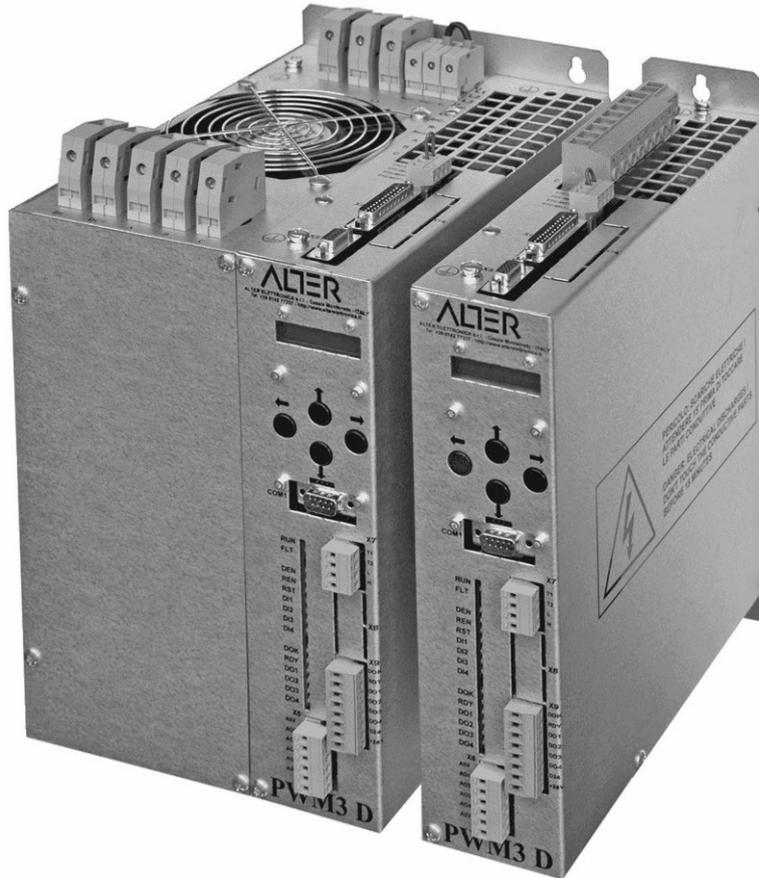


# ALTER

Alter ELETTRONICA s.r.l.  
15033 Casale Monferrato (AL) – ITALY



## PWM3D-000

## PWM3D-010

**Drive 4 quadrants series PWM Digital  
for asynchronous motors with transducer**  
Instructions manual: 91/104 - Version 9.3 - Date: 07/03/2024  
Compatible with Firmware V9.x

Combined with the drive:	
Type No.: ___ / ___	Serial No.: _____

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# 1 Safety information

Read this manual carefully before using the drives PWM3D-000.

Keep the manual carefully and in a place of easy access in order to consult it later in case of need.

Make sure this manual is delivered to the end user.

The safety symbols used in this manual are described below:

	<p><b>DANGER:</b></p> <p>This symbol indicates the possibility of even serious injuries to people, due to electrical or mechanical shocks.</p>
	<p><b>ATTENTION:</b></p> <p>This symbol indicates the possibility of damage to property or to the drive itself.</p>
	<p><b>WARNINGS:</b></p> <p>Additional information for proper use of the drive</p>

## 1.1 Danger

- Never feed the drive without the lid and never remove the lid while the power supply is present.
- Do not perform manipulations on the drive with wet hands. There is a danger of electrical shocks.
- Maintain a sufficient safety distance from the motor and the machine when the network is activated and never touch the rotating parts of the motor when it is in operation. There's a danger of getting hurt.
- When resetting alarms make sure the driving signal is disabled to avoid unexpected motor departures. Set up a separate emergency stop device. There's a danger of getting hurt.
- Before starting wiring make sure that there is no power supply and that the motor is still.
- All power sources must be disconnected before any maintenance is carried out.
- Before starting inspection, please wait at least 2 minutes after switching off voltage, make sure the LEDs and LCD display are switched off
- Maintenance, inspection and replacement shall be carried out by a designated person. Remove all metal accessories such as watches, bracelets etc before starting work.
- Make sure that the power supply voltage of the drive matches the license plate data.

## 1.2 Attention

- To comply with the regulations on electrical safety, make mass connections according to the standards of the country where the drive is installed.
- The installation must be carried out by qualified technical personnel.
- Always fix the drive before wiring.
- Install a protective circuit (fuse or magnetic switch) on the drive power supply.
- Do not connect a power source to terminals A, B, C.
- Make sure that the power supply voltage of the drive matches the license plate data.
- Attach the clamp screws with an appropriate tightening torque.
- Properly connect wires A, B, C. The motor may not start or rotate abnormally and damage the machine.
- If there is no power supply to the drive, do not connect the motor cable if it is in rotation. There is a danger of damaging the car.
- Do not occlude the drive ventilation slots.
- Ensure the motor's functionality as a single unit before mechanically attaching it to the machine and verify that the maximum motor speeds are tolerated by the machine. There is a danger of injury and damage to the car.
- Never change the drive.

- Clean the drive with a vacuum cleaner. Do not use organic solvents. There is a danger of damaging the drive.
- It is essential for your safety that any revision of the drive is carried out by our company.
- In case of disposal, the drive must be considered an industrial waste, therefore comply with the rules imposed by the laws in force in the country in which it is installed.

### 1.3 Warnings

- Maintenance shall be carried out by qualified technical personnel.
- The ground connection and installation of the drive must be carried out in accordance with the security rules imposed by the laws in force in the country where the drive is installed.
- Appropriate preparation must be given to operators and machine operators.
- The drive can cause radio frequency interference if it lacks the appropriate network filter.
- Follow the specifications of the drive and follow the instructions in this manual.
- Ensure that adequate ventilation and cleaning of the drive is maintained.
- Avoid penetration of water or other fluids inside the drive.
- For wiring use appropriate cables, possibly shielded.

### 1.4 Directives, trademarks and standards

The drive PWM3D-000 complies with the following industrial standards:

Standard/Marking	Description
<b>CEI EN 60204-1</b>	Low voltage safety directive, 73/23/EEC.
<b>CEI EN 61800-3</b>	Product standard related to EMC Directive 89/336/EEC.
<b>CEI EN 60529</b>	Degree of protection IP20.
<b>CE</b>	CE marking.

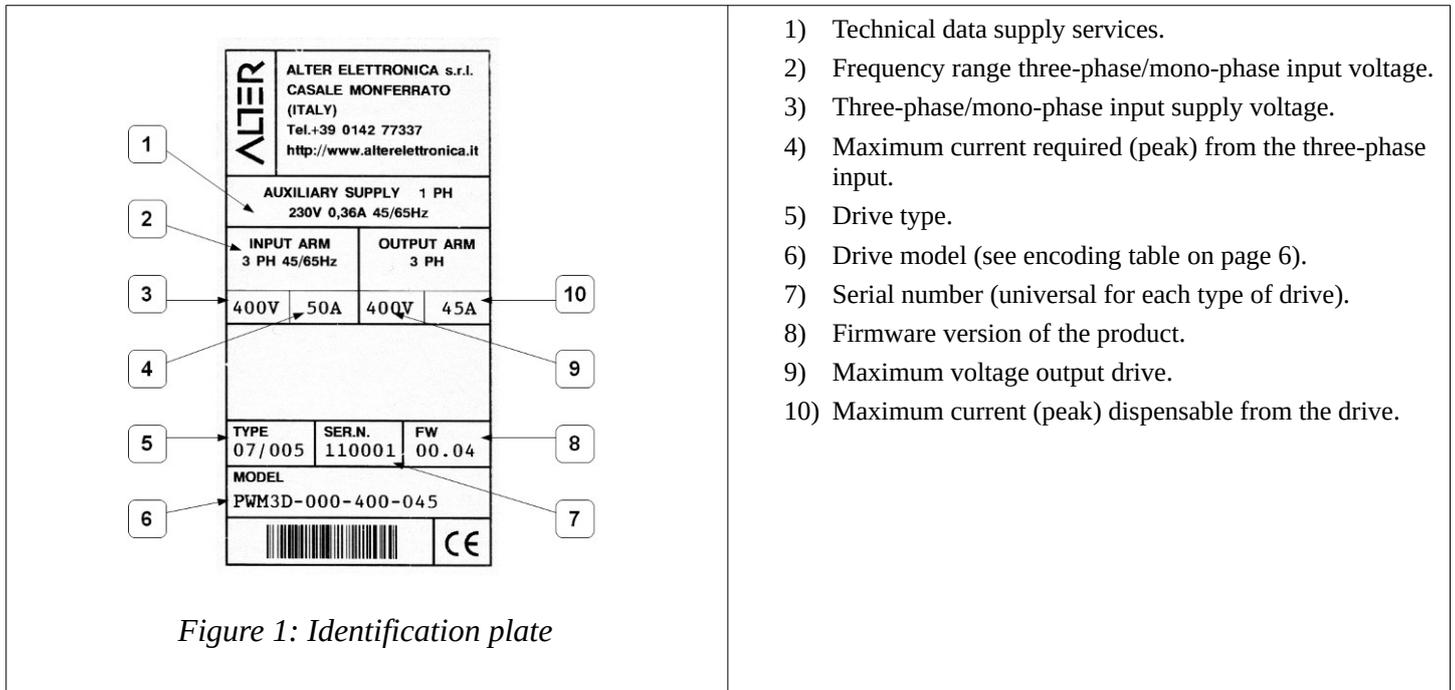
## 2 Identification of the product

### 2.1 CE marking and identification plate

The CE marking shall attest to the conformity of the apparatus with the essential health and safety requirements laid down in the European Directives set out in the EC declaration of conformity. It consists of a silver polyester adhesive label with a black print, of the following dimensions: L= 95 mm – H= 50 mm (Figure 1).

