
(4) HTL encoder supply, enabled via Dip-Switch +24VE1/+24VE2 = ON.
(5) TTL encoder supply, enabled via parameters IPA 704 - **Enc 1 supply enable** and IPA 754 - **Enc 2 supply enable**.

4.5 EtherNet - ModbusTCP/IP communication



4-9: RJ45 port on the R-TPD500 control board

TPD500 series drives are equipped with an RJ45 port as standard, supporting the **ModbusTCP/IP** protocol for drive-to-PC communication (via the **WEG_DriveLabs** configuration software).
The minimum requirements for the Ethernet cable are: shielded Category 5E, maximum length of 10 meters, and a data transfer rate of 100 Mbit/s.

Tabella 4-13: Significato dei segnali della porta ETH

PIN	SIGNAL	DESCRIPTION	IN/OUT
1	EN0TX+	Data transmission (+)	OUT
2	EN0TX-	Data transmission (-)	OUT
3	EN0RX+	Data reception (+)	IN
4	N.C.	n.c.	-
5	N.C.	n.c.	-
6	EN0RX-	Data reception (-)	IN
7	N.C.	n.c.	-
8	N.C.	n.c.	-

4.5.1 EtherNet configuration

At startup, based on the EtherNet configuration, the drive acquires an IP address that remains valid until the next reboot. Any changes to the EtherNet configuration will only take effect after the drive is restarted.

The IP address is assigned according to the configuration parameters found in the **COMMUNICATION/NETWORK CONFIG** menu (see **Chapter 6 – FUNCTION DESCRIPTION**).

4.5.2 Point-to-point network topology

In this topology, the PC is connected directly to the drive.

If the drive is configured in **DHCP** mode (parameter IPA 9604 - **IP assignement** set to *Static*, the default setting), and since no DHCP server is present in this configuration, the TPD500 will automatically acquire the local IP address **169.254.10.10**. Most PCs support a link-local protocol, so if the PC is also set to DHCP mode, it will obtain a local IP address in the same **169.254.x.y**, range and will be able to communicate with the drive.

IP address acquisition may take up to 2 minutes. If the PC does not support the link-local protocol or fails to obtain a valid address, it is possible to manually configure a static IP address compatible with the link-local addressing range. In this case, the PC should be configured as follows:

- Set the PC to use a static IP address;
- Assign an IP address in the format **169.254.x.y**, avoiding 169.254.10.10, which is reserved for the drive;
- Set the PC's subnet mask to **255.255.0.0**.

If the drive is configured to use a **static** IP address (parameter IPA 9604 - **IP assignement** set to *Static*), it will be reachable at the address specified in parameter IPA 9556 - **IP address set**, within the network defined by the subnet mask set in parameter IPA 9558 - **IP netmask set**.
The PC must also be configured with a compatible address, as follows:

- Set the PC to use a static IP address;
- Configure the PC's subnet mask with the same value defined in parameter IPA 9558 - **IP netmask set**;
- Assign the PC an IP address within the same subnet as the drive, but different from the drive's IP address.

4.6 RS485 - Modbus RTU serial communication

4.6.1 Description

TPD500 series drives are also equipped with a port (terminal M2, pins 39–42) for connecting the RS485 serial line, provided as standard.

The communication protocol used is **Modbus RTU**, with the following default settings:

- Serial Address = 1
- Serial Baudrate = 38400 bps
- Serial Frame = 8-N-1

For different settings, refer to the **COMMUNICATION/RS485** menu (see **Chapter 6 - FUNCTION DESCRIPTION**).

NOTE!

The standard communication for the TPD500 is ModbusTCP/IP over the Ethernet port. RS485 serial communication is maintained for compatibility with TPD32-EV series drives.

To access the terminals, the front cover of the drive must be removed (see **Chapter 3.2.1 – Disassembling the unit**).

4.6.1.1 Point-to-point connection drive–RS485 port (non-isolated)

CAUTION!

The indicated connection is not galvanically isolated!

This connection method is not recommended when the drive is enabled (Enable drive = ON).

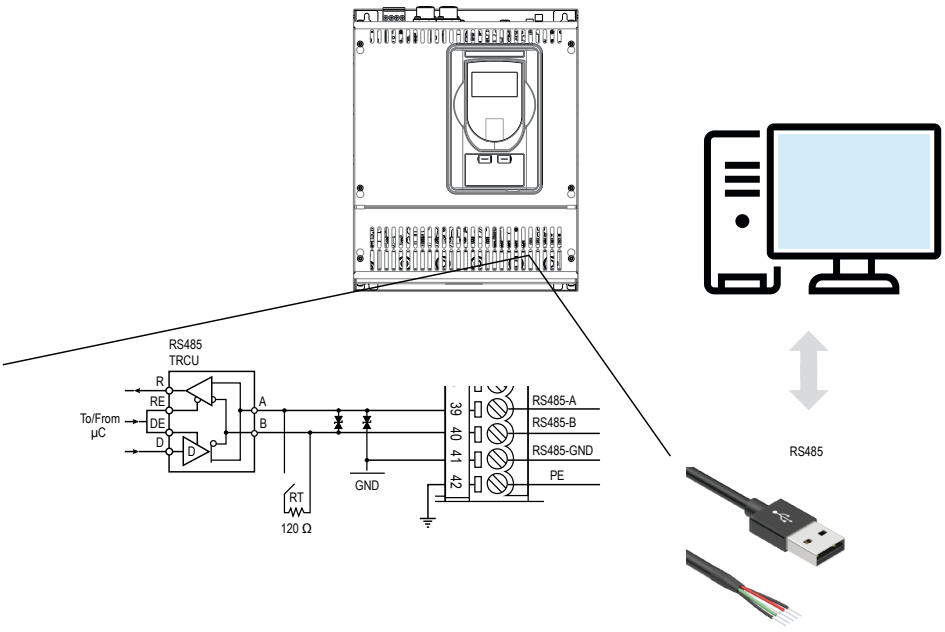


Figure 4.10: Point-to-point connection (non-isolated)

For the connection:

- Use a twisted pair with two symmetrical conductors and a common shield, plus a conductor for equipotential grounding (GND).
- Connect the shield of the twisted pair or cable (if present) to PE.
- Enable the termination resistor by setting dip-switch RT to ON (see Table 4.5.2: Jumpers and Dip-Switches on the control board).
- Connect the USB port to the PC (see figure).

Serial Converter USB / RS485
1.8 m (8S8F60) - FTDI code ESB-RS485-1800-BT
5.0 m (8S8F61) - FTDI code ESB-RS485-5000-BT

PC con porta USB

Figure 4-11: RS485 connection to PC

NOTE! WEG offers a range of approved cables, whose part numbers are listed in Figure 4-11.

4.6.1.2 Point-to-point connection drive-RS485 port (isolated)

To establish a galvanically isolated connection, a commercial external RS485 isolator must be used.

4.6.1.3 Multidrop connection drive-RS485 port (isolated)

To set up a multidrop connection, an external isolator must be installed on each drive (node) involved. It is important to place a termination resistor at both ends of the connection. For **TPD500** drives, this is done by setting the RT dip-switch to ON. Up to 20 drives can be connected, with a total maximum cable length of 200 meters.

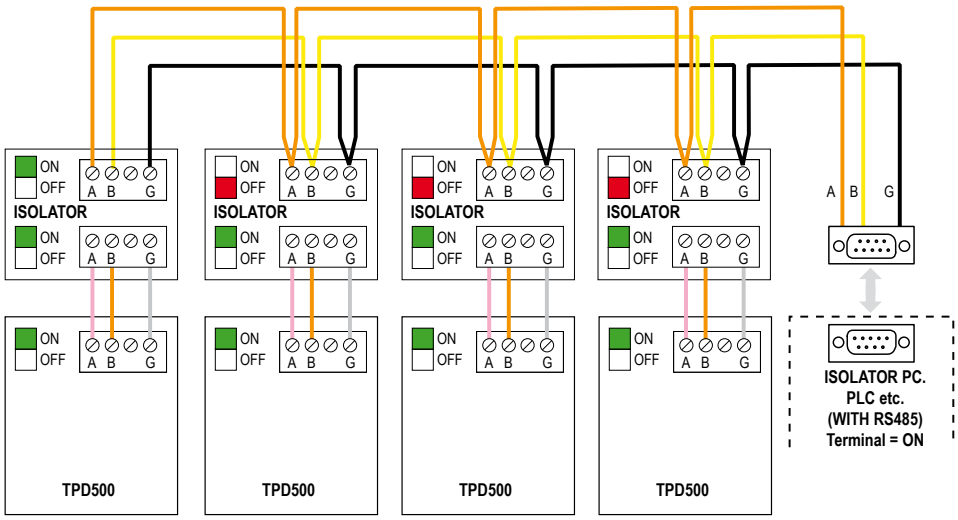


Figure 4-12: RS485 multidrop connection

4.7 Removable keypad

The female RJ45 port located on the front of the drive allows for the connection and mechanical fastening of the **KB-TPD500** keypad (Figure 4-13, ❶). The keypad is always included as standard equipment and the drive is not intended to be configured or operated without it.

Figure 4-13: Keypad and its housing

To remote the keypad up to a maximum distance of 10 meters (e.g., on the door of the electrical cabinet), the following

optional kits are available:
- **REMOTING KIT KB-TPD500 5 m** (code S5P12TK1)
- **REMOTINK KIT KB-TPD500 10 m** (code S5P12TK2)

NOTE! The remoting kit does not allow remote access to the USB port or the Wi-Fi port.

4.8 USB Interface

NOTE! The USB port does not support connection to a PC.

USB 2.0 port for data transfer using a USB flash drive with Type-A connector (Figure 4-13, ❷):
- Maximum available current: 150 mA
- Memory format: FAT32

For more information, refer to **Chapter 5.1.2 – Navigation via keypad**.

4.9 Wi-Fi module interface

TPD500 series drives support an optional external module for Wi-Fi connection, called **Wi-Fi Drive Link** (code S52969WF). The module is connected to the 10-pin connector (Figure 4-13, ❸) located on the keypad housing.

The Wi-Fi module creates a WLAN network, enabling communication with the TPD500 via the **Modbus TCP/IP** protocol. Once properly configured, the **WEG_DriveLabs** software can perform all configurator functions using the Wi-Fi connection.

Wi-Fi module insertion is handled automatically. To remove the module, use the command via parameter IPA 496 – **Wi-fi safe removal** to cut power to the module before unplugging it.

NOTE! The Wi-Fi module cannot be considered a stable and secure communication method and therefore must not be used for controlling an operational machine. It is intended to be used only as a wireless interface to the product for commissioning and temporary monitoring purposes.

For further information on the installation and use of the module, refer to the dedicated manual (code 1S5WDLT500).

4.10 Fieldbus communication

TPD500 series drives are compatible with standard industrial communication networks, commonly known as fieldbuses. Each fieldbus requires specific network hardware and dedicated configuration parameters.

The following table lists the supported fieldbuses, the required hardware options, and the corresponding reference documentation.

Table 4-14: Available fieldbus option boards

FIELDBUS	KIT CODE	MANUAL CODE
PROFIBUS DP | EXP-PDP-TPD500	S729771	1S5PBT500
PROFINET | EXP-ETH-PN-TPD500	S729772	1S5PNT500
EtherNet/IP | EXP-ETH-IP-TPD500	S729773	1S5IPT500

For usage details, refer to the instructions provided in the manuals.

The parameters related to fieldbus management are grouped under the **COMMUNICATION\FIELDBUS CONFIG** menu.

4.11 Protection features

4.11.1 Fuses

The built-in solid-state short-circuit protection does not protect branch circuits. Branch circuit protection must be provided in accordance with the manufacturer's instructions, the National Electrical Code, and any additional local regulations.

NOTE!

Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the Manufacturer Instructions, National Electrical Code and any additional local codes.

La protection intégrée contre les courts-circuits à semi-conducteurs n'assure pas la protection des circuits de dérivation. La protection du circuit de dérivation doit être assurée conformément aux instructions du fabricant, au Code national de l'électricité et à tout autre code local.

Power section fuses

To ensure proper protection of the thyristors in the power bridge, it is essential to always use appropriately rated ultra-fast fuses.

Frame A and B

- Ultra-fast fuses F_A and F_B are mounted externally and are not included in the standard supply. For procurement, refer to the tables provided later in this chapter.
- Ultra-fast fuses F_D, on the other hand, are already installed inside the device.

Frame C

- Ultra-fast fuses F_C and F_D are already installed inside the device.

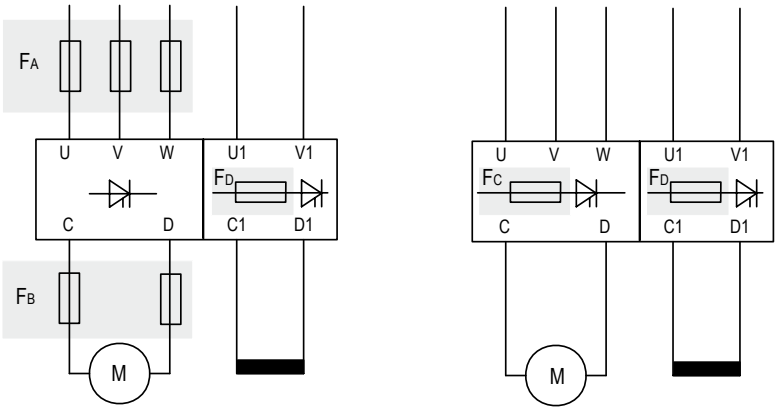


Figure 4-14: Arrangement of ultrafast fuses

NOTE!

The power supply cables must be protected in accordance with the regulations of the country of installation. For devices installed in North America, the requirements established during certification (cULus) must be observed.

The following tables list the protection devices required for installations in North America.

NOTE!

Technical data for the fuses – such as dimensions, weight, power dissipation, heat generation, etc. – are available in the respective fuse manufacturer catalogs.

NOTE!

If it is necessary to replace the armature fuses for Frame C (F_C), please contact technohelp@weg.net

Table 4-15: F_A, external input-side fuses

DRIVE	QUANTITY	MANUFACTURER	TYPE	cULus	CE
TPD500-500-00020-nB-A	3	MERSEN	A70QS25	x	x
		MERSEN	A70P25		x
		MERSEN	N1027330		x
TPD500-500-00040-nB-A	3	MERSEN	A70QS40	x	x
		MERSEN	A70P40		x
		MERSEN	B1027319		x

TPD500-500-00070-nB-A	3	MERSEN	A70QS80	x	x
		MERSEN	A70P80		x
		MERSEN	T094823		x
TPD500-500-00110-nB-A	3	MERSEN	A70QS100	x	x
		MERSEN	A70P100		x
		JEAN MÜLLER	R5184353		x
TPD500-500-00140-nB-A	3	MERSEN	A70QS150	x	x
		MERSEN	A70P150		x
		JEAN MÜLLER	R5184653		x
TPD500-500-00185-nB-A	3	MERSEN	A70QS175	x	x
		MERSEN	A70P175		x
		JEAN MÜLLER	R5185223		x
TPD500-500-00280-nB-B	3	MERSEN	A70QS300	x	x
		MERSEN	A70P300		x
		JEAN MÜLLER	R1185621		x
TPD500-500-00350-nB-B	3	MERSEN	A70QS350	x	x
		MERSEN	A70P350		x
		JEAN MÜLLER	R1185921		x
TPD500-500-00420-nB-B	3	MERSEN	A70QS400	x	x
		MERSEN	A70P400		x
		JEAN MÜLLER	R2186221		x
TPD500-500-00500-nB-B	3	MERSEN	A70QS500	x	x
		MERSEN	A70P500		x
		JEAN MÜLLER	R2186621		x
TPD500-500-00650-nB-B	3	MERSEN	A70QS600	x	x
		MERSEN	A70P600		x
		JEAN MÜLLER	R2186921		x

Table 4-16: F_R, external fuses for the armature circuit

DRIVE	QUANTITY	MANUFACTURER	TYPE
TPD500-500-00020-4B-A	2	MERSEN	A70QS25
		MERSEN	A70P25
		MERSEN	N1027330
TPD500-500-00040-4B-A	2	MERSEN	A70QS70
		MERSEN	A70P70
		MERSEN	T094823
TPD500-500-00070-4B-A	2	MERSEN	A70QS100
		MERSEN	A70P100
		JEAN MÜLLER	R5184353
TPD500-500-00110-4B-A	2	MERSEN	A70QS125
		MERSEN	A70P125
		JEAN MÜLLER	R5184653
TPD500-500-00140-4B-A	2	MERSEN	A70QS175
		MERSEN	A70P175
		JEAN MÜLLER	R5184953
TPD500-500-00185-4B-A	2	MERSEN	A70QS200
		MERSEN	A70P200
		JEAN MÜLLER	R5185223
TPD500-500-00280-4B-B	2	MERSEN	A70QS350
		MERSEN	A70P350
		JEAN MÜLLER	R1185921

TPD500-500-00350-4B-B	2	MERSEN	A70QS400
		MERSEN	A70P400
		JEAN MÜLLER	R2186221
TPD500--500-00420-4B-B	2	MERSEN	A70QS500
		MERSEN	A70P500
		JEAN MÜLLER	R2186621
TPD500--500-00500-4B-B	2	MERSEN	A70QS600
		MERSEN	A70P600
		JEAN MÜLLER	R2186921
TPD500--500-00650-4B-B	2	MERSEN	A70QS700
		MERSEN	A70P700
		JEAN MÜLLER	R2087021

NOTE! Required only for four-quadrant operation.

NOTE! UL does not provide specific requirements for the output fuses of the armature circuit.

Table 4-17: F_d internal fuses for the field circuit

DRIVE	QUANTITY	MANUFACTURER	TYPE	cULus	CE
TPD500-...-.....-..-A	2	COOPER BUSSMANN	FWH-016A6F	x	x
		SIBA	70 125 40.16	x	x
TPD500-...-.....-..-B	2	COOPER BUSSMANN	FWC-25A10F	x	x
		SIBA	60 033 05.25	x	x
TPD500-...-.....-..-C	2	COOPER BUSSMANN	FWC-25A10F	x	x
		SIBA	60 033 05.25	x	x

NOTE! These fuses are mounted internally and are included as part of the standard supply.

Table 4-18: Other internal fuses

FRAME	DESIGNATION	FUNCTION	FUSES	CODE	APPLICATION
A	F1	+ 24V power supply output	IEC 250 V 2.50 A slo-blo 0.2" x 0.8" (5 x 20 mm)	S8B29	SW1-31
B	F1(1)	Control power input (115 Vac or 230 Vac)	IEC 250 V 2.50 A slo-blo 0.2" x 0.8" (5 x 20 mm)	S8B29	SW2-32
	F2	+ 24V power supply output			
	F1(1) / F2(1) / F3(1)	Varistor fuse	IEC 500 V 16 A fast acting 0.24" x 1.26" (6 x 32 mm)	S824B	FIRS2-XX
C	F1(1)	Regulation power input (115 Vac or 230 Vac)	IEC 250 V 2.50 A slo-blo 0.2" x 0.8" (5 x 20 mm)	S8B29	SW3-32
	F2	+ 24V power supply output			
	F1(1) / F2(1) / F3(1)	Varistor fuse	IEC 690 V 25 A fast acting 0.55" x 2" (14 x 51 mm)	F4M09	FLS-50 (TPD500-500-...) FLS-60 (TPD500-690-...)

(1) Type and characteristics must not be changed when the product is used under North American directives (cULus).

4.11.2 Line contactors

NOTE! The size of the contactors must be selected based on the drive's rated current. Sizing must be performed according to the thermal current drawn by the drive under nominal operating conditions (AC1 category).

NOTE! echnical data for the contactors – such as weight, power dissipation, auxiliary contacts, etc. – can be found in the corresponding technical datasheets.

4.11.3 Control board circuit protection

The 115 V / 230 V input for the control power supply (terminals U2 and V2) must be protected against short circuits.
Protection can be implemented using either standard fuses or circuit breakers.
The circuit breaker and/or fuse must be selected based on the short-circuit current of the power source and the inrush current of the drive. They must therefore be sized to avoid nuisance tripping during inrush conditions.

The following table shows the control circuit current consumption for the different drive sizes.

Table 4-19: Control circuit current consumption

DRIVE	CONTROL BOARD POWER SUPPLY					
	BOARD	POWER	NOMINAL CURRENT CONSUMPTION		INRUSH CURRENT	
			115 V	230 V	115 V	230 V
TPD500-...-A	SW1-31	90 W	1 A	0.5 A	20 A	10 A
TPD500-...-B TPD500-...-C	SW2-32	110 W	1 A	0.5 A	15 A	7.5 A

It is recommended that the control power supply be provided by a source separate from the main power supply.
In systems with multiple drives, a single source may be used, provided that the associated protection devices are properly sized.

For installations in North America, fuses must be of type JDDZ/7, class CC, with a minimum short-circuit current rating (SCCR) of 50 kA for Frame A and B, and 100 kA for Frame C.

4.11.4 Field circuit protection

The power supply line for the field circuits (terminals U1 and V1) must be protected against short circuits.
Protection can be implemented using standard fuses or circuit breakers, which must be selected based on the short-circuit current of the power source and the drive's inrush current. They must therefore be properly sized to avoid nuisance tripping during inrush.

Follow the applicable standards and regulations of the country where the product is installed. For the rated voltage and current values of each frame size, refer to **Table 4-22**.

For installations in North America, fuses must be Class J, with a minimum short-circuit current rating (SCCR) of 50 kA for Frame A and B, and 100 kA for Frame C.

4.12 Inductors and filters

To enhance the operational safety of **TPD500** series drives, prevent network disturbances and mutual interference between drives, and ensure compliance with applicable standards (EN 60146-1-1, IEC 146-1-2, EN 61136-1), it is recommended to install a three-phase line inductor upstream of the equipment.
Considering that in most cases a relative short-circuit power of at least 100 kA and a simultaneity factor of 1 can be assumed (EN 50178, A 6.3.6), the addition of a commutation inductor (or transformer) with a relative voltage drop of uk = 4% ensures that the commutation dips at the point of common coupling (PCC) remain below 20%.

4.12.1 Line inductors

In accordance with standard EN 61800-3 (Table B.1), the maximum acceptable depth of commutation dips at the point of common coupling must be limited between 20% and 40%, depending on the installation environment. This can be

achieved by installing appropriate decoupling reactors or transformers.

To ensure proper operation, the drive must be connected to a power supply line with a reactance that causes a relative voltage drop between 2% and 10%. The decoupling reactance must be specifically calculated based on the relative short-circuit power (Rsc) at the point of connection and on the system configuration, which may include single or multiple drives, isolation transformers, etc.

As a reference, the following tables show the decoupling reactance values Ld (line inductors) corresponding to a 2% or 4% voltage drop. These values refer to the drive's rated output current but can also be calculated based on the motor's rated DC current. The line current is calculated as follows:

$$I_{LN} = I_{DN} \cdot 0.82$$

The listed values include a safety margin of +5% in the calculations. It is also important to note that drives operating with such a high voltage drop are generally classified under the "second environment."

The calculation formulas are as follows:

$$L_D = \frac{U_{KD} \cdot U_{LN}}{I_{DN} \cdot \sqrt{2} \cdot 2\pi \cdot f_N} \text{ [H]}$$

$$L_D = \frac{U_{KD} \cdot U_{LN}}{I_{LN} \cdot \sqrt{3} \cdot 2\pi \cdot f_N} [H]$$

Table 4-20: Line inductors at 400 Vac

DRIVE	DRIVE RATED CURRENT [A]	NOMINAL INDUCTANCE U_{KD} = 2% [μH]	NOMINAL INDUCTANCE U_{KD} = 4% [μH]	INDUCTOR RATED CURRENT [A]
Mains voltage 400 Vac, 3ph, **50 Hz**				
TPD500-500-00020-...-A	20	900.3	See **Table 4-23: Coded line inductors**	17
TPD500-500-00040-...-A	40	450.2		34
TPD500-500-00070-...-A	70	257.2		60
TPD500-500-00110-...-A	110	163.7		95
TPD500-500-00140-...-A	140	128.6		121
TPD500-500-00185-...-A	184	97.3		159
TPD500-500-00280-...-B	280	64.3		241
TPD500-500-00350-...-B	350	51.4		301
TPD500-500-00420-...-B	420	42.9		362
TPD500-500-00500-...-B	500	36.0		431
TPD500-500-00650-...-B	650	27.7		560
TPD500-500-00770-...-C	770	23.4		663
TPD500-500-01000-...-C	1000	18.0		861
TPD500-500-01050-...-C	1050	17.1		904
Mains voltage 400 Vac, 3ph, **60 Hz**				
TPD500-500-00020-...-A	20	750.3	1500.5	17
TPD500-500-00040-...-A	40	375.1	750.3	34
TPD500-500-00070-...-A	70	214.4	428.7	60
TPD500-500-00110-...-A	110	136.4	272.8	95
TPD500-500-00140-...-A	140	107.2	214.4	121
TPD500-500-00185-...-A	185	81.1	162.2	159
TPD500-500-00280-...-B	280	53.6	107.2	241
TPD500-500-00350-...-B	350	42.9	85.7	301
TPD500-500-00420-...-B	420	35.7	71.5	362
TPD500-500-00500-...-B	500	30.0	60.0	431
TPD500-500-00650-...-B	650	23.1	46.2	560
TPD500-500-00770-...-C	770	19.5	39.0	663
TPD500-500-01000-...-C	1000	15.0	30.0	861
TPD500-500-01050-...-C	1050	14.3	28.6	904

Table 4-21: Line inductors at 500 Vac

DRIVE	DRIVE RATED CURRENT [A]	NOMINAL INDUCTANCE U_{KD} = 2% [μH]	NOMINAL INDUCTANCE U_{KD} = 4% [μH]	INDUCTOR RATED CURRENT [A]
Mains voltage 500 Vac, 3ph, **50 Hz**				
TPD500-500-00020-...-A	20	1125.4	2250.8	17
TPD500-500-00040-...-A	40	562.7	1125.4	34
TPD500-500-00070-...-A	70	321.5	643.1	60
TPD500-500-00110-...-A	110	204.6	409.2	95
TPD500-500-00140-...-A	140	160.8	321.5	121
TPD500-500-00185-...-A	184	121.7	243.3	159
TPD500-500-00280-...-B	280	80.4	160.8	241
TPD500-500-00350-...-B	350	64.3	128.6	301
TPD500-500-00420-...-B	420	53.6	107.2	362
TPD500-500-00500-...-B	500	45.0	90.0	431
TPD500-500-00650-...-B	650	34.6	69.3	560
TPD500-500-00770-...-C	770	29.2	58.5	663
TPD500-500-01000-...-C	1000	22.5	45.0	861
TPD500-500-01050-...-C	1050	21.4	42.9	904
Mains voltage 500 Vac, 3ph, **60 Hz**				
TPD500-500-00020-...-A	20	937.8	1875.7	17
TPD500-500-00040-...-A	40	468.9	937.8	34
TPD500-500-00070-...-A	70	268.0	535.9	60
TPD500-500-00110-...-A	110	170.5	341.0	95
TPD500-500-00140-...-A	140	134.0	268.0	121
TPD500-500-00185-...-A	185	101.4	202.8	159
TPD500-500-00280-...-B	280	67.0	134.0	241
TPD500-500-00350-...-B	350	53.6	107.2	301
TPD500-500-00420-...-B	420	44.7	89.3	362
TPD500-500-00500-...-B	500	37.5	75.0	431
TPD500-500-00650-...-B	650	28.9	57.7	560
TPD500-500-00770-...-C	770	24.4	48.7	663
TPD500-500-01000-...-C	1000	18.8	37.5	861
TPD500-500-01050-...-C	1050	17.9	35.7	904

Table 4-22: Line inductors at 690 Vac

DRIVE	DRIVE RATED CURRENT [A]	NOMINAL INDUCTANCE U_{KD} = 2% [μH]	NOMINAL INDUCTANCE U_{KD} = 4% [μH]	INDUCTOR RATED CURRENT [A]
Mains voltage 690 Vac, 3ph, **50 Hz**				
TPD500-690-00560-...-C	560	55.5	110.9	482
TPD500-690-00700-...-C	700	44.4	88.7	603
TPD500-690-00900-...-C	900	34.5	69.0	775
Mains voltage 690 Vac, 3ph, **60 Hz**				
TPD500-690-00560-...-C	560	46.2	92.4 (**)	482
TPD500-690-00700-...-C	700	37.0	74.0	603
TPD500-690-00900-...-C	900	28.8	57.5 (**)	775

NOTE!

Tables 4-20, 4-21, and 4-22 generally list only the electrical data of the line inductors without any product codes. Please contact our sales network directly for ordering information.

Table 4-23: Coded line inductors

DRIVE	THREE-PHASE MAINS INDUCTANCE									
	RATED INDUCTANCE [mH]	RATED CURRENT [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										
TPD500-...-00020-..-A	1.62	22	42	50	68	74	LR3-011	S7FF6	180 x 183 x 125	8
TPD500-...-00040-..-A	0.68	41	61	50	95	104	LR3-41-61-0.68	S7D03	180 x 165 x 160	10
TPD500-...-00070-..-A	0.45	61	91	50	109	121	LR3-61-91-0.45	S7D04	180 x 165 x 185	15
TPD500-...-00110-..-A	0.3	90	135	50	142	157	LR3-90-135-0.30	S7D05	180 x 165 x 185	14
TPD500-...-00140-..-A	0.26	107	160	50	125	143	LR3-107-160-0.26	S7D06	180 x 165 x 190	15
TPD500-...-00185-..-A	0.17	163	244	50	202	214	LR3-163-244-0.17	S7D07	240 x 216 x 240	27
TPD500-...-00280-..-B	0.11	253	380	50	239	257	LR3-253-380-0.11	S7D09	300 x 265 x 230	34
TPD500-...-00350-..-B	0.1	287	430	50	268	288	LR3-287-430-0.1	S7D10	300 x 265 x 250	40
TPD500-...-00420-..-B	0.076	368	552	50	278	305	LR3-368-552-0.076	S7D11	300 x 270 x 280	47
TPD500-...-00500-..-B	0.06	458	687	50	347	373	LR3-458-687-0.06	S7D12	300 x 265 x 320	56
TPD500-...-00650-..-B	0.05	605	910	50	470	517	LR3-605-910-0.05	S7D27	380 x 415 x 220	78
TPD500-...-00770-.. -C	0.04	685	1027	50	533	573	LR3-685-1027-0.04	S7D14	386 x 410 x 270	77
TPD500-...-01000-.. -C	0.03	869	1303	50	560	625	LR3-869-1303-0.03	S7D15	420 x 495 x 270	110
TPD500-...-01050-.. -C	0.03	869	1303	50	560	625	LR3-869-1303-0.03	S7D15	420 x 495 x 270	110

To calculate the value of the line inductor for the field circuit, the following simplified formula is used, providing a value that should be evenly divided between the two supply phases.
The following table shows the inductance values for the nominal sizes of the field circuit.
The current for thermal sizing is given by I_{FN}·ff.

$$L_{DF} = \frac{U_{KD} \cdot U_{LN}}{I_{FN} \cdot ff \cdot 2\pi \cdot f_N} \ [H]$$

Where:

- U_{KD} is the relative voltage drop (typically 2% or 4%)
- U_{LN} is the supply voltage
- I_{FN} is the field circuit current
- ff is the form factor, typically 1.2
- f_N is the supply frequency

The resulting value is the total inductance, which must be evenly divided between the two supply phases.

Table 4-24: Line inductors for the field circuit

FRAME	SIZES	RATED FIELD CURRENT	POWER SUPPLY VOLTAGE 400 Vac				POWER SUPPLY VOLTAGE Vac			
			FIELD POWER FREQUENCY							
			50 Hz		60 Hz		50 Hz		60 Hz	
			U_{KD} 2%	U_{KD} 4%	U_{KD} 2%	U_{KD} 4%	U_{KD} 2%	U_{KD} 4%	U_{KD} 2%	U_{KD} 4%
			L [mH]				L [mH]			
A	20	6.25	3.395	6.791	2.830	5.659	4.244	8.489	3.537	7.074
A	40 - 70	8.33	2.548	5.095	2.123	4.246	3.184	6.369	2.654	5.307
A	110 ... 185	12.5	1.698	3.395	1.415	2.830	2.122	4.244	1.768	3.537
B	TUTTE	20	1.061	2.122	0.884	1.768	1.326	2.653	1.105	2.211
C	TUTTE	25	0.849	1.698	0.707	1.415	1.061	2.122	0.884	1.768

4.12.2 EMI filters

TPD500 series drives must be equipped with an external EMI filter to limit radio frequency emissions to the mains supply.
The choice of filter depends on the drive size and the characteristics of the installation environment.

Refer to the **Electromagnetic Compatibility Guide** (code 1S5E84), which provides installation standards for the electrical cabinet (filter wiring, line inductors, cable shielding, grounding connections, etc.) required to ensure EMC compliance according to Directive 2014/30/EU.

The document also outlines the regulatory framework for electromagnetic compatibility and describes the compliance tests carried out on WEG Automation Europe equipment.

Table 4-25: EMI filters

DRIVE	FILTER TYPE	CODE	DIMENSIONS W x H x d [mm]	WEIGHT [kg]	CATEGORY/ ENVIRONMENT/ MOTOR CABLE LENGTH (max)	DISSIPATED POWER @ 25 °C / 50 Hz [W]
Mains voltage 230-400 Vac ± 10%						
TPD500-500-00020-xB-A	EMI-FTF-480-42	S7G0A	310x50x85	1.3	C3/2°/30 m	18
TPD500-500-00040-xB-A	EMI-FTF-480-42	S7G0A	310x50x85	1.3	C3/2°/30 m	18
TPD500-500-00070-xB-A	EMI-FTF-480-75	S7G0C	270x80x135	2.6	C3/2°/30 m	26
TPD500-500-00110-xB-A	EMI-FTF-480-100	S7G0D	270x90x150	3	C3/2°/30 m	30
TPD500-500-00140-xB-A	EMI-FTF-480-130	S7G0E	270x90x150	3.6	C3/2°/30 m	38
TPD500-500-00185-xB-A	EMI-FTF-480-130	S7G0E	270x90x150	3.6	C3/2°/30 m	38
TPD500-500-00280-xB-B	EMI-480-320	S7DGH	300x260x135	13.2	C3/2°/100 m	40
TPD500-500-00350-xB-B	EMI-480-400	S7DGI	300x260x135	13.2	C3/2°/100 m	50
TPD500-500-00420-xB-B	EMI-480-400	S7DGI	300x260x135	13.2	C3/2°/100 m	50
TPD500-500-00500-xB-B	EMI-480-600	S7DGL	300x260x135	13.6	C3/2°/100 m	65
TPD500-500-00650-xB-B	EMI-480-600	S7DGL	300x260x135	13.6	C3/2°/100 m	65
TPD500-500-00770-xB-C	EMI-480-800	S7DGM	350x280x150	23.7	C3/2°/100 m	80
TPD500-500-01000-xB-C	EMI-480-1000	S7DGN	350x280x150	24	C3/2°/100 m	91
Mains voltage 480 Vac ± 10%						
TPD500-500-00020-xB-A	EMI-FTF-480-42	S7G0A	310x50x85	1.3	C3/2°/30 m	18
TPD500-500-00040-xB-A	EMI-FTF-480-42	S7G0A	310x50x85	1.3	C3/2°/30 m	18
TPD500-500-00070-xB-A	EMI-FTF-480-75	S7G0C	270x80x135	2.6	C3/2°/30 m	26
TPD500-500-00110-xB-A	EMI-FTF-480-100	S7G0D	270x90x150	3	C3/2°/30 m	30
TPD500-500-00140-xB-A	EMI-FTF-480-130	S7G0E	270x90x150	3.6	C3/2°/30 m	38
TPD500-500-00185-xB-A	EMI-FTF-480-130	S7G0E	270x90x150	3.6	C3/2°/30 m	38
TPD500-500-00280-xB-B	EMI-480-320	S7DGH	300x260x135	13.2	C3/2°/100 m	40
TPD500-500-00350-xB-B	EMI-480-400	S7DGI	300x260x135	13.2	C3/2°/100 m	50
TPD500-500-00420-xB-B	EMI-480-400	S7DGI	300x260x135	13.2	C3/2°/100 m	50
TPD500-500-00500-xB-B	EMI-480-600	S7DGL	300x260x135	13.6	C3/2°/100 m	65
TPD500-500-00650-xB-B	EMI-480-800	S7DGM	350x280x150	23.7	C3/2°/100 m	80
TPD500-500-00770-xB-C	EMI-480-800	S7DGM	350x280x150	23.7	C3/2°/100 m	80
TPD500-500-01000-xB-C	EMI-480-1000	S7DGN	350x280x150	24	C3/2°/100 m	91
Mains voltage 500 Vac ± 10%						
TPD500-500-00020-xB-A	EMI-FTF-480-42	S7G0A	310x50x85	1.3	C3/2°/30 m	18
TPD500-500-00040-xB-A	EMI-FTF-480-42	S7G0A	310x50x85	1.3	C3/2°/30 m	18
TPD500-500-00070-xB-A	EMI-FTF-480-75	S7G0C	270x80x135	2.6	C3/2°/30 m	26
TPD500-500-00110-xB-A	EMI-FTF-480-100	S7G0D	270x90x150	3	C3/2°/30 m	30
TPD500-500-00140-xB-A	EMI-FTF-480-130	S7G0E	270x90x150	3.6	C3/2°/30 m	38
TPD500-500-00185-xB-A	EMI-FTF-480-130	S7G0E	270x90x150	3.6	C3/2°/30 m	38
TPD500-500-00280-xB-B	EMI-480-320	S7DGH	300x260x135	13.2	C3/2°/100 m	40
TPD500-500-00350-xB-B	EMI-480-400	S7DGI	300x260x135	13.2	C3/2°/100 m	50
TPD500-500-00420-xB-B	EMI-480-400	S7DGI	300x260x135	13.2	C3/2°/100 m	50
TPD500-500-00500-xB-B	EMI-480-600	S7DGL	300x260x135	13.6	C3/2°/100 m	65
TPD500-500-00650-xB-B	EMI-480-800	S7DGM	350x280x150	23.7	C3/2°/100 m	80
TPD500-500-00770-xB-C	EMI-480-800	S7DGM	350x280x150	23.7	C3/2°/100 m	80
TPD500-500-01000-xB-C	EMI-480-1000	S7DGN	350x280x150	24	C3/2°/100 m	91
Mains voltage 690 Vac ± 10%						
TPD500-690-00560-xB-C	EMI-690-600	S7DGS	230x190x116	7.8	C3/2°/100 m	79
TPD500-690-00700-xB-C	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100 m	328
TPD500-690-00900-xB-C	EMI-690-1600	S7DGK	300x260x140	24.5	C3/2°/100 m	328

4.12.3 Mains harmonic currents generated by drives

The following information refers to the harmonic currents generated by AC/DC drives using SCRs in a fully controlled three-phase bridge (6-pulse configuration).

Due to their nonlinear load characteristics, SCR-based AC/DC drives draw non-sinusoidal currents from the mains supply, thus generating harmonic currents.

The exact harmonic current values in a given installation depend on several factors, including the specific system configuration and the drive's operating point. Further details can be found in standards EN 61800-3, IEC 146-1-2, and EN 61800-1.

The table below shows typical harmonic current values, expressed as a percentage of the fundamental current (I_1), for reference purposes only.

Table 4-26: Typical values of harmonic currents

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

5. OPERATION AND COMMISSIONING

5.1 Using the programming keypad

This chapter provides a detailed description of the **KB-TPD500** programming keypad (code S5P12TW) and its various operating modes, including parameter monitoring and programming.

5.1.1 Description

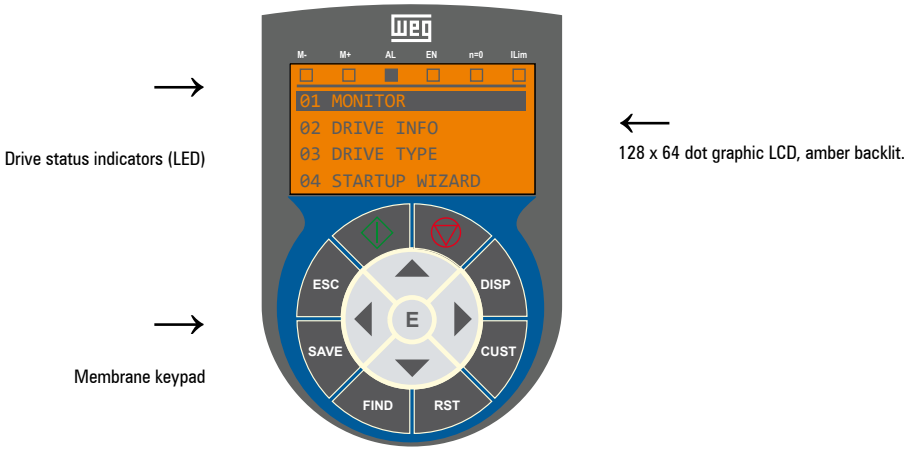


Figure 5-1: Front view of the programming keypad

5.1.1.1 Membrane keypad

Below are the descriptions of the keys on the membrane keypad and their functions.

Table 5-1: Description of the keypad commands

SYMBOL	REFERENCE	DESCRIPTION
◇	Start	Start command (valid only when IPA 500-**Main commands** is set to **Digital** mode).
▽	Stop	Stop command (valid only when IPA 500-**Main commands** is set to **Digital** mode; disables the drive with a double press).
ESC	Escape	Exits a parameter, a menu, or the **SAVE**, **FIND**, **CUST** and **DISP** functions, returning to the previous menu. Also allows clearing a message displayed on the keypad.
SAVE	Save	Saves the parameters by directly accessing parameter IPA 460-**Save parameters**. The save procedure is carried out by pressing the **SAVE** key and then, when prompted on the display, pressing the E key to execute the "Press E to execute" command. By scrolling down, it is also possible to directly access the IPA 472-**Drive reset**.
FIND	Find	Accesses the function that allows a parameter to be viewed by entering its IPA code.
RST	Reset	Resets alarms, only if the causes have been cleared.
CUST	Custom	Displays the last ten parameters modified via the keypad.
DISP	Display	Displays a list of drive status monitoring parameters.
E	Enter	Enters the selected submenu or parameter, or selects an operation. Used during parameter editing to confirm the new set value.
▲	Up	Scrolls up through a menu or a list of parameters. During parameter editing, increases the value of the digit under the cursor.
▼	Down	Moves the selection down in a menu or a list of parameters. During parameter editing, decreases the value of the digit under the cursor.
◀	Left	Returns to the previous menu. During parameter editing, moves the cursor to the left.
▶	Right	Enters the selected menu or submenu. During parameter editing, moves the cursor to the right.

5.1.1.2 Meaning of the status indicators (LED)

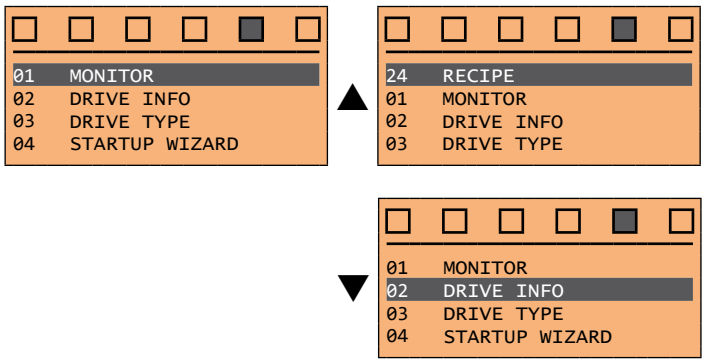
Table 5-2: Meaning of the status indicators

INDICATORS	MEANING
M-	Indicates activation of the negative bridge.
M+	Indicates activation of the positive bridge.
AL	Indicates alarm activation.
EN	Indicates whether the drive is enabled.
n=0	Indicates that the motor speed is 0 rpm (below the threshold set by IPA 810-**Speed 0 level**). Flashes when **Fast Stop** is active.
ILim	Indicates that the drive has reached the positive and/or negative current limits.

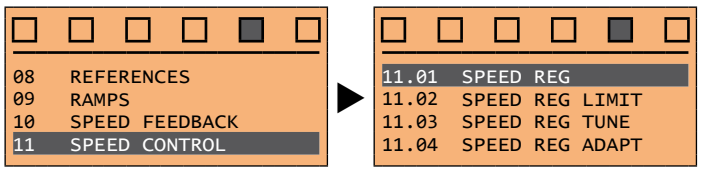
5.1.2 Navigation via keypad

5.1.2.1 Scanning first- and second-level menus

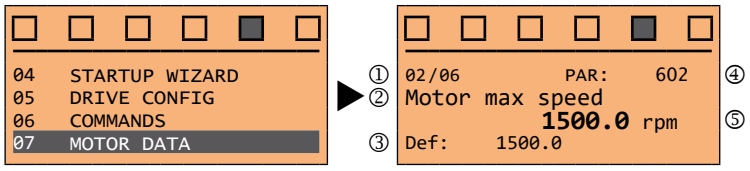
First level



First level **Second level**



5.1.2.2 Viewing a single parameter



① Parameter position within the **MOTOR DATA** menu structure (02/06).

② Parameter name (**Motor max speed**).

③ Depends on the parameter type:

- **Numeric parameter:** displays the numerical value of the parameter in the required format, along with the unit of measure.
- **Binary selection:** the parameter can have only two states, shown as **OFF-ON.**
- **ENUM-type parameter:** displays the description of the selected option.
- **Command:** displays the prompt **Press E to Execute** to run the command.

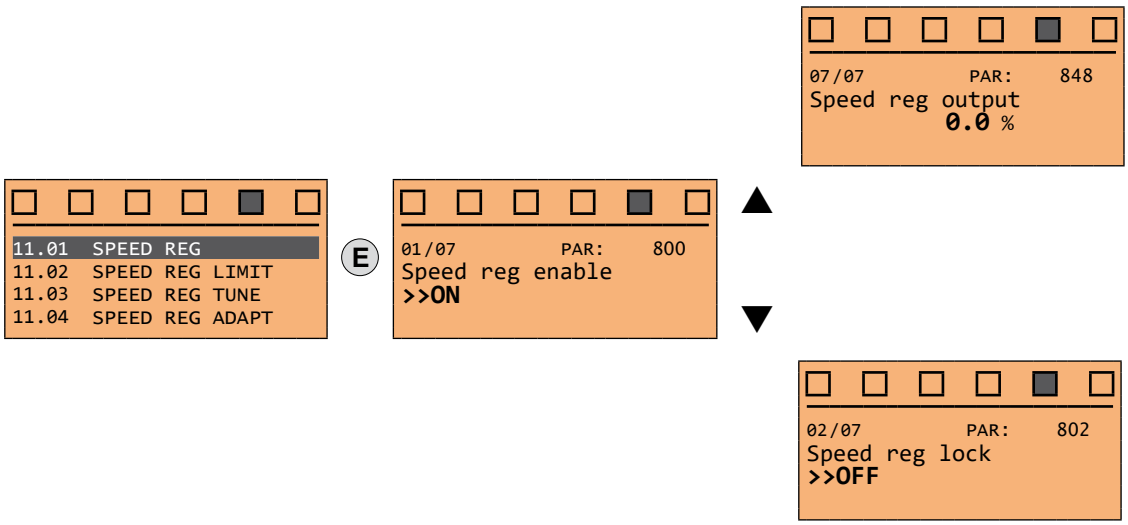
④ IPA (Index Parameter Address) of the parameter.

⑤ In this position, the following can be displayed:

- **Numeric parameter:** displays the default, minimum, and maximum values of the parameter. These values are shown in sequence by pressing the ► **key.**
- **ENUM-type parameter:** displays the numeric value corresponding to the current selection.
- **Possible warnings and error conditions:**

Par read only	attempt to modify a read-only parameter.
Drive enabled	attempt to modify a parameter that cannot be changed while the drive is enabled.
Out of range	attempt to enter a value outside the allowed minimum and maximum limits.

5.1.2.3 Parameter scanning



5.1.2.4 CUST function

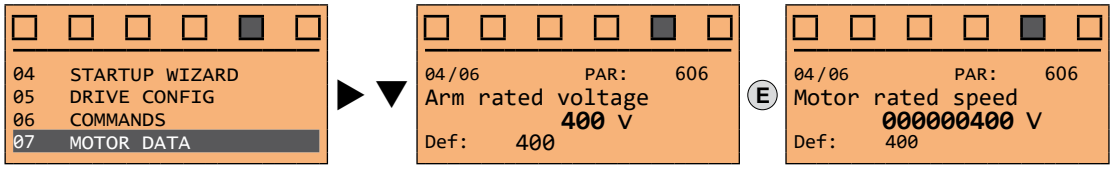
By pressing the **CUST** key, a list is accessed containing the last ten parameters modified via the keypad. One parameter is displayed at a time, and the ▲ and ▼ keys can be used to scroll through the list.
To exit the list, press the **ESC** key.

5.1.2.5 FIND function

By pressing the **FIND** key, parameter IPA 474-**Goto parameter** is activated, allowing access to any parameter by entering its IPA code.
Once the target parameter is displayed, it is possible to navigate through all parameters within the same menu using the ▲ and ▼ keys. Pressing the **ESC** key returns to the **FIND** function.

5.1.2.6 Editing parameters

To enter parameter editing mode, press the **E** key when the parameter to be modified is displayed.
To confirm and store the new value, press the **E** key again after editing.



When the **E**, key is pressed to enter editing mode, the cursor is activated on the digit corresponding to the units.
Using the ◄ and ► keys, the cursor can be moved across all digits, including leading zeros that are normally not displayed.
The ▲ and ▼ keys are used to increment or decrement the digit under the cursor.
Press **E** to confirm the change or **ESC** to cancel.
To exit parameter editing mode without saving the value, press the **ESC** key.

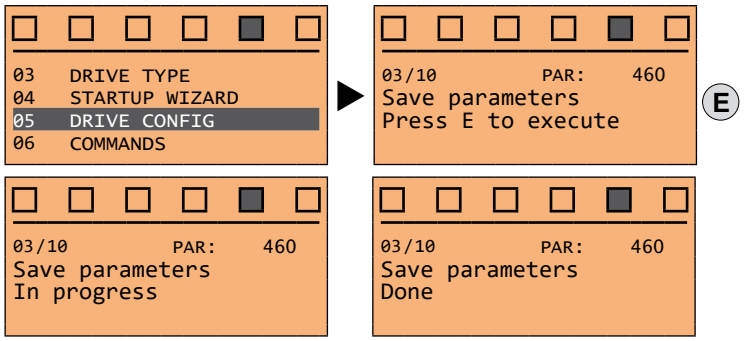
NOTE! To permanently save the parameters, see **Chapter 5.1.2.7 – Saving parameters.**

5.1.2.7 Saving parameters

To permanently save the parameters in the drive memory, two procedures are available:

1) Press the **SAVE** key on the keypad.
2) Access parameter IPA 460-**Save parameters** from the **DRIVE CONFIG** menu.

This allows the parameter setting changes to be retained even after power-off and subsequent restart.



To exit, press the **ESC** key.

5.1.2.8 Display startup

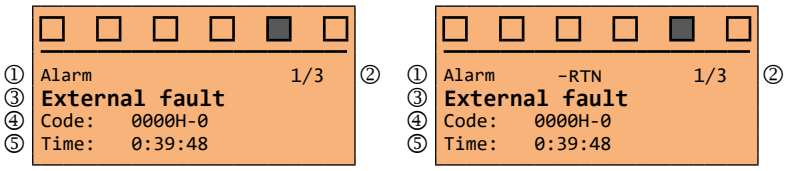
Through parameter IPA 484-**Display startup** in the **DRIVE CONFIG** menu, the parameter to be displayed automatically upon drive startup can be set.
Entering the value **-1** disables the function, and the main menu will be displayed at startup.
Entering the value **0** will display the **DISP** menu upon drive startup.

5.1.2.9 Display backlight

Through parameter IPA 482-**Display backlight** in the **DRIVE CONFIG** menu, the display backlight can be set to remain on at all times.
If set to **OFF**, the backlight will turn off three minutes after the last key press.

5.1.2.10 Alarms

The alarms page is displayed automatically when an alarm is triggered.



① **Alarm**: identifies the page of triggered alarms.
-RTN: indicates that the alarm has been cleared. If the alarm is still active, nothing is displayed.
② **x/y**: **x** indicates the position of this alarm in the alarm list, and **y** is the total number of triggered alarms (the alarm with the lower x is the most recent).
③ **Alarm description**.
④ **Alarm subcode**: provides additional information to the alarm description when available (further details are provided in **Chapter 6 – FUNCTIONALITY DESCRIPTION**).
⑤ Time of alarm occurrence in hours and minutes since power-on (IPA 490-**Time drive power on**).

With the ▲ and ▼ keys, the alarm list can be scrolled.

NOTE! For more information, see **Chapter 8 – FAULT REPORTING.**

5.1.2.10.1 Alarm reset

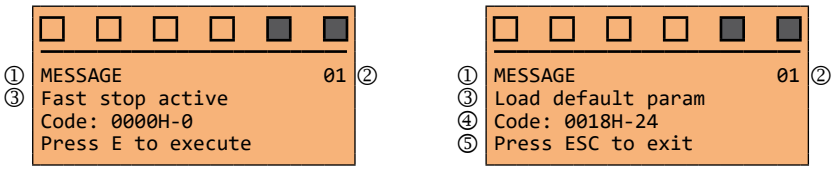
- **If the alarms page is displayed:**
  Pressing the **RST** key will reset the alarms and remove from the list all alarms that have been cleared. If the alarm list is empty after this operation, the alarms page will also close. If the list is not empty, press the **ESC** key to exit the alarms page.
- **If the alarms page is not displayed:**
  Pressing the **RST** key will reset the alarms. If there are still active alarms after the reset, the alarms page will open.

5.1.2.11 Messages

This page displays messages for the operator, divided into two categories:

- **Timed messages:** automatically close after a specified number of seconds.
- **Fixed messages:** remain visible until the operator presses the **ESC** key.

If multiple messages are generated simultaneously, they are queued and presented to the operator in sequence, from the most recent to the least recent.



① **Messagge**: identifies the message.

② **xx** indicates how many messages are in the queue. A maximum of 10 messages can be queued, with the highest number representing the most recent message.

③ **Message description**.

④ **Message subcode**: provides additional information to the message description.

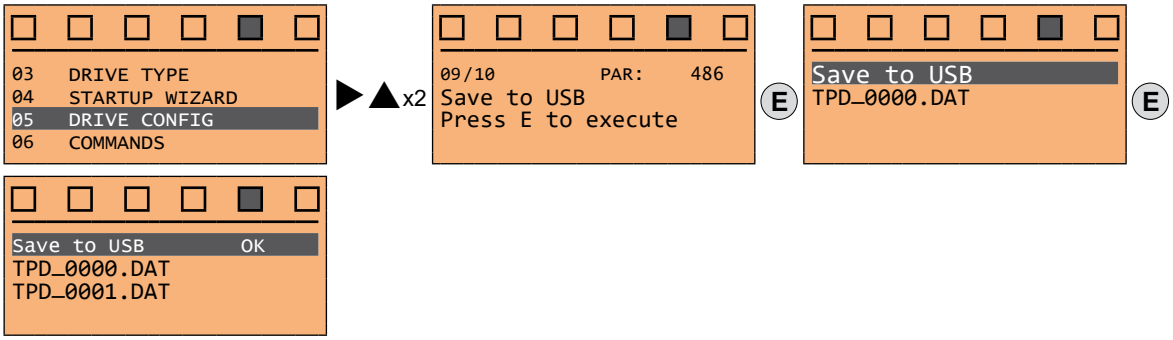
⑤ The message **Press ESC to exit** appears if the message requires acknowledgment.

When a message closes, the next message is displayed until the queue is empty.

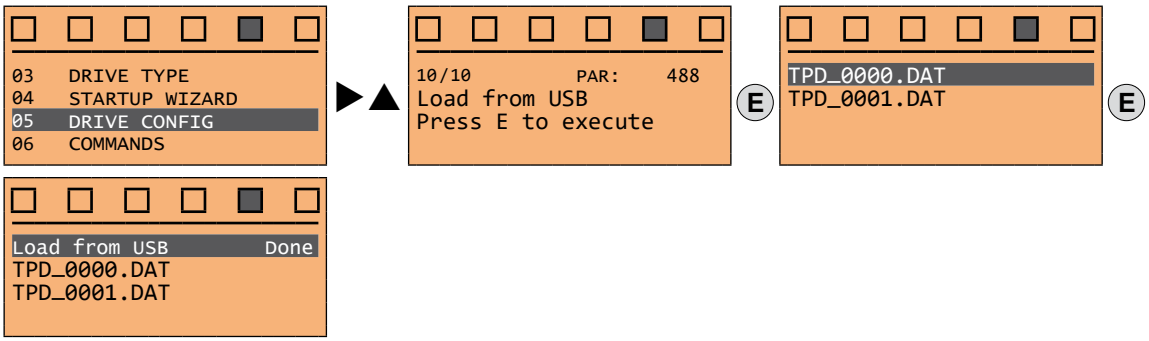
5.1.2.12 Saving and retrieving new parameter settings via USB

The drive parameters can be saved or loaded via a USB memory stick. This function is useful for having different sets of parameters available, performing a backup, or transferring parameters from one drive to another.

Access the **DRIVE CONFIG** menu, parameter IPA 486-**Save to USB**, to save the parameters from the drive to the USB memory stick:



To transfer parameters from the USB memory stick to the drive, access the **DRIVE CONFIG** menu, parameter IPA 488 -**Load from USB**:



5.2 COMMISSIONING

CAUTION!

Follow the instructions provided in **Chapter 1 – SAFETY INSTRUCTIONS** and **Chapter 2.2 – Technical data**.

5.2.1 Jumper and dip-switch configuration

Prima di accendere l'apparecchio in ogni specifico caso applicativo, è necessario adattare e verificare la configurazione hardware dei jumper e dei dip-switch della scheda di regolazione R-TPD500 (per maggiori informazioni consultare il Capitolo 4.4 - Parte di regolazione e di controllo).

Before powering on the device in each specific application case, it is necessary to adjust and verify the hardware configuration of the jumpers and dip-switches on the **R-TPD500** control board (for more information, refer to **Chapter 4.4 – Control and regulation section**).

Table 5-3: Main hardware configurations

Analog inputs 1/2/3	
Voltage input 0... 10V	Switch S9 / S10 / S11 = OFF
Current input 0...20 mA / 4...20 mA	Switch S9 / S10 / S11 = ON
Mixed configuration possible.	
Select the power supply for the digital encoders, respectively with switches S18 (+24VE1) and S19 (+24VE2)	
Voltage = 5 V	Switch +24VEx = OFF
Voltage = 15 ... 30 V	Switch +24VEx = ON
When the 24VEx voltage is activated, the green LED indicators light up.	
Configure dip-switch S4 for tachometer sensor scaling settings. For more information, see **Chapter 4.4 – Control and regulation section.**	
Configure dip-switch S14 for field current scaling settings. For more information, see **Chapter 4.4 – Control and regulation section.**	

5.2.2 Mounting and auxiliary voltages check

Before powering on the device, the following checks must be made:
- Correct wiring according to the typical diagram.
- Compliance with the design specifications.
- When the device's current limit is not set to the rated current of the connected motor, a thermal protection relay must be installed upstream of the drive, set to the motor's rated current multiplied by 0.86.

CAUTION!

External voltage must not be connected to the drive output.

- Drive disabled (remove the connection from terminal 12).
- Check the following voltages:

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

5.2.3 Basic settings for the drive

NOTA!

It is assumed that the device has the factory settings configured and has been connected and tested according to the typical wiring diagram shown in **Chapter 4.2 – Device connection**.

The factory default settings can be loaded using parameter IPA 470-**Load Default** in the **DRIVE CONFIG** menu. Loading this parameter will overwrite all modifications made by the user so far.

The allowed values for each parameter can be found in **Chapter 6 – FUNCTIONALITY DESCRIPTION** of the manual. The following settings must be made with the drive in a locked (disabled) state: IPA 3084-**Enable input mon** = 0 (no voltage applied to terminal 12).

For information on how to use the keypad, refer to **Chapter 5.1 – Using the programming keypad**.

Selection of the operating mode

- When the drive must be controlled exclusively by the terminal block, set IPA 500-**Main commands** = *Terminals*.
- When using the keypad, the **WEG_DriveLabs** configurator, or a fieldbus, set IPA 500-**Main commands** = *Digital*.

Saving settings

- Use IPA 460-**Save parameters** in the **DRIVE CONFIG** menu (or dedicated key).
- To retain the configured parameters even after powering off and on the drive, the parameters must be saved.
- When using the keypad: press **E**.

In standard supply conditions, IPA 500-**Main commands** is set to *Digital*.

5.2.4 Commissioning procedure

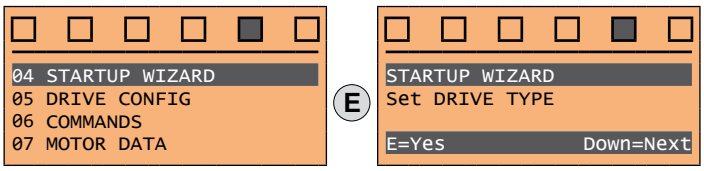
5.2.4.1 Commissioning via keypad - STARTUP WIZARD

The **STARTUP WIZARD** is a guided procedure that simplifies the commissioning of the drive by assisting with the configuration of the main parameters required for basic operation.
It consists of a series of steps, each corresponding to a sequence for entering and calculating the parameters necessary for the correct operation of the drive and any application that may be loaded.

The steps are carried out in the following order:

- Step 1 - **Set DRIVE TYPE**
- Step 2 - **Set DRIVE CONFIG**
- Step 3 - **Set MOTOR DATA**
- Step 4 - **Set SPEED FEEDBACK**
- Step 5 - **Set ENCODER 1**
- Step 6 - **Set ENCODER 2**
- Step 7 - **Set TACHO**
- Step 8 - **Set LIMITS**
- Step 9 - **Set REFERENCES**
- Step 10 - **Exe CURR REG TUNE**
- Step 11 - **Set FIELD CONTROL**
- Step 12 - **Exe SAVE PARAMETERS**

The keypad screen format for function selection is as follows:



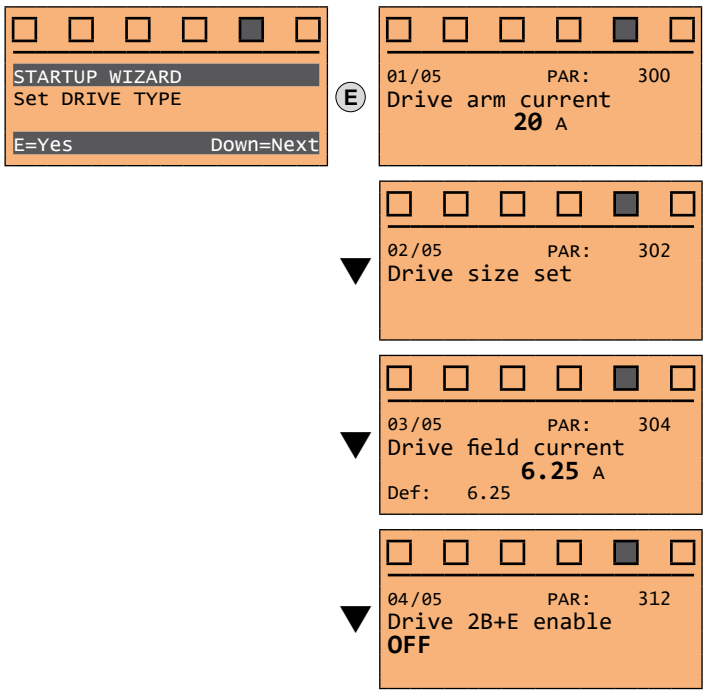
Pressing the **E** key accesses the selected function for programming.
Pressing the ▼ (Down) key skips the current function and moves to the next one.
Pressing the ▲ (Up) key returns to the previous function.

To exit the function sequence and return to the main menu, press the **ESC** key.

At the end of the sequence, after saving the parameters, if the commissioning has been completed successfully, the system returns to the main menu.

Step 1 - Set DRIVE TYPE

Setting the drive's basic parameters:



Read only.

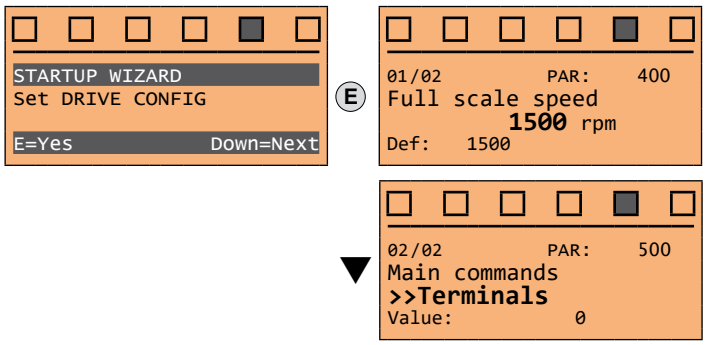
Visible only in TPD500-CU-... configuration

IPA 300-**Drive arm current** is the drive's rated current (read only).
IPA 302-**Drive size set** allows setting the drive's rated size (only for TPD500-CU-... configuration).
IPA 304-**Drive field current** is the drive's rated field current. Set the field using dip-switch **S14** on the control board.
PAR 312-**Drive 2B+E enable** enables the 2B+E function.

At the end of the procedure, proceed to the next step.

Step 2 - Set DRIVE CONFIG

Drive configuration parameter settings:

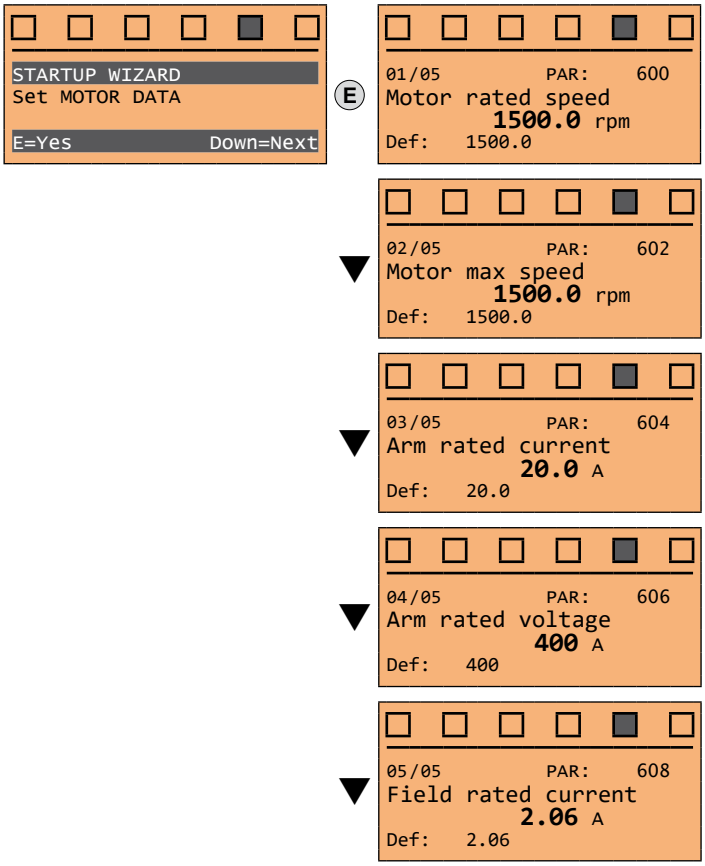


IPA 400-**Full scale speed** defines the speed (in RPM) corresponding to the maximum signal applied to an analog input (e.g., 10 V or 20 mA).
IPA 500-**Main commands** defines the drive's control and command mode.

At the end of the procedure, proceed to the next step.

Step 3 - Set MOTOR DATA

Motor nameplate data settings:

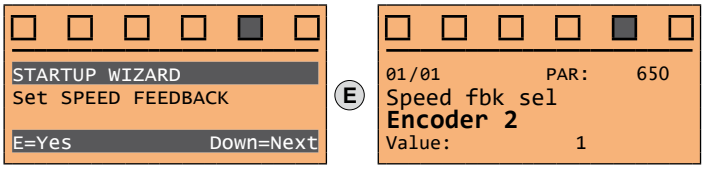


IPA 600-**Motor rated speed** is the motor's rated speed (nameplate data).
IPA 602-**Motor max speed** is the motor's maximum speed (nameplate data).
IPA 604-**Arm rated current** is the motor's rated armature current (nameplate data). The default value is the drive's rated current. Current limit and overload settings are based on this value.
IPA 606-**Arm rated voltage** is the motor's rated armature voltage (nameplate data).
IPA 608-**Field rated current** is the motor's rated field current (nameplate data).

At the end of the procedure, proceed to the next step.

Step 4 - Set SPEED FEEDBACK

Speed feedback configuration parameter settings:



IPA 650-**Speed fbk sel** allows selection of the speed feedback source (Encoder 1, Encoder 2, Tachogenerator, or Armature).

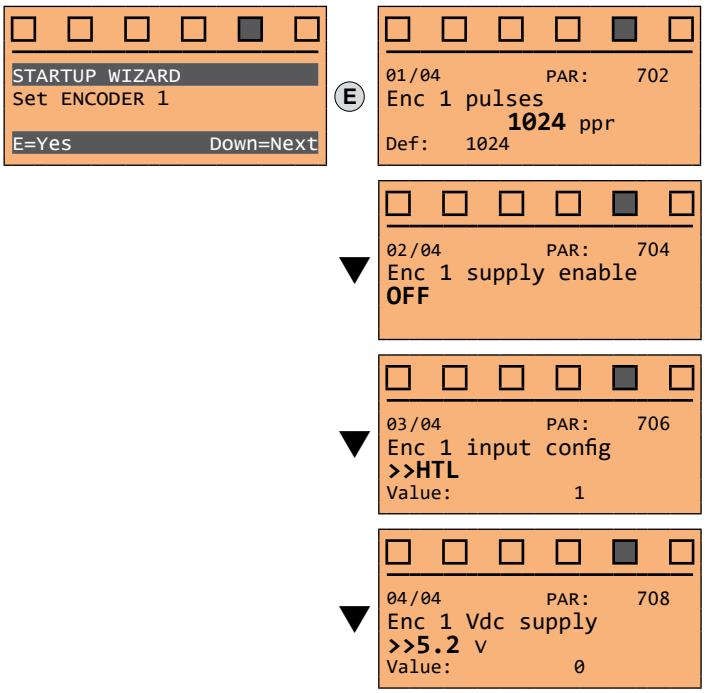
At the end of the procedure, proceed to the next step.

Step 5 - Set ENCODER 1

CAUTION!

Incorrect encoder voltage settings may cause irreversible damage to the device. Always check the encoder nameplate voltage.

ENCODER 1 configuration parameter settings:



IPA 702-**Enc 1 pulses,** number of pulses per revolution of the digital encoder connected to connector XE1.
IPA 704-**Enc 1 supply enable,** enables the power supply for Encoder 1.
IPA 706-**Enc 1 input config**, selects the input signal type (HTL / TTL).
IPA 708-**Enc 1 Vdc supply,** power supply voltage for Encoder 1 (used when the +24VE1 switch is OFF).

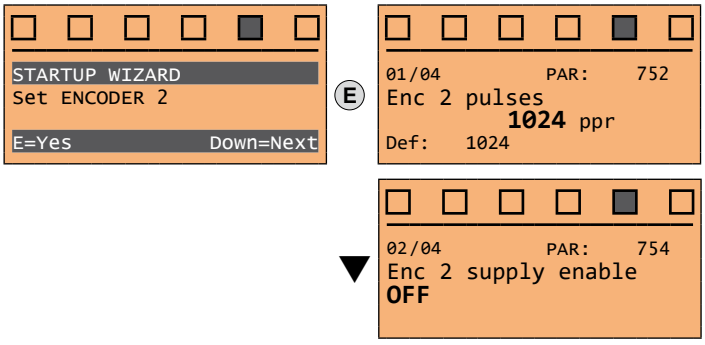
At the end of the procedure, proceed to the next step.

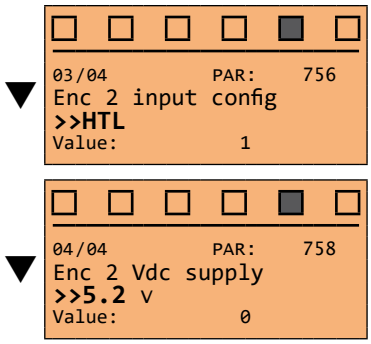
Step 6 - Set ENCODER 2

CAUTION!

Incorrect encoder voltage settings may cause irreversible damage to the device. Always check the encoder nameplate voltage.

ENCODER 2 configuration parameter settings:



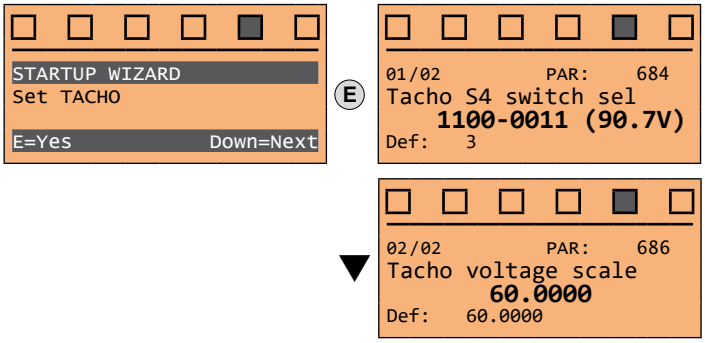


IPA 752-**Enc 2 pulses,** number of pulses per revolution of the digital encoder connected to connector XE2.
IPA 754-**Enc 2 supply enable,** enables the power supply for Encoder 2.
IPA 756-**Enc 2 input config,** selects the input signal type (HTL / TTL).
IPA 758-**Enc 2 Vdc supply,** power supply voltage for Encoder 2 (used when the +24VE2 switch is OFF).

At the end of the procedure, proceed to the next step.

Step 7 - Set TACHO

Tachogenerator configurator parameter settings:

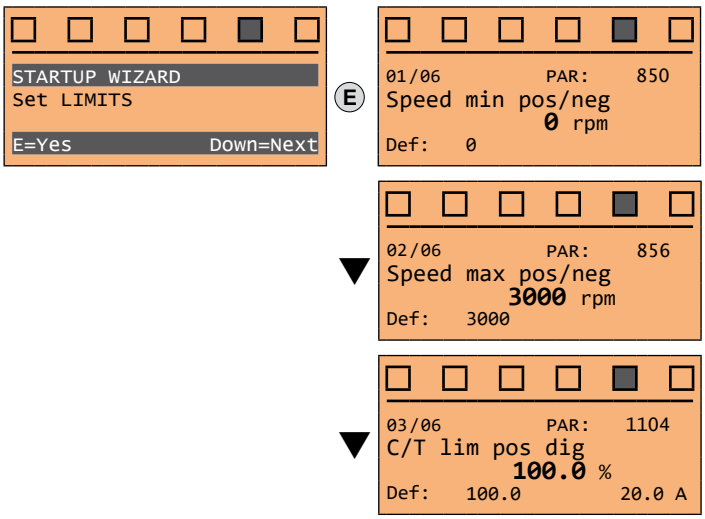


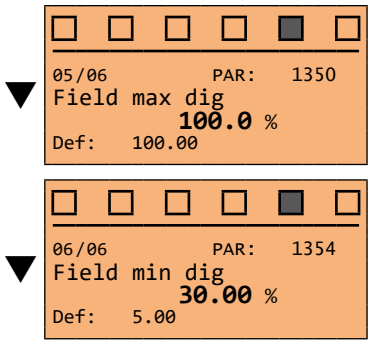
IPA 684-**Tacho DIP switch sel** corresponds to the setting of dip-switch **S4** for tachogenerator feedback.
IPA 686-**Tacho voltage scale** is the tachogenerator feedback voltage scale.

At the end of the procedure, proceed to the next step.

Step 8 - Set LIMITS

Speed, torque current, and field current limit settings:



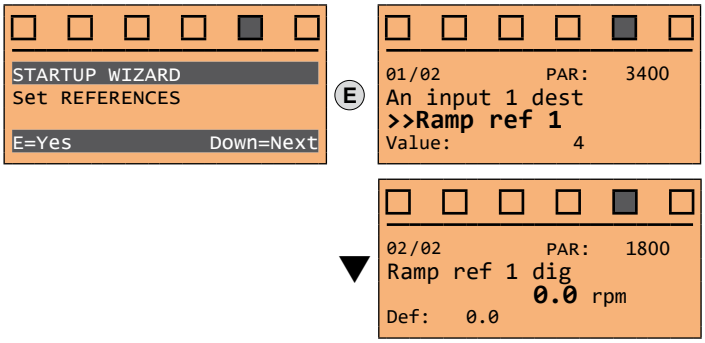


IPA 850-**Speed min pos/neg,** minimum speed reference limit.
IPA 856-**Speed max pos/neg,** maximum speed reference limit.
IPA 1104-**C/T lim pos dig** positive armature current limit, expressed as a percentage of IPA 604-**Arm rated current**.
IPA 1350-**Field max dig**, maximum field current value.
IPA 1354-**Field min dig** minimum field current value. Corresponds to the field reference when the IPA 1314-**Field Weak Speed-0** function is active.

At the end of the procedure, proceed to the next step.

Step 9 - Set REFERENCES

Basic parameters to configure the speed reference:

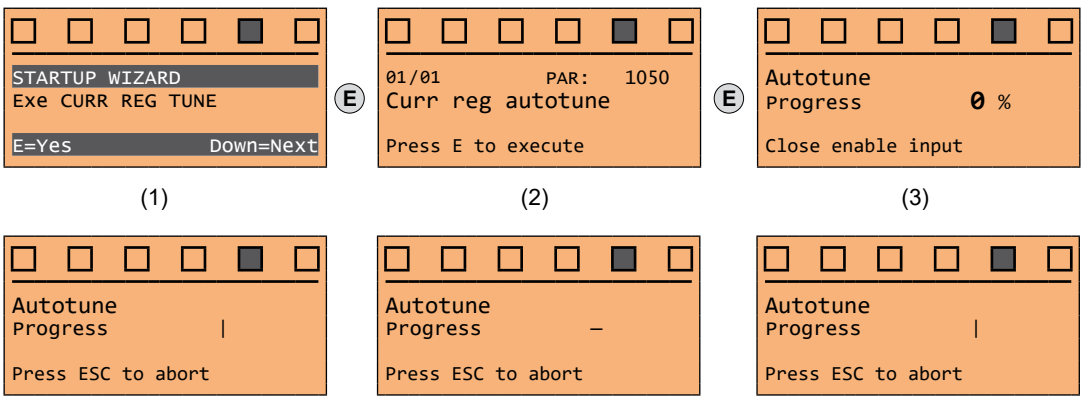


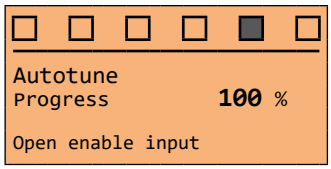
IPA 3400-**An input 1 dest**, destination of analog input 1. Set to OFF to define the speed reference numerically via the next parameter.
IPA 1800-**Ramp ref 1 dig**, speed reference input to the ramp function.

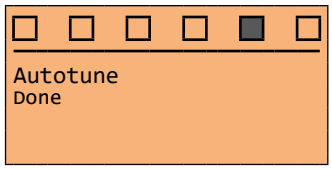
At the end of the procedure, proceed to the next step.

Step 10 - Exe CURR REG TUNE

The drive performs the auto-tuning procedure of the predictive current regulator (actual measurement of the motor's resistance and inductance parameters).
The procedure is fast and recommended in most cases.

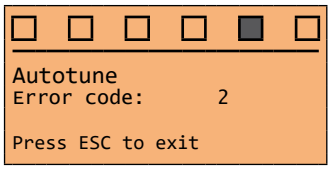






(5)

(1) Press the **E** key to start the auto-tuning procedure.
(2) Press the **E** key to execute parameter IPA 1050-**Curr reg autotune**.
(3) Enable the drive by closing the enable terminal within ten seconds; otherwise, an error message with code 2 will be displayed.



(4) Once the drive is enabled, the auto-tuning procedure begins. Depending on the motor type, the process may take several minutes.
The procedure can be interrupted at any time by pressing the **ESC** key or disabling the drive. In this case, an error message will be displayed with code 4 or 3, respectively.
During the procedure, the progress status alternates between the symbols – and |.

(5) At the end of the procedure, the indicated screen will appear.

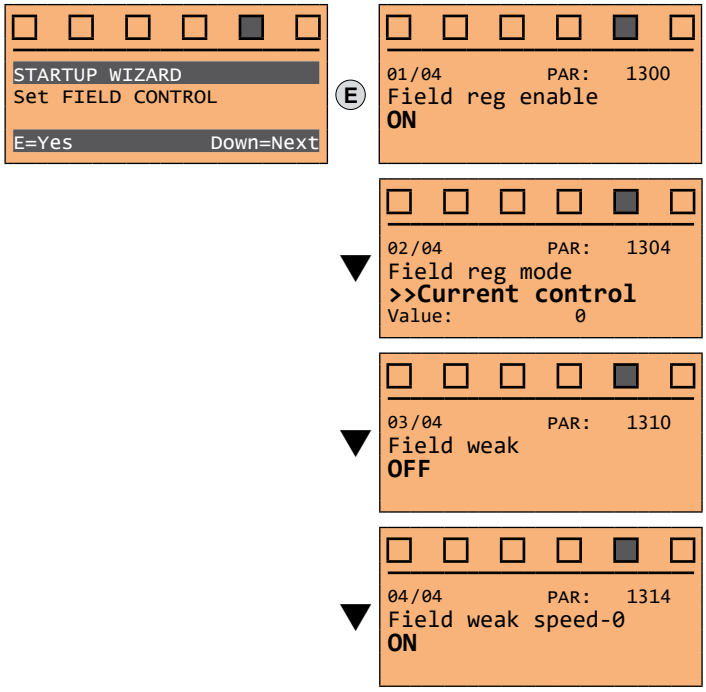
After opening the enable terminal, the procedure moves to the next step.
The procedure calculates parameters IPA 1052–**Arm resistance** and IPA 1054-**Arm inductance** in the **CURR REG TUNE** menu.

NOTE!

The calculated parameters are stored in volatile memory to allow the drive to perform the necessary calculations during operation.
If the device is powered off, this data will be lost. To save the motor data, follow the procedure described in **step 12**.

Step 11 - Set FIELD CONTROL

Basic field control configuration parameters:



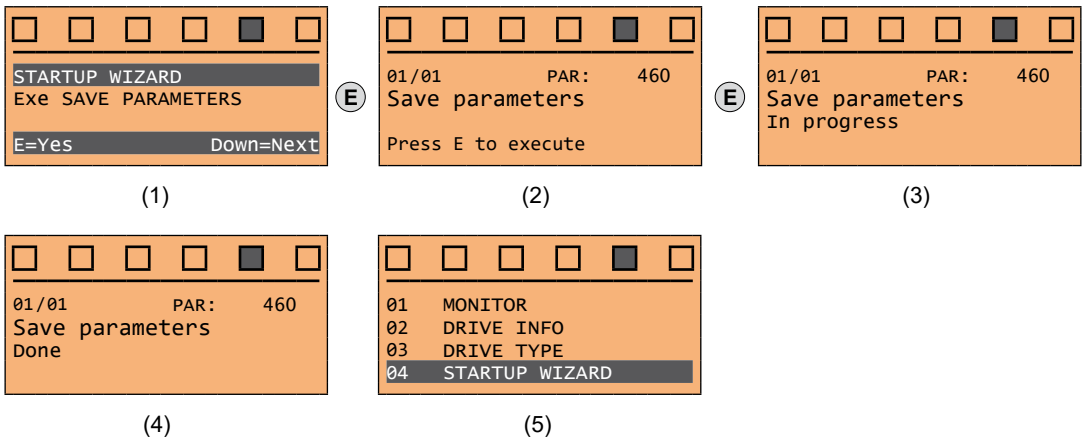
IPA 1300-**Field reg enable**, enables the field current regulator.
IPA 1304-**Field reg mode**, selects the flux regulation mode (fixed field constant current, armature voltage control, or external control).
IPA 1310-**Field weak**, enables field weakening.

IPA 1314-**Field weak speed-0**, enables field weakening at zero speed.

At the end of the procedure, proceed to the next step.

Step 12 - Exe SAVE PARAMETERS

To save the new parameter settings so that they are retained even after the device is powered off, follow this procedure:



(1) (2) (3)

(4) (5)

(1) Press the **E** key to start the parameter saving procedure.
(2) Confirm by pressing the **E** key again.
(3) The procedure will begin and show progress.
(4) The procedure completes.
(5) At the end of the procedure, the indicated screen will appear.

5.2.4.2 Commissioning using the STARTUP WIZARD via WEG_DriveLabs configuration tool

WEG_DriveLabs is the configuration software for WEG Automation Europe products. It allows users to connect to one or more target devices to monitor their status, view information, and read/write parameters.

The **WEG_DriveLabs** configurator provides users with the ability to connect and configure WEG Automation Europe devices through dedicated interfaces, intuitive toolbars, and informative status bars.

Key features included:

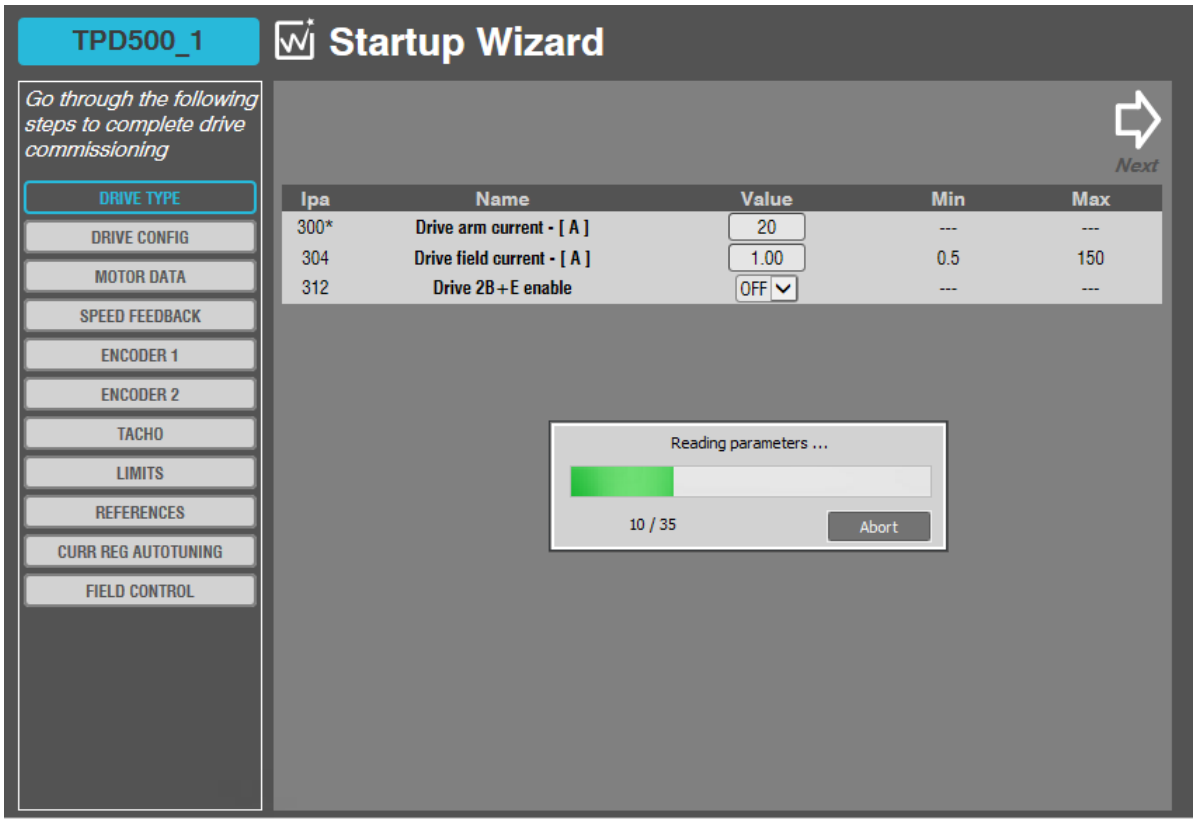
- Device-to-PC communication via RJ45 Ethernet port using the ModbusTCP protocol;
- Creation and management of projects, both for individual drives and multiple devices simultaneously;
- Parameter reading and writing;
- Saving parameters to the device;
- Device status monitoring;
- Softscope - an integrated real-time oscilloscope.

The drive can be commissioned not only via the keypad but also directly through the configurator.

From the **STARTUP WIZARD** menu, the drive can be started by following a step-by-step guided procedure. This allows the user to configure the main parameters such as drive type, motor, feedback, speed references, and perform auto-tuning of the current regulator.

The user can directly set the values of the parameters displayed in each menu and proceed simply by clicking “Next”. Parameters are automatically acquired when moving to the next step.

The sequence of steps corresponds to the order defined in the keypad procedure.



5.2.5 Speed sensor connection check

Before proceeding, it is necessary to check that the speed sensor provides the information with the correct sign according to the following convention:

- **Positive speed:** clockwise rotation of the motor, observed from the output side of the motor shaft.
- **Negative speed:** counterclockwise motor rotation, observed from the output side of the motor shaft.
- **Positive torque:** torque producing a clockwise rotation of the motor, observed from the output side of the motor shaft motor.
- **Negative torque:** torque producing a counterclockwise rotation of the motor, observed from the output side of the motor shaft motor.

To check the speed signal, select parameter IPA 234-**Motor speed** in the **MONITOR** menu.
- With the drive disabled, turn the motor clockwise (viewed from the motor shaft side). The value displayed must be positive.
- If the value does not change or appears unintelligible, check the power supply, configuration and connection of the encoder or tachogenerator.
- If the value is negative, the encoder or tachogenerator connections must be reversed:
  - by swapping channel A+ with A- or B+ with B- of the encoder;
  - by reversing the tachogenerator signal connections.

5.2.6 Field regulator settings

All settings described in this chapter must be carried out with the drive disabled (no voltage applied to terminal 12).

5.2.6.1 Operating mode

This section provides a brief explanation on how to configure the field mode for the main applications.
For advanced modes and a more detailed explanation, refer to **Chapter 6 – FUNCTION DESCRIPTION**.

Table 5-4: Main settings related to operating modes

Operating mode	Field regulator settings	Additional actions
Constant field	IPA 1304-**Field reg mode** = Current Control IPA 1300-**Field reg enable** = ON	Set IPA 1350-**Field max dig** Set IPA 1354-**Field min dig**
Field weakening managed by the drive	IPA 1304-**Field reg mode** = Voltage Control IPA 1300-**Field reg enable** = ON	Set **Field max dig** and **Field min dig** Tune the field regulator Set IPA 1306-**Volt control ref dig** Tune the voltage regulator
Field OFF	IPA 1304-**Field reg mode** = Current Control IPA 1300-**Field reg enable** = OFF	

5.2.6.2 Setting the rated field current

Based on the motor's rated field current, set the field converter current using dip-switch **S14**, following the instructions provided in **Chapter 2.3.3 – Field circuit calibration**.
This operation is always recommended to optimize performance, but it becomes necessary when the motor's rated field current is less than 10% of the field converter's rated current.

After setting dip-switch **S14**, update parameter IPA 304-**Drive field current** accordingly, as described in **Chapter 6.15.3 – Field current regulator tuning**.

These settings are not required if the motor field control is managed externally, outside of the TPD500's internal field converter.

5.2.6.3 Flux limits

The flux reference limits for the field regulator, available in the **FIELD CONTROL/FIELD REG LIM** menu, are set using parameters IPA 1350-**Field max dig** and IPA 1354-**Field min dig** as a percentage of the nominal flux.
The nominal flux corresponds to the flux generated when the rated field current - set via parameter IPA 608-**Field rated current** - is flowing through the field circuit.

5.2.7 Using the test generator

The **Test Generator** function allows system performance evaluation and, if necessary, manual tuning of the current and speed regulators.
This function generates square waveform signals with configurable frequency, amplitude, and offset.
Parameter IPA 4450-**Test Gen Dest** allows selection of the regulator input on which the generated signal will act.
For more details, refer to **Chapter 6.18.11 – Test generator**.

5.2.8 Current regulator tuning

5.2.8.1 Current regulator auto-tuning

This procedure must be carried out before the initial enabling of the drive, as previously mentioned in the commissioning procedure (**Chapter 5.2.4 – Commissioning procedure**).
The current regulator auto-tuning can be started via parameter IPA 1050-**Curr reg autotune**, using either the keypad or the **AUTOTUNING WIZARD** menu in **WEG_DriveLabs**.
The measured armature resistance and inductance values are saved in parameters IPA 1052-**Arm resistance** and IPA 1054-**Arm inductance**, accessible in the **CURR REG TUNE** menu.
If needed, the user can manually adjust these parameters.

- If the motor field is not powered by the converter, disconnect the field terminals. The internal field circuit is automatically disabled during the procedure, so manual disconnection is not required.
- The user must ensure that the drive does not rotate during the optimization process (even in the presence of residual magnetism, externally managed field, or a motor connected in series configuration). If necessary, mechanically lock the motor shaft.
- Power the drive's control section via terminals **U2** and **V2**.
- Make sure the drive is disabled (no voltage applied to terminal **12**).
- Set the desired armature current using parameters IPA 1104-**C/T lim pos dig** (positive torque) and IPA1108-**C/T lim neg dig** (negative torque). The higher value will be used for the auto-tuning procedure.
- To ensure accurate results, the set current must be sufficient to guarantee continuous conduction mode. If necessary, disable the overload function during the procedure (IPA 4300-**Overload mode** = None).
- Start the procedure via IPA 1050-**Curr reg autotune** from the keypad or via the **AUTOTUNING WIZARD** menu in **WEG_DriveLabs**.
- Power the drive's power section via terminals **U**, **V**, **W**.
- Enable the drive (+24 V to terminal **12**) to start the auto-tuning.
- The procedure takes a few minutes and can be interrupted by:
  - turning off the unit;
  - disabling the drive or pressing **ESC** if started from the keypad;
  - executing the **Autotune Break** command from the **AUTOTUNING WIZARD** menu in **WEG_DriveLabs**.
- At the end of the auto-tuning, the drive will automatically disable itself.
- Disconnect the enable terminal (remove voltage from terminal **12**).
- Reactivate the overload control function, if used (IPA 4300-**Overload mode** set to one of the available options).
- Save the settings using the keypad or the save button  in **WEG_DriveLabs**.

NOTE! If the procedure is interrupted by the user or due to an alarm, the parameters previously saved in the drive will be restored.

5.2.8.2 Fine (manual) tuning of the current regulator

During drive operation, the IPA 1060-**Compensation output** parameter can be monitored in the **CURRENT CONTROL\ CURR REG TUNE** menu. This parameter indicates the effectiveness of the current regulator tuning and is closely related to the load's inductance and resistance values.

The ideal value of IPA 1060-**Compensation output** should be close to zero, although dynamic variations between –40 V and +40 V are acceptable.

NOTE! To ensure a reliable reading, the drive should operate under a load of at least 30% of its rated capacity.

If needed, small adjustments can be made to parameter IPA 1054-**Arm inductance** in order to bring the value of IPA 1060-**Compensation output** closer to zero:

- If IPA 1060-**Compensation output** is positive, increase the value of IPA 1054-**Arm inductance**;
- If IPA 1060-**Compensation output** is negative, decrease the value of IPA 1054-**Arm inductance**.

5.2.9 Manual tuning of the field current regulator

The field regulator comes with a default tuning that generally provides satisfactory performance when the field reference is constant.
However, if the field reference varies over time - for example, when controlled by the armature voltage regulator (IPA 1304-**Field reg mode** = Voltage control) - it is recommended to optimize the tuning as described below.

NOTE! During the tuning of the field current regulator, the drive must not receive any **Start** command.

- Drive disabled (no voltage applied to terminal 12).
- Open the **FIELD CONTROL \ FIELD REG LIM** menu and set:
  - IPA 1350-**Field max dig** = 100.00% 100.00% corresponding to the motor's rated field current;
  - IPA 1354-**Field min dig** = 0.00%.
- Still in the **FIELD CONTROL\FIELD REG LIM** menu, set:
  - IPA 1320-**Field curr reg I** = 0.00%;
  - IPA 1322-**Field curr reg P** = 0.00%.
- Monitor the field reference and measured field current using **Softscope** or an analog output. To do this, assign the variable IPA 1342-**Field current [%]** to one output, and IPA 1340-**Field reference** to another (see **Chapter 6.17 – IOs**).

NOTE! Access to **Softscope** is available via the dedicated icon in the **WEG_DriveLabs** menu.

- Open the **FIELD CONTROL\FIELD REG** menu and set:
  - IPA 1300-**Field reg Enable** = ON.
  - IPA 1304-**Field reg mode** = Current control.
- Open the **FUNCTIONS\TEST GENERATOR** menu and set:
  - IPA 4450-**Test gen dest** = Field ref.
  - IPA 4454-**Test gen amplitude** to 70% of the motor's rated field current (this allows for system overshoot).
- Increase the value of parameter IPA 1320–**Field curr reg P** fino a ottenere una risposta della corrente (IPA 1342-**Field current [%]**) con al massimo una sovraelongazione del 4% e che non presenti oscillazioni.
- Increase the value of parameter IPA 1322–**Field curr reg I** until the field current response shows a maximum overshoot of 4% and no oscillations.

NOTE! Due to the high time constant, the rise time of the field current is limited. For this reason, increasing the gains may lead to a deterioration in current behavior. In such cases, it is advisable to simply find the gain values that provide the best possible response without introducing oscillations

Complete the optimization procedure by setting:
- IPA 4450-**Test gen dest** = OFF.
- IPA 1300-**Field reg enable** = OFF.
- IPA 1354-**Field min dig** to the desired value.
- Configure the analog outputs according to your specific requirements.
- Finally, save the settings using the keypad or the save button in **WEG_DriveLabs**.

Figures 5-2 to 5-7 show examples of field current regulator tuning.

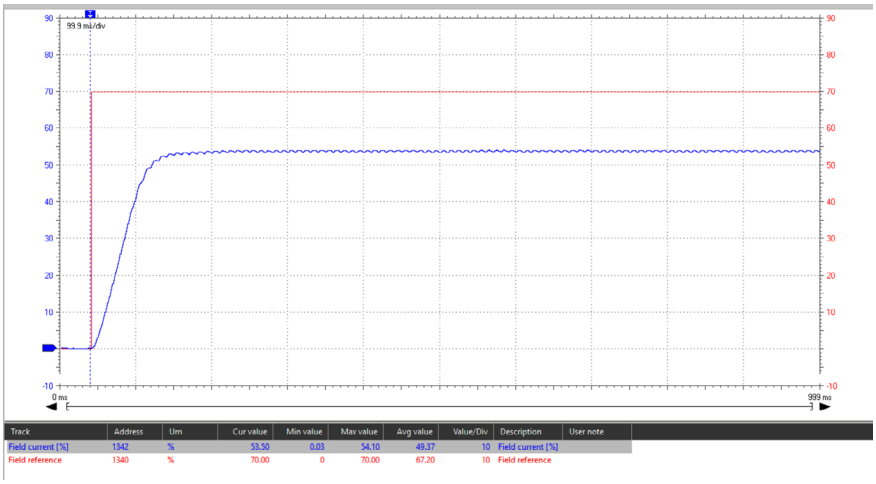


Figure 5-2: Field regulator Kp value too low

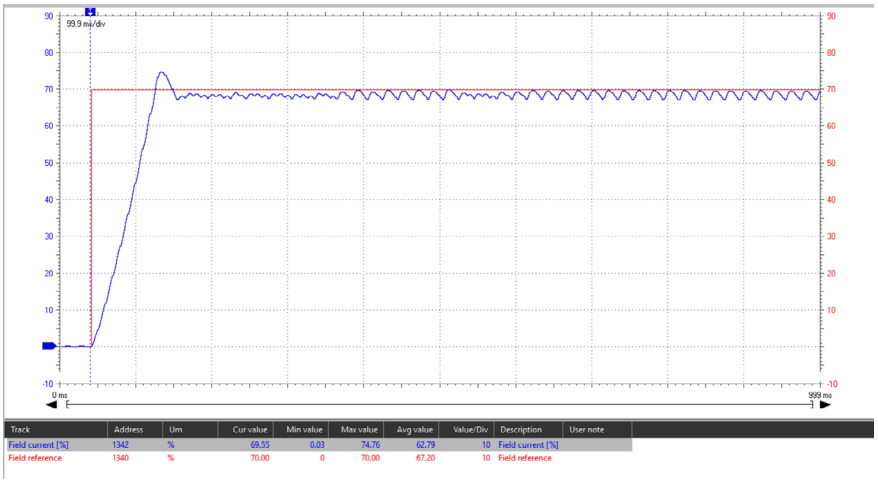


Figure 5-3: Field regulator Kp value too high. Presence of overshoot and field current oscillations

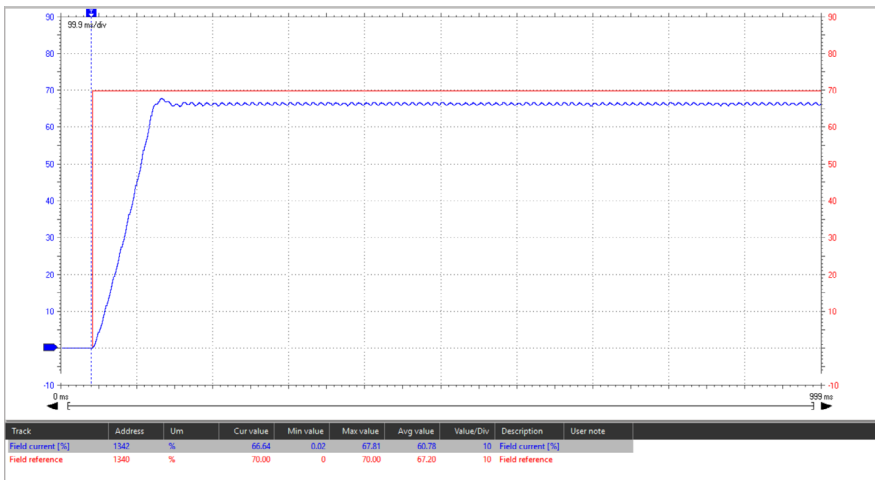


Figure 5-4: Correct Kp value

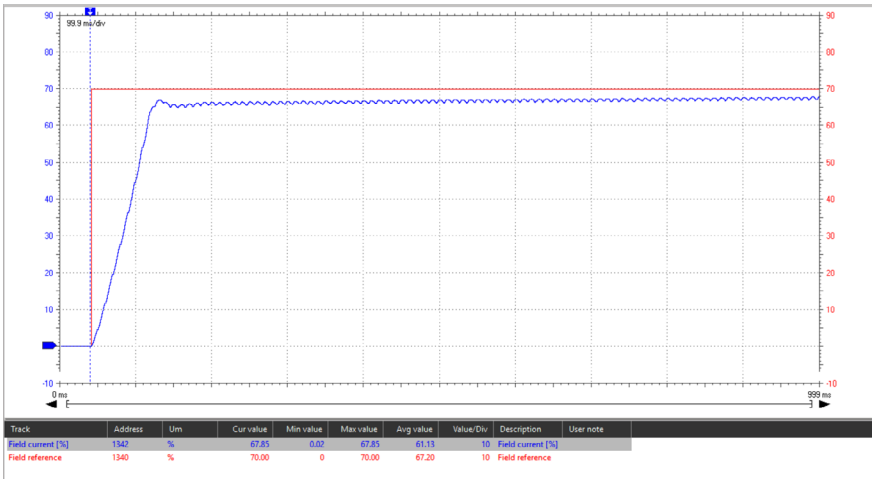


Figure 5-5: Ki value too low. The field current reaches the target value very slowly

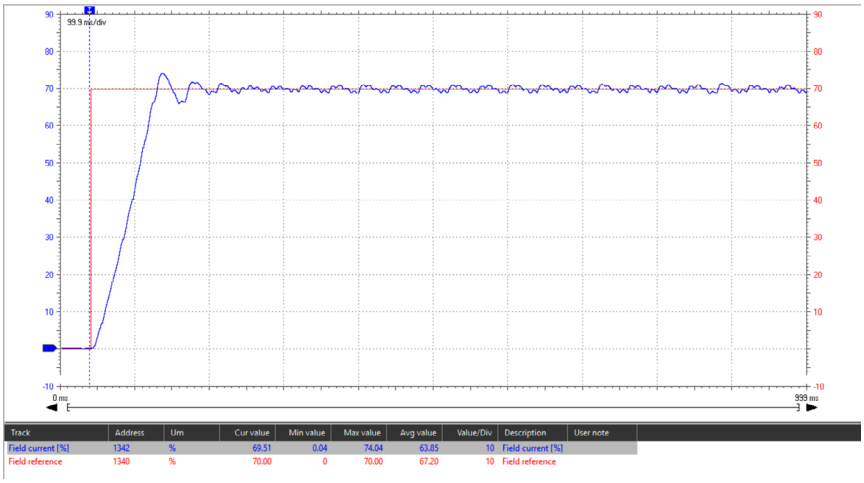


Figure 5-6: Ki value too high. Field current oscillations.

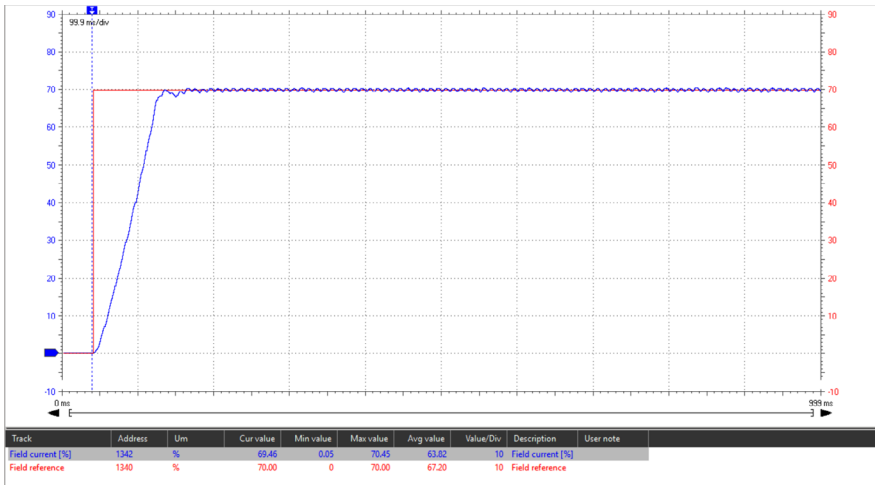


Figure 5-7: Regulator correctly tuned.

5.2.10 Manual tuning of the speed regulator

The speed regulator of the TPD500 drive is preset with default values that, under normal conditions, provide sufficient performance for initial operation in speed control mode.
The following procedure describes how to optimize the regulator's performance, if needed.
To generate a step signal, the internal test generator is used (**FUNCTION\TEST GENERATOR** menu), with the goal of achieving an optimal step response.
The analog output can be routed to the terminals with a sampling time of 1 ms.

- Drive disabled (no voltage applied to terminal 12).
- Open the **FUNCTION\TEST GENERATOR** menu and set:
  - IPA 4450-**Test gen dest** = Speed ref.
  - IPA 4452-**Test gen frequency** = 0,2 Hz.
  - IPA 4454-**Test gen amplitude** = 10%.
  - IPA 4456-**Test gen offset** = 10%.

- Monitor the step response using Softscope or an analog output. To do this, assign variable IPA 234–**Motor speed** to one output and IPA 214-**Armature current [%]** to another (see **Chapter 6.17 – IOs**).
- Open the **SPEED CONTROL / SPEED REG TUNE** menu and set:
  - IPA 900-**Speed reg P** = 0,00%;
  - IPA 902-**Speed I** = 0,00%.
- Enable the drive (voltage on terminal 12) and issue a Start command (voltage on terminal 13).
- Increase IPA 900-**Speed reg P** until the speed response has no oscillations and shows an overshoot of less than 4% with the shortest possible response time. If the armature current shows rapid oscillations, reduce the value.
- Increase IPA 902-**Speed reg I** until the speed response has no oscillations and shows an overshoot of less than 4% with the shortest possible response time. If the armature current shows oscillations, reduce the value.
- Stop and disable the drive (remove voltage from terminals 12 and 13).
- Set IPA 4450-**Test gen dest** = OFF.
- Save the settings using the keypad or the save button  in **WEG DriveLabs**.

NOTA!

When the **Bypass** function is enabled (IPA 656–**Speed fbk bypass** = ON) ithe drive automatically switches to armature feedback (estimated speed, not sensor-based) in the absence of the feedback signal.

In this scenario, with the feedback signal disconnected, it is necessary to repeat the speed regulator tuning as previously described. The proportional gain of the speed regulator is set using parameter IPA 930–**Speed reg P bypass**, while the integral gain is set using IPA 932–**Speed reg I bypass**.

In some cases, it is necessary to use different gain values depending on speed—for example, when field weakening is active or when the load behavior changes significantly with speed.
For this reason, TPD500 series drives are equipped with an adaptive speed regulator.
For more details on this function, refer to **Chapter 6.13.4 – Adaptive speed regulator**.

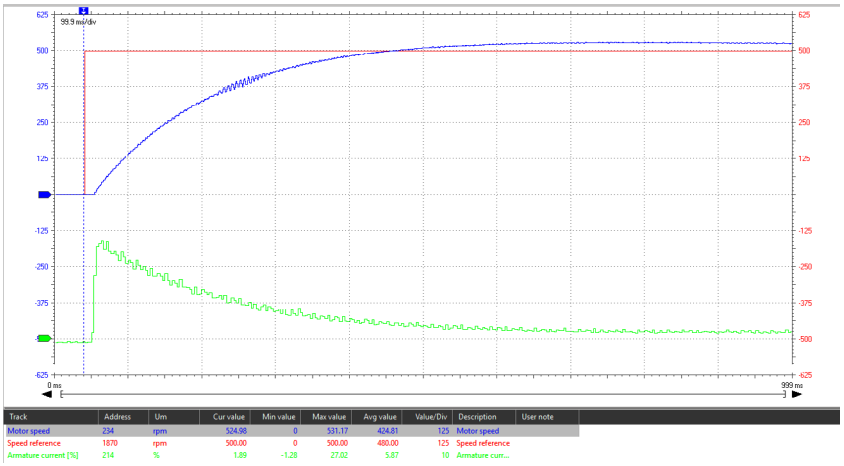


Figure 5-8: Speed reg P value too low

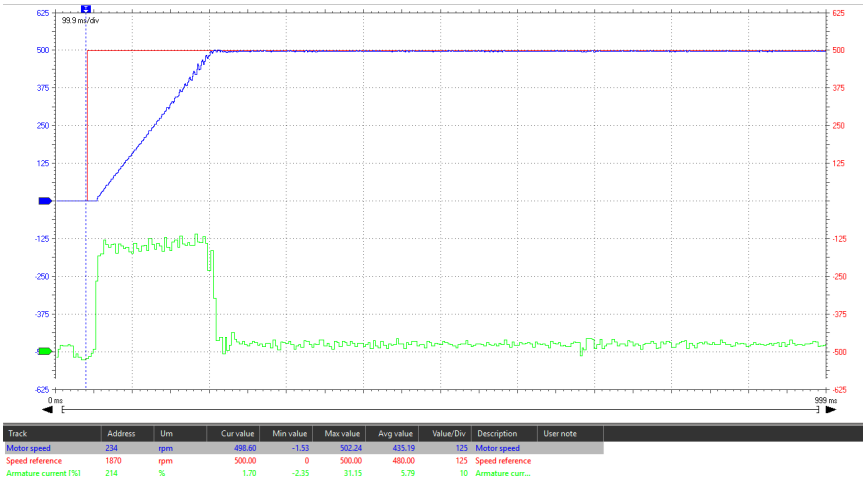


Figure 5-9: Speed reg P value too high, oscillations in armature current and speed

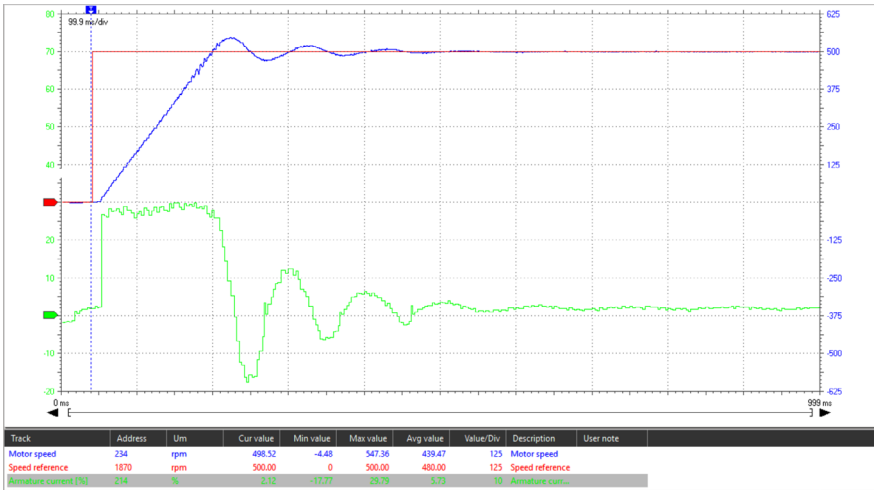


Figure 5-10: Speed reg I value too high, oscillations in armature current and speed

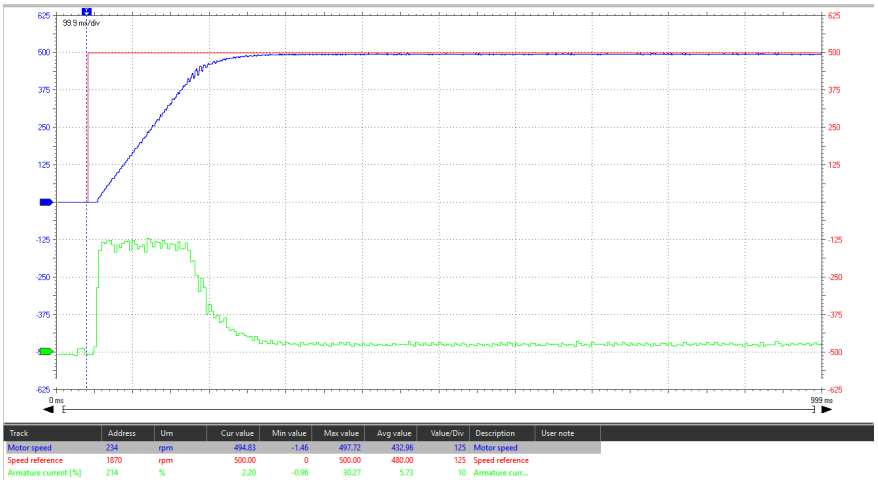


Figure 5-11: Speed reg P and Speed reg I values correctly set

5.2.11 Flux/If curve tuning

The magnetic flux in the motor may not be perfectly proportional to the field current.
If the drive operates with a constant field current equal to the nominal value (IPA 1350–**Field max dig** = 100%), %), this function does not need to be used.
However, in cases where the field current varies — such as during field weakening — tuning of the flux/current curve is necessary. This ensures that the field current is appropriately adjusted from its default value, in order to maintain correct behavior of the following flux-related variables at every operating point:

- Motor flux
- Torque calculation
- Speed estimation when using armature feedback

The figure below illustrates the relationship between flux and field current, comparing the case where the Flux/If curve is enabled (Curve B) with the case where it is not (Curve A).

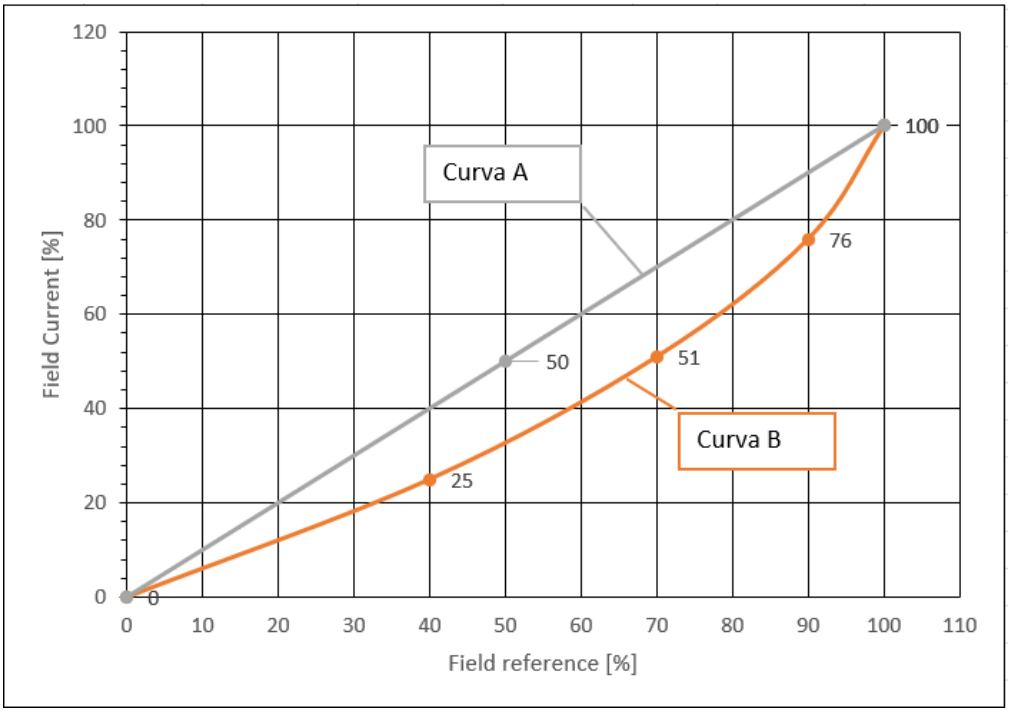


Figure 5-12: Example of field current tuning curve

Example:

Curve A – Keeping the tuning curve unchanged from the drive's standard factory settings will result in a linear behavior of IPA 1344-**Field current [A]** as IPA 1340-**Field reference varies**.

Therefore:
Field current max / Field reference = 100% → **Field current / Field reference** = Field rated current
Field current max / Field reference = 50% → **Field current / Field reference** = 50% di Field rated current

Curve B – It represents the curve obtained by performing the flux curve tuning (see tuning procedure below).
The values of parameter IPA 1344–**Field current [A]** will follow a profile that corresponds to the percentage of actual flux (IPA 1340–**Field reference**) required to ensure the proper circulation of field current in the connected system.
Curve B is derived from the **Field curr const** parameters calculated during the manual tuning procedure described below.

Therefore:
Field current max / Field reference = 100% → **Field current / Field reference** = Field rated current
Field current max / Field reference = 50% → **Field current / Field reference** = 33% di Field rated current
Field current max / Field reference = 40% → **Field current / Field reference** = 25% di Field rated current

Values obtained by setting the following parameters:

- IPA 1450-**Field curr const 40%** = 25%
- IPA 1452-**Field curr const 70%** = 51%
- IPA 1454-**Filed curr const 90%** = 76%

5.2.11.1 Manual tuning procedure

- Open the **FIELD CONTROL\ FIELD REG TUNE** menu and reset the flux/current curve using command IPA 1458-**Field curve reset**.
- Open the **MOTOR DATA** menu and set the motor's rated field current, which corresponds to the current that produces the rated flux, using parameter IPA 608-**Field rated current**.
- Open the **FIELD CONTROL\ FIELD REG** menu and set the desired output voltage using parameter IPA 1306-**Volt control ref dig**,expressed as a percentage of the motor's rated voltage, represented by parameter IPA 606-**Arm rated voltage** (**MOTOR DATA** menu).
- In the same menu **FIELD CONTROL\ FIELD REG**, set the field regulator mode via IPA 1304-**Field reg mode** = Current control.
- Open the **FIELD CONTROL\ FIELD REG LIM** menu and set the flux percentage to 100% using parameter IPA 1350-**Field max dig**.
- Run the motor at a speed such that the variable IPA 210-**Armature voltage** (**MONITOR** menu) matches the previously set value of IPA 606-**Arm rated voltage**.
- Using parameter IPA 1350-**Field max dig**, reduce the voltage displayed in IPA 210-**Armature voltage**, until it reaches 90% of IPA 606-**Arm rated voltage**.
- Read the circulating current from IPA 1342-**Field current [%]** (in the **MONITOR** menu) and enter it in parameter IPA 1454-**Field curr const 90%** (in the **FIELD CONTROL\FIELD REG TUNE** menu).
- Reduce the voltage shown in IPA 210–**Armature voltage** to 70% of IPA 606–**Arm rated voltage** using IPA 1350–**Field max dig**.
- Read the circulating current from IPA 1342–**Field current [%]** and enter it into IPA 1452–**Field curr const 70%**.
- Then, reduce the voltage further to 40% of IPA 606–**Arm rated voltage** using IPA 1350–**Field max dig**.
- Read the circulating current from IPA 1342–**Field current [%]** and enter it into IPA 1450-**Field curr const 40%**.
- Disable the drive (remove voltage from terminal 12).
- Set the desired field control operating mode via IPA 1304–**Field reg mode**, and set IPA 1350–**Field max dig** back to 100%.
- Save the parameters using the keypad or the save button  in **WEG DriveLabs**.

NOTE! Any change to parameter IPA 608–**Field rated current** requires a new tuning of the curve.

5.2.12 Armature voltage regulator (field regulator setpoint)

NOTE! In most applications, separately excited DC motors operate with a constant field (IPA 1304–**Field reg mode** = Current control). In this case, there is no need to optimize the armature voltage regulator.

When voltage control is active, the regulator maintains a constant armature voltage by adjusting the field current within the defined limits (IPA 1350–**Field max dig** and IPA 1354–**Field min dig**).
The critical point for this regulator is when voltage control becomes active, as motor field saturation requires faster field current adjustments to compensate for flux variations.
It is therefore important to tune the regulator in a way that minimizes armature voltage fluctuations.

NOTE! All other drive regulators must be properly configured before optimizing the voltage regulator.

- Drive disabled (no voltage applied to terminal 12).
- Open the **FUNCTION\TEST GENERATOR** menu and set:
  - IPA 4450-**Test gen dest** = Ramp ref.
  - IPA 4452-**Test gen frequency** = 0,2 Hz.
  - IPA 4454-**Test gen amplitude** = 10%.
  - IPA 4456-**Test gen offset** = in base al punto di passaggio dalla regolazione di armatura a quella di campo.

- Example: if field weakening starts at 1500 rpm and IPA 602–Motor max speed = 2000 rpm, set IPA 4456–Test gen offset = 75%.
- Monitor the field current and armature voltage using Softscope or analog outputs.
- To do this, assign variables IPA 1342–Field current [%] and IPA 210–Armature voltage to two separate analog outputs (see Chapter 6.17 – IOs).
- Enable the drive (apply voltage to terminal 12) and issue a Start command (apply voltage to terminal 13).

- Check the armature voltage (IPA 210–Armature voltage). After a possible brief transient, the voltage should remain stable. See figures 5-13 to 5-15. You can adjust the proportional and integral gains in the FIELD CONTROL \ FIELD REG TUNE menu using parameters IPA 1400–Voltage reg P and IPA 1402–Voltage reg I, respectively.
- Stop and disable the drive (remove voltage from terminals 12 and 13).
- Set IPA 4450-Test gen dest = OFF.
- Save the settings using the keypad or the save button  in **WEG DriveLabs**.

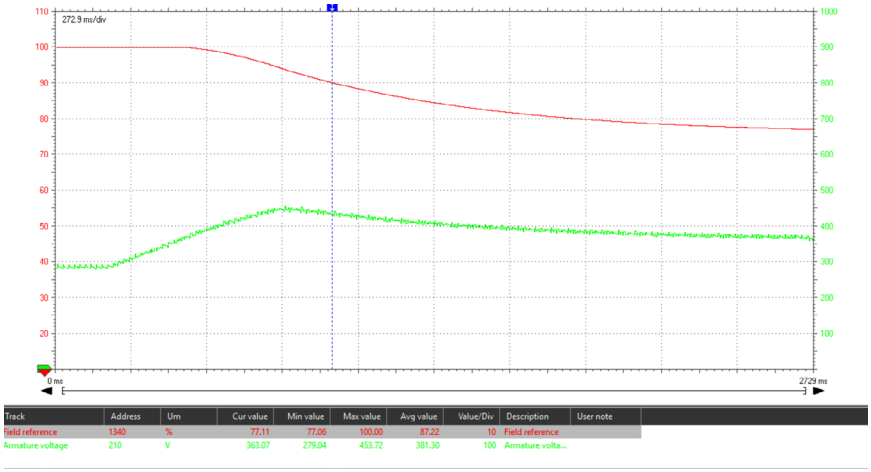


Figure 5-13: Regulator too slow, armature voltage rises above the maximum setpoint of 380 V

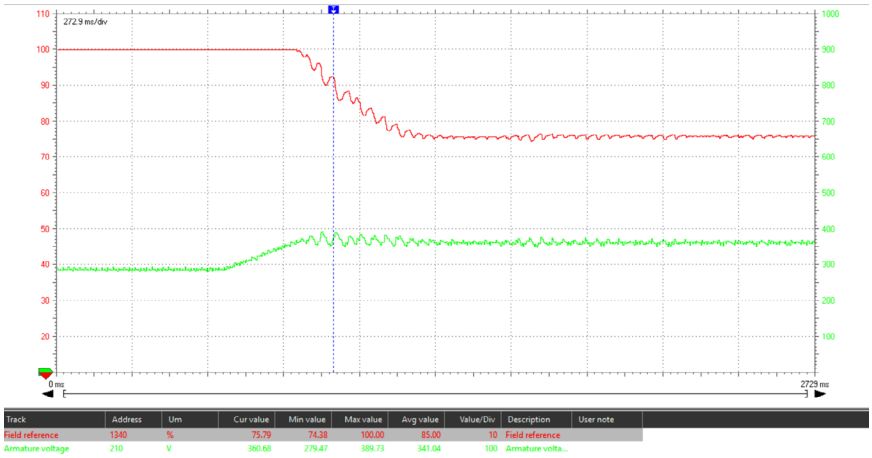


Figure 5-14: Regulator too reactive, armature voltage and flux reference show oscillations

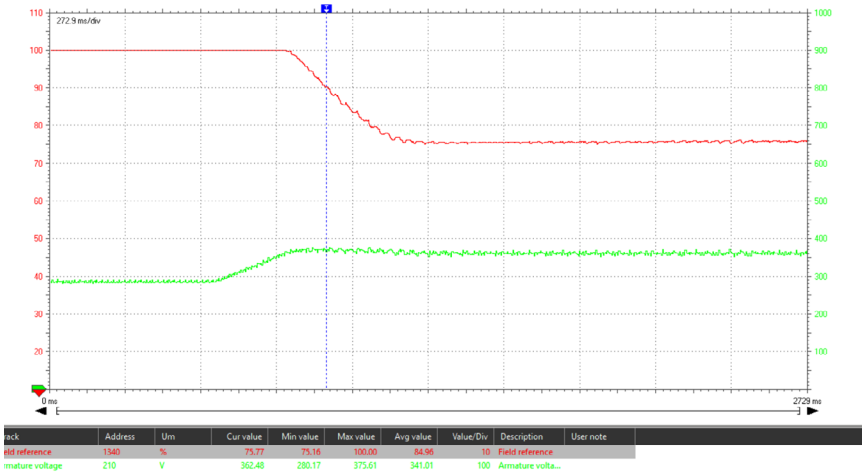


Figure 5-15: Regulator correctly set

6. FUNCTION PARAMETERS

6.1 Overview and use cases

This chapter describes the functions provided by the **TPD500** converter series to manage typical use cases.
The available functions are introduced and explained according to the menu structure accessible from both the keypad and the **WEG_DriveLabs** configuration software.
Descriptions of each parameter can be found in **Chapter 9 – PARAMETER LIST**, which also includes the unit of measurement, default values, and allowed minimum and maximum values.
In the standard delivery configuration, the devices are set up for speed control with cascaded current regulation, according to the following general block diagram.

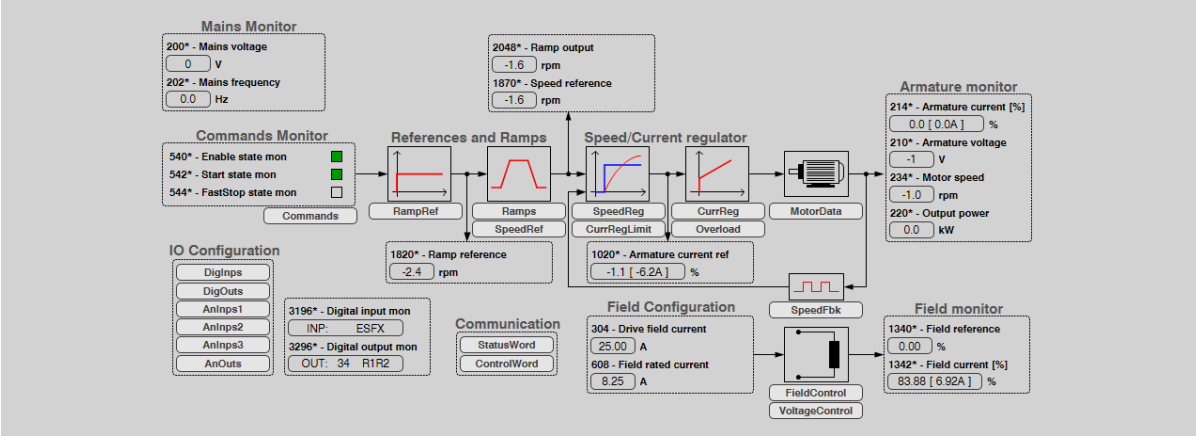


Figura 6-1: Panoramica

The device can be controlled using one or more of the following methods:
- terminal block (analog and digital inputs);
- keypad;
- fieldbus;
- WEG_DriveLabs configuration software (Modbus TCP or RS485 serial line).

Except for the terminal block, these methods can also be used to configure and parameterize the device.
Once the converter has been set up as desired, the parameters must be saved using the IPA 460–**Save parameters** command in the **DRIVE CONFIG** menu. Otherwise, the configured values will be lost when the device is powered off.

6.1.1 Common hardware configurations

This section lists the most common hardware configurations for using the converter.
The most typical setup involves the drive controlling either a separately excited motor or a permanent magnet motor, as shown in the following basic diagram.

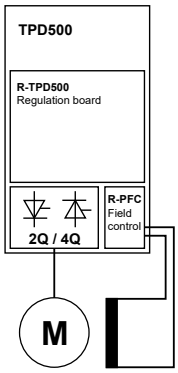


Figure 6-2: Drive controlling a separately excited motor

In some cases, a separate converter may be required to regulate the motor excitation.
The following diagram illustrates this configuration, where the drive managing the excitation (-FC) is controlled by the TPD500, which handles the motor armature control.

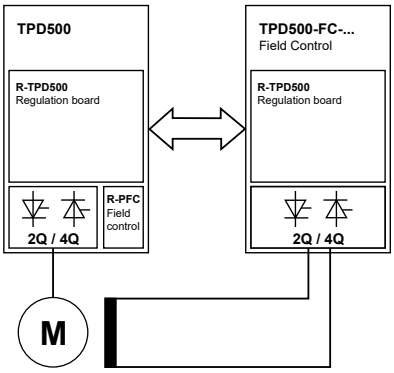


Figure 6-3: Motor control with an external drive for excitation regulation

For large motors and applications where fast direction changes are not required, the following **2B+E configuration** may be a suitable option.
In this setup, the **TPD500** operates in two-quadrant mode (2B), while the direction reversal is achieved by switching the excitation polarity using the four-quadrant (-FC) converter, which regulates the excitation.
.

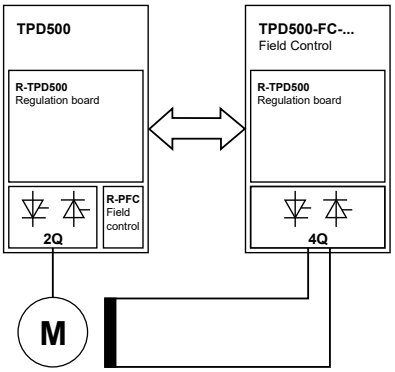


Figure 6-4: 2B+E configuration – two-quadrant converter combined with a four-quadrant -FC for direction reversal

NOTE!

The diagrams show the TPD500-FC-... as the field current controller (this version is currently unavailable), but a TPD32-EV-FC can also be used instead.

6.2 Main commands

The main commands of the drive are essential for its operation and can be a combination of digital inputs and commands received via keypad or fieldbus. The available commands are:

Table 6-1: Main control signals

Enable drive	Converter enable
Start	Regulation enable
Fast stop	The speed reference is immediately set to zero to stop the motor in a short (programmable) time
External fault	Triggers an alarm if an external fault is detected

A more detailed description of the commands and their logic is provided in the following paragraphs.

6.2.1 Commands via digital input

The following digital inputs must always be present to operate the drive, regardless of the selected operating mode. Wiring can be done as shown in the diagram; for detailed information on wiring and electrical data, refer to **Chapter 4 – ELECTRICAL CONNECTION.**

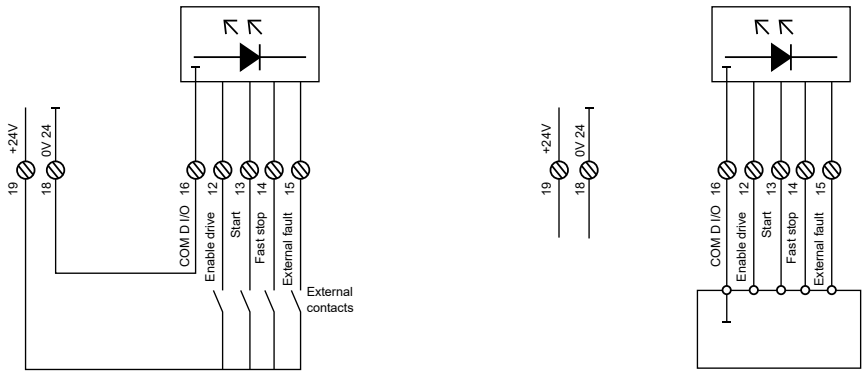


Figure 6-5: Example of digital input wiring

NOTE!

The **Enable drive** and **Start** signals use positive logic (active high), while the **Fast stop** and **External fault** signals use negative logic (active low). If the Fast stop and External fault signals are not used, they can be disabled by wiring them directly to the high potential (+24 V).

If parameter IPA 500–**Mains commands** is set to *Digital*, in addition to the signals described above, commands via keypad or fieldbus are also required.
If a fault is triggered by removing a signal from a terminal, to perform a new start, the signal must be restored at the corresponding terminal and the related command must also be sent via keypad or fieldbus.

6.2.2 Drive enable

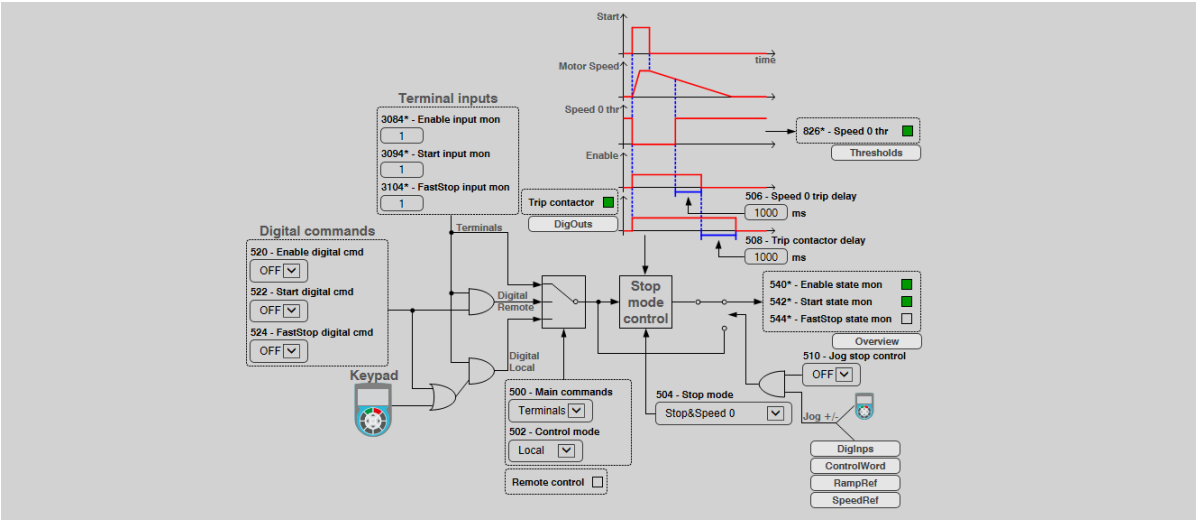


Figure 6-6: Drive control diagram (Commands diagram)

Drive enabling, as shown in the diagram, is achieved by applying a positive signal to the **Enable drive** terminal when parameter IPA 500-**Mains commands** is set to *Terminals*. If the parameter is set to *Digital*, enabling is determined by the logical AND between the digital input and parameter IPA 520-**Enable digital cmd** (available in the **COMMANDS** menu). The different configurations and states are summarized in the table below, which applies when parameter IPA 504-**Stop mode** is set to *OFF*.

Table 6-2: Drive command configurations

Main commands	Control mode	Enable HW (Digital in)	Enable parameter IPA 520 (keypad, WEG_DriveLabs)	Enable parameter IPA 520 (fieldbus)	Enable state
-	-	L	-	-	OFF
Terminals	-	H	-	-	ON
Digital	Local	H	L	-	OFF
Digital	Local	H	H	-	ON
Digital	Remote	H	-	L	OFF
Digital	Remote	H	-	H	ON

The user can check the drive enable status via parameter IPA 540-**Enable state mon**, available in the **MONITOR** menu.

NOTE! When the drive is not enabled, no other commands are accepted (e.g. Jog +, Jog –, or Start).

NOTE! If the **Enable drive** command is removed while the drive is operating, the motor will coast to a stop. Braking or controlled deceleration using the configured ramp time is therefore not possible.

6.2.3 Start/stop

When parameter IPA 500-**Main commands** is set to *Digital*, parameter IPA 522-**Start digital cmd** (ON-OFF) is used to start or stop the converter, similarly to the START and STOP keys on the keypad.

NOTE! For the drive to operate, the **Start** command is only effective if the **Enable drive** signal is also present.

The behavior of the drive in response to the **Start** command depends on the parameter settings:

- When using the ramp function (IPA 2000-**Ramp enable** to *ON* and IPA 800-**Speed reg enable** to *ON*). If the **Start** command is removed, the drive decelerates to a stop according to the deceleration time.
- When the ramp is disabled (IPA 2000-**Ramp enable** set to *OFF* and IPA 800-**Speed reg enable** set to *ON*) the speed reference set by IPA 1850-**Speed ref 1 dig** is sent directly to the speed controller. After the **Start** command is given, the drive immediately reaches the desired speed. If the command is removed, the speed is brought to zero. However, the **Start** command does not affect the correction value set by IPA 1860-**Speed ref 2 dig**.
- In current control mode (IPA 800-**Speed reg enable** set to *OFF*) the **Start** command enables the current references set by IPA 1900-**C/T ref 1 dig** and IPA 1910-**C/T ref 2 dig**.

The **Start** command is not required for jog operation.
If the **Start** and **Jog +/-** commands are issued simultaneously, the **Start** command has higher priority and can interrupt jog motion.
The **Start** status can be monitored in the **MONITOR** menu via parameter IPA 542-**Start state mon**.

6.2.4 Fast stop

For the converter to operate, the **Fast stop**, signal must always be present, regardless of the selected operating mode (*Terminals* or *Digital*).
This signal can be used in emergency or hazardous situations to stop the machine quickly and in a controlled manner.
If this signal is removed while the drive is operating, a deceleration is triggered using the ramp configured by parameters IPA 2032-**FastStop speed** and IPA 2034-**FastStop time** in the **RAMPS** menu.
Once the motor has stopped, the drive remains enabled and torque is still applied. To disable it, the **Start** and/or **Enable drive** commands must be removed.

The behavior after a **Fast stop** depends on the selected operating mode:

- Operation via terminal block (IPA 500-**Main commands** set to *Terminals*).
  The drive remains in braking condition as long as there is no voltage on terminal **14** (Fast stop).
  Once voltage is restored on this terminal, the drive automatically restarts with the configured reference, provided all other enabling conditions are still valid.

- Operation via parameters (IPA 500-**Main commands** set to *Digital*):
  The drive remains in braking condition until it reaches zero speed.
  When voltage is restored on terminal **14** (Fast stop), the drive does not restart automatically; it will only restart if a new **Start** command is issued via parameter IPA 522-**Start digital cmd**.
  If the **Fast stop** is triggered via parameter IPA 524-**FastStop** digital cmd in the **COMMANDS** menu while terminal **14** (Fast stop) still has voltage, the drive is brought to zero speed.
  To restart the drive, the state of IPA 524-**FastStop** digital cmd must be toggled, and a new **Start** command must be issued via IPA 522-**Start digital cmd**.

The **Fast stop** status can be monitored in the **MONITOR** menu via parameter IPA 544-**FastStop state mon**.

NOTE!

When **Fast stop** is active, the keypad displays the message Fast stop active, and once zero speed is reached, the **n=0** LED starts flashing.

6.2.5 External Fault

The **External fault** command allows the integration of an external fault signal into the converter's diagnostics and alarm system, using a dedicated digital input (active low on terminal **15**).
The converter's behavior upon detection of an external fault depends on the parameter settings in the **ALARM CONFIG \ EXTERNAL FAULT** menu.

6.3 Monitor

The **MONITOR** menu displays the main variables used to check the system status: measured voltage, frequency, current, and speed values; applied references; overall digital I/O status; and system variables.

Some measurements are processed through a low-pass filter to provide more stable readings. In such cases, in addition to the actual measured value, a parameter representing the filter time constant is also available.

The parameters available in the **MONITOR** menu are described in the following list:

IPA		DESCRIPTION
200	**Mains Voltage**	Mains voltage in [V]
202	**Mains Frequency**	Mains frequency in [Hz]
210	**Armature voltage**	Armature voltage in [V]
214	**Armature current [%]**	Armature current as a percentage of the motor's rated armature current. This parameter can be displayed in dual units [%]-[A]
222	**Armature current [A]**	Armature current in [A]
216	**Arm current filter**	Time constant of the low-pass filter applied to the displayed armature current
1342	**Field current [%]**	Field current as a percentage of the motor's rated field current. This parameter can be displayed in dual units [%]-[A]
1344	**Field current**	Field current in [A]
220	**Output power**	Output power from the converter in [kW]
234	**Motor speed**	Motor speed in [rpm]
236	**Motor speed filter**	Time constant, in seconds, of the low-pass filter applied to the displayed motor speed
1020	**Armature current ref**	Armature current reference as a percentage of the motor’s rated armature current. This parameter can be displayed in dual units [%]-[A]
1340	**Field reference**	Flux reference as a percentage of the motor’s rated flux
1338	**Field current ref**	Field current reference as a percentage of the motor’s rated field current
1820	**Ramp reference**	Ramp input reference in [rpm]
2048	**Ramp output**	Ramp output value in [rpm]
1870	**Speed reference**	Final speed reference in [rpm], input to the speed controller
3084	**Enable input mon**	Enable terminal (terminal **12**) status monitor
3094	**Start input mon**	Start terminal (terminal **13**) status monitor
3104	**FastStop input mon**	Fast stop terminal (terminal **14**) status monitor
3114	**Ext fault input mon**	External fault terminal (terminal **15**) status monitor
3196	**Digital input mon**	Overall digital input status display using the format **I: 1 2 3 4 5 6 7 8 E S F X**, where only active inputs (i.e., those with voltage applied) are shown by their number (1–8) or letter **E** = Enable, **S** = Start, **F** = Fast stop, **X** = External fault. For example, **I: 4 7 S X** means that only digital inputs 4 and 7, and the Start and External fault signals are active (high logic level).
3296	**Digital output mon**	Overall digital output status display using the format **O: 1 2 3 4 5 6 7 8 R1 R2**, where only active outputs are shown by their number (1–8) or by letter **R1** = Relay 1, **R2** = Relay 2. For example, **O: 2 3 5 6 R2** means that only digital outputs 2, 3, 5, 6, and R2 are active (high logic level).

In the standard delivery configuration, the devices are set up for speed control with cascaded current regulation, according to the following general **Overview** block diagram, where the above-mentioned monitor parameters are shown.

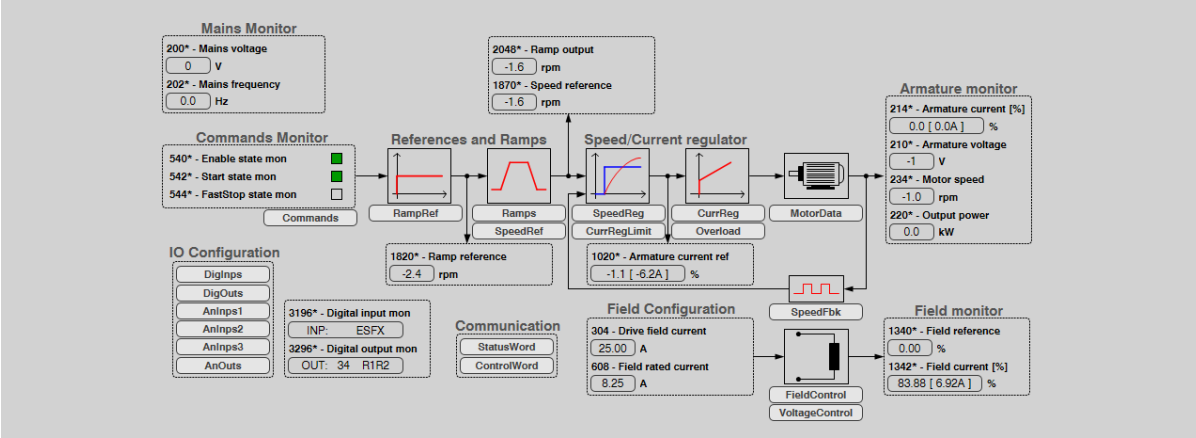


Figure 6-7: Overview diagram

6.4 Drive information

The **DRIVE INFO** menu displays product information useful for software-level identification.
The parameters available in the **DRIVE INFO** menu are described in the following list:

IPA		DESCRIPTION
172	**Drive series**	Product series identification string
174	**Firmware version**	Product firmware version, in the format *x.y.z*
176	**Firmware version DSP**	Product control firmware version, in the format *x.y.z*
182	**Boot version**	Product boot firmware version, in the format *x.y.z*
180	**Boot version DSP**	Product control boot firmware version, in the format *x.y.z*
184	**Application name**	String containing the name of the loaded application, if any (e.g., *PID* or *TW* for Torque Winder)
194	**Application type**	Application ID code developed with **WEG_DriveLogic**
192	**Application version**	Application version developed with **WEG_DriveLogic**, in the format *x.y.z*
490	**Time drive power on**	Converter power-on time, in *h.min* format
492	**Time drive enable**	Converter enable time, in *h.min* format
494	**Number power up**	Number of converter power-on cycles
440	**Product S/N**	Product serial number
444	**Regulation S/N**	Control board serial number
9600	**MAC address**	MAC address of the network interface associated with the R-TPD500 control board for EtherNet communication

NOTE!

The parameters **Time drive power on**, **Time drive enable** and **Number power up** retain their values even after the drive is powered off and restarted, without requiring manual parameter saving.

6.5 Drive type

The **DRIVE TYPE** menu includes parameters related to the configuration of the product's size and operating mode. The parameters available in the **DRIVE TYPE** menu are described in the following list:

IPA		DESCRIPTION
300	**Drive arm current**	Displays the converter's rated armature current, expressed in [A], based on the predefined setting of switch **S15** on the **R-TPD500** control board
302	**Drive size set**	Allows setting the drive's rated armature current (only in the case of a Control Unit) in the range 4-20000 A. After setting, parameter IPA 300-**Drive arm current** will match IPA 302-**Drive size set**
304	**Drive field current**	Allows setting the drive's rated field current, expressed in [A], and also defines the maximum allowed value for parameter IPA 608-**Field rated current**, corresponding to the motor's rated field current.
306	**Drive mains**	Displays the converter's rated armature voltage. Two values are available depending on the drive model: **1** 500V **2** 690V
308	**Drive 2/4 quadrant**	Displays the converter model. Two options are available depending on the drive: **0** 4B: four-quadrant drive, which accepts both positive and negative speed references **1** 2B: two-quadrant drive, which accepts only positive speed references
312	**Drive 2B+E enable**	Allows selection of the **2Q + external exciter TPD500-FC** configuration, available only for 2Q drives. When set to *ON*, ramp, speed, and current references behave like a 4Q converter. To operate in **2Q+E** mode, three digital signals from the external TPD500-FC field controller must be connected, and one analog signal must be sent to it. The TPD500 drive (handling armature current, acting as the master) must be configured with the following parameters: IPA 1304-**Field reg mode** set to *Ext wired FC volt* or *Ext wired FC curr*, depending on whether automatic field weakening is required. A digital input destination set to **Wired FC enable**, indicating the enable status of the external TPD500-FC unit. A digital input destination set to **Wired FC inv seq**, indicating the bridge inversion status of the external TPD500-FC unit. A digital input destination set to **Wired FC active brg**, indicating which bridge (positive or negative) is currently active in the external TPD500-FC unit. An analog output selection set to **Wired FC ref**, representing the field current reference for the external TPD500-FC unit.

NOTE!

The external TPD500-FC unit must be parameterized with an I/O signal configuration that mirrors this one.

Table 6-3: TPD500-FC signal management connections

TPD500 (master)			
IPA 3500 An output 1 sel	IPA 3500 Digital input 3 dest	IPA 3010 Digital input 2 dest	IPA 3000 Digital input 1 dest
Wired FC ref	**Wired FC act Brg**	**Wired FC Inv Seq**	**Wired FC EN**
21	33	32	31
1	28	27	26
T current ref 1	**Wired FC act Brg**	**Wired FC Inv Seq**	**Wired FC EN**
IPA 3400 An input 1 sel	IPA 3204 Digital output 3 sel	IPA 3202 Digital output 2 sel	IPA 3200 Digital input 1 sel
TPD500-FC			

NOTE!

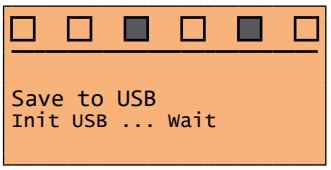
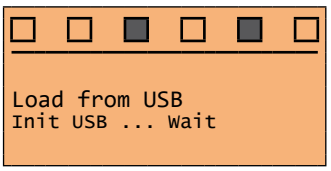
The manual refers to the TPD500-FC product, which is currently not available. The **TPD32-FC-EV** can be used as an alternative.

6.6 Startup Wizard

The **STARTUP WIZARD** menu provides access to the guided commissioning procedure of the drive. For more details, refer to **Chapter 5.2 – COMMISSIONING**.

6.7 Drive configuration

The **DRIVE CONFIG** menu contains a set of general-purpose parameters used for system-level drive management and configuration.
The parameters available in the **DRIVE CONFIG** menu are described in the following list:

IPA		DESCRIPTION
400	**Full scale speed**	Speed full scale, expressed in [rpm]
470	**Load default**	Command to restore parameters to factory default values. This operation is only possible when the converter is disabled. After executing the command, a parameter save must be performed before restarting; otherwise, the default values will be lost
460	**Save parameters**	Command to save parameters to permanent memory. Any changes made to parameter values take effect immediately on the converter's behavior and operation, but are not automatically stored in permanent memory. Therefore, this command must be executed if the modified parameter values are to be retained after power-off and restart
472	**Drive reset**	Software restart command, available only when the converter is disabled.
466	**Application enable**	Enables the application eventually loaded on board the drive (e.g., PID or Torque Winder).
462	**Access level**	Parameter to enable the **SERVICE** menu, access to which is password-protected and reserved for WEG technical support personnel. When the password is enabled, the access level is shown as "*Service*"; otherwise, it is shown as "*Expert*".
482	**Display backlight**	Enables the keypad display backlight to remain on for the entire time the drive is powered. If set to *OFF*, the display still lights up when the keypad is used and turns off after approximately three minutes of inactivity.
484	**Display startup**	Allows configuring what is automatically shown on the keypad display when the drive is powered on. The following values are supported: **Any existing IPA:** the corresponding parameter will be displayed, as if directly navigated from its respective menu **0:** displays the **DISPLAY** menu (equivalent to pressing the DISP key on the keypad) **-1:** displays the main menu (default setting)
486	**Save to USB**	Command to transfer the drive parameters to the memory device connected to the **USB** port 
488	**Load from USB**	Command to transfer into the drive the parameters previously stored on the memory device connected to the **USB** port 

NOTE!

The parameter IPA 400-**Full scale speed** defines the minimum and maximum allowable values for the following drive parameters, which are set to twice its value:

- **Ramp references**: IPA 1800-**Ramp ref 1 dig** and IPA 1810-**Ramp ref 2 dig**
- **Speed references**: IPA 1850-**Speed ref 1 dig** and IPA 1860-**Speed ref 2 dig**
- **Speed limits**: IPA 850-**Speed min pos/neg**, IPA 852-**Speed min pos**, IPA 854-**Speed min neg**, IPA 856-**Speed max pos/neg**, IPA 858-**Speed max pos**, and IPA 860-**Speed max neg**
- **Multi-speed settings**: IPA 4152-**Multi speed 1**, IPA 4154-**Multi speed 2**, IPA 4156-**Multi speed 3**, IPA 4158-**Multi speed 4**, IPA 4160-**Multi speed 5**, IPA 4162-**Multi speed 6**, and IPA 4164-**Multi speed 7**
- **Auxiliary functions**: IPA 954-**Adaptive ref dig**, IPA 4052-**Jog ref dig**, IPA 4008-**Motorpot bottom lim**, IPA 4010-**Motorpot top lim**, IPA 4408-**Droop limit**
- **Brake open/close references and thresholds**: IPA 4104-**Fwd open speed thr**, IPA 4106-**Fwd open speed ref**, IPA 4108-**Fwd close speed ref**, IPA 4112-**Rev open speed thr**, IPA 4114-**Rev open speed ref**, and IPA 4116-**Rev close speed ref**
- **Speed thresholds**: IPA 812-**Speed 0 level**, IPA 816-**Speed thr pos**, IPA 818-**Speed thr neg**, IPA 822-**Speed set error**, and IPA 920-**Speed ref 0 level**

NOTE!

The parameter IPA 400-**Full scale speed** also defines the full scale of the analog inputs, when they are configured to assign a speed.

NOTE!

The parameter IPA 400-**Full scale speed** also defines the full scale of the analog outputs, when they are configured to be assigned by a speed.

NOTE!

The parameter IPA 400-**Full scale speed** also defines the reference level for the amplitude and offset of the Test generator function, when it is configured to act on ramp or speed references.

NOTE!

The parameters IPA 486-**Save to USB** and IPA 488-**Load from USB** are not available in the **WEG_DriveLabs**

6.8 Commands

The **COMMANDS** menu contains parameters used to manage the drive command signals in various modes.
The parameters available in the **COMMANDS** menu are described in the following list:

IPA		DESCRIPTION
500	**Main commands**	Allows you to choose the origin of the drive command signals. Two selections are possible: **0 Terminals**: command signals come exclusively from terminal block **1 Digital**: command signals come from a digital channel (but commands from terminal block are still required)
502	**Control mode**	Allows the selection of the digital channel from which the control signals originate in Digital mode. Two selections are possible: **0 Local**: control signals come from keypad and/or WEG_DriveLabs configurator **1 Remote**: control signals come from fieldbus
504	**Stop mode**	Allows the enable/disable status of the drive to be linked to the **Start** and/or **Fast stop**. Four selections are possible: **0 OFF**: the drive is enabled/disabled only and exclusively in the presence/absence of the **Enable drivecommand**, regardless of the status of the **Start** and **Fast stop** commands **1 Stop&Speed 0**: the drive enables in the presence of the **Enable drive** and **Start** commands, while it disables with a programmable time delay after the 0 rpm speed condition indicated by **Speed 0 thr** has been reached when the **Start** command is removed. The **Fast stop** command does not affect the enable/disable status. **2 Fstop&Speed 0**: the drive is enabled in the presence of the **Enable drive** command, while it is disabled with a programmable time delay after the speed condition 0 rpm indicated by **Speed 0 thr** has been reached when the **Fast stop** command is applied. The Start command does not affect the enable/disable status. **3 Stop/Fstop&Speed 0**: the drive enables in the presence of the **Enable drive** and **Start** commands, while it disables with a programmable time delay after the 0 rpm speed condition indicated by **Speed 0 thr** has been reached when the **Start** command is removed or the Fast stop command is applied. In all cases the drive will always disable upon removal of the **Enable drive** command, regardless of the **Stop** mode value. This parameter therefore allows the drive to be disabled not only upon removal of the **Enable drive** command, but also following the **Stop** command caused by removal of the **Start** command and/or application of the **Fast stop** command.
506	**Speed 0 trip delay**	Delay time, expressed in [ms], between reaching the Speed 0 rpm **Speed 0 thr** condition and disabling the drive, following a stop command given in one of the **Stop&Speed 0**, **Fstop&Speed 0** or **Stop/Fstop&Speed 0** modes of the IPA 504-**Stop mode**
508	**Trip contactor delay**	Delay time, expressed in [ms], between disabling of the converter and transition to low logic level of the **Trip contactor** digital output, following a stop command given in one of the **Stop&Speed 0**, **Fstop&Speed 0** or **Stop/Fstop&Speed 0** modes of the IPA 504-**Stop mode**
510	**Jog stop control**	Enables the **Jog** function when **Stop** mode is not set to *OFF*. In this case, **Jog stop control** must be set to *ON*.
520	**Enable digital cmd**	Enabling parameter in *Digital* mode, which can also be assigned via fieldbus
522	**Start digital cmd**	**Start** parameter in *Digital* mode, which can also be assigned via fieldbus
524	**FastStop digital cmd**	Fast stop parameter in *Digital* mode, which can also be assigned via fieldbus

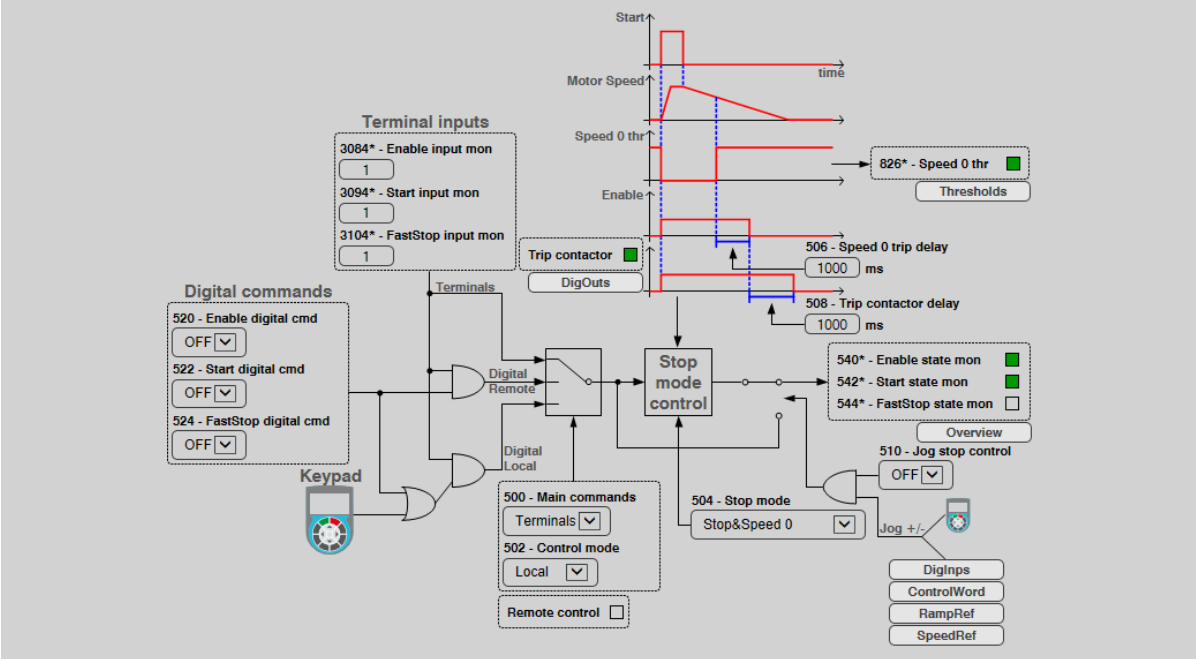


Figure 6-8: Commands diagram

The parameter IPA 504-**Stop mode**, if set to a value other than *OFF*, allows the line contactor to be coordinated with the converter's enable status.
In this case, after a stop command is issued, the motor speed decreases to 0 rpm, triggering the **Speed 0 thr** output (in the **THRESHOLDS** menu). This causes the converter to be disabled after the **Speed 0 trip delay** time. From that moment, after the Trip contactor delay time, the digital output Trip contactor is deactivated.

The parameter IPA 3218-**Relay 2 sel**, which controls the relay on terminals 75-76 (in the **DIGITAL OUTPUTS** menu), is set by default to **Trip contactor**. As a result, this relay output can be used to control the line contactor in sync with the converter's enable/disable state.
It is therefore possible to define the following operating modes, assuming that the **Enable drive** command is always present:

- **Stop mode = Stop&Speed 0**: the Start command controls operation. If the **Start** command is not active and the drive is stopped, the converter is disabled and the **Trip contactor output** is open (0 V, logic low). When the **Start** command is issued, the converter is enabled and the contact closes (24 V, logic high). If the **Start** command is removed again, once the speed reaches 0 rpm (Speed 0 thr), the converter is disabled after the **Speed 0 trip delay** time. The **Trip contactor output** then opens again after the **Trip contactor delay**, causing the line contactor to open.

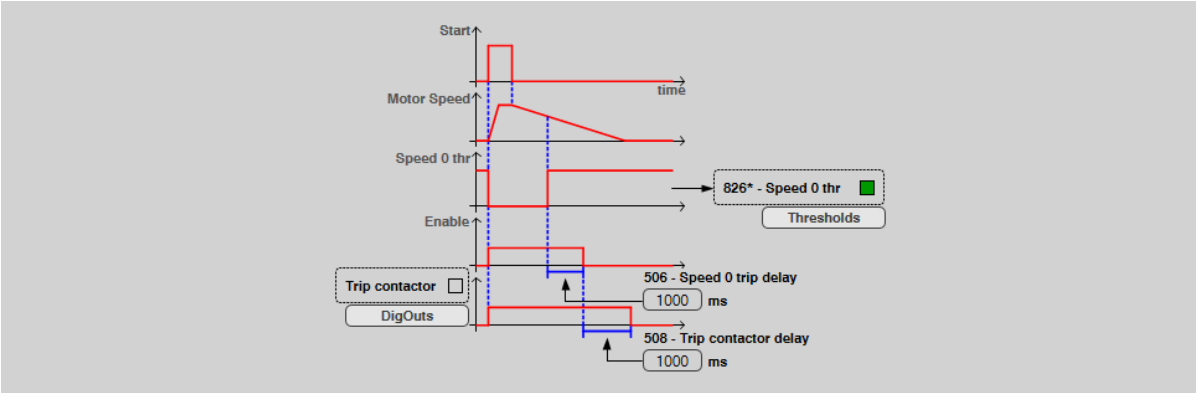


Figure 6-9: Operation when Stop mode = Stop&Speed 0

- **Stop mode = Fstop&Speed 0**: the **Fast stop** command controls operation. If the **Fast stop** command is active (active low, 0 V on terminal 14) and the drive is stopped, the converter is disabled and the Trip contactor output is open (0 V, logic low). When the **Fast stop** command is deactivated (24 V on terminal 14), the converter is enabled and the contact closes (24 V, logic high). If the **Fast stop** command is activated again, once the speed reaches 0 rpm (Speed 0 thr), the converter is disabled after the Speed 0 trip delay time. The **Trip contactor output** then opens again after the **Trip contactor delay**, causing the line contactor to open.

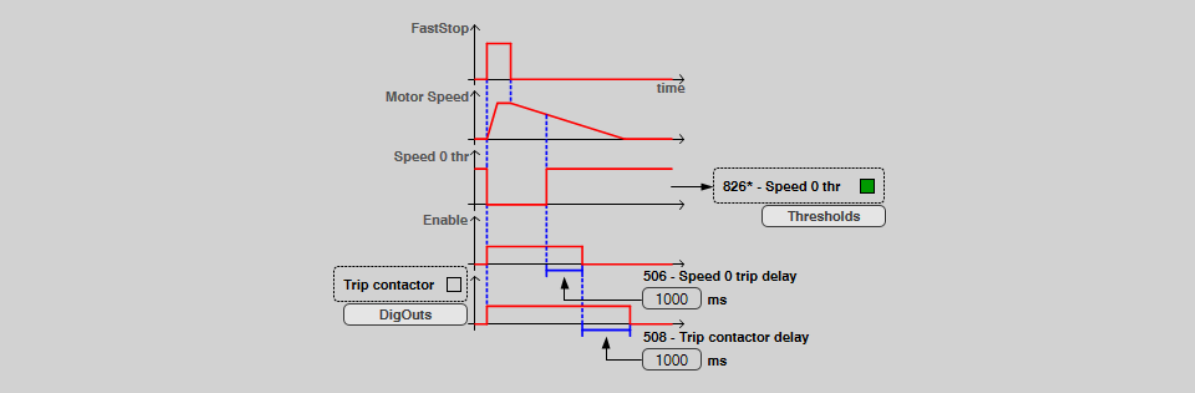


Figure 6-10: Operation when Stop mode = Fstop&Speed 0

- **Stop mode = Stop/Fstop&Speed 0**: the **Start** or **Fast stop** commands control operation. If the **Start** command is not active or the **Fast stop** command is active (active low, 0 V on terminal 14) and the drive is stopped, the converter is disabled and the Trip contactor output is open (0 V, logic low). When the **Start** command is issued or the **Fast stop** command is deactivated (24 V on terminal 14), the converter is enabled and the contact closes (24 V, logic high). If the **Start** command is removed again or the **Fast stop** command is activated, once the speed reaches 0 rpm (**Speed 0 thr**), the converter is disabled after the **Speed 0 trip delay** time. The **Trip contactor output** then opens again after the **Trip contactor delay**, causing the line contactor to open.

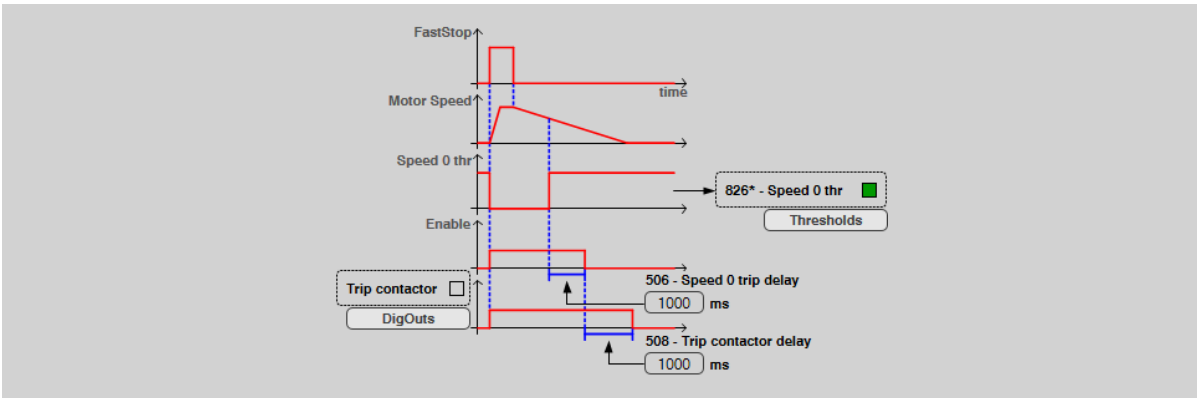


Figure 6-11: Operation when Stop mode = Stop/Fstop&Speed 0

NOTE!

The IPA 500-**Main commands** parameter can only be changed from *Digital* to *Terminals* if the **Enable drive** terminal (**12**) is not powered.
If the IPA 500-**Main commands** parameter is set to *Digital*, a disable command caused, for example, by removing the signal from the **Enable drive** terminal (**12**) means that, in order to obtain a new enable, it is necessary not only to restore the voltage on the relevant terminal but also to make a new transition from *OFF* to *ON* of the relevant digital command IPA 520-**Enable digital cmd**.
If the IPA 500-**Main commands** parameter is set to *Digital*, a **Stop** command caused, for example, by removing the signal from the **Start** terminal (**13**) means that in order to obtain a new **Start**, it is necessary not only to restore the voltage on the relevant terminal but also to make a new transition from *OFF* to *ON* of the relevant digital command IPA 520-**Start digital cmd**.

The **WEG_DriveLabs** configurator allows the drive to be controlled in *Digital* mode through an intuitive graphical interface, which can be opened by selecting the Keypad command from the Toolbar.

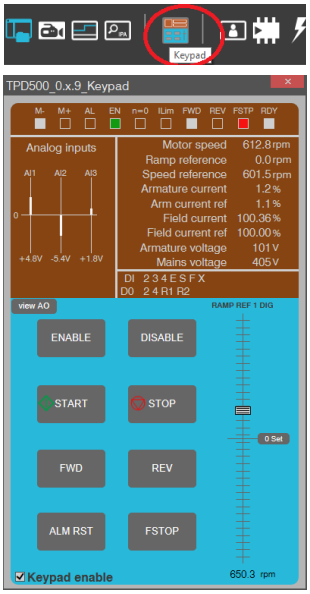


Figure 6-12: Keypad interface on PC

NOTE!

A virtual panel is opened, providing access to all drive commands and monitoring information. By enabling the Keypad enable checkbox, the panel becomes active. In this case, the parameters IPA 500-**Main commands** and IPA 502-**Control mode** are automatically set to *Digital* and *Local*, respectively, allowing the following commands to be managed:

- **ENABLE**: drive enable command
- **DISABLE**: drive disable command
- **START**: drive start command
- **STOP**: drive stop command
- **FWD**: forward direction selection
- **REV**: reverse direction selection
- **ALM RST**: alarm reset
- **FSTOP**: fast stop command

The panel display shows status LEDs and all monitoring data related to:

- Digital I/O (sections **DI** and **DO**)
- Analog I/O (sections **view AI** and **view AO**, which are mutually exclusive and selectable via the corresponding button)
- Main control variables, including:
  - **Motor speed**: filtered motor speed in [rpm]
  - **Ramp reference**: ramp reference in [rpm]
  - **Speed reference:** speed reference in [rpm]
  - **Armature current**: filtered armature current in [%]
  - **Armature current ref**: armature current reference in [%]
  - **Field current**: field current in [%]
  - **Field current ref**: field current reference in [%]
  - **Armature voltage**: armature voltage in [V]
  - **Mains voltage**: mains voltage in [V]

A scroll bar also allows control of the motor speed by adjusting the value of **Ramp ref 1 dig**.

This reference can be modified manually or instantly reset to 0 rpm using the **0 Set** command. For this control to be effective, the reference must not be assigned via an analog input.