It is applied externally at the bottom (considering vertical panel mounting).

The following data are indicated in a legible and indelible way on the plate:



- 1) Technical data supply services.
- 2) Frequency range three-phase/mono-phase input voltage.
- 3) Three-phase/mono-phase input supply voltage.
- 4) Maximum current required (peak) from the three-phase input.
- 5) Drive type.
- 6) Drive model (see encoding table on page 6).
- 7) Serial number (universal for each type of drive).
- 8) Firmware version of the product.
- 9) Maximum voltage output drive.
- 10) Maximum current (peak) dispensable from the drive.

### 2.2 Declaration of conformity

The *ALTER Elettronica S.r.l.* declares that, in the conditions specified in this document, the drives (CDM) model "PWM3D-000", are in conformity with the Community directives EMC, including the latest amendments, with the relative Italian transposition legislation and the Community directives Low Voltage, including the latest amendments, with the relevant Italian transposition legislation.

Therefore, the CE marking, affixed to drives (CDM) model "PWM3D-000", certifies compliance with both the EMC Directive and the Low Voltage Directive.

### 2.3 Manufacturer's declaration

The *ALTER Elettronica S.r.l.* for the purposes of the Machinery Directive (DM) 89/392 and subsequent amendments, with the relevant Italian legislation transposing D.P.R. 459 of 1996-07-24, declares that the model drives "PWM3D-000" must be installed according to the instructions contained in this manual and shall not be put into operation until the machines in which they are incorporated have been declared to comply with the DM Directive mentioned herein.

## 2.4 Model encoding

The following tables indicate the encoding method for ordering a model drive: PWM3D-000

Drive model	Options			Maximum voltage output	Current service continuous output
<b>PWM3D-</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>xxx</b>	<b>xxx</b>
				440 = 440Vac 480 = 480Vac	010= 10Arms 016=16Arms 021= 21Arms 026=26Arms 036= 36Arms 044= 44Arms 056= 56Arms 070= 70Arms 087=87Arms 095= 95Arms 111= 111Arms 130= 130Arms 200 = 200Arms
	000 = General asynchronous motor control. 010 = General asynchronous motor control (supply only by DC-BUS input).				
PWM3D = PWM drive, 3rd series, Digital					

Table 1: model encoding

**NOTE:** the maximum output voltage is attainable as long as you have at least the same input voltage value on the terminals L1, L2, L3 or the voltage on the DC BUS = 1.41 x output voltage.

## 3 Technical characteristics

### 3.1 Generality

These drives are designed to power and control the operation of asynchronous motors with transducer.

The IGBT bridge is inserted inside the case.

Energy recovery takes place on internally (or externally) mounted clamp resistance.

All control and control circuits are digital and completely insulated from power.

Digital inputs and outputs are static and opto-isolated.

With an external control it is possible to insert an acceleration and deceleration ramp on the speed reference.

Acceleration and deceleration times are adjustable.

The current limit is set internally in a fixed way.

The I/O connectors are mounted on a fully accessible board to facilitate connections.

These drives are suitable for the control of the motors used in machine tools, graphics, belt movement, etc. and in all those applications where it needs great flexibility of operation.

### 3.2 Technical data

Use the following table to know the technical characteristics of the various models **identified by the continuous service output current**; See the encoding table in Chapter 2.4 on page 6 to match the current with the order code.

DRIVE					ACCESSORIES					CONNECTIONS						
OUTPUT CURRENT (Arms)			SIZE	POWER RESIST. INTERNAL CLAMP (W)	CODE EXTERNAL CLAMP RESISTOR	THREE-PHASE FILTER	THREE-PHASE INDUCTANCE	FUSES ON L1-L2-L3 or DC+ DC-		MAXIMUM SECTION OF CABLES [mm <sup>2</sup> ]						
CONT.	NOM.	PEAK						[1]	[4]	Inom (A)	Max. I <sub>2t</sub> <sup>at10ms</sup> (A2s)	L1	L2	L3	Rest+ R-	X3
			[2]							A	B	C	X9	X10	X11	X12
10	6	12	1	150	RES32R1KW5	23/020	17/001	16	684	2,5	2,5	1,5				
16	10	20	1	150	RES32R1KW5	23/020	17/001	25	684	4	2,5	1,5				
21	13	26	1	150	RES20R900W10	23/003	17/001	32	684	6	2,5	1,5				
26	17	34	1	150	RES20R900W10	23/003	17/003	40	2400	6	2,5	1,5				
36	22	44	2	300	RES8R4KW5	23/003	17/003	50	8000	10	10	1,5				
44	26	52	2	300	RES8R4KW5	23/004	17/003	63	8000	16	10	1,5				
56	32	64	2	300	RES8R4KW5	23/004	17/003	100	8000	16	10	1,5				
70	43	86	2	300	RES8R4KW5	23/005	17/004	100	18000	25	10	1,5				
87	53	106	2	300	RES8R4KW5	23/005	17/005	160	18000	25	10	1,5				
95	64	128	2	-	RES3R38KW10	23/007	17/007	160	18000	50	10	1,5				
111	75	150	2	-	RES3R38KW10	23/007	17/007	200	51000	50	10	1,5				
130	90	180	2	-	RES3R38KW10	23/007	17/008	250	125000	50	10	1,5				
200	200	200	3	-	RES3R38KW10	23/008	17/008	250	125000	50	10	1,5				

Table 2: Data for the sizing of drives

#### NOTES:

- [1] With temperature inside the panel where the drive from 0 to 40 °C is mounted. Current reduction of 4 % for each °C above 40 °C. Meaning of the output current:
- **Continuous service:** The drive can dispense this current with infinite time, but the availability of the peak is not guaranteed, depending on the temperature of the heat sink.
  - **Rated:** The drive can dispense this current with infinite time also having the peak current available in case of need.
  - **Peak:** The drive can dispense this current for a time that depends on the temperature of the heat sink, so also the incoming air, but it is at least 30 seconds.

[2] Dimensions and masses on page 63 and page 68.

[3] The filter shall be mounted when the PWM3D drives are used in First Ambient, to meet the EMC compatibility requirements.

- [4] Only ultra-fast protective **fuses (for semiconductor protection) are essential for three** -phase or DC BUS inputs. Other fuses do not provide a sufficient degree of protection and therefore, in case of failure, the drive can be severely damaged.

### 3.2.1 Apparent power and absorbed current

To size the transformer/self-transformer, inductance and EMC filter, it is necessary to calculate the apparent power required by the drives connected to the supply line by following these points:

1. Calculate power from motor to load:

$$P_m = C \cdot \omega \quad \left| \begin{array}{l} P_m = \text{motor power [W]} \\ C = \text{Torque dispensed [Nm]} \\ \omega = \text{Maximum using speed [rad/sec]} \end{array} \right.$$

If you do not know the usage data, consider the plate data of the motor.

The following conversion formulas must be used with other Units of measure:

$$C [Nm] = C [Kgm] \cdot 9,81 \quad \omega [rad/sec] = \frac{n [giri/min]}{9,55}$$

2. Calculate the power required by each drive:

$$P_c = P_m \cdot 1,5 \quad \left| \begin{array}{l} P_m = \text{motor power [W]} \\ P_c = \text{Power absorbed by the drive [VA]} \end{array} \right.$$

and calculate the total power as the sum of the power absorbed by the individual drives:

$$P_t = P_{c1} + P_{c2} + P_{c3} + \dots \quad \left| \begin{array}{l} P_c = \text{Power absorbed by a drive [VA]} \\ P_t = \text{Total power absorbed by drives [VA]} \end{array} \right.$$

3. The apparent power and total current required shall be calculated using the following formulae:

$$P_a = \frac{P_t \cdot 1,73}{\sqrt{d+2}} \quad \left| \begin{array}{l} P_a = \text{Apparent power delivered by the transformer/autotransformer [VA].} \\ P_t = \text{Total power drives [VA].} \\ d = \text{Total number of drives connected to the same power supply.} \end{array} \right.$$

$$I_u = \frac{P_a}{1,73 \cdot V_a} \quad \left| \begin{array}{l} I_u = \text{Current to be used to size the line inductor and the filter EMC [A].} \\ V_a = \text{Power supply voltage of the drives [V].} \end{array} \right.$$

The apparent power and current value thus calculated are valid only if the motors always work under the conditions considered in the calculations. during normal operation there are variations in torque and speed leading to significant reductions in the average values of apparent power and current. To have more exact values it is necessary to know the actual conditions of use of all motors.