6.9 Motor data

In the **MOTOR DATA** menu, you can find the parameters used to set the motor nameplate data, which are required for the correct operation of the drive and must be configured during the initial commissioning phase.
The parameters available in the **MOTOR DATA** menu are described in the following list:

IPA		DESCRIPTION
600	**Motor rated speed**	Motor rated speed, expressed in [rpm]
602	**Motor max speed**	Motor maximum speed, expressed in [rpm]
604	**Arm rated current**	Motor rated armature current, expressed in [A]
606	**Arm rated voltage**	Motor rated armature voltage, expressed in [V]
608	**Field rated current**	Motor rated field current, expressed in [A]
612	**Motor EMF constant**	Motor back EMF constant, expressed in [V/rpm]

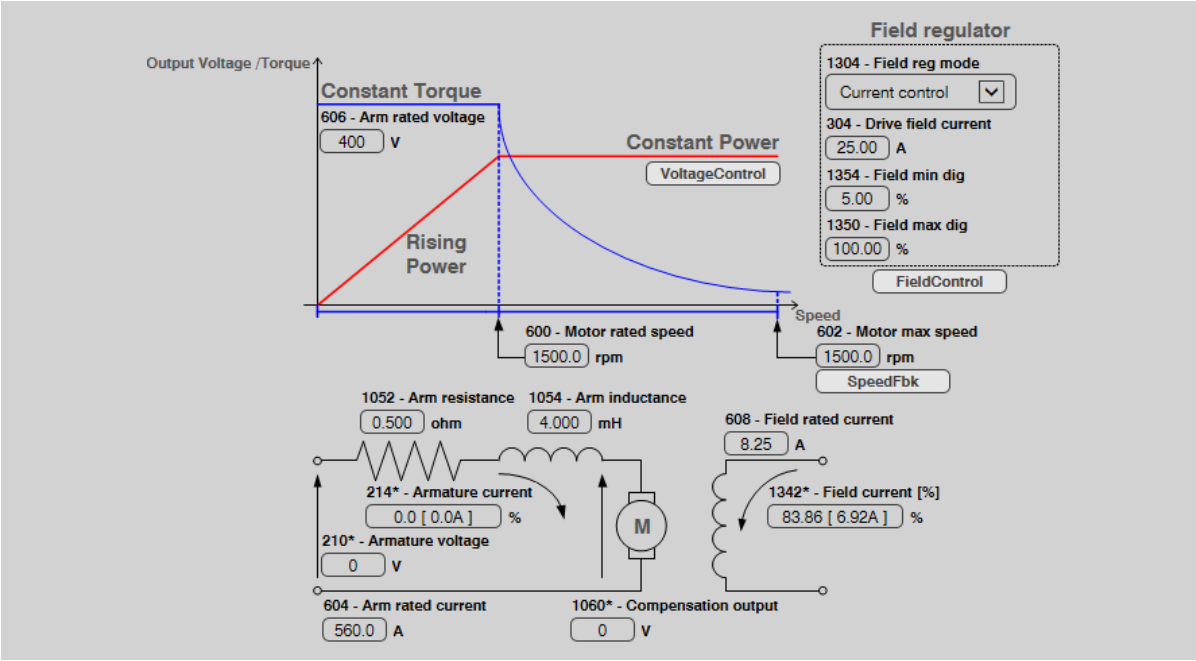


Figure 6-13: Motor Data diagram

6.10 References management

The **REFERENCES** menu provides parameters for managing the programmable ramp, speed, and current/torque references used to set the reference values for speed and/or current control of the converter.
Each of the three reference types is managed through a dedicated submenu, as detailed below.

6.10.1 Ramp reference

The ramp reference sets the target speed the drive must reach at the end of the acceleration phase. Changes to the ramp reference are followed according to the configured ramp times. The ramp reference value determines the motor speed. For four-quadrant drives (4B), the direction of rotation is determined by the sign of the reference. In contrast, two-quadrant drives (2B) accept only positive references; negative values are interpreted as zero, as indicated by parameter IPA 308-**Drive 2/4** quadrant in the following diagram.

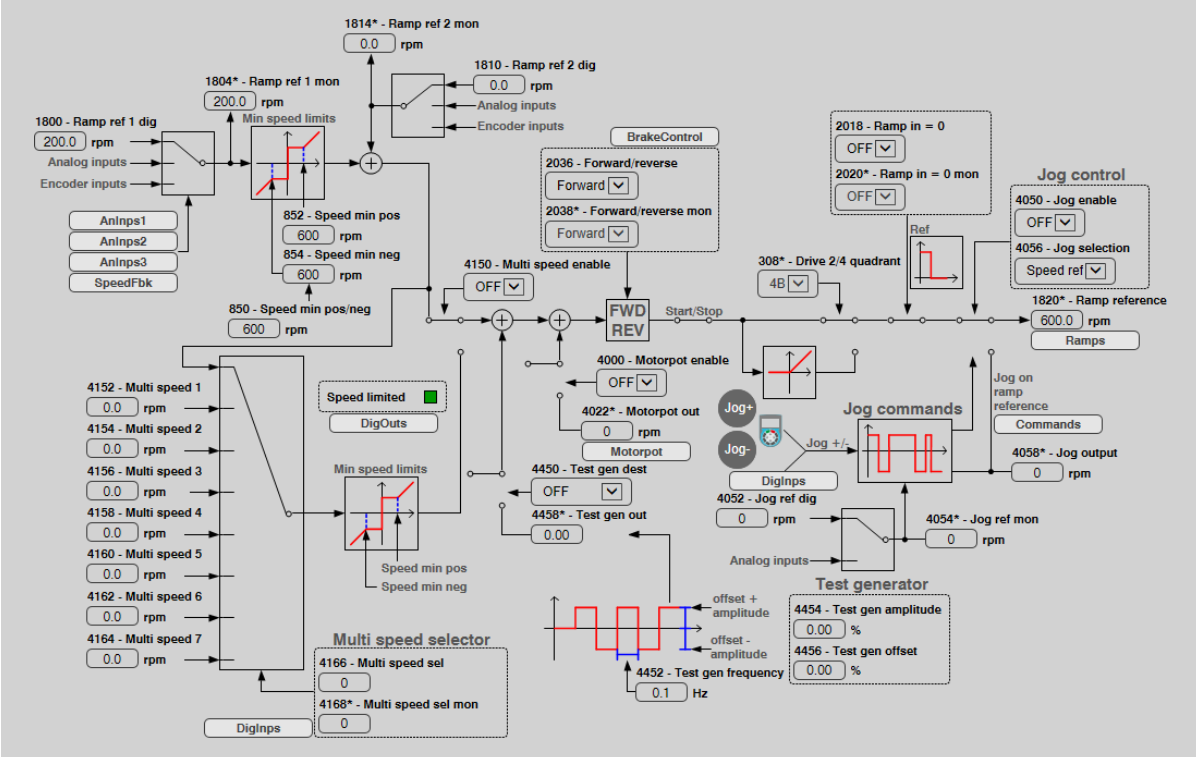


Figure 6-14: Ramp reference diagram

In the **REFERENCES\RAMP REF** menu, parameters are available for configuring the two programmable ramp references used to set the converter's ramp reference.

IPA		DESCRIPTION
1800	**Ramp ref 1 dig**	Ramp reference 1, expressed in [rpm]
1804	**Ramp ref 1 mon**	Monitor of ramp reference 1, which can also be assigned via: • Analog inputs 1, 2, or 3 • Encoder 1 or 2 • Fieldbus
1810	**Ramp ref 2 dig**	Ramp reference 2, expressed in [rpm]
1814	**Ramp ref 2 mon**	Monitor of ramp reference 2, which can also be assigned via: • Analog inputs 1, 2, or 3 • Encoder 1 or 2 • Fieldbus

To assign references via analog inputs, voltage and/or current signals can be used: ±10 V, 0–20 mA / 0–10 V, or 4–20 mA. References set via current signals are unipolar and are used only with two-quadrant drives (2B).
The parameter IPA 1820-**Ramp reference** (in the **MONITOR** menu) represents the total ramp reference input to the ramp function (in the **RAMPS** menu).
Under standard factory settings, it corresponds to the sum of the two ramp references (**Ramp ref 1 mon** + **Ramp ref 2 mon**), after the drive is enabled and the **Start** command is issued.
However, other parameters applied in cascade may influence the magnitude and sign of the reference, as shown in the diagram (see Figure 6-14), including:

IPA		DESCRIPTION
2036	**Forward/reverse**	Allows you to change the sign of the ramp reference (**RAMPS** menu). Three selections are possible: **0** **No**: the reference is reset to zero **1** **Forward**: the reference is not altered **2** **Reverse**: the reference is inverted (multiplied by -1)
2038	**Forward/reverse mon**	Monitor of the IPA 2036-**Forward/reverse command**, which can also be assigned from programmable digital inputs (**RAMPS** menu)
2018	**Ramp in = 0**	Monitor for immediate reset of the ramp reference, which can also be assigned by programmable digital inputs (**RAMPS** menu)
1814	**Ramp ref 2 mon**	Ramp reference monitor 2, also assignable from: • Analogue inputs 1, 2 or 3 • Encoder 1 or 2 • Fieldbus

The ramp reference can also be set through specialized functions in the **FUNCTIONS** menu:

- **Multispeed** function (**FUNCTIONS\MULTI SPEED**)
- **Motorpotentiometer** function (**FUNCTIONS\MOTORPOT**)
- **Jog** function (**FUNCTIONS\JOG**)
- **Test generator** function (**FUNCTIONS\TEST GENERATOR**)

Finally, the ramp reference is also influenced by the positive and negative minimum speed limits (in the **SPEED CONTROL\SPEED REG LIMIT** menu), which are applied only to **Ramp ref 1 mon** and **Multispeed** references.

6.10.2 Speed reference

The speed reference is processed by a PI controller, which calculates the current required to make the motor rotate at the requested speed. This is only possible if the required current is within the available current limits; otherwise, the drive operates in current limit mode.
For four-quadrant drives (4B), the direction of rotation is determined by the sign of the reference. Two-quadrant drives (2B), on the other hand, only accept positive references; negative values are interpreted as zero, as indicated by parameter IPA 308-**Drive 2/4 quadrant** in the following diagram.

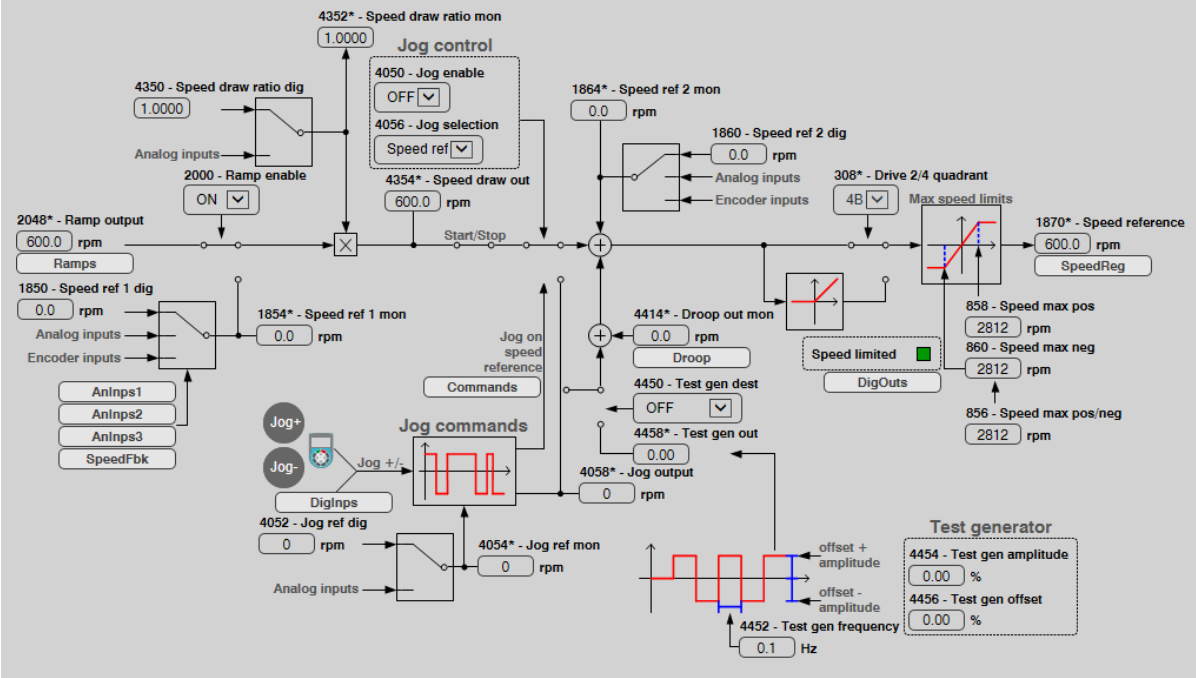


Figure 6-15: Speed reference diagram

In the **REFERENCES/SPEED REF** menu, parameters are available for configuring the two programmable speed references used to set the converter's speed reference.

IPA		DESCRIPTION
1850	**Speed ref 1 dig**	Speed reference 1 expressed in [rpm]
1854	**Speed ref 1 mon**	Speed reference monitor 1, also assignable from • Analogue inputs 1, 2 or 3 • Encoder 1 or 2 • Fieldbus
1860	**Speed ref 2 dig**	Speed reference 2 expressed in [rpm]
1864	**Speed ref 2 mon**	Speed reference monitor 1, also assignable from • Analogue inputs 1, 2 or 3 • Encoder 1 or 2 • Fieldbus

To assign references via analog inputs, voltage and/or current signals can be used: ±10 V, 0–20 mA / 0–10 V, or 4–20 mA. References assigned via current signals are unipolar and are used only with two-quadrant drives (2B).
The parameter IPA 1870-**Speed reference** (in the **MONITOR** menu) represents the total speed reference input to the PI speed controller (in the **SPEED REG** menu).
Only when the ramp is disabled (IPA 2048-**Ramp enable** = OFF) does it correspond to the sum of the two speed references (**Speed ref 1 mon** + **Speed ref 2 mon**), after the drive is enabled and the **Start** command is issued.
However, other parameters applied in cascade may affect the magnitude and sign of the reference, as shown in the

diagram (see Figure 6-15), including:

IPA		DESCRIPTION
2000	**Ramp enable**	Enables/disables ramp control of the speed reference. When selected *ON*, **Speed ref 1 mon** is disabled by the chain and is ineffective (**RAMPS** menu).
4352	**Speed draw ratio mon**	Correction factor acting on **Ramp output** or **Speed ref 1 mon** (**FUNCTIONS\ SPEED DRAW** menu)

The speed reference can also be set using specialised functions in the **FUNCTIONS** menu:
- **Jog** function (**FUNCTIONS** menu)
- **Test generator** function (**FUNCTIONS** menu)
- **Droop** function (**FUNCTIONS** menu)

Infine, il riferimento di velocità dipende anche dai limiti di velocità positivi e negativi massimi (menù **SPEED CONTROL\ SPEED REG LIMIT**), applicati a valle della catena.

6.10.3 Armature current reference

The armature current reference is the input to a current controller, which can be either predictive or PI type.
The current reference value is expressed as a percentage of the motor's rated armature current and determines the amount of torque required, while the sign defines the direction.

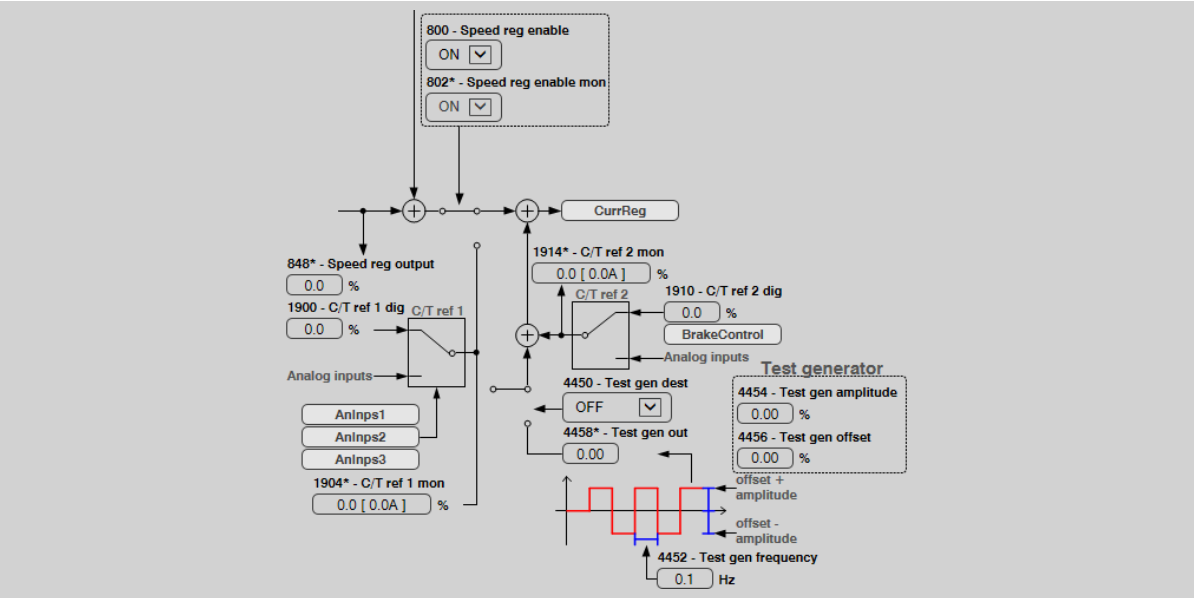


Figure 6-16: Torque reference diagram

In the **REFERENCES\TORQUE REF** menu, parameters are available for configuring the two programmable current/ torque references used to set the converter's current reference.

IPA		DESCRIPTION
1900	**C/T ref 1 dig**	Current reference 1 expressed as a percentage of the motor's rated armature current
1904	**C/T ref 1 mon**	Current reference monitor 1, also assignable from: • Analogue inputs 1, 2 or 3 • Fieldbus For this parameter, dual unit display is available [%]-[A]
1910	**C/T ref 2 dig**	Current reference 2 expressed as a percentage of the motor's rated armature current
1914	**C/T ref 2 mon**	Current reference monitor 2, also assignable from: • Analogue inputs 1, 2 or 3 • Fieldbus For this parameter, dual unit display is available [%]-[A]

To assign references via analog inputs, voltage and/or current signals can be used: ±10 V, 0–20 mA / 0–10 V, or 4–20 mA. References assigned via current signals are unipolar and are used only with two-quadrant drives (2B).

The parameter IPA 1020-**Armature current ref** (in the **MONITOR** menu) represents the total armature current reference input to the current controller (in the **CURRENT CONTROL** menu).
Only when speed control is disabled (IPA 800-**Speed reg enable = OFF**) does it correspond to the sum of the two current references (**C/T ref 1 mon** + **C/T ref 2 mon**), after the drive is enabled and the **Start** command is issued.
However, other parameters applied in cascade may affect the magnitude and sign of the reference, as shown in the diagram (figure 6-16), including:

IPA		DESCRIZIONE
800	**Speed reg enable**	Enables/disables speed control (**SPEED CONTROL\SPEED REG** menu). If *ON* is selected, the current reference 1 **C/T ref 1 mon** is disabled by the chain and is ineffective.
1004	**Zero torque**	Immediate reset command for the armature current reference, downstream of the two references (**CURRENT CONTROL\CURR REG** menu)

The armature current reference can also be set through specialized functions in the **FUNCTIONS** menu:
- **Test generator** function (**FUNCTIONS\TEST GENERATOR**)
- **Brake control** function (**FUNCTIONS\BRAKE CONTROL**)

Finally, the armature current reference is also influenced by the current limits (in the **CURRENT CONTROL\CURR REG LIMIT** menu), which are applied downstream in the chain.
For both current references **C/T ref 1 dig** and **C/T ref 2 dig**, the maximum allowable value depends on the overload control setting defined by parameter IPA 4300-**Overload mode** (in the **FUNCTIONS\OVERLOAD** menu):
- If **Overload mode = None**, the maximum value is 100%
- If **Overload mode = I2t Drive**, **I2t Drive and Motor**, or **Current limited**, the maximum value is 150%

6.11 Ramp management

The ramp function defines the drive's acceleration and deceleration times, which can be set independently.
For rapid stopping, a **Fast stop** ramp is available, which can be activated via a digital input or a dedicated parameter.
The ramp profile can be either linear or S-shaped.
The ramp is managed using the following parameters in the **RAMPS** menu.

IPA		DESCRIPTION
2000	**Ramp enable**	Enables/disables ramp control of the speed reference. When set to *ON*, speed reference 1 IPA 1854-**Speed ref 1 mon** is disabled by the speed reference chain and is ineffective, while when set to *OFF*, the ramp output IPA 2048-**Ramp output** in favour of speed reference 1 IPA 1854-**Speed ref 1 mon** (see figure 6-17), however, the ramp generator continues to operate and can be used in stand-alone configuration regardless of the **Enable**, **Start** and/or **Fast stop** commands.
2002	**Acc speed**	Standard ramp acceleration speed expressed in [rpm]
2004	**Acc time**	Standard ramp acceleration time expressed in [s], representing the time to reach the IPA 2002-**Acc speed** starting from zero speed with constant increments
2006	**Dec speed**	Standard ramp deceleration speed expressed in [rpm]
2008	**Dec time**	Standard ramp deceleration time expressed in [s], representing the time to reach zero speed from the IPA 2006-**Dec speed** with constant decrements

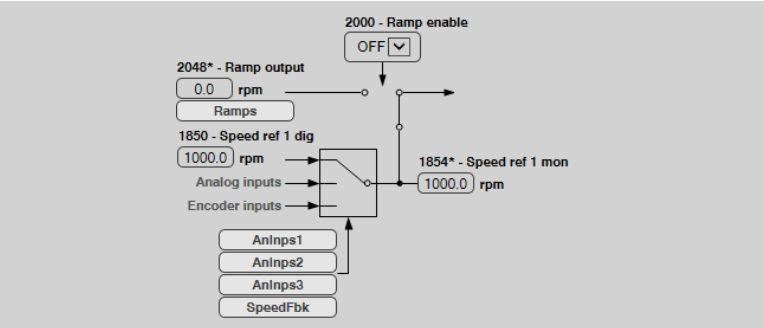


Figura 6-17: Funzionamento di Ramp Enable

2010	**Ramp shape**	Ramp type selector. Two selections are possible: **0 Linear**: linear ramp, with constant acceleration defined by the **Acc speed / Acc time ratio** and constant deceleration defined by the **Dec speed / Dec time ratio** (see figure 6-18)

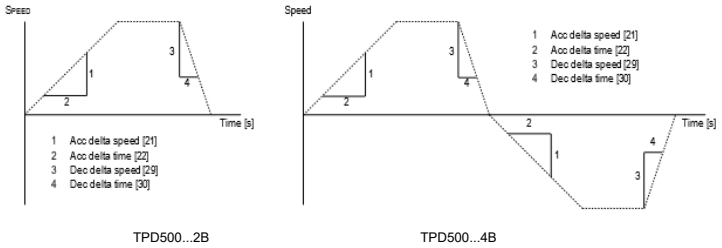


Figure 6-18: Acceleration and deceleration ramps

1 S-shape: S-shaped ramp, with acceleration and deceleration varying linearly over time. Jerk can be used to avoid sudden mechanical changes in the system at the start/end of the acceleration and deceleration phases.

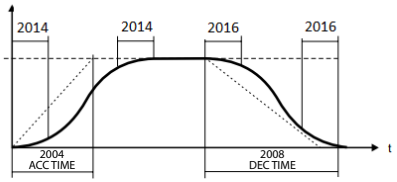


Figure 6-19: Indication of available Jerk parameters

2014	**Acc time jerk**	Jerk time during acceleration of the S ramp expressed in [ms]
2016	**Dec time jerk**	Jerk time during deceleration of the S ramp expressed in [ms]
2018	**Ramp in = 0**	Immediate reset command for the ramp reference
2020	**Ramp in = 0 mon**	Monitor for the immediate reset command for the ramp reference, which can also be assigned by programmable digital inputs or fieldbus
2022	**Ramp out = 0**	Immediate reset command for the ramp output
2024	**Ramp out = 0 mon**	Monitor for immediate reset command of ramp output, which can also be assigned by programmable digital inputs or fieldbus
2026	**Ramp freeze**	Command to freeze the output value at the ramp, regardless of changes in the input reference
2028	**Ramp freeze mon**	Monitor for command to freeze the output value at the ramp, which can also be assigned by programmable digital inputs or fieldbus
2030	**Ramp +/- delay**	Delay time in [ms] on **Ramp +** and **Ramp –** signals

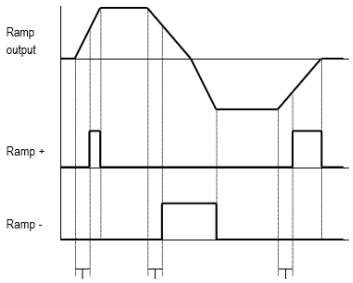


Figure 6-20: Operation of signals dependent on the Ramp delay parameter

2032	**FastStop speed**	Fast stop ramp deceleration speed expressed in [rpm]
2034	**FastStop time**	Fast stop ramp deceleration time expressed in [s], representing the time to reach zero speed from the IPA 2032-**FastStop speed** with constant decrements
2036	**Forward/reverse**	Command to change the sign of the ramp reference
2038	**Forward/reverse mon**	Monitor of the IPA 2036-**Forward/reverse** command, which can also be assigned by programmable digital inputs or fieldbus

The parameter IPA 1820-**Ramp reference** (in the **MONITOR** menu) represents the total ramp reference input to the ramp function.
Its purpose is to ensure that the drive reaches the desired speed within the configured acceleration time after the **Start** command is issued, and decelerates to a stop within the configured deceleration time after the command is removed.

The generation of the IPA 1820-**Ramp reference input** is described in the **REFERENCES\RAMP REF** menu.

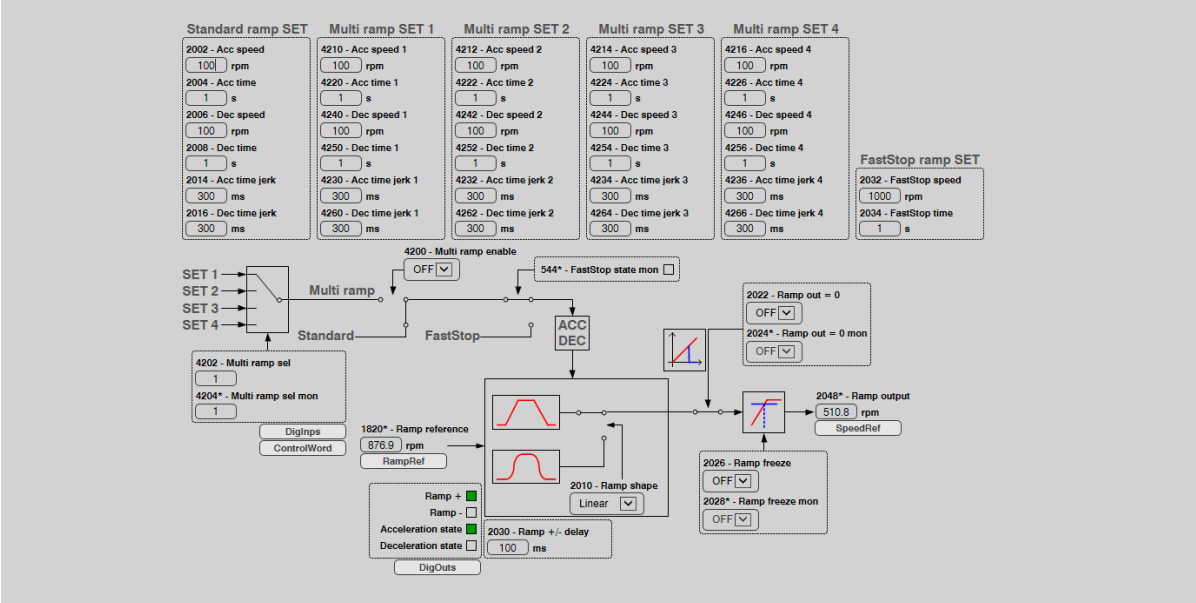


Figure 6-21: Ramps diagram

NOTE! Setting the **Acc time**, **Dec time**, and/or **FastStop time** to 0 causes the corresponding acceleration, deceleration, and/or Fast stop ramp to follow the reference immediately.

6.12 Speed feedback

The **SPEED FEEDBACK** menu provides parameters for configuring the motor speed feedback.
Each of the three feedback types is managed through a dedicated submenu (**ENCODER 1**, **ENCODER 2**, **TACHO**), and a general configuration menu (**CONFIG**) is also available.

NOTE! There is no dedicated menu for armature feedback, but further details are provided below.

6.12.1 Configuration

The **SPEED FEEDBACK\CONFIG** menu provides parameters for configuring the type of speed feedback and managing any feedback faults.

IPA		DESCRIPTION
650	**Speed fbk sel**	Selection of the type of feedback to be used for measuring or estimating the motor speed for speed control via a PI controller. Four selections are available: **0 Encoder 1**: the digital encoder connected to connector XE1 is used **1 Encoder 2**: the digital encoder connected to connector XE2 is used **2 Tacho**: the tachometer dynamo connected to the dedicated +/- terminals of the MOT connector is used **3 Armature**: the internal speed estimate derived from the armature voltage measurement is used, therefore no external connection is required
654	**Speed fbk error**	Error threshold for the **Speed fbk loss alarm** caused by comparing the measured and estimated speed after enabling parameter IPA 658-**Speed fbk control**
656	**Speed fbk bypass**	Enables automatic switching to armature feedback in the event of a fault or failure of the encoder or tachometer feedback, without losing control of the motor or stopping the drive following the **Speed fbk loss** alarm
658	**Speed fbk control**	Enables comparison between the speed measured by the feedback sensor and the speed estimated by the armature voltage, generating the **Speed fbk loss** alarm

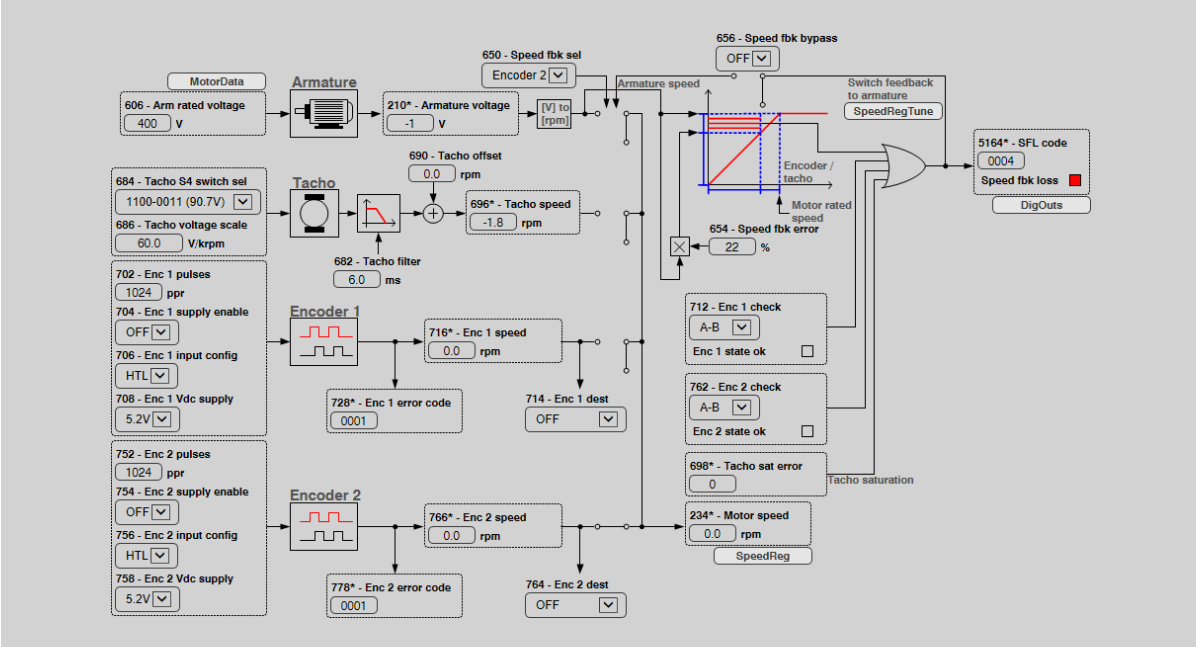


Figure 6-22: Speed feedback diagram

The motor speed, shown in parameter IPA 234-**Motor speed**, is assigned based on the type of speed feedback selected via parameter IPA 650-**Speed fbk sel**, which can be set to either of the two encoders, the tacho, or the speed estimate calculated from system variables.
Parameters for configuring the connected sensors are available in the **SPEED FEEDBACK\ENCODER 1**, **SPEED FEEDBACK\ENCODER 2**, and **SPEED FEEDBACK\TACHO** menus.

The drive includes self-diagnostic functions to detect whether a sensor is faulty, with configurable parameters available in the respective menus.
In addition to these features, it is possible to activate a comparison between the measured and estimated speeds by enabling parameter IPA 658-**Speed fbk control**.
If the difference between the measured speed and the estimated speed exceeds the threshold defined by IPA 654-**Speed fbk error** (expressed as a percentage of the motor rated speed set in IPA 600-Motor rated speed), the drive detects an error on the active sensor.
The faulty or disconnected sensor is reported via parameter IPA 5164-**SFL code** in the **ALARM CONFIG\SPEED FBK LOSS** menu, triggering a **Speed fbk loss** alarm.

NOTE!

To ensure correct operation and avoid false **Speed fbk loss** alarms, accurate speed estimation is required. See Chapter 6.12.5 – Speed Estimation.

By enabling parameter IPA 656-**Speed fbk bypass**, the system allows automatic switching of the speed feedback from the faulty sensor to the speed estimate.
This prevents motor control loss or drive shutdown due to a **Speed fbk loss** alarm.
Since speed estimation does not offer the same precision and dynamics as sensor-based measurement, once the system switches to armature feedback, the PI speed regulator operates with a dedicated set of gains.
These gains are configured using parameters IPA 930-**Speed reg P bypass** and IPA 932-**Speed reg I bypass** in the **SPEED CONTROL\SPEED REG TUNE** menu.
This gain switching also occurs automatically (see Figure 6-23).

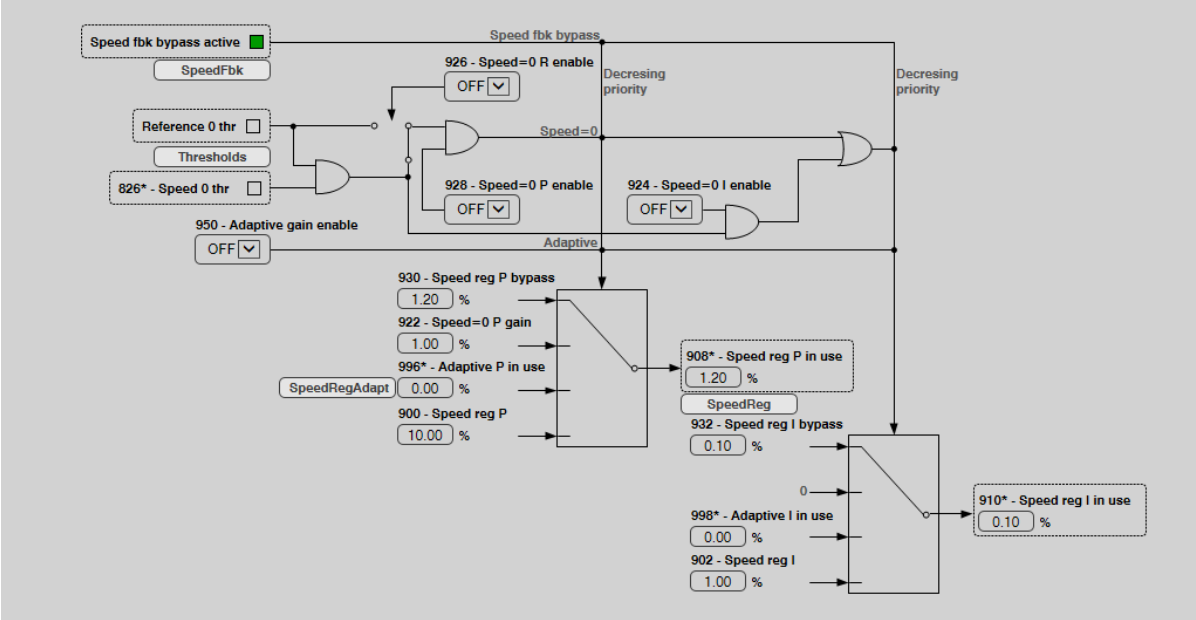


Figure 6-23: Speed regulator diagram

NOTE!

To use the feedback bypass function, parameter IPA 5160-**SFL activity** must be set to Ignore or Warning, in order to prevent the drive from being disabled when a fault condition is detected.

6.12.2 Encoder 1

The **SPEED FEEDBACK\ENCODER 1** menu provides parameters for configuring the digital encoder connected to connector **XE1** on the **R-TPD500** control board, used for measuring motor speed.

IPA		DESCRIPTION
702	**Enc 1 pulses**	Number of pulses per revolution of the digital encoder connected to connector **XE1**. A high resolution corresponds to better motor speed control.
704	**Enc 1 supply enable**	Enables the generation of power supply for encoder 1 at 5 V
706	**Enc 1 input config**	Encoder signal type selection 1. Two selections are possible: **0** **TTL**: TTL signal type **1** **HTL**: HTL signal type
708	**Enc 1 Vdc supply**	Allows you to adjust the power supply level of encoder 1 if the **Enc 1 supply** enable parameter is set to *ON*. Four selections are possible: **0** 5.2 V **1** 5.6 V **2** 6.0 V **3** 6.4 V
712	**Enc 1 check**	Enables hardware-level control of encoder 1 channels for generating the **Speed fbk loss** alarm. Three selections are possible: **0** **None**: no control is performed **1** **A-B**: only channels A-B are checked, not Z **2** **A-B-Z**: channels A-B and Z are checked

714	**Enc 1 dest**	Allows you to set the destination of encoder 1. There are five options: **0 OFF** **2 Speed ref 1**: Encoder 1 is used as speed reference 1

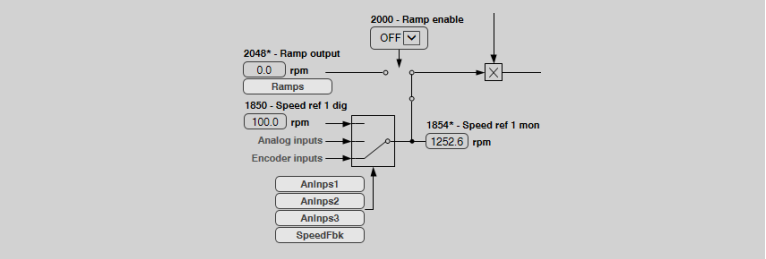


Figure 6-24: Logic diagram in the case where Encoder 1 dest = Speed Ref 1

3 Speed ref 2: Encoder 1 is used as speed reference 2

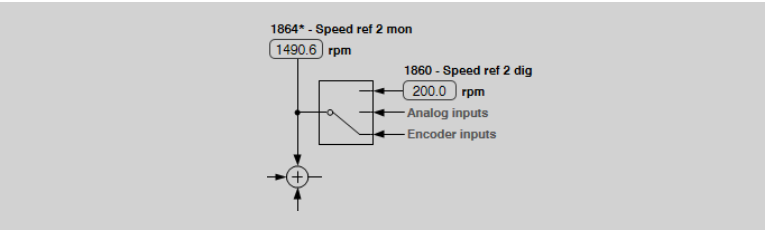


Figure 6-25: Logic diagram in the case where Encoder 1 dest = Speed Ref 2

4 Ramp ref 1: Encoder 1 is used as ramp reference 1

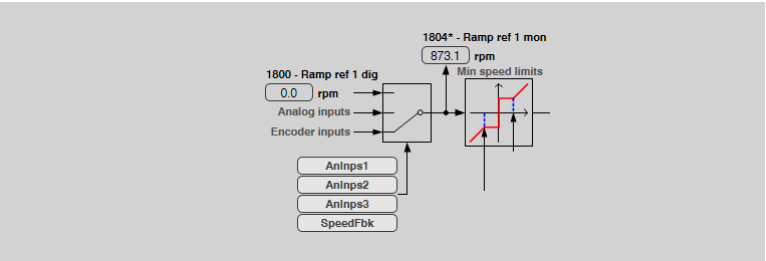


Figure 6-26: Logic diagram in the case where Encoder 1 dest = Ramp Ref 1

5 Ramp ref 2: Encoder 1 is used as ramp reference 2

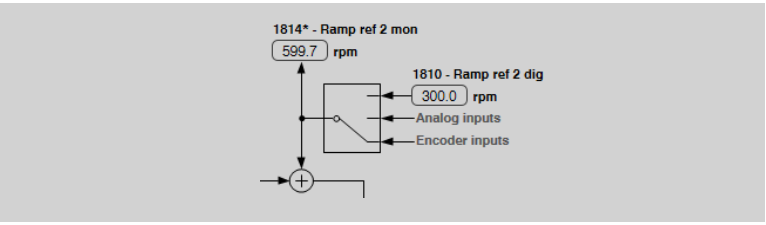


Figure 6-27: Logic diagram in the case where Encoder 1 dest = Ramp Ref 2

716	**Enc 1 speed**	Speed measurement provided by encoder 1, expressed in [rpm]
728	**Enc 1 error code**	Code indicating the type of error detected on encoder 1 **Enc 1 error code = 0**: no error **Enc 1 error code = 1**: error on channels A-B **Enc 1 error code = 2**: error on channel Z **Enc 1 error code = 3**: error on channels A-B and Z

Digital encoder 1 can be used as a speed feedback source by setting parameter IPA 650-**Speed fbk sel** to **Encoder 1**, or as a ramp (1/2) or speed (1/2) reference by configuring parameter IPA 714-**Enc 1 dest**.
Before connecting encoder 1, the user must ensure that the **+24VE1 switch** on the **R-TPD500** control board is properly set.
When an encoder requiring 24 V power supply is connected, power generation must be enabled by setting the **+24VE1 switch** to *ON* (the corresponding LED on the control board will turn on).
When an encoder requiring 5 V power supply is connected, power generation for encoder 1 must be enabled via parameter IPA 704-**Enc 1 supply enable**, and the voltage can be adjusted between 5.2 V and 6.4 V using parameter IPA 708-**Enc 1 Vdc supply**.
This voltage adjustment is used to compensate for any voltage drop along the cable between the sensor and the drive. To select the correct value, measure the voltage at the encoder's power supply terminals directly.
The drive includes a self-diagnostic feature to detect possible connection issues or encoder 1 faults.
This check can be disabled (None), enabled on channels **A-B** only, or on **A-B-Z** (index), via parameter IPA 712-**Enc 1 check**.

Any detected fault is reported through parameter IPA 728-**Enc 1 error code** and may result in feedback bypass activation or trigger a **Speed fbk loss** alarm, which can be managed via parameters in the **ALARM CONFIG\SPEED FBK LOSS** menu.

6.12.3 Encoder 2

The **SPEED FEEDBACK\ENCODER 2** menu provides parameters for configuring the digital encoder connected to connector **XE2** on the **R-TPD500** control board, used for measuring motor speed.
Encoder 2 is the default feedback source for speed regulation.

IPA		DESCRIPTION
752	**Enc 2 pulses**	Number of pulses per revolution of the digital encoder connected to the **XE2** connector. A high resolution corresponds to better motor speed control.
754	**Enc 2 supply enable**	Enables the generation of power supply for encoder 2 at 5 V
756	**Enc 2 input config**	Encoder signal type selection 2. Two selections are possible: **0** **TTL**: TTL signal type **1** **HTL**: HTL signal type
758	**Enc 2 Vdc supply**	Allows you to adjust the power supply level of encoder 1 if the **Enc 1 supply enable** parameter is set to *ON*. Four selections are possible: **0** 5.2V **1** 5.6V **2** 6.0V **3** 6.4V
762	**Enc 2 check**	Enables hardware-level control of encoder 2 channels for generating the **Speed fbk loss** alarm. Three selections are possible: **0** **None**: no control is performed **1** **A-B**: only channels A-B are checked, not Z **2** **A-B-Z**: channels A-B and Z are checked
764	**Enc 2 dest**	Allows you to set the destination of encoder 2. Five selections are possible: **0** **OFF** **2** **Speed ref 1**: Encoder 2 is used as speed reference 1

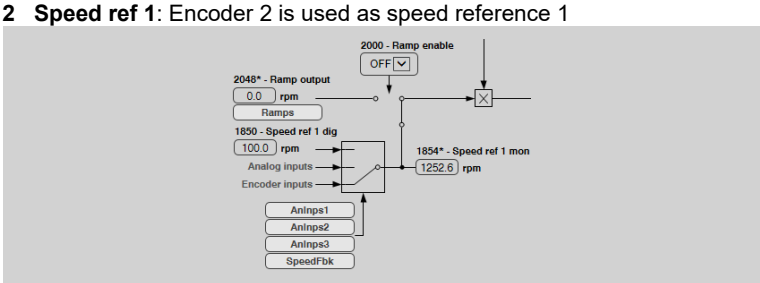


Figure 6-28: Logic diagram when Encoder 2 dest = Speed Ref 1

3 **Speed ref 2**: Encoder 2 is used as speed reference 2

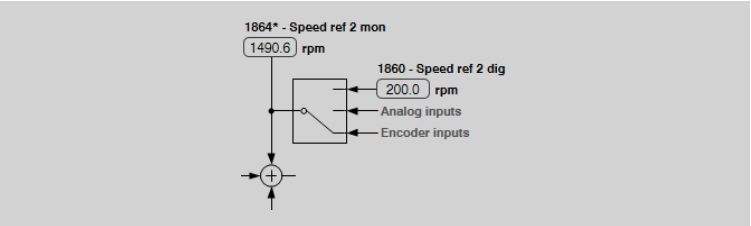


Figure 6-29: Logic diagram when Encoder 2 dest = Speed Ref 2

4 **Ramp ref 1**: Encoder 2 is used as ramp reference 1

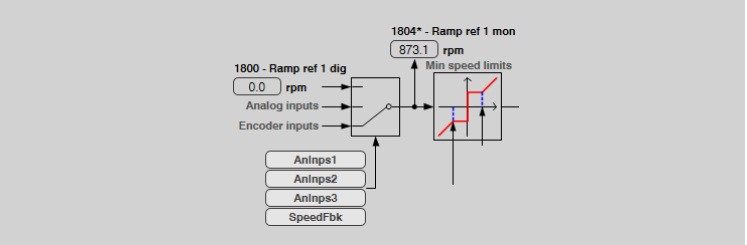


Figure 6-30: Logic diagram when Encoder 2 dest = Ramp Ref 1

5 Ramp ref 2: Encoder 2 is used as ramp reference 2

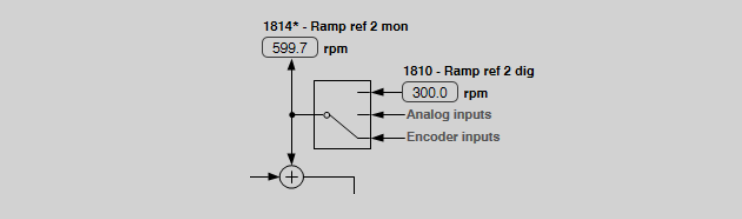


Figure 6-31: Logic diagram when Encoder 2 dest = Ramp Ref 2

766	**Enc 2 speed**	Speed measurement provided by encoder 2, expressed in [rpm]
778	**Enc 2 error code**	Code indicating the type of error detected on encoder 2: **Enc 2 error code = 0**: no error **Enc 2 error code = 1**: error on channels A-B **Enc 2 error code = 2**: error on channel Z **Enc 2 error code = 3**: error on channels A-B and Z

Digital encoder 2 can be used as a speed feedback source by setting parameter IPA 650-**Speed fbk sel** to **Encoder 2**, or as a ramp (1/2) or speed (1/2) reference via parameter IPA 764-**Enc 2 dest**.
Before connecting encoder 2, the user must ensure that the **+24VE2 switch** on the **R-TPD500** control board is properly set.
When connecting an encoder that requires a 24 V power supply, power generation must be enabled by setting the **+24VE2** switch to *ON* (the corresponding LED on the control board will turn on).
When connecting an encoder that requires a 5 V power supply, encoder 2 power generation must be enabled using parameter IPA 754-**Enc 2 supply enable**, and the voltage can be adjusted between 5.2 V and 6.4 V via parameter IPA 758-**Enc 2 Vdc supply**.
This voltage adjustment is used to compensate for any voltage drop in the cable connecting the sensor to the drive.
To select the correct value, measure the voltage directly at the encoder's power supply terminals. The drive features a self-diagnostic function to detect possible connection issues or encoder 2 faults.
This check can be disabled (None), enabled on **A-B** channels only, or on **A-B-Z** (index), via parameter IPA 762-**Enc 2 check**.
Any detected fault is reported through parameter IPA 778-**Enc 2 error code**, and may trigger feedback bypass or generate a Speed fbk loss alarm, which can be managed through parameters in the **ALARM CONFIG\SPEED FBK LOSS** menu.

6.12.4 Tachogenerator

The **SPEED FEEDBACK\TACHO** menu provides parameters for configuring the tachogenerator, which can be used to measure motor speed.

IPA		DESCRIPTION
682	**Tacho filter**	Filter time constant on the speed measurement provided by the tachometer, expressed in [ms]
684	**Tacho DIP switch sel**	Setting made with selector **S4** on the **R-TPD500** control board, based on the correspondence given in **Table 4-6: Dip-switch S4 - Input voltage adjustment of the tachometer response**
686	**Tacho voltage scale**	Tachometer sensitivity rating
688	**Tacho scale tuning**	Gain allowing finer cascade calibration at **Tacho voltage scale**
690	**Tacho offset**	Offset that can be used to correct the speed measurement provided by the tachometer
696	**Tacho speed**	Tachometer speed measurement monitor, which is assigned to the motor speed IPA 234-**Motor speed** when IPA 650-**Speed fbk sel = Tacho**
698	**Tacho sat error**	Monitor of the error signal generated by the tachometer

To configure the drive, the setting made using selector S4 must be confirmed via parameter IPA 684-**Tacho DIP switch sel** (see **Table 4-6: Dip-switch S4 – Input voltage adaptation for tacho feedback**), and the rated sensitivity value must be entered in parameter IPA 686-**Tacho voltage scale**.
A fine calibration can also be performed to remove any measurement offset using parameter IPA 690-**Tacho offset**, or to compensate for possible gain errors using parameter IPA 688-**Tacho scale tuning**.
If the input voltage reaches saturation, an error signal is generated and shown in parameter IPA 698-**Tacho sat error**.
This triggers a Speed fbk loss alarm, which can be configured via parameters in the **ALARM CONFIG\SPEED FBK LOSS** menu. In such a case, it is important to enable either the alarm or the feedback bypass via parameter IPA 656-**Speed fbk bypass**, otherwise the motor could run away.
When the tacho sensor is selected as speed feedback, it is also possible to enable comparison with the armature speed estimation via parameter IPA 658-**Speed fbk control**, to prevent potential wiring faults or sensor failures from causing a motor runaway.

6.12.5 Speed estimation

Motor speed is estimated based on the motor nameplate data:

- IPA 604-**Arm rated current**
- IPA 606-**Arm rated voltage**
- IPA 1052-**Arm resistance** which is the armature resistance estimated through autotuning of the current regulator (see **CURRENT CONTROL\CURR REG TUNE** menu)
- Current–flux curve

and the system state variables:

- IPA 214-**Armature current [%],** which is the armature current
- IPA 210-**Armature voltage,** which is the armature voltage
- IPA 1340-**Field reference,** which is the flux reference

Therefore, to ensure an accurate estimation, the nameplate data must be correctly set.

NOTE! If parameter IPA 612-**Motor EMF constant** is set to a value other than 0, the motor EMF constant is used instead of the rated voltage for speed estimation.

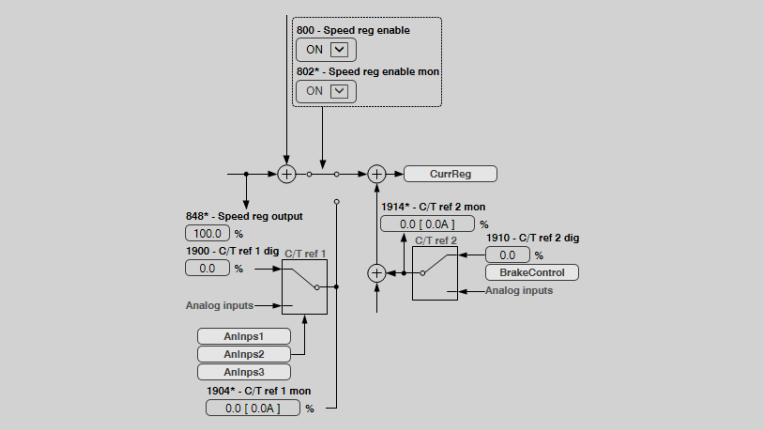
NOTE! Even when motor speed is measured via sensors (encoder or tacho, depending on the setting of parameter IPA 650-**Speed fbk sel**), it is still important to ensure that the speed estimation is accurate, as it is used to detect measurement faults that can be managed via parameter IPA 656-**Speed fbk bypass**.

6.13 Motor speed control

The **SPEED CONTROL** menu provides parameters for configuring the drive's speed control, which is based on a **PI** regulator.
The parameters are organized into dedicated submenus, described in detail below.

6.13.1 Speed regulator

The speed regulator is configured using the following parameters in the **SPEED CONTROL\SPEED REG** menu.

IPA		DESCRIPTION
800	**Speed reg enable**	Allows dynamic switching from speed control to torque control, even with the drive enabled. If set to *ON*, the speed controller is enabled, while if set to *OFF*, the speed controller is disabled and parameter IPA 1900-**C/T ref 1 dig** becomes the reference for the current controller.  Figure 6-32: Speed control enable management diagram
802	**Speed reg enable mon**	Monitor of the speed controller enable status, which can also be assigned by programmable digital inputs or fieldbus
804	**Speed reg lock**	Used to separate the speed controller output from the current controller during operation. When this happens, the current reference is set to zero and the drive stops. The stopping time therefore depends on the load inertia. When the connection between the speed and current controllers is restored, speed control resumes
806	**Speed reg lock mon**	IPA 804-**Speed reg lock** status monitor, which can also be assigned by programmable digital inputs or fieldbus
808	**Speed reg lock I**	Allows the integral action of the speed controller to be blocked
810	**Speed reg lock I mon**	Monitor of the speed controller integral action block parameter, which can also be assigned by programmable digital inputs or fieldbus
838	**Speed auto capture**	Enables the fly-in function to be enabled on a motor that is already rotating. When the converter **Start** command is set to *ON*, the motor speed is detected and the ramp is adjusted accordingly, while if set to *OFF*, the ramp always starts with zero reference. This feature is useful for fly-in coupling to a motor already set in motion by the load (e.g. with fluid-driven pump motors) or for restarting after an alarm has been triggered. If the function is disabled, it is advisable to enable the converter only when the motor is stopped, otherwise the converter's current regulator could reach the current limits and cause a sudden deceleration
848	**Speed reg output**	Speed regulator output, expressed as a percentage of the motor's rated armature current, which acts as a reference for the current regulator

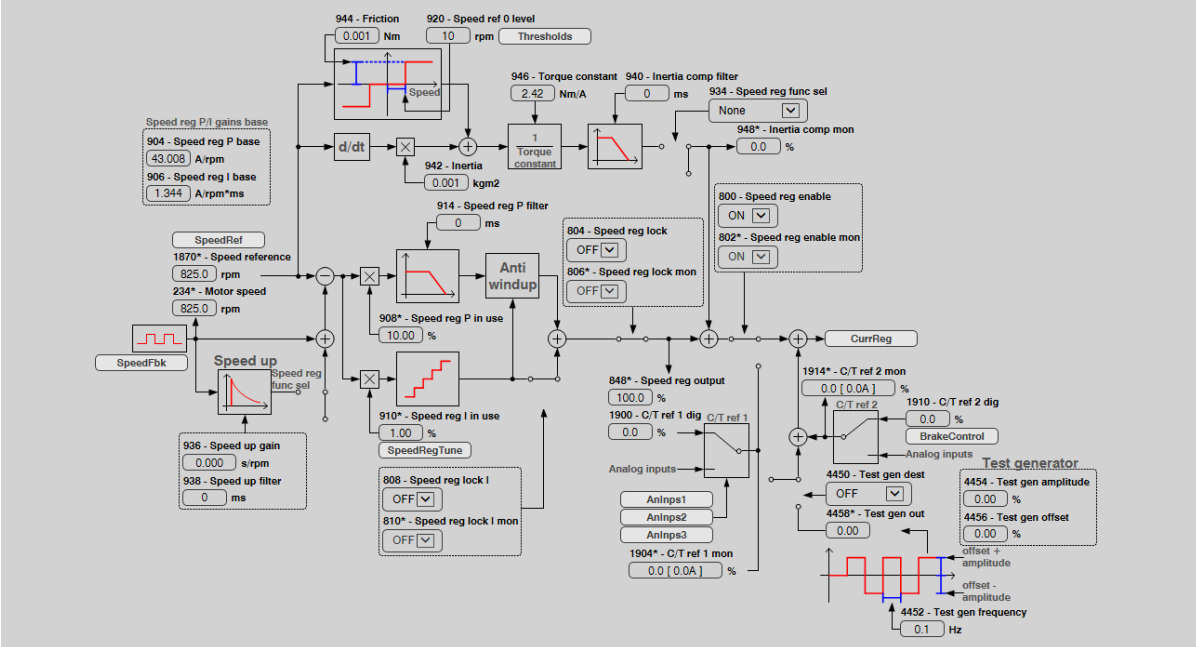


Figure 6-33: General diagram of speed control (Speed Regulator diagram)

The converter includes a motor speed regulation function that can be flexibly adapted to various applications.
Under standard factory settings, the regulator operates as a PI controller with constant P-I gains across the entire regulation range.
The speed regulator's task is to bring the motor to the reference speed IPA 1870-**Speed reference** generated by the speed reference function, by producing the current reference IPA 848-**Speed reg output** for the current regulator.
If the speed regulator is disabled via parameter IPA 800-**Speed reg enable**, the **Speed reg output** is deactivated, allowing direct current/torque control using references IPA 1900-**C/T ref 1 dig** and IPA 1910-**C/T ref 2 dig**, which generate the armature current reference IPA 1020-**Armature current ref**.

The speed feedback IPA 234-**Motor speed** is either estimated from the armature voltage or provided by an encoder or tacho mounted on the motor shaft.

The following auxiliary functions are also available:
- **Speed up** function (see section 6.13.5) to prevent oscillations with high-inertia loads
- **Inertia compensation** function (see section 6.13.5)
- **Zero speed logic** to control regulator behavior when the motor is stopped (see section 6.13.3)
- **Adaptive speed control** for optimizing regulation based on motor speed (see section 6.13.4)

6.13.2 Speed regulator limits

Speed limits are managed using the following parameters in the **SPEED CONTROL\SPEED REG LIMIT** menu.

IPA		DESCRIZIONE
850	**Speed min pos/neg**	Set the minimum speed reference in rpm for both directions of rotation (4B). It is not possible to go below this value; the function operates on the ramp input, regardless of the reference set. When this parameter is changed, the parameters IPA 852-**Speed min pos** and IPA 854-**Speed min neg** are also set to the same value. These parameters can also be changed individually and made different from each other.
856	**Speed max pos/neg**	Set the maximum speed reference in rpm for both directions of rotation (4B). The function operates on the speed regulator input and takes into account both the references coming from the ramp and those entered directly. When this parameter is changed, the parameters IPA 858-**Speed max pos** and IPA 860-**Speed max neg** are also set to the same value. These parameters can also be changed individually and made different from each other.
852	**Speed min pos**	Set the minimum speed reference for positive motor rotation. It is not possible to go below this value, regardless of the reference set. The function operates on the ramp input
858	**Speed max pos**	Set the maximum speed reference for positive motor rotation. The parameter operates on the speed controller input and takes into account both the references coming from the ramp and those entered directly

854	**Speed min neg**	Set the minimum speed reference for the negative direction of rotation of the motor (4B). It is not possible to go below this value, regardless of the reference set. The parameter operates on the ramp input
860	**Speed max neg**	Set the maximum speed reference for the negative direction of rotation of the motor (4B). The parameter operates on the speed controller input and takes into account both the references coming from the ramp and those introduced directly

Speed limited is a digital output available in the selection lists of the **DIGITAL OUTPUTS** menu. It indicates that the speed reference is currently being limited by the configured minimum and/or maximum values.
The output is at logic low only when the reference is within the defined limits.

NOTE!

By convention, the positive direction of rotation is clockwise.

NOTE!

The parameters **Speed min pos** and **Speed min neg** apply only to the **Ramp ref 1 mon** and **Multispeed references**, but not to the **Ramp ref 2 mon** reference.

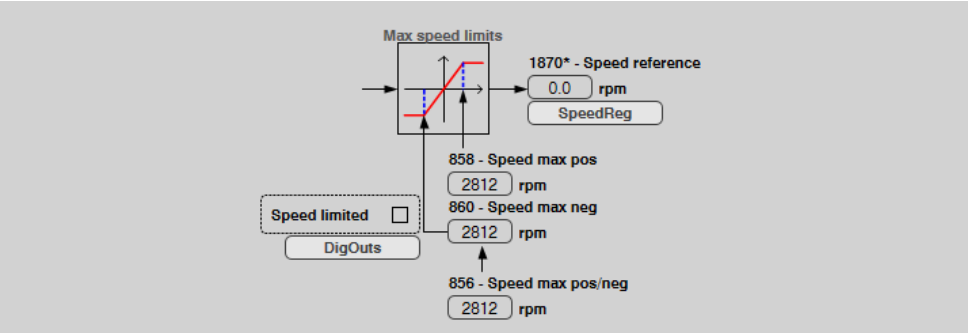


Figure 6-34: Operating diagram of Speed Limits on the speed reference

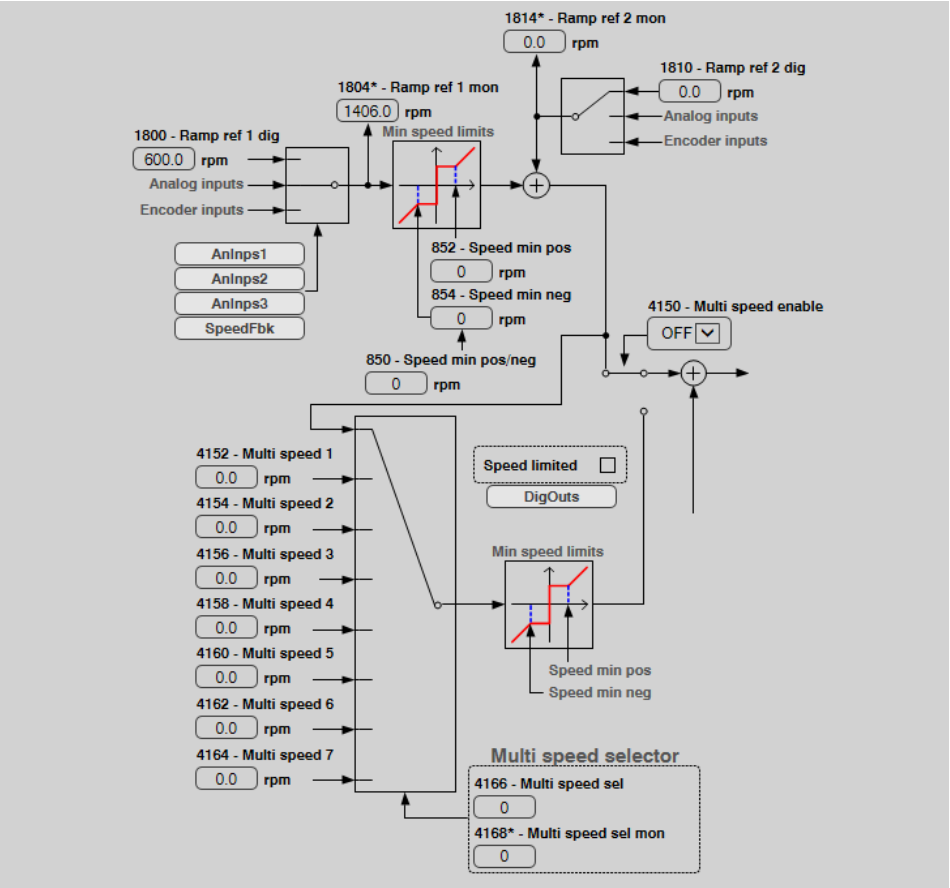


Figure 6-35: Operating diagram of Speed Limits on the ramp reference

6.13.3 Speed regulator tuning

The speed regulator gains are configured using the following parameters in the **SPEED CONTROL\SPEED REG TUNE** menu.

IPA		DESCRIPTION
900	**Speed reg P**	Proportional gain Kp of the speed controller, expressed as a percentage of the base gain IPA 904-**Speed reg P base**
902	**Speed reg I**	Integral gain Ki of the speed controller, expressed as a percentage of the base gain IPA 906-**Speed reg I base**
904	**Speed reg P base**	Base proportional coefficient Kp of the speed controller, expressed in [A/rpm]
906	**Speed reg I base**	Integral coefficient Ki base of the speed controller, expressed in [A/rpm*ms]
908	**Speed reg P in use**	Monitor of the current proportional gain of the speed controller, expressed as a percentage of the base coefficient IPA 904-**Speed reg P base**. Under standard supply conditions, **Speed reg P in use = Speed reg P**
910	**Speed reg I in use**	Monitor of the current integral gain of the speed regulator, expressed as a percentage of the base coefficient IPA 906-**Speed reg I base**. Under standard supply conditions, **Speed reg I in use = Speed reg I**
914	**Speed reg P filter**	Time constant of the low-pass filter applied to the proportional action of the speed regulator
920	**Speed ref 0 level**	Speed used to define the intervention threshold for managing the speed controller gains at zero speed. The **Reference 0 thr** signal indicates that the speed reference (**Ramp reference** if **Ramp enable = ON** or **Speed reference** if **Ramp enable = OFF**) is below the IPA 920-**Speed ref 0 level threshold**
922	**Speed=0 P gain**	Proportional gain of the speed controller at zero speed, expressed as a percentage of the base gain IPA 904-**Speed reg P base**, active only if IPA 928-**Speed=0 P enable** is set to *ON*
924	**Speed=0 I enable**	Parameter enabling the reset of the integral gain of the speed controller at zero speed. Two selections are possible: **ON**: the integral gain is reset when the **Speed 0 thr** and **Reference 0 thr** signals are activated, regardless of the **Speed=0 P enable** setting, i.e. when the motor speed drops below the IPA 812-**Speed 0 level** threshold with the delay time given by the IPA 814-**Speed 0 delay** parameter and when the ramp reference drops below the IPA 920-**Speed ref 0 level** threshold **OFF**: integral gain is also active when the motor is stopped
926	**Speed=0 R enable**	It should only be used when IPA 928-**Speed=0 P enable** is set to *ON*. Two selections are possible: **ON**: the proportional and integral gains are equal to **Speed=0 P gain** and **0** respectively when the **Reference 0 thr** and **Speed 0 thr** signals are activated, i.e. when the ramp reference falls below the IPA 920-**Speed ref 0 level** threshold and the speed falls below IPA 812-**Speed 0 level**, and are restored (to their previous values) only when the reference is above the **Reference 0 thr** **OFF**: to the **Reference 0 thr** condition of the *ON* case, the **Speed 0 thr** condition must also be added, obtaining a behaviour similar to when **Speed=0 P enable = ON**

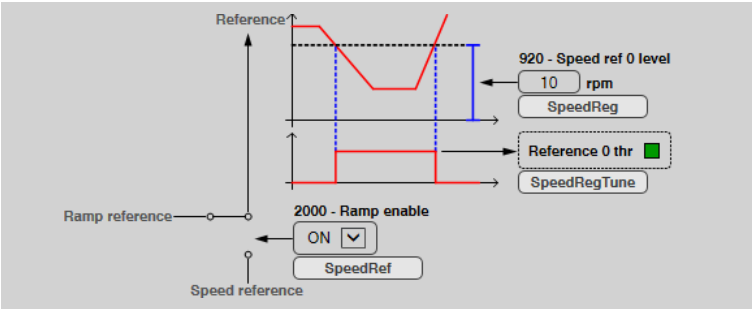


Figure 6-36: Operation of signals dependent on Reference 0 thr

928	**Speed=0 P enable**	Parameter for enabling speed controller gains at zero speed. Two selections are possible: **ON**: the proportional and integral gains are equal to **Speed=0 P gain** and **0** respectively when the **Speed 0 thr** and **Reference 0 thr** signals are activated, i.e. when the motor speed drops below the IPA 812-**Speed 0 level** threshold with the delay time given by parameter IPA 814-**Speed 0 delay** and when the speed reference drops below the IPA 920-**Speed ref 0 level** threshold.

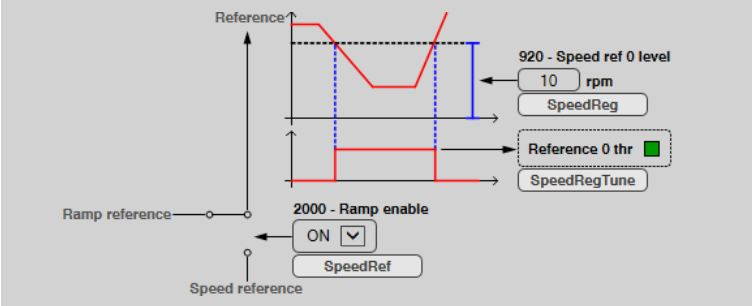


Figure 6-37: Operation of signals dependent on Reference 0 thr

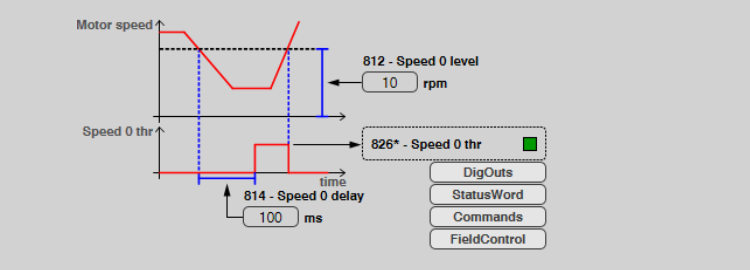


Figure 6-38: Operation of signals dependent on Speed 0 thr

930	**Speed reg P bypass**	Proportional gain of the speed controller, expressed as a percentage of the base gain IPA 904-**Speed reg P** applied following activation of the feedback bypass function when feedback from an encoder or tachometer automatically switches to a speed estimate based on the armature (in this case, lower gains should be used).
932	**Speed reg I bypass**	Integral gain of the speed controller, expressed as a percentage of the base gain IPA 906-**Speed reg I** applied following activation of the feedback bypass function when feedback from an encoder or tachometer automatically switches to a speed estimate based on the armature (in this case, lower gains should be used).

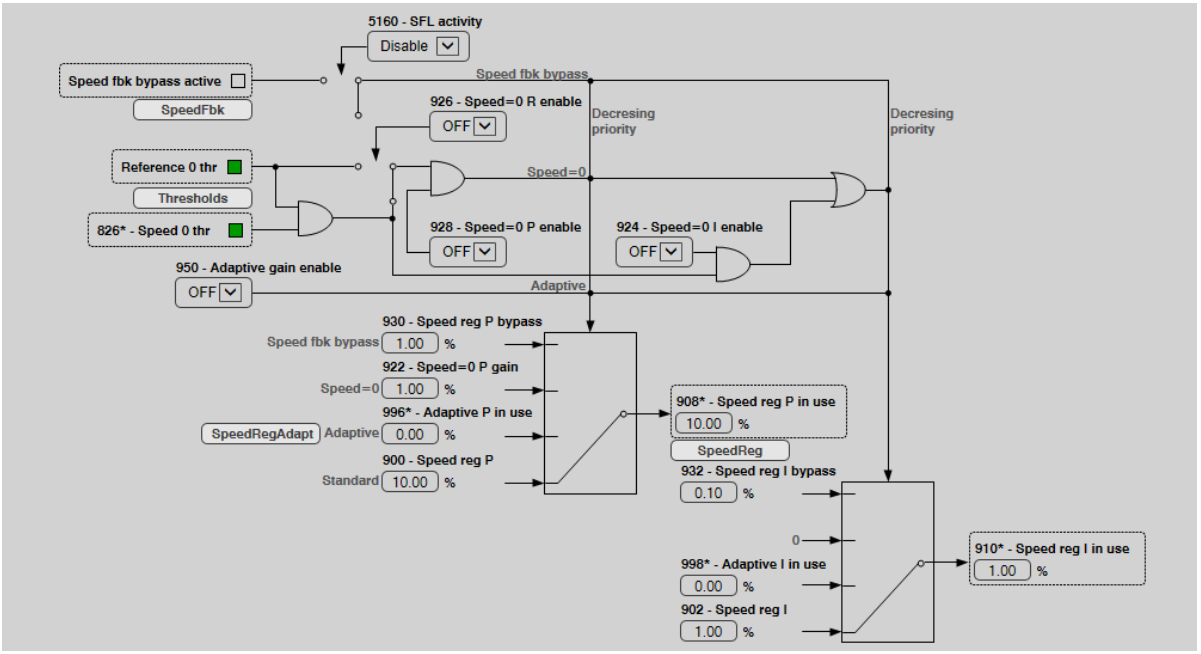


Figure 6-39: General diagram of speed control parameters (Speed Reg Tune diagram)

The proportional and integral gains of the PI speed regulator are divided into a base value, expressed in engineering units, and a percentage of that value, according to the following formulas:

$K_P = K_{P\%} \times K_{Pbase} /100 = [A/rpm]$

$K_I = K_{I\%} \times K_{Ibase} /100 = [A/(rpm \times ms)]$

There are therefore four possible sources and switching modes for the speed regulator gains, with decreasing priority in case of simultaneous activation (see figure 6-39):

1. **Speed fbk bypass**: this mode has the highest priority and is activated by the speed feedback bypass function.

   In this case:
   - **Speed reg P in use = Speed reg P bypass**
   - **Speed reg I in use = Speed reg I bypass**

   The **Speed = 0, Adaptive** and **Standard** modes are disabled.

2. **Speed = 0**: this mode is based on zero-speed gains.

   In this case:
   - **Speed reg P in use = Speed=0 P gain**
   - **Speed reg I in use = 0**

   The **Adaptive** and **Standard** modes are disabled.

3. **Adaptive**: this mode is based on adaptive gain control.

   In this case:
   - **Speed reg P in use = Adaptive P in use**
   - **Speed reg I in use = Adaptive in I use**

   The **Standard** mode is disabled.

4. **Standard**: this is the lowest-priority mode, active only when the **Speed fbk bypass**, **Speed = 0**, and **Adaptive** modes are not active.

   In this case:
   - **Speed reg P in use = Speed reg P**
   - **Speed reg I in use = Speed reg I**

   That is, the gains set directly by the user are applied.

6.13.4 Adaptive speed regulator

The adaptive speed function allows the **PI** speed regulator gains to vary based on motor speed or another variable (selected via **Adaptive ref**).
This makes it possible to optimize the behavior of the speed regulator according to the specific needs of the application.

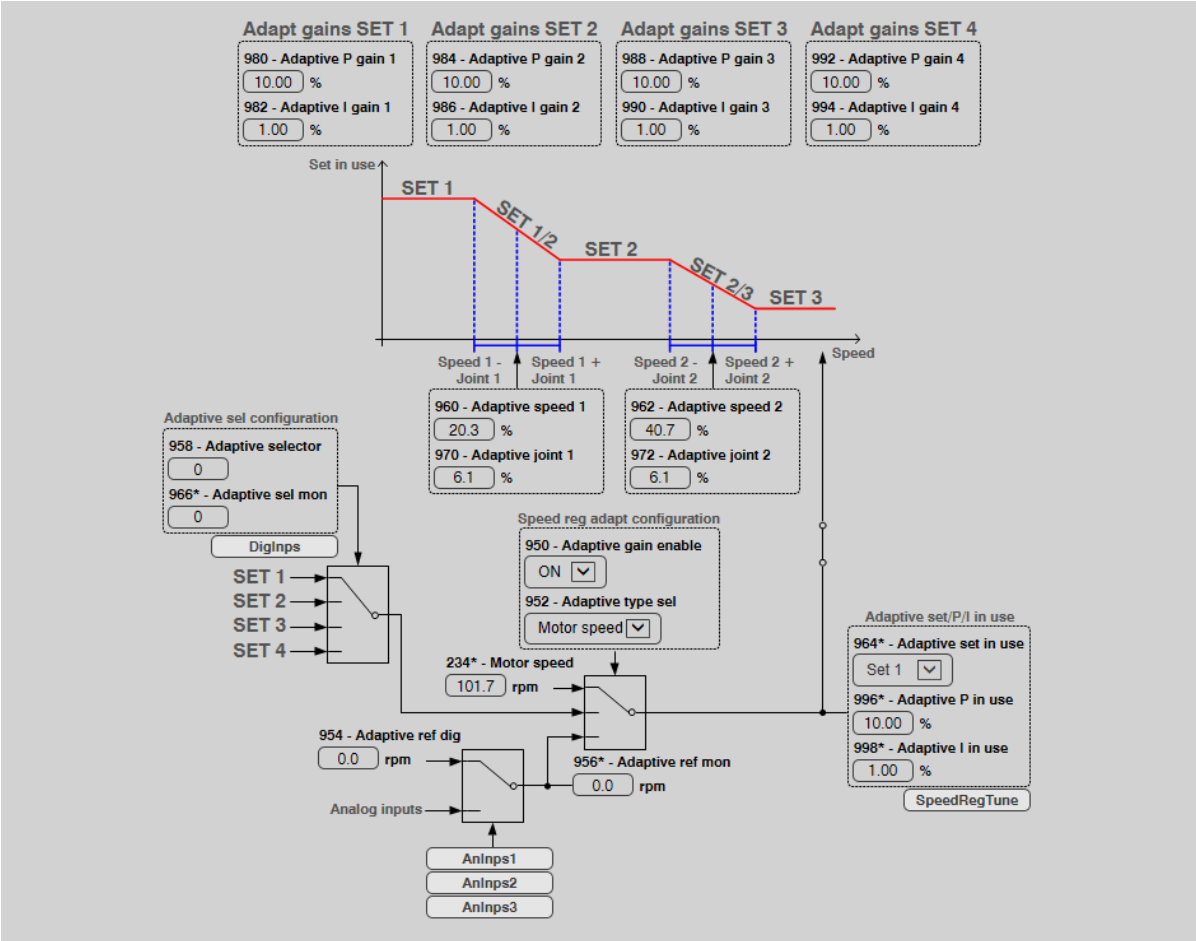


Figure 6-40: General diagram of adaptive speed regulation parameters (Speed Reg Adapt diagram)

The function is managed using the following parameters in the **SPEED CONTROL\SPEED REG ADAPT** menu.

IPA		DESCRIZIONE
950	**Adaptive gain enable**	Enables speed adaptation
952	**Adaptive type sel**	Allows you to select the magnitude by which to vary the speed controller gains: **0 Motor speed** selection: gains are varied according to motor speed **1 Adaptive ref** selection: gains are varied according to Adaptive ref mon **2 Adaptive sel** selection: gains are varied by selecting a dedicated SET that can also be selected from digital inputs. Only under these operating conditions are 4 **PI** gain SETs available (**SET 1** - **SET 2** - **SET 3** - **SET 4**)
954	**Adaptive ref dig**	Allows, only if **Adaptive type sel=Adaptive ref**, to set the speed at which to vary the speed controller gains.
956	**Adaptive ref mon**	Speed monitor at which to vary the gains, which can also be assigned by analogue inputs or fieldbus
958	**Adaptive selector**	Allows, only if **Adaptive type sel=Adaptive sel**, to select a SET of **PI** gains from 1 to 4
966	**Adaptive sel mon**	Monitor of the **PI** gain SET selector, which can also be assigned by combining two digital inputs (selections **Adapt sel 1** / **Adapt sel 2**)
960	**Adaptive speed 1**	Central speed of the connection band between **SET 1** and **SET 2**, defined as [**Speed 1 - Joint 1**, **Speed 1 + Joint 1**], expressed as a percentage of **Full scale speed**
970	**Adaptive joint 1**	Defines the width of the connection band between **SET 1** and **SET 2**

962	**Adaptive speed 2**	Central speed of the connection band between **SET 2** and **SET 3**, defined as [**Speed 2 - Joint 2**, **Speed 2 + Joint 2**], expressed as a percentage of **Full scale speed**
972	**Adaptive joint 2**	Defines the width of the connection band between **SET 2** and **SET 3**
980	**Adaptive P gain 1**	Proportional gain **P** of **SET 1**, expressed as a percentage of **Speed reg P base**
982	**Adaptive I gain 1**	Integral gain **I** of **SET 1**, expressed as a percentage of **Speed reg I base**
984	**Adaptive P gain 2**	Integral gain **I** of **SET 1**, expressed as a percentage of **Speed reg I base**
986	**Adaptive I gain 2**	Integral gain **I** of **SET 2**, expressed as a percentage of **Speed reg I base**
988	**Adaptive P gain 3**	Proportional gain **P** of **SET 3**, expressed as a percentage of **Speed reg P base**
990	**Adaptive I gain 3**	Integral gain **I** of **SET 3**, expressed as a percentage of **Speed reg I base**
992	**Adaptive P gain 4**	Proportional gain **P** of **SET 4**, expressed as a percentage of base **Speed reg P**
994	**Adaptive I gain 4**	Integral gain **I** of **SET 4**, expressed as a percentage of base **Speed reg I**
964	**Adaptive set in use**	Monitor of the status of the **PI** gain **SET** in use
996	**Adaptive P in use**	Monitor of the adaptive **P** gain in use
998	**Adaptive I in use**	Monitor of the adaptive **I** gain in use

To activate adaptive gains for the speed regulator, parameter IPA 950-**Adaptive gain enable** must be set to *ON*.

By default, the gains depend on motor speed. However, they can also vary based on a programmable speed level using the **Adaptive ref dig** parameter, or be selected directly and dynamically via the **Adaptive selector** parameter.

The parameters **Adaptive speed 1**, **Adaptive joint 1**, **Adaptive speed 2** and **Adaptive joint 2** allow the definition of five gain ranges, named as follows:

- **SET 1**: range with constant PI gains
- **SET 1 / 2**: linear transition range between SET 1 and SET 2
- **SET 2**: range with constant PI gains
- **SET 2 / 3**: linear transition range between SET 2 and SET 3
- **SET 3**: range with constant PI gains

These ranges correspond to the possible states displayed by the parameter **Adaptive set in use**.

Parameter IPA 970-**Adaptive joint 1** enables a smooth transition between **SET 1** and **SET 2**.
If set to 0.0, the **SET 1 / 2** range does not exist, and the gain transition between **SET 1** and **SET 2** is abrupt.

Similarly, parameter IPA 972-**Adaptive joint 2** enables a smooth transition between **SET 2** and **SET 3**.
If set to 0.0, the **SET 2 / 3** range does not exist, and the gain transition between **SET 2** and **SET 3** is abrupt.

When adaptive speed regulator gains are enabled, the standard gains IPA 900-**Speed reg P** and IPA 902-**Speed reg I** are inactive.

6.13.5 Speed regulator – Auxiliary functions

The converter's PI speed regulator provides auxiliary **Speed up** and **Inertia compensation** functions to optimize speed control performance. These functions are mutually exclusive.
The auxiliary compensation functions of the speed regulator are configured using the following parameters in the **SPEED CONTROL\SPEED REG FUNC** menu.

IPA		DESCRIPTION
934	**Speed reg func sel**	Enables the speed controller compensation functions. Three selections are possible: **0 None**: the **Speed up** and **Inertia comp** functions are both disabled **1 Speed up**: the **Speed up** function is enabled and the **Inertia comp** function is disabled **2 Inertia comp**: the **Inertia comp** function is enabled and the **Speed up** function is disabled
936	**Speed up gain**	**Speed up** function gain, expressed in s/rpm and applied to the derivative of the speed measurement IPA 234-**Motor speed**
938	**Speed up filter**	Time constant of the low-pass filter acting downstream of the derivative of the speed measurement, after application of the gain IPA 936-**Speed up gain**
940	**Inertia comp filter**	Time constant, expressed in ms, of the low-pass filter acting on the output generated by the **inertia compensation** function
942	**Inertia**	Total value of the inertia at the motor shaft, expressed in [Kgm^2]
944	**Friction**	Friction value, expressed in [Nm]
946	**Torque constant**	Motor torque constant, expressed in [Nm/A]
948	**Inertia comp mon**	Monitor of the output produced by the inertia compensation function, expressed as a percentage of the motor's rated armature current and added to the output of the speed regulator Speed reg output (see figure 6-42)

The Speed up function can be used to prevent speed oscillations in the presence of loads with high inertia or variable cyclic loads applied to the motor (e.g., cams).
Compensation is achieved by modifying the speed regulator feedback: instead of using the measured motor speed (**Motor speed**), the feedback becomes the sum of **Motor speed** and the output of the **Speed up** function (see Figure 6-41).
This output is obtained by applying in cascade the gain IPA 936-**Speed up gain** to the derivative of IPA 234-**Motor speed**, followed by the low-pass filter IPA 938-**Speed up filter**.

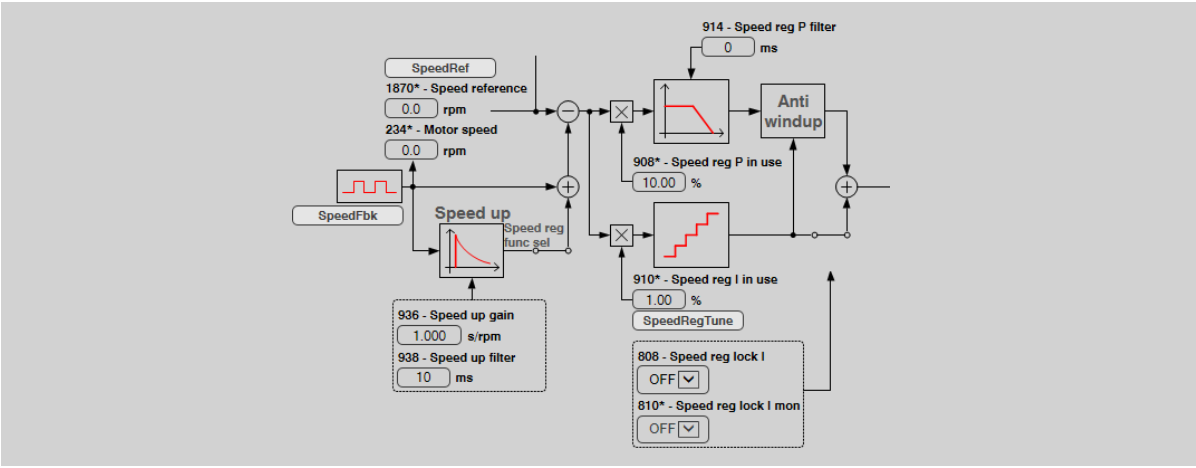


Figure 6-41: Operating diagram of the Speed Up control function

The **Inertia compensation** function performs feed-forward compensation of inertia and friction to improve the dynamic response of the speed regulator to variations in IPA 1870-**Speed reference**.
The current required to overcome inertia and friction is estimated and added to the PI speed regulator output **Speed reg output** (see Figure 6-42).
A low-pass filter with a programmable time constant is included to reduce noise caused by the derivative used in the inertia compensation process.
To achieve good results, it is essential that the parameters IPA 942-**Inertia**, IPA 944-**Friction**, and IPA 946-**Torque constant**, which characterize the load, are set as close as possible to their actual values.

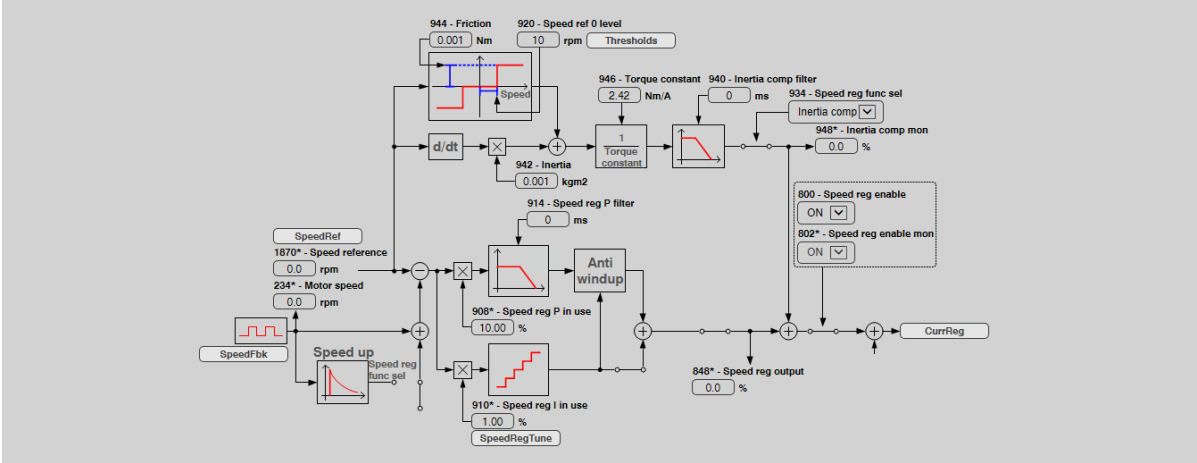


Figure 6-42: Operating diagram of the Inertia Comp control function

6.14 Armature current control

The **CURRENT CONTROL** menu provides parameters for configuring the drive's armature current control, which is based on either a predictive or **PI**-type regulator.

6.14.1 Current regulator

The armature current regulator operates downstream of the PI speed regulator, generating the control signals for the converter's power board in order to ensure that a DC current equal to the **Armature current ref** is delivered to the load, as provided by the speed regulator.

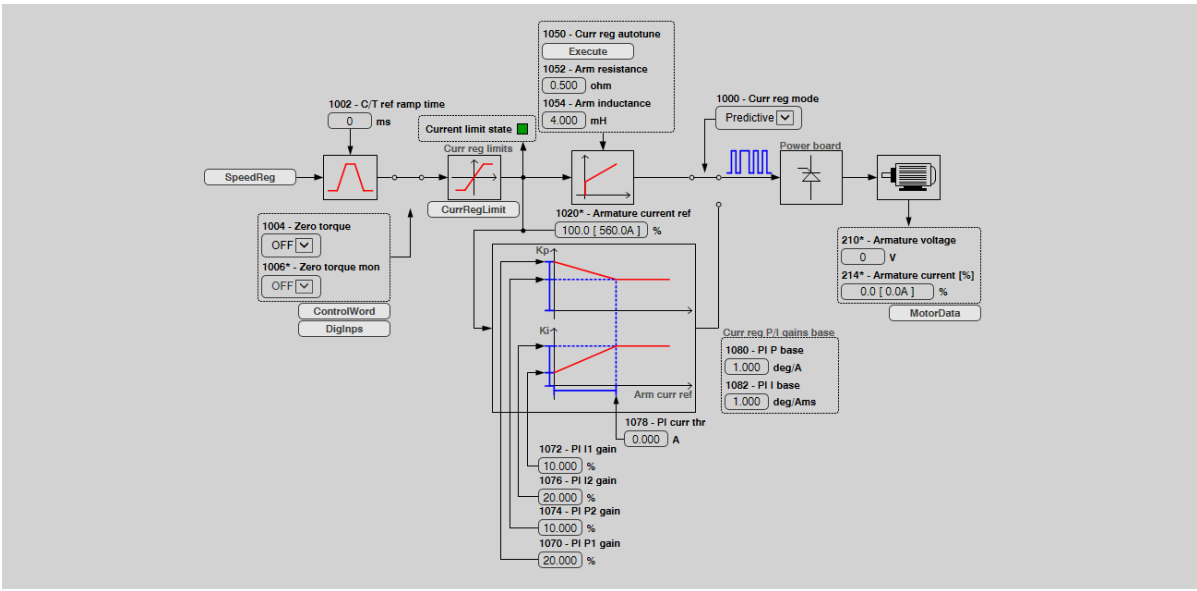


Figure 6-43: Armature current control diagram (Current reg diagram)

The armature current regulator is configured using the following parameters in the **CURRENT CONTROL\CURR REG** menu.

IPA		DESCRIPTION
1000	**Curr reg mode**	Allows you to set the type of armature current regulator. Two selections are possible: **0 Predictive**: predictive type regulator, which can be used in electric motors to reach the required current reference more quickly. The predictive current regulator guarantees excellent performance if the inductance and resistance values are set correctly. For this reason, it is essential to self-calibrate the current regulator before using the drive for the first time or when the load is changed. The regulator consists of a predictive part, which acts in an open loop, and an integral action that has the task of zeroing the current error; this term can be monitored via the IPA 1060-Compensation output parameter, which can be used as an indicator of the quality of the predictive part and therefore as an aid to fine tuning. The predictive part must be calibrated as accurately as possible to ensure a fast, precise response without current overshoots. **1 PI**: proportional-integral controller, which can be used for loads with very high inductance values and not necessarily with electric motors
1002	**C/T ref ramp time**	It acts between the output of the speed regulator and the input of the current regulator limitation block by setting the linear ramp time that the current reference must take to go from zero to the nominal armature current value of the motor IPA 604-**Arm rated current**. In this way, it is possible to ensure that changes in the current reference are not applied in steps but gradually
1004	**Zero torque**	**Armature current ref** reset command, so that the drive immediately stops supplying torque.
1006	**Zero torque mon**	Monitor for the armature current reference reset command, which can also be assigned by programmable digital inputs or fieldbus

6.14.2 Current regulator limits

The torque current limits, which act on the input of the current regulator and refer only to armature current, are managed using the following parameters in the **CURRENT CONTROL\CURR REG LIMIT** menu.

IPA		DESCRIZIONE
1104	**C/T lim pos dig**	Set the drive current limit for positive current direction (clockwise rotation and counterclockwise braking), expressed as a percentage of the motor's rated armature current
1106	**C/T lim pos mon**	Positive current limit monitor, which can also be assigned by analogue inputs. This parameter can be displayed in two units of measurement, [%-A]
1108	**C/T lim neg dig**	Sets the drive current limit for the negative current direction (counterclockwise rotation and clockwise braking), expressed as a percentage of the motor's rated armature current
1110	**C/T lim neg mon**	Negative current limit monitor, which can also be assigned from analogue inputs. In the case of symmetrical limits, it is equal to C/T lim pos mon (with sign -). For this parameter, dual unit display is available, [%-A]
1112	**C/T lim sym enable**	Enables symmetrical current limits for both current directions. In this case, there is only one current limit that can actually be set, given by the **C/T lim pos mon** parameter, which acts as both a positive and negative limit, while the negative limit **C/T lim neg dig** becomes ineffective (see figure 6-44). By setting this parameter to *ON*, symmetrical limits can be managed with a single analogue input.

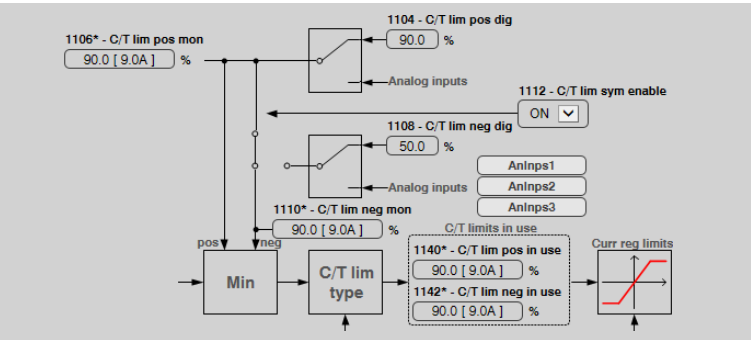


Figure 6-44: Control diagram for symmetrical torque limits

1120	**C/T lim reduction**	Allows you to set the level of current limit reduction, enabling this function via parameter IPA 1122-**C/T lim reduct cmd**
1122	**C/T lim reduct cmd**	Allows you to enable current limit reduction. When reduction is active, the current limits are lowered to the level set in parameter **IPA 1120-C/T lim reduction**
1124	**C/T lim reduct mon**	Monitor of the status of the current reduction command, which can also be assigned by programmable digital inputs
1140	**C/T lim pos in use**	Monitor of the positive current limit actually in use, downstream of all contributions that may be present in the limit chain (see figure 6-45), expressed as a percentage of the motor's rated armature current. For this parameter, dual unit display is available, [%-A]
1142	**C/T lim neg in use**	Monitor of the negative current limit actually in use, downstream of any contributions present in the limit chain (see figure 6-45), expressed as a percentage of the motor's rated armature current. This parameter can be displayed in two units of measurement, [%-A]

NOTE!

The maximum default value for all torque current limits is 100%, but it can be increased to 150% by enabling one of the various types of overload allowed via the IPA 4300-**Overload mode** parameter in the **FUNCTIONS\OVERLOAD** menu (see paragraph 6.18.8).

IPA		DESCRIPTION
1126	**C/T lim type**	Determines the operation of the converter at the current limits. If **Pos/neg** is selected, the active positive current limit is **C/T lim pos mon** and the active negative current limit is **C/T lim neg mon**. If **Mot/gen** is selected, three conditions are possible: If the motor speed is greater than +1% of **Motor rated speed** • the active positive current limit is **C/T lim pos mon** • the active negative current limit is **C/T lim pos mon** If the motor speed is less than -1% of the **Motor rated speed** • the active positive current limit is **C/T lim neg mon** • the active negative current limit is **C/T lim pos mon** If the motor speed is between -1% and +1% of the **Motor rated speed** • the active positive and negative current limit is **C/T lim pos mon**

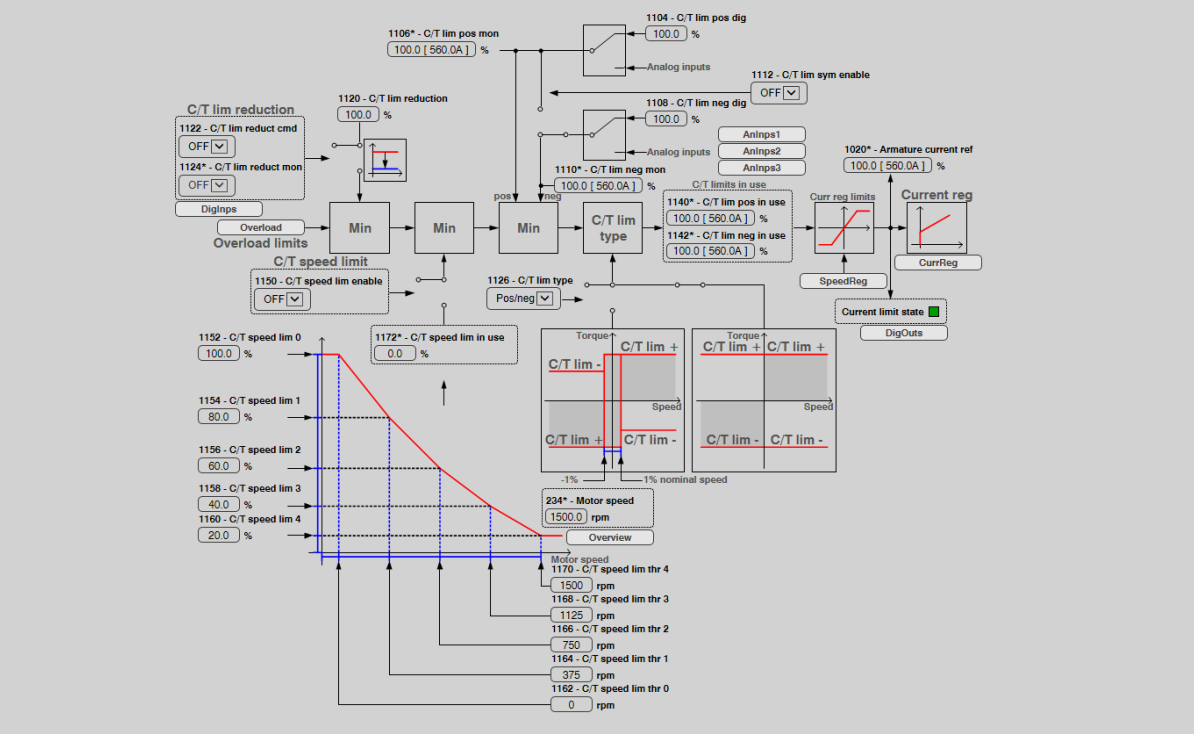


Figure 6-45: General diagram of current limit management (Curr Reg Limit diagram)

Current limit state is a digital output available in the selection lists of the **DIGITAL OUTPUTS** menu, used to indicate that the converter is operating under current limiting conditions. In this case, the **ILim** LED on the keypad is turned on.

NOTE!

The effective current/torque limits applied to the current regulator, represented by parameters IPA 1140-**C/T lim pos in use** and IPA 1142-**C/T lim neg in use**, result from a cascade of contributions from different functions. The final applied limit is always the minimum value among all of them:

- Positive/negative torque limits set by user parameters IPA 1106-**C/T lim pos mon** and IPA 1110-**C/T lim neg mon**
- Torque limits defined by the **limit reduction** parameter IPA 1120-**C/T lim reduction**
- Torque limits set by the overload function via parameter IPA 4324-**C/T overload lim mon**
- Torque limits based on motor speed, defined by parameter IPA 1172-**C/T speed lim in use**

6.14.3 Current regulator tuning

The current regulator gains are configured using the following parameters in the **CURRENT CONTROL\CURR REG TUNE** menu.

IPA		DESCRIPTION
1050	**Curr reg autotune**	Command for executing a self-tuning cycle of the current regulator (valid only when IPA 1000-**Curr reg mode = Predictive**). The calculated armature resistance and inductance values are automatically assigned to the IPA 1052-**Arm resistance** and IPA 1054-**Arm inductance** parameters at the end of the procedure.
1052	**Arm resistance**	Load armature resistance, expressed in [Ω]. When performing a self-calibration cycle, this parameter is overwritten with the calculated value, but can be changed manually if necessary
1054	**Arm inductance**	Load armature reactance, expressed in [mH]. When performing an autotuning cycle, this parameter is overwritten with the calculated value, but can be changed manually if necessary
1060	**Compensation output**	Monitor useful for assessing whether the current regulator is correctly calibrated (only valid when IPA 1000-**Curr reg mode = Predictive**). The value should be as small as possible, typically less than ±30…40 V
1070	**PI P1 gain**	Percentage value of the proportional gain of the current PI controller, expressed in [%] relative to the base value IPA 1080-**PI P base**, with current reference at zero.
1072	**PI I1 gain**	Percentage value of the integral gain of the current PI controller, expressed in [%] relative to the base value IPA 1082-**PI I base**, with current reference at zero
1074	**PI P2 gain**	Percentage value of the proportional gain of the current PI controller, expressed as a percentage of the base value IPA 1080-**PI P base**, with a current reference higher than IPA 1078-**PI curr thr**
1076	**PI I2 gain**	Percentage value of the integral gain of the current PI controller, expressed as a percentage of the base value IPA 1082-**PI I base**, with a current reference greater than IPA 1078-**PI curr thr**
1078	**PI curr thr**	Threshold below which the proportional and integral gains of the current controller vary linearly with the current reference from value 1 to value 2. Above this threshold, the **PI P2 gain** and **PI I2 gain** values are maintained (see figure 6-46).
1080	**PI P base**	Base value of the proportional gain of the current PI controller, expressed in [deg/A]
1082	**PI I base**	Base value of the integral gain of the current PI controller, expressed in [deg/A x ms]

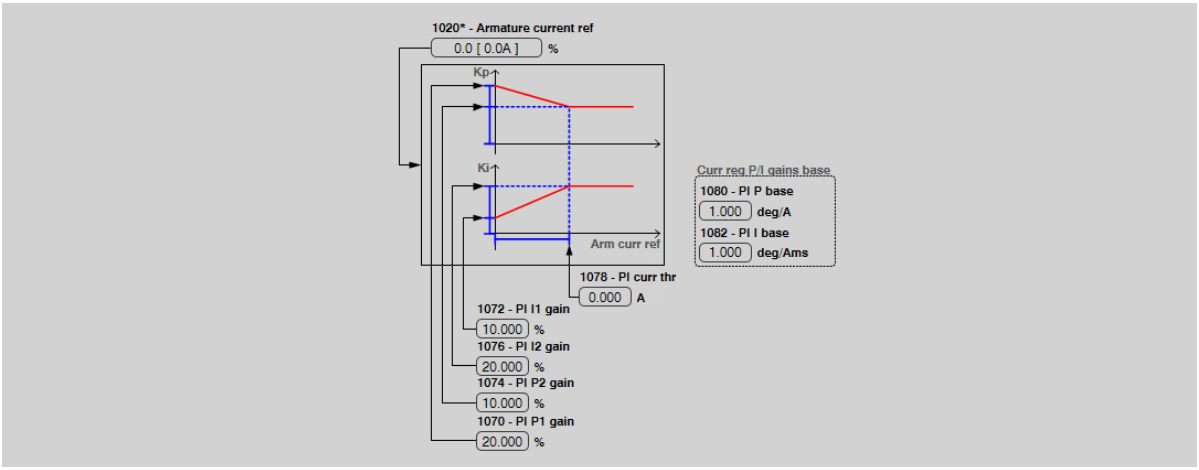


Figure 6-46: Diagram of current control parameter management when using the PI regulator

The **PI-type current regulator** is suitable for highly inductive loads or in applications where high dynamic response of the current regulator is not required.
To account for the different system behavior in continuous and discontinuous current conduction modes, this regulator provides a gain variation proportional to the current (see Figure 6-46).
The applied gain varies linearly from value 1 to value 2, starting from zero current up to the threshold set by parameter IPA 1078-**PI curr thr**, and remains constant beyond that threshold.
As shown in Figure 6-46, it is recommended that the proportional gain decreases and the integral gain increases with increasing current.

6.15 Field current control

The **FIELD CONTROL** menu provides parameters for configuring the drive's field current control, which can be managed either by an internal PI regulator or by an external exciter.
The various parameters are organized into dedicated submenus, described in detail below.

6.15.1 Field current regulator

The motor field is controlled through a PI-type current regulator, which takes the current error as input and generates, as output, the firing angle of the SCRs on the corresponding power board.
When the drive is operated with a constant field, regulator tuning may not be necessary; however, precise tuning becomes essential when a good dynamic response is required, such as in field weakening applications.

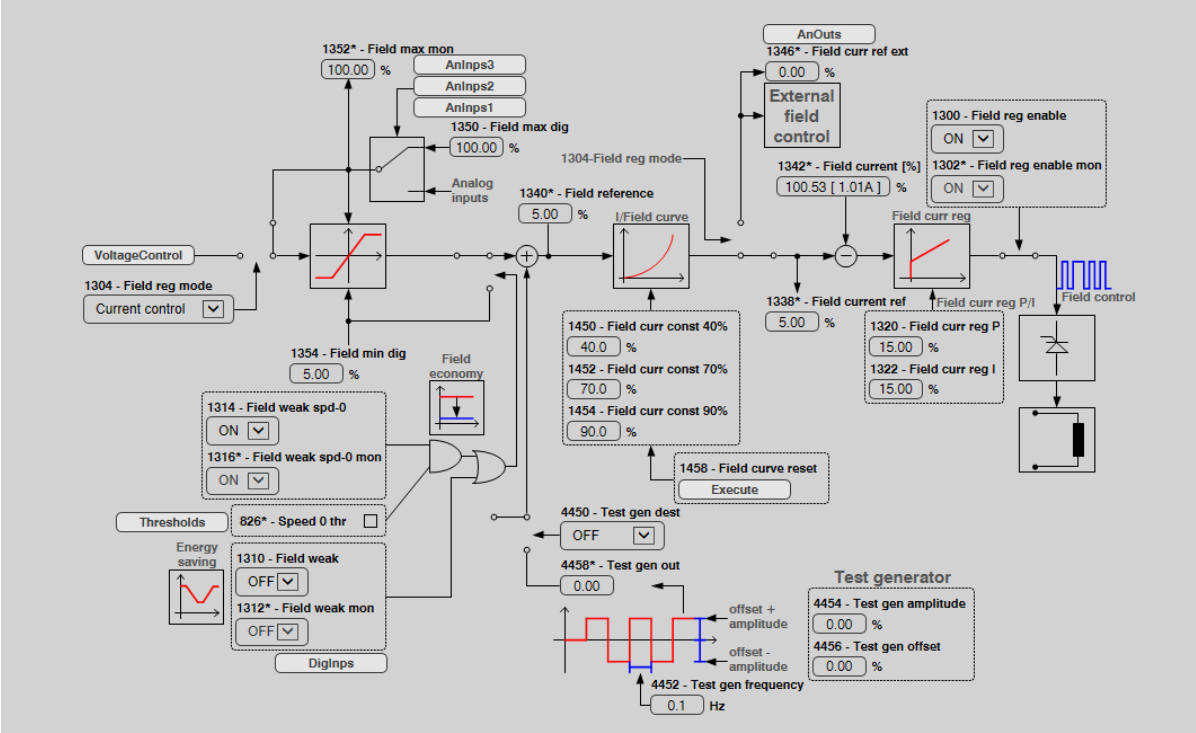


Figure 6-47: General diagram of field current control (Field Control diagram)

The field current regulator is configured using the following parameters in the **FIELD CONTROL\FIELD REG** menu.

IPA		DESCRIPTION
1300	**Field reg enable**	Field converter enable command. When set to *OFF*, the field current is zero because the field power board is disabled
1302	**Field reg enable mon**	Field converter enable command monitor, which can also be assigned by programmable digital inputs or fieldbus

1304 Field reg mode

Allows you to configure the field converter operating mode according to the type of system to be controlled and the drive in use.

Five selections are possible:

0 Current control: the field current applied depends on the flow reference and the set I/F curve (see figure 6-47). The controller takes the value of IPA 1352-**Field max mon** as the flow reference if no flow reductions (energy saving or field economy) are active, otherwise it takes the value of IPA 1354-**Field min dig**. The controller then performs constant flow control, unless an analogue input is set as **Field max**. In this mode, the armature voltage controller is disabled

1 Voltage control: this mode allows the nominal motor speed to be exceeded by weakening the field, which is managed independently by the drive based on the voltage of the motor armature circuit. The PI armature voltage regulator modifies the flow reference to ensure that the armature voltage is equal to **Volt control ref mon * Arm rated voltage**. The output of this controller is limited between IPA 1354-**Field min dig** and IPA 1352-**Field max mon** (see figure 6-48). If the I/F flow-current curve is correctly calibrated, the speed estimate is still valid, allowing it to be used as speed feedback or to enable the feedback control function via parameter IPA 658-**Speed fbk control**.

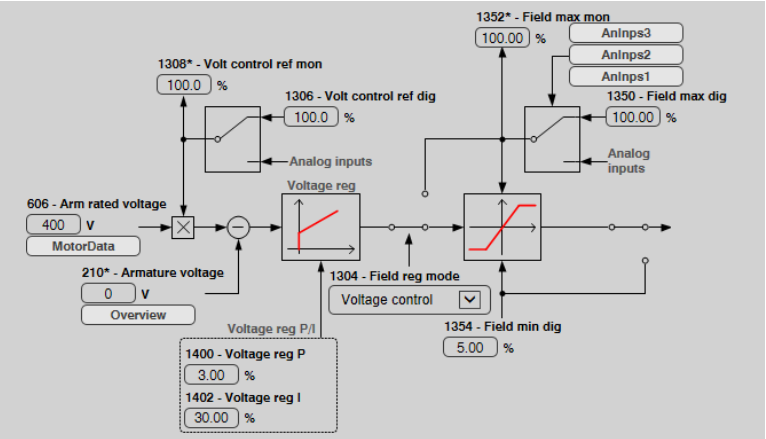


Figure 6-48: General voltage control diagram

2 External control: The field current is regulated by a device external to the drive. In this mode, the field current reference is calculated by controlling the armature voltage with automatic derating, as is typical for voltage control. The **TPD500** drive (master) regulates the armature current and supplies the field reference to the external device via an analogue output or field bus. The **TPD500** acts as if the actual field is always adhering to the reference requested by it, which is why the **Field loss alarm** signal is no longer managed internally but can come from a digital input configured as **Field Loss ext**, in order to inhibit the enabling of the armature in the absence of a field. The internal PI field current regulator is disabled

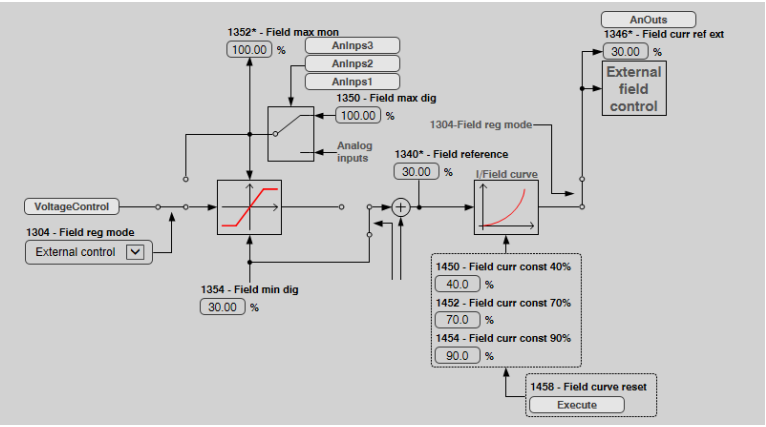


Figure 6-49: Voltage control when Field reg mode = External Control

4 Ext wired FC volt: The field current is regulated by an external **TPD500-FC unit** via a wired connection on standard I/O. In this mode, the field current reference is calculated by the armature voltage control with automatic current reduction typical of the **Voltage control case**.

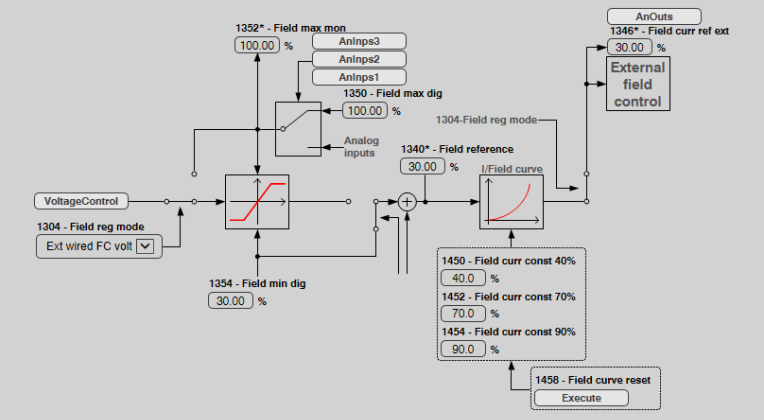


Figure 6-50: Voltage control when Field reg mode = External Wired FC Volt

The TPD500 drive (master) regulates the armature current and provides the field current reference to the TPD500-FC external unit. The internal PI field current regulator is disabled. To use this mode, connect a digital signal received from the TPD500-FC external unit and send an analogue signal to it, then configure the following parameters on the TPD500 drive:

- A digital input destination set as **Wired FC enable**, indicating the enable status of the external field controller **TPD500-FC**
- A selection of analogue outputs set as **Wired FC ref**, indicating the field current reference for the external unit **TPD500-FC**

Table 6-4: Connection diagram for managing the TPD500-FC

TPD500 (master)	
IPA 3500 An output 1 sel	IPA 3000 Digital input 1 dest
Wired FC ref	**Wired FC EN**
21	31
1	26
T current ref 1	**Wired FC EN**
IPA 3400 An input 1 sel	IPA 3200 Digital input 1 sel
TPD500-FC	

6 Ext wired FC curr: Field current adjustment performed by an external **TPD500-FC** unit via wired connection on standard I/O. In this mode, the field current reference is calculated in the same way as for **Current control** (constant flow).

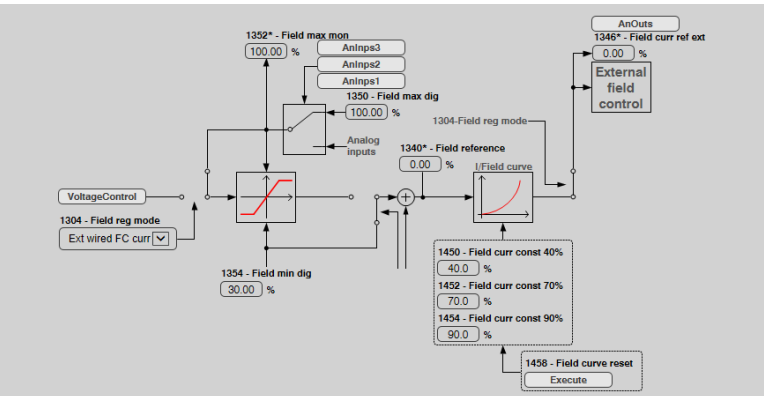


Figure 6-51: Voltage control when Field reg mode = External Wired FC Curr

The TPD500 drive (master) regulates the armature current and provides the field current reference to the TPD500-FC external unit. The internal PI field current regulator is disabled. To use this mode, connect a digital signal received from the external TPD500-FC unit and send an analogue signal to it, then configure the following parameters on the TPD500 drive (same wiring as for Ext wired FC volt):

- A digital input destination set as **Wired FC enable**, indicating the enable status of the **TPD500-FC/TPD32 EV-FC** external field controller
- A selection of analogue outputs set as **Wired FC ref**, indicating the field current reference for the **TPD500-FC/TPD32 EV-FC** external unit

Table 6-4: Connection diagram for managing the TPD500-FC

TPD500 (master)	
IPA 3500 An output 1 sel	IPA 3000 Digital input 1 dest
Wired FC ref	**Wired FC EN**
21	31
1	26
T current ref 1	**Wired FC EN**
IPA 3400 An input 1 sel	IPA 3200 Digital input 1 sel
TPD500-FC	

1310 Field weak

Field weakening enable command. When set to *ON*, the field reference takes the value **Field min dig**, while when set to *OFF*, the field current is supplied according to the selection of the **Field reg mode** parameter and the operating point of the drive.

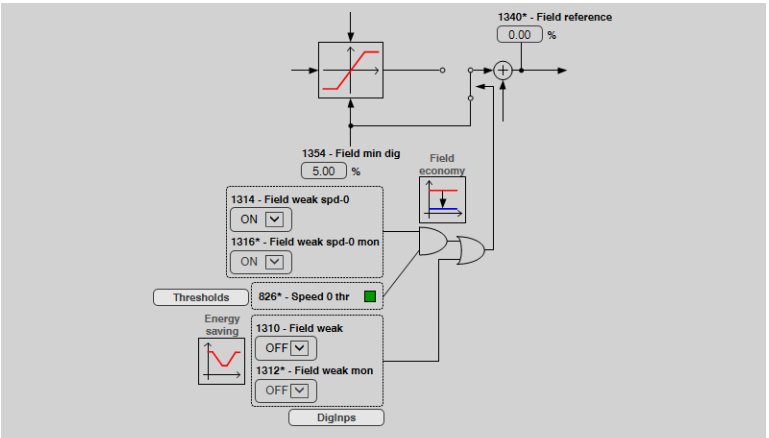


Figure 6-52: Field weakening control diagram

1312 Field weak mon

Monitor for field weakening enable command, which can also be assigned by programmable digital inputs or fieldbus

1314 Field weak spd-0

Command to enable field weakening at zero speed. When set to *ON*, the field reference takes on the value **Field min dig** when the zero speed signal **Speed 0 thr** takes on a high logic value and the converter is disabled. This function is useful to prevent overheating of motors that must remain stationary or to prevent condensation from forming in motors operating outdoors

1316 Field weak spd-0 mon

Monitor for field weakening command at zero speed, which can also be assigned by programmable digital inputs or fieldbus

6.15.2 Field current regulator limits

The field current limits, which act on the input of the field regulator IPA 1340-**Field reference**, are managed using the following parameters in the **FIELD CONTROL\FIELD REG LIMIT** menu.

IPA		DESCRIPTION
1350	**Field max dig**	Maximum flow reference, expressed as a percentage of the motor's nominal value, i.e. that obtained at the nominal field current. The maximum value of 100% therefore corresponds to the circulation of a current equal to the field rated current in the motor's field circuit. If no I/F flow-current curve is defined using parameters IPA 1450-**Field curr const 40%**, IPA 1452-**Field curr const 70%** and IPA 1454-**Field curr const 90%**, the variation of the parameter has a linear effect on the circulating field current
1352	**Field max mon**	Maximum flow monitor, expressed as a percentage of the nominal motor flow, which can also be assigned by analogue inputs or fieldbus
1354	**Field min dig**	Minimum flow, expressed as a percentage of the nominal motor current, i.e. that obtained at the **Field rated current**. Its value determines the circulation of a minimum current in the motor field circuit. The field loss alarm threshold corresponds to 50% of the **Field min dig value**

Field current limits are active for all selections of parameter IPA 1304-**Field reg mode**.
In cases where **Field reg mode = Current control** or **Ext wired FC const**, the field current regulator uses **Field max mon** as its input reference, thus achieving constant flux regulation (see Figure 6-53).

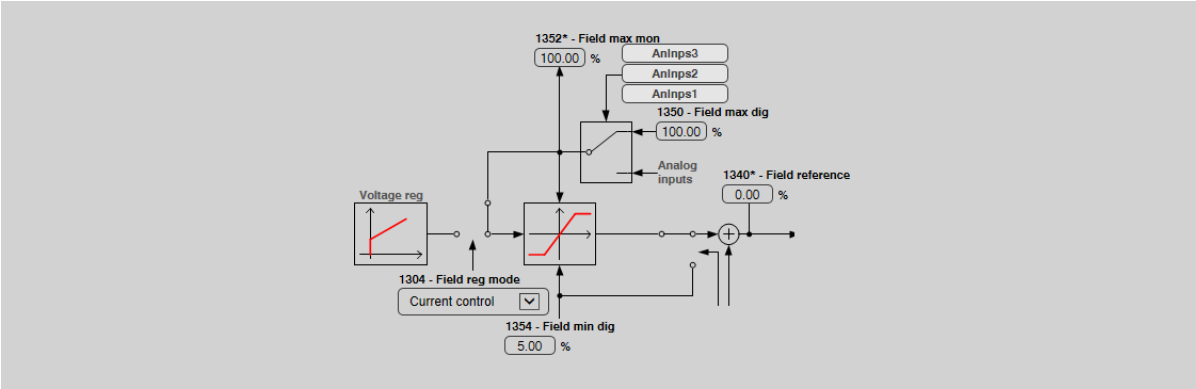


Figure 6-53: Operating diagram for Field Reg Limit = Current Control

In cases where **Field reg mode = Voltage control**, **External control**, or **Ext wired FC**, the output of the armature voltage regulator is limited between the values **Field min dig** and **Field max mon** (see Figure 6-54)

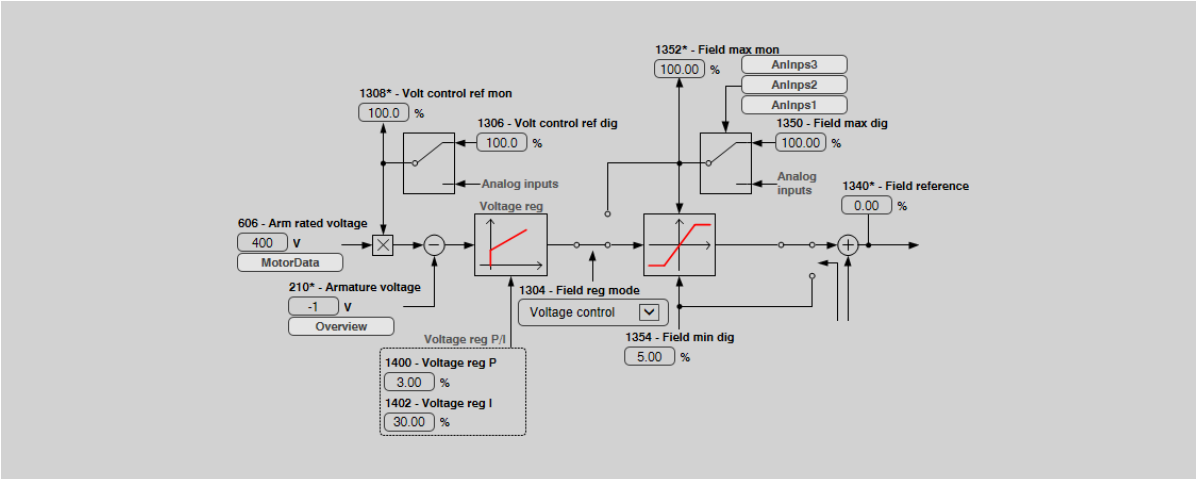


Figure 6-54: Operating diagram when Field Reg Limit = Voltage Control

6.15.3 Field current regulator calibration

The gains of the field current regulators are set using the following parameters in the **FIELD CONTROL\FIELD REG TUNE** menu.

IPA		DESCRIPTION
1320	**Field curr reg P**	Proportional gain Kp of the field current controller, expressed in [%] relative to the base gain IPA 1324-**Field curr P base**
1322	**Field curr reg I**	Integral Ki gain of the field current regulator, expressed in [%] relative to the base gain IPA 1326-**Field curr I base**
1324	**Field curr P base**	Proportional coefficient Kp base of the field current regulator
1326	**Field curr I base**	Integral coefficient Ki base of the field current regulator
1450	**Field curr const 40%**	Field current that results in a flow equal to 40% of the nominal flow
1452	**Field curr const 70%**	Field current that results in a flow equal to 70% of the nominal flow
1454	**Field curr const 90%**	Field current that results in a flow equal to 90% of the nominal flow
1458	**Field curve reset**	Command to restore the set flow curve by modifying parameters IPA 1450-**Field curr const 40%**, IPA 1452-**Field curr const 70%** and IPA 1454-**Field curr const 90%**

The proportional and integral gains of the PI field current regulators are divided into a base value and a percentage of that value, according to the following formulas:

$$\mathbf{K_P} = K_{P\%} \times K_{Pbase} / 100$$

$$\mathbf{K_I} = K_{I\%} \times K_{Ibase} / 100$$

The relationship between motor flux and field current can be described by a **flux–current curve**.
This curve is useful when manual or automatic field weakening is applied by setting parameter IPA 1304-**Field reg mode** to **Voltage control**, as it allows for optimized field regulation and accurate motor speed estimation.
The converter estimates the curve based on the values defined at 40%, 70%, and 90% of the flux, which can be set using the following parameters:

- IPA 1450-**Field curr const 40%**
- IPA 1452-**Field curr const 70%**
- IPA 1454-**Field curr const 90%**

The curve can be restored to default conditions by executing the command associated with parameter IPA 1458-**Field curve reset**.

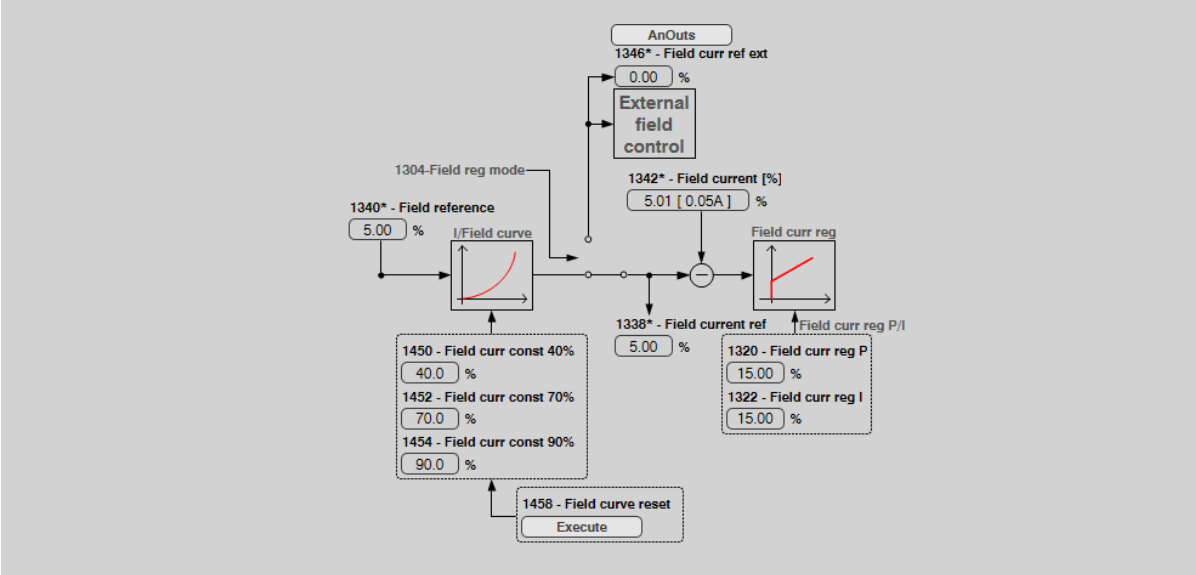


Figure 6-55: General diagram for managing flux references

6.16 Armature voltage control

The **VOLTAGE CONTROL** menu provides parameters for configuring the motor armature voltage control, which is based on a PI-type regulator.

6.16.1 Armature voltage regulator

TPD500 series drives can perform field weakening based on the motor armature circuit voltage.
This operating mode allows the motor to exceed its rated speed through a field weakening process managed automatically by the drive via a PI-type armature voltage regulator.

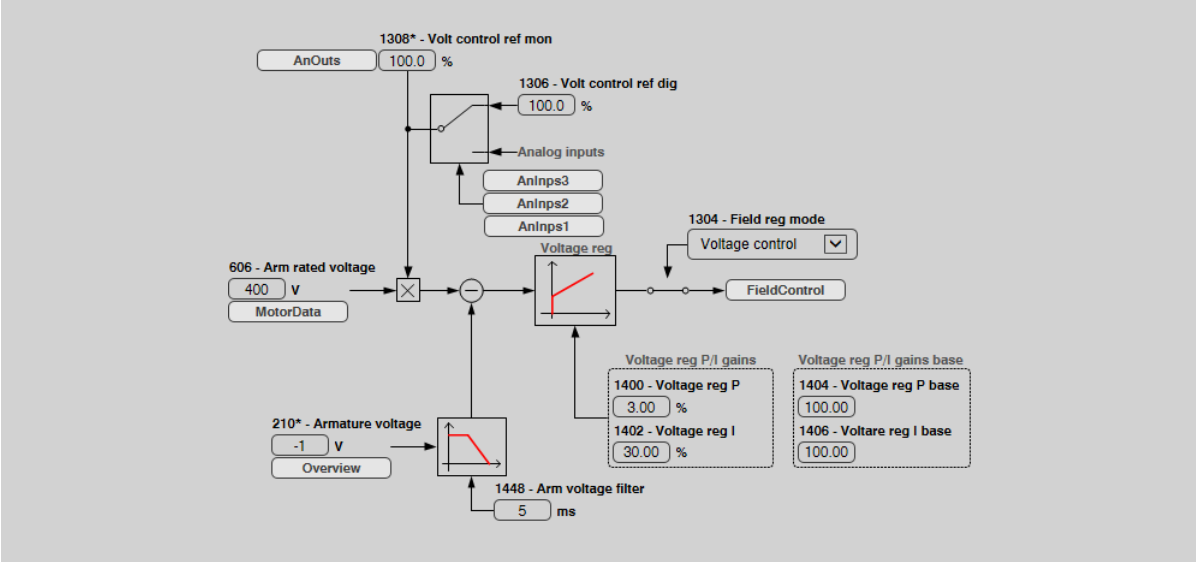


Figure 6-56: Voltage control management diagram (Voltage Control diagram)

The armature voltage regulator is configured using the following parameters in the **VOLTAGE CONTROL\VOLT REG** menu.

IPA		DESCRIPTION
1306	**Volt control ref dig**	Armature voltage reference, expressed as a percentage of the motor's rated armature voltage. Arm rated voltage is used when IPA 1304-**Field reg mode = Voltage control**, **External control** or **Ext wired FC**. The converter provides a PI-type armature voltage regulator that modifies the flux reference at the input to the field regulator to ensure that the armature voltage is equal to **Volt control ref mon * Arm rated voltage**. The output of this regulator is limited between IPA 1354-**Field min dig** and IPA 1352-**Field max mon**.
1308	**Volt control ref mon**	Armature voltage reference monitor, which can also be assigned from programmable analogue inputs or fieldbus
1448	**Arm voltage filter**	Time constant of the low-pass filter applied to the voltage used by the armature voltage regulator, downstream of the **Armature voltage** parameter

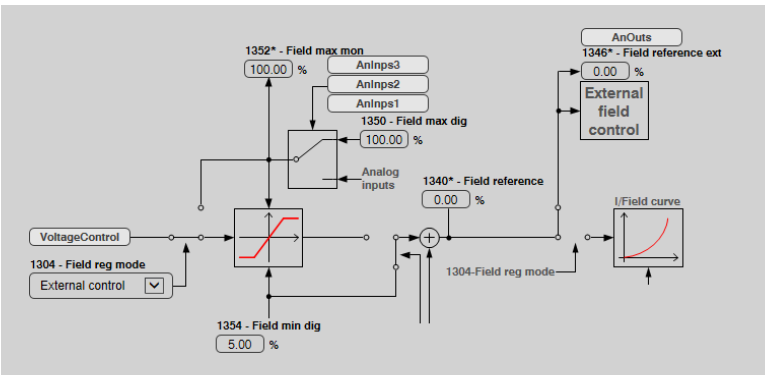


Figure 6-57: Voltage control reference diagram

6.16.2 Armature voltage regulator tuning

I guadagni del regolatore di tensione di armatura (vedi paragrafo 6.16.1) vengono impostati tramite i seguenti parametri del menù **VOLTAGE CONTROL\VOLT REG TUNE**.

IPA		DESCRIPTION
1400	**Voltage reg P**	Proportional gain Kp of the armature voltage regulator, expressed as a percentage of the base gain IPA1404-**Voltage reg P base**
1402	**Voltage reg I**	Integral gain Ki of the armature voltage regulator, expressed as a percentage of the base gain IPA 1406-**Voltage reg I base**
1404	**Voltage reg P base**	Base proportional coefficient Kp of the armature voltage regulator
1406	**Voltage reg I base**	Base integral coefficient Ki of the armature voltage regulator

The proportional and integral gains of the PI armature voltage regulator are divided into a base value and a percentage of that value, according to the following formulas:

$$\mathbf{K_P} = K_{P\%} \times K_{Pbase} / 100$$

$$\mathbf{K_I} = K_{I\%} \times K_{Ibase} / 100$$

6.17 Analogue and digital interface (IOs)

6.17.1 Digital inputs

The **DIGITAL INPUTS** menu provides parameters for managing eight programmable digital inputs (1…8), used to control the activation of certain drive functions.
Four inputs are available as standard, while the remaining four are available through an optional board (**TBO-32**).

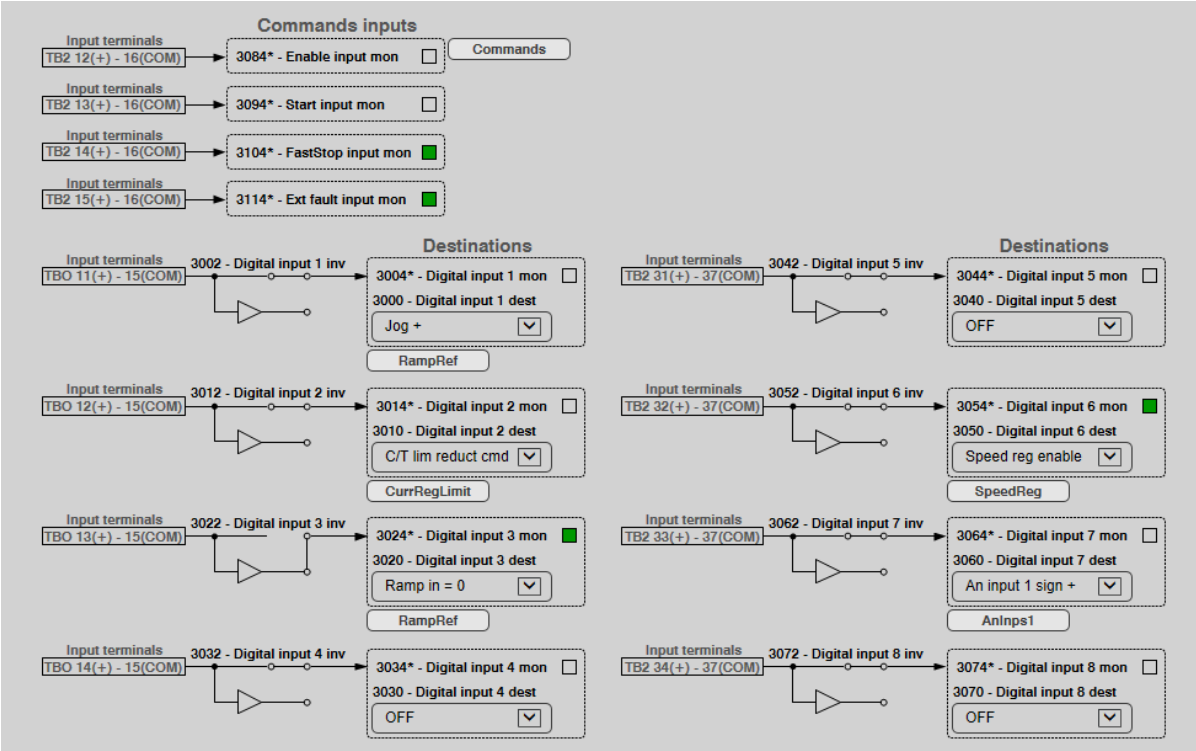


Figure 6-58: General diagram of digital input commands (Digital Inputs diagram)

IPA		DESCRIPTION
3000	**Digital input 1 dest**	Selection of the function to be controlled via **Digital input 1**
3010	**Digital input 2 dest**	Selection of the function to be controlled via **Digital input 2**
3020	**Digital input 3 dest**	Selection of the function to be controlled via **Digital input 3**
3030	**Digital input 4 dest**	Selection of the function to be controlled via **Digital input 4**

3040	**Digital input 5 dest**	Selection of the function to be controlled via **Digital input 5**
3050	**Digital input 6 dest**	Selection of the function to be controlled via **Digital input 6**
3060	**Digital input 7 dest**	Selection of the function to be controlled via **Digital input 7**
3070	**Digital input 8 dest**	Selection of the function to be controlled via **Digital input 8**
3002	**Digital input 1 inv**	Enabling signal polarity reversal **Digital input 1**
3012	**Digital input 2 inv**	Enabling signal polarity reversal **Digital input 2**
3022	**Digital input 3 inv**	Enabling signal polarity reversal **Digital input 3**
3032	**Digital input 4 inv**	Enabling signal polarity reversal **Digital input 4**
3042	**Digital input 5 inv**	Enabling signal polarity reversal **Digital input 5**
3052	**Digital input 6 inv**	Enabling signal polarity reversal **Digital input 6**
3062	**Digital input 7 inv**	Enabling signal polarity reversal **Digital input 7**
3072	**Digital input 8 inv**	Enabling signal polarity reversal **Digital input 8**
3004	**Digital input 1 mon**	Monitor (0/1) of the status of signal **Digital input 1**
3014	**Digital input 2 mon**	Monitor (0/1) of the status of signal **Digital input 2**
3024	**Digital input 3 mon**	Monitor (0/1) of the status of signal **Digital input 3**
3034	**Digital input 4 mon**	Monitor (0/1) of the status of signal **Digital input 4**
3044	**Digital input 5 mon**	Monitor (0/1) of the status of signal **Digital input 5**
3054	**Digital input 6 mon**	Monitor (0/1) of the status of signal **Digital input 6**
3064	**Digital input 7 mon**	Monitor (0/1) of the status of signal **Digital input 7**
3074	**Digital input 8 mon**	Monitor (0/1) of the status of signal **Digital input 8**

For each digital input (1…8), the following functions (destinations) can be selected:

0 **OFF**: destination disabled, the input does not control any function
1 **Motorpot preset**: motor potentiometer preset command
2 **Motorpot up**: motor potentiometer increase command
3 **Motorpot down**: motor potentiometer decrease command
4 **Motorpot invert**: motor potentiometer inversion command
5 **Jog +**: positive jog command
6 **Jog -**: negative jog command
7 **Alarm reset**: alarm reset command (effective if the alarm has cleared)
8 **C/T lim reduct cmd**: torque limit reduction command
10 **Ramp out = 0**: ramp output reset command
11 **Ramp in = 0**: ramp input reset command
12 **Ramp freeze**: ramp hold command
13 **Speed reg lock**: disconnects speed regulator output from current regulator
14 **Speed reg lock I**: locks the integral part of the speed regulator
15 **Speed autocapture**: enables flying speed capture
16 **An input 1 sign +**: select positive sign for analog input 1
17 **An input 1 sign –**: select negative sign for analog input 1
18 **An input 2 sign +**: select positive sign for analog input 2
19 **An input 2 sign –**: select negative sign for analog input 2
20 **An input 3 sign +**: select positive sign for analog input 3
21 **An input 3 sign –**: select negative sign for analog input 3
22 **Zero torque**: : torque zeroing command
23 **Multi speed sel 0**: bit 0 for multi-speed selection (1 to 7)
24 **Multi speed sel 1**: bit 1 for multi-speed selection (1 to 7)
25 **Multi speed sel 2**: bit 2 for multi-speed selection (1 to 7)
26 **Multi ramp sel 0**: bit 0 for multi-ramp selection (1 to 4)
27 **Multi ramp sel 1**: bit 1 for multi-ramp selection (1 to 4)
28 **Field loss ext**: external field loss alarm signal
29 **Speed reg enable**: speed PI regulator enable command
30 **Field reg enable**: field current regulator enable command
31 **Field weak**: field weakening enable command
32 **Field weak spd-0**: field weakening enable command at zero speed
33 **PAD A bit 0**: force bit 0 of Bitword PAD A (state 0/1)
34 **PAD A bit 1**: force bit 1 of Bitword PAD A (state 0/1)
35 **PAD A bit 2**: force bit 2 of Bitword PAD A (state 0/1)
36 **PAD A bit 3**: force bit 3 of Bitword PAD A (state 0/1)
37 **PAD A bit 4**: force bit 4 of Bitword PAD A (state 0/1)
38 **PAD A bit 5**: force bit 5 of Bitword PAD A (state 0/1)
39 **PAD A bit 6**: force bit 6 of Bitword PAD A (state 0/1)
40 **PAD A bit 7**: force bit 7 of Bitword PAD A (state 0/1)

41 PAD A bit 8: force bit 8 of Bitword PAD A (state 0/1)
42 PAD A bit 9: force bit 9 of Bitword PAD A (state 0/1)
43 PAD A bit 10: force bit 10 of Bitword PAD A (state 0/1)
44 PAD A bit 11: force bit 11 of Bitword PAD A (state 0/1)
45 PAD A bit 12: force bit 12 of Bitword PAD A (state 0/1)
46 PAD A bit 13: force bit 13 of Bitword PAD A (state 0/1)
47 PAD A bit 14: force bit 14 of Bitword PAD A (state 0/1)
48 PAD A bit 15: force bit 15 of Bitword PAD A (state 0/1)
68 Forward: forward direction command
69 Reverse: reverse direction command
70 An input 1 enable: enable command for analog input 1
71 An input 2 enable: enable command for analog input 2
72 An input 3 enable: enable command for analog input 3
73 Droop enable: droop function enable command
74 Enable digital: enable command in **Digital** mode
75 Start digital: start command in **Digital** mode
76 FastStop digital: fast stop command in **Digital** mode
84 Brake fbk: mechanical brake feedback
86 Adapt sel 1: bit 0 for adaptive speed set selection
87 Adapt sel 2: bit 1 for adaptive speed set selection
88 Wired FC enable: enable command for field control via FC unit with standard I/Os
89 Wired FC inv seq: indicates field control performed during inversion sequence
90 Wired FC active brg: indicates currently active bridge (positive or negative) of the FC unit

NOTE! The selections **Multi speed sel 0**, **Multi speed sel 1** and **Multi speed sel 2** must be used together.

NOTE! The selections **Multi ramp sel 0** and **Multi ramp sel 1** must be used together.

NOTE!

For some of the selections available in the digital input destination lists, a corresponding ON/OFF user parameter also exists. In such cases, the general rule follows the example below:

- IPA 2018-**Ramp in = 0** is the ramp input reset command, located in the **RAMPS** menu
- IPA 2020-**Ramp in = 0 mon** is the actual status of the command, also in the **RAMPS** menu
- IPA 3000-**Digital input 1 dest** set to **Ramp in = 0**

In this case, the **Ramp in = 0** parameter becomes ineffective and the actual function status, monitored by **Ramp in = 0 mon**, is controlled by **digital input 1**.

Therefore, digital inputs take precedence over the corresponding assignable user command parameters.

6.17.2 Digital outputs

In the **DIGITAL OUTPUTS** menu, parameters are available for managing eight programmable digital outputs (1…8) used to signal the status of certain drive functions.
Four outputs are available as standard, while the remaining four are available through the optional **TBO-32** board.
Additionally, two programmable relay outputs, R1 and R2, are available on the FIR board, connected to terminals 35–36 and 75–76, respectively.

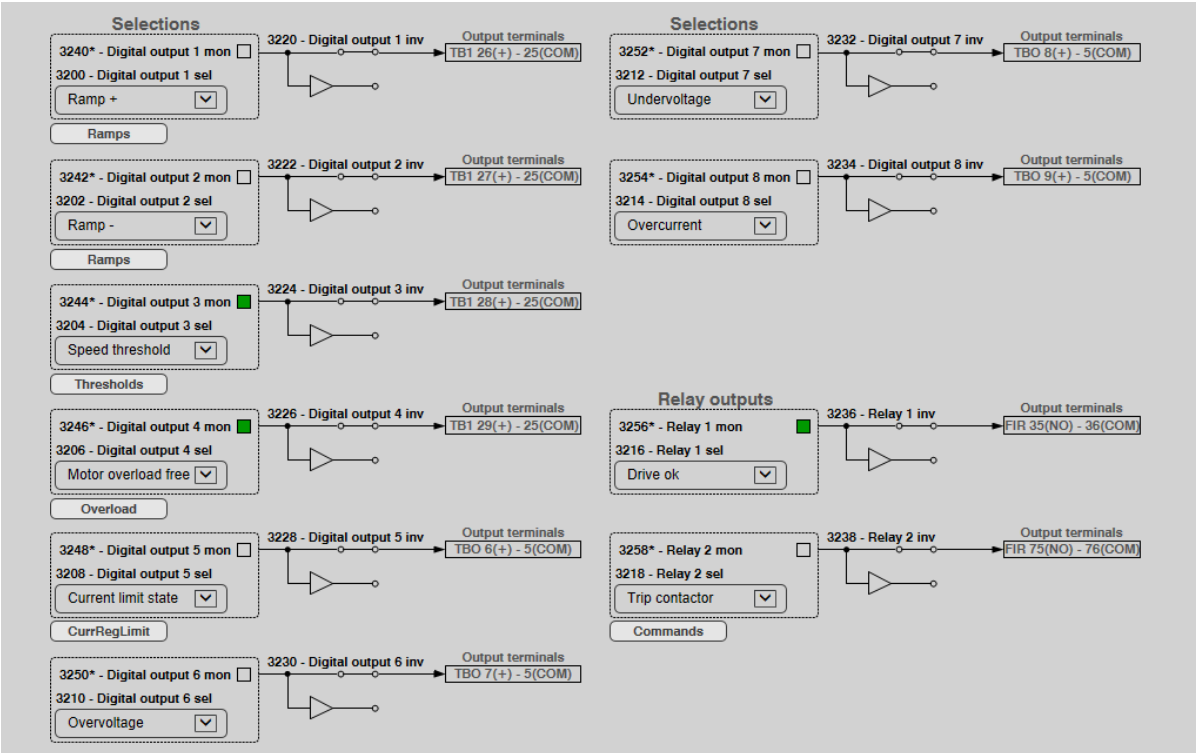


Figure 6-59: General diagram of digital output signals (Digital Outputs diagram)

IPA		DESCRIPTION
3200	**Digital output 1 sel**	Selecting the function to be assigned to **Digital output 1**
3202	**Digital output 2 sel**	Selecting the function to be assigned to **Digital output 2**
3204	**Digital output 3 sel**	Selecting the function to be assigned to **Digital output 3**
3206	**Digital output 4 sel**	Selecting the function to be assigned to **Digital output 4**
3208	**Digital output 5 sel**	Selecting the function to be assigned to **Digital output 5**
3210	**Digital output 6 sel**	Selecting the function to be assigned to **Digital output 6**
3212	**Digital output 7 sel**	Selecting the function to be assigned to **Digital output 7**
3214	**Digital output 8 sel**	Selecting the function to be assigned to **Digital output 8**
3216	**Relay 1 sel**	Selecting the function to assign to **Relay 1**
3218	**Relay 2 sel**	Selecting the function to assign to **Relay 2**
3220	**Digital output 1 inv**	Enabling signal inversion **Digital output 1**
3222	**Digital output 2 inv**	Enabling signal inversion **Digital output 2**
3224	**Digital output 3 inv**	Enabling signal inversion **Digital output 3**
3226	**Digital output 4 inv**	Enabling signal inversion **Digital output 4**
3228	**Digital output 5 inv**	Enabling signal inversion **Digital output 5**
3230	**Digital output 6 inv**	Enabling signal inversion **Digital output 6**
3232	**Digital output 7 inv**	Enabling signal inversion **Digital output 7**
3234	**Digital output 8 inv**	Enabling signal inversion **Digital output 8**
3236	**Relay 1 inv**	Enabling signal reversal **Relay 1**
3238	**Relay 2 inv**	Enabling signal reversal **Relay 2**
3240	**Digital output 1 mon**	Monitor (0/1) of the status of signal **Digital output 1**
3242	**Digital output 2 mon**	Monitor (0/1) of the status of signal **Digital output 2**
3244	**Digital output 3 mon**	Monitor (0/1) of the status of signal **Digital output 3**

3246	**Digital output 4 mon**	Monitor (0/1) of the status of signal **Digital output 4**
3248	**Digital output 5 mon**	Monitor (0/1) of the status of signal **Digital output 5**
3250	**Digital output 6 mon**	Monitor (0/1) of the status of signal **Digital output 6**
3252	**Digital output 7 mon**	Monitor (0/1) of the status of signal **Digital output 7**
3254	**Digital output 8 mon**	Monitor (0/1) of the status of signal **Digital output 8**
3256	**Relay 1 mon**	Monitor (0/1) of the status of signal **Relay 1**
3258	**Relay 2 mon**	Monitor (0/1) of the status of signal **Relay 2**

For each digital output (1…8), the following functions (destinations) can be selected:

0 **OFF**: output set to 0 (logic low)
100 **ON**: output set to 1 (logic high)
1 **Speed 0 thr**: speed zero threshold signal
2 **Speed threshold**: speed within programmed thresholds
3 **Speed set**: speed reached (with programmable tolerance band)
4 **Current limit state**: drive at current limit
5 **Drive ready**: drive in Ready state
6 **Motor overload free**: motor overload protection available
8 **Ramp +**: ramp increasing
9 **Ramp -**: ramp decreasing
10 **Speed limited**: speed limitation active
11 **Undervoltage**: **Undervoltage** alarm active
12 **Overvoltage**: **Overvoltage** alarm active
13 **Heatsink**: **Heatsink** alarm active
14 **Overcurrent**: **Overcurrent** alarm active
15 **Motor overtemp**: **Motor overtemperature** alarm active
16 **External fault**: **External fault alarm** active
17 **Failure supply**: Power supply **failure alarm** active
18 **Pad A bit**: status of **Bitword Pad A** bit n–1 on digital output n
19 **Pad B bit**: status of **Bitword Pad B** bit n–1 on digital output n
20 **Control word bit**: status of **Control word mon** bit n–1 on digital output n
21 **Torque sign**: output torque sign indication
23 **Trip contactor**: contactor disabled after delayed stop
24 **Field loss**: **Field loss alarm** active
25 **Speed fbk loss**: **Speed feedback loss** alarm active
26 **Bus loss**: **Bus loss** alarm active
30 **Enc 1 state ok**: **Encoder 1** status OK
31 **Enc 2 state ok**: **Encoder 2** status OK
35 **Enable seq err**: **Enable sequence error** alarm active
42 **Drive ok**: drive running with no alarms
49 **An inp 1 cmp match**: analog input 1 comparator match reached
50 **Enable state mon**: drive enable status
51 **Start state mon**: drive start status
52 **FastStop state mon**: fast stop status
60 **Acceleration state**: ramp in acceleration phase
61 **Deceleration state**: ramp in deceleration phase
62 **Brake cmd mon**: mechanical brake open command
63 **Brake fault**: **Brake fault** alarm active
65 **Motor I2t alert**: motor overload alert at 80%
66 **Drive I2t alert**: drive overload alert at 80%
67 **Drive overload free**: drive overload protection available
68 **Motor I2t overload**: **Motor overload** alarm active
69 **Drive I2t overload**: **Drive overload** alarm active
70 **Arm curr threshold**: armature current threshold exceeded
71 **Overspeed**: **Overspeed** alarm active
72 **Delta freq err**: **Delta frequency error** alarm active
76 **Drv ready to start**: drive ready to start
77 **Remote control**: **Remote control** mode active
80 **Firing**: armature circuit firing active
81 **Cont current**: continuous conduction mode active
82 **Sustained curr**: **Sustained current** alarm active

NOTE! Digital outputs associated with alarm states are meaningful even if the corresponding alarm is ignored.
For example, if IPA 5070-**EF activity = Ignore**, it is still possible to monitor the alarm status by assigning IPA 3200-**Digital output 1 sel** to **External fault**.

NOTE! Digital outputs associated with alarm states are active low.

NOTE!

The **Drv ready to start** signal is at logic high if and only if the following conditions are met:

- Power supply is present
- No active alarms
- Three-phase mains synchronization achieved

6.17.3 Analog inputs

The **ANALOG INPUTS** menu provides parameters for managing three programmable analog inputs (1…3), used to set certain control parameters of the drive.
Each of the three inputs is managed through a dedicated submenu: **ANALOG INPUT 1**, **ANALOG INPUT 2**, and **ANALOG INPUT 3**.

6.17.3.1 Analog input 1

The **ANALOG INPUT 1** menu provides parameters for managing analog input 1, which is programmable and connected to terminals **1–2** of the **R-TPD500** control board, to set certain drive control parameters.

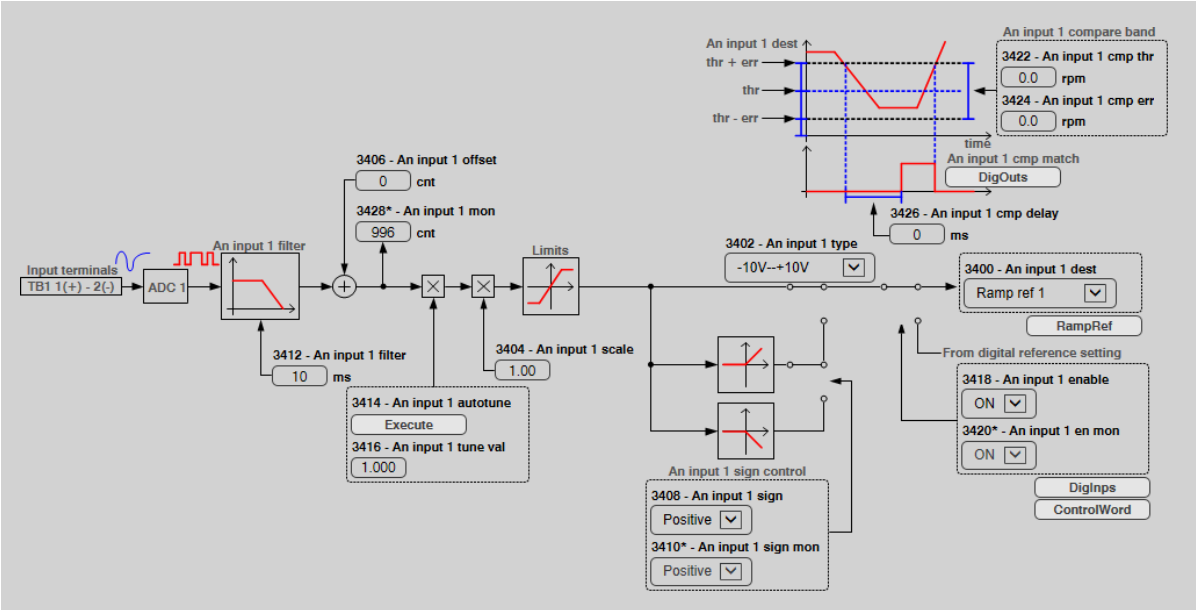


Figure 6-60: General diagram of analog input 1 management (Analog Input 1 diagram)

IPA		DESCRIPTION
3400	**An input 1 dest**	Select the parameter whose value is to be received from analogue input 1. The following selections are available: **0 OFF**: destination disabled, the input does not control any parameters **1 Jog ref**: Jog reference **2 Speed ref 1**: speed reference 1 **3 Speed ref 2**: speed reference 2 **4 Ramp ref 1**: ramp reference 1 **5 Ramp ref 2**: ramp reference 2 **6 C/T ref 1**: current/torque reference 1 **7 C/T ref 2**: current/torque reference 2 **8 Adaptive ref**: speed reference for adaptive gains **10 C/T lim pos**: positive current/torque limit **11 C/T lim neg**: negative current/torque limit **12 Pad 0**: Pad 0 **13 Pad 1**: Pad 1 **14 Pad 2**: Pad 2 **15 Pad 3**: Pad 3 **16 Pad 4**: Pad 4 **17 Pad 5**: Pad 5 **18 Pad 6**: Pad 6 **19 Pad 7**: Pad 7 **24 Load comp**: input for the **Droop** function **25 Field max**: maximum current field value **26 Volt control ref**: voltage reference in **Voltage control** mode **27 Brake pretorque**: pre-torque level for mechanical brake release **28 Speed draw ratio**: speed ratio level in action at the ramp exit

3402	**An input 1 type**	Selection of input type (voltage or current). Depending on the input signal used, jumpers must be positioned on the **R-TPD500** board. In the standard delivery condition, the inputs are coded for voltage signals, see **Table 4-5: Jumpers and Dip-Switches on the control board**. The following selections are available: **Selection -10V±10V**: A maximum voltage of ±10V is connected to analogue input 1. If the signal is used as a reference, the direction of rotation can be reversed by reversing the polarity of the voltage (4B converters only). 2B converters only accept positive speed references; negative references are ignored and the drive remains stationary **Selection 0...20 mA, 0...10V**: A maximum voltage of 10V or a current signal of 0...20 mA is connected to analogue input 1. If the signal is used as a reference, the direction of rotation can be reversed using parameter IPA 3408-An input 1 sign (4B converters only) or the An input 1 sign+/An input 1 sign- selections of the digital inputs **Selection 4...20 mA**: A 4...20 mA current signal is connected to analogue input 1. The signal must be positive. If the signal is used as a reference, the direction of rotation can be reversed using parameter IPA 3408-An input 1 sign (4B converters only) or the An input 1 sign+/An input 1 sign- selections of the digital inputs
3404	**An input 1 scale**	Analogue input scale factor 1
3416	**An input 1 tune val**	It acts in cascade at **An input 1 scale** for fine adjustment of analogue input 1 when the maximum signal does not correspond exactly to the nominal value. With **An input 1 scale = 1** and **An input 1 tune val = 1**, 10 V or 20 mA at the input correspond to the following full scale values, depending on the selected destination: **0 OFF**: destination disabled **1 Jog ref**: IPA 400-**Full scale speed (see paragraph 6.7)** **2 Speed ref 1**: IPA 400-**Full scale speed** **3 Speed ref 2**: IPA 400-**Full scale speed** **4 Ramp ref 1**: IPA 400-**Full scale speed** **5 Ramp ref 2**: IPA 400-**Full scale speed** **6 C/T ref 1**: maximum permissible armature current (150% with overload) **7 C/T ref 2**: maximum permissible armature current (150% with overload) **8 Adaptive ref**: IPA 400-**Full scale speed** **10 C/T lim pos**: maximum permissible armature current (150% with overload) **11 C/T lim neg**: maximum permissible armature current (150% with overload) **12 Pad 0**: 32767.0 count **13 Pad 1**: 32767.0 count **14 Pad 2**: 32767.0 count **15 Pad 3**: 32767.0 count **16 Pad 4**: 32767.0 count **17 Pad 5**: 32767.0 count **18 Pad 6**: 32767.0 count **19 Pad 7**: 32767.0 count **24 Load comp**: maximum permissible armature current (150% with overload) **25 Field max**: IPA 608-**Field rated current** (100%) **26 Volt control ref**: IPA 608-**Field rated current** (100%) **27 Brake pretorque**: maximum permissible armature current (150% with overload) **28 Speed draw ratio**: 2.0000
3414	**An input 1 autotune**	Command to perform automatic fine tuning of analogue input 1. In this case, **An input 1 tune val** is calculated automatically so that the available input signal corresponds to the maximum value of the associated variable, for example IPA 400-**Full scale speed**. To perform automatic tuning, two conditions must be met: • Input voltage greater than 1 V or input current greater than 2 mA • Positive polarity
3406	**An input 1 offset**	Allows you to compensate for a small offset on the analogue signal
3408	**An input 1 sign**	Sign reversal command in the case of unipolar input signal (0...20mA, 0...10V, 4...20mA)
3410	**An input 1 sign mon**	Sign reversal command monitor, which can also be assigned by digital inputs

3412	**An input 1 filter**	Time constant of the low-pass filter applied to the measurement of analogue input signal 1
3418	**An input 1 enable**	Analogue input 1 enable command. If set to *OFF*, the target variable set via **An input 1 dest** is not assigned via analogue input but only from the respective user value, as in the following example: **An input 1 dest = Ramp ref 1** **An input 1 enable = OFF** **Ramp ref 1 dig** = 1000.0 rpm (user value) **Ramp ref 1 mon** = 1000.0 rpm regardless of the voltage level of analogue input 1
3420	**An input 1 mon**	Monitor for the enable command of analogue input 1, which can also be assigned from digital inputs
3428	**An input 1 en mon**	Monitor in count of analogue input signal 1, after A/D conversion, filtering and offset application

Only **analog input 1** supports the comparison function, which signals when the input reaches a programmable threshold using the following parameters:

- IPA 3422-**An input 1 cmp thr**: sets the comparison threshold, in the same unit as the variable assigned to **An input 1 dest**
- IPA 3424-**An input 1 cmp error**: sets a tolerance band around **An input 1 cmp thr**, also in the same unit as the assigned variable
- **An inp 1 cmp match**: available in the digital output selection list (see section 6.17.2), indicates when the input reaches the comparison threshold (match)
- IPA 3426-**An input 1 cmp delay**: delay in milliseconds before signaling that the threshold has been reached (match)

To use the comparison function, refer to the following example.

To signal when **Ramp ref 1** reaches **700 rpm** through a digital output, with a tolerance band of **100 rpm**, configure the following:

IPA 3200-**Digital output 1 sel = An imp 1 cmp match**
IPA 3400-**An input 1 dest = Ramp ref 1**
IPA 3422-**An input 1 cmp thr** = 700 rpm
IPA 3424-**An input 1 cmp error** = 100 rpm
IPA 3426-**An input a cmp delay** = 1000 ms

The digital output **An inp 1 cmp match** switches from 0 to 1 with a 1-second delay after **Ramp ref 1 mon** reaches **600 rpm**, and returns to 0 as soon as **Ramp ref 1 mon** exceeds **800 rpm** (see Figure 6-60).

For all selections available in the analog input destination lists, a corresponding numerical user parameter also exists. In such cases, the general rule follows the example below:

IPA 1800-**Ramp ref 1 dig** is the ramp reference 1 (user-set value), found in the **REFERENCES\RAMP REF** menu

IPA 1804-**Ramp ref 1 mon** is the monitor for ramp reference 1 (normally follows **Ramp ref 1 dig**)

IPA 3400-**An input 1 dest** is set to **OFF** or any value other than **Ramp ref 1**. In this case, **Ramp ref 1 mon** follows **Ramp ref 1 dig**, as shown by the selector in the diagram below.

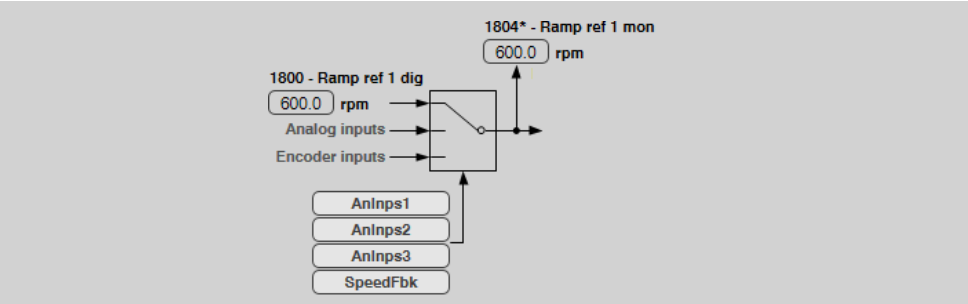


Figure 6-61: Logic diagram when An input 1 dest ≠Ramp Ref 1

NOTE!

If instead **An input 1 dest** is set to **Ramp ref 1**, the parameter **Ramp ref 1 dig** becomes ineffective (while retaining its value) and the actual reference value, monitored by **Ramp ref 1 mon**, is determined by the voltage or current level of **analog input 1**, as shown by the selector switch in the diagram below.

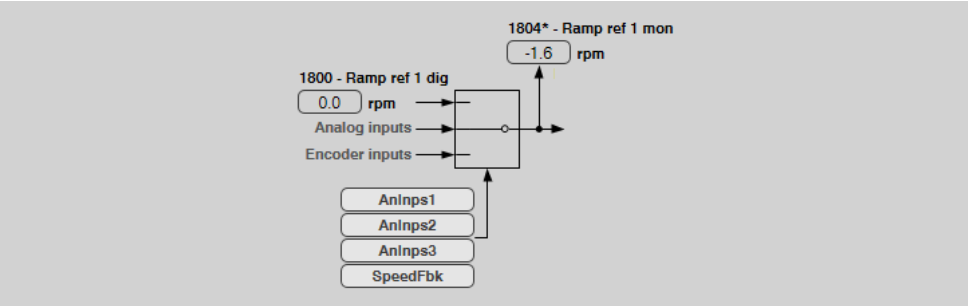


Figure 6-62: Logic diagram when An input 1 dest = Ramp Ref 1

The analog inputs therefore have a higher priority than the corresponding user parameters with assignable numerical values.

6.17.4 Analog outputs

The **ANALOG OUTPUTS** menu provides parameters for managing four programmable analog outputs (1…4), which can be used to transmit the status of selected analog monitor variables from the drive to external systems. Two outputs are available as standard, while the other two are available via the optional expansion board (TBO-32).

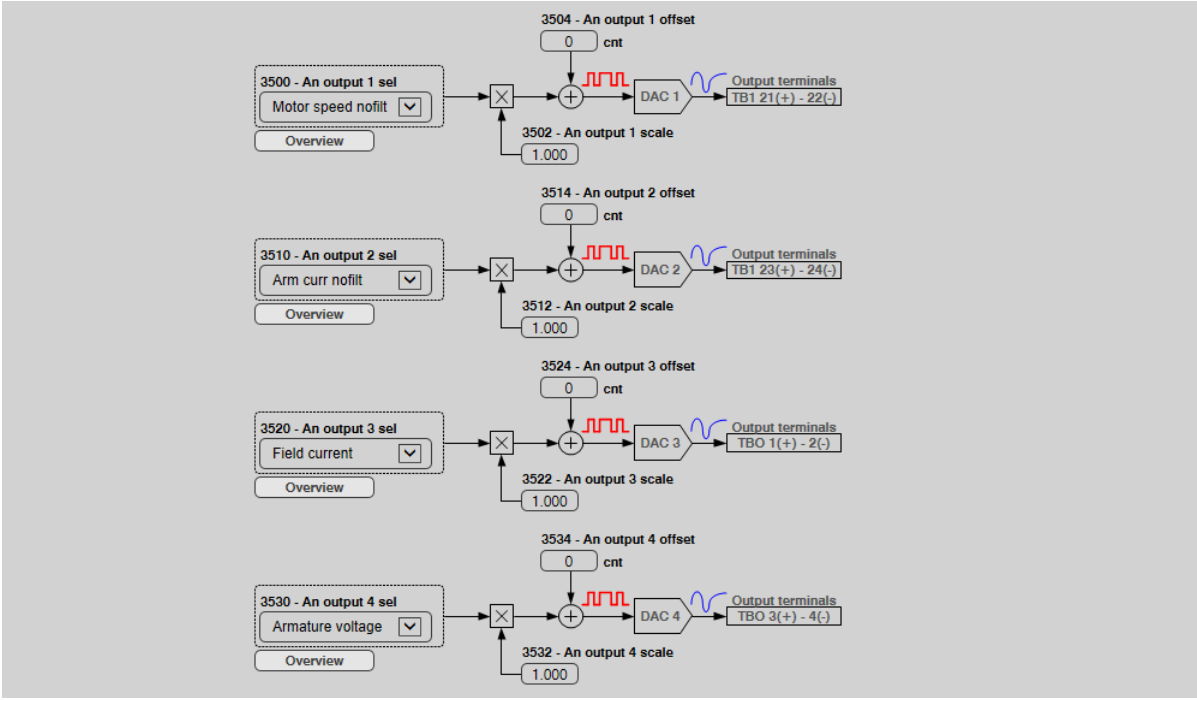


Figure 6-63: General operating diagram of the analog outputs (Analog Outputs diagram)

IPA		DESCRIPTION
3500	**An output 1 sel**	Selecting the variable to be assigned to **Analog output 1**
3510	**An output 2 sel**	Selecting the variable to be assigned to **Analog output 2**
3520	**An output 3 sel**	Selecting the variable to be assigned to **Analog output 3**
3530	**An output 4 sel**	Selecting the variable to be assigned to **Analog output 4**
3502	**An output 1 scale**	Analogue output scale factor 1
3512	**An output 2 scale**	Analogue output scale factor 2
3522	**An output 3 scale**	Analogue output scale factor 3
3532	**An output 4 scale**	Analogue output scale factor 4
3504	**An output 1 offset**	Analogue output 1 offset compensation
3514	**An output 2 offset**	Analogue output 2 offset compensation
3524	**An output 3 offset**	Analogue output 3 offset compensation
3534	**An output 4 offset**	Analogue output 4 offset compensation

Each analogue output 1…4 can be controlled by the following monitor variables:

0 **OFF**: output disabled, set to 0 V
1 **Speed ref 1 mon**: speed reference 1 monitor
2 **Speed ref 2 mon**: speed reference 2 monitor
3 **Ramp ref 1 mon**: ramp reference 1 monitor
4 **Ramp ref 2 mon**: ramp reference 2 monitor
5 **Ramp reference**: overall ramp reference
6 **Speed reference**: overall speed reference
7 **Ramp output**: ramp function output
8 **Motor speed nofilt**: unfiltered motor speed monitor
9 **C/T ref 1 mon**: current/torque reference 1 monitor
10 **C/T ref 2 mon**: current/torque reference 2 monitor
11 **Armature current ref**: armature current reference
15 **Speed reg output**: speed regulator output
16 **Arm curr nofilt**: unfiltered armature current monitor
20 **Armature voltage**: armature voltage monitor
24 **An input 1 mon**: analog input 1 monitor
25 **An input 2 mon**: analog input 2 monitor
26 **An input 3 mon**: analog input 3 monitor
27 **Field current**: field current monitor
31 **Pad 8**: value of parameter Pad 8
32 **Pad 9**: value of parameter Pad 9
33 **Pad 10**: value of parameter Pad 10
34 **Pad 11**: value of parameter Pad 11
35 **Pad 12**: value of parameter Pad 12
36 **Pad 13**: value of parameter Pad 13
37 **Pad 14**: value of parameter Pad 14
38 **Pad 15**: value of parameter Pad 15
70 **Field reference**: field reference monitor
79 **Volt control ref**: voltage reference in **Voltage Control** mode
80 **Field curr max mon**: maximum field current monitor
81 **Motor speed**: filtered motor speed monitor
82 **Armature current**: filtered armature current monitor
84 **Speed draw out**: **Speed Draw** function output monitor
88 **Output power**: output power monitor
95 **Wired FC ref**: field current reference for external FC converter
96 **Motorpot out**: Motopotentiometer function output speed

With **An output 1/2/3/4 scale = 1**, **10V** is generated when the selected monitor variable reaches the following full-scale values:

0 **OFF**: output disabled, set to 0 V
1 **Speed ref 1 mon**: IPA 400-**Full scale speed**
2 **Speed ref 2 mon**: IPA 400-**Full scale speed**
3 **Ramp ref 1 mon**: IPA 400-**Full scale speed**
4 **Ramp ref 2 mon**: IPA 400-**Full scale speed**
5 **Ramp reference**: IPA 400-**Full scale speed**
6 **Speed reference**: IPA 400-**Full scale speed**
7 **Ramp output**: IPA 400-**Full scale speed**
8 **Motor speed nofilt**: IPA 400-**Full scale speed**
9 **C/T ref 1 mon**: maximum admissible armature current (150% with overload)
10 **C/T ref 2 mon**: maximum admissible armature current (150% with overload)

11 **Armature current ref**: maximum admissible armature current (150% with overload)
15 **Speed reg output**: maximum admissible armature current (150% with overload)
16 **Arm curr nofilt**: maximum admissible armature current (150% with overload)
20 **Armature voltage**: IPA 606-**Arm rated voltage**
24 **An input 1 mon**: input voltage equal to 10 V on analog input 1
25 **An input 2 mon**: input voltage equal to 10 V on analog input 2
26 **An input 3 mon**: input voltage equal to 10 V on analog input 3
27 **Field current**: IPA 608-**Field rated current**
31 **Pad 8**: 32767.0
32 **Pad 9**: 32767.0
33 **Pad 10**: 32767.0
34 **Pad 11**: 32767.0
35 **Pad 12**: 32767.0
36 **Pad 13**: 32767.0
37 **Pad 14**: 32767.0
38 **Pad 15**: 32767.0
70 **Field reference**: IPA 608-**Field rated current**
79 **Volt control ref**: IPA 1308-**Volt control ref mon**
80 **Field curr max mon**: IPA 608-**Field rated current**
81 **Motor speed**: IPA 400-**Full scale speed**
82 **Armature current**: maximum admissible armature current (150% with overload)
84 **Speed draw out**: 2.0000
88 **Output power**: twice the rated output power (**Arm rated current** * **Arm rated voltage**)
95 **Wired FC ref**: IPA 608-**Field rated current**
96 **Motorpot out**: IPA 4010-**Motorpot top lim**

NOTE!