Contact the ALTER Technical Office to examine special cases.

### 3.2.2 Current absorbed with DC-BUS power supply

To size the power supply supply supply voltage to the DC-BUS it is necessary to calculate the total current required by the drives connected to the power supply itself with the following formula:

$$I_t = \frac{P_t}{V_{dc}} \quad \left| \begin{array}{l} P_t = \text{Total power drives [VA]} \\ V_{dc} = \text{DC-BUS power supply voltage [V]} \\ I_t = \text{Total current required by drives [A]} \end{array} \right.$$

The total power of the drives can be calculated using the formulas of paragraph above “Apparent power and absorbed current”. The power supply voltage on the DC-BUS depends on the power supply used, but when using the PSR3 model this value is 650Vcc.

### 3.2.3 General technical characteristics

- Execution for fixing on panel. Degree of protection IP20.
- Ambient operating temperature: from 0 °C to +40 °C.
- Storage temperature: from -10 °C to +70 °C
- Relative humidity max.: 95 % without condensation.
- Maximum altitude: 1000 m. a.s.l.
- Single-phase service supply: 230Va.c. ±10 % – 500mA max (protection with external retarded fuses 250V – 1A).
- Power supply: from a minimum of 60V to a maximum indicated on the drive plate. (protect with external fuses as show in table 7 at page 7.
- Frequency of supply: 50/60Hz.
- Output current: As from table 2 at page 7.

- Max. dissipated power: 10 x Output Current.
- Thermal time constant: 15'
- Continuous power dissipated by internal clamp resistance: As from table 2 at page 7.
- Resistance of internal or external clamps (available separately).
- Connecting terminals to the D.C. BUS.
- Galvanic isolation between power and control electronics.
- Over-voltage protection on:
  - Signal inputs and outputs.
  - Service and power supplies.
- Frequency of "switching": 16KHz.
- Minimum value of the electric time constant of the motor: 1 msec. To calculate this value, see the formula in paragraph "Motor wiring" on page 13.
- Connections:
  - Power on connectors (Size 1) or terminal block (Size 2).
  - Service and signals on connectors.
- Use with asynchronous motors equipped with one of the following devices:
  - Incremental encoder (5V line driver).
  - Resolver [optional card].
  - Sinusoidal encoder (Sin-Cos outputs line driver 5V) [optional card].
  - Phonic wheel [optional card].
  - EnDat encoder [optional card].
  - Any other transducers upon request [optional card].
- Emulated encoder output.
- Ramp on the speed signal adjustable between 0.1Sec and 650 sec (insert with logical control).
- Opto-isolated logical inputs (command from 15 to 30Vcc – 10mA max):
  - Enable drive.
  - Speed ramp rating.
  - Alarm reset command.
  - 4 programmable inputs.
- Opto-isolated logic outputs (24Vc. – 100mA max) protected against overload and short circuit:
  - Report no alarms.
  - Converter ready.
  - No. 4 programmable outputs.
- Analog inputs (maximum differential voltage and common mode 10V).
  - N°1 differential input with resolution of 15 bit + sign, input resistance: 10KW, programmable.
  - N°3 inputs with resolution of 11 bit + sign, input resistance: 70KW, programmable.
- Analog outputs ( $\pm 10V$  max. – output resistance 1KW):
  - No. 4 programmable outputs.
- Power outputs:
  - +24V  $\pm 20\%$  – 100mA max.
  - +10V  $\pm 5\%$  – 5mA max.
  - -10V  $\pm 5\%$  – 5mA max.
- Input for the thermal probe (PTC or N.C. contact) mounted in the motor.
- Input for the thermal probe (PTC or N.C. contact) mounted on the external braking resistance group.
- LED display of operation status.
- 16-character LCD display on 2 lines for parameter setting and diagnostics.
- Automatic locking of the drive for:
  - Internal power supply is missing or insufficient.
  - Insufficient or excessive power supply (three-phase or DC-Bus).
  - motor not connected or incorrectly connected.
  - Over-temperature of the drive.
  - Over-temperature of capacitors on the DC-BUS.
  - Over-temperature of the motor.
  - Converter overload.
  - Over-current in the drive.
  - Transducer failure mounted on the motor.
  - Failure or overload in the recovery circuit on resistance.
  - Failure in the drive.
  - Overload or short circuit of digital outputs.
  - Wrong settings.

## 3.2.4 Power supplies

### 3.2.4.1 NOTE

Any differential switches placed to protect drives shall have type B intervention characteristics (in accordance with the second amendment to IEC 755).

### 3.2.4.2 SERVICES

Power supply: single-phase 230Va.c.  $\pm 10\%$  – 500mA max. (terminals: 230V)

Minimum section of connecting cables: 1,5 mm<sup>2</sup>

Protect the supply with no.2 delayed fuses with a rated current 1A.

### 3.2.4.3 POWER

The power supply of the **PWM3D-000 drive** can be supplied in the following ways:

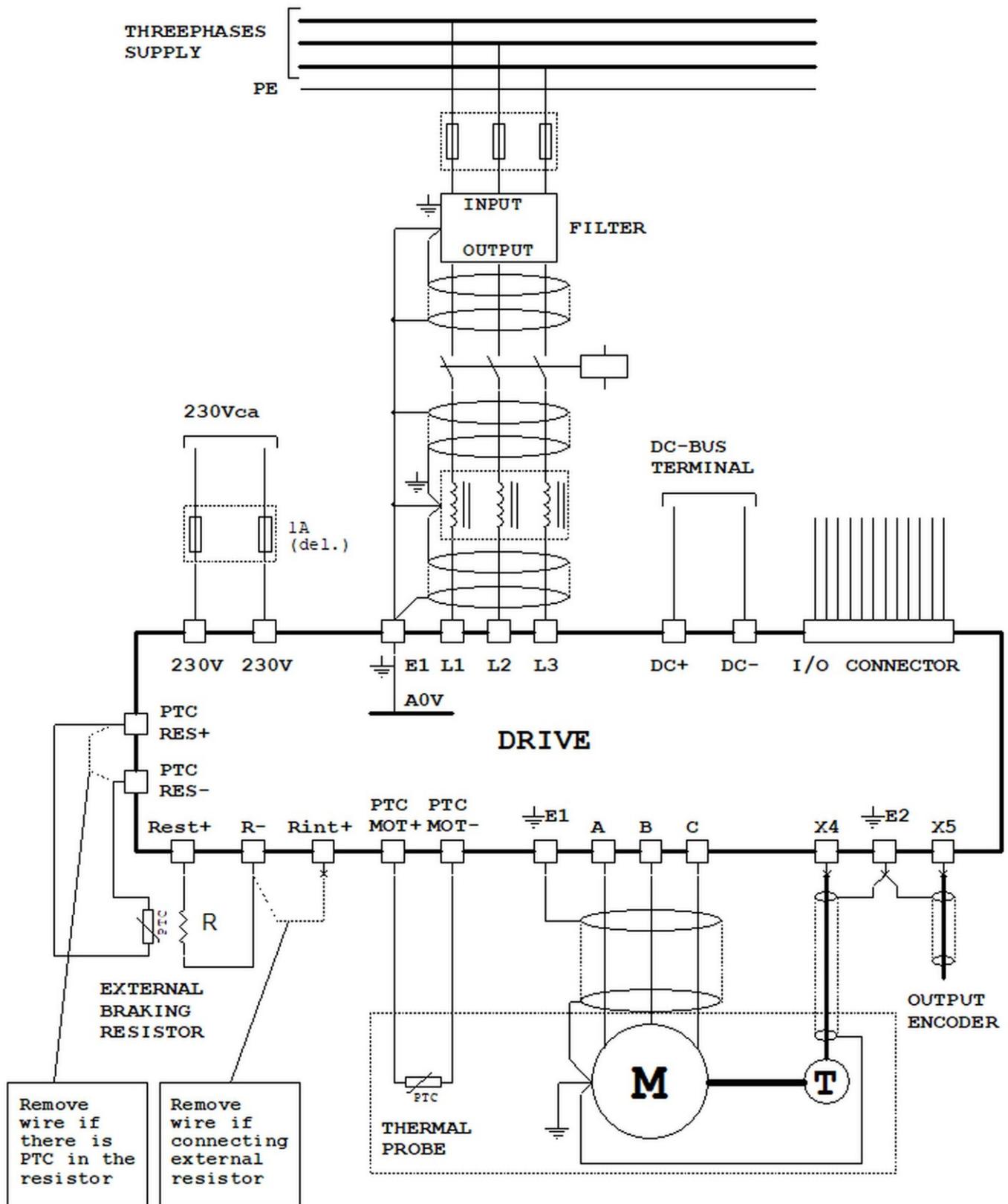
- A three-phase ground neutral network with a chained voltage within the limits indicated on the drive plate (see "Identification plate on page 5. Insert between the three-phase network and the drive a three-phase inductance of at least 100 uH sized for the current absorbed by the drive and having a saturation current equal to at least twice the rated current (see Drawing 1 on page 11).
- From a transformer with connections  $\Delta/\Delta$  and centre star on the ground or a self-transformer ( $\Delta/\Delta$ ) to adapt the mains voltage.
- From a D.C. line (see Drawing 2 to page 12).
- Only for the drive Size 1: From a single-phase network with voltage within the limits indicated on the drive plate (see "Identification plate" on page 5). Insert between the single-phase network and the drive an inductance of at least 100 uH sized for the current absorbed by the drive and having a saturation current of at least twice the rated current (see Drawing 1 on page 11).

The power supply of the **PWM3D-010 drive** can only be supplied in the following way:

- From a D.C. line (see Drawing 2 to page 12).

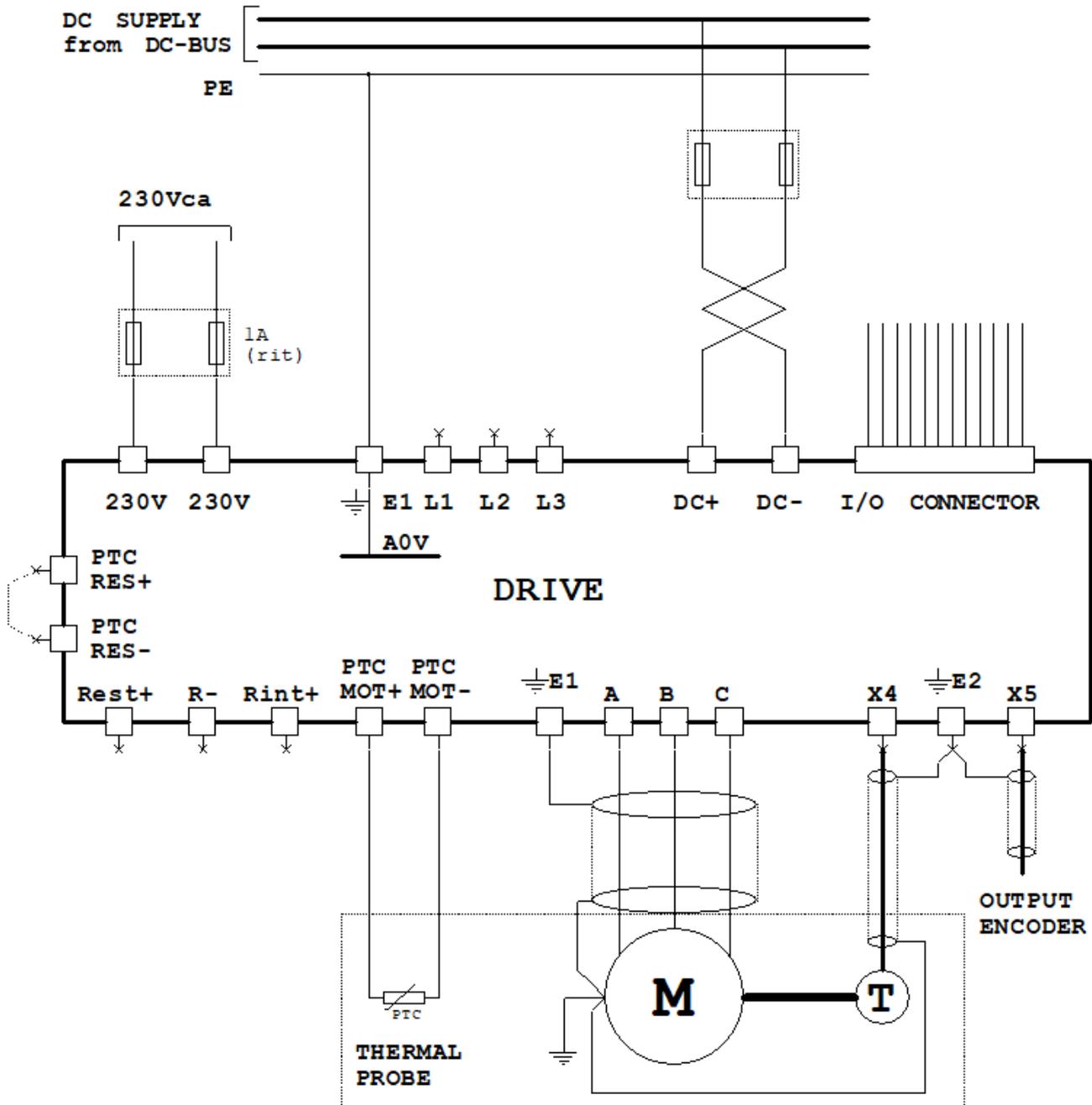
Always protect your feeding with ultra-fast fuses as shown in table 2 on page 7.

# 4 Installation



Drawing 1

Connection to a three-phase power line (PWM3D-000 only)



Drawing 2

Connection from a DC power line

## 4.1 Preliminary operations

- Check that the drive has suffered no damage in the transport.
- Mount the drive vertically away from heat sources and so that there is sufficient free space above and below for good cooling air circulation.
- Use unpainted sheet fixing panels connected to the ground.
- Connect to a good ground the ground terminal placed on the right side of the drive terminal.
- Follow the link patterns in the manual carefully.
- Use shielded cables for signal and power connections.
- Connect to the ground on the carpentry or on the terminals arranged on the two ends of the shields.
- Do not use terminal blocks but only shielded connectors for signal and power shielded cable junctions.
- Mounting noise suppressors (off for a.c./diodes for D.C.) parallel to the coils of all contactors, relays, solenoid valves, single-phase motors, three-phase motors, etc.

## 4.2 Motor wiring

Only use shielded cable with 3 conductors + earth for powering the motor and twisted shielded cable in pairs for the transducer (ALTER model CAV16PSCH-SP1).

The section of the conductors of power cables is shown in drawing 2 on page 7.

Connect the shields of the power and signal cables to the case of the drive and motor.

The connection of the shield to the case shall be as short as possible (maximum length 100 mm). The uncovered part of the cable shall not exceed 50 mm.

It is recommended to use shielded cables without joints. If this is impossible, use:

- For signals: shielded connectors that do not interrupt the shield
- For power: shielded connectors or terminal blocks.

If a terminal block is used, the uncovered (unshielded) part of the cable must be minimised and the shields of the two cables must be connected to a (non-insulated) ground terminal.

Using the following formula, calculate the value of the “electric time constant ” of the motor; If the result is less than 10msec, an inductance between the motor and the drive shall be mounted. In case of doubt or for further information, please contact the ALTER Technical Office.

$$T_e = \frac{L_{mot}}{R_{mot}}$$

$T_e =$  Electric time constant [msec].  
 $L_{mot} =$  Inductance of the motor (see motor technical specifications) [mH].  
 $R_{mot} =$  Resistance of the motor (see technical specifications of the motor).

For the sizing of the components drawn in Drawing 1 on page 11 and in Drawing 2 on page 12, see 2 on page 7.

Connect the thermal probe as indicated in Drawing 1 on page 11 or Drawing 2 on page 12 only if the signal is not available on the transducer connector.

## 4.3 Power connections

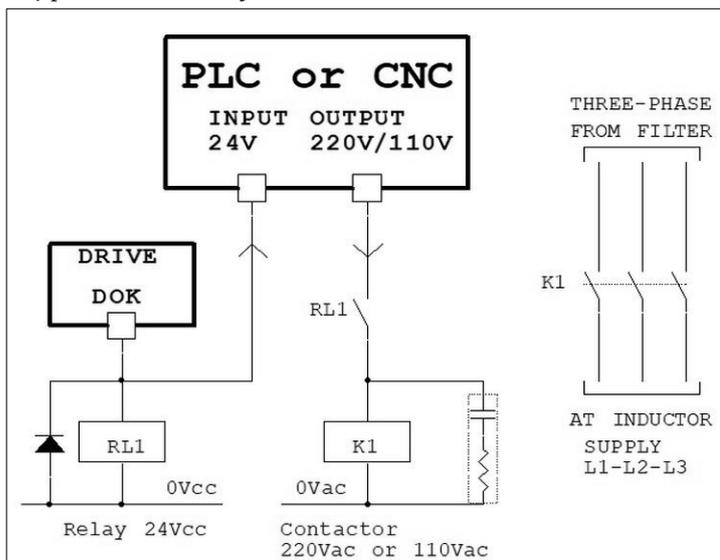
To identify the location of the connectors on the drive, see Drawing 29 on page 85 and Drawing Drawing 30 on page 86.

### 4.3.1 Three-phase or single-phase network (only for PWM3D-000)

The three-phase power supply network shall be connected to the L1, L2, L3 terminals **available** on the X1 connector in the case of a size 1 drive or on a screw terminal in the case of a drive of size 2.

Only for **drives in size 1** it is possible to supply them with **single-phase** voltage: In this case, use only the **L1** and **L2** terminals.

**NOTE:** The contacts of the contactor mounted on the power supply line (as indicated in Drawing 1 on page 11) can be closed *only* if the DOK output is active at +24V; in the event that the DOK output go to 0V (in case of alarm for example) the switch must be opened immediately.