The analog output scaling factor can be used to adapt the 0–10 V signal—generated when the drive reaches its maximum speed—to an analog measuring instrument with a display range of 0–Vmax (where Vmax is less than 10 V). In this case, the scaling factor should be set to Vmax/10.

6.18 Additional functions

The **FUNCTIONS** menu provides several general-purpose auxiliary functions that allow customization or alternative control of some of the basic features already available in the drive (such as speed control and ramp function). These functions are normally disabled, but each one has a dedicated enable parameter.
Each function is managed through a dedicated menu and is described in detail below.

6.18.1 Motorpotentiometer

The **Motorpotentiometer** function acts on the ramp reference chain (see Figure 6-14) with the purpose of adjusting the drive speed by applying dedicated Up/Down commands. It features its own ramp times, which are independent from the main speed control ramp.

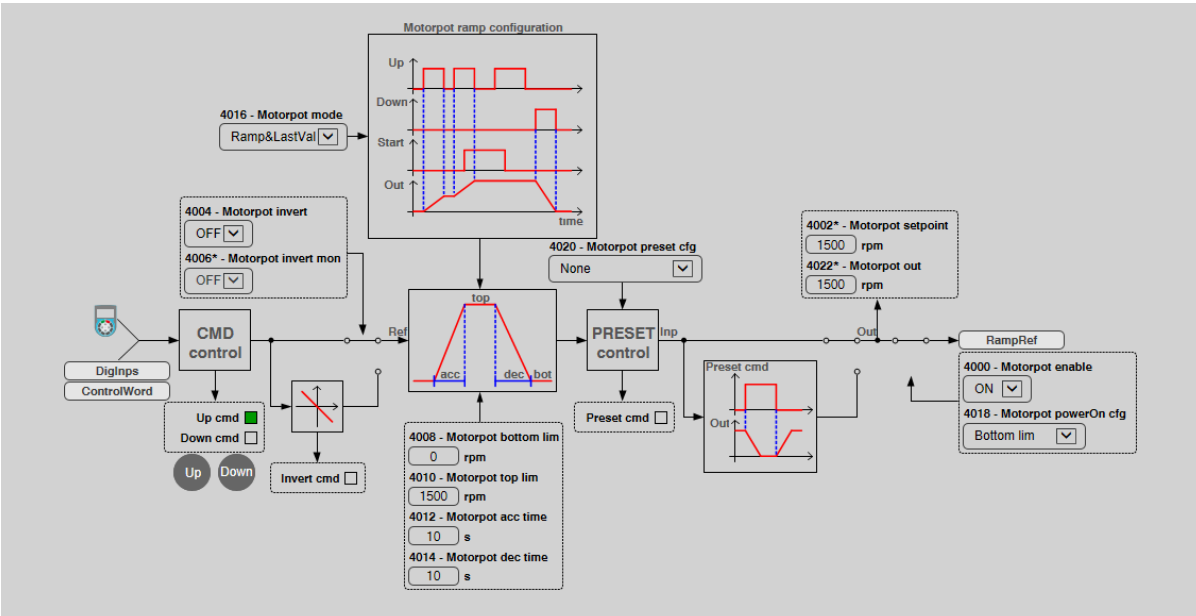


Figure 6-64: General functional diagram of the Motorpotentiometer function (Motorpot diagram)

The function is managed through the following parameters in the **FUNCTIONS\MOTORPOT** menu:

IPA		DESCRIPTION
4000	**Motorpot enable**	Enables the motor potentiometer function
4002	**Motorpot setpoint**	Motor potentiometer output speed, expressed in [rpm], which can be increased or decreased by applying the Up/Down commands
4004	**Motorpot invert**	Motor potentiometer output reversal command
4006	**Motorpot invert mon**	Output reversal command monitor, which can also be assigned by programmable digital inputs
4008	**Motorpot bottom lim**	Lower limit of the motor potentiometer output speed, expressed in [rpm]
4010	**Motorpot top lim**	Upper limit of the motor potentiometer output speed, expressed in [rpm]
4012	**Motorpot acc time**	Motor potentiometer ramp acceleration time, between the lower limit and the upper limit, expressed in [s]
4014	**Motorpot dec time**	Motor potentiometer ramp deceleration time, between the upper limit and the lower limit, expressed in [s]
4016	**Motorpot mode**	Setting of the motor potentiometer operating mode. Four selections are possible: **0 Ramp&LastVal**: by applying the **Up/Down** commands, the output is subject to the ramp set with the **Motorpot acc time** / **Motorpot dec time** parameters and, in the absence of commands, it maintains the value even when the **Start** command is removed.

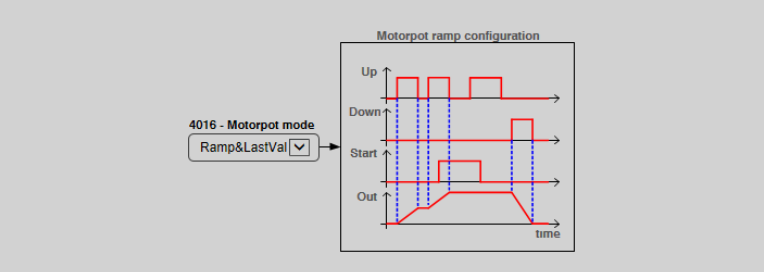


Figure 6-65: Logic diagram in the case of Motorpot mode = Ramp&LastVal selection

1 Ramp&Follow: by applying the **Up/Down** commands, the output is subjected to the ramp action set with the **Motorpot acc time** / **Motorpot dec time** parameters and, in the absence of commands, does not maintain the value when the **Start** command is removed.

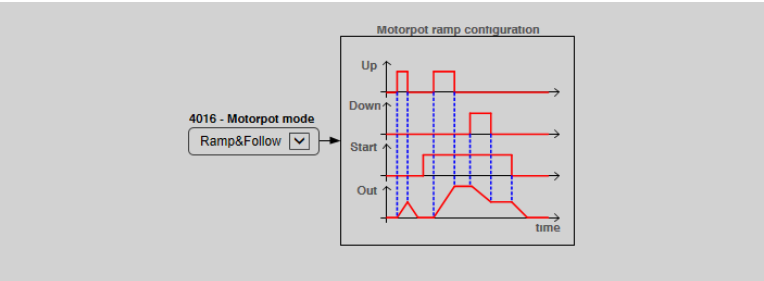


Figure 6-66: Logic diagram for Motorpot mode = Ramp&Follow selection

2 Fine&LastVal: by pressing the **Up/Down** commands once, the output varies by 1 rpm, while pressing and holding (for at least 1 second) activates the ramp set with the **Motorpot acc time** / **Motorpot dec time** parameters. In the absence of commands, it maintains the value even when the **Start** command is removed.

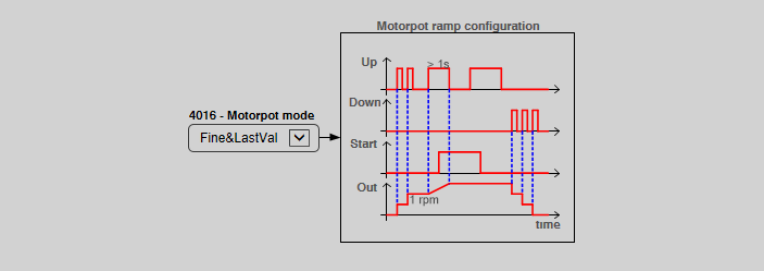


Figure 6-67: Logic diagram in the case of Motorpot mode = Fine&LastVal selection

3 Fine&Follow: by pressing the **Up/Down** commands once, the output varies by 1 rpm, while pressing and holding (for at least 1 second) causes the ramp set with the **Motorpot acc time** / **Motorpot dec time** parameters to be activated. If no commands are given, the value is not maintained when the **Start** command is removed.

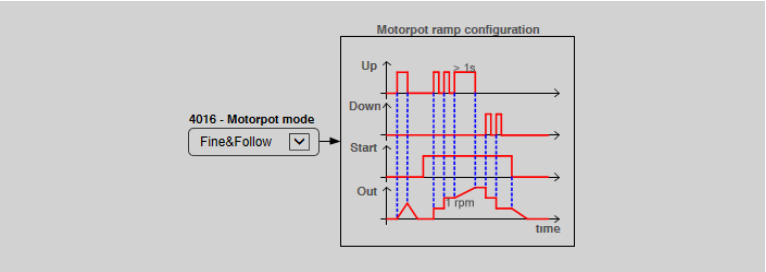


Figure 6-68: Logic diagram in the case of Motorpot mode = Fine&Follow selection

4018 Motorpot powerOn Cfg

Allows you to select the initial value of the motor potentiometer output when the drive is switched on. Four selections are possible:
0 Last power off: the output starts from the last reference set before shutdown
1 Zero: output starts from 0 rpm
2 Bottom lim: the output starts from **Motorpot bottom lim**
3 Top lim: the output starts from **Motorpot top lim**

4020 Motorpot preset cfg

Enables the preset command to act in various ways on the output speed of the motor potentiometer. Twelve selections are possible:
0 None: the preset command is disabled

1 Inp=0: The preset command sets the output to 0 with ramp, which returns to the previous value after the command is removed.

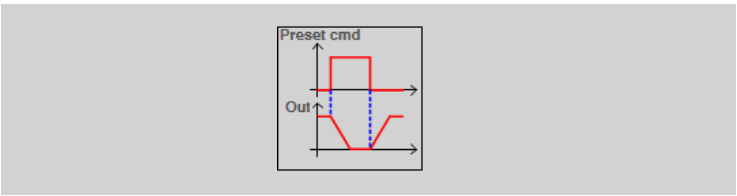


Figure 6-69: Logical diagram of Motorpot Preset operation cfg = Inp=0

2 Inp=bottom lim: The preset command sets the output to **Motorpot bottom lim** with ramp, which returns to the previous value after the command is removed

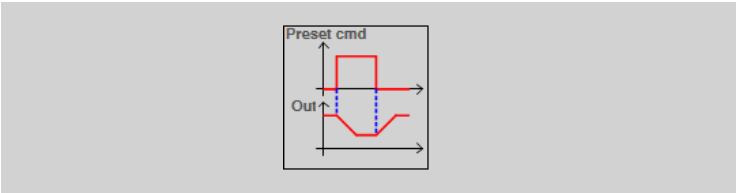


Figure 6-70: Logical diagram of Motorpot Preset operation cfg = Inp=bottom lim

3 Inp&ref=0: the preset command sets the output to 0 with ramp, which remains at 0 even after the command is removed.

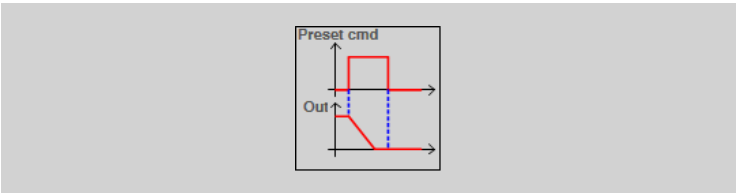


Figure 6-71: Logical diagram of Motorpot Preset operation cfg = Inp&ref=0

4 Inp&ref=bottom lim: the preset command sets the output to **Motorpot bottom lim** with ramp, which remains at **Motorpot bottom lim** even after the command is removed.

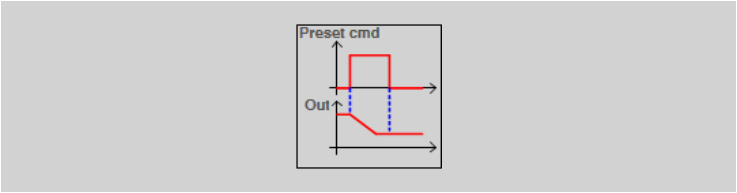


Figure 6-72: Logical diagram of Motorpot Preset operation cfg = Inp&ref=bottom lim

5 **Out=0**: the preset command sets the output to 0 without ramping, returning to the previous value immediately after the command is removed.

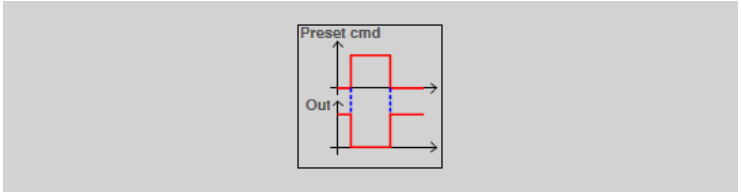


Figure 6-73: Logical diagram of Motorpot Preset operation cfg = Out=0

6 **Out=bottom lim**: the preset command sets the output to **Motorpot bottom lim** without ramp, which returns to the previous value immediately after the command is removed.

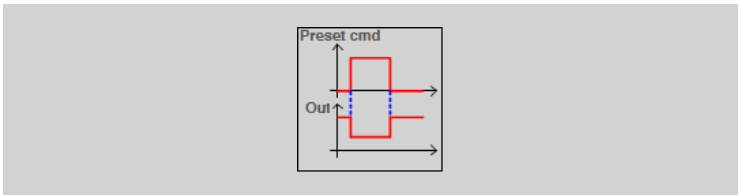


Figure 6-74: Logical diagram of Motorpot Preset operation cfg = Out=bottom lim

7 **Out&ref=0**: the preset command sets the output to 0 without ramping, and it remains at 0 even after the command is removed.

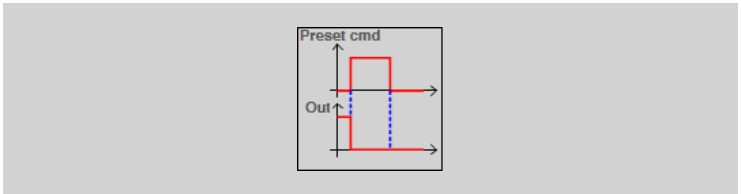


Figure 6-75: Logical diagram of Motorpot Preset operation cfg = Out&ref=0

8 **Out&ref=bottom lim**: the preset command sets the output to **Motorpot bottom lim** without ramp, which remains at **Motorpot bottom lim** even after the command is removed.

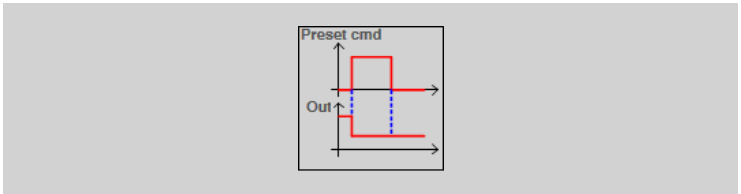


Figure 6-76: Logical diagram of Motorpot Preset operation cfg = Out&ref=bottom lim

9 **Inp=top lim:** the preset command sets the output to **Motorpot top lim** with ramp, which returns to the previous value after the command is removed.

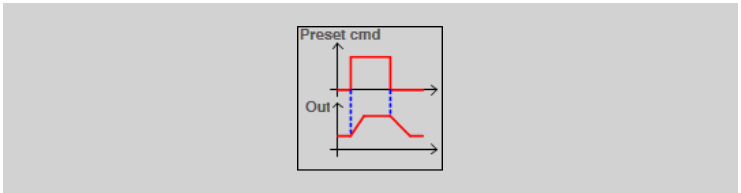


Figure 6-77: Logical diagram of Motorpot Preset operation cfg = Inp=top lim

10 **Inp&ref=top lim**: the preset command sets the output to **Motorpot top lim** with ramp, which remains at **Motorpot top lim** even after the command is removed.

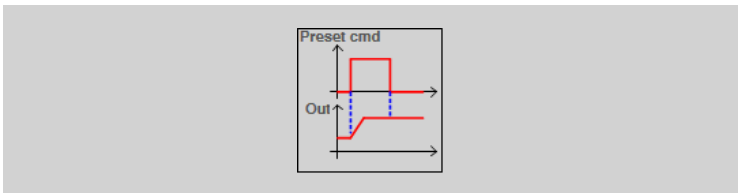


Figure 6-78: Logical diagram of Motorpot Preset operation cfg = Inp&ref=top lim

11 Inp freeze: the preset command causes the output to lock, which only returns to responding to the **Up/Down** commands when the command is removed.

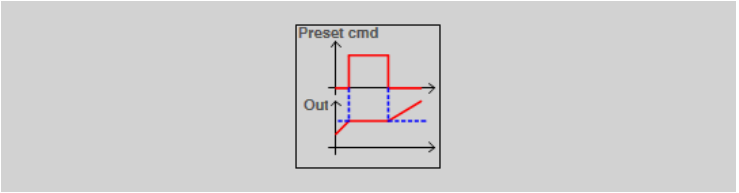


Figure 6-79: Logical diagram of Motorpot Preset operation cfg = Inp=freeze

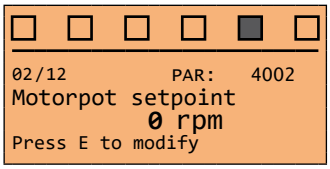
4022	**Motorpot out**	Monitor of the motor potentiometer output, at the input to the ramp reference chain after the **Multispeed** function and before the **FWD/REV** logic (see figure 6-14), expressed in [rpm]. This parameter can be assigned to the analogue outputs.

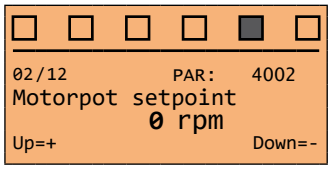
The Motorpotentiometer can be controlled in the following ways:

- Via **digital inputs**
  In the **DIGITAL INPUTS** menu, the digital inputs can be configured with the following selections:

  1. **Motorpot preset** assigns the preset command
  2. **Motorpot up** assigns the Up (+) command
  3. **Motorpot down** assigns the Down (–) command
  4. **Motorpot invert** assigns the output inversion command

- Via the **Up (+)** and **Down (-)** keys on the keypad
  Access parameter IPA 4002-**Motorpot setpoint** and press the E, Up, and Down keys as shown in the following figures to generate the Up (+) and Down (–) commands.





- Via dedicated Up and Down commands in the **MOTORPOT** diagram of the **WEG_DriveLabs** configurator, accessible from the **DIAGRAMS MENU\FUNCTIONS\MOTORPOT** node.

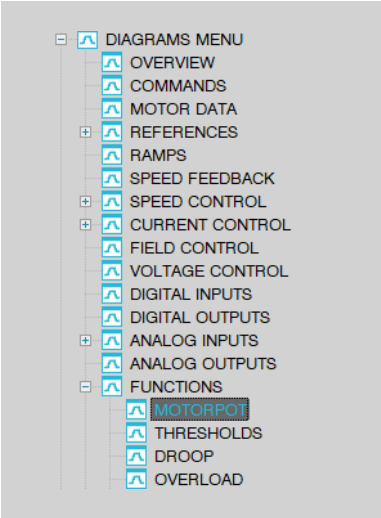


Figure 6-80: Positioning of the Motorpot menu in the diagram list

The **Up (+)** command increases the output of the Motorpotentiometer.
The **Down (–)** command decreases the output of the Motorpotentiometer.

NOTE!

Pressing the Up (+) and Down (–) keys on the keypad has no effect if the Motorpotentiometer is configured to be controlled by digital inputs, which have higher priority than the dedicated keys.

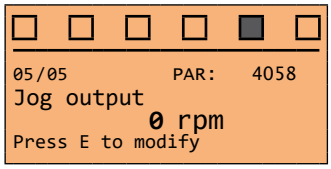
6.18.2 Jog

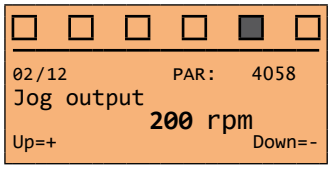
The Jog function allows pulse-controlled operation of the drive. It is managed through the following parameters in the **FUNCTIONS\JOG** menu:

IPA		DESCRIPTION
4050	**Jog enable**	Jog function enable command
4052	**Jog ref dig**	Jog function enable command
4054	**Jog ref mon**	Monitor of the ramp reference or speed of the Jog function, which can also be assigned via analogue inputs or fieldbus
4056	**Jog selection**	Allows you to select the mode of operation of the Jog function. Two selections are possible: **0 Speed ref**: the Jog acts on the speed reference **1 Ramp ref**: the Jog acts on the ramp reference
4058	**Jog output**	Monitor of the Jog function output expressed in [rpm]

Jog operation can be controlled in the following ways:

- Via digital inputs
  In the **DIGITAL INPUTS** menu, two digital inputs can be configured with the selections **Jog +** and **Jog –** to generate the Jog +/- commands.
- Via the **Up (+)** and **Down (–)** keys on the keypad
  Access parameter IPA 4058-**Jog output** and press the E, Up, and Down keys as shown in the following figures to generate the Jog +/– commands.





- Via dedicated **Jog+** and **Jog–** commands in the **RAMP REF** and **SPEED REF** diagrams of the **WEG_DriveLabs** configurator, accessible from the **DIAGRAMS MENU\REFERENCES\RAMP REF** and **DIAGRAMS MENU\ REFERENCES\SPEED REF** nodes

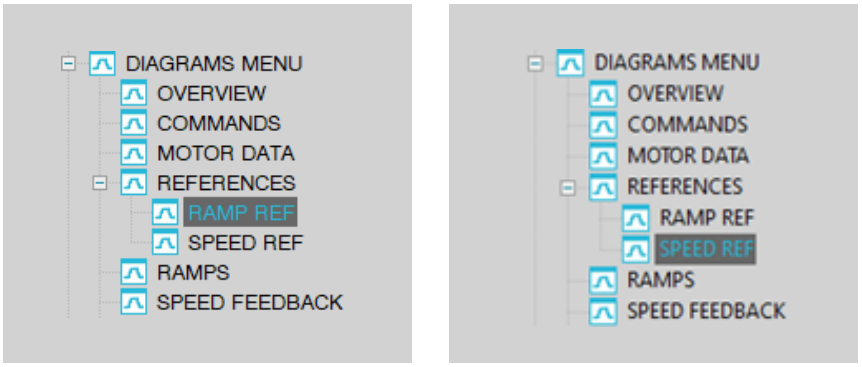


Figure 6-81: Positioning of the menus in the diagram list

The **Jog+** command corresponds to pulse-controlled motion in the clockwise direction.
The **Jog–** command corresponds to pulse-controlled motion in the counterclockwise direction, which is only possible with four-quadrant (4Q) drives.
If parameter IPA 4056-**Jog selection** is set to **Ramp ref**, the Jog output acts directly after the ramp reference chain, bypassing all previous contributions (**Ramp ref 1 mon**, **Ramp ref 2 mon**, **Multi speed**, **Motorpotentiometer** and **Test generator**) (see Figure 6-82). In this case, the Jog output acts directly on Ramp reference and is therefore subject to the ramp function.

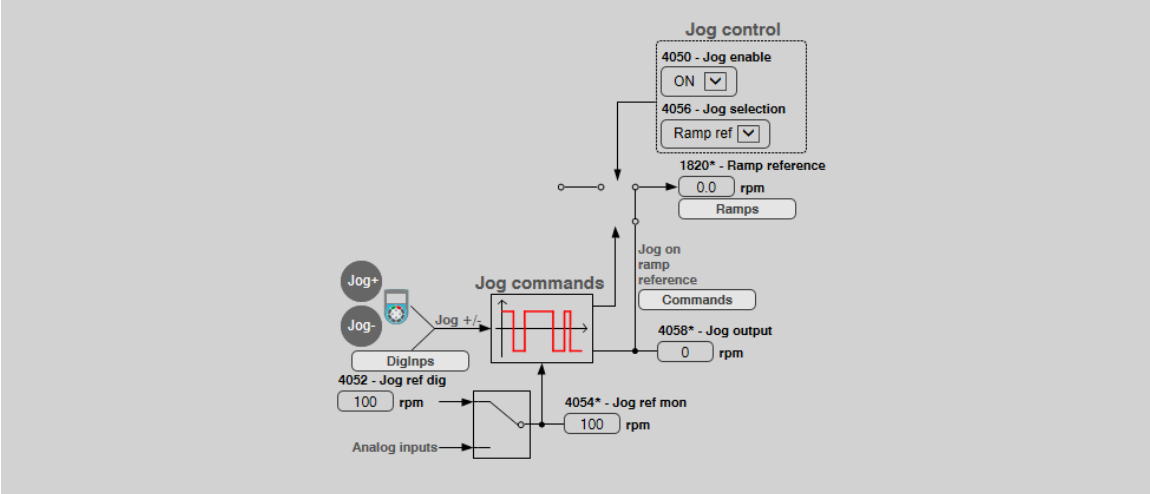


Figure 6-82: Jog reference management with Jog Selection = Ramp Ref

If parameter IPA 4056-**Jog selection** is set to **Speed ref**, the **Jog output** acts directly after the ramp function, bypassing all previous contributions (**Speed ref 1 mon** and **Speed draw out**) (see Figure 6-83). In this case, the **Jog output** is summed with the speed reference **Speed ref 2 mon** (see Figure 6-83) and acts on **Speed reference**.

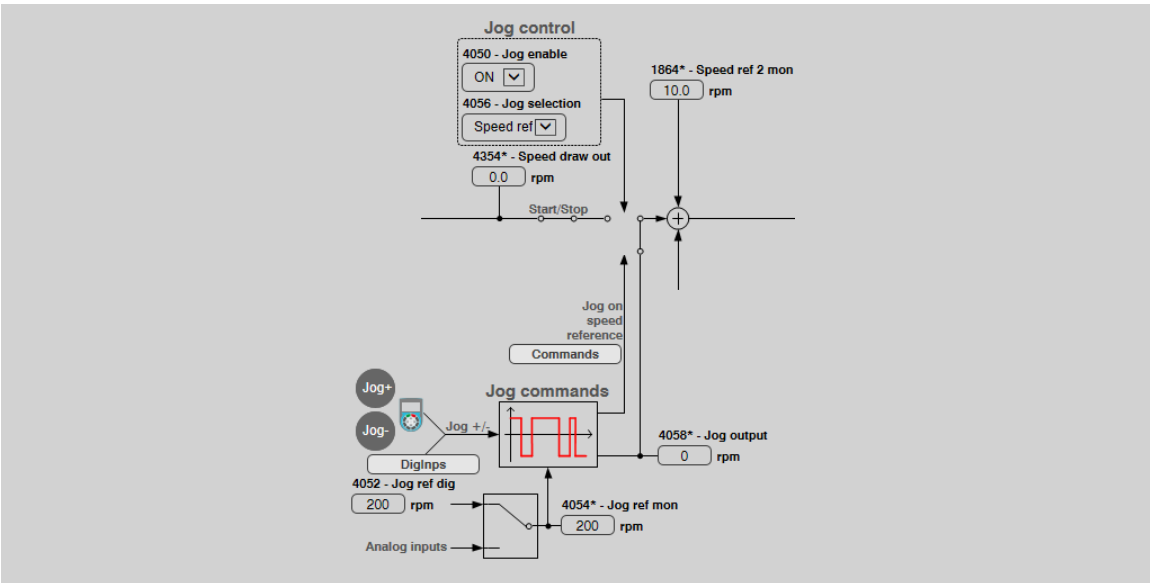


Figure 6-83: Jog reference management with Jog Selection = Speed Ref

In both **Speed ref** and **Ramp ref** operating modes, the **Jog reference** - activated by the Jog +/– commands in the various ways described - becomes effective only when the **Start** command is not active. If a **Start** command is issued while Jog +/– commands are present, pulse-controlled operation is disabled and the drive gives priority to the **Start** command.

NOTE!

If parameter IPA 504-**Stop mode** (**COMMANDS** menu, see section 6.8) is set to a value other than OFF, the **Jog function** can be used only if parameter IPA 510-**Jog stop control**, available in the same menu, is enabled (see Figure 6-84).

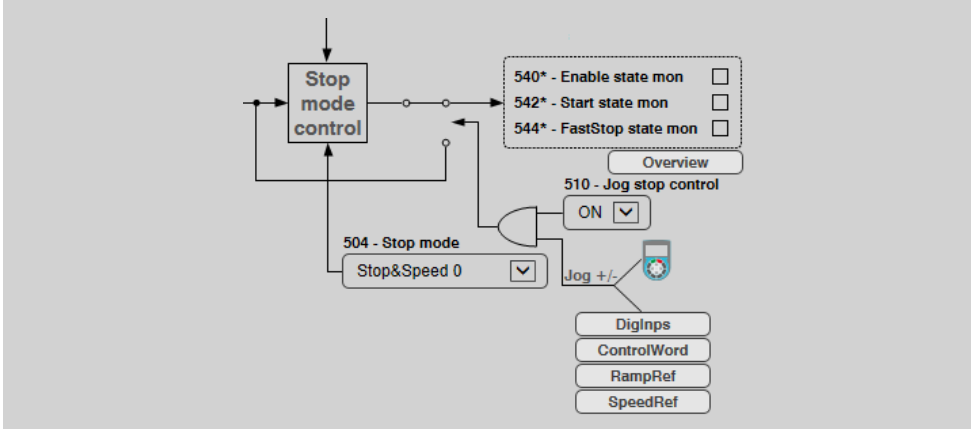


Figure 6-84: Jog Stop Control parameter action

NOTE! t is not possible to apply the **Jog +** and **Jog –** commands simultaneously; in such case, the Jog reference is reset to zero.

NOTE! Pressing the **Up (+)** and **Down (–)** keys on the keypad has no effect if the Jog function is configured to be controlled by digital inputs, which have higher priority than the dedicated keys.

6.18.3 Multi speed

The **Multi speed** function operates within the ramp reference chain (see Figure 6-14) and allows on-the-fly selection - also via digital inputs - of up to seven preconfigured ramp references (1…7).
The function is managed using the following parameters in the **FUNCTIONS\MULTI SPEED** menu:

IPA		DESCRIPTION
4150	**Multi speed enable**	Enables the Multi speed function
4152	**Multi speed 1**	Multi speed 1 can be used as a ramp reference, expressed in [rpm]
4154	**Multi speed 2**	Multi speed 2 can be used as a ramp reference, expressed in [rpm]
4056	**Multi speed 3**	Multi speed 3 can be used as a ramp reference, expressed in [rpm]
4058	**Multi speed 4**	Multi speed 4 can be used as a ramp reference, expressed in [rpm]
4160	**Multi speed 5**	Multi speed 5 can be used as a ramp reference, expressed in [rpm]
4162	**Multi speed 6**	Multi speed 6 can be used as a ramp reference, expressed in [rpm]
4064	**Multi speed 7**	Multi speed 7 can be used as a ramp reference, expressed in [rpm]
4066	**Multi speed 8**	Multi speed 8 can be used as a ramp reference, expressed in [rpm]
4166	**Multi speed sel**	Selector for the desired multi speed setting, ranging from 0 to 7
4168	**Multi speed sel mon**	Monitor for the desired multi speed selector, which can also be assigned via digital inputs or fieldbus

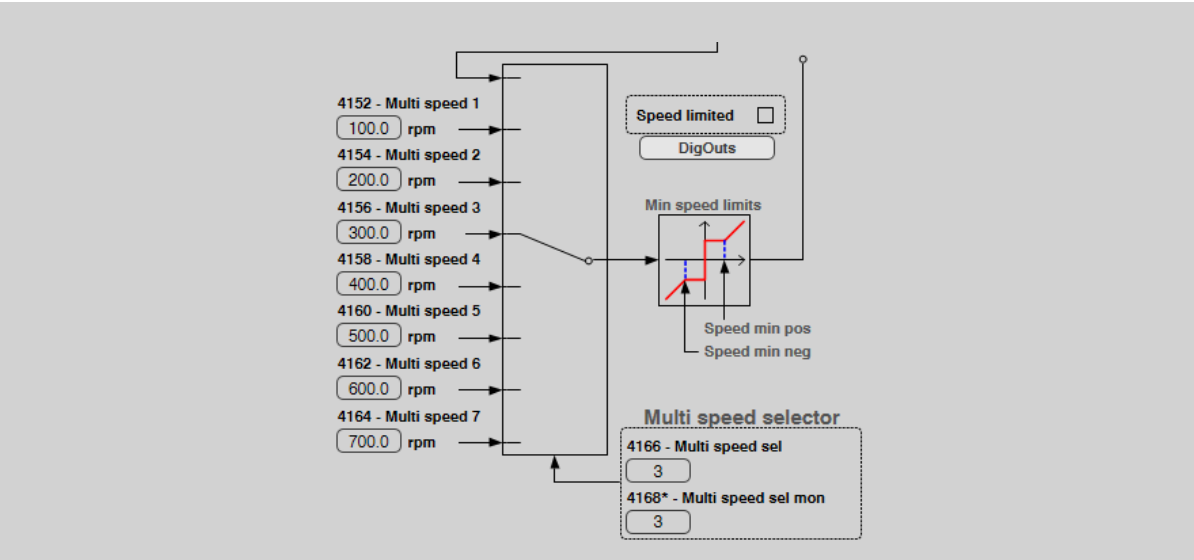


Figure 6-85: General diagram of Multi-Speed reference management

By enabling the **Multi speed** function via parameter IPA 4150-**Multi speed enable** set to *ON*, the ramp references **Ramp ref 1 mon** and **Ramp ref 2 mon** are excluded from the ramp reference chain. However, if the **Multi speed sel** selector is set to 0, it is still possible to use the sum **Ramp ref 1 mon** + **Ramp ref 2 mon** as the active reference instead of one of the predefined multi speed values 1…7.
The selected speed is processed by the **Min speed limits** limiter before being applied as the ramp reference, after the drive has received the enable and start commands.
The seven predefined speeds can also be negative. Therefore, in four-quadrant (4Q) drives, the direction of rotation can be determined via multi-speed selection. Two-quadrant (2Q) drives only accept positive reference values; negative multi speed values are interpreted as zero.
In the **DIGITAL INPUTS** menu, up to three digital inputs can be configured with the selections **Multi speed sel 0**, **Multi speed sel 1** and **Multi speed sel 2**, which generate the value of the Multi speed sel mon selector based on the state of the inputs, according to the following rule:

Multi speed sel mon value = (state of digital input set to **Multi speed sel 0**) x 1 +
(state of digital input set to **Multi speed sel 1**) x 2 +
(state of digital input set to **Multi speed sel 2**) x 4

Table 6-5: Multi speed sel mon encoding

Multi speed sel 2	Multi speed 1	Multi speed sel 0	Multi speed sel mon
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

The selection via digital inputs has higher priority than the corresponding user parameter **Multi speed sel**, which becomes. ineffective in this case.

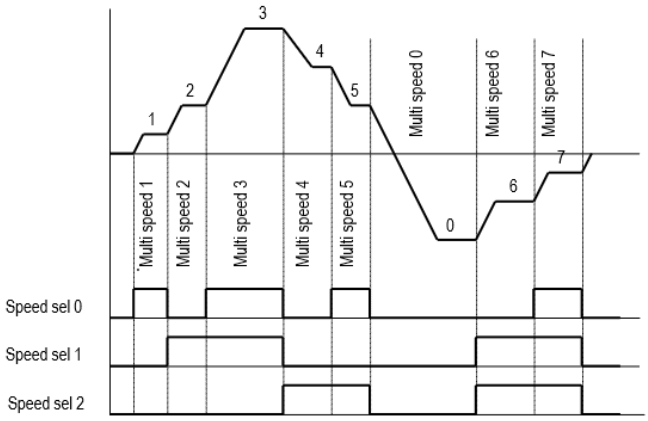


Figure 6-86: Operating logic using the Multi-speed selector

6.18.4 Multi Ramp

The **Multi ramp** function operates at the input of the ramp function (see Figure 6,21), allowing on-the-fly selection, also via digital inputs, of up to four predefined ramp sets (1…4).
Each set allows the configuration of both linear and S-curve ramps, for both acceleration and deceleration phases.
The function is managed using the following parameters in the **FUNCTIONS\MULTI RAMP** menu:

IPA		DESCRIPTION
4200	**Multi ramp enable**	Enables the Multi ramp function
4202	**Multi ramp sel**	Selector for the desired multiramp set, ranging from 1 to 4
4204	**Multi ramp sel mon**	Monitor for the desired multiramp set selector, which can also be assigned via digital inputs or fieldbus
4210	**Acc speed 1**	Acceleration speed of multiramp 1 expressed in [rpm]
4220	**Acc time 1**	Acceleration time of multiramp 1 expressed in [s]
4230	**Acc time jerk 1**	Multiramp 1 acceleration jerk time expressed in [ms]
4240	**Dec speed 1**	Multiramp 1 deceleration speed expressed in [rpm]
4250	**Dec time 1**	Multiramp 1 deceleration time expressed in [s]
4260	**Dec time jerk 1**	Multiramp 1 deceleration jerk time expressed in [ms]
4212	**Acc speed 2**	Multiramp 2 acceleration speed expressed in [rpm]
4222	**Acc time 2**	Multiramp 2 acceleration time expressed in [s]
4232	**Acc time jerk 2**	Multiramp 2 acceleration jerk time expressed in [ms]
4242	**Dec speed 2**	Deceleration speed of multiramp 2 expressed in [rpm]
4252	**Dec time 2**	Deceleration time of multiramp 2 expressed in [s]
4262	**Dec time jerk 2**	Jerk time in deceleration of multiramp 2 expressed in [ms]
4214	**Acc speed 3**	Acceleration speed of multiramp 3 expressed in [rpm]
4224	**Acc time 3**	Acceleration time of multiramp 3 expressed in [s]

4234	**Acc time jerk 3**	Multiramp 3 acceleration jerk time expressed in [ms]
4244	**Dec speed 3**	Multiramp 3 deceleration speed expressed in [rpm]
4254	**Dec time 3**	Multiramp 3 deceleration time expressed in [s]
4264	**Dec time jerk 3**	Multiramp 3 deceleration jerk time expressed in [ms]
4216	**Acc speed 4**	Multiramp 4 acceleration speed expressed in [rpm]
4226	**Acc time 4**	Multiramp 4 acceleration time expressed in [s]
4236	**Acc time jerk 4**	Multiramp 4 acceleration jerk time expressed in [ms]
4246	**Dec speed 4**	Multiramp 4 deceleration speed expressed in [rpm]
4256	**Dec time 4**	Multiramp 4 deceleration time expressed in [s]
4266	**Dec time jerk 4**	Multiramp 4 deceleration jerk time expressed in [ms]

By enabling the **Multi ramp** function via parameter IPA 4200-**Multi ramp enable** set to *ON*, the parameters from the standard ramp set (IPA 2002-**Acc speed**, IPA 2004-**Acc time**, IPA 2006-**Dec speed**, IPA 2008-**Dec time**, IPA 2014-**Acc time jerk**, and IPA 2016-**Dec time jerk**) are excluded from the generation of the linear and/or S-curve ramp.
Instead, the ramp follows the profile defined by the selected set. For example, if **Multi ramp sel = 2** and IPA 2010-**Ramp shape = Linear**, the drive performs a linear ramp using as reference the parameters **Acc speed 2** and **Acc time 2** during acceleration, and **Dec speed 2** and **Dec time 2** during deceleration (see Figure 6-87).

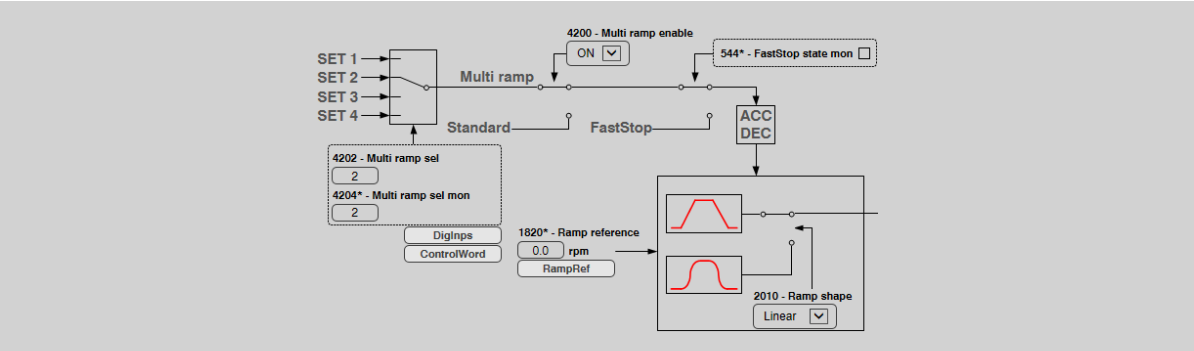


Figure 6-87: Multi-ramp selector management diagram

In the **DIGITAL INPUTS** menu (see paragraph 6.17.1), up to two digital inputs can be configured with the selections **Multi ramp sel 0** and **Multi ramp sel 1** to generate, based on the state of the inputs, the value of the **Multi ramp sel mon** selector, according to the following rule:

Multi ramp sel mon value = (state of digital input set to **Multi ramp sel 0**) x 1 +
(state of digital input set to **Multi ramp sel 1**) x 2

Table 6-6: Multi ramp sel mon encoding

Multi ramp sel 1	Multi ramp sel 0	Multi ramp sel mon
0	0	0
0	1	1
1	0	2
1	1	3

The selection via digital inputs has higher priority than the corresponding user parameter **Multi ramp sel**, which becomes ineffective in this case.

6.18.5 Threshold

The drive provides a set of motor speed and current signals, used by control functions and also available in the selection lists for digital outputs (see paragraph 6.17.2). For example, in the case of IPA 3200-**Digital output 1 sel**, it is possible to select:

1 Speed 0 thr
2 Speed threshold
3 Speed set
70 Arm curr threshold
…

The operation of these signals is defined by the following parameters in the **FUNCTIONS\THRESHOLDS** menu:

IPA		DESCRIPTION
812	**Speed 0 level**	Speed threshold for **Speed 0 thr** signal, expressed in [rpm]
814	**Speed 0 delay**	Time delay for **Speed 0 thr** signal, expressed in [ms]
816	**Speed thr pos**	Positive speed threshold for **Speed threshold** signal, expressed in [rpm]
818	**Speed thr neg**	Negative speed threshold for **Speed threshold** signal, expressed in [rpm]
820	**Speed thr delay**	Time delay for **Speed threshold** signal, expressed in [ms]
822	**Speed set error**	Speed threshold for **Speed set** signal, expressed in [rpm]
824	**Speed set delay**	Time delay for **Speed set** signal, expressed in [ms]
1012	**Arm curr thr**	Current threshold for **Arm curr threshold** signal, expressed as [%] of the motor's rated armature current
1018	**Arm curr thr delay**	Time delay for **Arm curr threshold** signal, expressed in [ms]

The **Speed 0 thr** signal (see Figure 6-88) switches to a high logic level with a time delay defined by parameter IPA 814-**Speed 0 delay**, after the motor speed (in absolute value), IPA 234-**Motor speed**, drops below the threshold set by parameter IPA 812-**Speed 0 level**. The signal returns to a low logic level as soon as the speed rises above the same threshold.

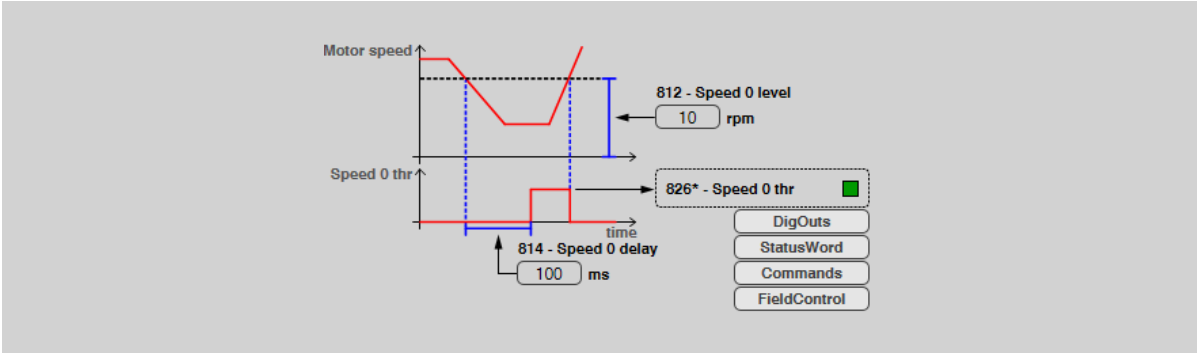


Figure 6-88: Logic diagram of the Speed 0 thr signal operation

The **Speed 0 thr** signal is used by the control software in the following cases:
- Management of the **n=0** LED on the keypad (see Table 5.1.1.2)
- Field weakening management at zero speed via IPA 1314-**Field weak spd-0** (see paragraph 6.15.1)
- Start/stop logic management via IPA 504-Stop mode and IPA 506-**Speed 0 trip delay** (see paragraph 6.8)
- Speed PI regulator gain management via IPA 928-**Speed=0 P enable** (see paragraph 6.13.3)

The **Speed threshold** signal (see Figure 6-89) switches to a high logic level with a time delay defined by parameter IPA 820-**Speed thr delay**, when the motor speed IPA 234-**Motor speed** falls within the range [**Speed thr neg**, **Speed thr pos**]. The signal returns to a low logic level as soon as the speed falls outside this range.

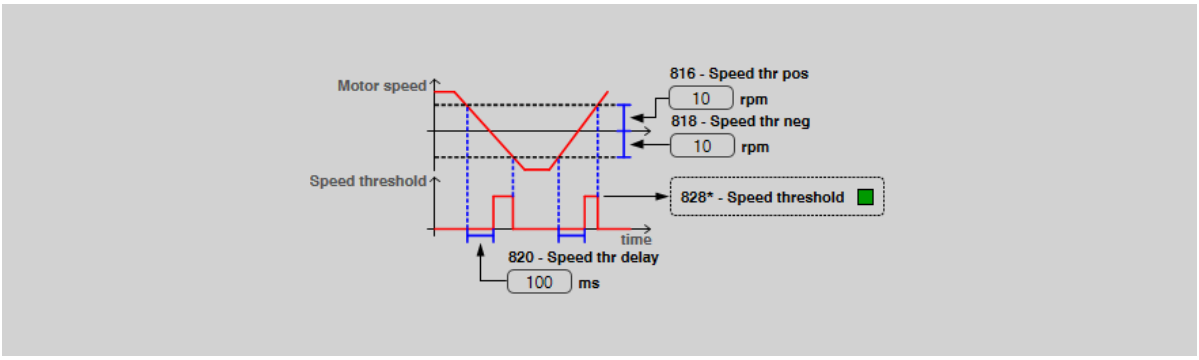


Figure 6-89: Logic diagram of the Speed threshold signal operation

The **Speed threshold** signal can therefore be used to indicate that a given speed threshold, whether positive or negative, has not been exceeded.

The **Speed set** signal (see Figure 6,90) switches to a high logic level with a time delay defined by parameter IPA 824-**Speed set delay**, when the motor speed is within the range [reference - **Speed set error**, reference + **Speed set error**]. The signal returns to a low logic level as soon as the speed falls outside this range.

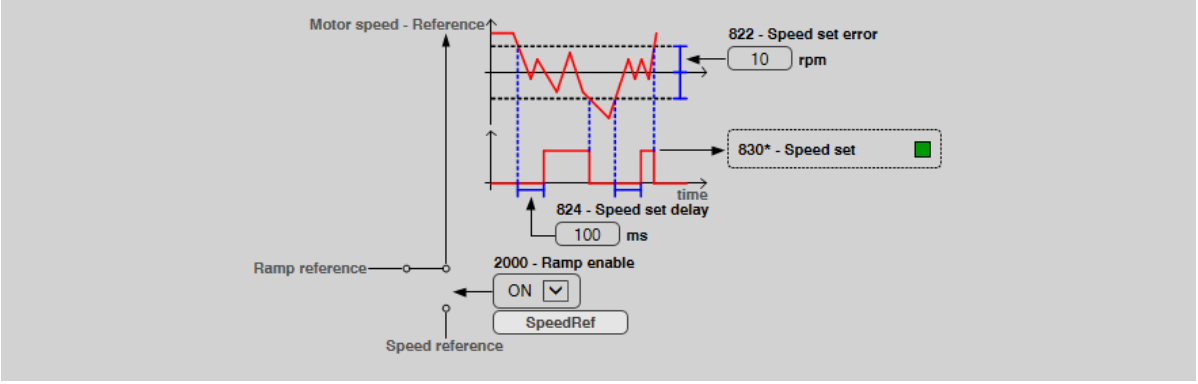


Figure 6-90: Logic diagram of the Speed set signal operation

The choice of the reference used for comparison depends on the enable status of parameter IPA 2000-**Ramp enable**:
- If *ON*, the reference used is IPA 1820-**Ramp reference**
- If *OFF*, the reference used is IPA 1870-**Speed reference**

The **Speed set** signal can therefore be used to indicate that the motor speed matches the target reference, meaning the speed has reached the reference within a programmable tolerance.
The **Arm curr threshold** signal (see Figure 6,91) switches to a high logic level with a time delay defined by parameter IPA 1018-**Arm curr thr delay**, when the motor armature current (absolute value), IPA 214-**Armature current [%]**, exceeds the threshold set by IPA 1012-**Arm curr thr**. The signal returns to a low logic level as soon as the current drops below the same threshold.

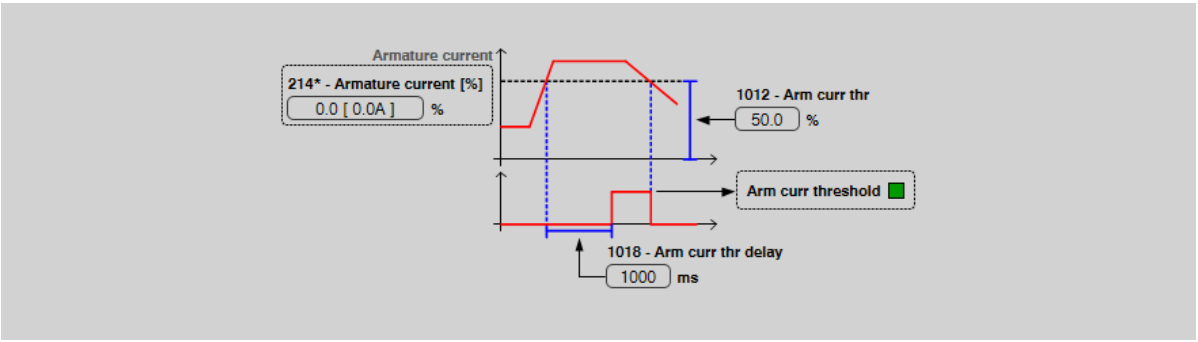


Figure 6-91: Logic diagram of the Arm curr threshold signal operation

6.18.6 Droop

The **Droop** function is used to achieve current balancing.
A typical application is when two motors are mechanically coupled (for example, connected to the same shaft) and therefore must rotate at the same speed. Due to differences that may exist between the two speed controllers, the motors, or the measurement systems, one motor may tend to rotate at a higher speed, entering an overload condition, while the second motor behaves like a brake. This leads to an imbalance between the currents of the two motors.
The Droop function corrects this malfunction by adding a correction term to the drive's speed reference, which is proportional to the load difference between the two units.
As a result, the motor currents are balanced, with the additional benefit of keeping both speed regulators enabled.

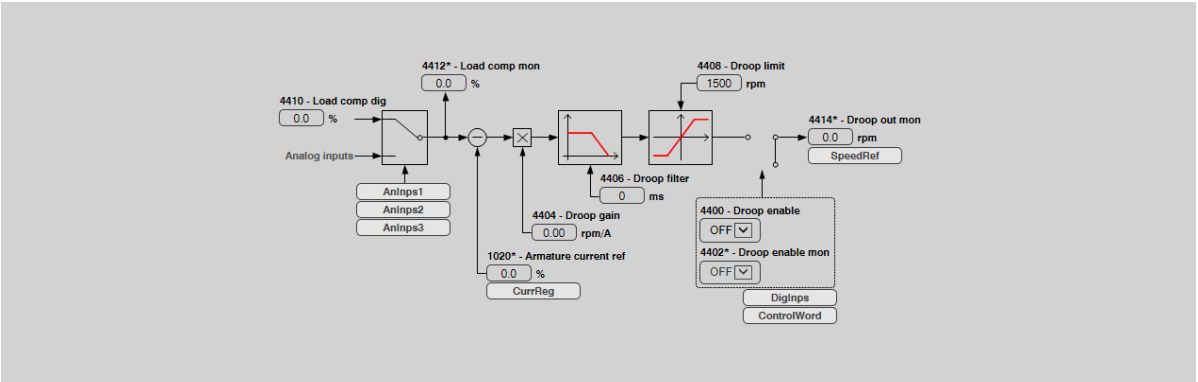


Figure 6-92: General diagram of the Droop function

Il funzionamento è definito tramite i seguenti parametri del menù **FUNCTIONS\DROOP**:

IPA		DESCRIPTION
4400	**Droop enable**	Enables the **Droop** function, inserting the **Droop out mon** output produced by the function in the drive speed reference chain, in addition to the **Speed ref 2 mon** speed reference (see figure 6-93).

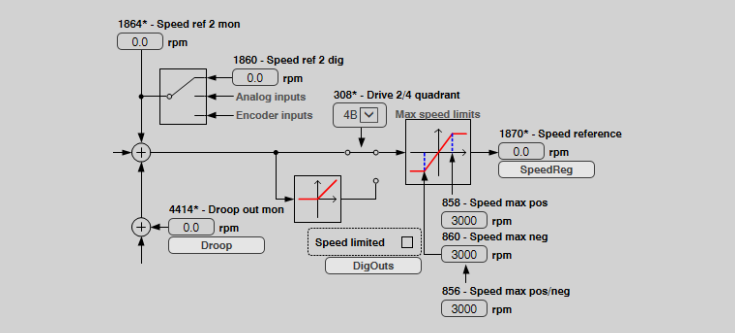


Figure 6-93: Diagram of speed reference management for the Droop function

4402	**Droop enable mon**	Monitor of the **Droop** function enable parameter, which can also be assigned by programmable digital inputs
4404	**Droop gain**	Proportional gain of the **Droop** function, expressed in [rpm/A]
4406	**Droop filter**	Time constant of the filter applied between the gain and the output limitation block of the **Droop** function
4408	**Droop limit**	Maximum absolute value that the **Droop out mon** output can take, i.e. it represents the minimum/maximum limits of the speed reference compensation
4410	**Load comp dig**	Current value supplied by the Master drive (see figure 6-94), provided via fieldbus, expressed as a % of the motor's rated armature current
4412	**Load comp mon**	Monitor of the current supplied by the Master drive (see figure 6-94), which can also be assigned by programmable analogue inputs
4414	**Droop out mon**	Monitor of the output of the Droop function, expressed in rpm, which acts on the speed reference chain in addition to the other contributions (see figure 6-94)

The **Droop** function can be used as shown in the following example, based on a steel tube processing machine:

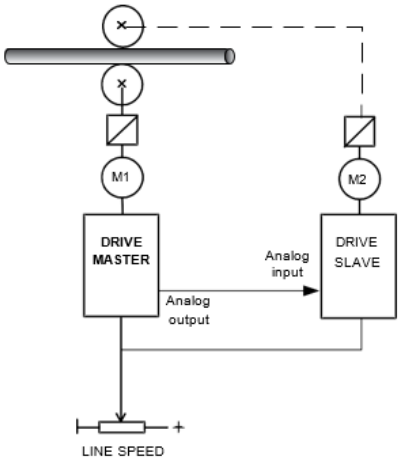


Figura 6-94: Schema di principio dell'utilizzo della funzione Droop

The torque of motor 1 (M1), controlled by the MASTER drive, must match the torque of motor 2 (M2), controlled by the SLAVE drive:

DRIVE A (Master)
- Set **An input 1 dest = Speed ref 1** via analog input 1 (shared with the slave)
- Set **An output 1 sel = Armature curr ref** via analog output 1, connected to the slave's analog input 1

DRIVE B (Slave)
- Set **An input 1 dest = Speed ref** 1 via analog input 1 (shared with the master)
- Set **An input 2 dest = Load comp** and wire this input to the master's analog output 1
- Set **Droop enable = ON** and adjust the parameters Droop gain, Droop filter, and Droop limit as needed

With this configuration, the master and slave drives share the same speed reference, while the armature current reference from the master drive acts as the reference signal for the **Droop** function, which is enabled only on the slave.

In this way, the current error - defined as the difference between the master's current reference and the slave's current reference - is processed by a proportional controller to generate a correction factor. This correction is applied to the slave's speed reference chain in order to achieve current balancing between master and slave drives.

6.18.7 Speed Draw

The **Speed draw** function allows a configurable scaling factor to be applied to the drive's main speed reference. This function is useful in multi-drive systems where a slip value is required between the different motors used (see Figure 6-96).

The operation is defined by the following parameters in the **FUNCTIONS\SPEED DRAW** menu:

IPA		DESCRIPTION
4350	**Speed draw ratio dig**	Allows you to set the scale factor, with a resolution of 0.0001
4352	**Speed draw ratio mon**	Scale factor monitor, which can also be assigned via programmable analogue inputs or fieldbus
4354	**Speed draw out**	Monitor of the speed reference output from the function, after application of the scale factor, directly present on the speed reference chain (see figure 6-95)

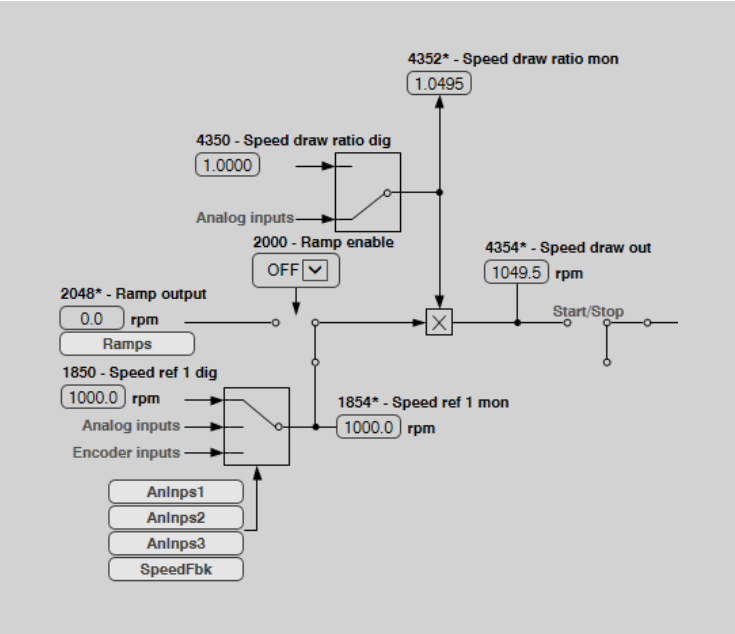


Figure 6-95: Speed reference management diagram for the Speed Draw function

The effective scale factor is given by **Speed draw ratio mon** and is applied to:

- IPA 2048-**Ramp output** if ramp enabled (IPA 2000-**Ramp enable = ON**)
- IPA 1854-**Speed ref 1 mon** if ramp disabled (IPA 2000-**Ramp enable = OFF**)

The **Speed draw** function can be used as in the following example, referring to a calender for rubber processing:

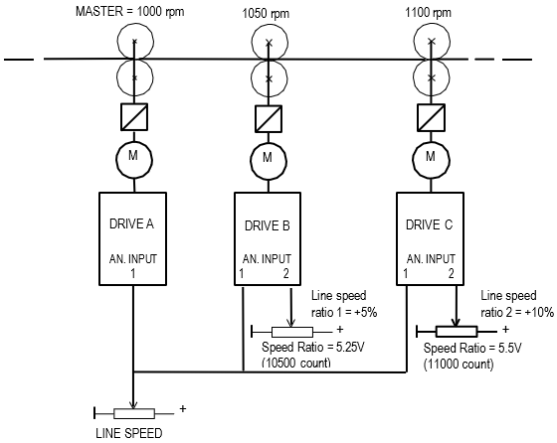


Figure 6-96: Application principle diagram of the Speed Draw function

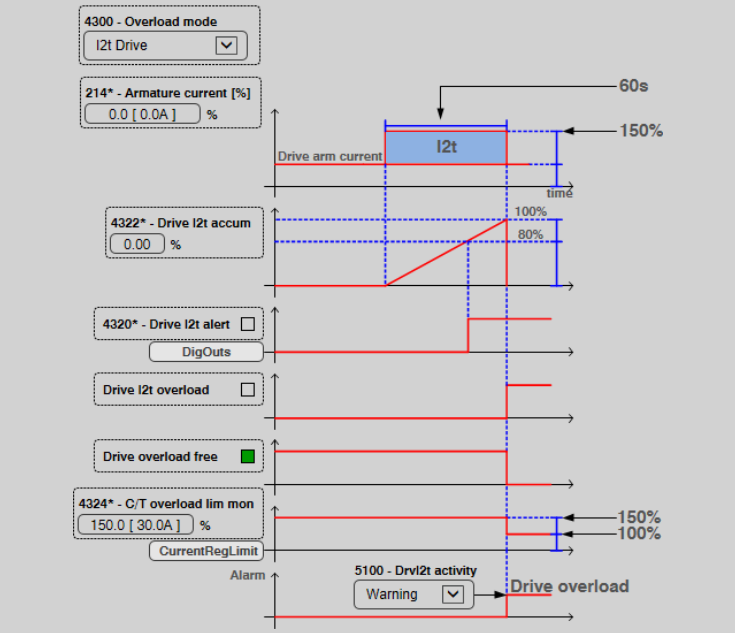
1. DRIVE A (master)
- Line speed = 1000 rpm
- Set **An input 1 dest = Ramp ref 1** via analog input 1

2. DRIVE B (slave 1)
- Line speed ratio 1 = Line speed + 5% (1050 rpm)
- Set **An input 1 dest = Ramp ref 1** via analog input 1
- Use the **Speed draw** function by setting **Speed draw ratio dig** = 1.0500 oor use analog input 2 by setting **An input 2 dest = Speed draw ratio** with a voltage level such that **Speed draw ratio mon** = 1.05 (5.25 V, since 10 V = full scale 2.0 for this selection)

3. DRIVE C (slave 2)
- Line speed ratio 2 = Line speed + 10% (1100 rpm)
- Set **An input 1 dest = Ramp ref 1** via analog input 1
- Use the **Speed draw** function by setting **Speed draw ratio dig** = 1.1000 or use analog input 2 by setting **An input 2 dest = Speed draw ratio** with a voltage level such that **Speed draw ratio mon** = 1.10 (5.5 V, since 10 V = full scale 2.0 for this selection)

6.18.8 Overload

The **overload** control function allows the drive to deliver a current higher than its rated armature current for a limited time. It is used to provide the motor with a higher starting torque or to allow current peaks in machines with cyclic load profiles. This function also protects the drive from thermal overload.
The operation of the overload function is defined by the following parameters in the **FUNCTIONS\OVERLOAD** menu:

IPA		DESCRIPTION
4300	**Overload mode**	Allows you to set the overload type using four possible selections: **0 None:** Overload is disabled, so the drive can only deliver 100% of its rated current continuously. In this mode, all current references and limits have a maximum value of 100% (corresponding to the motor's rated armature current). **1 I2t Drive:** the converter delivers 100% of its rated current (IPA 300-**Drive arm current**) continuously, allowing an overload of 60 s at 150% of the derated rated current (see table 2.15). Current limits are controlled by an I2t algorithm based on the charging and discharging of the **Drive I2t accum** storage battery, which triggers the **Drive overload** alarm when the critical value of 100% is reached (see section 6.20.10). The alarm is set to *Warning* by default and therefore does not cause the converter to shut down immediately, but only lowers the current limits to 100% of the converter's rated current. To reset the alarm, **Drive I2t accum** must be completely discharged by lowering the output current. In this mode, all current references and limits have a maximum value of 150%  Figure 6-97: Logic diagram of the overload function when Overload mode = I2t Drive

2 I2t Drive and Motor: More restrictive conditions are added to **I2t Drive** mode to also ensure motor protection, allowing an overload for the **Motor I2t time** at the **Motor I2t current**. Current limits are controlled by an I2t algorithm based on the charging and discharging of the **Motor I2t accum** accumulator, which triggers the **Motor overload** alarm when the critical value of 100% is reached (see paragraph 6.20.9). The alarm is set to *Warning* by default and therefore does not cause the converter to shut down immediately. To reset the alarm, **Motor I2t accum** must be completely discharged by lowering the output current. All current references and limits have a maximum value of 150%

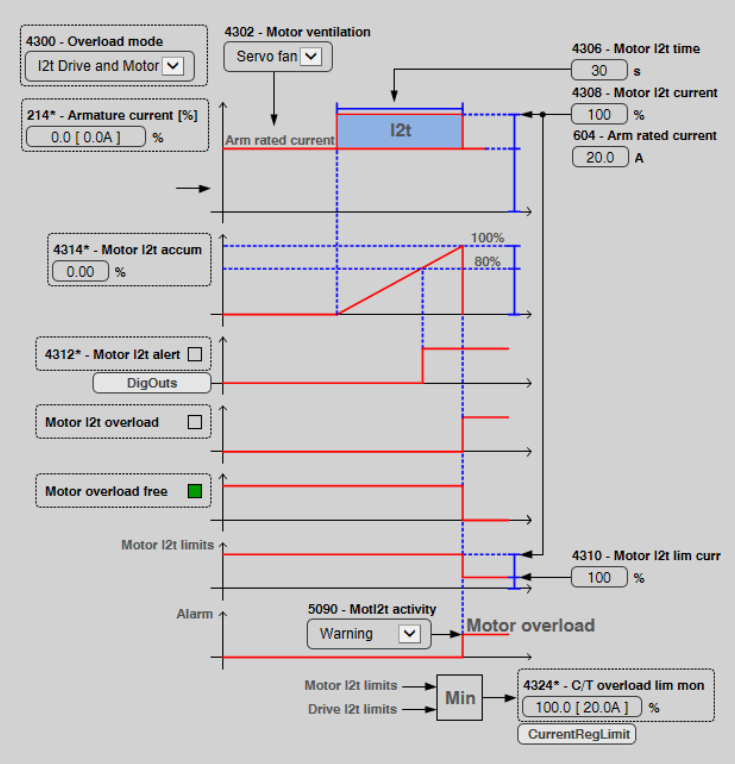


Figure 6-98: Logic diagram of the overload function when Overload mode = I2t Drive and Motor

3 Current limited: The converter delivers 100% of its derated rated current (see Table 2.15) continuously, while an overload of 60 seconds at 150% of the derated rated current is permitted. After an overload cycle, a fixed pause time of 540 seconds is required, during which the converter can only deliver 100% of the derated rated current before the next overload cycle can be enabled. During the pause phase, the current limits are lowered to 100% by the **C/T overload lim mon** parameter, which acts on the limit chain at the input of the current regulator. The **Motor overload** free digital output indicates whether or not an overload cycle is available. All current references and limits have a maximum value of 150%.

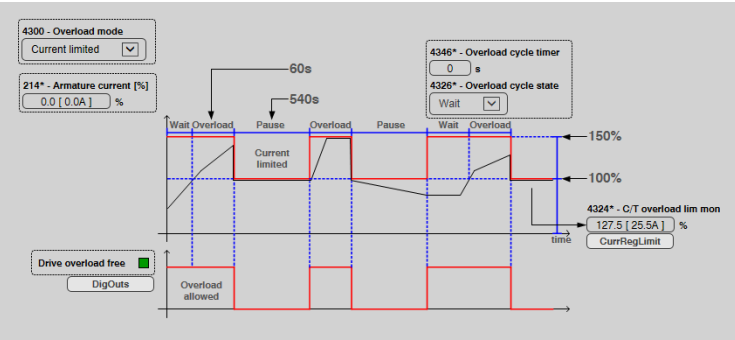


Figure 6-99: Logic diagram of the overload function when Overload mode = Current limited

4302 Motor ventilation

Allows you to set the motor ventilation type when **Overload mode = I2t Drive and Motor**. Two selections are possible:

1 Servo fan: the fan is independent of the motor and guarantees effective cooling at all speeds, without the need to apply a reduction factor to the motor's rated current based on the rotation speed, which can therefore be supplied continuously. In this mode, the **Motor I2t accum** only starts to increase above the motor's rated current, regardless of the motor speed.

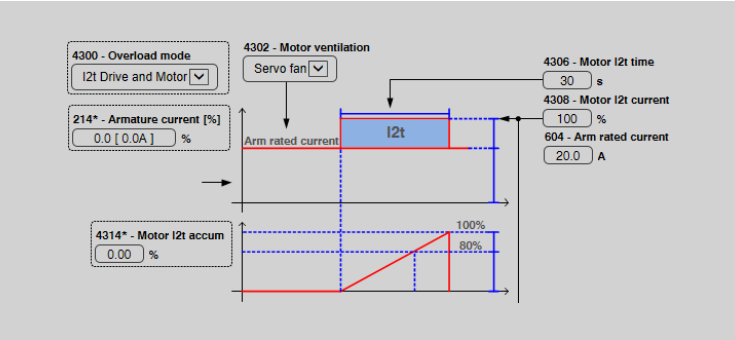


Figure 6-100: Logic diagram of the motor overload function when Motor ventilation = Servo fan

1 Auto fan: The fan is mounted on the motor shaft and therefore rotates at the same speed as the motor. Cooling is less effective at low speeds, so a reduction factor must be applied to the motor's rated current. In this mode, the **Motor I2t accum** begins to increase even below the motor's rated current if the motor speed is less than half the motor rated speed. A linear derating is applied according to the motor speed from 0 rpm to half the motor rated speed, so when the motor is stopped, the overload begins above the current **I0 = Motor derating x Arm rated current**, while as the speed increases, there is overload above the straight line from point (**0, I0**) to point (**s0, Arm rated current**) (see figure 6-101)
Depending on the motor speed, the Auto fan mode has two operating regions:
1. If **Motor speed > s0**, it is equivalent to Servo fan mode, with overload only above the motor's rated current **Arm rated current**
2. If **Motor speed < s0**, there is overload only above the current
I0 + (Arm rated current - I0) * (Motor speed) / s0
Where **I0 = Motor derating x Arm rated current** is the continuous output current at zero speed and **s0 = Motor rated speed / 2**

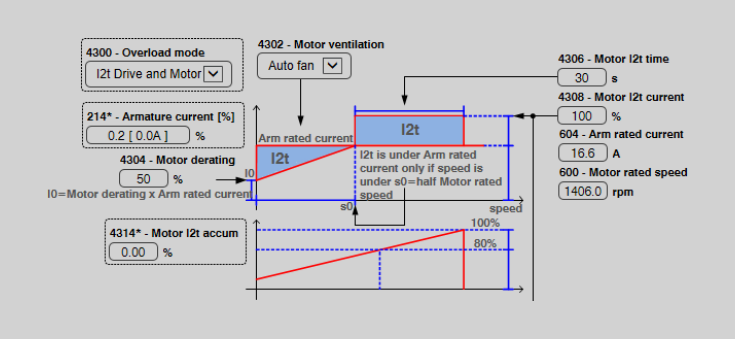


Figure 6-101: Logic diagram of the motor overload function when Motor ventilation = Auto fan

4304	**Motor derating**	Derating factor when **Motor ventilation = Auto fan**, which allows the continuous output current at zero speed I0 to be calculated as a percentage of the motor's rated current, **I0 = Motor derating x Arm rated current**. When the motor speed is less than half the motor rated speed (indicated by s0), the continuous output current allowed without overload decreases linearly from **Arm rated current** to I0 according to the straight line **I0 + (Arm rated current - I0) * (Motor speed) / s0**
4306	**Motor I2t time**	Allows you to set the time in seconds to define the motor **I2t** overload in case **Overload mode = I2t Drive and Motor**. Represents the maximum time during which the **Motor I2t** current is allowed
4308	**Motor I2t current**	Allows you to set the current level to define the motor **I2t** overload in case **Overload mode = I2t Drive and Motor**. Represents the maximum armature current allowed during **Motor I2t** time
4310	**Motor I2t lim curr**	Allows you to set the current limit when the motor overload condition **Motor I2t accum = 100%** is reached. Normally, the limits are not lowered as the default value is 100%
4312	**Motor I2t alert**	Monitor used to signal that the **Motor I2t accum** parameter has reached 80% and is available in the digital output selection lists. The signal returns to 0 when **Motor I2t accum** is completely discharged

4314	**Motor I2t accum**	Monitor of the status of the motor's **I2t** accumulator, which indicates how close the drive is to motor overload. If the **Armature current [%]** exceeds the motor's rated current, the accumulator starts to increase up to 100%, indicating the overload limit condition. The time to go from 0 to 100% is equal to **Motor I2t time** if a current equal to **Motor I2t current** is supplied. To discharge the accumulator, the output current must be brought below the motor's rated current
4316	**Drive I2t time**	Allows you to set the time in seconds to define the **I2t** overload of the drive in Control Unit configuration if **Overload mode = I2t drive or I2t Drive and Motor**. This is the maximum time during which the Drive I2t current is allowed. In the case of Control Unit configuration, it is therefore also possible for the drive to have a fully programmable overload
4318	**Drive I2t current**	Allows you to set the current to define the **I2t** overload of the drive in Control Unit configuration if **Overload mode = I2t drive or I2t Drive and Motor**. Represents the maximum armature current allowed during **Drive I2t time**
4320	**Drive I2t alert**	Monitor used to signal that the **Drive I2t accum** parameter has reached 80% and is available in the digital output selection lists. The signal returns to 0 when **Drive I2t accum** is completely discharged
4322	**Drive I2t accum**	Monitor of the status of the drive's **I2t** accumulator, in the range 0-100%, which indicates how close the drive is to overload condition. If the **Armature current [%]** output current exceeds the rated current of the drive, the accumulator starts to increase up to 100%, indicating the overload limit condition. The time to go from 0 to 100% is 60s if a current equal to 150% of the derated rated current of the drive is supplied. To discharge the accumulator, the output current must be brought below the rated current of the drive.
4324	**C/T overload lim mon**	Monitor of the current limit imposed by the cascade overload function on the other limitation contributions (see paragraph 16.14.2 and figure 6-45). This parameter can be displayed in two units of measurement [%-A].

NOTE!

The actual current limits applied to the current regulator, defined by parameters IPA 1140-**C/T lim pos in use** and IPA 1142-**C/T lim neg in use**, result from the cascade of multiple contributing functions. The lowest value among them is always selected:

- Positive/negative torque limits defined by the user parameters IPA 1106-**C/T lim pos mon** and IPA 1110-**C/T lim neg mon**
- Torque limits derived from the reduction parameter IPA 1120-**C/T lim reduction**
- Torque limits imposed by the overload function, through IPA 4324-**C/T overload lim mon**
- Torque limits based on motor speed, via IPA 1172-**C/T speed lim in use**

Once overload is enabled using IPA 4003-**Overload mode**, it is necessary to increase the parameters IPA 1104-**C/T lim pos dig** and IPA 1108-**C/T lim neg dig** beyond 100% (up to 150%).

Otherwise, no overload current will be delivered, since these parameters also contribute to defining the actual current limits in use.

6.18.9 C/T Speed Limit

The torque current limits, which act at the input of the current regulator and refer only to the armature current, can also vary as a function of motor speed through a piecewise linear curve composed of six segments.
This curve is defined using the following parameters in the **FUNCTIONS\C/T SPEED LIMIT** menu:

IPA		DESCRIPTION
1150	**C/T speed lim enable**	Enables torque limits based on speed
1152	**C/T speed lim 0**	Torque current limit 0 for the torque/speed limit curve, in [%] relative to the motor's rated armature current
1154	**C/T speed lim 1**	Torque current limit 1 for the torque/speed limit curve, in [%] relative to the motor's rated armature current
1156	**C/T speed lim 2**	Torque current limit 2 for the torque/speed limit curve, in [%] relative to the motor's rated armature current
1158	**C/T speed lim 3**	Torque current limit 3 for the torque/speed limit curve, in [%] relative to the motor's rated armature current
1160	**C/T speed lim 4**	Torque current limit 4 for the torque/speed limit curve, in [%] relative to the motor's rated armature current
1162	**C/T speed lim thr 0**	Speed threshold 0 for the torque/speed limit curve, in [rpm]
1164	**C/T speed lim thr 1**	Speed threshold 1 for the torque/speed limit curve, in [rpm]
1166	**C/T speed lim thr 2**	Speed threshold 2 for the torque/speed limit curve, in [rpm]
1168	**C/T speed lim thr 3**	Speed threshold 3 for the torque/speed limit curve, in [rpm]
1170	**C/T speed lim thr 4**	Speed threshold 4 for the torque/speed limit curve, in [rpm]

1172	**C/T speed lim in use**	Monitor of the current limit imposed by the function, in [%]

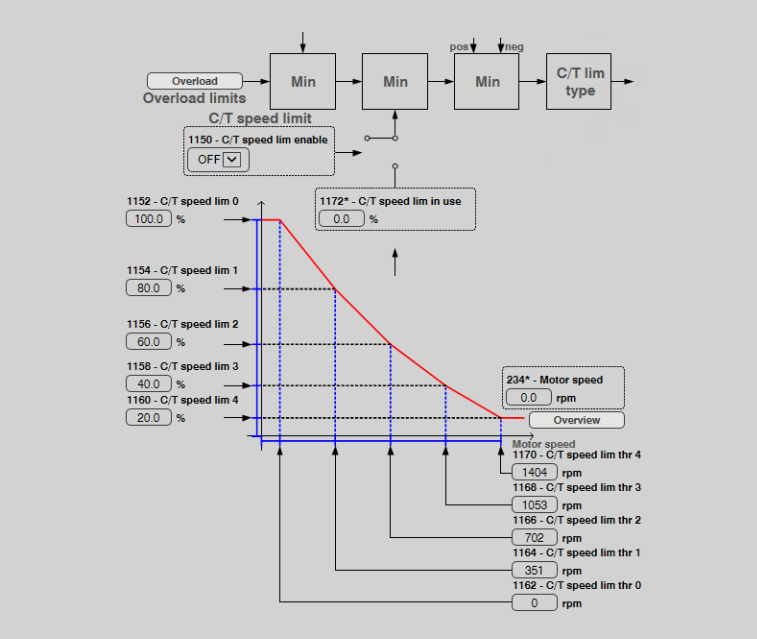


Figure 6-102: Logical diagram of current limit generation

The **C/T speed lim** in use value can therefore take on the following values depending on the motor speed:

- **C/T speed lim 0** is applied constantly for all speeds below **C/T speed lim thr 0**
- Linear interpolation between **C/T speed lim 0** e **C/T speed lim 1** for all speeds between **C/T speed lim thr 0** e **C/T speed lim thr 1**
- Linear interpolation between **C/T speed lim 1** and **C/T speed lim 2** for all speeds between **C/T speed lim thr 1** e **C/T speed lim thr 2**
- Linear interpolation between **C/T speed lim 2** and **C/T speed lim 3** for all speeds between **C/T speed lim thr 2** e **C/T speed lim thr 3**
- Linear interpolation between **C/T speed lim 3** and **C/T speed lim 4** for all speeds between **C/T speed lim thr 3** e **C/T speed lim thr 4**
- **C/T speed lim 4** is applied constantly for all speeds above **C/T speed lim thr 4**

The speed bands of the piecewise linear curve are reinitialized each time the parameter IPA 602-**Motor max speed** (in the **MOTOR DATA** menu, see paragraph 6.9) is modified, in order to define intervals of equal width equal to IPA 602-**Motor max speed / 4**.
However, they can later be adjusted as needed for specific application requirements.

NOTE!

It is the user's responsibility to configure contiguous and non-overlapping bands, both in speed and current.

NOTE!

The default maximum allowed value for all torque limits in the curve is 100%, but it can be increased up to 150% by enabling one of the available overload types via parameter IPA 4300-**Overload mode** in the **FUNCTIONS\OVERLOAD** menu (see paragraph 6.18.8).

NOTE!

The actual current/torque limits applied to the current regulator, defined by parameters IPA 1140-**C/T lim pos in use** and IPA 1142-**C/T lim neg in use** (see Figure 6,45), result from a cascade of contributions from several functions. The lowest value among them is always applied:

- Positive/negative torque limits defined by user parameters IPA 1106-**C/T lim pos mon** and IPA 1110-**C/T lim neg mon**
- Torque limits from the reduction parameter IPA 1120-**C/T lim reduction**
- Torque limits from the overload function, via IPA 4324-**C/T overload lim mon**
- Torque limits based on motor speed, via IPA 1172-**C/T speed lim in use**

Therefore, in order for the current/torque limits to effectively match those calculated by the function under consideration, the contribution C/T speed lim in use must have a lower value than all other limits in the cascade.