Drawing 3

The diagram next to it illustrates the correct connection of the contactor coil control that dissects the power supply to the drive.

The digital output “DOK” of the drive controls the coil of a 24Vcc relay (RL1) and the same signal goes to the PLC or CNC to signal if the drive goes to FAULT.

The auxiliary contact of the RL1 relay is serialised to the coil of the power contactor (K1) which is controlled by the CNC or PLC whenever it wishes.

In the case that the drive goes into alarm or in case of lack of power to the auxiliary services, thus making the contactor off and the power supply on the L1, L2, L3 is removed even if the CNC tries to drive the K1 contactor.

This ensures the correct management logic of the contactor.

### 4.3.2 Motor

The motor must be connected to terminals **A, B, C**. In the case of a drive size 1 this connection is on the X2 connector; instead, with a drive size 2 you have to use the special screw terminals.

### 4.3.3 Clamp resistor

The rated power of this resistance (or resistor battery) shall be equal to the average power dissipated during the motor shutdown phase and shall be calculated using the following formula:

$$P = 0,2 \cdot J \cdot \omega^2 \cdot F$$

$P$	= Power dissipated by resistance [W]
$J$	= Total moment of inertia on the motor shaft [Kg·m <sup>2</sup> ](rotor + load)
$\omega$	= Maximum angular speed of the motor [rad/sec]
$F$	= Repeat frequency of the work cycle [cycles/sec]

If the speed is expressed in “RPM” the following conversion formula must be used:  $\omega [rad/sec] = \frac{n [RPM]}{9,55}$

If you use the resistance of the internal clamp to the drive, you must leave the bridge wired between the **R-** and **Rint+** terminals and between the **PTC-RES-** and **PTC-RES+** of X3.

If the power of the internal resistance is not sufficient and an external clamp resistance is used, then the wire bridge between the **R-** and **Rint+** terminals and between **PTC-RES-** and **PTC-RES+** of X3 must be removed: connect the resistance between the **Rest+** and **R-** terminals and the PTC temperature probe between the terminals **PTC-RES-** and **PTC-RES+** of X3. If the external resistance group is not equipped with a temperature probe, the flush bridge between **PTC-RES-** and **PTC-RES+** of X3 shall be left connected: in this case, overload protection on external resistors cannot work.

In the case of a drive size 1, the connection of **Rest+** and **R-** is on the X2 connector; instead, with a drive size 2 you have to use the special screw TERMINALS.

### 4.3.4 DC-Bus

DC+ and DC- TERMINALS can be used for different purposes:

1. **Balancing clamp energy:** having multiple drives installed in the same electrical cabinet, all DC+ and DC- terminals of the various drives are connected in parallel, while maintaining the three-phase power supply for each of them. In this case the energy recovered from the drive working as a brake is used partially or totally by the other drives operating from the motor. This leads to a partial or total reduction of the energy discarded in heat by the clamp resistance of the drives. With this connection the total recoverable energy is equal to the sum of the energy recoverable from the individual drives and sometimes makes the use of external clamp resistors unnecessary. With this connection, the three-phase power supply (locks L1,L2,L3) must be the same for all drives and must be supplied and removed simultaneously using a single contactor or multiple controlled contactors at the same time.
2. **Additional battery of capacitors on the dc-bus:** in order to store more recovered energy, then reduce the energy discarded in heat in the clamp resistance, it is also possible to use an additional battery of capacitors appropriately sized and connected to the DC BUS.
3. **D.C. Power supply:** In this case it is necessary to use an external power supply capable of providing the necessary current for the operation of all the drives connected to it. This power supply must:
  1. Power the DC BUS with a voltage that slowly rises from zero to the final value (to avoid current peaks while charging capacitors mounted on the DC BUS).
  2. Provide an end-of-charge signal to enable the drive.
  3. Be able to send back into the power line or dissipate on resistance all the energy recovered from the drives connected to it. If the power supply is designed to dissipate on resistance the recovered energy it is possible to use an additional capacitors battery appropriately sized and connected to the DC BUS to reduce the energy discarded in heat in the resistance (ALTER module 13/007).

**NOTE:** *The power supply shall only supply the voltage on the DC-BUS if the DOK output is active at +24V; in the event that the DOK output goes to 0V (in case of alarm for example) the power supply must immediately discharge the voltage to the DC-BUS.*

It is advisable to protect the DC-BUS supply with two fuses (see Table 2: Data for the sizing of drives on page 7) and use braided cables (twistates) and shielded cables.

For the sizing of the various elements described in this paragraph it is advisable to contact the ALTER technical service.

In the case of drive size 1 this connection is on the X2 connector; instead, with a drive size 2 you have to use the special screw terminals.

## 4.4 Signal connections

To identify the location of the connectors on the drive, see Drawing 29 on page 85 and Drawing 30 on page 86.

### 4.4.1 Connector X3

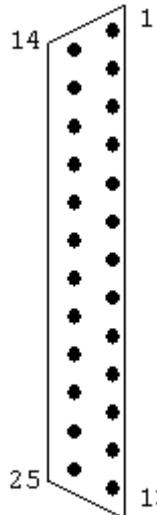
Connection of the motor-mounted thermistor (maximum resistance at room temperature = 1K $\Omega$ ) and the protection thermistor for external braking resistances. In case the terminals of the thermistor are on the connection cable to the transducer, the special PINs can be used on the X4 connector.

1	<b>PTC-RES-</b>	Connect the thermistor mounted to the resistors of external clamps, otherwise leave the bridge connected (only for PWM3D-000).
2	<b>PTC-RES+</b>	
3	<b>PTC-MOT-</b>	Connect the thermistor mounted in the motor.
4	<b>PTC-MOT+</b>	NOTE: this contact is also available in the X4 connector.

### 4.4.2 Connector X4

Connection of the transducer “Encoder TTL” mounted in the motor. The connection cable must be shielded and the shield must be grounded on both ends. If a transducer connected to the X14 connector is used, then this connector must remain free and unused.

Assigning connector PINs:



Drive (Connector X4)		CONNECTION	motor	
SIGNAL	N. PIN		N. PIN	SIGNAL
+5V (positive feeding encoder)	1			
0V (Power supply 0V encoder)	2			
Channel “A ” encoder	3			
Channel “A̅” encoder	4			
0V (shield pair A + A̅)	5			
Channel “B ” encoder	6			
Channel “B̅” encoder	7			
0V (shield pair B + B̅)	8			
PTC probe in the motor (signal)	13			
0V (pair Z + Z̅)	16			
Channel “Z ” encoder	17			
Channel “Z̅” encoder	18			
PTC probe in the motor (0V)	25			
0V (cable shield) – Connector box				

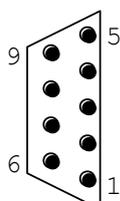
View of the Flying connector type “D ” 25 poles female on the soldering side.

### 4.4.3 Connector X5

On this connector are available channels A, A̅, B, B̅, Z, Z̅ of the TTL encoder connected to the X4 connector or a simulated encoder if you use a transducer connected to the X14 connector and in this case you can select the simulated encoder type (see paragraph “Emulated encoder“ on page 56).

The connection cable must be shielded and the shield must be grounded on both ends.

Assigning connector PINs:



N. PIN	SIGNAL
1	Channel “A ” encoder
2	Channel “A̅” encoder
3	Channel “B ” encoder
4	Channel “B̅” encoder
5	Channel “Z ” encoder
6	Channel “Z̅” encoder
9	0V

View of the Flying connector type “D ” 9 poles male on the soldering side.

### 4.4.4 Connector X6

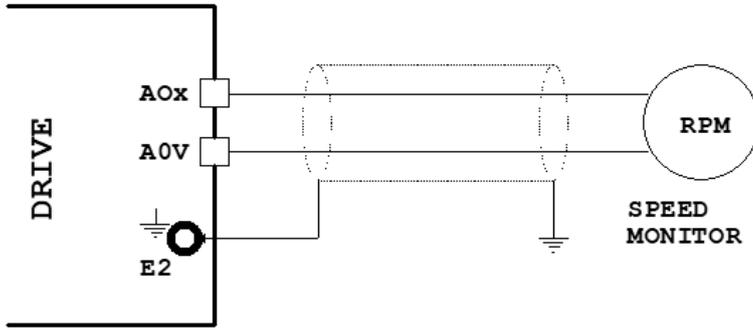
Connection analog outputs. Voltage ±10V max or 0-10Vcc max. – Output resistance 1KΩ. More information can be found in paragraph “Analog Output X“ on page 42.

Always use good quality shielded cables and connect the two ends of the shield to the ground. On the drive case, near the connectors, anchorages are available for screens (see Mechanical characteristics page 85).

Signal allocation to PINs:

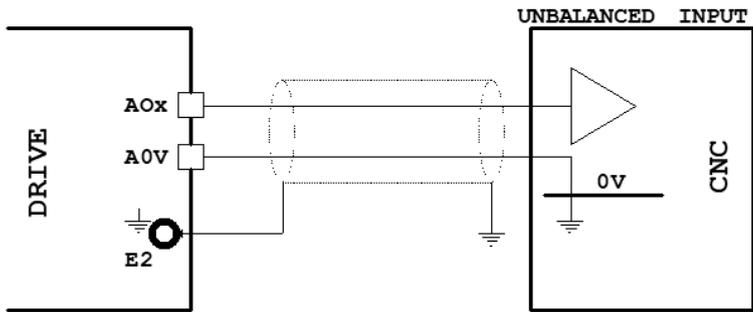
- 1 **AOV** 0V analog. The analog 0V is connected to the drive case.
- 2 **AO1** Analog output 1 programmable.  
It is normally used to provide a voltage signal proportional to the load on the motor.
- 3 **AO2** Analog output 2 programmable.  
It is normally used to provide a voltage signal proportional to the speed of the motor.
- 4 **AO3** Analog output 3 programmable.  
It is normally used to provide a voltage signal proportional to the motor torque.
- 5 **AO4** Analog output 4 programmable.  
Normally it is not used.

6 **A0V** 0V analog. The analog 0V is connected to the drive case. Below are some sample drawings for a correct use of the various signals on X6.



Drawing 4

Analog output connection ( $\pm 10V_{cc}$ ) to a **speed indicator tool**.



Drawing 5

Analog output connection ( $\pm 10V_{cc}$ ) to CNC **analog input** (or a PLC) to detect motor speed.

#### 4.4.5 Connector X7

Connector prepared for connection between two drives in "anti backlash" mode (see section "Anti-backlash system" from page 71).

Signal allocation to PINs:

- |   |           |   |
|---|-----------|---|
| 1 | <b>T1</b> | Resistance Bus termination value 110 $\Omega$ . |
| 2 | <b>T2</b> |   |
| 3 | <b>L</b>  | Connecting cable "L" pole                       |
| 4 | <b>H</b>  | Connecting cable "H" pole                       |

#### 4.4.6 Connector X8

Connector for optional communication cards.

#### 4.4.7 Connector X9

Connect digital outputs.

Power supply voltage from 18Vcc to 30Vcc (nominal 24Vc.c.)

States of exits:

Off = Floating

On = Connected to +24V power supply (D24) (marked by the lighting of the corresponding led)

Maximum current for each output 100 mA, voltage drop inside the maximum current 2V.

Without service power all outputs are OFF.

In case of overload or short circuit on one or more outputs, all outputs are permanently forced into the OFF state.

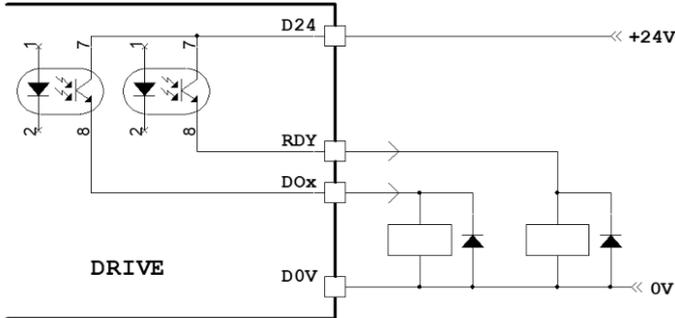
For connections please refer to Drawing 6 and Drawing 7 from page 17.

Signal allocation to PINs:

- |   |            |  |
|---|------------|--|
| 1 | <b>DOK</b> | Digital output "Drive OK". It indicates that there are no alarms that prevent the drive from working and that it has finished the peripheral initialisation phase.<br>Further information can be found in paragraph "Alarm messages" on page 77. |
| 2 | <b>RDY</b> | "Ready" digital output. It signals that the drive is ready for operation and is therefore able to perform the commands. See also paragraph "RDY (Ready)" on page 76.   |

- 3 **DO1** Digital output 1 programmable.  
It is normally used to signal "Zero Speed" i.e. that the motor is stationary.
- 4 **DO2** Digital output 2 programmable.  
It is normally used to signal the achievement of a speed threshold.
- 5 **DO3** Digital output 3 programmable.  
Normally it is used to report that the motor load is more than 90 % (see page 66)
- 6 **DO4** Digital output 4 programmable.  
It is normally used to report that the motor position has been reached (see page 74)
- 7 **D24** Common to connect to +24Vcc for digital outputs.
- 8 **+24V** Output +24Vcc  $\pm 20\%$  – 100mA max.

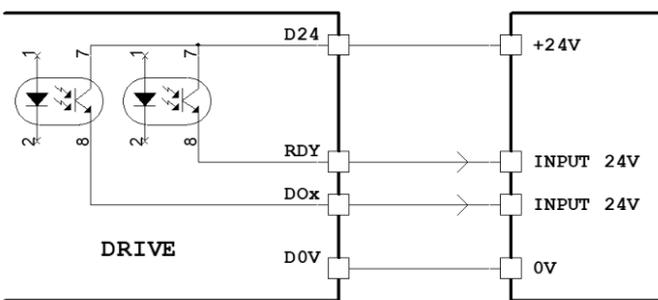
Below are some drawings to explain the correct connections to the X9 connector:



Drawing 6

Relay connection to receive signals from the digital outputs of the drive.

It is necessary to connect the D24 to a power supply +24Vcc and the D0V to 0V.



Drawing 7

Connection of a **PLC** to receive signals from the drive.

The digital inputs of the PLC must receive a voltage of 24Vcc.

It is necessary to connect the PLC +24V power supply with the D24 of the drive and the 0V of the PLC with the D0V of the drive.

The 24Vcc power supply can be supplied by the drive itself (if the total current absorbed by the loads connected to the outputs does not exceed 100mA): connect D24 with clamp +24V (X9) and D0V with A0V clamp (X12).

If the internal power supply cannot be used, an external power supply must be used.

#### 4.4.8 Connector X10

Power connection auxiliary services 230Vac 500mA (Max). Mount protective fuses with 1 retarded amperes. The power supply of the services MUST be present before the power supply and must not be removed before the power supply.

#### 4.4.9 Connector X11

Connection reference voltages and analog inputs.

Always use good quality shielded cables and connect the two ends of the shield to the ground. On the drive case, near the connectors, anchorages are available for shields (see Mechanical characteristics page 85).

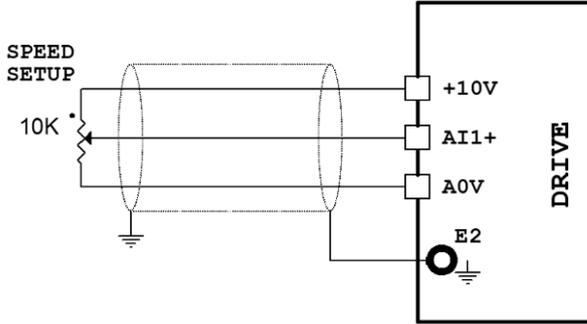
Signal allocation to PINs:

- 1 **+24V** Output +24Vcc  $\pm 20\%$  – 100mA max.
- 2 **+10V** Output +10Vcc  $\pm 5\%$  – 5mA max.
- 3 **-10V** Output -10Vcc  $\pm 5\%$  – 5mA max.
- 4 **AI1+** Main analog input hot pole 1 (resolution 15 bit + sign) programmable which is normally used for speed reference.  
Tensions between: AI1+ and A0V, AI1- and A0V, AI1+ and AI1- =  $\pm 10V$  max. 10K $\Omega$  input resistance.
- 5 **AI1-** Cold pole of the analog input 1.
- 6 **A0V** 0V analog. The analog 0V is connected to the drive case.
- 7 **AI2** Analog input 2 (resolution 11 bit + sign) programmable. Voltage between AI2 and A0V =  $\pm 10V$ cc max.

- 8 **AI3** Analog input 3 (resolution 11 bit + sign) programmable. Voltage between AI3 and A0V =  $\pm 10V_{cc}$  max.
- 9 **AI4** Analog input 4 (resolution 11 bit + sign) programmable. Voltage between AI4 and A0V =  $\pm 10V_{cc}$  max.
- 10 **A0V** 0V analog.

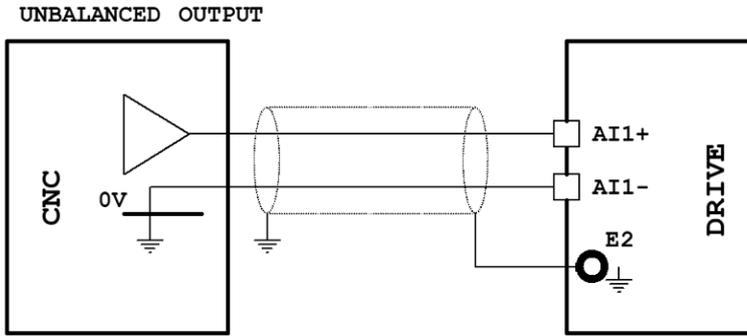
To connect analog I/Os to other electronic equipment (CNC, PLC, etc.), it is essential to use good quality shielded cables and connect the ends of the shield to reduce noise.