6.18.10 Brake control

The drive allows control of the opening and closing of a mechanical holding brake mounted on the motor shaft, via a digital output operated according to the run/stop status of the converter.
Brake control, which is useful in industrial hoisting applications, is managed through the following parameters in the **FUNCTIONS\BRAKE CONTROL** menu:

IPA		DESCRIPTION
4100	**Brake control enable**	**Brake control** enable parameter. If set to *OFF*, the **Brake cmd mon** digital output for brake control always assumes a low logic value.
4102	**Fwd open C/T thr**	Current threshold for opening the brake in the **forward** direction, expressed as a percentage of the motor armature current.
4104	**Fwd open speed thr**	Speed threshold for opening the brake in the **forward** direction, expressed in [rpm]
4106	**Fwd open speed ref**	Speed reference for opening the brake in the **forward** direction, expressed in [rpm]
4108	**Fwd close speed thr**	Speed threshold for closing the brake in the **forward** direction, expressed in [rpm]
4110	**Rev open C/T thr**	Current threshold for opening the brake in the **reverse** direction, expressed as a percentage of the motor armature current
4112	**Rev open speed thr**	Speed threshold for opening the brake in the **reverse** direction, expressed in [rpm]
4114	**Rev open speed ref**	Speed reference for brake opening in **reverse** direction, expressed in [rpm]
4116	**Rev close speed thr**	Speed threshold for brake closing in **reverse** direction, expressed in [rpm]
4134	**Brake ramp acc time**	Ramp acceleration time during brake opening phase, relative to full scale speed IPA 400-**Full scale speed**
4118	**Brake pretorque dig**	Level of torque injected at the moment the brake is released, expressed as a percentage of the motor's rated armature current
4120	**Brake pretorque mon**	Monitor of the level of torque injected at the moment the brake is released, which can also be assigned via programmable analogue inputs or fieldbus. The torque rises linearly from 0 to this value according to the ramp time defined by the **Brake pretorque time** parameter
4136	**Brake pretorque time**	Ramp time, expressed in ms, used for the gradual increase of the torque to be injected at the moment the brake is released, from 0 to 100% of the motor's rated armature current. If set to 0, the torque is applied instantly, without ramp
4122	**Brake open delay**	Brake release delay with respect to the relative threshold being exceeded, expressed in [ms]
4124	**Brake disable delay**	Converter disable delay after brake closure during stopping, expressed in [ms]
4126	**Brake fbk type**	Enables brake feedback control, if available. Three selections are possible, depending on the type of feedback signal present: **0 None**: the feedback signal is not available and the corresponding control is disabled **1 Normally closed**: the feedback signal is at a high logic level when the brake is closed **2 Normally open**: the feedback signal is at a low logic level when the brake is closed
4128	**Brake fbk time**	Maximum time allowed between sending the brake release command and receiving the feedback signal. If, at the end of the maximum time set, the feedback signal is not consistent with the command signal (depending on how **Brake fbk type** has been set), the converter signals the **Brake fault** alarm (see paragraph 6.20.8)
4130	**Brake fbk mon**	Brake feedback status monitor, available in the digital input selection lists
4132	**Brake cmd mon**	Brake open/close command monitor, available in the digital output selection lists
4148	**Brake control state**	Brake control function status monitor

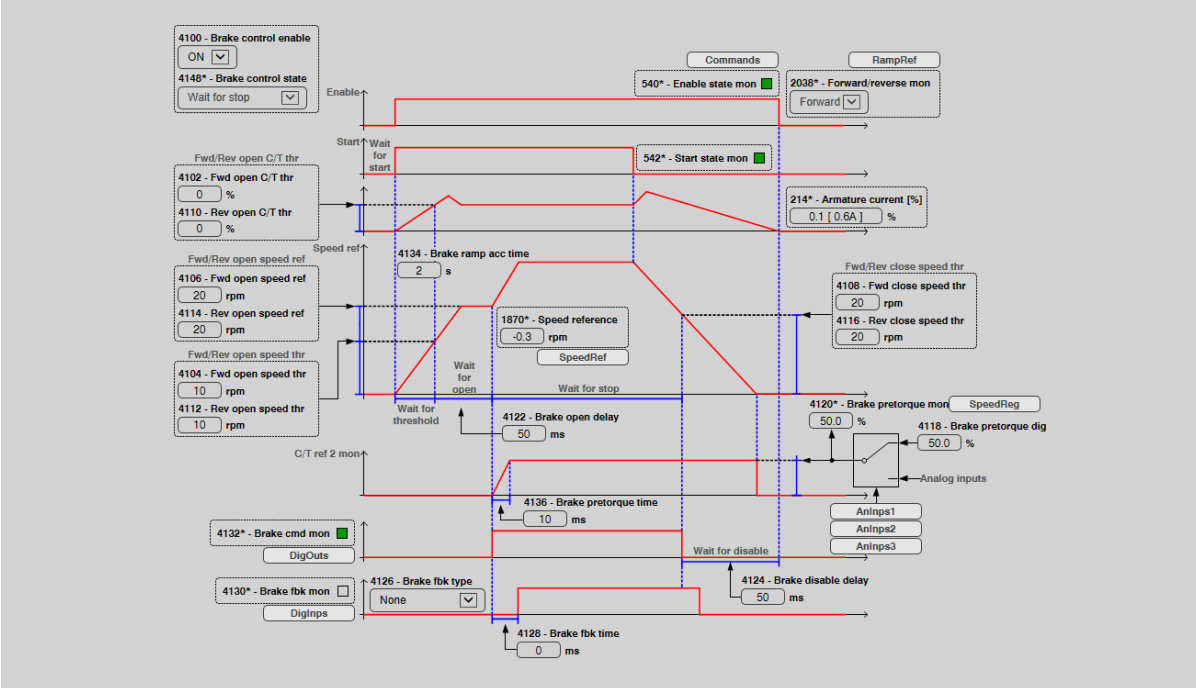


Figure 6-103: General diagram of the brake control function

The brake opening is conditioned on exceeding thresholds for both the speed reference and output current. Separate sets of parameters can be defined for the **Forward** and **Reverse** directions, and a delay time can be programmed for the brake opening command after these thresholds are exceeded.

The brake closing is conditioned only on exceeding a threshold on the speed reference, which can also be differentiated for the Forward and Reverse directions. A delay can be programmed for converter disable after the brake has closed.

The selection of the threshold set in use is based on the state of parameter IPA 2038-**Forward/reverse mon** (see paragraph 6.10.1).

The ramp reference during the brake opening phase is defined by IPA 4106-**Fwd open speed ref** or IPA 4114-**Rev open speed ref**, and remains active until the brake opening is commanded.

If Brake control enable is set to *ON*, the parameter IPA 4148-**Brake control state** displays the status of the brake control function, which is useful for monitoring the full sequence of brake opening and closing.

Five operating states are possible, as shown in the diagram (see Figure 6-103), with reference to the **Forward** direction:

- **0 Wait for start**: the brake is closed, the converter is disabled, and it is waiting for a **Start** command, which may also come from a **Jog** command (see paragraph 6.18.2). After enabling, once the **Start** command is received, the state changes to **Wait for thresholds**
- **1 Wait for thresholds**: the brake is still closed, and the **ramp reference** is not the one normally set by the ramp reference chain, but is instead replaced by the parameter **Fwd open speed ref.** The acceleration ramp uses the dedicated time **Brake ramp acc time**. The **Speed reference** and **Armature current [%]** start to increase, and as soon as they reach their respective threshold **Fwd open speed thr** and **Fwd open C/T thr** the state changes to **Wait for open**
- **2 Wait for open**: the brake is still closed, but after the delay set by **Brake open delay** the brake opening command (**Brake cmd mon) is issued.** At the same time, the pre-torque value set by **Brake pretorque mon** is applied using **C/T reference 2** at the input of the current regulator (IPA 1910-**C/T ref 2 dig = Brake pretorque mon**) with the ramp time defined by **Brake pretorque time**. The state then changes to **Wait for stop.**

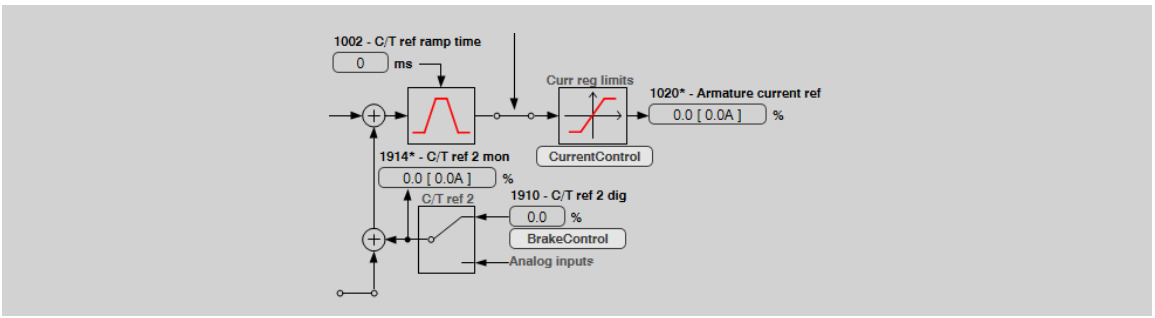


Figure 6-104: Logic diagram of the pretorque brake function

- **3 Wait for stop**: the brake is open, and the drive resumes following the standard speed reference with standard ramp times. When the **Start** command is removed and the **speed reference** drops below the **Fwd close speed thr**, the brake closing command (**Brake cmd mon**) is issued, and the state changes to **Wait for disable**
- **4 Wait for disable**: the brake is closed, and after the time defined by **Brake close delay**, the converter is disabled. The state returns to **Wait for start**, and the converter is ready for a new brake open/close cycle.

In all states of the brake open/close cycle, if the **Brake fbk type** parameter is set to *Normally open* or *Normally closed*, the converter performs a consistency check between the brake open/close command (**Brake cmd mon**) and the feedback signal (**Brake fbk mon**).
If the two signals differ for a period longer than the time set in parameter **Brake fbk time**, the **Brake fault** alarm is triggered.

The **Brake fbk mon** signal depends on the physical state of the digital input signal from which the feedback is received, and on the setting of the Brake fbk type parameter:
• If IPA 3000-**Digital input 1 dest = Brake fbk** and **Brake fbk type = Normally closed**
→ Then: **Brake fbk mon state = Digital input 1 mon state**
• If IPA 3000-**Digital input 1 dest = Brake fbk** and **Brake fbk type = Normally open**
→ Then: **Brake fbk mon** state = inverted state of **Digital input 1 mon**

6.18.11 Test generator

The **Test generator** function is a rectangular waveform generator with programmable frequency and amplitude, intended for debugging and/or commissioning purposes.
A typical use case is the manual tuning of the speed regulator (see paragraph 5.2.10).
The function is managed through the following parameters in the **FUNCTIONS\TEST GENERATOR** menu:

IPA		DESCRIPTION
4450	**Test gen dest**	Allows you to select the destination of the generated waveform to simulate certain reference signals for speed, current or field control. The following selections are possible: **0 OFF**: function disabled **2 C/T ref**: simulation of the armature current reference (see figure 6-35) **3 Field ref**: simulation of the field current reference (see figure 6-47) **4 Ramp ref**: ramp reference simulation (see figure 6-14) **5 Speed ref**: speed reference simulation (see figure 6-15)
4452	**Test gen frequency**	Frequency in [Hz] of the waveform
4454	**Test gen amplitude**	Amplitude in [%] of the waveform
4456	**Test gen offset**	Offset in [%] of the waveform
4458	**Test gen out**	Instantaneous monitor of the waveform value, which takes the unit of measurement of the quantity selected with **Test gen dest** (respectively [%], [%], [rpm] or [rpm] for selections 2-3-4-5)

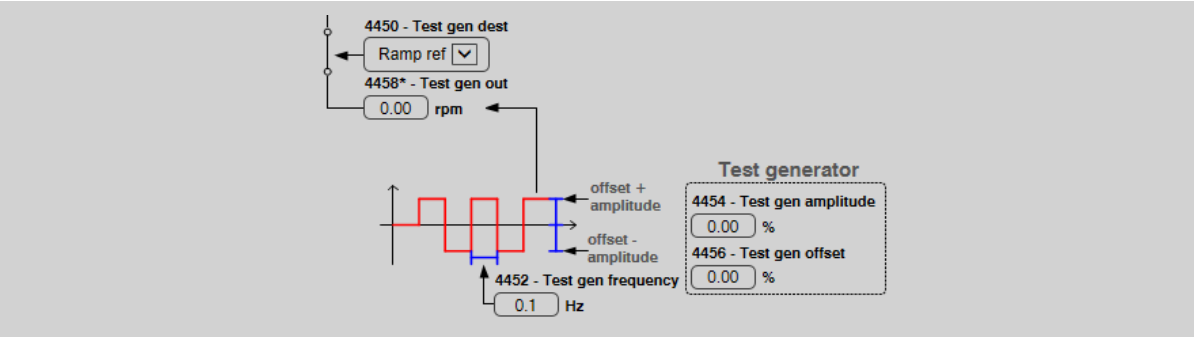


Figure 6-105: General diagram of the Test generator function

The **Test gen out** signal generated by the Test generator toggles instantly between the levels **Test gen offset + Test gen amplitude** and **Test gen offset** – **Test gen amplitude**, making it possible to generate negative levels as well.

In the case of **C/T ref** selection, the Test gen out signal is expressed as a percentage of parameter IPA 604-**Arm rated current** and is added into the armature current reference chain, summed with **C/T ref 1 mon + C/T ref 2 mon** (see Figure 6-35).
Both the amplitude and offset values are expressed as a percentage of the **Arm rated current**.

In the case of **Field ref** selection, the **Test gen out** signal is expressed as a percentage of parameter IPA 608-**Field rated current** and is added into the field current reference chain, summed with the output of the field current limiter (see Figure 6-47).
Both the amplitude and offset values are expressed as a percentage of the **Field rated current**.

In the case of **Ramp ref** selection, the **Test gen out** signal is expressed in rpm and is added into the ramp reference chain, summed with **Ramp ref 1 mon + Ramp ref 2 mon** or with the Multi speed values (see Figure 6-14).
Amplitude and offset values are expressed as a percentage of parameter IPA 400-**Full scale speed**.

In the case of **Speed ref** selection, the **Test gen out** signal is expressed in rpm and is added into the speed reference chain, summed with **Speed ref 1 mon + Speed ref 2 mon** (see Figure 6-15).
Amplitude and offset values are expressed as a percentage of parameter IPA 400-**Full scale speed**.

6.18.12 Signal adaptation

The **Link** function provides a sequence of operations that allows the value of a source parameter to be modified through a series of mathematical operations and then applied to a destination parameter.

The Link function is managed through the following parameters in the **FUNCTIONS\LINK 1 … LINK 6** menu:

- **Link 1 source:** IPA of the source parameter for Link **Link 1**
- **Link 1 destination:** IPA of the destination parameter for **Link 1**
- **Link 1 mul gain:** Multiplication factor applied to the source of **Link 1**
- **Link 1 div gain:** Division factor applied to the source of **Link 1**
- **Link 1 input max**: Maximum limit applied to the source of **Link 1**
- **Link 1 input min:** Minimum limit applied to the source of **Link 1**
- **Link 1 input offset:** Offset added to the source of **Link 1**
- **Link 1 output offset:** Offset added to the destination of **Link 1**
- **Link 1 input abs:** Enables the absolute value function for the source of **Link 1**

The above list applies similarly to Link functions from 1 to 6.

Table 6-7: Parameters related to the configuration of the Link functions

Parameter	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6
Link X source	IPA 4650	IPA 4670	IPA 4690	IPA 4710	IPA 4730	IPA 4750
Link X destination	IPA 4652	IPA 4672	IPA 4692	IPA 4712	IPA 4732	IPA 4752
Link X mul gain	IPA 4654	IPA 4674	IPA 4694	IPA 4714	IPA 4734	IPA 4754
Link X div gain	IPA 4656	IPA 4676	IPA 4696	IPA 4716	IPA 4736	IPA 4756
Link X input max	IPA 4658	IPA 4678	IPA 4698	IPA 4718	IPA 4738	IPA 4758
Link X input min	IPA 4660	IPA 4680	IPA 4700	IPA 4720	IPA 4740	IPA 4760
Link X input offset	IPA 4662	IPA 4682	IPA 4702	IPA 4722	IPA 4742	IPA 4762
Link X output offset	IPA 4664	IPA 4684	IPA 4704	IPA 4724	IPA 4744	IPA 4764
Link X input abs	IPA 4666	IPA 4686	IPA 4706	IPA 4726	IPA 4746	IPA 4766

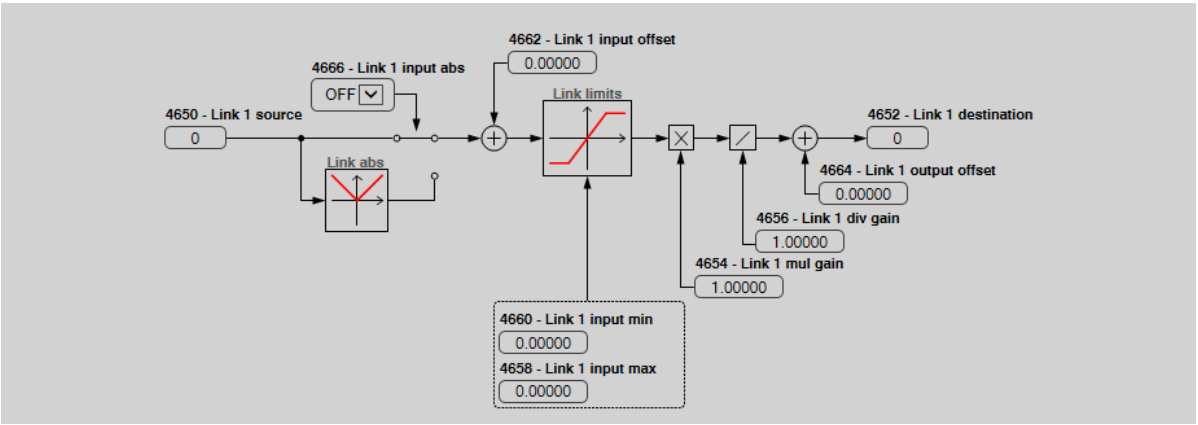


Figure 6-106: Operating diagram of a Link channel

The source parameter is acquired and then processed through the following operations in sequence:

- Application of the absolute value (only if enabled)
- Application of an input offset
- Limitation between a minimum and a maximum value
- Multiplication
- Division
- Application of an output offset

The resulting value after the last operation is assigned to the destination parameter.

NOTE! The destination parameter cannot be read-only, and command-type parameters are not allowed.

NOTE! It is the user's responsibility to configure operations that are meaningful within their specific application and that do not cause malfunctions or unexpected results.

NOTE! The Link function is not executed within a cyclic control task with a fixed period. Therefore, it is recommended to use it only for parameter adaptation and connection involving simple logical or mathematical operations, and not for critical control or regulation functions.

6.18.13 PAD parameters

The **PADs** are general-purpose variables used for data exchange between the drive's system software, applications developed using the **WEG_DriveLogic** tool, and/or a connected fieldbus system (see section 6.19.2).
These variables can be accessed through the following parameters in the **FUNCTIONS\PAD PARAMETERS** menu:

IPA		DESCRIPTION
4500	**Pad 0**	General-purpose variable 0 in floating point
4502	**Pad 1**	General-purpose variable 1 in floating point
4504	**Pad 2**	General-purpose variable 2 in floating point
4506	**Pad 3**	General-purpose variable 3 in floating point
4508	**Pad 4**	General-purpose variable 4 in floating point
4510	**Pad 5**	General-purpose variable 5 in floating point
4512	**Pad 6**	General-purpose variable 6 in floating point
4514	**Pad 7**	General-purpose variable 7 in floating point
4516	**Pad 8**	General-purpose variable 8 to 16 bits with sign
4518	**Pad 9**	General-purpose variable 9 to 16 bits with sign
4520	**Pad 10**	General-purpose variable 10 to 16 bits with sign
4522	**Pad 11**	General-purpose variable 11 to 16 bits with sign
4524	**Pad 12**	General-purpose variable 12 to 16 bits with sign
4526	**Pad 13**	General-purpose variable 13 to 16 bits with sign
4528	**Pad 14**	General-purpose variable 14 to 16 bits with sign
4530	**Pad 15**	General-purpose variable 15 to 16 bits with sign
4550	**Bitword Pad A**	General-purpose 16-bit unsigned bitword A
4552	**Pad A bit 0**	Bit 0 of Bitword Pad A
4554	**Pad A bit 1**	Bit 1 of Bitword Pad A
4556	**Pad A bit 2**	Bit 2 of Bitword Pad A
4558	**Pad A bit 3**	Bit 3 of Bitword Pad A
4560	**Pad A bit 4**	Bit 4 of Bitword Pad A
4562	**Pad A bit 5**	Bit 5 of Bitword Pad A
4564	**Pad A bit 6**	Bit 6 of Bitword Pad A
4566	**Pad A bit 7**	Bit 7 of Bitword Pad A
4568	**Pad A bit 8**	Bit 8 of Bitword Pad A
4570	**Pad A bit 9**	Bit 9 of Bitword Pad A
4572	**Pad A bit 10**	Bit 10 of Bitword Pad A
4574	**Pad A bit 11**	Bit 11 of Bitword Pad A
4576	**Pad A bit 12**	Bit 12 of Bitword Pad A
4578	**Pad A bit 13**	Bit 13 of Bitword Pad A
4580	**Pad A bit 14**	Bit 14 of Bitword Pad A
4582	**Pad A bit 15**	Bit 15 of Bitword Pad A
4600	**Bitword Pad B**	General-purpose 16-bit unsigned bitword B

4602	**Pad B bit 0**	Bit 0 of Bitword Pad B
4604	**Pad B bit 1**	Bit 1 of Bitword Pad B
4606	**Pad B bit 2**	Bit 2 of Bitword Pad B
4608	**Pad B bit 3**	Bit 3 of Bitword Pad B
4610	**Pad B bit 4**	Bit 4 of Bitword Pad B
4612	**Pad B bit 5**	Bit 5 of Bitword Pad B
4614	**Pad B bit 6**	Bit 6 of Bitword Pad B
4616	**Pad B bit 7**	Bit 7 of Bitword Pad B
4618	**Pad B bit 8**	Bit 8 of Bitword Pad B
4620	**Pad B bit 9**	Bit 9 of Bitword Pad B
4622	**Pad B bit 10**	Bit 10 of Bitword Pad B
4624	**Pad B bit 11**	Bit 11 of Bitword Pad B
4626	**Pad B bit 12**	Bit 12 of Bitword Pad B
4628	**Pad B bit 13**	Bit 13 of Bitword Pad B
4630	**Pad B bit 14**	Bit 14 of Bitword Pad B
4632	**Pad B bit 15**	Bit 15 of Bitword Pad B

Parameters **Pad 0, Pad 1, Pad 2, Pad 3, Pad 4, Pad 5, Pad 6 and Pad 7** are floating-point variables and can be set via programmable analog inputs 1, 2, or 3 (see section 6.17.3).

Parameters **Pad 8, Pad 9, Pad 10, Pad 11, Pad 12, Pad 13, Pad 14 and Pad 15** are 16-bit signed integers and can be assigned to programmable analog outputs 1, 2, 3, or 4 (see section 6.17.4).

The parameter **Bitword Pad A** is a 16-bit unsigned integer whose bits 0 to 15 are directly accessible for read/write operations through the corresponding dedicated parameters **Pad A bit 0 to Pad A bit 15** (see figure 6-107), which can be set via programmable digital inputs 1 to 8 (see section 6.17.1).

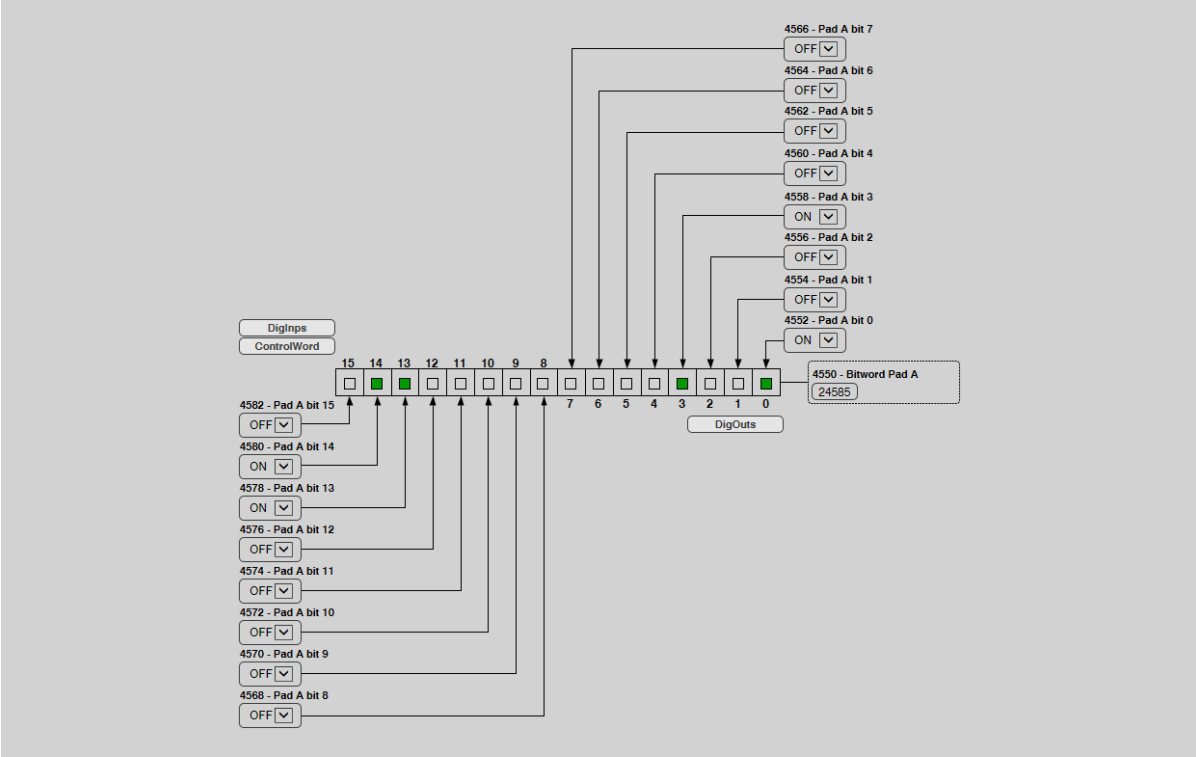


Figure 6-107: Configuration diagram of the Bitword Pad A variable

The parameter **Bitword Pad B** is a 16-bit unsigned integer whose bits 0 to 15 are directly accessible for read/write operations through the corresponding dedicated parameters **Pad B bit 0 to Pad B bit 15** (see figure 6-108), which can be set via programmable digital inputs 1 to 8 (see section 6.17.1).

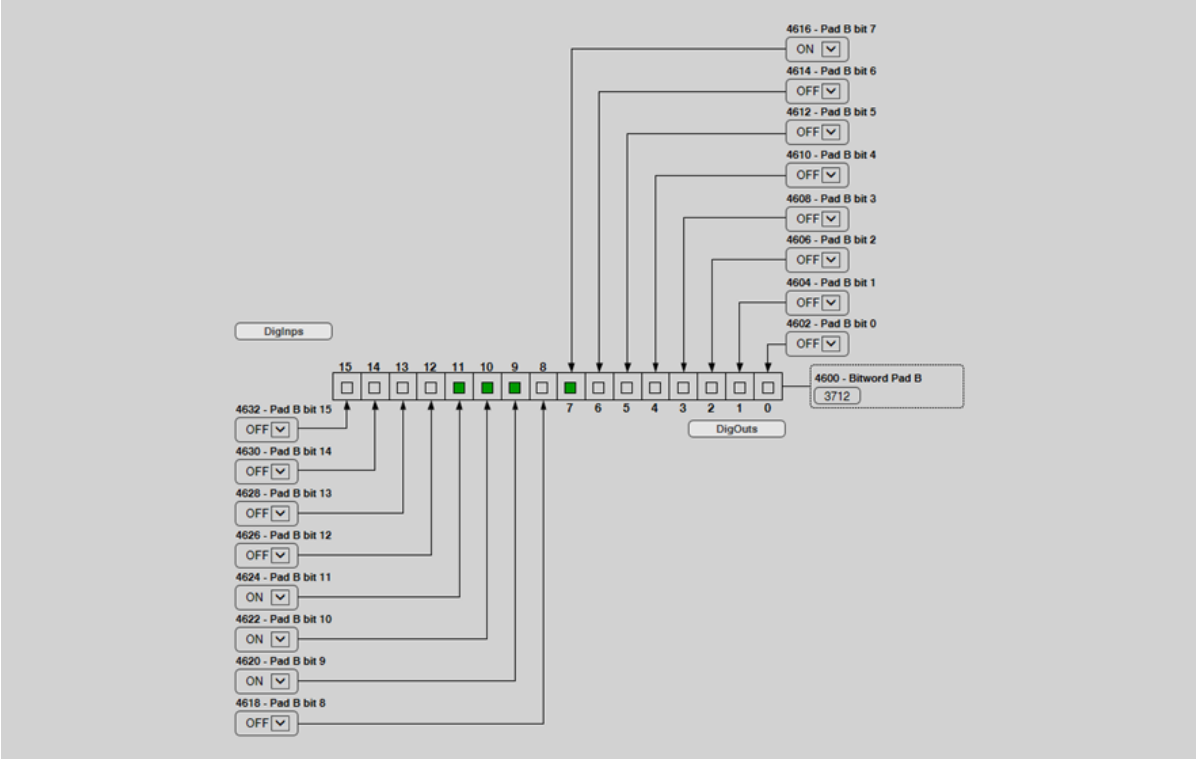


Figure 6-108: Configuration diagram of the Bitword Pad B variable

The individual bits of the **Bitword Pad A** and **Bitword Pad B** parameters can be assigned to programmable digital outputs 1, 2, 3, 4, 5, 6, 7, 8, R1, or R2 (see section 6.17.2), using the selections **Pad A bit** or **Pad B bit**. The assignment follows a predefined rule based on the bit position (example below refers to Pad A, and is analogous for Pad B):

- If IPA 3200-**Digital output 1 sel = Pad A bit** then **Digital output 1 mon** = status of **Pad A bit 0**
- If IPA 3202-**Digital output 2 sel = Pad A bit** then **Digital output 2 mon** = status of **Pad A bit 1**
- If IPA 3204-**Digital output 3 sel = Pad A bit** then **Digital output 3 mon** = status of **Pad A bit 2**
- If IPA 3206-**Digital output 4 sel = Pad A bit** then **Digital output 4 mon** = status of **Pad A bit 3**
- If IPA 3208-**Digital output 5 sel = Pad A bit** then **Digital output 5 mon** = status of **Pad A bit 4**
- If IPA 3210-**Digital output 6 sel = Pad A bit** then **Digital output 6 mon** = status of **Pad A bit 5**
- If IPA 3212-**Digital output 7 sel = Pad A bit** then **Digital output 7 mon** = status of **Pad A bit 6**
- If IPA 3214-**Digital output 8 sel = Pad A bit** then **Digital output 8 mon** = status of **Pad A bit 7**

6.19 Communication interface

The **COMMUNICATION** menu provides the parameters for configuring the converter's communication interfaces. Each function is managed through a dedicated submenu, described in detail below.

6.19.1 Network configuration

The drive's network communication can be configured using the following parameters in the **COMMUNICATION\ NETWORK CONFIG** menu:

IPA		DESCRIPTION
9562	**IP address**	Display of IP address in use
9564	**IP netmask**	Subnet IP address in use
9566	**IP gateway**	Gateway IP address in use
9604	**IP assignment**	IP address assignment. **0 DHCP**: the drive's IP address is assigned by the network's DHCP server. If there is no DHCP server, the drive waits for about 3 minutes, then takes the static IP address configured via parameter (IPA 9556-**IP address set**, default = 169.254.10.10). Typical use case: drive connected to a network with multiple devices. **1 Static:** the drive's IP address is assigned via the IPA 9556-**IP address** set parameter, default = 169.254.10.10. Typical use case: drive connected directly to the PC.

9556	**IP address set**	Network IP address settings
9558	**IP netmask set**	Subnet IP address setting
9560	**IP gateway set**	Gateway IP address setting
9200	**Wi-Fi fw version**	Indicates the FW version of the **Wi-Fi Drive Link** module connected to the drive
9202	**Wi-Fi S/N**	Indicates the serial number of the **Wi-Fi Drive Link** module connected to the drive
9204	**Wi-Fi network name**	Name of the Wi-Fi network generated by the **Wi-Fi Drive Link** module
9206	**Wi-Fi network pwd**	Password used to connect to the network generated by the **Wi-Fi Drive Link** module

6.19.2 Fieldbus configuration

The **R-TPD500** control board is equipped with an optional interface for standard fieldbus communication:

- **PROFIBUS** - EXP-PDP-TPD500
- **PROFINET** - EXP-ETH-PN-TPD500
- **EtherNet/IP** - EXP-ETH-IP-TPD500

Fieldbus-based communication, where the converter operates as a slave device, can be configured using the following parameters in the **COMMUNICATION\FIELDBUS CONFIG** menu:

IPA		DESCRIPTION
6000	**Fieldbus enable**	Parameter for enabling communication with the fieldbus. When set to *ON*, it activates the fieldbus communication card, thus establishing data exchange with the PLC.
6002	**Fieldbus type**	Monitor of the type of fieldbus module installed. The following displays are possible: **0 None:** no fieldbus connected or module not recognised **137 PROFINET**: PROFINET RT fieldbus **5 PROFIBUS**: PROFIBUS DP V2 fieldbus **155 EtherNet/IP**: EtherNet/IP fieldbus
6004	**Fieldbus state**	Monitor of the status of the installed field bus module. The following displays are possible: **0 Setup**: the module is in setup mode **1 Init**: the module is performing operations related to network initialisation **2 Wait process**: the network is temporarily inactive or waiting for the PLC master **3 Idle**: the network is waiting **4 Active**: the fieldbus network is processing data correctly with no problems **5 Error**: the network is in error **7 Exception**: the module has generated an error exception from which it has not been possible to restore correct operation
6006	**Fieldbus baudrate**	Fieldbus baud rate selection. The following selections are possible: **0 Auto**: communication speed negotiation is handled at the PLC master level **1 125k**: network speed 125 kbps **2 250k**: network speed 250 kbps **3 500k**: network speed 500 kbps **4 1M**: network speed 1 Mbps
6008	**Fieldbus address**	Fieldbus address if permitted by the protocol (PROFIBUS)
6010	**Fieldbus IP address**	Fieldbus IP address if permitted by the protocol (PROFINET, EtherNet/IP)
6012	**Fieldbus IP netmask**	Fieldbus netmask if permitted by the protocol (PROFINET, EtherNet/IP)
6014	**Fieldbus DHCP enable**	DHCP enable parameter if permitted by the protocol (PROFINET, EtherNet/IP)

6.19.3 Fieldbus - Master/Slave

Once an optional fieldbus communication interface is installed, it is possible to exchange up to sixteen parameters simultaneously from the master (PLC) to the slave (converter) in cyclic mode (commonly referred to as "process data" or PDO).

The **COMMUNICATION\FIELDBUS MS** menu allows the configuration of converter (slave) parameters to be assigned by the PLC (master) via cyclic fieldbus communication.

IPA		DESCRIPTION
6020	**Fieldbus MS 1 ipa**	Channel 1 configuration parameter from master to slave
6030	**Fieldbus MS 2 ipa**	Channel 2 configuration parameter from master to slave
6040	**Fieldbus MS 3 ipa**	Channel 3 configuration parameter from master to slave
6050	**Fieldbus MS 4 ipa**	Channel 4 configuration parameter from master to slave
6060	**Fieldbus MS 5 ipa**	Channel 5 configuration parameter from master to slave
6070	**Fieldbus MS 6 ipa**	Channel 6 configuration parameter from master to slave
6080	**Fieldbus MS 7 ipa**	Channel 7 configuration parameter from master to slave
6090	**Fieldbus MS 8 ipa**	Channel 8 configuration parameter from master to slave
6100	**Fieldbus MS 9 ipa**	Channel 9 configuration parameter from master to slave
6110	**Fieldbus MS 10 ipa**	Channel 10 configuration parameter from master to slave
6120	**Fieldbus MS 11 ipa**	Channel 11 configuration parameter from master to slave
6130	**Fieldbus MS 12 ipa**	Channel 12 configuration parameter from master to slave
6140	**Fieldbus MS 13 ipa**	Channel 13 configuration parameter from master to slave
6150	**Fieldbus MS 14 ipa**	Channel 14 configuration parameter from master to slave
6160	**Fieldbus MS 15 ipa**	Channel 15 configuration parameter from master to slave
6170	**Fieldbus MS 16 ipa**	Channel 16 configuration parameter from master to slave
6024	**Fieldbus MS 1 div**	Divider of the value received on channel 1 from master to slave
6034	**Fieldbus MS 2 div**	Divider of the value received on channel 2 from master to slave
6044	**Fieldbus MS 3 div**	Divider of the value received on channel 3 from master to slave
6054	**Fieldbus MS 4 div**	Divider of the value received on channel 4 from master to slave
6064	**Fieldbus MS 5 div**	Divider of the value received on channel 5 from master to slave
6074	**Fieldbus MS 6 div**	Divider of the value received on channel 6 from master to slave
6084	**Fieldbus MS 7 div**	Divider of the value received on channel 7 from master to slave
6094	**Fieldbus MS 8 div**	Divider of the value received on channel 8 from master to slave
6104	**Fieldbus MS 9 div**	Divider of the value received on channel 9 from master to slave
6114	**Fieldbus MS 10 div**	Divider of the value received on channel 10 from master to slave
6124	**Fieldbus MS 11 div**	Divider of the value received on channel 11 from master to slave
6134	**Fieldbus MS 12 div**	Divider of the value received on channel 12 from master to slave
6144	**Fieldbus MS 13 div**	Divider of the value received on channel 13 from master to slave
6154	**Fieldbus MS 14 div**	Divider of the value received on channel 14 from master to slave
6164	**Fieldbus MS 15 div**	Divider of the value received on channel 15 from master to slave
6174	**Fieldbus MS 16 div**	Divider of the value received on channel 16 from master to slave
6022	**Fieldbus MS 1 mon**	Monitor of the value received on channel 1 from master to slave
6032	**Fieldbus MS 2 mon**	Monitor of the value received on channel 2 from master to slave
6042	**Fieldbus MS 3 mon**	Monitor of the value received on channel 3 from master to slave
6052	**Fieldbus MS 4 mon**	Monitor of the value received on channel 4 from master to slave
6062	**Fieldbus MS 5 mon**	Monitor of the value received on channel 5 from master to slave
6072	**Fieldbus MS 6 mon**	Monitor of the value received on channel 6 from master to slave
6082	**Fieldbus MS 7 mon**	Monitor of the value received on channel 7 from master to slave
6092	**Fieldbus MS 8 mon**	Monitor of the value received on channel 8 from master to slave
6102	**Fieldbus MS 9 mon**	Monitor of the value received on channel 9 from master to slave
6112	**Fieldbus MS 10 mon**	Monitor of the value received on channel 10 from master to slave
6122	**Fieldbus MS 11 mon**	Monitor of the value received on channel 11 from master to slave

6132	**Fieldbus MS 12 mon**	Monitor of the value received on channel 12 from master to slave
6142	**Fieldbus MS 13 mon**	Monitor of the value received on channel 13 from master to slave
6152	**Fieldbus MS 14 mon**	Monitor of the value received on channel 14 from master to slave
6162	**Fieldbus MS 15 mon**	Monitor of the value received on channel 15 from master to slave
6172	**Fieldbus MS 16 mon**	Monitor of the value received on channel 16 from master to slave

Sixteen sets of configuration parameters are available: **Fieldbus MS 1…16 ipa**, **Fieldbus MS 1…16 div** and **Fieldbus MS 1…16 mon**, one for each data item that can be assigned to the converter via fieldbus communication.
Each **Fieldbus MS 1…16 ipa** parameter must contain the IPA of the parameter to be assigned, as shown in the following examples:

- To write **Ramp reference 1** (IPA 1800-**Ramp ref 1 dig**) via fieldbus, set **Fieldbus MS 1 ipa = 1800** (or any of the available channels).
- To write **Positive current limit** (IPA 1104-**C/T lim pos dig**) via fieldbus, set **Fieldbus MS 2 ipa = 1104** (or any of the available channels).
- To write the **Control word** (IPA 6450-**Control word dig**) via fieldbus, set **Fieldbus MS 3 ipa = 6450** (or any of the available channels).

For the parameters to be correctly assigned based on the values sent by the PLC, the fieldbus must be enabled by setting IPA 6000-**Fieldbus enable** = *ON*, and communication must be active and error-free, as indicated by IPA 6004 – **Fieldbus state** = *Active*.
In this case, the original values of the assigned parameters will be irreversibly overwritten.

The **Fieldbus MS 1…16 div** parameters are monitors of the division factors, which are automatically calculated by the drive each time a channel is configured via **Fieldbus MS 1…16 ipa**, based on the type and display format of the mapped parameter. Typical values include 1, 10, 100, and 1000, as shown in the following examples:

- If **Fieldbus MS 1 ipa = 1800**, then **Fieldbus MS 1 div = 10**, since IPA 1800-**Ramp ref 1 dig** is a floating-point value with one decimal place.
- If **Fieldbus MS 2 ipa = 900**, then **Fieldbus MS 2 div = 100**, since IPA 900-**Speed reg P** is a floating-point value with two decimal places.
- If Fieldbus **MS 3 ipa = 6450**, then **Fieldbus MS 3 div = 1**, since IPA 6450-**Control word dig** is an integer value.

The Fieldbus **MS 1…16 mon** parameters are 32-bit signed integer monitors that indicate the value which must be transmitted by the PLC to the master in order for the corresponding parameter to assume the correct value, as shown in the following examples:

- To write **Ramp reference 1** (IPA 1800-**Ramp ref 1 dig**) via fieldbus with a value of 500.5 rpm:
  After setting **Fieldbus MS 1 ipa = 1800**, the drive sets **Fieldbus MS 1 div = 10**.
  Therefore, the PLC must send **Fieldbus MS 1 mon = 5005** (500.5 × 10, since div = 10).
- To write the **Speed regulator gain** (IPA 900-**Speed reg P**) via fieldbus with a value of 20.05%:
  After setting **Fieldbus MS 2 ipa = 900**, the drive sets **Fieldbus MS 2 div = 100**.
  Therefore, the PLC must send **Fieldbus MS 2 mon = 2005** (20.05 × 100, since div = 100).
- To write the **Control word** (IPA 6450-**Control word dig**) via fieldbus with a value of 65535:
  After setting **Fieldbus MS 3 ipa = 6450**, the drive sets **Fieldbus MS 3 div = 1**.
  Therefore, the PLC must send **Fieldbus MS 3 mon = 65535** (65535 × 1, since div = 1).

The PLC must therefore transmit on the bus a 32-bit signed integer value equal to the product of the desired value of the parameter to be written (in engineering units), as configured on each channel, and the corresponding division factor automatically calculated by the drive during channel configuration.
Even float-type parameters must be transmitted as 32-bit signed integers.

Value transmitted on the bus (channel n) = Value to be assigned to the parameter (channel n) × Division factor (channel n)

Many of the parameters that can be assigned via cyclic fieldbus communication can also be written via analog inputs. However, analog inputs have higher priority than the corresponding user parameters.

Therefore, for fieldbus writing to be effective, it is necessary to check that the parameter to be written is not already configured as the destination of an analog input—and if so, to remove that assignment. Refer to the following example:

- IPA 1800-**Ramp ref 1 dig** is the ramp reference 1 user value (manually assignable or assignable via fieldbus by setting IPA 6020-**Fieldbus MS 1 ipa = 1800**)
- IPA 1804-**Ramp ref 1 mon** is the monitor of ramp reference 1, corresponding to the actual value applied to the reference chain (see figure 6-14)
- If **An input 1 dest** is set to **Ramp ref 1**, then IPA 1800-**Ramp ref 1 dig** becomes ineffective, even if it is written via fieldbus. The actual reference value, as shown by IPA 1804-**Ramp ref 1 mon**, is controlled by the signal level of analog input 1, as highlighted in the selector of the following diagram:

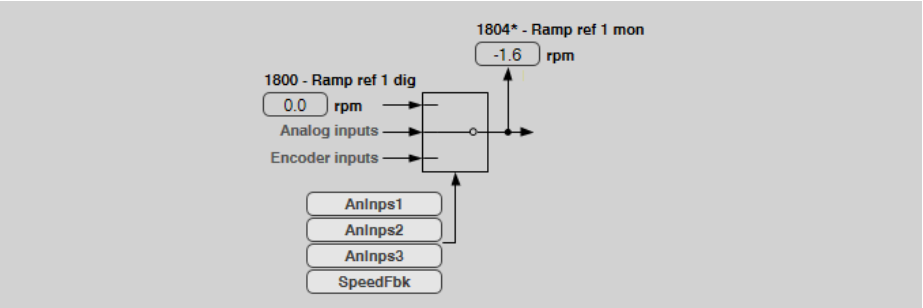


Figure 6-109: Operating logic when An input 1 dest = Ramp ref 1

NOTE!

- Therefore, if IPA 6020-**Fieldbus MS 1 ipa = 1800**, fieldbus writing - although functioning correctly - will be ineffective because:
- **Ramp ref 1 dig** = numerical value correctly received from fieldbus channel 1
- **Ramp ref 1 mon** = analog input 1 value (this is the value actually applied to the reference chain)

- Conversely, if IPA 3400-**An input 1 dest** is set to **OFF** or to any value other than **Ramp ref 1, Ramp ref 1 mon** follows **Ramp ref 1 dig**, as shown by the selector switching in the following diagram:

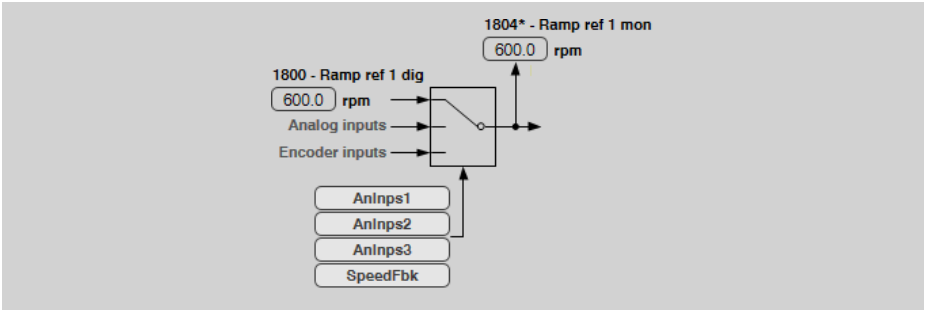


Figure 6-110: Operating logic when An input 1 dest ≠ Ramp ref 1

Therefore, if IPA 6020-**Fieldbus MS 1 ipa = 1800** fieldbus writing is effective, and the result is:

- **Ramp ref 1 mon = Ramp ref 1 dig** = numerical value received from fieldbus channel 1

NOTE!

Not all parameters can be written via cyclic fieldbus communication. The drive accepts in the **Fieldbus MS 1...16 ipa** configuration channels only writable parameters that, by their function, are suitable for this type of communication. These typically include ramp and speed references, current references, current limits, control words, digital enable/start commands, regulator gains, and PAD variables used in **WEG_DriveLogic** applications.

All other parameters related to system configuration - such as motor nameplate data or other parameters set once during commissioning - are not considered process data. However, they can still be exchanged over the fieldbus using acyclic communication (refer to the Fieldbus manuals for details).

6.19.4 Bus di campo - Slave/Master

Once an optional fieldbus communication interface is installed, it is possible to exchange up to sixteen parameters simultaneously from the slave (converter) to the master (PLC) in cyclic mode (commonly referred to as "process data" or PDO).

The **COMMUNICATION\FIELDBUS SM** menu allows the configuration of converter (slave) parameters to be transmitted to the PLC (master) via cyclic fieldbus communication.

IPA		DESCRIPTION
6220	**Fieldbus SM 1 ipa**	Channel 1 configuration parameter from slave to master
6230	**Fieldbus SM 2 ipa**	Channel 2 configuration parameter from slave to master
6240	**Fieldbus SM 3 ipa**	Channel 3 configuration parameter from slave to master
6250	**Fieldbus SM 4 ipa**	Channel 4 configuration parameter from slave to master
6260	**Fieldbus SM 5 ipa**	Channel 5 configuration parameter from slave to master
6270	**Fieldbus SM 6 ipa**	Channel 6 configuration parameter from slave to master
6280	**Fieldbus SM 7 ipa**	Channel 7 configuration parameter from slave to master
6290	**Fieldbus SM 8 ipa**	Channel 8 configuration parameter from slave to master
6300	**Fieldbus SM 9 ipa**	Channel 9 configuration parameter from slave to master
6310	**Fieldbus SM 10 ipa**	Channel 10 configuration parameter from slave to master
6320	**Fieldbus SM 11 ipa**	Channel 11 configuration parameter from slave to master
6330	**Fieldbus SM 12 ipa**	Channel 12 configuration parameter from slave to master
6340	**Fieldbus SM 13 ipa**	Channel 13 configuration parameter from slave to master
6350	**Fieldbus SM 14 ipa**	Channel 14 configuration parameter from slave to master
6360	**Fieldbus SM 15 ipa**	Channel 15 configuration parameter from slave to master
6370	**Fieldbus SM 16 ipa**	Channel 16 configuration parameter from slave to master
6222	**Fieldbus SM 1 mul**	Multiplier of the value sent on channel 1 from slave to master
6232	**Fieldbus SM 2 mul**	Multiplier of the value sent on channel 2 from slave to master
6242	**Fieldbus SM 3 mul**	Multiplier of the value sent on channel 3 from slave to master
6252	**Fieldbus SM 4 mul**	Multiplier of the value sent on channel 4 from slave to master
6262	**Fieldbus SM 5 mul**	Multiplier of the value sent on channel 5 from slave to master
6272	**Fieldbus SM 6 mul**	Multiplier of the value sent on channel 6 from slave to master
6282	**Fieldbus SM 7 mul**	Multiplier of the value sent on channel 7 from slave to master
6292	**Fieldbus SM 8 mul**	Multiplier of the value sent on channel 8 from slave to master
6302	**Fieldbus SM 9 mul**	Multiplier of the value sent on channel 9 from slave to master
6312	**Fieldbus SM 10 mul**	Multiplier of the value sent on channel 10 from slave to master
6322	**Fieldbus SM 11 mul**	Multiplier of the value sent on channel 11 from slave to master
6332	**Fieldbus SM 12 mul**	Multiplier of the value sent on channel 12 from slave to master
6342	**Fieldbus SM 13 mul**	Multiplier of the value sent on channel 13 from slave to master
6352	**Fieldbus SM 14 mul**	Multiplier of the value sent on channel 14 from slave to master
6362	**Fieldbus SM 15 mul**	Multiplier of the value sent on channel 15 from slave to master
6372	**Fieldbus SM 16 mul**	Multiplier of the value sent on channel 16 from slave to master

Sixteen sets of configuration parameters are available: **Fieldbus SM 1…16 ipa** and **Fieldbus SM 1…16 mul**, one for each data item that can be transmitted to the PLC via fieldbus communication.
Each **Fieldbus SM 1…16 ipa** parameter must be set to the IPA of the parameter to be transmitted, as shown in the following examples:

- To transmit **Armature current** (IPA 222-**Armature current [A]**) via fieldbus, set **Fieldbus SM 1 ipa = 222** (or any other available channel).
- To transmit the current **Speed regulator proportional gain** (IPA 908-**Speed reg P in use**) via fieldbus, set **Fieldbus SM 2 ipa = 908** (or any other available channel).
- To transmit the **Status word** (IPA 6432-**Status word mon**) via fieldbus, set **Fieldbus SM 3 ipa = 6432** (or any other available channel).

For the parameters to be correctly transmitted in line with the actual values on the slave, the fieldbus must be enabled by setting IPA 6000-**Fieldbus enable** = *ON*, and communication must be active and error-free, as indicated by IPA 6004-**Fieldbus state** = *Active*.

The **Fieldbus SM 1…16 mul** parameters are monitors of the multiplication factors, which are automatically calculated by the drive each time a channel is configured via **Fieldbus SM 1…16 ipa**, based on the type and display format of the mapped parameter. Typical values include 1, 10, 100, and 1000, as shown in the following examples:

- If **Fieldbus SM 1 ipa = 222**, then **Fieldbus SM 1 mul = 10**, since IPA 222-**Armature current [A]** is a float with one decimal place.
- If **Fieldbus SM 2 ipa = 908**, then **Fieldbus SM 2 mul = 100**, since IPA 908-**Speed reg P in use** is a float with two decimal places.
- If **Fieldbus SM 3 ipa = 6432**, then **Fieldbus SM 3 mul = 1**, since IPA 6432-**Status word mon** is an integer.

The converter transmits on the bus a 32-bit signed integer value equal to the product of the parameter value to be transmitted (in engineering units), as configured on each channel, and the corresponding multiplication factor automatically calculated by the drive during channel configuration.
Even float-type parameters are therefore transmitted as 32-bit signed integers.

Value transmitted on the bus (channel n) = Parameter value (channel n) × Multiplication factor (channel n).

The PLC must then independently perform the division between the value received on a given channel and the corresponding channel's multiplication factor before using it within its program.

NOTE!

Not all parameters can be transmitted via cyclic fieldbus communication. The drive accepts in the **Fieldbus SM 1…16 ipa** configuration channels only those parameters that, by their function, are suitable for this type of transmission. These typically include monitors of control-related physical quantities, ramp and speed reference monitors, current reference monitors, current limit monitors, status words, monitors of enable/start commands, and PAD variables used in **WEG_DriveLogic** applications.

All other parameters related to system configuration - such as motor nameplate data or parameters that are typically set only once during commissioning - are not considered process data. However, they can still be exchanged via fieldbus using acyclic communication (refer to the Fieldbus manuals for details).

6.19.5 Status Word

The **Status word** is a fully programmable word used for communication from the converter to the fieldbus, where each bit corresponds to specific information about the drive status.

In a typical configuration, the status word must be assigned to one of the sixteen communication channels **Fieldbus SM 1 ipa … Fieldbus SM 16 ipa** in the **COMMUNICATION\FIELDBUS SM** menu (see section 6.19.4).

The status word is managed through the following parameters in the **COMMUNICATION\STATUS WORD** menu.

IPA		DESCRIPTION
6400	**Status word 0 sel**	Selection of bit 0 of the status word
6402	**Status word 1 sel**	Selection of bit 1 of the status word
6404	**Status word 2 sel**	Selection of bit 2 of the status word
6406	**Status word 3 sel**	Selection of bit 3 of the status word
6408	**Status word 4 sel**	Selection of bit 4 of the status word
6410	**Status word 5 sel**	Selection of bit 5 of the status word
6412	**Status word 6 sel**	Selection of bit 6 of the status word
6414	**Status word 7 sel**	Selection of bit 7 of the status word
6416	**Status word 8 sel**	Selection of bit 8 of the status word
6418	**Status word 9 sel**	Selection of bit 9 of the status word
6420	**Status word 10 sel**	Selection of bit 10 of the status word
6422	**Status word 11 sel**	Selection of bit 11 of the status word
6424	**Status word 12 sel**	Selection of bit 12 of the status word
6426	**Status word 13 sel**	Selection of bit 13 of the status word
6428	**Status word 14 sel**	Selection of bit 14 of the status word
6430	**Status word 15 sel**	Selection of bit 15 of the status word
6432	**Status word mon**	Status word monitor, in hexadecimal format

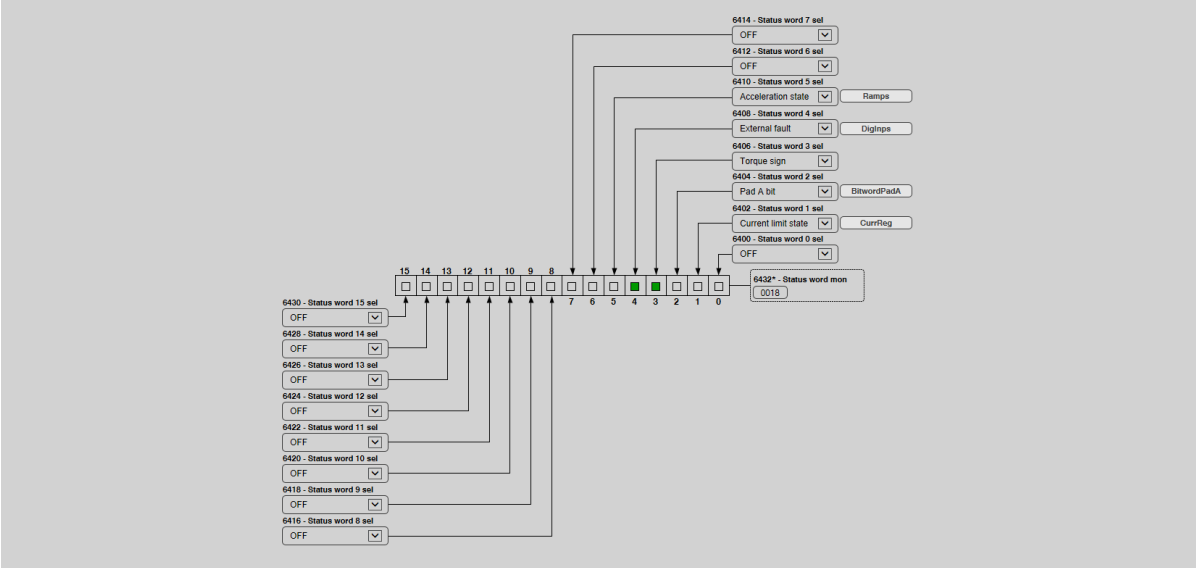


Figure 6-111: Configuration diagram for the Status word bit variable

Each bit (0…15) of the status word can be controlled by the following drive states:

0 **OFF**: bit set to 0 (logic low)
100 **ON**: bit set to 1 (logic high)
1 **Speed 0 thr**: zero speed detection
2 **Speed threshold**: speed within programmable thresholds
3 **Speed set**: speed reached within a programmable band
4 **Current limit state**: drive at current limit
5 **Drive ready**: drive in Ready state
6 **Motor overload free**: motor overload condition cleared
8 **Ramp +**: ramping up
9 **Ramp -**: ramping down
10 **Speed limited**: speed limitation active
11 **Undervoltage**: **Undervoltage** alarm active
12 **Overvoltage**: **Overvoltage** alarm active
13 **Heatsink**: **Heatsink** alarm active
14 **Overcurrent**: **Overcurrent** alarm active
15 **Motor overtemp**: **Motor overtemperature** alarm active
16 **External fault**: **External fault** alarm active
17 **Failure supply**: **Supply failure** alarm active
18 **Pad A bit**: state of **Bitword Pad A** bit n–1 on digital output n
19 **Pad B bit**: state of **Bitword Pad B** bit n–1 on digital output n
20 **Control word bit**: state of **Control word mon** bit n–1 on digital output n
21 **Torque sign**: sign of output torque
23 **Trip contactor**: shutdown completed after delayed stop
24 **Field loss**: **Field loss** alarm active
25 **Speed fbk loss**: **Speed feedback** loss alarm active
26 **Bus loss**: **Fieldbus loss** alarm active
30 **Enc 1 state ok**: **Encoder 1** in valid state
31 **Enc 2 state ok**: **Encoder 2** in valid state
35 **Enable seq err**: **Enable seq err** alarm active
42 **Drive ok**: no alarms active on the drive
49 **An inp 1 cmp match**: analog input 1 comparator match reached
50 **Enable state mon**: drive enable state active
51 **Start state mon**: drive start state active
52 **FastStop state mon**: fast stop state active
60 **Acceleration state**: acceleration ramp active
61 **Deceleration state**: deceleration ramp active
62 **Brake cmd mon**: mechanical brake open command
63 **Brake fault**: **Brake fault** alarm active
65 **Motor I2t alert**: motor overload warning at 80%
66 **Drive I2t alert**: drive overload warning at 80%
67 **Drive overload free**: drive overload condition cleared
68 **Motor I2t overload**: **Motor overload** alarm active
69 **Drive I2t overload**: **Drive overload** alarm active
70 **Arm curr threshold**: armature current threshold exceeded
71 **Overspeed**: **Overspeed** alarm active
72 **Delta freq err**: **Delta frequency** error alarm active

76 **Drv ready to start**: drive ready to start
77 **Remote control**: **Remot**e control mode active
80 **Firing**: armature circuit in firing (commutation) state
81 **Cont current**: output current in continuous conduction mode
82 **Sustained curr**: **Sustained** current alarm active

NOTE!

The digital outputs associated with alarm states remain meaningful even if the corresponding alarm is set to be ignored. For example, if IPA 5070-**EF activity = Ignore**, it is still possible to monitor the status of the alarm by assigning IPA 6400-**Status word 0 sel** to **External fault**).

6.19.6 Control Word

The **Control word** is a fully programmable word used for communication from the fieldbus to the converter, where each bit corresponds to a command for controlling the drive.

In a typical configuration, the control word must be assigned to one of the sixteen communication channels **Fieldbus MS 1 ipa … Fieldbus MS 16 ipa** in the **COMMUNICATION\FIELDBUS MS** menu (see section 6.19.3).

The control word is managed through the following parameters in the **COMMUNICATION\CONTROL WORD** menu.

IPA		DESCRIPTION
6450	**Control word dig**	Direct parameter on which to set the control word
6452	**Control word sel**	Control word source selector. In default conditions, it is equal to Control word dig, but other selections are also possible: **0 OFF**: all bits of the control word are set to 0 **1 Control word dig**: the **Control word dig** parameter is used as the control word **2 Pad 8**: IPA 4516-**Pad 8** is used as the control word **3 Pad 9**: IPA 4518-**Pad 9** is used as the control word **4 Pad 10**: IPA 4520-**Pad 10** is used as the control word **5 Pad 11**: IPA 4522-**Pad 11** is used as the control word **6 Pad 12**: IPA 4524-**Pad 12** is used as the control word **7 Pad 13**: IPA 4526-**Pad 13** is used as the control word **8 Pad 14**: IPA 4528-**Pad 14** is used as the control word **9 Pad 15**: IPA 4530-**Pad 15** is used as the control word **10 Bitword Pad A**: IPA 4550-**Bitword Pad A** is used as the control word **11 Bitword Pad B**: IPA 4600-**Bitword Pad B** is used as the control word
6454	**Control word 0 dest**	Selection of bit 0 function of the control word
6456	**Control word 1 dest**	Selection of bit 1 function of the control word
6458	**Control word 2 dest**	Selection of bit 2 function of the control word
6460	**Control word 3 dest**	Selection of bit 3 function of the control word
6462	**Control word 4 dest**	Selection of bit 4 function of the control word
6464	**Control word 5 dest**	Selection of bit 5 function of the control word
6466	**Control word 6 dest**	Selection of bit 6 function of the control word
6468	**Control word 7 dest**	Selection of bit 7 function of the control word
6470	**Control word 8 dest**	Selection of bit 8 function of the control word
6472	**Control word 9 dest**	Selection of bit 9 function of the control word
6474	**Control word 10 dest**	Selection of bit 10 function of the control word
6476	**Control word 11 dest**	Selection of bit 11 function of the control word
6478	**Control word 12 dest**	Selection of bit 12 function of the control word
6480	**Control word 13 dest**	Selection of bit 13 function of the control word
6482	**Control word 14 dest**	Selection of bit 14 function of the control word
6484	**Control word 15 dest**	Selection of bit 15 function of the control word
6486	**Control word mon**	Control word status monitor. Based on the value of the **Control word sel** parameter, the following value is obtained: • If **Control word sel** = **OFF**, then **Control word mon** = **0** • If **Control word sel** = **Control word dig**, then **Control word mon** = **Control word dig** • If **Control word sel** = **Pad 8**, then **Control word mon** = **Pad 8** (same for Pad 9…Pad 15) • If **Control word sel** = **Bitword Pad A**, then **Control word mon** = **Bitword Pad A** • If **Control word sel** = **Bitword Pad B**, then **Control word mon** = **Bitword Pad B**

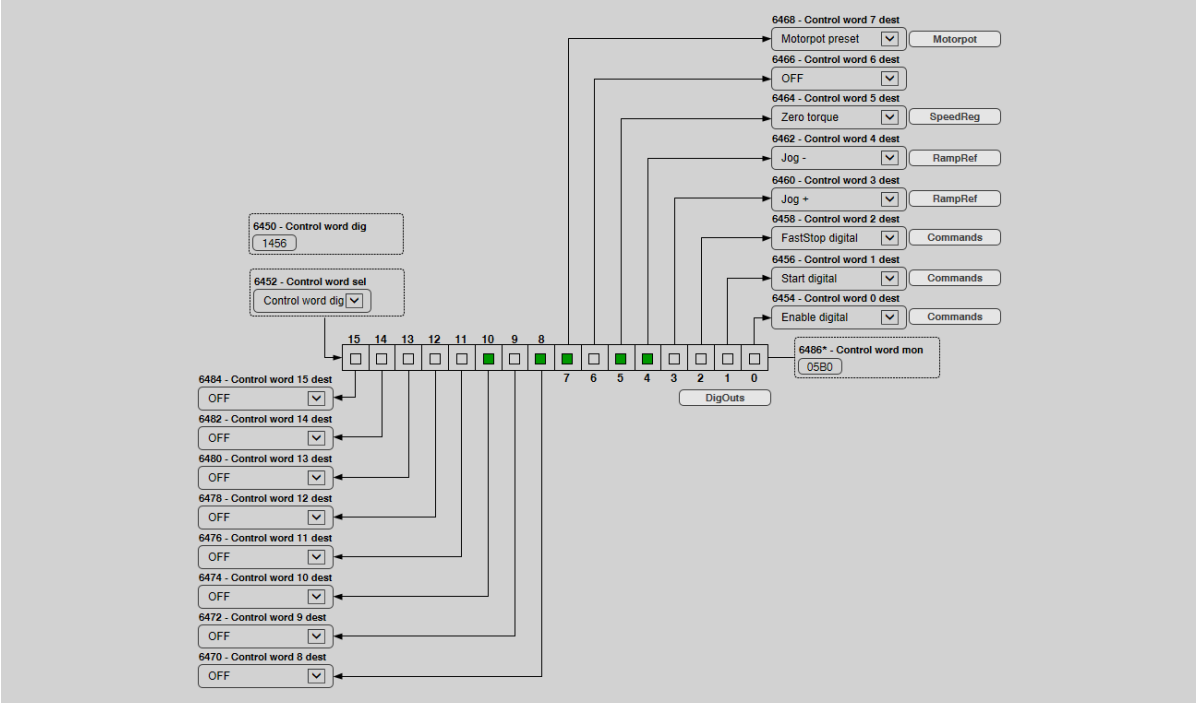


Figure 6-112: Configuration diagram of the Control word bit variable

For each bit (0…15) of the control word, the following functions (destinations) can be selected:

0 **OFF**: destination disabled, the input does not control any function
1 **Motorpot preset**: motor potentiometer preset command
2 **Motorpot up**: motor potentiometer increase command
3 **Motorpot down**: motor potentiometer decrease command
4 **Motorpot invert**: motor potentiometer inversion command
5 **Jog +**: jog + command
6 **Jog -**: jog – command
7 **Alarm reset**: alarm reset command (active if the alarm has cleared)
8 **C/T lim reduct cmd**: torque limit reduction command
10 **Ramp out = 0**: command to zero ramp output
11 **Ramp in = 0**: command to zero ramp input
12 **Ramp freeze**: ramp freeze command
13 **Speed reg lock**: disconnect speed regulator output from current regulator
14 **Speed reg lock I**: lock integral part of speed regulator
15 **Speed autocapture**: enable speed flying capture
16 **An input 1 sign +**: select positive sign for analog input 1
17 **An input 1 sign –**: select negative sign for analog input 1
18 **An input 2 sign +**: select positive sign for analog input 2
19 **An input 2 sign –**: select negative sign for analog input 2
20 **An input 3 sign +**: select positive sign for analog input 3
21 **An input 3 sign –**: select negative sign for analog input 3
22 **Zero torque**: zero torque command
23 **Multi speed sel 0**: bit 0 for multi-speed selection (speeds 1 to 7)
24 **Multi speed sel 1**: bit 1 for multi-speed selection (speeds 1 to 7)
25 **Multi speed sel 2**: bit 2 for multi-speed selection (speeds 1 to 7)
26 **Multi ramp sel 0**: bit 0 for multi-ramp selection (ramps 1 to 4)
27 **Multi ramp sel 1**: bit 1 for multi-ramp selection (ramps 1 to 4)
28 **Field loss ext**: external **Field loss** alarm signal
29 **Speed reg enable**: enable PI speed regulator
30 **Field reg enable**: enable field current regulator
31 **Field weak**: enable field weakening
32 **Field weak spd-0**: enable field weakening at zero speed
33 **PAD A bit 0**: force state (0/1) of Bitword Pad A bit 0
34 **PAD A bit 1**: force state (0/1) of Bitword Pad A bit 1
35 **PAD A bit 2**: force state (0/1) of Bitword Pad A bit 2
36 **PAD A bit 3**: force state (0/1) of Bitword Pad A bit 3
37 **PAD A bit 4**: force state (0/1) of Bitword Pad A bit 4
38 **PAD A bit 5**: force state (0/1) of Bitword Pad A bit 5
39 **PAD A bit 6**: force state (0/1) of Bitword Pad A bit 6
40 **PAD A bit 7**: force state (0/1) of Bitword Pad A bit 7
41 **PAD A bit 8**: force state (0/1) of Bitword Pad A bit 8
42 **PAD A bit 9**: force state (0/1) of Bitword Pad A bit 9

43 PAD A bit 10: force state (0/1) of Bitword Pad A bit 10
44 PAD A bit 11: force state (0/1) of Bitword Pad A bit 11
45 PAD A bit 12: force state (0/1) of Bitword Pad A bit 12
46 PAD A bit 13: force state (0/1) of Bitword Pad A bit 13
47 PAD A bit 14: force state (0/1) of Bitword Pad A bit 14
48 PAD A bit 15: force state (0/1) of Bitword Pad A bit 15
68 Forward: forward direction command
69 Reverse: reverse direction command
70 An input 1 enable: enable analog input 1
71 An input 2 enable: enable analog input 2
72 An input 3 enable: enable analog input 3
73 Droop enable: enable droop function
74 Enable digital: enable command in **Digital** mode
75 Start digital: start command in **Digital** mode
76 FastStop digital: fast stop command in **Digital** mode
84 Brake fbk: mechanical brake feedback
86 Adapt sel 1: bit 0 for adaptive speed set selection
87 Adapt sel 2: bit 1 for adaptive speed set selection
88 Wired FC enable: enable field control via FC unit with standard I/Os
89 Wired FC inv seq: field control active during inversion sequence
90 Wired FC active brg: current active bridge (positive or negative) of the FC unit

NOTE!

It is not possible to control the same function simultaneously via digital inputs and the control word.

For example, if **Digital input 1 dest = Zero torque** and **Control word 0 dest = Zero torque**, then **Digital input 1 dest** will automatically be set to **OFF** (and vice versa).

NOTE!

For some of the selectable functions in the control word bit destination list, there is also a corresponding ON/OFF user parameter. In such cases, the following general rule applies:

- IPA 2018-**Ramp in = 0** is the command to zero the ramp input, located in the **RAMPS** menu (see section 6.11)
- IPA 2020-**Ramp in = 0 mon** is the actual status of the command, also in the **RAMPS** menu
- IPA 6454-**Control word 0 dest** is set to **Ramp in = 0**
- In this case, the parameter **Ramp in = 0** becomes ineffective, and the actual status of the function - monitored by **Ramp in = 0 mon**, risulta comandato dal bit 0 della word di controllo

The control word therefore has higher priority than the corresponding user parameters of assignable commands (the same rule also applies to digital inputs).

6.19.7 RS485

The **R-TPD500** control board is also equipped with an interface for connecting the converter to a communication network based on the standard **Modbus-RTU protocol** operating over an **RS485 serial line**.
This enables point-to-point communication between the converter and a PC using the **WEG_DriveLabs** configuration tool, which operates as the Modbus-RTU master.

The **RS485 serial communication** based on the Modbus-RTU protocol, with the converter operating as a slave, can be configured using the following parameters in the **COMMUNICATION\RS485** menu:

IPA		DESCRIPTION
5900	**Serial address**	Allows you to set the address to which the converter responds when connected via RS485 serial line with Modbus-RTU protocol
5902	**Serial baudrate**	Allows you to set the serial communication speed. Five selections are available, expressed in bits per second: **0** 9600 bps **1** 19200 bps **2** 38400 bps **3** 57600 bps **4** 115200 bps
5904	**Serial frame**	Allows you to set the frame format for serial communication. There are six options available: **0 8-N-1**: 8 data bits, no parity bit, 1 stop bit **1 8-E-1**: 8 data bits, even parity, 1 stop bit **2 8-O-1**: 8 data bits, odd parity, 1 stop bit **3 8-N-2**: 8 data bits, no parity bit, 2 stop bits **4 8-E-2**: 8 data bits, even parity, 2 stop bits **5 8-O-2**: 8 data bits, odd parity, 2 stop bits

6.20 Alarm configuration

The drive includes a diagnostic system designed to manage various alarm signals in a flexible way.
The **ALARM CONFIG** menu provides the parameters for alarm management. Each alarm is handled through a dedicated submenu that allows individual configuration. These submenus are described in detail below.

The status of each alarm can also be assigned to a programmable digital output (see section 6.17.2).

All alarm menus share a similar structure based on the following generic settings (which may not always be available, depending on the type of alarm):

- **Alarm activity**: defines the type of drive response when the alarm is triggered. Up to six types of activity may be available, although in some cases the user cannot select the alarm reaction type:

  0 Ignore: no alarm message is displayed on the keypad and the drive takes no action.
  However, any digital output assigned to the alarm is still activated and requires a RESET after the alarm clears to be deactivated.
  1 Warning: an alarm message is displayed on the keypad (see section 5.1.2.10), but the drive takes no action.
  2 Disable: an alarm message is displayed on the keypad, and the drive is immediately disabled, causing the motor to coast to stop.
  3 Fast stop: an alarm message is displayed on the keypad, and the drive is stopped using the **Fast stop ramp** (see section 6.2.4). Once zero speed is reached, the drive is disabled.
  4 Stop: an alarm message is displayed on the keypad, and the drive is stopped using the currently active deceleration ramp. Once zero speed is reached, the drive is disabled.
  5 C/T lim stop: an alarm message is displayed on the keypad, and the drive is stopped by disabling ramp control and braking at the torque limits. Once zero speed is reached, the drive is disabled.

  Some alarms cannot be ignored and will necessarily disable the drive. In other cases, a controlled stop cannot be performed. However, signaling via digital output is always possible (if configured).
  The following table lists the possible actions for each type of alarm indication.

Table 6-8: Configurable drive responses to alarm events

ALARM	IGNORE	WARNING	DISABLE	FAST STOP	STOP	C\T LIM STOP
FAILURE SUPPLY			X			
UNDERVOLTAGE			X			
OVERVOLTAGE	X	X	X			
OVERSPEED	X	X	X	X	X	X
HEATSINK			X	X	X	X
MOTOR OVERTEMP	X	X	X	X	X	X
EXTERNAL FAULT	X	X	X	X	X	X
BRAKE FAULT	X	X	X	X	X	X
MOTOR I2T	X	X	X	X	X	X
DRIVE I2T	X	X	X	X	X	X
OVERCURRENT	X	X	X			
FIELD LOSS			X			
DELTA FREQ ERR	X	X	X			
SPEED FBK LOSS	X	X	X			
BUS LOSS	X	X	X	X	X	X
ENABLE SEQ ERR	X		X			
SUSTAINED CURR	X		X			

The following additional settings may also be available for alarms:

- **Alarm holdoff**: for certain alarms, it is possible to set a delay time between the occurrence of the alarm condition and its actual signaling. This helps to avoid undesired alarms caused by brief or fast transients. An alarm is effectively triggered and managed only if, after its initial detection, the condition remains active continuously for a duration equal to or greater than the configured holdoff time. If the alarm condition remains active for a shorter time than the holdoff time, the drive ignores it.
- **Alarm restart time**: for certain alarms, automatic restart is possible without user intervention.
- The restart time defines the time window within which the alarm condition must clear in order to allow automatic re-enabling of the converter. This is only valid if the corresponding **Alarm latch** parameter is set to *OFF*.
- **Alarm latch**: when set to *OFF*, it allows automatic restart without user intervention. When set to *ON*, restart is only possible - after the alarm condition has cleared - following a manual user action (pressing the **RST** key on the keypad or issuing the Alarm reset command via a programmed digital input). The latch setting also affects the behavior of the digital output associated with the alarm status:
  - If set to *OFF*, the output automatically returns to logic low once the alarm clears.

- If set to *ON*, the output returns to logic low only after the alarm clears and the user performs a manual reset (via the keypad or digital input).

- **OK Relay open**: for certain alarms, it is possible to configure the opening of a relay-type digital output (e.g., IPA 3216-**Relay 1 sel = Drive ok**) when the alarm is triggered, if the corresponding **OK Relay open** parameter is set to *ON*.
- **Alarm thresold**: for certain alarms based on comparison with a physical quantity (such as voltage, current, or speed), it is possible to set a programmable trigger threshold.

6.20.1 Failure supply

The **Failure supply** alarm indicates an anomaly in the power supply voltage, typically caused by a fault in the internal regulation circuit voltages. The alarm is also triggered if, while the converter is enabled, the voltage at terminals **U2 / V2** is lost (see section 4.2).

The parameters for managing the Failure supply alarm are available in the **ALARM CONFIG\FAILURE SUPPLY** menu.

IPA		DESCRIPTION
5000	**FS latch**	Defines the restart mode after the alarm has been triggered. If set to *OFF*, restarting occurs automatically and the digital output **Failure supply** automatically returns to the low logic level, while if set to *ON*, restarting also requires user intervention (pressing the **RST** button on the keypad or executing the **Alarm reset** command programmed on the digital inputs), which also causes the digital output Failure supply to return to the low logic level.
5002	**FS OK relay open**	Parameter to enable the command to open a digital relay output in the event of an alarm (e.g. IPA 3216-**Relay 1 sel = Drive ok**)

The alarm activity is not user-programmable.

6.20.2 Undervoltage

The **Undervoltage** alarm indicates a mains undervoltage condition when the converter is enabled. In this case, the drive is immediately disabled.

The parameters for managing the Undervoltage alarm are available in the **ALARM CONFIG\UNDERVOLTAGE** menu.

IPA		DESCRIPTION
5010	**UV holdoff**	Alarm holdoff time
5012	**UV restart time**	Alarm restart time. If the alarm returns within the restart time and **UV latch = OFF**, the drive attempts automatic restart
5014	**UV latch**	Alarm restart enable parameter. If **UV latch = OFF**, if the voltage returns within the **UV restart time**, the converter performs an automatic restart. To avoid speed oscillations when the voltage returns to normal, you can enable the motor speed fly capture function using parameter IPA 838-**Speed auto capture** (see section 6.13.1)
5016	**UV OK relay open**	Parameter to enable the command to open a digital relay output in the event of an alarm (e.g. IPA 3216-**Relay 1 sel = Drive ok**)
5018	**UV threshold**	Voltage threshold, expressed in [V], for alarm activation

The alarm activity is not user-programmable.

6.20.3 Overvoltage

The **Overvoltage** alarm indicates an armature overvoltage condition when the converter is enabled. The alarm is triggered when the voltage reaches 120% of the motor's nominal armature voltage.

The parameters for managing the Overvoltage alarm are available in the **ALARM CONFIG\OVERVOLTAGE** menu.

IPA		DESCRIPTION
5020	**OV activity**	Defines the behaviour of the drive when an alarm occurs. Three selections are possible: **0 Ignore**: the alarm is ignored **1 Warning**: the alarm is only signalled, without any action **2 Disable**: the drive is immediately disabled
5022	**OV holdoff**	Alarm holdoff time. If the condition persists for less than this time, the alarm is ignored

5024	**OV restart time**	Alarm restart time. If the alarm returns within the restart time and **OV latch = OFF**, the drive attempts automatic restart.
5026	**OV latch**	Alarm restart enable parameter. If **OV latch = OFF**, if the armature voltage drops within the **OV restart time**, the converter automatically restarts. To avoid speed oscillations when the voltage returns to normal, it is possible to enable the motor speed fly-by capture function using parameter IPA 838-**Speed auto capture** (see paragraph 6.13.1).
5028	**OV OK relay open**	Parameter to enable the command to open a digital relay output in the event of an alarm (e.g. IPA 3216-**Relay 1 sel = Drive ok**)

6.20.4 Overspeed

The **Overspeed** alarm indicates a motor overspeed condition when the converter is enabled. The alarm is triggered when the speed exceeds the threshold set in parameter IPA 5040-**OS threshold**.

The parameters for managing the Overspeed alarm are available in the **ALARM CONFIG\OVERSPEED** menu.

IPA		DESCRIPTION
5030	**OS activity**	Defines the behaviour of the drive when an alarm occurs. All possible selections are allowed: **0 Ignore**: the alarm is ignored **1 Warning**: the alarm is only signalled, without any action **2 Disable**: the drive is immediately disabled **3 Fast stop**: the drive executes the Fast stop ramp and then disables itself **4 Stop**: the drive executes the normal ramp and then disables itself **5 C/T lim stop**: the drive stops at the torque limits and then disables itself
5032	**OS holdoff**	Alarm holdoff time. If the condition persists for less than this time, the alarm is ignored
5034	**OS restart time**	Alarm restart time. If the alarm returns within the restart time and **OS latch = OFF**, the drive attempts automatic restart.
5038	**OS OK relay open**	Parameter to enable the command to open a digital relay output in the event of an alarm (e.g. IPA 3216-**Relay 1 sel = Drive ok**)
5040	**OS threshold**	Threshold, expressed in rpm, for alarm activation. It is initialised at 120% of the IPA 400-**Full scale speed**

6.20.5 Heatsink

The **Heatsink** alarm indicates an overtemperature condition on the heatsink.

The parameters for managing the Heatsink alarm are available in the **ALARM CONFIG\HEATSINK** menu.

IPA		DESCRIPTION
5050	**HS activity**	Defines the behaviour of the drive when an alarm occurs. Only selections that involve direct action on the drive are permitted, and the alarm cannot be ignored: **2 Disable**: the drive is immediately disabled **3 Fast stop**: the drive executes the Fast stop ramp and then disables itself **4 Stop**: the drive executes the normal ramp and then disables **5 C/T lim stop**: the drive stops at the torque limits and then disables
5052	**HS OK relay open**	Parameter to enable the command to open a digital relay output in the event of an alarm (e.g. IPA 3216-**Relay 1 sel = Drive ok**)

6.20.6 Motor overtemp

The **Motor overtemp** alarm indicates a motor overtemperature condition, detected via a thermistor connected to terminals **78–79** on the **R-TPD500** control board (see section 4.4.2).

The parameters for managing the **Motor overtemp** alarm are available in the **ALARM CONFIG\MOTOR OVERTEMP** menu.

IPA		DESCRIPTION
5060	**MotOT activity**	Defines the behaviour of the drive when an alarm occurs. All possible selections are permitted: **0 Ignore**: the alarm is ignored **1 Warning**: the alarm is only signalled, without any action **2 Disable**: the drive is immediately disabled **3 Fast stop**: the drive executes the Fast stop ramp and then disables itself **4 Stop**: the drive executes the normal ramp and then disables itself **5 C/T lim stop**: the drive stops at the torque limits and then disables itself
5062	**MotOT OK relay open**	Parameter to enable the command to open a digital relay output in the event of an alarm (e.g. IPA 3216-**Relay 1 sel = Drive ok**)

6.20.7 External fault

The **External fault alarm** indicates an external fault condition communicated to the drive by the absence of voltage at terminal **15** of the **R-TPD500** control board (see section 4.4.2).

The parameters for managing the External fault alarm are available in the **ALARM CONFIG\EXTERNAL FAULT** menu.

IPA		DESCRIPTION
5070	**EF activity**	Defines the behaviour of the drive when an alarm occurs. All possible selections are permitted: **0 Ignore**: the alarm is ignored **1 Warning**: the alarm is only signalled, without any action **2 Disable**: the drive is immediately disabled **3 Fast stop**: the drive executes the Fast stop ramp and then disables itself **4 Stop**: the drive executes the normal ramp and then disables itself **5 C/T lim stop**: the drive stops at the torque limits and then disables itself
5072	**EF holdoff**	Alarm holdoff time. If the condition persists for less than this time, the alarm is ignored
5074	**EF restart time**	Alarm restart time. If the alarm returns within the restart time and **EF latch = OFF**, the drive attempts automatic restart
5076	**EF latch**	Alarm restart enable parameter. If **EF latch = OFF**, if the voltage at terminal **15** returns within the **EF restart time**, the converter automatically restarts
5078	**EF OK relay open**	Parameter to enable the command to open a digital relay output in the event of an alarm (e.g. IPA 3216-**Relay 1 sel = Drive ok**)

6.20.8 Brake fault

The **Brake fault** alarm indicates a mismatch condition between the brake open/close command and its corresponding feedback signal (see section 6.18.10).

The parameters for managing the **Brake fault** alarm are available in the **ALARM CONFIG\BRAKE FAULT** menu.

IPA		DESCRIPTION
5080	**BF activity**	Defines the behaviour of the drive when an alarm occurs. All possible selections are permitted: **0 Ignore**: the alarm is ignored **1 Warning**: the alarm is only signalled, without any action **2 Disable**: the drive is immediately disabled **3 Fast stop**: the drive executes the Fast stop ramp and then disables itself **4 Stop**: the drive executes the normal ramp and then disables itself **5 C/T lim stop**: the drive stops at the torque limits and then disables itself
5082	**BF OK relay open**	Parameter to enable the command to open a digital relay output in the event of an alarm (e.g. IPA 3216-**Relay 1 sel = Drive ok**)

6.20.9 Motor I2t

The **Motor overload** alarm indicates a motor overload condition when parameter IPA 4314-**Motor I²t accum** reaches 100% (see section 6.18.8).

The parameters for managing the Motor overload alarm are available in the **ALARM CONFIG\MOTOR I2T** menu.

IPA		DESCRIPTION
5090	**MotI2t activity**	Defines the behaviour of the drive when an alarm occurs. All possible selections are permitted: **0 Ignore**: the alarm is ignored **1 Warning**: the alarm is only signalled, without any action **2 Disable**: the drive is immediately disabled **3 Fast stop**: the drive executes the Fast stop ramp and then disables itself **4 Stop**: the drive executes the normal ramp and then disables itself **5 C/T lim stop**: the drive stops at the torque limits and then disables itself
5092	**MotI2t latch**	Defines the restart mode after the alarm has been triggered. If set to *OFF*, restart occurs automatically after the IPA 4314-**Motor I2t accum** accumulator has been completely discharged (see paragraph 6.18.8) and the **Motor I2t overload** digital output automatically returns to the low logic level. while if set to *ON*, restarting also requires user intervention (pressing the RST button on the keypad or executing the Alarm reset command programmed on the digital inputs), which also causes the **Motor I2t overload** digital output to return to the low logic level.
5094	**MotI2t OK relay open**	Parameter to enable the command to open a digital relay output in the event of an alarm (e.g. IPA 3216-**Relay 1 sel = Drive ok**)

6.20.10 Drive I2t

The **Drive overload** alarm indicates a motor overload condition when parameter IPA 4322-**Drive I²t accum** reaches 100% (see section 6.18.8).