Below are some sample drawings for a correct use of the various signals on X11.



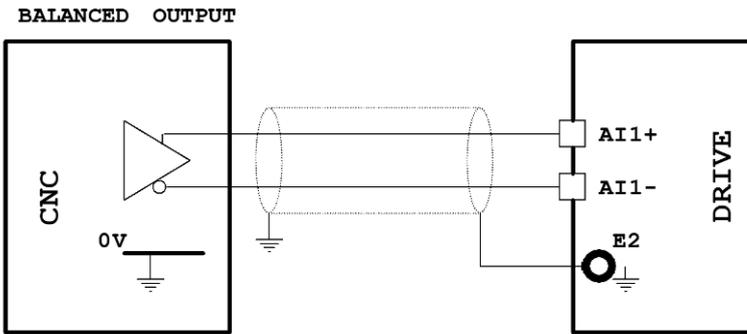
Drawing 8

Connection of a **potentiometer** to provide the speed reference.



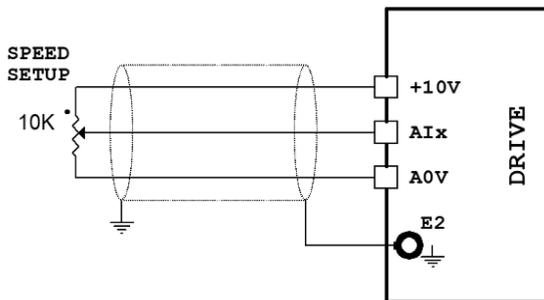
Drawing 9

Connection of a numerical control (or a PLC) with an **unbalanced output** to provide the speed reference.



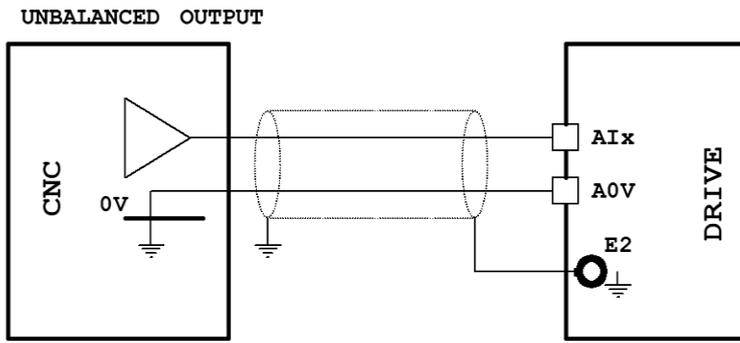
Drawing 10

Connection of a numerical control (or a PLC) with **balanced output** to provide the speed reference.



Drawing 11

Connecting a **potentiometer** to a generic analog input to provide a reference.



Drawing 12

Connection of a numerical control (or PLC) with **unbalanced output** to a generic analogue input to provide a reference.

### 4.4.10 Connector X12

Connect digital inputs.

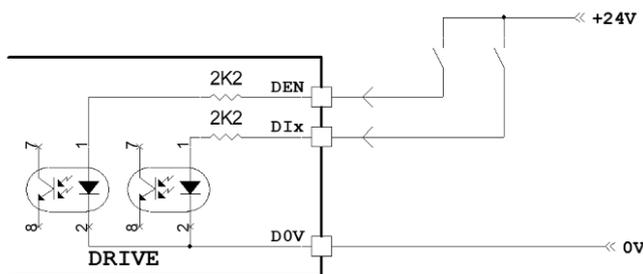
Power supply voltage from 18Vcc to 30Vcc (nominal 24Vcc). Current absorbed 10mA. The status of each digital input is displayed by the corresponding LED which indicates that the command is valid (see paragraph "Yellow LEDs – Commands" from page 76).

In the presence of severe disturbances it is recommended to use good quality shielded cables and connect the two ends of the screen to ground. On the drive case, near the connectors, anchorages are available for screens (see Mechanical characteristics page 85).

Signal allocation to PINS:

- 1 **DEN** Enable input of the drive. If this command is missing, the motor is free.
- 2 **REN** "Ramp Enable" input. Enable the speed ramp.  
**NOTE:** If the drive is controlled by a CNC, only the speed ramp on the CNC and not that of the drive must be used.
- 3 **RTD** "Reset" input. It allows you to exit the alarm state and restore the drive's operation after removing the cause that generated it.
  - Alarm reset is only possible if the drive is disabled (led DEN off).
  - Alarm reset is only possible if the cause that generated it has been eliminated.
- 4 **DI1** Digital input 1 programmable.  
It is normally used to control the "Motor direction inversion".
- 5 **DI2** Digital input 2 programmable.  
It is normally used to enable "JOG " operation of the motor (see page 71).
- 6 **DI3** Digital input 3 programmable.  
Normally it is used to select the gain for the analog input AI1 (see page 39)
- 7 **DI4** Digital input 4 programmable.  
It is normally used to enable motor positioning on the selected position (see page 74)
- 8 **D0V** 0V digital inputs.
- 9 **A0V** 0V analog.
- 10 **+24V** Output +24Vcc ±20 % – 100mA max.
- 11 - Not used
- 12 - Not used

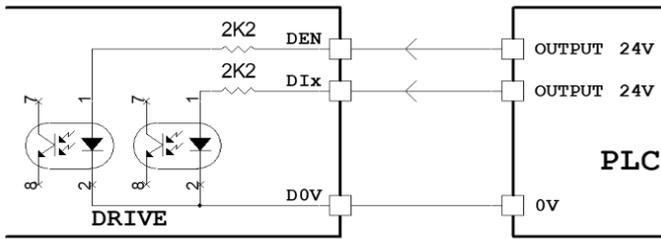
Below are some drawings to explain the correct connections to the X12 connector:



Drawing 13

Connection of contacts to send commands to the digital inputs of the drive.

It is necessary to connect the D0V to 0V.



Drawing 14

Connecting a **PLC** to send commands to the digital inputs of the drive.

The digital outputs of the PLC must provide a voltage of 24Vcc.

It is necessary to connect the 0V of the PLC with the D0V of the drive.

The 24Vcc power supply can be supplied by the drive itself (if the total current absorbed by the loads connected to the outputs does not exceed 100mA): connect D24 with clamp +24V (X9) and D0V with A0V clamp (X12).

If the internal power supply cannot be used, an external power supply must be used.

#### 4.4.11 Connector X14

Transducer connection to the optional "Transducer Board" card. Pin assignment is variable depending on the type of card used and therefore reference is made to the paragraph relating to the mounted card (see "Optional transducers" from page 59).

### 4.5 Commands starting sequence

Please refer to the connectors Connector X9 on page 16 and Connector X12 page 19.

1. Give 230Vca service power supply on the X10 connector.
2. In the case of **model PWM3D-000** when the DOK output switches to ON status and the green LED DOK turns on, you can give the three-phase/monofase power supply on the terminals L1, L2, L3 or D.C. power supply on the DC-BUS if this mode has been selected (see Drawing 2 on page 12 and menu "Power supply from" on page 57).

In the case of **model PWM3D-010** when the DOK output switches to ON status and the green LED DOK turns on, you can enable the DC-BUS power supply to generate the DC voltage at DC+ and DC- terminals.

After the charge of the capacitors on the DC-BUS, the RDY output switches to ON status. If all the necessary parameters have been inserted and the autotune has been completed, the green RDY LED lights up. From this point the drive is *ready* to be enabled for operation.

3. When the RDY output switches to ON status, you can enable the drive with the DEN command.
4. When the drive is enabled and works regularly, the green RUN LED is switched on and the DOK and RDY outputs remain in the ON state and it is possible to give the speed reference resulting in motor rotation.

### 4.6 Commands shutdown sequence

Please refer to the connectors Connector X9 on page 16 and Connector X12 page 19.

1. Bring the speed reference to 0V and wait until the motor is stationary or alternatively you can use the "DEN" command to stop the motor if the "Drive Stop/Run" function has been activated (see page 67). When the motor is stationary it is signalled on the selected output (normally it is the DO1 output) leading to the ON state and turning on the associated green led.
2. Deactivate the drive (DEN command = OFF). The green RUN LED goes off.
3. Remove the three-phase/monophase power supply (L1, L2, L3) or the D.C. power supply on the DC-BUS. The RDY output is brought into the state of OFF and the green LED RDY turns off.
4. Remove the 230Vac service power supply (if necessary).

**NOTE:** During normal motor gear-stop operation, it is recommended to act only on the speed reference (or on the "Stop motor" control) and on the enable command (DEN) to avoid unnecessary waiting times due to the charge of capacitors on the DC-BUS. Remove power supply only when you want to stop the motor safely.