The parameters for managing the Drive overload alarm are available in the **ALARM CONFIG\DRIVE I2T** menu.

IPA		DESCRIPTION
5100	**DrvI2t activity**	Defines the behaviour of the drive when an alarm occurs. All possible selections are allowed: **0 Ignore**: the alarm is ignored **1 Warning**: the alarm is only signalled, without any action **2 Disable**: the drive is immediately disabled **3 Fast stop**: the drive executes the Fast stop ramp and then disables itself **4 Stop**: the drive executes the normal ramp and then disables itself **5 C/T lim stop**: the drive stops at the torque limits and then disables itself
5104	**DrvI2t OK relay open**	Parameter to enable the command to open a digital relay output in the event of an alarm (e.g. IPA 3216-**Relay 1 sel = Drive ok**)

6.20.11 Overcurrent

The **Overcurrent** alarm indicates a motor overcurrent condition when the converter is enabled. The alarm is triggered when the armature current exceeds the threshold set in parameter IPA 5120-**OC threshold**.

The parameters for managing the Overcurrent alarm are available in the **ALARM CONFIG\OVERCURRENT** menu.

IPA		DESCRIPTION
5110	**OC activity**	Defines the behaviour of the drive when an alarm occurs. All possible selections are permitted: **0 Ignore**: the alarm is ignored **1 Warning**: the alarm is only signalled, without any action **2 Disable**: the drive is immediately disabled
5112	**OC holdoff**	Alarm holdoff time. If the condition persists for less than this time, the alarm is ignored
5114	**OC restart time**	Alarm restart time. If the alarm returns within the restart time and **OC latch = OFF**, the drive attempts automatic restart
5116	**OC latch**	Alarm restart enable parameter. If **OC latch = OFF**, if the speed drops within the **OC restart time**, the converter automatically restarts.

5118	**OC OK relay open**	Parameter to enable the command to open a digital relay output in the event of an alarm (e.g. IPA 3216-**Relay 1 sel = Drive ok**)
5120	**OC threshold**	Alarm threshold, expressed as a percentage of the motor's rated armature current. It is initialised at 180%

6.20.12 Field Loss

The **Field loss** alarm indicates that the motor field current is too low when the converter is enabled.
The alarm is triggered when the field current drops below 50% of the minimum field current set in parameter IPA 1354-**Field min dig** (see section 6.15.2). In this case, the drive is immediately disabled.

The parameters for managing the Field loss alarm are available in the **ALARM CONFIG\FIELD LOSS** menu.

IPA		DESCRIPTION
5132	**FL holdoff**	Alarm holdoff time. If the condition persists for less than this time, the alarm is ignored
5134	**FL restart time**	Alarm restart time. If the alarm returns within the restart time and **FL latch = OFF**, the drive attempts automatic restart
5136	**FL latch**	Alarm restart enable parameter. If **FL latch = OFF**, if the speed drops within the **FL restart time**, the converter automatically restarts
5138	**FL OK relay open**	Parameter to enable the command to open a digital relay output in the event of an alarm (e.g. IPA 3216-**Relay 1 sel = Drive ok**)

The alarm activity cannot be programmed by the user.

6.20.13 Delta Frequency

The **Delta frequency** alarm indicates that the converter's three-phase supply frequency deviates too much from the nominal value detected at power-up.
The alarm threshold is defined as a programmable percentage of the three-phase supply frequency (50 Hz / 60 Hz), which is automatically calculated at startup and monitored in parameter IPA 202-**Mains frequency** (see section 6.3).

The parameters for managing the **Delta frequency** alarm are available in the **ALARM CONFIG\DELTA FREQUENCY** menu.

IPA		DESCRIPTION
5030	**DF activity**	Defines the behaviour of the drive when an alarm occurs. All possible selections are permitted: **0 Ignore**: the alarm is ignored **1 Warning**: the alarm is only signalled, without any action **2 Disable**: the drive is immediately disabled **3 Fast stop**: the drive executes the Fast stop ramp and then disables itself **4 Stop**: the drive executes the normal ramp and then disables itself **5 C/T lim stop**: the drive stops at the torque limits and then disables itself
5032	**DC holdoff**	Alarm holdoff time. If the condition persists for less than this time, the alarm is ignored
5034	**DF restart time**	Alarm restart time. If the alarm returns within the restart time and **DF latch = OFF**, the drive attempts automatic restart.
5036	**DF latch**	Alarm restart enable parameter. If **DF latch = OFF**, if the speed drops within the **DF restart time**, the converter automatically restarts.
5038	**DF OK relay open**	Parameter to enable the command to open a digital relay output in the event of an alarm (e.g. IPA 3216-**Relay 1 sel = Drive ok**)
5040	**DF threshold**	Threshold, expressed as a percentage of the mains frequency value calculated at start-up, for alarm activation

6.20.14 Speed Feedback Loss

The **Speed feedback loss** alarm indicates a missing or inconsistent motor speed feedback signal, based on encoder or tacho feedback (e.g., due to a fault, wiring issue, or incorrect configuration - see section 6.12.1), when the converter is enabled.

The parameters for managing the Speed feedback loss alarm are available in the **ALARM CONFIG\SPEED FBK LOSS** menu.

IPA		DESCRIPTION
5160	**SFL activity**	Defines the behaviour of the drive when an alarm occurs. All possible selections are allowed: **0 Ignore**: the alarm is ignored **1 Warning**: the alarm is only signalled, without any action **2 Disable**: the drive is immediately disabled
5162	**SFL holdoff**	Alarm holdoff time. If the condition persists for less than this time, the alarm is ignored
5164	**SFL code**	Hexadecimal code indicating the sensor identified as faulty. Combinations of the following values are possible: **0x2**: error on Encoder 1 **0x4**: error on Encoder 2 **0x8**: error on Tachometer
5168	**OC OK relay open**	Parameter to enable the command to open a digital relay output in the event of an alarm (e.g. IPA 3216-**Relay 1 sel = Drive ok**)

By using parameter IPA 656-**Speed fbk bypass** (see section 6.18.8), it is possible to enable automatic fallback to armature feedback in case of a fault or failure in the encoder or tacho feedback, without losing motor control or stopping the drive as a result of the Speed fbk loss alarm.
To use the feedback bypass function, the SFL activity parameter must be set to Ignore or Warning, in order to prevent the drive from being disabled when a fault condition is detected.

6.20.15 Bus Loss

The **Bus loss** alarm indicates a communication fault with the fieldbus.
The alarm is triggered when parameter IPA 6004-**Fieldbus state** (see section 6.19.2) is different from Active while the converter is enabled.

The parameters for managing the Bus loss alarm are available in the **ALARM CONFIG\BUS LOSS** menu.

IPA		DESCRIPTION
5170	**BLoss activity**	Defines the behaviour of the drive when an alarm occurs. All possible selections are allowed: **0 Ignore**: the alarm is ignored **1 Warning**: the alarm is only signalled, without any action **2 Disable**: the drive is immediately disabled **3 Fast stop**: the drive executes the Fast stop ramp and then disables itself **4 Stop**: the drive executes the normal ramp and then disables itself **5 C/T lim stop**: the drive stops at the torque limits and then disables itself
5172	**BLoss holdoff**	Alarm holdoff time. If the condition persists for less than this time, the alarm is ignored
5174	**Bloss restart time**	Alarm restart time. If the alarm returns within the restart time and **BLoss latch = OFF**, the drive attempts automatic restart
5176	**BLoss latch**	Alarm restart enable parameter. If **BLoss latch = OFF**, if the speed drops within the **BLoss restart time**, the converter performs an automatic restart
5178	**BLoss OK relay open**	Parameter to enable the command to open a digital relay output in the event of an alarm (e.g. IPA 3216-**Relay 1 sel = Drive ok**)

6.20.16 Enable Sequence Error

The **Enable sequence** error alarm indicates an error in the converter enable sequence.
The alarm is typically triggered when the converter is powered on and the enable terminal (see section 6.2.1) is already at a logic high level, in order to prevent the converter from starting without an explicit user command.

The parameters for managing the Enable sequence error alarm are available in the **ALARM CONFIG\ENABLE SEQ ERR** menu.

IPA		DESCRIPTION
5200	**EnSEQ activity**	Defines the behaviour of the drive when an alarm occurs. Only the following selections are permitted: **0 Ignore**: the alarm is ignored **2 Disable**: the drive is immediately disabled

5206	**EnSEQ latch**	Defines the restart mode after an alarm has been triggered. If set to *OFF*, restart is possible by lowering and raising the enable terminal, while if set to *ON*, user intervention is also required for restart (pressing the RST button on the keypad or executing the Alarm reset command programmed on the digital inputs).
5208	**EnSEQ OK relay open**	Parameter to enable the command to open a digital relay output in the event of an alarm (e.g. IPA 3216-**Relay 1 sel = Drive ok**)

The correct enable sequence to avoid triggering the **Enable seq err** alarm is described in the following steps, depending on the selected command mode (see section 6.2):

- If IPA 500-**Main commands = Terminals**

  1. Power up the control board.
  2. System hardware/software initialization: this takes a few seconds during which the keypad displays the message "Wait for loading…". At this stage, the enable terminal (12) can be in any logic state.
  3. At the end of the initialization, the enable terminal (12) must be at logic low and remain in this state for at least 1 second; otherwise, the Enable seq err alarm will be triggered.
  4. After 1 second, the enable terminal (12) can be set to logic high, enabling the drive.

- If IPA 500-**Main commands = Digital**

  1. Power up the control board.
  2. System hardware/software initialization: this takes a few seconds during which the keypad displays the message "Wait for loading…". At this stage, the enable terminal (12) can be in any logic state.
  3. At the end of the initialization, parameter IPA 520-**Enable digital** cmd must be *OFF* and remain in this state for at least 1 second. Otherwise, if the enable terminal (12) is at logic high and **Enable digital cmd = ON**, the **Enable seq err** alarm will be triggered.
  4. After 1 second, Enable digital cmd can be set to *ON* (accepted only if the enable terminal is also at logic high), thus enabling the drive.

After the **Enable seq err** alarm is triggered, a new start attempt can be made by resetting the alarm using the following steps:

- If IPA 5206-**EnSEQ latch** = **ON**

  1. Set the enable terminal (12) to logic low.
  2. Reset the alarm by either pressing the RST key on the keypad or executing the **Alarm reset** command assigned to a digital input.
  3. Perform a new enable sequence.

- If IPA 5206-**EnSEQ latch** = **OFF**

  1. Set the enable terminal (12) to logic low: in this case, the alarm is automatically reset without user intervention.
  2. Perform a new enable sequence.

6.20.17 Sustained current

The **Sustained current** alarm indicates that the converter was unable to bring the armature current to zero within a configurable time limit, following a bridge change command or a disable command.

The parameters for managing the Sustained current alarm are available in the **ALARM CONFIG\SUSTAINED CURR** menu.

IPA		DESCRIPTION
5220	**SC activity**	Defines the behaviour of the drive in the event of an alarm. Only the following selections are permitted: **0 Ignore**: the alarm is ignored **2 Disable**: the drive is immediately disabled
5226	**SC holdoff**	Alarm holdoff time. If the armature current condition remains non-zero for less than this time, the alarm is ignored
5228	**SC OK relay open**	Parameter to enable the open command of a digital relay output in the event of an alarm (e.g. IPA 3216-**Relay 1 sel = Drive ok**)

6.21 Recipe configuration

The **RECIPE CONFIG** menu provides configuration parameters for creating a fully customizable menu - accessible from both the keypad and **WEG_DriveLabs** - containing up to 24 parameters.
This feature allows grouping existing parameters of specific interest, even if located in different menus, to speed up access and navigation.

The menu created on the keypad is called **RECIPE**. By default, it is empty and can be accessed under the **RECIPE CONFIG** menu.

IPA		DESCRIPTION
5500	**Recipe config 1**	IPA of the parameter to be entered in position 1 of the **RECIPE** menu
5502	**Recipe config 2**	IPA of the parameter to be entered in position 2 of the **RECIPE** menu
5504	**Recipe config 3**	IPA of the parameter to be entered in position 3 of the **RECIPE** menu
5506	**Recipe config 4**	IPA of the parameter to be entered in position 4 of the **RECIPE** menu
5508	**Recipe config 5**	IPA of the parameter to be entered in position 5 of the **RECIPE** menu
5510	**Recipe config 6**	IPA of the parameter to be entered in position 6 of the **RECIPE** menu
5512	**Recipe config 7**	IPA of the parameter to be entered in position 7 of the **RECIPE** menu
5514	**Recipe config 8**	IPA of the parameter to be entered in position 8 of the **RECIPE** menu
5516	**Recipe config 9**	IPA of the parameter to be entered in position 9 of the **RECIPE** menu
5518	**Recipe config 10**	IPA of the parameter to be entered in position 10 of the **RECIPE** menu
5520	**Recipe config 11**	IPA of the parameter to be entered in position 11 of the **RECIPE** menu
5522	**Recipe config 12**	IPA of the parameter to be entered in position 12 of the **RECIPE** menu
5524	**Recipe config 13**	IPA of the parameter to be entered in position 13 of the **RECIPE** menu
5526	**Recipe config 14**	IPA of the parameter to be entered in position 14 of the **RECIPE** menu
5528	**Recipe config 15**	IPA of the parameter to be entered in position 15 of the **RECIPE** menu
5530	**Recipe config 16**	IPA of the parameter to be entered in position 16 of the **RECIPE** menu
5532	**Recipe config 17**	IPA of the parameter to be entered in position 17 of the **RECIPE** menu
5534	**Recipe config 18**	IPA of the parameter to be entered in position 18 of the **RECIPE** menu
5536	**Recipe config 19**	IPA of the parameter to be entered in position 19 of the **RECIPE** menu
5538	**Recipe config 20**	IPA of the parameter to be entered in position 20 of the **RECIPE** menu
5540	**Recipe config 21**	IPA of the parameter to be entered in position 21 of the **RECIPE** menu
5542	**Recipe config 22**	IPA of the parameter to be entered in position 22 of the **RECIPE** menu
5544	**Recipe config 23**	IPA of the parameter to be entered in position 23 of the **RECIPE** menu
5546	**Recipe config 24**	IPA of the parameter to be entered in position 24 of the **RECIPE** menu
5548	**Take recipe config**	**RECIPE** menu creation command

In each configuration parameter, it is possible to set the IPA of any parameter in the drive, regardless of the original menu it belongs to. Any non-existent or hidden IPA will be rejected.

It is also possible to include parameters created through **WEG_DriveLogic** applications.
Once the configuration is complete, the custom menu must be generated by executing parameter IPA 5548-**Take recipe config**.

Duplicate parameters cannot be included in the **RECIPE** menu. If a duplicated parameter is configured, it will still be accepted, but the previously inserted instance will be removed from the menu.

To remove a parameter from the **RECIPE** menu, set the corresponding parameter in **RECIPE CONFIG** to 0, and then re-execute IPA 5548-**Take recipe config**.

To save the newly created custom menu permanently, execute IPA 460-**Save parameters** (from the **DRIVE CONFIG** menu). This allows access to the menu even after powering off and restarting the drive.

To completely clear the **RECIPE** menu, execute IPA 470-**Load default** (from the **DRIVE CONFIG** menu); all configuration parameters will be reset to 0.

A fully configurable custom menu can also be created in the **WEG_DriveLabs** configurator. In this case, two Toolbar commands are available to interact with the **RECIPE CONFIG** menu on the keypad.

- Download **recipe** command:

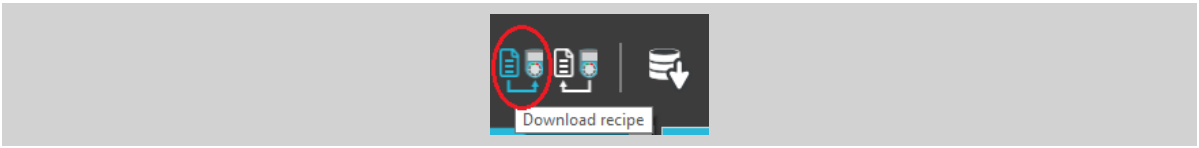


Figure 6-113: Icon for downloading the custom menu parameter list to the keypad

Allows downloading to the keypad a menu that has just been created in the configurator.
Proceed with the following steps:

1. In the **RECIPES** node of the configurator's tree menu, launch the Add recipe command to create a new custom menu, or select an existing **RECIPE** node.

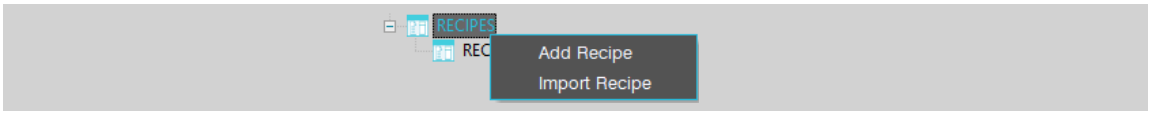


Figure 6-114: Creating a new custom menu

2. Assign a name to the newly created (and initially empty) menu node.

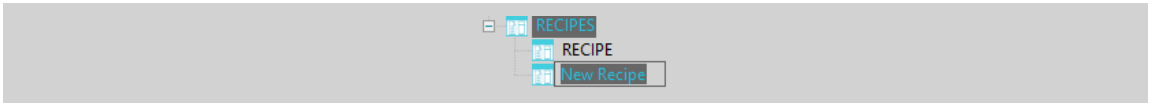


Figure 6-115: Custom menu name definition

3. Manually drag the desired parameters from the configurator menus into the newly created node.
4. Select the node and launch the Download recipe command.

Figure 6-116: Waiting message while downloading custom parameters to the keypad

At the end of the download, the **Take recipe config** command is executed automatically, and the **RECIPE** menu on the keypad will contain the same parameters as the node.
Alternatively, the existing **RECIPES\RECIPE** node can be used, following the same steps.
Execute IPA 460-**Save parameters** if you want to save the menu permanently.

- **Upload recipe** command:

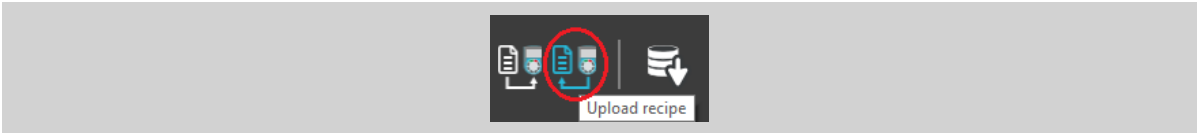


Figure 6-117: Icon for uploading the custom menu created on the keypad to the PC

Allows uploading a menu that was just created on the keypad to the configurator.
Proceed with the following steps:

1. In the **RECIPES** node of the configurator's tree menu, launch the **Add recipe** command to create a new custom menu, or select an existing RECIPE node.
2. Assign a name to the newly created menu node.
3. Select the node and launch the Upload recipe command.

Figure 6-118: Message indicating the loading of custom parameters from the keypad

At the end of the upload, the created node will contain the same parameters as the **RECIPE** menu on the keypad.
Alternatively, you can use the existing **RECIPES\RECIPE** node and repeat the same steps.

NOTE!

Downloading a custom menu only creates the same menu on the keypad; it does not modify the current values of the parameters in the menu being downloaded!

NOTE!

In **WEG_DriveLabs**, multiple recipes can be created and are viewable through the **RECIPES** node, while on the keypad, only one recipe is available, accessible through the **RECIPE** menu. This menu can be created directly on the keypad or downloaded from **WEG_DriveLabs**, as previously explained.

7. MAINTENANCE

7.1 Handlig and care

WARNING!

Before performing any cleaning or maintenance operation, whether ordinary or extraordinary, always disconnect the device from the power supply.

TPD500 series drives must be installed exclusively in accordance with the mounting and installation instructions provided in this manual.

After commissioning, the device does not require any special care - only a few simple guidelines regarding cleaning and connection checks must be followed:

- For cleaning the device, use only dry cloths; the use of wet or damp cloths is strictly prohibited.
- To remove dust and foreign objects, a vacuum cleaner or compressed air (maximum 1 bar) may also be used.
- Two weeks after initial startup, check that all terminals and connection points are tightened according to the specified torque values. This operation should be repeated annually.

7.2 Repairs

It is strongly recommended that any repairs to the device be carried out exclusively by qualified personnel authorized by WEG Automation Europe. Please contact: technohelp@weg.net

If spare parts need to be ordered, keep the following points in mind. When ordering spare parts, do not simply indicate the device type. Also specify:

- The serial number, as shown on the nameplate;
- The type of control board and the system software version (these can be found on the EEPROM of the R-TPD500 control board).

When replacing boards, ensure that the configuration of switches and jumpers on the replacement board exactly matches that of the original components.

In particular, pay close attention to dip-switch S15 on the control board, as it defines the rated current of the device.

NOTE!

An incorrect configuration or improper adjustment of this dip-switch may cause damage to the equipment.
Any faults or damage resulting from such actions shall not be the responsibility of the manufacturer.

7.3 Control board firmware update

The control board firmware update can be performed in one of the following two ways.

NOTE!

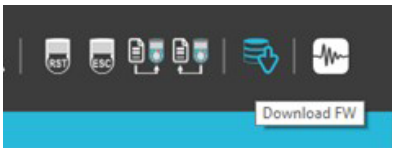
This procedure must be carried out when the drive is not operating the motor or the load.

NOTE!

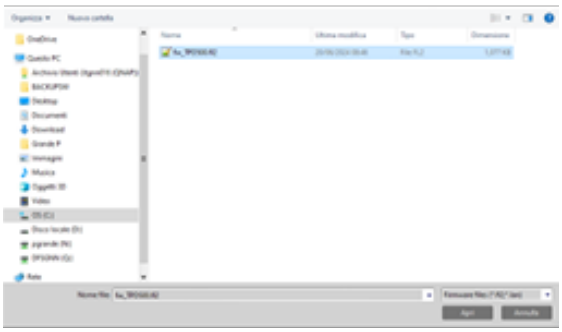
After a firmware update, all parameters will be reset to their default values. Therefore, all parameters must be reconfigured to ensure proper operation. We recommend saving the parameters on your PC or a USB flash drive before starting the procedure.

Using the WEG_DriveLabs configuration software

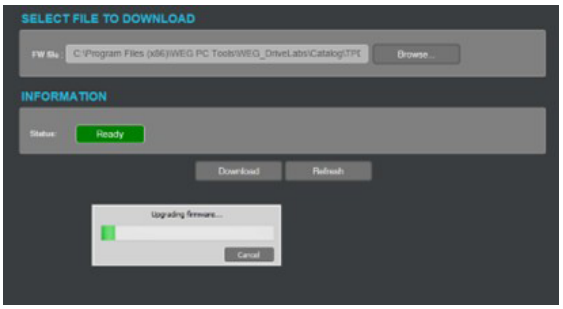
- Connect to the TPD500 using **WEG_DriveLabs**
- Select the *Download Firmware* icon



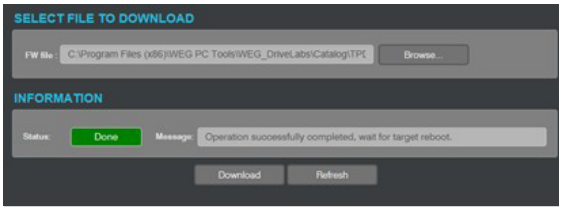
- Select the file to be downloaded to the TPD500
  *- Use the desired firmware file with the *.fl2 extension*



- Press the Download button and wait for the file transfer to complete
  - At this stage, the file is only being transferred to the device



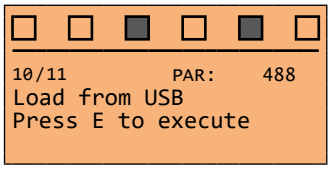
- At this point, the TPD500 fully restarts and begins the internal firmware reprogramming (this may take a few minutes)
  - During this process, WEG_DriveLabs is not able to monitor what is happening inside the device



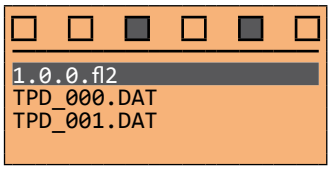
- The keypad displays a status message with a progress bar
- Once the internal reprogramming is complete, the system performs a full restart
- Upon restart, the system may require acknowledgment via the keypad (ESC button) to indicate that all default parameters have been fully reloaded

Using the keypad and the USB port

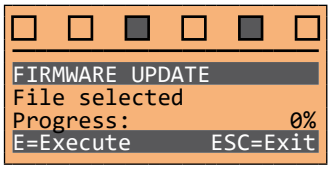
- Navigate using the keypad to the **DRIVE CONFIG** menu
- Scroll to parameter IPA 488–**Load from USB**



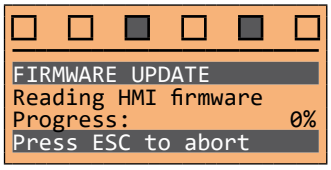
- Using the arrow keys, select the correct programming file (.fl2) and confirm with the **E** key

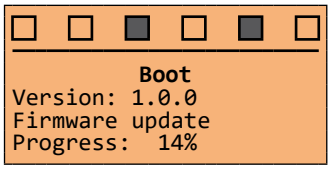


- Follow the instructions displayed on the keypad:
  - The procedure will copy the programming file into the drive, which will then restart and proceed with the update autonomously
  - The complete update may take a few minutes



  - The programming file may contain software components for HMI, DSP, and APP. The drive automatically updates the appropriate part of the code.





- At the end of the update, the drive restarts:
  - Normally, it is necessary to load the default parameters
  - Then save the parameters and perform a drive reset

8. FAULT INDICATIONS

8.1 Alarm indications

The following section lists and describes the possible alarms, their most common causes, and the recommended solutions.
If the proposed solutions do not resolve the current alarm, please contact the support service at: technohelp@weg.net

Table 8-1: Drive alarm list

CODE	ALARM	DESCRIPTION	
		PROBABLE CAUSES	POSSIBLE SOLUTIONS
1	**Failure supply**	**The control board supply voltages are outside the allowed limits.**	
		Wiring issue.	**WARNING: Before removing the pluggable terminals, make sure the power supply is disconnected!** Disconnect the pluggable terminals from the control board and issue a **RESET** command. If the alarm does not reappear, check the wiring for possible short circuits, such as between the shield and the conductor.
		Wiring issue on the TBO board.	Remove the terminal block of the optional **TBO** board (if installed) and issue another **RESET** command.
		Internal fault.	If the above actions do not resolve the issue, contact the support service.
2	**Undervoltage**	**The three-phase supply voltage has dropped below the minimum threshold or one phase is missing.**	
		IPA 5018–**UV threshold** parameter set too high.	Set IPA 5018–**UV threshold** correctly, according to the supply voltage used.
		Wiring issue, terminals not properly tightened.	Check and tighten the terminals of the contactor, inductor, filter, etc., if necessary.
		Line fuses tripped.	Restore the protection devices. If the issue recurs, investigate the cause. Refer to the troubleshooting section for **Overcurrent**.
		No voltage or low voltage at terminals U, V, W, or prolonged voltage sags. Mains dips or high distortion of the supply voltage.	Check the electrical connections.
3	**Overvoltage**	**Overvoltage on the armature circuit.**	
		IPA 606–**Arm rated** voltage parameter set too low.	Set the IPA 606–**Arm rated voltage** parameter correctly.
		The drive is not operating in field weakening mode, even though a speed has been set that requires it.	Reduce the speed limit via IPA 856–**Speed max pos/neg**, or enable field weakening through IPA 1304–**Field reg mode**, after properly tuning the regulators.
		The voltage and/or field regulator is not properly tuned.	Tune the regulators correctly.
4	**Speed fbk loss**	**Speed measurement issue.**	
		Incorrect speed sensor configuration.	Check the speed sensor parameter settings.
		Wiring issue.	Check the wiring and verify that the motor polarity and direction of rotation are correct.
		Incorrect speed estimation with IPA 658–**Speed fbk control** enabled.	Verify that the parameters used for speed estimation are correct.
		Faulty speed sensor.	Replace the sensor.
5	**Heatsink**	**Heatsink temperature too high**	
		Ambient temperature too high.	Improve environmental conditions or modify the duty cycle.
		Clogged heatsinks.	Perform maintenance.
		Device fan not working (for sizes ≥ 70 A).	Replace the fan.
6	**External fault**	**External fault detected at terminal 15 (active low)**	
		External fault signaling not used, and the connection between terminals 16 and 18 (reference potential) and/or 15 and 19 is missing.	Wire correctly.
		External fault signaling used, but no signal is present at terminal 15 (15...30 V with respect to terminal 16), or—if using an external power supply—the reference potentials have not been connected together.	Wire correctly.
8	**Overcurrent**	**Overcurrent detected in the motor armature circuit**	
		Short circuit at the drive output.	Check the power circuit wiring.
			Check the load integrity and impedance.
		Current regulator not optimized.	Run the auto-tuning procedure for the current regulator.
		IPA 5120–**OC threshold** parameter set too low.	Increase the threshold using the IPA 5120–**OC threshold** parameter.
9	**Sustained Curr**	**The drive is unable to bring the armature current (terminals C-D) to zero.**	
		Current sensing circuit fault.	Check the measured current using a clamp meter.
		SCR fault.	Contact the service team for support.

CODE	ALARM	DESCRIPTION	
		PROBABLE CAUSES	POSSIBLE SOLUTIONS
10	**Power down**	**When the drive is enabled, the mains voltage is not present.**	
		Wiring issue, terminals not properly tightened.	Check for the presence of armature voltage at terminals U, V, W.
		Line fuses tripped.	Check the proper operation of any contactor used to disconnect the three-phase supply, and verify the correct parameter settings for controlling the contactor in the **DIGITAL OUTPUTS** menu (typically using the "Drive ok" signal assigned to relay 1 or 2).
		No voltage or low voltage at terminals U, V, W.	
13	**Overtemp motor**	**Motor overtemperature.**	
		Broken wire or short circuit in the wiring between the motor's thermistor and terminals 78 and 79.	Check wiring integrity and impedance at terminals 78 and 79; repair if necessary.
		Missing 1 kΩ resistor in series with the contact connected to terminals 78 and 79.	Insert a resistor in series with the contact.
		The motor is not equipped with a thermistor, and no 1 kΩ resistor is present between terminals 78 and 79.	Insert a 1 kΩ resistor between terminals 78 and 79.
		The motor has external forced ventilation, but the fan is not working.	Replace the fan.
		Ambient temperature too high.	Improve environmental conditions, change the duty cycle, or enhance motor cooling.
		The motor has no external forced ventilation, and the load is too high at low speed.	Improve environmental conditions, change the duty cycle, or cool the motor using forced ventilation.
		The fan mounted on the motor shaft is not sufficient for this duty cycle.	
14	**Bus loss**	**Communication issue on the bus.**	
		Communication is not active and the enable command has been issued.	Check that the external controller is active.
		Wiring issue.	Check connections and the integrity of cables and connectors.
		EMC compatibility issues.	Take appropriate countermeasures.
		Internal fault.	Contact the support service.
16	**Field loss**	**Field current too low.**	
		Field control circuit not powered.	Apply the correct voltage to terminals U1 and V1.
		Field not connected to the drive.	Check that the field circuit wires are not broken or disconnected.
		Field fuses have blown.	Restore the fuses; if the issue recurs, investigate the cause.
		If the field is controlled by an external -FC, the drive is disabled or in fault.	Set and wire the drives correctly for the selected configuration, and ensure the -FC is enabled.
		Field regulator not properly tuned.	Tune the field regulator.
		Incorrect parameter settings.	Set parameter IPA 5128–**FL missing bypass** to ON.
18	**Enable seq err**	**The drive is switched on with terminal strip commands already set to a state that enables it immediately.**	
		The drive is powered on, or a reset command is issued, while the **ENABLE** input is connected to 24 V and the device is configured for terminal strip control.	The IPA 5200–**EnSEQ** activity parameter can be set to Ignore.
19	**Brake fault**	**Error in the brake opening or closing sequence.**	
		Wiring issue in the brake feedback signals.	Refer to **Chapter 6.18.10 – Brake control** for proper configuration and use of the function.
		Incorrect parameter settings for the brake control function.	
		Signal sequencing error.	
20	**Motor overload**	**Motor overload condition reached.**	
		Motor I²t protection active. Incorrect parameter configuration and/or excessive duty cycle.	Refer to **Chapter 6.20.9 – Motor I2t** and verify that the configured parameters are correct. If everything is correctly set, it is necessary to wait for the accumulator IPA 4314–**Motor I2t accum** to discharge before resetting the alarm and re-enabling the drive.
21	**Overspeed**	**Motor speed too high.**	
		IPA 5040–**OS threshold** parameter set too low.	Set the IPA 5040–**OS threshold** parameter correctly.
		Speed measurement error.	Check that parameter IPA 650–**Speed fbk sel** is set consistently with the selected feedback source (Encoder 1, Encoder 2, Tacho, Armature).
			Verify the correct configuration of the speed sensor in use, including the encoder power supply.
			Check the wiring of the selected sensor.
22	**Delta frequency**	**The frequency of the input three-phase supply deviates excessively from the value measured at first power-up.**	
		Incorrect alarm parameter setting; IPA 5150–**DF threshold** is set too low.	Set the IPA 5150–**DF threshold** parameter correctly.
		System-related issues.	Ensure that the frequency of the three-phase supply remains stable and within the threshold limits throughout the operation of the drive.

CODE	ALARM	DESCRIPTION	
		PROBABLE CAUSES	POSSIBLE SOLUTIONS
23	**Drive overload**	**Drive overload condition reached.**	
		Drive I2t protection active. Incorrect parameter configuration and/or excessively demanding duty cycle.	You must wait for the IPA 4322–**Drive I2t accum** to discharge before resetting the alarm and subsequently enabling the drive. Refer to **Chapter 6.20.10 – Drive I2t** for more information.

8.2 Other anomaly indications

The following section lists additional anomalies that may occur, along with their probable causes and possible solutions.
If the proposed solutions do not resolve the issue, please contact the support service at: technohelp@weg.net

Table 8-2: List of possible drive anomalies

ANOMALY	PROBABLE CAUSES	POSSIBLE SOLUTIONS
Motor not rotating	Drive in alarm.	Remove the cause of the alarm and issue a **RESET** command.
	If the keypad is off, there may be no supply voltage at terminals U2 / V2, or an internal fuse may have blown.	Provide proper supply voltage to U2/V2.
		If necessary, replace the fuse.
	Unlock and/or Start commands are missing.	Send the appropriate Unlock and/or Start commands.
	The drive does not accept commands.	Check parameter IPA 500–**Main commands** and select the correct operating mode.
	Power supply protection devices have tripped.	Verify proper sizing of the protection devices and check the integrity of the SCRs.
	Ramp or speed reference not configured correctly.	Configure the ramp or speed reference properly.
	Negative reference with TPD500-... -2B-…	For bi-quadrant converters, the reference must be positive.
Incorrect motor rotation	Incorrect polarity of the reference signal.	Check the polarity.
	Motor incorrectly connected.	Connect the motor properly.
		Invert the armature or field conductors, and reverse the polarity of the speed sensor: swap the two encoder connections (A+ with A– or B+ with B–), or, if a tachogenerator is used, reverse its wiring.
The motor fails to reach its rated speed	The drive is at a speed limit.	Check parameters IPA 858–**Speed max pos** and IPA 860–**Speed max neg**.
	The drive is operating at current limits (**ILim LED ON**): • Motor is overloaded • Drive size is too small • Torque reduction is active • Field weakening is active	Reduce the load or torque demand; change the motor.
		Reduce the load or torque demand; increase the drive size.
		Check parameter IPA 1124–**C/T lim reduct mon**.
		Check parameters IPA 1312–**Field weak mon** and IPA 1342–**Field current [%]**.
		Check the settings of the **CURR REG LIMIT** block.
		If field weakening is active, check the field regulator settings.
	Incorrect speed measurement.	Check the speed feedback settings.
	A compensation is reducing the main reference.	Check the configuration.
	IPA 400–**Full scale speed** parameter set too low (if speed reference is from analog input).	Check the IPA 400–**Full scale speed** parameter.
The motor reaches maximum speed immediately	Speed reference error.	If the reference is assigned via terminal strip, check that parameter IPA 1870–**Speed reference** varies correctly from the minimum to the maximum value.
		If the reference comes from a potentiometer, verify that it is properly connected to 0V.
	Speed measurement error.	Ensure that parameter IPA 650–**Speed fbk sel** is set consistently with the selected feedback (Encoder 1, Encoder 2, Tacho, Armature).
		Check the correct configuration of the speed sensor in use, including encoder power supply.
Il motore accelera troppo lentamente	Ramp values and times not set correctly.	Set the ramp values and times correctly.
	The drive is operating at current limits (**ILim LED ON**): • Motor is overloaded • Drive size is too small • Torque reduction is active • Field weakening is active	Reduce the load or torque demand; replace the motor.
		Reduce the load or torque demand; increase the drive size.
		Check parameter IPA 1124–**C/T lim reduct mon**.
		Check parameters IPA 1312–**Field weak mon** and IPA 1342–**Field current [%]**.
		Check the settings of the **CURR REG LIMIT** block.
		If field weakening is active, check the field regulator settings.
The motor slows down but fails to stop	A minimum speed is set.	Set parameter IPA 850–**Speed min pos/neg** correctly.
	Noise on an analog input generates an unwanted speed or torque reference.	Set the parameters IPA 3400/3430/3460–**An input 1/2/3** dest of unused analog inputs to OFF.
	Tachogenerator sensor offset present.	Remove the offset.
	Offset present on the analog input configured as speed or ramp reference.	Disconnect the cable from the used input. • If the motor stops, the issue is due to the resistance of the 0 V conductor cable. • If the motor continues to move, perform an analog input offset adjustment by setting parameters IPA 3406/3436/3466–**An input 1/2/3** offset so that the motor remains stationary (i.e., the reference is zero).

ANOMALY	PROBABLE CAUSES	POSSIBLE SOLUTIONS
The motor thermal protection is triggered	The motor is equipped with forced ventilation, but the fan is not working.	Replace the fan.
	Ambient temperature is too high.	Improve environmental conditions, change the duty cycle, and enhance motor cooling.
	The motor is not equipped with forced ventilation, and the load is too high at low speed.	Improve environmental conditions, change the duty cycle, and cool the motor using forced ventilation.
	The shaft-mounted fan is not sufficient for this duty cycle.	
	Motor thermal protection relay incorrectly set.	Adjust the motor thermal protection properly.
The motor is unable to supply maximum torque and power	The drive is operating at current limits (ILim LED ON): • Incorrect configuration • Motor is overloaded • Drive size is too small • Torque reduction is active • Field weakening is active	Check parameter IPA 604–**Arm rated current.**
		Reduce the load or torque demand; replace the motor.
		Reduce the load or torque demand; increase the drive size.
		Check parameter IPA 1124–**C/T lim reduct mon**.
		Check parameters IPA 1312–**Field weak mon** and IPA 1342–**Field current [%]**.
		Check the settings of the **CURR REG LIMIT** block.
		If in field weakening mode, check the field regulator settings.
Non-linear speed behavior during acceleration at maximum current	Speed regulator not properly tuned.	Proportionally reduce parameters IPA 900–**Speed reg I** and IPA 902–**Speed reg P**. If no improvement is observed, proceed with regulator optimization.
The speed oscillates	Speed regulator not properly tuned.	Check the tuning of the speed regulator.
	Armature or field voltage regulator not properly tuned.	If the operating point falls within the field weakening range, optimize the field regulator and, if necessary, the armature voltage regulator.
The drive does not react to the speed adaptive function	Speed adaptation not enabled.	Enable speed adaptation by setting parameter IPA 950–**Adaptive gain** enable to ON.
The motor potentiometer function is not being performed	Function not enabled.	Enable the motorpotentiometer function by setting parameter IPA 4000–**Motorpot enable** to ON.
	In terminal strip operation: **Motorpot up** and/or **Motorpot down** not assigned to digital inputs.	Assign **Motorpot up** and/or **Motorpot down** to digital inputs.
Jog operation does not work	A **Start** command is still active.	Disable the active **Start** command.
	Function not enabled.	Enable the Jog function by setting parameter IPA 4050–**Jog enable** to ON.
	In terminal strip operation: Jog + and/or Jog – not assigned to digital inputs.	Assign Jog + and/or Jog – to digital inputs.
Internal speed references do not work	Function not enabled.	Enable the multi-speed function by setting parameter IPA 4150–**Multi speed enable** to ON.
	In terminal strip operation: **Multi speed sel 0**, **Multi speed sel 1** and **Multi speed sel 2** not assigned to digital inputs.	Assign **Multi speed sel 0**, **Multi speed sel 1**, and **Multi speed sel 2** to digital inputs.
The multi-ramp function does not respond	Function not enabled.	Enable the multi-ramp function by setting parameter IPA 4200–**Multi ramp enable** to ON.
	In terminal strip operation: **Multi Ramp sel 0** and **Multi Ramp sel 1** not assigned to digital inputs.	Assign **Multi Ramp sel 0** and **Multi Ramp sel 1** to digital inputs.
Overload operation is not executed	Function not enabled.	Enable the overload function by setting parameter IPA 4300–**Overload mode** to **I2t drive** or **I2t Drive and Motor**.
		Increase the values of parameters IPA 1104–**C/T lim pos dig** and IPA 1108–**C/T lim neg dig** to 150%.

9. PARAMETER LIST

9.1 MENU STRUCTURE

The menu consists of a main menu with submenus and parameters. The structure is comparable to the organization of files and subfolders on a PC.

Main menu It corresponds to the main menu of a PC (Main menu = Root).
Submenu It corresponds to the submenus of a PC.
Parameter It corresponds to the individual parameter.

NOTE! **Chapter 6 – FUNCTION PARAMETERS** provides detailed information about menu functions and related parameters.

9.2 DESCRIPTION OF PARAMETERS AND FUNCTIONS – LEGEND

4 STARTUP WIZARD
4.1 SET DRIVE TYPE

⓿	❶	❷	❸	❹	❺	❻	❼	❽	❾
Menu	**IPA**	**Parameter name**	**Unit**	**Type**	**FB mode**	**Def**	**Min**	**Max**	**Acc**
4.1.1	**300**	**Drive arm current**	A	UINT16	SDO	0	-	-	R

⓾ Rated current of the drive (armature circuit).

⓿	Menu and parameter indexing		
❶	Index Parameter Address		
❷	Parameter name		
❸	Unit		
❹	Parameter type	BIT	Boolean value, represented as 16 bits when accessed via Modbus
		ENUM	Selection list, represented as 16 bits via Modbus [1]
		FLOAT	Real, represented as 32 bits via Modbus
		INT16	Signed 16-bit integer, represented as 16 bits via Modbus
		INT32	Signed 32-bit integer, represented as 32 bits via Modbus
		UINT16	Unsigned 16-bit integer, represented as 16 bits via Modbus
		UINT32	Unsigned 32-bit integer, represented as 32 bits via Modbus
		STRING16	16-character strings, represented as 8 uint16 via Modbus
❺	Fieldbus exchange mode	SDO	Acyclic exchange
		PDO	Cyclic/acyclic exchange
❻	Default value	CALC	Value calculated based on the drive size or dependent on other parameters
❼	Minimum value	Numerical value	
❽	Maximum value		
❾	Access	R	Read (lettura) [2]
		W	Write (scrittura)
			Parameter editable only when the drive is disabled
⓾	Parameter description		
[1]	The selection lists are provided in Chapter 6 – FUNCTION PARAMETERS of this manual.		
[2]	For read-only (R) parameters, the minimum and maximum values are not provided (–).		

1 MONITOR

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
1.1	200	**Mains Voltage**	V	FLOAT	PDO	0	-	-	R
		Mains voltage.							
1.2	202	**Mains Frequency**	Hz	FLOAT	PDO	0	-	-	R
		Network frequency.							
1.3	210	**Armature voltage**	V	FLOAT	PDO	0	-	-	R
		Armature voltage.							
1.4	214	**Armature current [%]**	%	FLOAT	PDO	0	-	-	R
		Armature current as a percentage of the motor's nominal armature current.							
1.5	222	**Armature current [A]**	A	FLOAT	PDO	0	-	-	R
		Armature current.							
1.6	216	**Arm current filter**	s	FLOAT	SDO	0.1	0.001	1	RW
		Time constant of the filter on the displayed armature current.							
1.7	1342	**Field current [%]**	%	FLOAT	PDO	0	-	-	R
		Field current as a percentage of the motor's rated field current.							
1.8	1344	**Field current [A]**	A	FLOAT	PDO	0	-	-	R
		Field current.							
1.9	220	**Output power**	kW	FLOAT	PDO	0	-	-	R
		Drive output power.							
1.10	234	**Motor speed**	rpm	FLOAT	PDO	0	-	-	R
		Motor rotation speed.							
1.11	236	**Motor speed filter**	s	FLOAT	SDO	0.1	0.001	1	RW
		Filter time constant on displayed motor speed.							
1.12	1020	**Armature current ref**	%	FLOAT	PDO	0	-	-	R
		Armature current reference as a percentage of the motor's rated armature current.							
1.13	1340	**Field reference**	%	FLOAT	PDO	0	-	-	R
		Flow reference as a percentage of the nominal motor flow.							
1.14	1338	**Field current ref**	%	FLOAT	PDO	0	-	-	R
		Field current reference as a percentage of the motor's rated field current.							
1.15	1820	**Ramp reference**	rpm	FLOAT	PDO	0	-	-	R
		Ramp reference at the input to the ramp function.							
1.16	2048	**Ramp output**	rpm	FLOAT	PDO	0	-	-	R
		Ramp function output.							
1.17	1870	**Speed reference**	rpm	FLOAT	PDO	0	-	-	R
		Overall reference speed input to the speed controller.							
1.18	3084	**Enable input mon**	-	UINT16	PDO	0	-	-	R
		Enable drive terminal status monitor (terminal 12).							
1.19	3094	**Start input mon**	-	UINT16	PDO	0	-	-	R
		Start terminal status monitor (terminal 13).							
1.20	3104	**FastStop input mon**	-	UINT16	PDO	0	-	-	R
		Fast stop terminal status monitor (terminal 14).							
1.21	3114	**Ext fault input mon**	-	UINT16	PDO	0	-	-	R
		External fault terminal status monitor (terminal 15).							
1.22	3196	**Digital input mon**	-	UINT16	PDO	0	-	-	R
		Overall monitor of the status of digital inputs.							
1.23	3296	**Digital output mon**	-	UINT16	PDO	0	-	-	R
		Overall monitor of the status of digital outputs.							
1.24	540	**Enable state mon**	-	UINT16	PDO	0	-	-	R

		Enable drive status monitor.							
1.25	542	**Start state mon**	-	UINT16	PDO	0	-	-	R
		Drive start status monitor.							
1.26	544	**FastStop state mon**	-	UINT16	PDO	0	-	-	R
		Fast stop status monitor for the drive.							

2 DRIVE INFO

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
2.1	172	**Drive series**	-	Enum	-	TPD500	-	-	R
		Product series identification string.							
2.2	174	**Firmware version**	-	UINT32	SDO	0	-	-	R
		Product firmware version.							
2.3	176	**Firmware version DSP**	-	UINT32	SDO	0	-	-	R
		Product control firmware version.							
2.4	182	**Boot version**	-	UINT32	-	0	-	-	R
		Product boot firmware version.							
2.5	180	**Boot version DSP**	-	UINT32	-	0	-	-	R
		Product control boot firmware version.							
2.6	184	**Application name**	-	STRING16	-	0	-	-	R
		String containing the name of any application loaded.							
2.7	194	**Application type**	-	UINT16	SDO	0	-	-	R
		Identification code of the application loaded, if any.							
2.8	192	**Application version**	-	UINT32	SDO	0	-	-	R
		Version of the application loaded, if any.							
2.9	490	**Time drive power on**	h.min	UINT32	PDO	0	-	-	R
		Drive power-on time.							
2.10	492	**Time drive enable**	h.min	UINT32	PDO	0	-	-	R
		Drive enable time.							
2.11	494	**Number power on**	-	UINT32	PDO	0	-	-	R
		Number of drive power-ons.							
2.12	440	**Product S/N**	-	UINT32	SDO	0	-	-	R
		Product serial number.							
2.13	444	**Regulation S/N**	-	UINT32	SDO	0	-	-	R
		Serial number of the R-TPD500 product regulation card.							
2.14	9600	**MAC address**	-	STRING16	-	0	-	-	R
		MAC address of the network card associated with the R-TPD500 product regulation card for Ethernet communication.							

3 DRIVE TYPE

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
3.1	300	**Drive arm current**	A	UINT16	SDO	0	-	-	R
		Nominal armature current of the drive.							
3.2	302	**Drive size set**	A	UINT16	SDO	4	4	20000	RWZ
		Nominal armature current setting of the drive (only in the case of Control Unit).							
3.3	304	**Drive field current**	A	FLOAT	SDO	CALC	0.5	150	RWZ
		Nominal field current of the drive.							

3.4	306	**Drive mains**	-	Enum	SDO	500 V	-	-	R
		Nominal armature supply voltage of the drive.							
3.5	308	**Drive 2/4 quadrant**	-	Enum	SDO	2B	-	-	R
		Drive model (2B or 4B).							
3.6	312	**Drive 2B+E enable**	-	BIT	SDO	0	0	1	RWZ
		Enable 2B + E configuration (external exciter).							

4 STARTUP WIZARD

4.1 Set DRIVE TYPE

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
4.1.1	300	**Drive arm current**	A	UINT16	SDO	0	-	-	R
		Nominal armature current of the drive.							
4.1.2	302	**Drive size set**	A	UINT16	SDO	4	4	20000	RWZ
		Drive armature current setting (only for Control Unit).							
4.1.3	304	**Drive field current**	A	FLOAT	SDO	CALC	0.5	150	RWZ
		Nominal field current of the drive.							
4.1.4	312	**Drive 2B+E enable**	-	BIT	SDO	0	0	1	RWZ
		Enabling 2B + E configuration (external exciter).							

4.2 Set DRIVE CONFIG

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
4.2.1	400	**Full scale speed**	rpm	UINT32	SDO	1500	10	6500	RWZ
		Speed full scale.							
4.2.2	500	**Main commands**	-	Enum	SDO	Digital	0	1	RWZ
		Drive command mode.							

4.3 Set MOTOR DATA

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
4.3.1	600	**Motor rated speed**	rpm	FLOAT	SDO	1500	10	6500	RW
		Motor rated speed.							
4.3.2	602	**Motor max speed**	rpm	FLOAT	SDO	1500	10	6500	RW
		Motor maximum speed.							
4.3.3	604	**Arm rated current**	A	FLOAT	SDO	CALC	0.1	CALC	RW
		Rated armature current of the motor.							
4.3.4	606	**Arm rated voltage**	V	FLOAT	SDO	400	20	999	RW
		Motor armature rated voltage.							
4.3.5	608	**Field rated current**	A	FLOAT	SDO	3.33	0	CALC	RW
		Motor field rated current.							

4.4 Set SPEED FEEDBACK

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
4.4.1	650	**Speed fbk sel**	-	Enum	SDO	Encoder 2	0	3	RW
		Selection of the type of feedback to be used for measuring or estimating the motor speed for speed control via a PI controller.							

4.5 Set ENCODER 1

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
4.5.1	702	**Enc 1 pulses**	ppr	UINT16	SDO	1024	150	16384	RWZ
		Number of pulses per revolution of the digital encoder connected to connector XE1.							
4.5.2	704	**Enc 1 supply enable**	-	BIT	SDO	0	0	1	RW
		Enables the generation of 5V power supply to encoder 1.							
4.5.3	706	**Enc 1 input config**	-	Enum	SDO	HTL	0	1	RW
		Selection of encoder 1 signal type (TTL or HTL voltage level).							
4.5.4	708	**Enc 1 Vdc supply**	-	Enum	SDO	5.2V	0	3	RWZ
		Allows you to adjust the power supply level of encoder 1 if the Enc 1 supply enable parameter is set to ON.							

4.6 Set ENCODER 2

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
4.6.1	752	**Enc 2 pulses**	ppr	UINT16	SDO	1024	150	16384	RWZ
		Number of pulses per revolution of the digital encoder connected to the XE2 connector.							
4.6.2	754	**Enc 2 supply enable**	-	BIT	SDO	0	0	1	RW
		Enables the generation of 5V power supply to encoder 2.							
4.6.3	756	**Enc 2 input config**	-	Enum	SDO	HTL	0	1	RW
		Selection of encoder 2 signal type (TTL or HTL voltage level).							
4.6.4	758	**Enc 2 Vdc supply**	-	Enum	SDO	5.2V	0	3	RWZ
		Allows you to adjust the power supply level of encoder 2 if the Enc 2 supply enable parameter is set to ON.							

4.7 Set TACHO

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
4.7.1	684	**Tacho S4 switch sel**	-	Enum	SDO	1100-0011 (90.7V)	0	4	RW
		Configuration used for DIP switch S4 on the R-TPD500 control board.							
4.7.2	686	**Tacho voltage scale**	V/Krpm	FLOAT	SDO	60.0	1	4000	RW
		Tachometer sensitivity rating.							

4.8 Set LIMITS

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
4.8.1	850	**Speed min pos/neg**	rpm	FLOAT	SDO	0	0	CALC	RW
		Sets the minimum speed reference for both rotation directions (4B).							
4.8.2	856	**Speed min pos**	rpm	FLOAT	SDO	3000	0	CALC	RW
		Sets the maximum speed reference for both directions of rotation (4B).							
4.8.3	1104	**C/T lim pos dig**	%	FLOAT	PDO	100	0	CALC	RW
		Drive current limit for positive current direction, expressed as a percentage of the motor's rated armature current.							
4.8.5	1350	**Field max dig**	%	FLOAT	PDO	100	5	100	RW
		Maximum flux as a percentage of the nominal flux (obtained at the nominal field current).							
4.8.6	1354	**Field min dig**	%	FLOAT	PDO	30	0	100	RW
		Minimum flux as a percentage of the nominal flux (obtained at the nominal field current).							

4.9 Set REFERENCES

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
4.9.1	3400	**An input 1 dest**	-	Enum	SDO	Ramp ref 1	0	23	RW
		Selection of the parameter whose value must be received from analogue input 1.							
4.9.2	1800	**Ramp ref 1 dig**	rpm	FLOAT	PDO	0	CALC	CALC	RW
		Ramp reference 1.							

4.10 Exe CURR REG TUNE

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
4.10.1	1050	**Curr reg autotune**	-	BIT	-	0	0	0	RW
		Command for executing a self-calibration cycle of the current regulator.							

4.11 Set FIELD CONTROL

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
4.11.1	1300	**Field reg enable**	-	BIT	PDO	1	0	1	RW
		Field converter enable.							
4.11.2	1304	**Field reg mode**	-	Enum	SDO	Current control	0	4	RWZ
		Field controller operating mode.							
4.11.3	1310	**Field weak**	-	BIT	PDO	0	0	1	RW
		Enabling field weak.							
4.11.4	1314	**Field weak speed-0**	-	BIT	PDO	1	0	1	RW
		Enabling field weak at zero speed.							

4.12 Exe SAVE PARAMETERS

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
4.13.1	460	**Save parameters**	-	BIT	PDO	0	0	1	RW
		Command to save parameters to permanent memory.							

5 DRIVE CONFIG

Menu	IPA	Parameter name	Type	Def	Min	Max	Min	Max	Acc
5.1	400	**Full scale speed**	rpm	UINT32	SDO	1500	10	6500	RWZ
		Speed full scale.							
5.2	470	**Load default**	-	BIT	SDO	0	0	1	RWZ
		Command to reset the parameters to the factory default values, only possible if the converter is disabled.							
5.3	460	**Save parameters**	-	BIT	SDO	0	0	1	RW
		Command to save the parameters to permanent memory.							
5.4	472	**Drive reset**	-	BIT	SDO	0	0	1	RWZ
		Command to restart the software, only possible if the converter is disabled.							
5.5	466	**Application enable**	-	BIT	-	0	0	1	RWZ
		Enables any application that may have been loaded.							
5.6	462	**Access level**	-	Enum	-	Expert	3	4	RW
		Access level setting.							
5.7	482	**Display backlight**	-	BIT	-	0	0	1	RW
		Enables permanent backlighting of the keypad display.							

5.8	484	**Display startup**	-	INT16	SDO	-1	-1	20000	RW
		Allows you to set what is automatically displayed on the keypad when the drive is turned on.							
5.9	486	**Save to USB**	-	BIT	-	0	0	1	RWZ
		Command to transfer the drive parameters to the memory connected to the USB port.							
5.10	488	**Load from USB**	-	BIT	-	0	0	1	RWZ
		Command to use the USB flash drive connected to the USB port to save or recover configuration parameters or to update the drive firmware.							
5.11	496	**Wi-Fi safe removal**	-	BIT	-	0	0	1	RWZ
		Command that removes power from the optional Wifi_DriveLink module.							

6 COMMANDS

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
6.1	500	**Main commands**	-	Enum	SDO	Digital	0	1	RWZ
		Drive command mode.							
6.2	502	**Control mode**	-	Enum	SDO	Local	0	1	RWZ
		Enabling fieldbus control mode (note: in standby).							
6.3	504	**Stop mode**	-	Enum	SDO	Stop&Speed 0	0	3	RWZ
		Drive disable management mode at stop or Fast stop.							
6.4	506	**Speed 0 trip delay**	ms	UINT16	SDO	0	0	40000	RW
		Drive disabling delay after stop and reaching speed 0.							
6.5	508	**Trip contactor delay**	ms	UINT16	SDO	0	0	40000	RW
		Delay on setting the Trip contactor output to control relay 2 after disabling.							
6.6	510	**Jog stop control**	-	BIT	SDO	0	0	1	RWZ
		Command to disable Stop mode when using the Jog function.							
6.7	520	**Enable digital cmd**	-	BIT	PDO	0	0	1	RW
		Enable command in Digital mode.							
6.8	522	**Start digital cmd**	-	BIT	PDO	0	0	1	RW
		Start command in Digital mode.							
6.9	524	**FastStop digital cmd**	-	BIT	PDO	0	0	1	RW
		Fast stop command in Digital mode.							

7 MOTOR DATA

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
7.1	600	**Motor rated speed**	rpm	FLOAT	SDO	1500	10	6500	RWZ
		Motor rated speed.							
7.2	602	**Motor max speed**	rpm	FLOAT	SDO	1500	10	6500	RWZ
		Motor maximum speed.							
7.3	604	**Arm rated current**	A	FLOAT	SDO	CALCI	0.1	CALCI	RWZ
		Nominal armature current of the motor.							
7.4	606	**Arm rated voltage**	V	FLOAT	SDO	400	20	999	RWZ
		Nominal armature voltage of the motor.							
7.5	608	**Field rated current**	A	FLOAT	SDO	3.33	0	CALCI	RWZ
		Nominal field current of the motor.							
7.6	612	**Motor EMF constant**	V/rpm	FLOAT	SDO	0	0	100	RWZ
		Electromotive force constant of the motor.							

8 REFERENCES

8.1 RAMP REF

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
8.1.1	1800	**Ramp ref 1 dig**	rpm	FLOAT	PDO	0	CALCI	CALCI	RW
		Ramp reference 1.							
8.1.2	1804	**Ramp ref 1 mon**	rpm	FLOAT	PDO	0	-	-	R
		Ramp reference monitor 1.							
8.1.3	1810	**Ramp ref 2 dig**	rpm	FLOAT	PDO	0	CALCI	CALCI	RW
		Ramp reference 2.							
8.1.4	1814	**Ramp ref 2 mon**	rpm	FLOAT	PDO	0	-	-	R
		Ramp reference monitor 2.							

8.2 SPEED REF

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
8.2.1	1850	**Speed ref 1 dig**	rpm	FLOAT	PDO	0	CALCI	CALCI	RW
		Speed reference 1.							
8.2.2	1854	**Speed ref 1 mon**	rpm	FLOAT	PDO	0	-	-	R
		Speed reference monitor 1.							
8.2.3	1860	**Speed ref 2 dig**	rpm	FLOAT	PDO	0	CALCI	CALCI	RW
		Speed reference 2.							
8.2.4	1864	**Speed ref 2 mon**	rpm	FLOAT	PDO	0	-	-	R
		Speed reference 2 monitor.							

8.3 TORQUE REF

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
8.3.1	1900	**C/T ref 1 dig**	%	FLOAT	PDO	0	CALCI	CALCI	RW
		Armature current reference 1, expressed as a percentage of the motor's rated armature current.							
8.3.2	1904	**C/T ref 1 mon**	%	FLOAT	PDO	0	-	-	R
		Armature current reference monitor 1.							
8.3.3	1910	**C/T ref 2 dig**	%	FLOAT	PDO	0	CALCI	CALCI	RW
		Armature current reference 2, expressed as a percentage of the motor's rated armature current.							
8.3.4	1914	**C/T ref 2 mon**	%	FLOAT	PDO	0	-	-	R
		Armature current reference 2 monitor.							

9 RAMPS

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
9.1	2000	**Ramp enable**	-	BIT	SDO	1	0	1	RWZ
		Enables/disables ramp control of the speed reference.							
9.2	2002	**Acc speed**	rpm	UINT32	SDO	100	1	65535	RW
		Standard ramp acceleration speed.							
9.3	2004	**Acc time**	s	UINT16	SDO	1	0	65535	RW
		Standard ramp acceleration time.							
9.4	2006	**Dec speed**	rpm	UINT32	SDO	100	1	65535	RW

		Standard ramp deceleration speed.							
9.5	2008	**Dec time**	s	UINT16	SDO	1	0	65535	RW
		Standard ramp deceleration time.							
9.6	2010	**Ramp shape**	-	Enum	SDO	Linear	0	1	RWZ
		Ramp type selector.							
9.7	2014	**Acc time jerk**	ms	FLOAT	SDO	300	20	15000	RW
		Acceleration jerk time of ramp at S.							
9.8	2016	**Dec time jerk**	ms	FLOAT	SDO	300	20	15000	RW
		Deceleration jerk time of the S ramp.							
9.9	2018	**Ramp in = 0**	-	BIT	PDO	0	0	1	RW
		Immediate reset command for the ramp reference.							
9.10	2020	**Ramp in = 0 mon**	-	BIT	PDO	0	-	-	R
		Monitor for immediate reset command of ramp reference.							
9.11	2022	**Ramp out = 0**	-	BIT	PDO	0	0	1	RW
		Command for immediate reset of ramp output.							
9.12	2024	**Ramp out = 0 mon**	-	BIT	PDO	0	-	-	R
		Monitor for the immediate reset command of the ramp output.							
9.13	2026	**Ramp freeze**	-	BIT	PDO	0	0	1	RW
		Command to freeze the output value at the ramp, regardless of changes in the input reference.							
9.14	2028	**Ramp freeze mon**	-	BIT	PDO	0	-	-	R
		Monitor for the immediate reset command of the ramp output.							
9.15	2030	**Ramp +/- delay**	ms	UINT16	SDO	100	0	65535	RW
		Delay time on Ramp + and Ramp - signals for digital outputs.							
9.16	2032	**FastStop speed**	rpm	UINT32	SDO	1000	1	65535	RW
		Fast stop ramp deceleration speed.							
9.17	2034	**FastStop time**	s	UINT16	SDO	1	0	65535	RW
		Fast stop ramp deceleration time.							
9.18	2036	**Forward/reverse**	-	Enum	PDO	Forward	0	3	RW
		Command to change the sign of the ramp reference.							
9.19	2038	**Forward/reverse mon**	-	Enum	PDO	Forward	-	-	R
		Monitor for the command to change the sign of the ramp reference.							

10 SPEED FEEDBACK

10.1 CONFIG

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
10.1.1	650	**Speed fbk sel**	-	Enum	SDO	Encoder 2	0	3	RWZ
		Selection of the type of feedback to be used for measuring or estimating the motor speed for speed control via PI regulator.							
10.1.2	654	**Speed fbk error**	%	UINT16	SDO	22	0	100	RW
		Error threshold for the Speed fbk loss alarm caused by the comparison between the measured and estimated speed following the enabling of parameter IPA 658-Speed fbk control							
10.1.3	656	**Speed fbk bypass**	-	BIT	SDO	0	0	1	RW
		Enables automatic switching to armature feedback in the event of a fault or failure of the encoder or tachometer feedback.							
10.1.4	658	**Speed fbk control**	-	BIT	SDO	1	0	1	RW
		Enables comparison between the speed measured by the feedback sensor and the speed estimated by the armature voltage, generating the Speed fbk loss alarm.							

10.2 ENCODER 1

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
10.2.1	702	**Enc 1 pulses**	ppr	UINT16	SDO	1024	150	16384	RW
		Number of pulses per revolution of the digital encoder connected to connector XE1.							
10.2.2	704	**Enc 1 supply enable**	-	BIT	SDO	0	0	1	RW
		Enables the generation of the 5 V power supply for encoder 1.							
10.2.3	706	**Enc 1 input config**	-	Enum	SDO	HTL	0	1	RW
		Selects the signal type of encoder 1 (TTL or HTL voltage level).							
10.2.4	708	**Enc 1 Vdc supply**	-	Enum	SDO	5.2V	0	3	RW
		Allows the power supply level of encoder 1 to be adjusted if the Enc 1 supply enable parameter is set to ON.							
10.2.5	712	**Enc 1 check**	-	Enum	SDO	A-B	0	2	RW
		Enables hardware consistency checking of channels A-B and/or Z of encoder 1 for the generation of the Speed fbk loss alarm.							
10.2.6	714	**Enc 1 dest**	-	Enum	SDO	OFF	0	4	RW
		Allows the destination of encoder 1 (ramp or speed reference) to be set.							
10.2.7	716	**Enc 1 speed**	rpm	FLOAT	PDO	0	-	-	R
		Speed measurement provided by encoder 1.							
10.2.8	728	**Enc 1 error code**	-	UINT16	PDO	0	-	-	R
		Code indicating the type of error detected on encoder 1.							

10.3 ENCODER 2

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
10.3.1	752	**Enc 2 pulses**	ppr	UINT16	SDO	1024	150	16384	RW
		Number of pulses per revolution of the digital encoder connected to connector XE2.							
10.3.2	754	**Enc 2 supply enable**	-	BIT	SDO	0	0	1	RW
		Enables the generation of the 5 V power supply for encoder 2.							
10.3.3	756	**Enc 2 input config**	-	Enum	SDO	HTL	0	1	RW
		Selects the signal type of encoder 2 (TTL or HTL voltage level).							
10.3.4	758	**Enc 2 Vdc supply**	-	Enum	SDO	5.2V	0	3	RW
		Allows the power supply level of encoder 2 to be adjusted if the Enc 2 supply enable parameter is set to ON.							
10.3.5	762	**Enc 2 check**	-	Enum	SDO	A-B	0	2	RW
		Enables hardware consistency checking of channels A-B and/or Z of encoder 2 for generating the Speed fbk loss alarm.							
10.3.6	764	**Enc 2 dest**	-	Enum	SDO	OFF	0	4	RWZ
		Sets the destination of encoder 2 (ramp or speed reference).							
10.3.7	766	**Enc 2 speed**	rpm	FLOAT	PDO	0	-	-	R
		Speed measurement provided by encoder 2.							
10.3.8	778	**Enc 2 error code**	-	UINT16	PDO	0	-	-	R
		Code indicating the type of error detected on encoder 2.							

10.4 TACHO

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
10.4.1	682	**Tacho filter**	ms	FLOAT	SDO	6	0.0	1000.0	RW
		Time constant of the filter on the speed measurement provided by the tachometer.							
10.4.2	684	**Tacho S4 switch sel**	-	Enum	SDO	1100-0011 (90.7V)	0	4	RW
		Configuration used for DIP switch S4 on the R-TPD500 control board.							
10.4.3	686	**Tacho voltage scale**	V/krpm	FLOAT	SDO	60.0	1	4000	RW

		Tachometer sensitivity setting.							
10.4.4	688	**Tacho scale tuning**	-	FLOAT	SDO	1.0	0.8	1.2	RW
		Gain that allows finer tuning in cascade with Tacho voltage scale.							
10.4.5	690	**Tacho offset**	rpm	FLOAT	SDO	0.0	-20	20	RW
		Offset that can be used to correct the speed measurement provided by the tachometer.							
10.4.6	696	**Tacho speed**	rpm	FLOAT	PDO	0	-	-	R
		Speed measurement provided by the tachometer.							
10.4.7	698	**Tacho sat error**	-	UINT16	PDO	0	-	-	R
		Monitor of the error signal generated by the tachometer, with generation of a Speed fbk loss alarm.							

11 SPEED CONTROL

11.1 SPEED REG

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
11.1.1	800	**Speed reg enable**	-	BIT	PDO	1	0	1	RW
		Enabling the speed regulator.							
11.1.2	802	**Speed reg enable mon**	-	BIT	PDO	0	-	-	R
		Monitoring the enable status of the IPA 800 speed regulator - Speed reg enable.							
11.1.3	804	**Speed reg lock**	-	BIT	PDO	0	0	1	RW
		Command used to separate the speed controller output from the current controller during operation. When this occurs, the current reference is set to zero and the motor stops due to inertia.							
11.1.4	806	**Speed reg lock mon**	-	BIT	PDO	0	-	-	R
		Monitor of the status of IPA 804-Speed reg lock.							
11.1.5	808	**Speed reg lock I**	-	BIT	PDO	0	0	1	RW
		Command to block the integral action of the speed regulator.							
11.1.6	810	**Speed reg lock I mon**	-	BIT	PDO	0	-	-	R
		Monitor of the command to block the integral action of the IPA 808-Speed reg lock I speed regulator.							
11.1.7	838	**Speed auto capture**	-	BIT	PDO	0	0	1	RW
		Enabling the fly-in function for a motor that is already rotating.							
11.1.8	848	**Speed reg output**	%	FLOAT	PDO	0	-	-	R
		Monitor of the speed regulator output, expressed as a percentage of the motor's rated armature current, which acts as a reference for the current regulator.							

11.2 SPEED REG LIMIT

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
11.2.1	850	**Speed min pos/neg**	rpm	FLOAT	SDO	0	0	CALC	RWZ
		Sets the minimum speed reference for both rotation directions (4B).							
11.2.2	852	**Speed min pos**	rpm	FLOAT	PDO	0	0	8191	RWZ
		Sets the minimum speed reference for the positive direction of rotation of the motor.							
11.2.3	854	**Speed min neg**	rpm	FLOAT	PDO	0	0	8191	RWZ
		Sets the minimum speed reference for negative motor rotation (4B).							
11.2.4	856	**Speed max pos/neg**	rpm	FLOAT	SDO	3000	0	CALC	RWZ
		Sets the maximum speed reference for both rotation directions (4B).							
11.2.5	858	**Speed max pos**	rpm	FLOAT	PDO	3000	0	8191	RWZ
		Sets the maximum speed reference for the positive direction of rotation of the motor.							
11.2.6	860	**Speed max neg**	rpm	FLOAT	PDO	3000	0	8191	RWZ
		Sets the maximum speed reference for the negative direction of rotation of the motor (4B).							

11.3 SPEED REG TUNE

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
11.3.1	900	**Speed reg P**	%	FLOAT	PDO	10	0	100	RW
		Proportional gain Kp of the speed controller, expressed as a percentage of the base gain IPA 904-Speed reg P base.							
11.3.2	902	**Speed reg I**	%	FLOAT	PDO	1	0	100	RW
		Integral gain Ki of the speed regulator, expressed as a percentage of the base gain IPA 906-Speed reg I base.							
11.3.3	904	**Speed reg P base**	A/rpm	FLOAT	-	CALC	0.001	CALC	RWZ
		Proportional coefficient Kp base of the speed controller.							
11.3.4	906	**Speed reg I base**	-	FLOAT	-	CALC	0.001	CALC	RWZ
		Integral coefficient Ki base of the speed controller.							
11.3.5	908	**Speed reg P in use**	%	FLOAT	PDO	0	-	-	R
		Monitor of the proportional gain in use of the speed controller, expressed as a percentage of IPA 904-Speed reg P base.							
11.3.6	910	**Speed reg I in use**	%	FLOAT	PDO	0	-	-	R
		Monitor of the integral gain in use of the speed regulator, expressed as a percentage of IPA 906-Speed reg I base.							
11.3.7	914	**Speed reg P filter**	ms	UINT16	SDO	0	0	1000	RW
		Time constant of the low-pass filter applied to the proportional action of the PI speed regulator.							
11.3.8	920	**Speed ref 0 level**	rpm	UINT16	SDO	10	1	8191	RW
		Speed used to define the intervention threshold for managing the speed controller gains at zero speed.							
11.3.9	922	**Speed=0 P gain**	%	FLOAT	PDO	1	0	100	RW
		Proportional gain of the speed controller at zero speed, expressed as a percentage of IPA 904-Speed reg P base.							
11.3.10	924	**Speed=0 I enable**	-	BIT	PDO	0	0	1	RWZ
		Enables the reset of the integral gain of the speed controller at zero speed.							
11.3.11	926	**Speed=0 R enable**	-	BIT	PDO	0	0	1	RWZ
		Enabling the proportional gain of the speed controller at zero reference.							
11.3.12	928	**Speed=0 P enable**	-	BIT	PDO	0	0	1	RWZ
		Enabling the gains of the speed controller at zero speed.							
11.3.13	930	**Speed reg P bypass**	%	FLOAT	PDO	1	0	100	RW
		Proportional gain of the speed controller, expressed as a percentage of IPA 904-Speed reg P base, used in the speed feedback bypass condition.							
11.3.14	932	**Speed reg I bypass**	%	FLOAT	PDO	0.1	0	100	RW
		Integral gain of the speed controller, expressed as a percentage of IPA 906-Speed reg I base, used in the speed feedback bypass condition.							

11.4 SPEED REG ADAPT

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
11.4.1	950	**Adaptive gain enable**	-	Enum	SDO	OFF	0	1	RWZ
		Enables adaptive gains for the speed controller.							
11.4.2	952	**Adaptive type sel**	-	Enum	SDO	Motor speed	0	2	RWZ
		Allows you to select the quantity relative to which the speed controller gains are varied.							
11.4.3	954	**Adaptive ref dig**	rpm	FLOAT	PDO	0	-8191	8191	RW
		Input reference speed relative to which the adaptive gains of the speed controller are performed.							
11.4.4	956	**Adaptive ref mon**	rpm	FLOAT	PDO	0	-	-	R
		Monitor of the reference speed with respect to which the adaptive gains of the speed controller are to be performed.							
11.4.5	958	**Adaptive selector**	-	UINT16	PDO	0	0	3	RW
		Selection index of the set of adaptive PI gains of the speed controller.							
11.4.6	966	**Adaptive sel mon**	-	UINT16	PDO	0	-	-	R
		Monitor selection index of the SET of adaptive PI gains of the speed controller.							
11.4.7	960	**Adaptive speed 1**	%	FLOAT	SDO	20.3	0	200	RW

		Speed threshold for connecting SET 1-2 of the adaptive PI gains of the speed controller.							
11.4.8	962	**Adaptive speed 2**	%	FLOAT	SDO	40.7	0	200	RW
		Speed threshold for connecting SET 2-3 of the adaptive PI gains of the speed controller.							
11.4.9	970	**Adaptive joint 1**	%	FLOAT	SDO	6.1	0	200	RW
		Speed band width for connecting SET 1-2 of the adaptive PI gains of the speed controller.							
11.4.10	972	**Adaptive joint 2**	%	FLOAT	SDO	6.1	0	200	RW
		Speed band width for connecting SET 2-3 of the adaptive PI gains of the speed controller.							
11.4.11	980	**Adaptive P gain 1**	%	FLOAT	SDO	10.00	0	100	RW
		Proportional gain P of SET 1, expressed as a percentage of IPA 904-Speed reg P base.							
11.4.12	982	**Adaptive I gain 1**	%	FLOAT	SDO	1.00	0	100	RW
		Integral gain I of SET 1, expressed as a percentage of IPA 906-Speed reg I base.							
11.4.13	984	**Adaptive P gain 2**	%	FLOAT	SDO	10.00	0	100	RW
		Proportional P gain of SET 2, expressed as a percentage of IPA 904-Speed reg P base.							
11.4.14	986	**Adaptive I gain 2**	%	FLOAT	SDO	1.00	0	100	RW
		Integral gain I of SET 2, expressed as a percentage of IPA 906-Speed reg I base.							
11.4.15	988	**Adaptive P gain 3**	%	FLOAT	SDO	10.00	0	100	RW
		Proportional P gain of SET 3, expressed as a percentage of IPA 904-Speed reg P base.							
11.4.16	990	**Adaptive I gain 3**	%	FLOAT	SDO	1.00	0	100	RW
		Integral gain I of SET 3, expressed as a percentage of IPA 906-Speed reg I base.							
11.4.17	992	**Adaptive P gain 4**	%	FLOAT	SDO	10.00	0	100	RW
		Proportional gain P of SET 4, expressed as a percentage of IPA 904-Speed reg P base.							
11.4.18	994	**Adaptive I gain 4**	%	FLOAT	SDO	1.00	0	100	RW
		Integral gain I of SET 4, expressed as a percentage of IPA 906-Speed reg I base.							
11.4.19	964	**Adaptive set in use**	-	Enum	PDO	None	-	-	R
		Monitor of the adaptive PI gain SET in use.							
11.4.20	996	**Adaptive P in use**	%	FLOAT	PDO	0	-	-	R
		Monitor of the adaptive proportional gain P in use.							
11.4.21	998	**Adaptive I in use**	%	FLOAT	PDO	0	-	-	R
		Monitor of the adaptive integral gain I in use.							

11.5 SPEED REG FUNC

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
11.5.1	934	**Speed reg func sel**	-	Enum	SDO	None	0	2	RWZ
		Enabling speed controller compensation functions (speed up or inertia compensation).							
11.5.2	936	**Speed up gain**	s/rpm	FLOAT	SDO	0	0	1000	RW
		Gain of the Speed up function applied to the derivative of the IPA 234-Motor speed measurement.							
11.5.3	938	**Speed up filter**	ms	UINT16	SDO	0	0	1000	RW
		Time constant of the low-pass filter of the Speed up function.							
11.5.4	940	**Inertia comp filter**	ms	UINT16	SDO	0	0	1000	RW
		Time constant of the low-pass filter of the inertia compensation.							
11.5.5	942	**Inertia**	kgm^2	FLOAT	SDO	0.001	0.001	1000	RW
		Inertia of the load on the motor shaft.							
11.5.6	944	**Friction**	Nm	FLOAT	SDO	0.001	0	100.00	RW
		Friction of the load on the motor shaft.							
11.5.7	946	**Torque constant**	Nm/A	FLOAT	SDO	2.42	0.01	100.00	RW
		Motor torque constant.							
11.5.8	948	**Inertia comp mon**	%	FLOAT	SDO	0	-	-	R

		Monitor of the output produced by the inertia compensation function, expressed as a percentage of the motor's rated armature current.							

12 CURRENT CONTROL

12.1 CURR REG

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
12.1.1	1000	**Curr reg mode**	-	Enum	SDO	Predictive	0	1	RWZ
		Selection of current regulator type (predictive or PI).							
12.1.2	1002	**C/T ref ramp time**	ms	UINT16	SDO	0	0	100	RW
		Ramp time defining the di/dt of the current controller.							
12.1.3	1004	**Zero torque**	-	BIT	PDO	0	0	1	RW
		Armature current reference reset command.							
12.1.4	1006	**Zero torque mon**	-	BIT	PDO	0	-	-	R
		Armature current reference reset command monitor.							

12.2 CURR REG LIMIT

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
12.2.1	1104	**C/T lim pos dig**	%	FLOAT	PDO	100	0	CALC	RW
		Drive current limit for positive current direction, expressed as a percentage of the motor's rated armature current.							
12.2.2	1106	**C/T lim pos mon**	%	FLOAT	PDO	0	-	-	R
		Positive current limit monitor.							
12.2.3	1108	**C/T lim neg dig**	%	FLOAT	PDO	100	0	CALC	RW
		Drive current limit for negative current direction, expressed as a percentage of the motor's rated armature current.							
12.2.4	1110	**C/T lim neg mon**	%	FLOAT	PDO	0	-	-	R
		Negative current limit monitor.							
12.2.5	1112	**C/T lim sym enable**	-	Enum	SDO	ON	0	1	RWZ
		Enabling of symmetrical current limits for both current directions.							
12.2.6	1120	**C/T lim reduction**	%	FLOAT	PDO	100	0	CALC	RW
		Current limit with reduction active.							
12.2.7	1122	**C/T lim reduct cmd**	-	BIT	PDO	0	0	1	RW
		Enabling current limit reduction.							
12.2.8	1124	**C/T lim reduct mon**	-	BIT	PDO	0	-	-	R
		Monitor of the enable command for current limit reduction.							
12.2.9	1126	**C/T lim type**	-	Enum	SDO	Pos/neg	0	1	RWZ
		Determines the operation of the drive at the current limits.							
12.2.10	1140	**C/T lim pos in use**	%	FLOAT	PDO	0	-	-	R
		Monitor of the positive current limit actually in use, expressed as a percentage of the motor's rated armature current.							
12.2.11	1142	**C/T lim neg in use**	%	FLOAT	PDO	0	-	-	R
		Monitor of the negative current limit actually in use, expressed as a percentage of the motor's rated armature current.							

12.3 CURR REG TUNE

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
12.3.1	1050	**Curr reg autotune**	-	BIT	-	0	0	0	RWZ
		Command for executing a current regulator self-tuning cycle.							

12.3.2	1052	**Arm resistance**	Ω	FLOAT	SDO	0.5	0	CALCI	RW
		Motor armature resistance.							
12.3.3	1054	**Arm inductance**	mH	FLOAT	SDO	4.0	CALCI	CALCI	RW
		Motor armature inductance.							
12.3.4	1060	**Compensation output**	V	FLOAT	PDO	0	0	0	R
		Monitor useful for assessing whether the current regulator is correctly calibrated.							
12.3.5	1070	**PI P1 gain**	%	FLOAT	SDO	20	0	0	RW
		Proportional gain of the PI current controller, expressed as a percentage of the base value IPA 1080-PI P base, with current reference at zero.							
12.3.6	1072	**PI I1 gain**	%	FLOAT	SDO	10	0	0	RW
		Integral gain of the PI current controller, expressed as a percentage of the base value IPA 1082-PI I base, with current reference at zero.							
12.3.7	1074	**PI P2 gain**	%	FLOAT	SDO	10	0	0	RW
		Proportional gain of the PI current controller, expressed as a percentage of the base value IPA 1080-PI P base, with current reference greater than IPA 1078- PI curr thr.							
12.3.8	1076	**PI I2 gain**	%	FLOAT	SDO	20	0	0	RW
		Integral gain of the PI current controller, expressed as a percentage of the base value IPA 1082-PI I base, with current reference greater than IPA 1078-PI curr thr.							
12.3.9	1078	**PI curr thr**	A	FLOAT	SDO	0	0	0	RW
		Threshold below which the proportional and integral gains vary linearly with the current from value 1 to value 2. Above this threshold, the values of IPA 1074-PI P2 gain and IPA 1076-PI I2 gain are maintained.							
12.3.10	1080	**PI P base**	deg/A	FLOAT	-	1.0	0.1	100	RWZ
		Base value of the proportional gain of the current controller.							
12.3.11	1082	**PI I base**	deg/Ams	FLOAT	-	1.0	0.1	100	RWZ
		Base value of the integral gain of the current controller.							

13 FIELD CONTROL

13.1 FIELD REG

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
13.1.1	1300	**Field reg enable**	-	BIT	PDO	1	0	1	RW
		Field converter enable.							
13.1.2	1302	**Field reg enable mon**	-	BIT	PDO	0	-	-	R
		Field converter enable command monitor.							
13.1.3	1304	**Field reg mode**	-	Enum	SDO	Current control	0	4	RW
		Field regulator operating mode.							
13.1.4	1310	**Field weak**	-	BIT	PDO	0	0	1	RW
		Field weak enable.							
13.1.5	1312	**Field weak mon**	-	BIT	PDO	0	-	-	R
		Field weak enable command monitor.							
13.1.6	1314	**Field weak speed-0**	-	BIT	PDO	1	0	1	RW
		Field weak enable at zero speed.							
13.1.7	1316	**Field weak speed-0 mon**	-	BIT	PDO	0	-	-	R
		Field weakening enable command monitor at zero speed.							

13.2 FIELD REG LIM

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
13.2.1	1350	**Field max dig**	%	FLOAT	PDO	100	5	100	RW
		Maximum current in percent of the rated current (obtained at the rated field current).							

13.2.2	1352	**Field max mon**	%	FLOAT	PDO	0	-	-	R
		Monitor of maximum flow as a percentage of nominal flow.							
13.2.3	1354	**Field min dig**	%	FLOAT	PDO	30	0	100	RW
		Minimum flow as a percentage of nominal flow (obtained at nominal field current).							

13.3 FIELD REG TUNE

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
13.3.1	1320	**Field curr reg P**	%	FLOAT	SDO	15.00	0	100	RW
		Proportional gain Kp of the field current controller, expressed as a percentage of IPA 1324-Field curr P base.							
13.3.2	1322	**Field curr reg I**	%	FLOAT	SDO	15.00	0	100	RW
		Integral gain Ki of the field current controller, expressed as a percentage of IPA 1326-Field curr I base.							
13.3.3	1324	**Field curr P base**	-	FLOAT	-	100	1	1000	RWZ
		Base proportional coefficient Kp of the field current controller.							
13.3.4	1326	**Field curr I base**	-	FLOAT	-	100	1	1000	RWZ
		Integral coefficient Ki base of the field current controller.							
13.3.5	1450	**Field curr const 40%**	%	FLOAT	SDO	40	0	100	RWZ
		Field current that leads to a flow equal to 40% of the nominal flow.							
13.3.6	1452	**Field curr const 70%**	%	FLOAT	SDO	70	0	100	RWZ
		Field current that leads to a flow equal to 70% of the nominal flow.							
13.3.7	1454	**Field curr const 90%**	%	FLOAT	SDO	90	0	100	RWZ
		Field current that leads to a flow equal to 90% of the nominal flow.							
13.3.8	1458	**Field curve reset**	-	BIT	SDO	0	0	1	RW
		Command to reset the flow/field current curve.							

14 VOLTAGE CONTROL

14.1 VOLT REG

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
14.1.1	1306	**Volt control ref dig**	%	FLOAT	PDO	100	0	100	RW
		Armature voltage reference, expressed as a percentage of the motor's rated armature voltage.							
14.1.2	1308	**Volt control ref mon**	%	FLOAT	PDO	0	-	-	R
		Armature voltage reference monitor.							
14.1.3	1448	**Arm voltage filter**	ms	UINT16	SDO	5	0	100.0	RW
		Time constant of the low-pass filter applied to the voltage used by the armature voltage regulator.							

14.2 VOLT REG TUNE

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
14.2.1	1400	**Voltage reg P**	%	FLOAT	SDO	3	0	100	RW
		Proportional gain Kp of the armature voltage regulator, expressed as a percentage of IPA1404-Voltage reg P base.							
14.2.2	1402	**Voltage reg I**	%	FLOAT	SDO	30	0	100	RW
		Integral gain Ki of the armature voltage regulator, expressed as a percentage of IPA 1406-Voltage reg I base.							
14.2.3	1404	**Voltage reg P base**	-	FLOAT	-	100	1.0	1000	RWZ
		Proportional coefficient Kp base of the armature voltage regulator.							
14.2.4	1406	**Voltare reg I base**	-	FLOAT	-	100	1.0	1000	RWZ

		Integral coefficient Ki base of the armature voltage regulator.

15 DIGITAL INPUTS

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
15.1	3000	**Digital input 1 dest**	-	Enum	SDO	OFF	0	90	RWZ
		Selection of the function to be controlled via Digital input 1.							
15.2	3010	**Digital input 2 dest**	-	Enum	SDO	OFF	0	90	RWZ
		Selection of the function to be controlled via Digital input 2.							
15.3	3020	**Digital input 3 dest**	-	Enum	SDO	OFF	0	90	RWZ
		Selection of the function to be controlled via Digital input 3.							
15.4	3030	**Digital input 4 dest**	-	Enum	SDO	OFF	0	90	RWZ
		Selection of the function to be controlled via Digital input 4.							
15.5	3040	**Digital input 5 dest**	-	Enum	SDO	OFF	0	90	RWZ
		Selection of the function to be controlled via Digital input 5.							
15.6	3050	**Digital input 6 dest**	-	Enum	SDO	OFF	0	90	RWZ
		Selection of the function to be controlled via Digital input 6.							
15.7	3060	**Digital input 7 dest**	-	Enum	SDO	OFF	0	90	RWZ
		Selection of the function to be controlled via Digital input 7.							
15.8	3070	**Digital input 8 dest**	-	Enum	SDO	OFF	0	90	RWZ
		Selection of the function to be controlled via Digital input 8.							
15.9	3002	**Digital input 1 inv**	-	BIT	SDO	0	0	1	RW
		Enabling the polarity reversal of the Digital input 1 signal.							
15.10	3012	**Digital input 2 inv**	-	BIT	SDO	0	0	1	RW
		Enabling the polarity reversal of the Digital input 2 signal.							
15.11	3022	**Digital input 3 inv**	-	BIT	SDO	0	0	1	RW
		Enabling the polarity reversal of the Digital input 3 signal.							
15.12	3032	**Digital input 4 inv**	-	BIT	SDO	0	0	1	RW
		Enabling the polarity reversal of the Digital input 4 signal.							
15.13	3042	**Digital input 5 inv**	-	BIT	SDO	0	0	1	RW
		Enabling the polarity reversal of the Digital input 5 signal.							
15.14	3052	**Digital input 6 inv**	-	BIT	SDO	0	0	1	RW
		Enabling the polarity reversal of the Digital input 6 signal.							
15.15	3062	**Digital input 7 inv**	-	BIT	SDO	0	0	1	RW
		Enabling the polarity reversal of the Digital input 7 signal.							
15.16	3072	**Digital input 8 inv**	-	BIT	SDO	0	0	1	RW
		Enabling the polarity reversal of the Digital input 8 signal.							
15.17	3004	**Digital input 1 mon**	-	UINT16	PDO	0	-	-	R
		Monitor (0/1) of digital input 1 signal status.							
15.18	3014	**Digital input 2 mon**	-	UINT16	PDO	0	-	-	R
		Monitor (0/1) of digital input 2 signal status.							
15.19	3024	**Digital input 3 mon**	-	UINT16	PDO	0	-	-	R
		Monitor (0/1) of digital input 3 signal status.							
15.20	3034	**Digital input 4 mon**	-	UINT16	PDO	0	-	-	R
		Monitor (0/1) of digital input 4 signal status.							
15.21	3044	**Digital input 5 mon**	-	UINT16	PDO	0	-	-	R
		Monitor (0/1) of digital input 5 signal status.							
15.22	3054	**Digital input 6 mon**	-	UINT16	PDO	0	-	-	R

		Monitor (0/1) of digital input 6 signal status.							
15.23	3064	**Digital input 7 mon**	-	UINT16	PDO	0	-	-	R
		Monitor (0/1) of digital input 7 signal status.							
15.24	3074	**Digital input 8 mon**	-	UINT16	PDO	0	-	-	R
		Monitor (0/1) of digital input 8 signal status.							

16 DIGITAL OUTPUTS

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
16.1	3200	**Digital output 1 sel**	-	Enum	SDO	Ramp +	0	82	RWZ
		Select the function to be assigned to Digital output 1.							
16.2	3202	**Digital output 2 sel**	-	Enum	SDO	Ramp -	0	82	RWZ
		Select the function to be assigned to Digital output 2.							
16.3	3204	**Digital output 3 sel**	-	Enum	SDO	Speed threshold	0	82	RWZ
		Select the function to be assigned to Digital output 3.							
16.4	3206	**Digital output 4 sel**	-	Enum	SDO	Motor overload free	0	82	RWZ
		Select the function to be assigned to Digital output 4.							
16.5	3208	**Digital output 5 sel**	-	Enum	SDO	Current limit state	0	82	RWZ
		Select the function to be assigned to Digital output 5.							
16.6	3210	**Digital output 6 sel**	-	Enum	SDO	Overvoltage	0	82	RWZ
		Select the function to be assigned to Digital output 6.							
16.7	3212	**Digital output 7 sel**	-	Enum	SDO	Undervoltage	0	82	RWZ
		Select the function to be assigned to Digital output 7.							
16.8	3214	**Digital output 8 sel**	-	Enum	SDO	Overcurrent	0	82	RWZ
		Select the function to be assigned to Digital output 8.							
16.9	3216	**Relay 1 sel**	-	Enum	SDO	Drive ok	0	82	RWZ
		Selecting the function to be assigned to Relay 1.							
16.10	3218	**Relay 2 sel**	-	Enum	SDO	Trip contactor	0	82	RWZ
		Selecting the function to be assigned to Relay 2.							
16.11	3220	**Digital output 1 inv**	-	BIT	SDO	0	0	1	RWZ
		Enabling signal inversion Digital output 1.							
16.12	3222	**Digital output 2 inv**	-	BIT	SDO	0	0	1	RWZ
		Enabling signal inversion Digital output 2.							
16.13	3224	**Digital output 3 inv**	-	BIT	SDO	0	0	1	RWZ
		Enabling signal inversion Digital output 3.							
16.14	3226	**Digital output 4 inv**	-	BIT	SDO	0	0	1	RWZ
		Enabling signal inversion Digital output 4.							
16.15	3228	**Digital output 5 inv**	-	BIT	SDO	0	0	1	RWZ
		Enabling signal inversion Digital output 5.							
16.16	3230	**Digital output 6 inv**	-	BIT	SDO	0	0	1	RWZ
		Enabling signal inversion Digital output 6.							
16.17	3232	**Digital output 7 inv**	-	BIT	SDO	0	0	1	RWZ
		Enabling signal inversion Digital output 7.							
16.18	3234	**Digital output 8 inv**	-	BIT	SDO	0	0	1	RWZ
		Enabling signal inversion Digital output 8.							
16.19	3236	**Relay 1 inv**	-	BIT	SDO	0	0	1	RWZ
		Enabling signal inversion Relay 1.							
16.20	3238	**Relay 2 inv**	-	BIT	SDO	0	0	1	RWZ

		Enabling signal inversion Relay 2.							
16.21	3240	**Digital output 1 mon**	-	UINT16	PDO	0	-	-	R
		Monitor (0/1) of the status of signal Digital output 1.							
16.22	3242	**Digital output 2 mon**	-	UINT16	PDO	0	-	-	R
		Monitor (0/1) of the status of signal Digital output 2.							
16.23	3244	**Digital output 3 mon**	-	UINT16	PDO	0	-	-	R
		Monitor (0/1) of the status of signal Digital output 3.							
15.24	3246	**Digital output 4 mon**	-	UINT16	PDO	0	-	-	R
		Monitor (0/1) of the status of signal Digital output 4.							
16.25	3248	**Digital output 5 mon**	-	UINT16	PDO	0	-	-	R
		Monitor (0/1) of the status of signal Digital output 5.							
16.26	3250	**Digital output 6 mon**	-	UINT16	PDO	0	-	-	R
		Monitor (0/1) of the status of signal Digital output 6.							
16.27	3252	**Digital output 7 mon**	-	UINT16	PDO	0	-	-	R
		Monitor (0/1) of the status of signal Digital output 7.							
16.28	3254	**Digital output 8 mon**	-	UINT16	PDO	0	-	-	R
		Monitor (0/1) of the status of signal Digital output 8.							
16.29	3256	**Relay 1 mon**	-	UINT16	PDO	0	-	-	R
		Monitor (0/1) of the status of the Relay 1 signal.							
16.30	3258	**Relay 2 mon**	-	UINT16	PDO	0	-	-	R
		Monitor (0/1) of the status of the Relay 2 signal.							

17 ANALOG INPUTS

17.1 ANALOG INPUT 1

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
17.1.1	3400	**An input 1 dest**	-	Enum	SDO	Ramp ref 1	0	28	RWZ
		Selection of the parameter whose value must be received from analogue input 1.							
17.1.2	3402	**An input 1 type**	-	Enum	SDO	-10V+10V	0	2	RWZ
		Selection of the input type (voltage or current).							
17.1.3	3404	**An input 1 scale**	-	FLOAT	SDO	1.0	-10.0	10.0	RW
		Scaling factor of analogue input 1.							
17.1.4	3406	**An input 1 offset**	cnt	INT16	PDO	0	-2048	2047	RW
		Allows compensation of a small offset on analogue signal 1.							
17.1.5	3408	**An input 1 sign**	-	Enum	PDO	Positive	0	1	RW
		Sign reversal command in the case of a unipolar input signal on analogue signal 1.							
17.1.6	3410	**An input 1 sign mon**	-	Enum	PDO	Positive	-	-	R
		Monitor of the sign reversal command of analogue signal 1.							
17.1.7	3412	**An input 1 filter**	ms	FLOAT	PDO	10.0	0.0	1000.0	RW
		Time constant of the low-pass filter applied to the measurement of analogue input signal 1.							
17.1.8	3414	**An input 1 autotune**	-	BIT	-	0	0	1	RW
		Command to perform automatic fine tuning of analogue input 1.							
17.1.9	3416	**An input 1 tune val**	-	FLOAT	SDO	1.0	-10.0	10.0	RW
		Gain acting in cascade with IPA 3404-An input 1 scale for fine calibration of analogue input 1.							
17.1.10	3418	**An input 1 enable**	-	BIT	PDO	1	0	1	RW
		Command to enable analogue input 1.							
17.1.11	3420	**An input 1 en mon**	-	BIT	PDO	1	-	-	R

		Analogue input 1 enable command monitor.							
17.1.12	3422	**An input 1 cmp thr**	-	FLOAT	SDO	CALC	-10000	10000	RW
		Analogue input 1 comparison function intervention threshold.							
17.1.13	3424	**An input 1 cmp error**	-	FLOAT	SDO	CALC	0	10000	RW
		Tolerance band for analogue input 1 comparison function.							
17.1.14	3426	**An input 1 cmp delay**	ms	UINT16	SDO	0	0	65000	RW
		Delay on the signal indicating that the analogue input 1 comparison level has been reached.							
17.1.15	3428	**An input 1 mon**	cnt	INT16	PDO	0	-	-	R
		Monitor in count of analogue input 1 signal, after A/D conversion, filtering and offset application.							

17.2 ANALOG INPUT 2

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
17.2.1	3430	**An input 2 dest**	-	Enum	SDO	OFF	0	28	RWZ
		Selection of the parameter whose value must be received from analogue input 2.							
17.2.2	3432	**An input 2 type**	-	Enum	SDO	-10V+10V	0	2	RWZ
		Selects the input type (voltage or current).							
17.2.3	3434	**An input 2 scale**	-	FLOAT	SDO	1.0	-10.0	10.0	RW
		Scaling factor for analogue input 2.							
17.2.4	3436	**An input 2 offset**	cnt	INT16	PDO	0	-2048	2047	RW
		Allows compensation of an offset contained in analogue signal 2.							
17.2.5	3438	**An input 2 sign**	-	Enum	PDO	Positive	0	1	RW
		Sign reversal command in the case of a unipolar input signal on analogue signal 2.							
17.2.6	3440	**An input 2 sign mon**	-	Enum	PDO	Positive	-	-	R
		Monitor of the sign reversal command of analogue signal 2.							
17.2.7	3442	**An input 2 filter**	ms	FLOAT	SDO	10.0	0.0	1000.0	RW
		Time constant of the low-pass filter applied to the measurement of analogue input signal 2.							
17.2.8	3444	**An input 2 autotune**	-	BIT	-	0	0	1	RW
		Command to perform automatic fine tuning of analogue input 2.							
17.2.9	3446	**An input 2 tune val**	-	FLOAT	SDO	1.0	-10.0	10.0	RW
		Gain acting in cascade with IPA 3404-An input 1 scale for fine calibration of analogue input 2.							
17.2.10	3448	**An input 2 enable**	-	BIT	PDO	1	0	1	RW
		Command to enable analogue input 2.							
17.2.11	3450	**An input 2 en mon**	-	BIT	PDO	1	-	-	R
		Analogue input 2 enable command monitor.							
17.2.12	3458	**An input 2 mon**	cnt	INT16	PDO	0	-	-	R
		Monitor in count of analogue input 2 signal, after A/D conversion, filtering and offset application.							

17.3 ANALOG INPUT 3

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
17.3.1	3460	**An input 3 dest**	-	Enum	SDO	OFF	0	19	RWZ
		Selection of the parameter whose value must be received from analogue input 3.							
17.3.2	3462	**An input 3 type**	-	Enum	SDO	-10V+10V	0	2	RWZ
		Selects the input type (voltage or current).							
17.3.3	3464	**An input 3 scale**	-	FLOAT	SDO	1.0	-10.0	10.0	RW
		Scaling factor for analogue input 3.							

17.3.4	3466	**An input 3 offset**	cnt	INT16	PDO	0	-2048	2047	RW
		Allows compensation of an offset contained in analogue signal 3.							
17.3.5	3468	**An input 3 sign**	-	Enum	PDO	Positive	0	1	RW
		Sign reversal command in the case of a unipolar input signal on analogue signal 3.							
17.3.6	3470	**An input 3 sign mon**	-	Enum	PDO	Positive	-	-	R
		Monitor for the sign reversal command of analogue signal 3.							
17.3.7	3472	**An input 3 filter**	ms	FLOAT	SDO	10.0	0.0	1000.0	RW
		Time constant of the low-pass filter applied to the measurement of analogue input signal 3.							
17.3.8	3474	**An input 3 autotune**	-	BIT	-	0	0	1	RW
		Command to perform automatic fine tuning of analogue input 3.							
17.3.9	3476	**An input 3 tune val**	-	FLOAT	SDO	1.0	-10.0	10.0	RW
		Gain acting in cascade with IPA 3404-An input 1 scale for fine calibration of analogue input 3.							
17.3.10	3478	**An input 3 enable**	-	BIT	PDO	1	0	1	RW
		Command to enable analogue input 3.							
17.3.11	3480	**An input 3 en mon**	-	BIT	PDO	1	-	-	R
		Analogue input 3 enable command monitor.							
17.3.12	3488	**An input 3 mon**	cnt	INT16	PDO	0	-	-	R
		Monitor in count of analogue input 3 signal, after A/D conversion, filtering and offset application.							

18 ANALOG OUTPUTS

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
18.1	3500	**An output 1 sel**	-	Enum	SDO	Motor speed nofilt	0	96	RW
		Selection of the variable to be assigned to Analog output 1.							
18.2	3502	**An output 1 scale**	-	FLOAT	SDO	1.0	-10.0	10.0	RW
		Analogue output 1 scale factor.							
18.3	3504	**An output 1 offset**	cnt	INT16	SDO	0	-100	100	RW
		Analogue output 1 offset compensation.							
18.4	3510	**An output 2 sel**	-	Enum	SDO	Arm curr nofilt	0	96	RW
		Variable selection to be assigned to Analog output 2.							
18.5	3512	**An output 2 scale**	-	FLOAT	SDO	1.0	-10.0	10.0	RW
		Analogue output 2 scale factor.							
18.6	3514	**An output 2 offset**	cnt	INT16	SDO	0	-100	100	RW
		Analogue output 2 offset compensation.							
18.7	3520	**An output 3 sel**	-	Enum	SDO	Field current	0	96	RW
		Variable selection to be assigned to Analog output 3.							
18.8	3522	**An output 3 scale**	-	FLOAT	SDO	1.0	-10.0	10.0	RW
		Analogue output 3 scale factor.							
18.9	3524	**An output 3 offset**	cnt	INT16	SDO	0	-100	100	RW
		Analogue output 3 offset compensation.							
18.10	3530	**An output 4 sel**	-	Enum	SDO	Armature voltage	0	96	RW
		Selection of the variable to be assigned to Analog output 4.							
18.11	3532	**An output 4 scale**	-	FLOAT	SDO	1.0	-10.0	10.0	RW
		Analogue output 4 scale factor.							
18.12	3534	**An output 4 offset**	cnt	INT16	SDO	0	-100	100	RW
		Analogue output 4 offset compensation.							

19 FUNCTIONS

19.1 MOTORPOT

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
19.1.1	4000	**Motorpot enable**	-	BIT	SDO	0	0	1	RWZ
		Motor potentiometer function enable.							
19.1.2	4002	**Motorpot setpoint**	rpm	INT16	-	0	0	0	R
		Motor potentiometer output speed, which can be increased or decreased by applying the Up/Down commands.							
19.1.3	4004	**Motorpot invert**	-	BIT	PDO	0	0	1	RW
		Motor potentiometer output inversion command.							
19.1.4	4006	**Motorpot invert mon**	-	BIT	PDO	0	0	0	R
		Monitor of the motor potentiometer output reversal command.							
19.1.5	4008	**Motorpot bottom lim**	rpm	FLOAT	SDO	0	CALC	CALC	RW
		Lower limit of the motor potentiometer output speed.							
19.1.6	4010	**Motorpot top lim**	rpm	FLOAT	SDO	1500	CALC	CALC	RW
		Upper limit of the motor potentiometer output speed.							
19.1.7	4012	**Motorpot acc time**	s	UINT16	SDO	10	0	65535	RW
		Acceleration time of the motor potentiometer ramp, between the lower limit and the upper limit.							
19.1.8	4014	**Motorpot dec time**	s	UINT16	SDO	10	0	65535	RW
		Deceleration time of the motor potentiometer ramp, between the upper limit and the lower limit.							
19.1.9	4016	**Motorpot mode**	-	Enum	SDO	Ramp & Last Val	0	3	RW
		Setting the motor potentiometer operating mode.							
19.1.10	4018	**Motorpot powerOn cfg**	-	Enum	SDO	Bottom lim	0	3	RW
		Allows you to select the initial value of the Motorpot output when the drive is turned on.							
19.1.11	4020	**Motorpot preset cfg**	-	Enum	SDO	None	0	11	RW
		Allows you to enable the preset command to act in various ways on the output speed of the Motorpot.							
19.1.12	4022	**Motorpot out**	rpm	FLOAT	PDO	0	-	-	R
		Monitor of the motor potentiometer output, at the input of the ramp reference chain after the multispeed function and before the FWD/REV logic.							

19.2 JOG

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
19.2.1	4050	**Jog enable**	-	Enum	SDO	OFF	0	1	RWZ
		Jog function enable.							
19.2.2	4052	**Jog ref dig**	rpm	FLOAT	PDO	0	0	8191	RW
		Ramp or speed reference for the Jog function.							
19.2.3	4054	**Jog ref mon**	rpm	FLOAT	PDO	0	-	-	R
		Monitor of the ramp or speed reference of the Jog function.							
19.2.4	4056	**Jog selection**	-	Enum	Enum	Speed input	0	1	RWZ
		Allows you to select the action mode of the Jog function.							
19.2.5	4058	**Jog output**	rpm	INT16	PDO	0	-	-	R
		Monitor of the output of the Jog function.							

19.3 MULTI SPEED

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
19.3.1	4150	**Multi speed enable**	-	Enum	SDO	OFF	0	1	RWZ

		Multispeed function enabled.							
19.3.2	4152	**Multi speed 1**	rpm	FLOAT	PDO	0	-8191	8191	RW
		Speed 1 can be used as ramp reference.							
19.3.3	4154	**Multi speed 2**	rpm	FLOAT	PDO	0	-8191	8191	RW
		Speed 2 can be used as ramp reference.							
19.3.4	4156	**Multi speed 3**	rpm	FLOAT	PDO	0	-8191	8191	RW
		Speed 3 can be used as ramp reference.							
19.3.5	4158	**Multi speed 4**	rpm	FLOAT	PDO	0	-8191	8191	RW
		Speed 4 can be used as ramp reference.							
19.3.6	4160	**Multi speed 5**	rpm	FLOAT	PDO	0	-8191	8191	RW
		Speed 5 can be used as ramp reference.							
19.3.7	4162	**Multi speed 6**	rpm	FLOAT	PDO	0	-8191	8191	RW
		Speed 6 can be used as ramp reference.							
19.3.8	4164	**Multi speed 7**	rpm	FLOAT	PDO	0	-8191	8191	RW
		Speed 7 can be used as ramp reference.							
19.3.9	4166	**Multi speed sel**	-	UINT16	PDO	0	0	7	RW
		Desired speed selector.							
19.3.10	4168	**Multi speed sel mon**	-	UINT16	PDO	0	-	-	R
		Desired speed selector monitor.							

19.4 MULTI RAMP

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
19.4.1	4200	**Multi ramp enable**	-	Enum	SDO	OFF	0	1	RWZ
		Multi ramp function enable.							
19.4.2	4202	**Multi ramp sel**	-	UINT16	PDO	1	1	4	RW
		Desired multi ramp set selector.							
19.4.3	4204	**Multi ramp sel mon**	-	UINT16	PDO	0	-	-	R
		Monitor of the desired multi ramp set selector.							
19.4.4	4210	**Acc speed 1**	rpm	UINT32	SDO	100	1	65535	RW
		Acceleration speed of linear ramp set 1.							
19.4.5	4220	**Acc time 1**	s	UINT16	SDO	1	0	65535	RW
		Acceleration time of ramp set 1.							
19.4.6	4230	**Acc time jerk 1**	ms	FLOAT	SDO	300	20	15000	RW
		Jerk time in acceleration of ramp S set 1.							
19.4.7	4240	**Dec speed 1**	rpm	UINT32	SDO	100	1	65535	RW
		Linear ramp deceleration speed set 1.							
19.4.8	4250	**Dec time 1**	s	UINT16	SDO	1	0	65535	RW
		Linear ramp deceleration time set 1.							
19.4.9	4260	**Dec time jerk 1**	ms	FLOAT	SDO	300	20	15000	RW
		Jerk time during S ramp deceleration set 1.							
19.4.10	4212	**Acc speed 2**	rpm	UINT32	SDO	100	1	65535	RW
		Acceleration speed of linear ramp set 2.							
19.4.11	4222	**Acc time 2**	s	UINT16	SDO	1	0	65535	RW
		Acceleration time of ramp set 2.							
19.4.12	4232	**Acc time jerk 2**	ms	FLOAT	SDO	300	20	15000	RW
		Jerk time during acceleration of S ramp set 2.							
19.4.13	4242	**Dec speed 2**	rpm	UINT32	SDO	100	1	65535	RW

		Linear ramp deceleration speed set 2.							
19.4.14	4252	**Dec time 2**	s	UINT16	SDO	1	0	65535	RW
		Linear ramp deceleration time set 2.							
19.4.15	4262	**Dec time jerk 2**	ms	FLOAT	SDO	300	20	15000	RW
		Deceleration jerk time of ramp S set 2.							
19.4.16	4214	**Acc speed 3**	rpm	UINT32	SDO	100	1	65535	RW
		Acceleration speed of linear ramp set 3.							
19.4.17	4224	**Acc time 3**	s	UINT16	SDO	1	0	65535	RW
		Acceleration time of ramp set 3.							
19.4.18	4234	**Acc time jerk 3**	ms	FLOAT	SDO	300	20	15000	RW
		Jerk time during acceleration of ramp S set 3.							
19.4.19	4244	**Dec speed 3**	rpm	UINT32	SDO	100	1	65535	RW
		Linear ramp deceleration speed set 3.							
19.4.20	4254	**Dec time 3**	s	UINT16	SDO	1	0	65535	RW
		Linear ramp deceleration time set 3.							
19.4.21	4264	**Dec time jerk 3**	ms	FLOAT	SDO	300	20	15000	RW
		Jerk time during S ramp deceleration set 3.							
19.4.22	4216	**Acc speed 4**	rpm	UINT32	SDO	100	1	65535	RW
		Acceleration speed of linear ramp set 4.							
19.4.23	4226	**Acc time 4**	s	UINT16	SDO	1	0	65535	RW
		Acceleration time of ramp set 4.							
19.4.24	4236	**Acc time jerk 4**	ms	FLOAT	SDO	300	20	15000	RW
		Jerk time during acceleration of ramp S set 4.							
19.4.25	4246	**Dec speed 4**	rpm	UINT32	SDO	100	1	65535	RW
		Linear ramp deceleration speed set 4.							
19.4.26	4256	**Dec time 4**	s	UINT16	SDO	1	0	65535	RW
		Linear ramp deceleration time set 4.							
19.4.27	4266	**Dec time jerk 4**	ms	FLOAT	SDO	300	20	15000	RW
		Jerk time during S ramp deceleration set 4.							

19.5 THRESHOLDS

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
19.5.1	812	**Speed 0 level**	rpm	UINT16	SDO	10	1	8191	RW
		Speed threshold for Speed 0 thr signal.							
19.5.2	814	**Speed 0 delay**	ms	UINT16	SDO	100	0	65535	RW
		Time delay for Speed 0 thr signal.							
19.5.3	816	**Speed thr pos**	rpm	UINT16	SDO	10	0	8191	RW
		Positive speed threshold for Speed threshold signal.							
19.5.4	818	**Speed thr neg**	rpm	UINT16	SDO	10	0	8191	RW
		Negative speed threshold for Speed threshold signal.							
19.5.5	820	**Speed thr delay**	ms	UINT16	SDO	100	0	65535	RW
		Time delay for the Speed threshold signal.							
19.5.6	822	**Speed set error**	rpm	UINT16	SDO	10	1	8191	RW
		Speed threshold for the Speed set signal.							
19.5.7	824	**Speed set delay**	ms	UINT16	SDO	100	0	65535	RW
		Time delay for Speed set signal.							
19.5.8	1012	**Arm curr thr**	%	FLOAT	SDO	100	0	150	RW

		Current threshold for Arm curr threshold signal, expressed as a percentage of the motor's rated armature current.							
19.5.9	1018	**Arm curr thr delay**	ms	UINT16	SDO	1000	0	65535	RW
		Time delay for Arm curr threshold signal.							

19.6 DROOP

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
19.6.1	4400	**Droop enable**	-	BIT	PDO	0	0	1	RW
		Droop function enable.							
19.6.2	4402	**Droop enable mon**	-	BIT	PDO	0	-	-	R
		Droop function enable parameter monitor.							
19.6.3	4404	**Droop gain**	rpm/A	FLOAT	SDO	0	0	100	RW
		Proportional gain of the Droop function.							
19.6.4	4406	**Droop filter**	ms	UINT16	SDO	0	0	1000	RW
		Time constant of the low-pass filter applied between the gain and the output limitation block of the Droop function.							
19.6.5	4408	**Droop limit**	rpm	UINT16	SDO	1500	0	8191	RW
		Maximum absolute value that the Droop out mon output can assume.							
19.6.6	4410	**Load comp dig**	%	FLOAT	PDO	0	-150	150	RW
		Current value supplied by the Master drive (see fig. below), expressed as a percentage of the motor's rated armature current.							
19.6.7	4412	**Load comp mon**	%	FLOAT	PDO	0	-	-	R
		Monitor of the current supplied by the Master drive, expressed as a percentage of the motor's rated armature current.							
19.6.8	4414	**Droop out mon**	rpm	FLOAT	PDO	0	-	-	R
		Monitor of the output of the Droop function.							

19.7 SPEED DRAW

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
19.7.1	4350	**Speed draw ratio dig**	-	FLOAT	PDO	1.0	0	4	RW
		Setting of the scale factor in action at the ramp output, with resolution 0.0001.							
19.7.2	4352	**Speed draw ratio mon**	-	FLOAT	PDO	0	-	-	R
		Monitor of the scale factor in action at the ramp output.							
19.7.3	4354	**Speed draw out**	rpm	FLOAT	PDO	0	-	-	R
		Monitor of the speed reference at the output of the Speed draw function, after application of the scale factor.							

19.8 OVERLOAD

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
19.8.1	4300	**Overload mode**	-	Enum	SDO	None	0	3	RWZ
		Overload type selection.							
19.8.2	4302	**Motor ventilation**	-	Enum	SDO	Servo fan	0	1	RWZ
		Motor ventilation type selection.							
19.8.3	4304	**Motor derating**	%	UINT16	SDO	50	0	100	RWZ
		Derating factor when Motor ventilation = Auto fan.							
19.8.4	4306	**Motor I2t time**	s	UINT16	SDO	30	0	540	RWZ
		Allows you to set the time for defining the motor I2t overload in case Overload mode = I2t Drive and Motor. Represents the maximum time during which the Motor I2t current is allowed.							
19.8.5	4308	**Motor I2t current**	%	FLOAT	SDO	100	80	CALC	RWZ

		Allows you to set the current level to define the I2t overload of the motor when Overload mode = I2t Drive and Motor. Represents the maximum armature current allowed during Motor I2t time.							
19.8.6	4310	**Motor I2t lim curr**	%	FLOAT	SDO	100	0	100.01	RW
		Allows you to set the current limit when the motor overload condition Motor I2t accum = 100% is reached.							
19.8.7	4312	**Motor I2t alert**	-	UINT16	PDO	0	-	-	R
		Monitor used to signal that the Motor I2t accum parameter has reached the value 80%.							
19.8.8	4314	**Motor I2t accum**	%	FLOAT	PDO	0	-	-	R
		Monitor of the status of the motor I2t accumulator, which represents an indication of how close the drive is to the motor overload condition.							
19.8.9	4316	**Drive I2t time**	s	FLOAT	SDO	60	1	100	RWZ
		Allows you to set the time for defining the drive I2t overload in Control Unit configuration if Overload mode = I2t drive or I2t Drive and Motor.							
19.8.10	4318	**Drive I2t current**	%	FLOAT	SDO	100	100	CALC	RWZ
		Allows you to set the current to define the I2t overload of the drive in Control Unit configuration when Overload mode = I2t drive or I2t Drive and Motor.							
19.8.11	4320	**Drive I2t alert**	-	UINT16	PDO	0	-	-	R
		Monitor used to signal that the Drive I2t accum parameter has reached 80%.							
19.8.12	4322	**Drive I2t accum**	%	FLOAT	PDO	0	-	-	R
		Monitor of the status of the drive's I2t accumulator, which indicates how close the drive is to overload condition.							
19.8.13	4324	**C/T overload lim mon**	%	FLOAT	PDO	0	-	-	R
		Monitor of the current limit imposed by the cascade overload function on the other limiting contributions.							

19.9 C/T SPEED LIMIT

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
19.9.1	1150	**C/T speed lim enable**	-	BIT	SDO	0	0	1	RWZ
		Enabling of armature current limits based on speed.							
19.9.2	1152	**C/T speed lim 0**	%	FLOAT	SDO	100.0	0	CALC	RWZ
		Current limit 0, as a percentage of the motor armature rated current.							
19.9.3	1154	**C/T speed lim 1**	%	FLOAT	SDO	80.0	0	CALC	RWZ
		Current limit 1, as a percentage of the motor's rated armature current.							
19.9.4	1156	**C/T speed lim 2**	%	FLOAT	SDO	60.0	0	CALC	RWZ
		Current limit 2, as a percentage of the motor's rated armature current.							
19.9.5	1158	**C/T speed lim 3**	%	FLOAT	SDO	40.0	0	CALC	RWZ
		Current limit 3, as a percentage of the motor's rated armature current.							
19.9.6	1160	**C/T speed lim 4**	%	FLOAT	SDO	20.0	0	CALC	RWZ
		Current limit 4, as a percentage of the motor's rated armature current.							
19.9.7	1162	**C/T speed lim thr 0**	rpm	FLOAT	SDO	CALC	0	6500	RWZ
		Speed threshold 0.							
19.9.8	1164	**C/T speed lim thr 1**	rpm	FLOAT	SDO	CALC	0	6500	RWZ
		Speed threshold 1.							
19.9.9	1166	**C/T speed lim thr 2**	rpm	FLOAT	SDO	CALC	0	6500	RWZ
		Speed threshold 2.							
19.9.10	1168	**C/T speed lim thr 3**	rpm	FLOAT	SDO	CALC	0	6500	RWZ
		Speed threshold 3.							
19.9.11	1170	**C/T speed lim thr 4**	rpm	FLOAT	SDO	CALCI	0	6500	RWZ
		Speed threshold 4.							
19.9.12	1172	**C/T speed lim in use**	%	FLOAT	PDO	0	-	-	R
		Monitor of the current limit imposed by the function, as a percentage of the motor's rated armature current.							

19.10 BRAKE CONTROL

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
19.10.1	4100	**Brake control enable**	-	Enum	SDO	OFF	0	1	RWZ
		Enables brake control function.							
19.10.2	4102	**Fwd open C/T thr**	%	FLOAT	SDO	0	0	150	RW
		Current threshold for opening the brake in the forward direction, expressed as a percentage of the motor's rated armature current.							
19.10.3	4104	**Fwd open speed thr**	rpm	UINT16	SDO	10	0	CALC	RW
		Speed threshold for opening the brake in the forward direction.							
19.10.4	4106	**Fwd open speed ref**	rpm	UINT16	SDO	20	0	CALC	RW
		Speed reference for opening the brake in the forward direction.							
19.10.5	4108	**Fwd close speed thr**	rpm	UINT16	SDO	20	0	CALC	RW
		Speed threshold for closing the brake in the forward direction.							
19.10.6	4110	**Rev open C/T thr**	%	FLOAT	SDO	0	0	150	RW
		Current threshold for opening the brake in the reverse direction, expressed as a percentage of the motor's rated armature current.							
19.10.7	4112	**Rev open speed thr**	rpm	UINT16	SDO	10	0	CALC	RW
		Speed threshold for opening the brake in reverse direction.							
19.10.8	4114	**Rev open speed ref**	rpm	UINT16	SDO	20	0	CALC	RW
		Speed reference for opening the brake in Reverse direction.							
19.10.9	4116	**Rev close speed thr**	rpm	UINT16	SDO	20	0	CALC	RW
		Speed threshold for closing the brake in Reverse direction.							
19.10.10	4134	**Brake ramp acc time**	s	UINT16	SDO	2	1	65535	RW
		Ramp acceleration time during the brake opening phase.							
19.10.11	4118	**Brake pretorque dig**	%	FLOAT	PDO	50	0	150	RW
		Torque level injected at the moment the brake is opened, expressed as a percentage of the motor's rated armature current.							
19.10.12	4120	**Brake pretorque mon**	%	FLOAT	PDO	0	-	-	R
		Monitor of the torque injected at the moment the brake is released.							
19.10.13	4136	**Brake pretorque time**	ms	UINT16	SDO	10	0	5000	RW
		Ramp time, used for the gradual increase of the torque to be injected at the moment the brake is released, from 0 to 100% of the motor's rated armature current.							
19.10.14	4122	**Brake open delay**	ms	UINT16	SDO	50	0	10000	RW
		Delay in opening the brake after the relevant threshold is exceeded.							
19.10.15	4124	**Brake disable delay**	ms	UINT16	SDO	50	0	10000	RW
		Delay in disabling the drive after the brake is closed during stopping.							
19.10.16	4126	**Brake fbk type**	-	Enum	SDO	None	0	2	RW
		Selection of brake feedback type.							
19.10.17	4128	**Brake fbk time**	ms	UINT16	SDO	0	0	10000	RW
		Maximum time allowed between sending the brake release command and receiving the feedback signal. If, at the end of the maximum time set, the feedback signal is not consistent with the command signal, the drive signals the Brake fault alarm.							
19.10.18	4130	**Brake fbk mon**	-	UINT16	PDO	0	-	-	R
		Brake feedback status monitor.							
19.10.19	4132	**Brake cmd mon**	-	UINT16	PDO	0	-	-	R
		Brake open/close command status monitor.							
19.10.20	4148	**Brake control state**	-	Enum	PDO	Wait for start	-	-	R
		Brake control function status monitor.							

19.11 TEST GENERATOR

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
19.11.1	4450	**Test gen dest**	-	Enum	SDO	OFF	0	4	RWZ
		Allows you to select the destination of the generated waveform to simulate certain reference signals for speed, current or field control.							
19.11.2	4452	**Test gen frequency**	Hz	FLOAT	SDO	0.1	0.1	62.5	RW
		Frequency of the generated waveform.							
19.11.3	4454	**Test gen amplitude**	%	FLOAT	SDO	0	0	200	RW
		Amplitude of the generated waveform, as a percentage of the full scale of the selected quantity.							
19.11.4	4456	**Test gen offset**	%	FLOAT	SDO	0	-200	200	RW
		Offset of the generated waveform, as a percentage of the full scale of the selected quantity.							
19.11.5	4458	**Test gen out**	-	FLOAT	PDO	0	-	-	R
		Instantaneous monitoring of the value of the generated waveform.							

19.12 LINK 1

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
19.12.1	4650	**Link 1 source**	-	UINT16	SDO	0	0	9999	RW
		IPA parameter source Link 1.							
19.12.2	4652	**Link 1 destination**	-	UINT16	SDO	0	0	9999	RW
		IPA parameter destination Link 1.							
19.12.3	4654	**Link 1 mul gain**	-	FLOAT	SDO	1.0	-10000	10000	RW
		Link 1 source multiplication factor.							
19.12.4	4656	**Link 1 div gain**	-	FLOAT	SDO	1.0	-10000	10000	RW
		Link 1 source divider.							
19.12.5	4658	**Link 1 input max**	-	FLOAT	SDO	99999	-99999	99999	RW
		Maximum value of Link 1 source.							
19.12.6	4660	**Link 1 input min**	-	FLOAT	SDO	0	-99999	99999	RW
		Minimum value of Link 1 source.							
19.12.7	4662	**Link 1 input offset**	-	FLOAT	SDO	0	-10000	10000	RW
		Offset on Link 1 source.							
19.12.8	4664	**Link 1 output offset**	-	FLOAT	SDO	0	-10000	10000	RW
		Offset on Link 1 destination.							
19.12.9	4666	**Link 1 input abs**	-	Enum	SDO	OFF	0	1	RW
		Enable absolute value applicable to Link 1 source.							

19.13 LINK 2

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
19.13.1	4670	**Link 2 source**	-	UINT16	SDO	0	0	9999	RW
		IPA parameter source Link 2.							
19.13.2	4672	**Link 2 destination**	-	UINT16	SDO	0	0	9999	RW
		IPA parameter destination Link 2.							
19.13.3	4674	**Link 2 mul gain**	-	FLOAT	SDO	1.0	-10000	10000	RW
		Link 2 source multiplication factor.							
19.13.4	4676	**Link 2 div gain**	-	FLOAT	SDO	1.0	-10000	10000	RW
		Link 2 source divider.							
19.13.5	4678	**Link 2 input max**	-	FLOAT	SDO	99999	-99999	99999	RW

		Maximum value of Link 2 source.							
19.13.6	4680	**Link 2 input min**	-	FLOAT	SDO	0	-99999	99999	RW
		Minimum value of Link 2 source.							
19.13.7	4682	**Link 2 input offset**	-	FLOAT	SDO	0	-10000	10000	RW
		Offset on Link 2 source.							
19.13.8	4684	**Link 2 output offset**	-	FLOAT	SDO	0	-10000	10000	RW
		Offset on Link 2 destination.							
19.13.9	4686	**Link 2 input abs**	-	Enum	SDO	OFF	0	1	RW
		Enabling the absolute value applicable to the Link 2 source.							

19.14 LINK 3

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
19.14.1	4690	**Link 3 source**	-	UINT16	SDO	0	0	9999	RW
		IPA parameter source Link 3.							
19.14.2	4692	**Link 3 destination**	-	UINT16	SDO	0	0	9999	RW
		IPA parameter destination Link 3.							
19.14.3	4694	**Link 3 mul gain**	-	FLOAT	SDO	1.0	-10000	10000	RW
		Link 3 source multiplication factor.							
19.14.4	4696	**Link 3 div gain**	-	FLOAT	SDO	1.0	-10000	10000	RW
		Link 3 source divider.							
19.14.5	4698	**Link 3 input max**	-	FLOAT	SDO	99999	-99999	99999	RW
		Link 3 source maximum value.							
19.14.6	4700	**Link 3 input min**	-	FLOAT	SDO	0	-99999	99999	RW
		Minimum value of Link 3 source.							
19.14.7	4702	**Link 3 input offset**	-	FLOAT	SDO	0	-10000	10000	RW
		Offset on Link 3 source.							
19.14.8	4704	**Link 3 output offset**	-	FLOAT	SDO	0	-10000	10000	RW
		Offset on Link 3 destination.							
19.14.9	4706	**Link 3 input abs**	-	Enum	SDO	OFF	0	1	RW
		Enable absolute value applicable to Link 3 source.							

19.15 LINK 4

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
19.15.1	4710	**Link 4 source**	-	UINT16	SDO	0	0	9999	RW
		IPA parameter source Link 4.							
19.15.2	4712	**Link 4 destination**	-	UINT16	SDO	0	0	9999	RW
		IPA parameter destination Link 4.							
19.15.3	4714	**Link 4 mul gain**	-	FLOAT	SDO	1.0	-10000	10000	RW
		Link 4 source multiplication factor.							
19.15.4	4716	**Link 4 div gain**	-	FLOAT	SDO	1.0	-10000	10000	RW
		Link 4 source divider.							
19.15.5	4718	**Link 4 input max**	-	FLOAT	SDO	99999	-99999	99999	RW
		Link 4 source maximum value.							
19.15.6	4720	**Link 4 input min**	-	FLOAT	SDO	0	-99999	99999	RW
		Link 4 source minimum value.							

19.15.7	4722	**Link 4 input offset**	-	FLOAT	SDO	0	-10000	10000	RW
		Offset on Link 4 source.							
19.15.8	4724	**Link 4 output offset**	-	FLOAT	SDO	0	-10000	10000	RW
		Offset on Link 4 destination.							
19.15.9	4726	**Link 4 input abs**	-	Enum	SDO	OFF	0	1	RW
		Enabling the absolute value applicable to the Link 4 source.							

19.16 LINK 5

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
19.16.1	4730	**Link 5 source**	-	UINT16	SDO	0	0	9999	RW
		IPA parameter source Link 5.							
19.16.2	4732	**Link 5 destination**	-	UINT16	SDO	0	0	9999	RW
		IPA parameter destination Link 5.							
19.16.3	4734	**Link 5 mul gain**	-	FLOAT	SDO	1.0	-10000	10000	RW
		Link 5 source multiplication factor.							
19.16.4	4736	**Link 5 div gain**	-	FLOAT	SDO	1.0	-10000	10000	RW
		Link 5 source divider.							
19.16.5	4738	**Link 5 input max**	-	FLOAT	SDO	99999	-99999	99999	RW
		Link 5 source maximum value.							
19.16.6	4740	**Link 5 input min**	-	FLOAT	SDO	0	-99999	99999	RW
		Minimum value of Link 5 source.							
19.16.7	4742	**Link 5 input offset**	-	FLOAT	SDO	0	-10000	10000	RW
		Offset on Link 5 source.							
19.16.8	4744	**Link 5 output offset**	-	FLOAT	SDO	0	-10000	10000	RW
		Offset on Link 5 destination.							
19.16.9	4746	**Link 5 input abs**	-	Enum	SDO	OFF	0	1	RW
		Enable absolute value applicable to Link 5 source.							

19.17 LINK 6

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
19.17.1	4750	**Link 6 source**	-	UINT16	SDO	0	0	9999	RW
		IPA parameter source Link 6.							
19.17.2	4752	**Link 6 destination**	-	UINT16	SDO	0	0	9999	RW
		IPA parameter destination Link 6.							
19.17.3	4754	**Link 6 mul gain**	-	FLOAT	SDO	1.0	-10000	10000	RW
		Link 6 source multiplication factor.							
19.17.4	4756	**Link 6 div gain**	-	FLOAT	SDO	1.0	-10000	10000	RW
		Link 6 source divider.							
19.17.5	4758	**Link 6 input max**	-	FLOAT	SDO	99999	-99999	99999	RW
		Link 6 source maximum value.							
19.17.6	4760	**Link 6 input min**	-	FLOAT	SDO	0	-99999	99999	RW
		Minimum value of Link 6 source.							
19.17.7	4762	**Link 6 input offset**	-	FLOAT	SDO	0	-10000	10000	RW
		Offset on Link 6 source.							
19.17.8	4764	**Link 6 output offset**	-	FLOAT	SDO	0	-10000	10000	RW

		Offset on destination Link 6.							
19.17.9	4766	**Link 6 input abs**	-	Enum	SDO	OFF	0	1	RW
		Enabling the absolute value applicable to the source of Link 6.							

19.18 PAD PARAMETERS

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
19.18.1	4500	**Pad 0**	-	FLOAT	PDO	0	-32768	32767	RW
		Pad 0 value.							
19.18.2	4502	**Pad 1**	-	FLOAT	PDO	0	-32768	32767	RW
		Pad 1 value.							
19.18.3	4504	**Pad 2**	-	FLOAT	PDO	0	-32768	32767	RW
		Pad 2 value.							
19.18.4	4506	**Pad 3**	-	FLOAT	PDO	0	-32768	32767	RW
		Pad 3 value.							
19.18.5	4508	**Pad 4**	-	FLOAT	PDO	0	-32768	32767	RW
		Pad 4 value.							
19.18.6	4510	**Pad 5**	-	FLOAT	PDO	0	-32768	32767	RW
		Pad 5 value.							
19.18.7	4512	**Pad 6**	-	FLOAT	PDO	0	-32768	32767	RW
		Pad 6 value.							
19.18.8	4514	**Pad 7**	-	FLOAT	PDO	0	-32768	32767	RW
		Pad 7 value.							
19.18.9	4516	**Pad 8**	-	INT16	PDO	0	-32768	32767	RW
		Pad 8 value.							
19.18.10	4518	**Pad 9**	-	INT16	PDO	0	-32768	32767	RW
		Pad 9 value.							
19.18.11	4520	**Pad 10**	-	INT16	PDO	0	-32768	32767	RW
		Pad 10 value.							
19.18.12	4522	**Pad 11**	-	INT16	PDO	0	-32768	32767	RW
		Pad 11 value.							
19.18.13	4524	**Pad 12**	-	INT16	PDO	0	-32768	32767	RW
		Pad 12 value.							
19.18.14	4526	**Pad 13**	-	INT16	PDO	0	-32768	32767	RW
		Pad 13 value.							
19.18.15	4528	**Pad 14**	-	INT16	PDO	0	-32768	32767	RW
		Pad 14 value.							
19.18.16	4530	**Pad 15**	-	INT16	PDO	0	-32768	32767	RW
		Pad 15 value.							
19.18.17	4550	**Bitword Pad A**	-	UINT16	PDO	0	0	65535	RW
		Value of Pad A bit.							
19.18.18	4552	**Pad A bit 0**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of Pad A bit - bit 0.							
19.18.19	4554	**Pad A bit 1**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit A pad - bit 1.							
19.18.20	4556	**Pad A bit 2**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit A pad - bit 2.							
19.18.21	4558	**Pad A bit 3**	-	BIT	PDO	0	0	1	RW

		Setting and monitoring of bit A pad - bit 3.							
19.18.22	4560	**Pad A bit 4**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit A pad - bit 4.							
19.18.23	4562	**Pad A bit 5**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit A pad - bit 5.							
19.18.24	4564	**Pad A bit 6**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit A pad - bit 6.							
19.18.25	4566	**Pad A bit 7**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit A pad - bit 7.							
19.18.26	4568	**Pad A bit 8**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit A pad - bit 8.							
19.18.27	4570	**Pad A bit 9**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit A pad - bit 9.							
19.18.28	4572	**Pad A bit 10**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit A pad - bit 10.							
19.18.29	4574	**Pad A bit 11**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit A pad - bit 11.							
19.18.30	4576	**Pad A bit 12**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit A pad - bit 12.							
19.18.31	4578	**Pad A bit 13**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit A pad - bit 13.							
19.18.32	4580	**Pad A bit 14**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit A pad - bit 14.							
19.18.33	4582	**Pad A bit 15**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit A pad - bit 15.							
19.18.34	4600	**Bitword Pad B**	-	UINT16	PDO	0	0	65535	RW
		Value of Pad bit B.							
19.18.35	4602	**Pad B bit 0**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit B pad - bit 0.							
19.18.36	4604	**Pad B bit 1**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit B pad - bit 1.							
19.18.37	4606	**Pad B bit 2**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit B pad - bit 2.							
19.18.38	4608	**Pad B bit 3**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit B pad - bit 3.							
19.18.39	4610	**Pad B bit 4**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit B pad - bit 4.							
19.18.40	4612	**Pad B bit 5**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit B pad - bit 5.							
19.18.41	4614	**Pad B bit 6**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit B pad - bit 6.							
19.18.42	4616	**Pad B bit 7**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit B pad - bit 7.							
19.18.43	4618	**Pad B bit 8**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit B pad - bit 8.							
19.18.44	4620	**Pad B bit 9**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit B pad - bit 9.							
19.18.45	4622	**Pad B bit 10**	-	BIT	PDO	0	0	1	RW

		Setting and monitoring of bit B pad - bit 10.							
19.18.46	4624	**Pad B bit 11**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit B pad - bit 11.							
19.18.47	4626	**Pad B bit 12**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit B pad - bit 12.							
19.18.48	4628	**Pad B bit 13**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit B pad - bit 13.							
19.18.49	4630	**Pad B bit 14**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit B pad - bit 14.							
19.18.50	4632	**Pad B bit 15**	-	BIT	PDO	0	0	1	RW
		Setting and monitoring of bit B pad - bit 15.							

20 COMMUNICATION

20.1 NETWORK CONFIG

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
20.1.1	9562	**IP Address**	-	UINT32	-	0	-	-	R
		IP address of the drive network.							
20.1.2	9564	**IP Netmask**	-	UINT32	-	0	-	-	R
		IP address of the subnet.							
20.1.3	9566	**IP Gateway**	-	UINT32	-	0	-	-	R
		Gateway IP address.							
20.1.4	9604	**IP assignment**	-	Enum	-	Static	0	1	RW
		IP address assignment mode.							
20.1.5	9556	**IP Address set**	-	UINT32	-	169.254.10.10	0	0	RW
		Drive network IP address setting.							
20.1.6	9558	**IP Netmask set**	-	UINT32	-	255.255.0.0	0	0	RW
		Set the IP address of the subnet.							
20.1.7	9560	**IP Gateway set**	-	UINT32	-	0.0.0.0	0	0	RW
		Set the IP address of the gateway.							
20.1.8	9200	**Wi-Fi fw version**	-	UINT32	-	0	-	-	R
		Indicates the FW version of the WiFi Drive Link module connected to the drive.							
20.1.9	9202	**Wi-Fi S/N**	-	UINT32	-	0	-	-	R
		Indicates the serial number of the WiFi Drive Link module connected to the drive.							
20.1.10	9204	**Wi-Fi network name**	-	STRING16	-	0	-	-	R
		Name of the Wi-Fi network generated by the Wi-Fi Drive Link module.							
20.1.11	9206	**Wi-Fi network pwd**	-	STRING16	-	0	-	-	R
		Password used to connect to the network generated by the Wi-Fi Drive Link module.							

20.2 FIELDBUS CONFIG

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
20.2.1	6000	**Fieldbus enable**	-	Enum	-	OFF	0	1	RWZ
		Enables communication with the fieldbus.							
20.2.2	6002	**Fieldbus type**	-	Enum	-	None	-	-	R
		Monitors the type of fieldbus module installed.							

20.2.3	6004	**Fieldbus state**	-	Enum	-	Disable	-	-	R
		Monitor the status of the installed fieldbus module.							
20.2.4	6006	**Fieldbus baudrate**	-	Enum	-	500k	0	4	RW
		Select the fieldbus baudrate.							
20.2.5	6008	**Fieldbus address**	-	UINT16	SDO	0	0	255	RW
		Fieldbus address (PROFIBUS).							
20.2.6	6010	**Fieldbus IP address**	-	UINT32	-	0	0	0	RW
		Fieldbus IP address (PROFINET, EtherNet/IP).							
20.2.7	6012	**Fieldbus IP netmask**	-	UINT32	-	0	0	0	RW
		Fieldbus netmask (PROFINET, EtherNet/IP).							
20.2.8	6014	**Fieldbus DHCP enable**	-	Enum	-	OFF	0	1	RW
		DHCP enable (PROFINET, EtherNet/IP).							

20.3 FIELDBUS MS

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
20.3.1	6020	**Fieldbus MS 1 ipa**	-	UINT16	SDO	0	0	20000	RW
		Configuration parameter for channel 1 from Master to Slave.							
20.3.2	6030	**Fieldbus MS 2 ipa**	-	UINT16	SDO	0	0	20000	RW
		Configuration parameter for channel 2 from Master to Slave.							
20.3.3	6040	**Fieldbus MS 3 ipa**	-	UINT16	SDO	0	0	20000	RW
		Configuration parameter for channel 3 from Master to Slave.							
20.3.4	6050	**Fieldbus MS 4 ipa**	-	UINT16	SDO	0	0	20000	RW
		Configuration parameter for channel 4 from Master to Slave.							
20.3.5	6060	**Fieldbus MS 5 ipa**	-	UINT16	SDO	0	0	20000	RW
		Configuration parameter for channel 5 from Master to Slave.							
20.3.6	6070	**Fieldbus MS 6 ipa**	-	UINT16	SDO	0	0	20000	RW
		Configuration parameter for channel 6 from Master to Slave.							
20.3.7	6080	**Fieldbus MS 7 ipa**	-	UINT16	SDO	0	0	20000	RW
		Configuration parameter for channel 7 from Master to Slave.							
20.3.8	6090	**Fieldbus MS 8 ipa**	-	UINT16	SDO	0	0	20000	RW
		Configuration parameter for channel 8 from Master to Slave.							
20.3.9	6100	**Fieldbus MS 9 ipa**	-	UINT16	SDO	0	0	20000	RW
		Configuration parameter for channel 9 from Master to Slave.							
20.3.10	6110	**Fieldbus MS 10 ipa**	-	UINT16	SDO	0	0	20000	RW
		Configuration parameter for channel 10 from Master to Slave.							
20.3.11	6120	**Fieldbus MS 11 ipa**	-	UINT16	SDO	0	0	20000	RW
		Configuration parameter for channel 11 from Master to Slave.							
20.3.12	6130	**Fieldbus MS 12 ipa**	-	UINT16	SDO	0	0	20000	RW
		Configuration parameter for channel 12 from Master to Slave.							
20.3.13	6140	**Fieldbus MS 13 ipa**	-	UINT16	SDO	0	0	20000	RW
		Configuration parameter for channel 13 from Master to Slave.							
20.3.14	6150	**Fieldbus MS 14 ipa**	-	UINT16	SDO	0	0	20000	RW
		Configuration parameter for channel 14 from Master to Slave.							
20.3.15	6160	**Fieldbus MS 15 ipa**	-	UINT16	SDO	0	0	20000	RW
		Configuration parameter for channel 15 from Master to Slave.							
20.3.16	6170	**Fieldbus MS 16 ipa**	-	UINT16	SDO	0	0	20000	RW
		Configuration parameter for channel 16 from Master to Slave.							

20.3.17	6024	**Fieldbus MS 1 div**	-	UINT16	PDO	1	-	-	R
		Divider of the value received on channel 1 from Master to Slave.							
20.3.18	6034	**Fieldbus MS 2 div**	-	UINT16	PDO	1	-	-	R
		Divider of the value received on channel 2 from Master to Slave.							
20.3.19	6044	**Fieldbus MS 3 div**	-	UINT16	PDO	1	-	-	R
		Divider of the value received on channel 3 from Master to Slave.							
20.3.20	6054	**Fieldbus MS 4 div**	-	UINT16	PDO	1	-	-	R
		Divider of the value received on channel 4 from Master to Slave.							
20.3.21	6064	**Fieldbus MS 5 div**	-	UINT16	PDO	1	-	-	R
		Divider of the value received on channel 5 from Master to Slave.							
20.3.22	6074	**Fieldbus MS 6 div**	-	UINT16	PDO	1	-	-	R
		Divider of the value received on channel 6 from Master to Slave.							
20.3.23	6084	**Fieldbus MS 7 div**	-	UINT16	PDO	1	-	-	R
		Divider of the value received on channel 7 from Master to Slave.							
20.3.24	6094	**Fieldbus MS 8 div**	-	UINT16	PDO	1	-	-	R
		Divider of the value received on channel 8 from Master to Slave.							
20.3.25	6104	**Fieldbus MS 9 div**	-	UINT16	PDO	1	-	-	R
		Divider of the value received on channel 9 from Master to Slave.							
20.3.26	6114	**Fieldbus MS 10 div**	-	UINT16	PDO	1	-	-	R
		Divider of the value received on channel 10 from Master to Slave.							
20.3.27	6124	**Fieldbus MS 11 div**	-	UINT16	PDO	1	-	-	R
		Divider of the value received on channel 11 from Master to Slave.							
20.3.28	6134	**Fieldbus MS 12 div**	-	UINT16	PDO	1	-	-	R
		Divider of the value received on channel 12 from Master to Slave.							
20.3.29	6144	**Fieldbus MS 13 div**	-	UINT16	PDO	1	-	-	R
		Divider of the value received on channel 13 from Master to Slave.							
20.3.30	6154	**Fieldbus MS 14 div**	-	UINT16	PDO	1	-	-	R
		Divider of the value received on channel 14 from Master to Slave.							
20.3.31	6464	**Fieldbus MS 15 div**	-	UINT16	PDO	1	-	-	R
		Divider of the value received on channel 15 from Master to Slave.							
20.3.32	6174	**Fieldbus MS 16 div**	-	UINT16	PDO	1	-	-	R
		Divider of the value received on channel 16 from Master to Slave.							
20.3.33	6022	**Fieldbus MS 1 mon**	-	INT32	-	0	-	-	R
		32-bit monitor of the value received on channel 1 from Master to Slave.							
20.3.34	6032	**Fieldbus MS 2 mon**	-	INT32	-	0	-	-	R
		32-bit monitor of the value received on channel 2 from Master to Slave.							
20.3.35	6042	**Fieldbus MS 3 mon**	-	INT32	-	0	-	-	R
		32-bit monitor of the value received on channel 3 from Master to Slave.							
20.3.36	6052	**Fieldbus MS 4 mon**	-	INT32	-	0	-	-	R
		32-bit monitor of the value received on channel 4 from Master to Slave.							
20.3.37	6062	**Fieldbus MS 5 mon**	-	INT32	-	0	-	-	R
		32-bit monitor of the value received on channel 5 from Master to Slave.							
20.3.38	6072	**Fieldbus MS 6 mon**	-	INT32	-	0	-	-	R
		32-bit monitor of the value received on channel 6 from Master to Slave.							
20.3.39	6082	**Fieldbus MS 7 mon**	-	INT32	-	0	-	-	R
		32-bit monitor of the value received on channel 7 from Master to Slave.							
20.3.40	6092	**Fieldbus MS 8 mon**	-	INT32	-	0	-	-	R
		32-bit monitor of the value received on channel 8 from Master to Slave.							

20.3.41	6102	**Fieldbus MS 9 mon**	-	INT32	-	0	-	-	R
		32-bit monitor of the value received on channel 9 from Master to Slave.							
20.3.42	6112	**Fieldbus MS 10 mon**	-	INT32	-	0	-	-	R
		32-bit monitor of the value received on channel 10 from Master to Slave.							
20.3.43	6122	**Fieldbus MS 11 mon**	-	INT32	-	0	-	-	R
		32-bit monitor of the value received on channel 11 from Master to Slave.							
20.3.44	6132	**Fieldbus MS 12 mon**	-	INT32	-	0	-	-	R
		32-bit monitor of the value received on channel 12 from Master to Slave.							
20.3.45	6142	**Fieldbus MS 13 mon**	-	INT32	-	0	-	-	R
		32-bit monitor of the value received on channel 13 from Master to Slave.							
20.3.46	6152	**Fieldbus MS 14 mon**	-	INT32	-	0	-	-	R
		32-bit monitor of the value received on channel 14 from Master to Slave.							
20.3.47	6162	**Fieldbus MS 15 mon**	-	INT32	-	0	-	-	R
		32-bit monitor of the value received on channel 15 from Master to Slave.							
20.3.48	6172	**Fieldbus MS 16 mon**	-	INT32	-	0	-	-	R
		32-bit monitor of the value received on channel 16 from Master to Slave.							

20.4 FIELDBUS SM

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
20.4.1	6220	**Fieldbus SM 1 ipa**	-	UINT16	SDO	0	0	2000	RW
		Configuration parameter for channel 1 from Slave to Master.							
20.4.2	6230	**Fieldbus SM 2 ipa**	-	UINT16	SDO	0	0	2000	RW
		Configuration parameter for channel 2 from Slave to Master.							
20.4.3	6240	**Fieldbus SM 3 ipa**	-	UINT16	SDO	0	0	2000	RW
		Configuration parameter for channel 3 from Slave to Master.							
20.4.4	6250	**Fieldbus SM 4 ipa**	-	UINT16	SDO	0	0	2000	RW
		Configuration parameter for channel 4 from Slave to Master.							
20.4.5	6260	**Fieldbus SM 5 ipa**	-	UINT16	SDO	0	0	2000	RW
		Configuration parameter for channel 5 from Slave to Master.							
20.4.6	6270	**Fieldbus SM 6 ipa**	-	UINT16	SDO	0	0	2000	RW
		Configuration parameter for channel 6 from Slave to Master.							
20.4.7	6280	**Fieldbus SM 7 ipa**	-	UINT16	SDO	0	0	2000	RW
		Configuration parameter for channel 7 from Slave to Master.							
20.4.8	6290	**Fieldbus SM 8 ipa**	-	UINT16	SDO	0	0	2000	RW
		Configuration parameter for channel 8 from Slave to Master.							
20.4.9	6300	**Fieldbus SM 9 ipa**	-	UINT16	SDO	0	0	2000	RW
		Configuration parameter for channel 9 from Slave to Master.							
20.4.10	6310	**Fieldbus SM 10 ipa**	-	UINT16	SDO	0	0	2000	RW
		Configuration parameter for channel 10 from Slave to Master.							
20.4.11	6320	**Fieldbus SM 11 ipa**	-	UINT16	SDO	0	0	2000	RW
		Configuration parameter for channel 11 from Slave to Master.							
20.4.12	6330	**Fieldbus SM 12 ipa**	-	UINT16	SDO	0	0	2000	RW
		Configuration parameter for channel 12 from Slave to Master.							
20.4.13	6340	**Fieldbus SM 13 ipa**	-	UINT16	SDO	0	0	2000	RW
		Configuration parameter for channel 13 from Slave to Master.							
20.4.14	6350	**Fieldbus SM 14 ipa**	-	UINT16	SDO	0	0	2000	RW
		Configuration parameter for channel 14 from Slave to Master.							

20.4.15	6360	**Fieldbus SM 15 ipa**	-	UINT16	SDO	0	0	2000	RW
		Configuration parameter for channel 15 from Slave to Master.							
20.4.16	6370	**Fieldbus SM 16 ipa**	-	UINT16	SDO	0	0	2000	RW
		Configuration parameter for channel 16 from Slave to Master.							
20.4.17	6222	**Fieldbus SM 1 mul**	-	UINT16	PDO	1	-	-	R
		Multiplier of the value sent on channel 1 from Slave to Master.							
20.4.18	6232	**Fieldbus SM 2 mul**	-	UINT16	PDO	1	-	-	R
		Multiplier of the value sent on channel 21 from Slave to Master.							
20.4.19	6242	**Fieldbus SM 3 mul**	-	UINT16	PDO	1	-	-	R
		Multiplier of the value sent on channel 3 from Slave to Master.							
20.4.20	6252	**Fieldbus SM 4 mul**	-	UINT16	PDO	1	-	-	R
		Multiplier of the value sent on channel 4 from Slave to Master.							
20.4.21	6262	**Fieldbus SM 5 mul**	-	UINT16	PDO	1	-	-	R
		Multiplier of the value sent on channel 5 from Slave to Master.							
20.4.22	6272	**Fieldbus SM 6 mul**	-	UINT16	PDO	1	-	-	R
		Multiplier of the value sent on channel 6 from Slave to Master.							
20.4.23	6282	**Fieldbus SM 7 mul**	-	UINT16	PDO	1	-	-	R
		Multiplier of the value sent on channel 7 from Slave to Master.							
20.4.24	6292	**Fieldbus SM 8 mul**	-	UINT16	PDO	1	-	-	R
		Multiplier of the value sent on channel 8 from Slave to Master.							
20.4.25	6302	**Fieldbus SM 9 mul**	-	UINT16	PDO	1	-	-	R
		Multiplier of the value sent on channel 9 from Slave to Master.							
20.4.26	6312	**Fieldbus SM 10 mul**	-	UINT16	PDO	1	-	-	R
		Multiplier of the value sent on channel 10 from Slave to Master.							
20.4.27	6322	**Fieldbus SM 11 mul**	-	UINT16	PDO	1	-	-	R
		Multiplier of the value sent on channel 11 from Slave to Master.							
20.4.28	6332	**Fieldbus SM 12 mul**	-	UINT16	PDO	1	-	-	R
		Multiplier of the value sent on channel 12 from Slave to Master.							
20.4.29	6342	**Fieldbus SM 13 mul**	-	UINT16	PDO	1	-	-	R
		Multiplier of the value sent on channel 13 from Slave to Master.							
20.4.30	6352	**Fieldbus SM 14 mul**	-	UINT16	PDO	1	-	-	R
		Multiplier of the value sent on channel 14 from Slave to Master.							
20.4.31	6362	**Fieldbus SM 15 mul**	-	UINT16	PDO	1	-	-	R
		Multiplier of the value sent on channel 15 from Slave to Master.							
20.4.32	6372	**Fieldbus SM 16 mul**	-	UINT16	PDO	1	-	-	R
		Multiplier of the value sent on channel 16 from Slave to Master.							

20.5 STATUS WORD

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
20.5.1	6400	**Status word 0 sel**	-	Enum	SDO	OFF	0	82	RW
		Selection of bit 0 of the status word.							
20.5.2	6402	**Status word 1 sel**	-	Enum	SDO	OFF	0	82	RW
		Selection of bit 1 of the status word.							
20.5.3	6404	**Status word 2 sel**	-	Enum	SDO	OFF	0	82	RW
		Selection of bit 2 of the status word.							
20.5.4	6406	**Status word 3 sel**	-	Enum	SDO	OFF	0	82	RW
		Selection of bit 3 of the status word.							

20.5.5	6408	**Status word 4 sel**	-	Enum	SDO	OFF	0	82	RW
		Selection of bit 4 of the status word.							
20.5.6	6410	**Status word 5 sel**	-	Enum	SDO	OFF	0	82	RW
		Selection of bit 5 of the status word.							
20.5.7	6412	**Status word 6 sel**	-	Enum	SDO	OFF	0	82	RW
		Selection of bit 6 of the status word.							
20.5.8	6414	**Status word 7 sel**	-	Enum	SDO	OFF	0	82	RW
		Selection of bit 7 of the status word.							
20.5.9	6416	**Status word 8 sel**	-	Enum	SDO	OFF	0	82	RW
		Selection of bit 8 of the status word.							
20.5.10	6418	**Status word 9 sel**	-	Enum	SDO	OFF	0	82	RW
		Selection of bit 9 of the status word.							
20.5.11	6420	**Status word 10 sel**	-	Enum	SDO	OFF	0	82	RW
		Selection of bit 10 of the status word.							
20.5.12	6422	**Status word 11 sel**	-	Enum	SDO	OFF	0	82	RW
		Selection of bit 11 of the status word.							
20.5.13	6424	**Status word 12 sel**	-	Enum	SDO	OFF	0	82	RW
		Selection of bit 12 of the status word.							
20.5.14	6426	**Status word 13 sel**	-	Enum	SDO	OFF	0	82	RW
		Selection of bit 13 of the status word.							
20.5.15	6428	**Status word 14 sel**	-	Enum	SDO	OFF	0	82	RW
		Selection of bit 14 of the status word.							
20.5.16	6430	**Status word 15 sel**	-	Enum	SDO	OFF	0	82	RW
		Selection of bit 15 of the status word.							
20.5.17	6432	**Status word mon**	-	UINT16	PDO	0	-	-	R
		Status word monitor, in hexadecimal format.							

20.6 CONTROL WORD

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
20.6.1	6450	**Control word dig**	-	UINT16	PDO	0	0	65535	RW
		Direct parameter on which to set the control word.							
20.6.2	6452	**Control word sel**	-	Enum	SDO	Control word dig	0	11	RW
		Control word source selector.							
20.6.3	6454	**Control word 0 dest**	-	Enum	SDO	OFF	0	90	RW
		Selection of the function of bit 0 of the control word.							
20.6.4	6456	**Control word 1 dest**	-	Enum	SDO	OFF	0	90	RW
		Selection of the function of bit 1 of the control word.							
20.6.5	6458	**Control word 2 dest**	-	Enum	SDO	OFF	0	90	RW
		Selection of the function of bit 2 of the control word.							
20.6.6	6460	**Control word 3 dest**	-	Enum	SDO	OFF	0	90	RW
		Selection of the function of bit 3 of the control word.							
20.6.7	6462	**Control word 4 dest**	-	Enum	SDO	OFF	0	90	RW
		Selection of the function of bit 4 of the control word.							
20.6.8	6464	**Control word 5 dest**	-	Enum	SDO	OFF	0	90	RW
		Selection of the function of bit 5 of the control word.							
20.6.9	6466	**Control word 6 dest**	-	Enum	SDO	OFF	0	90	RW
		Selection of the function of bit 6 of the control word.							

20.6.10	6468	**Control word 7 dest**	-	Enum	SDO	OFF	0	90	RW
		Selection of the function of bit 7 of the control word.							
20.6.11	6470	**Control word 8 dest**	-	Enum	SDO	OFF	0	90	RW
		Selection of the function of bit 8 of the control word.							
20.6.12	6472	**Control word 9 dest**	-	Enum	SDO	OFF	0	90	RW
		Selection of the function of bit 9 of the control word.							
20.6.13	6474	**Control word 10 dest**	-	Enum	SDO	OFF	0	90	RW
		Selection of the function of bit 10 of the control word.							
20.6.14	6476	**Control word 11 dest**	-	Enum	SDO	OFF	0	90	RW
		Selection of the function of bit 11 of the control word.							
20.6.15	6478	**Control word 12 dest**	-	Enum	SDO	OFF	0	90	RW
		Selection of the function of bit 12 of the control word.							
20.6.16	6480	**Control word 13 dest**	-	Enum	SDO	OFF	0	90	RW
		Selection of the function of bit 13 of the control word.							
20.6.17	6482	**Control word 14 dest**	-	Enum	SDO	OFF	0	90	RW
		Selection of the function of bit 14 of the control word.							
20.6.18	6484	**Control word 15 dest**	-	Enum	SDO	OFF	0	90	RW
		Selection of the function of bit 15 of the control word.							
20.6.19	6486	**Control word mon**	-	UINT16	PDO	0	-	-	R
		Control word status monitor.							

20.7 RS485

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
20.7.1	5900	**Serial address**	-	UINT16	-	1	0	255	RW
		Allows you to set the address to which the drive responds when connected via RS485 serial line with Modbus-RTU protocol.							
20.7.2	5902	**Serial baudrate**	-	Enum	-	38400 bps	0	4	RW
		Allows you to set the serial communication speed.							
20.7.3	5904	**Serial frame**	-	Enum	-	8-N-1	0	5	RW
		Allows you to set the frame format for serial communication.							

21 ALARM CONFIG

21.1 FAILURE SUPPLY

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
21.1.1	5000	**FS latch**	-	Enum	SDO	ON	0	1	RWZ
		Alarm latch management.							
21.1.2	5002	**FS OK relay open**	-	Enum	SDO	ON	0	1	RW
		Relay OK open in case of alarm intervention.							

21.2 UNDERVOLTAGE

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
21.2.1	5010	**UV holdoff**	ms	UINT16	SDO	0	0	5000	RW
		Alarm holdoff time.							
21.2.2	5012	**UV restart time**	ms	UINT16	SDO	1000	0	10000	RW

		Maximum alarm reset time to perform automatic restart.							
21.2.3	5014	**UV latch**	-	Enum	SDO	ON	0	1	RWZ
		Alarm latch management.							
21.2.4	5016	**UV OK relay open**	-	Enum	SDO	ON	0	1	RW
		Relay OK open in case of alarm intervention.							
21.2.5	5018	**UV threshold**	V	UINT16	SDO	230	1	1000	RW
		Alarm intervention threshold.							

21.3 OVERVOLTAGE

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
21.3.1	5020	**OV activity**	-	Enum	SDO	Disable	0	2	RWZ
		Defines the behaviour of the drive in the event of an alarm.							
21.3.2	5022	**OV holdoff**	ms	UINT16	SDO	0	0	10000	RW
		Alarm holdoff time.							
21.3.3	5024	**OV restart time**	ms	UINT16	SDO	0	0	10000	RW
		Maximum alarm reset time for automatic restart.							
21.3.4	5026	**OV latch**	-	Enum	SDO	ON	0	1	RWZ
		Alarm latch management.							
21.3.5	5028	**OV OK relay open**	-	Enum	SDO	ON	0	1	RW
		OK relay open in case of alarm intervention.							

21.4 OVERSPEED

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
21.4.1	5030	**OS activity**	-	Enum	SDO	Disable	0	5	RWZ
		Defines the behaviour of the drive in the event of an alarm.							
21.4.2	5032	**OS holdoff**	ms	UINT16	SDO	0	0	10000	RW
		Alarm holdoff time.							
21.4.3	5034	**OS restart time**	ms	UINT16	SDO	0	0	10000	RW
		Maximum alarm reset time for automatic restart.							
21.4.4	5036	**OS latch**	-	Enum	SDO	ON	0	1	RWZ
		Alarm latch management.							
21.4.5	5038	**OS OK relay open**	-	Enum	SDO	ON	0	1	RW
		OK relay open in case of alarm intervention.							
21.4.6	5040	**OS threshold**	rpm	FLOAT	SDO	1800	1	8000	RW
		Alarm intervention threshold.							

21.5 HEATSINK

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
21.5.1	5050	**HS activity**	-	Enum	SDO	Disable	0	3	RWZ
		Defines the behaviour of the drive in the event of an alarm.							
21.5.2	5052	**HS OK relay open**	-	Enum	SDO	ON	0	1	RW
		Relay OK open in the event of an alarm							

21.6 MOTOR OVERTEMP

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
21.6.1	5060	**MotOT activity**	-	Enum	SDO	Disable	0	5	RWZ
		Defines the behaviour of the drive in the event of an alarm.							
21.6.2	5062	**MotOT OK relay open**	-	Enum	SDO	ON	0	1	RW
		Relay OK open in the event of an alarm.							

21.7 EXTERNAL FAULT

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
21.7.1	5070	**EF activity**	-	Enum	SDO	Disable	0	5	RWZ
		Defines the behaviour of the drive in the event of an alarm.							
21.7.2	5072	**EF holdoff**	ms	UINT16	SDO	104	0	10000	RW
		Alarm holdoff time.							
21.7.3	5074	**EF restart time**	ms	UINT16	SDO	0	0	10000	RW
		Maximum alarm reset time to perform automatic restart.							
21.7.4	5076	**EF latch**	-	Enum	SDO	ON	0	1	RWZ
		Alarm latch management.							
21.7.5	5078	**EF OK relay open**	-	Enum	SDO	ON	0	1	RW
		OK relay open in case of alarm intervention.							

21.8 BRAKE FAULT

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
21.8.1	5080	**BF activity**	-	Enum	SDO	Disable	0	5	RWZ
		Defines the behaviour of the drive in the event of an alarm.							
21.8.2	5082	**BF OK relay open**	-	Enum	SDO	ON	0	1	RW
		Relay OK open in the event of an alarm.							

21.9 MOTOR I2T

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
21.9.1	5090	**MotI2T activity**	-	Enum	SDO	Warning	0	5	RWZ
		Defines the behaviour of the drive in the event of an alarm.							
21.9.2	5092	**MotI2T latch**	-	Enum	SDO	ON	0	1	RWZ
		Alarm latch management.							
21.9.3	5094	**MotI2T OK relay open**	-	Enum	SDO	ON	0	1	RW
		Relay OK open in case of alarm intervention.							

21.10 DRIVE I2T

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
21.10.1	5100	**DrvI2T activity**	-	Enum	SDO	Warning	0	5	RWZ
		Defines the behaviour of the drive in the event of an alarm.							
21.10.2	5104	**DrvI2T OK relay open**	-	Enum	SDO	ON	0	1	RW

		Relay opening OK in case of alarm activation.							

21.11 OVERCURRENT

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
21.11.1	5110	**OC activity**	-	Enum	SDO	Disable	0	2	RWZ
		Defines the behaviour of the drive in the event of an alarm.							
21.11.2	5112	**OC holdoff**	ms	UINT16	SDO	0	0	10000	RW
		Alarm holdoff time.							
21.11.3	5114	**OC restart time**	ms	UINT16	SDO	0	0	10000	RW
		Alarm latch management.							
21.11.4	5116	**OC latch**	-	Enum	SDO	ON	0	1	RWZ
		Gestione latch allarme.							
21.11.5	5118	**OC OK relay open**	-	Enum	SDO	ON	0	1	RW
		OK relay open in case of alarm intervention.							
21.11.6	5120	**OC threshold**	%	UINT16	SDO	150	0	200	RWZ
		Alarm intervention threshold, expressed as a percentage of the motor's rated armature current.							

21.12 FIELD LOSS

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
21.12.1	5132	**FL holdoff**	ms	UINT16	SDO	100	0	10000	RW
		Alarm holdoff time.							
21.12.2	5134	**FL restart time**	ms	UINT16	SDO	0	0	10000	RW
		Maximum alarm reset time to perform automatic restart.							
21.12.3	5136	**FL latch**	-	Enum	SDO	ON	0	1	RWZ
		Alarm latch management.							
21.12.4	5138	**FL OK relay open**	-	Enum	SDO	ON	0	1	RW
		Relay OK open in case of alarm intervention.							
21.12.5	5128	**FL missing bypass**	-	Enum	SDO	OFF	0	1	RWZ
		Disabling detection of missing cable connecting the field card to the control card.							

21.13 DELTA FREQUENCY

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
21.13.1	5140	**DF activity**	-	Enum	SDO	Ignore	0	2	RWZ
		Defines the behaviour of the drive in the event of an alarm.							
21.13.2	5142	**DF holdoff**	ms	UINT16	SDO	0	0	10000	RW
		Alarm holdoff time.							
21.13.3	5144	**DF restart time**	ms	UINT16	SDO	0	0	10000	RW
		Maximum alarm reset time to perform automatic restart.							
21.13.4	5146	**DF latch**	-	Enum	SDO	ON	0	1	RWZ
		Alarm latch management.							
21.13.5	5148	**DF OK relay open**	-	Enum	SDO	ON	0	1	RW
		OK relay open in case of alarm intervention.							
21.13.6	5150	**DF threshold**	%	UINT16	SDO	5	1	15	RWZ
		Alarm intervention threshold, expressed as a percentage of the mains frequency value calculated at power-up.							

21.14 SPEED FBK LOSS

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
21.14.1	5160	**SFL activity**	-	Enum	SDO	Disable	0	2	RWZ
		Defines the behaviour of the drive in the event of an alarm.							
21.14.2	5162	**SFL holdoff**	ms	UINT16	SDO	8	0	10000	RW
		Alarm holdoff time.							
21.14.3	5164	**SFL code**	-	UINT16	SDO	0	-	-	R
		Hexadecimal code indicating the sensor identified as faulty.							
21.14.4	5168	**SFL OK relay open**	-	Enum	SDO	ON	0	1	RW
		Relay OK open in case of alarm intervention.							

21.15 BUS LOSS

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
21.15.1	5170	**BLoss activity**	-	Enum	SDO	Disable	0	5	RWZ
		Defines the behaviour of the drive in the event of an alarm.							
21.15.2	5172	**BLoss holdoff**	ms	UINT16	SDO	0	0	10000	RW
		Alarm holdoff time.							
21.15.3	5174	**BLoss restart time**	ms	UINT16	SDO	0	0	10000	RW
		Maximum alarm reset time for automatic restart.							
21.15.4	5176	**BLoss latch**	-	Enum	SDO	ON	0	1	RWZ
		Alarm latch management.							
21.15.5	5178	**BLoss OK relay open**	-	Enum	SDO	ON	0	1	RW
		OK relay open in case of alarm intervention.							

21.16 ENABLE SEQ ERR

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
21.16.1	5200	**EnSEQ activity**	-	Enum	SDO	Disable	0	2	RWZ
		Defines the behaviour of the drive in the event of an alarm.							
21.16.2	5206	**EnSEQ latch**	-	Enum	SDO	ON	0	1	RWZ
		Alarm latch management.							
21.16.3	5208	**EnSEQ OK relay open**	-	Enum	SDO	ON	0	1	RW
		OK relay open in case of alarm intervention.							

20.17 SUSTAINED CURR

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
21.17.1	5220	**SC activity**	-	Enum	SDO	Ignore	0	2	RWZ
		Defines the behaviour of the drive in the event of an alarm.							
21.17.2	5226	**SC holdoff**	ms	UINT16	SDO	ON	0	1	RW
		Alarm holdoff time.							
21.17.3	5228	**SC OK relay open**	-	Enum	SDO	ON	0	1	RWZ
		OK relay open in case of alarm intervention.							

24 RECIPE CONFIG

Menu	IPA	Parameter name	Unit	Type	FB mode	Def	Min	Max	Acc
24.1	5500	**Recipe config 1**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 1 of the RECIPE menu.							
24.2	5502	**Recipe config 2**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 2 of the RECIPE menu.							
24.3	5504	**Recipe config 3**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 3 of the RECIPE menu.							
24.4	5506	**Recipe config 4**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 4 of the RECIPE menu.							
24.5	5508	**Recipe config 5**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 5 of the RECIPE menu.							
24.6	5510	**Recipe config 6**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 6 of the RECIPE menu.							
24.7	5512	**Recipe config 7**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 7 of the RECIPE menu.							
24.8	5514	**Recipe config 8**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 8 of the RECIPE menu.							
24.9	5516	**Recipe config 9**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 9 of the RECIPE menu.							
24.10	5518	**Recipe config 10**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 10 of the RECIPE menu.							
24.11	5520	**Recipe config 11**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 11 of the RECIPE menu.							
24.12	5522	**Recipe config 12**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 12 of the RECIPE menu.							
24.13	5524	**Recipe config 13**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 13 of the RECIPE menu.							
24.14	5526	**Recipe config 14**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 14 of the RECIPE menu.							
24.15	5528	**Recipe config 15**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 15 of the RECIPE menu.							
24.16	5530	**Recipe config 16**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 16 of the RECIPE menu.							
24.17	5532	**Recipe config 17**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 17 of the RECIPE menu.							
24.18	5534	**Recipe config 18**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 18 of the RECIPE menu.							
24.19	5536	**Recipe config 19**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 19 of the RECIPE menu.							
24.20	5538	**Recipe config 20**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 20 of the RECIPE menu.							
24.21	5540	**Recipe config 21**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 21 of the RECIPE menu.							
24.22	5542	**Recipe config 22**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 22 of the RECIPE menu.							
24.23	5544	**Recipe config 23**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 23 of the RECIPE menu.							

24.24	5546	**Recipe config 24**	-	UINT16	SDO	0	0	20000	RW
		IPA of the parameter to be entered in position 24 of the RECIPE menu.							
24.25	5548	**Take recipe config**	-	BIT	SDO	0	0	1	RW
		Recipe menu acquisition command.							

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