### 4.7 Restarting after an alarm

When the drive enters alarm status (DOK output = OFF and flashing of the red led FLT) it behaves as if suddenly lacked the enable command (DEN = OFF), then the motor of the motor becomes free and is dragged by the load. It is therefore advisable to provide for a mechanical braking system if this situation could cause danger. If you have an alarm when the drive is enabled regularly, the DOK output goes to the OFF state, flashes the red FLT LED and the alarm message appears on the LCD display. When the control system (PLC or CNC) detects this alarm state, the following sequence shall be performed:

1. Immediately remove power supply (on L1, L2, L3 or DC+, DC-) and drive enable command (DEN = OFF).
2. Detect and whether it is possible to eliminate the cause that generated the alarm.
3. Reset the alarm with the digital input (RST = ON) or by pressing one of the buttons on the front.
4. Repeat the sequence of starting commands (page 20).

# 5 Commissioning

The PWM3D digital drive comes standard with an LCD display to display various information and internal states (alarms, parameters, settings) and four keys that are used to navigate the internal menu or change the various parameters.

The parameters and alarms are written on the display clearly (in English) and it is therefore not necessary to have the instruction manual at hand to identify them. The menu is structured with a tree and allows a simple and intuitive navigation: the various parameters are grouped according to their function.

The PWM3D digital drive can be set and calibrated directly using the built-in keyboard and display and it is not necessary to use a PC.

## 5.1 Menu structure

The following drawing indicates the tree structure of the PWM3D drive menu. As you can see the structure can reach up to 4 levels of depth and the various menus are grouped from a main menu.

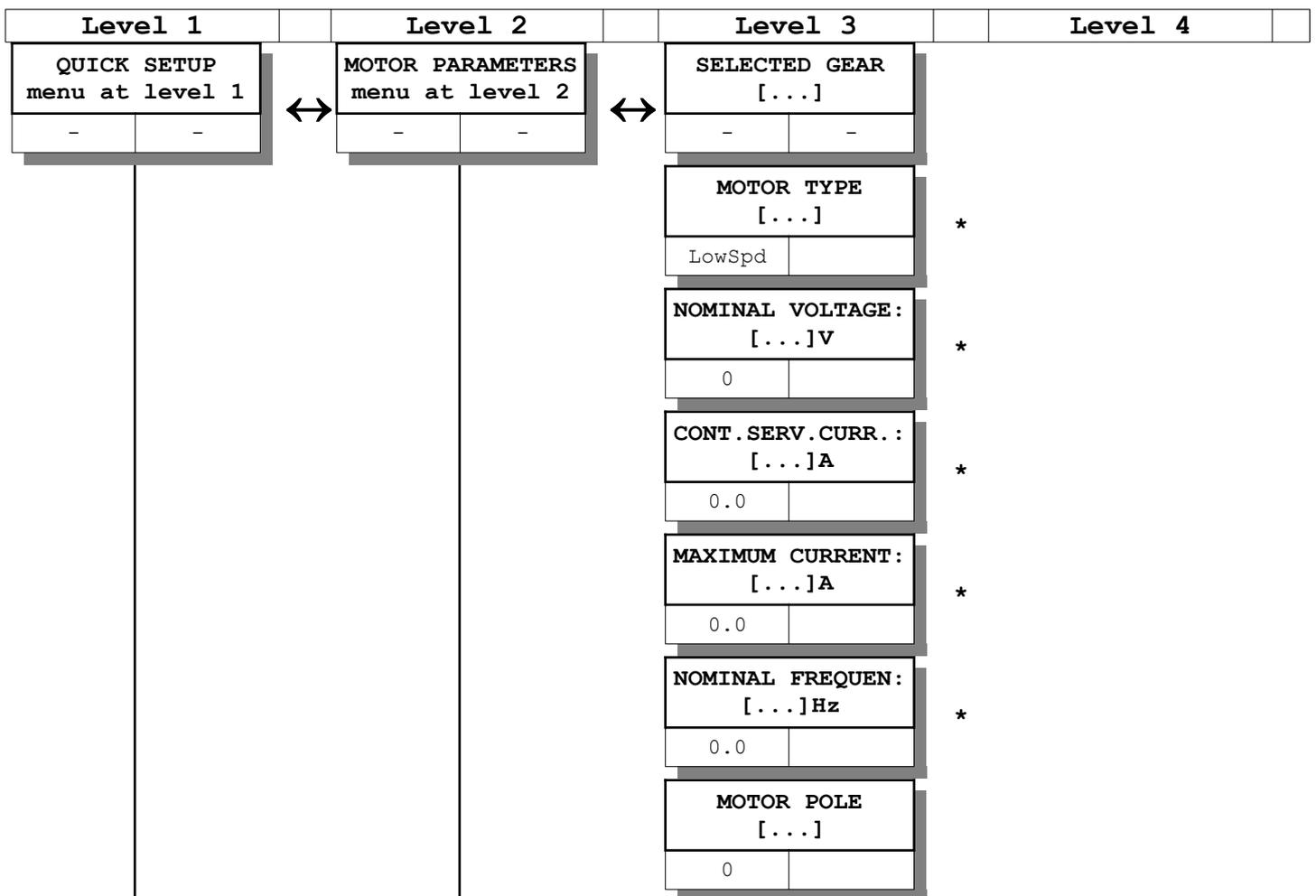
Some menus can only be displayed when using a certain type of transducer, or if an optional card is mounted.

Each menu is made up of 3 different zones:

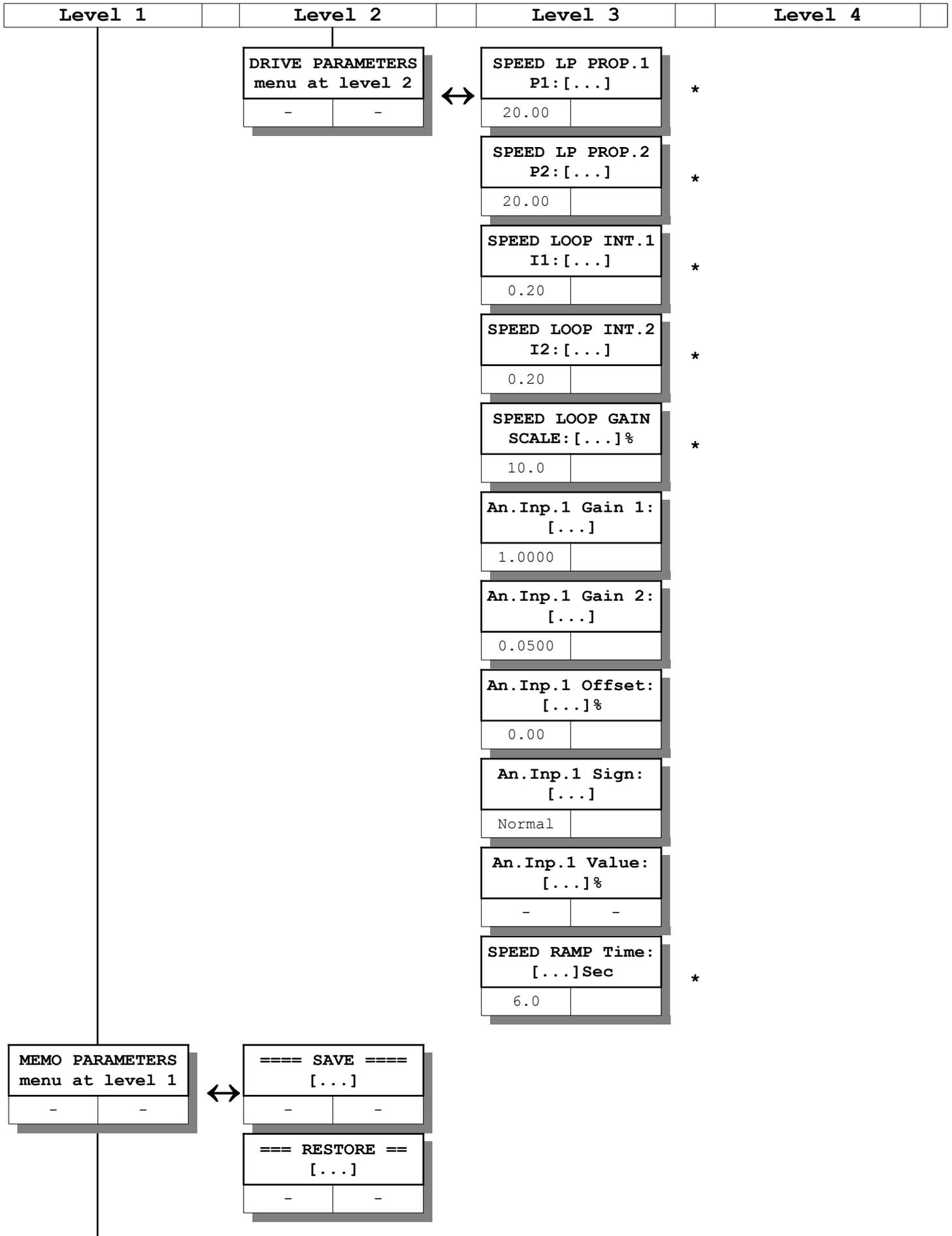
1. At the top indicates the inscription that will be read on the display. At the point where "[...]" is indicated, a letter will appear which can change based on the value of the parameter displayed.
2. At the bottom left indicates the original standard value of the displayed parameter.
3. In the bottom right there is a space available to the customer to note any changes in the displayed parameter.

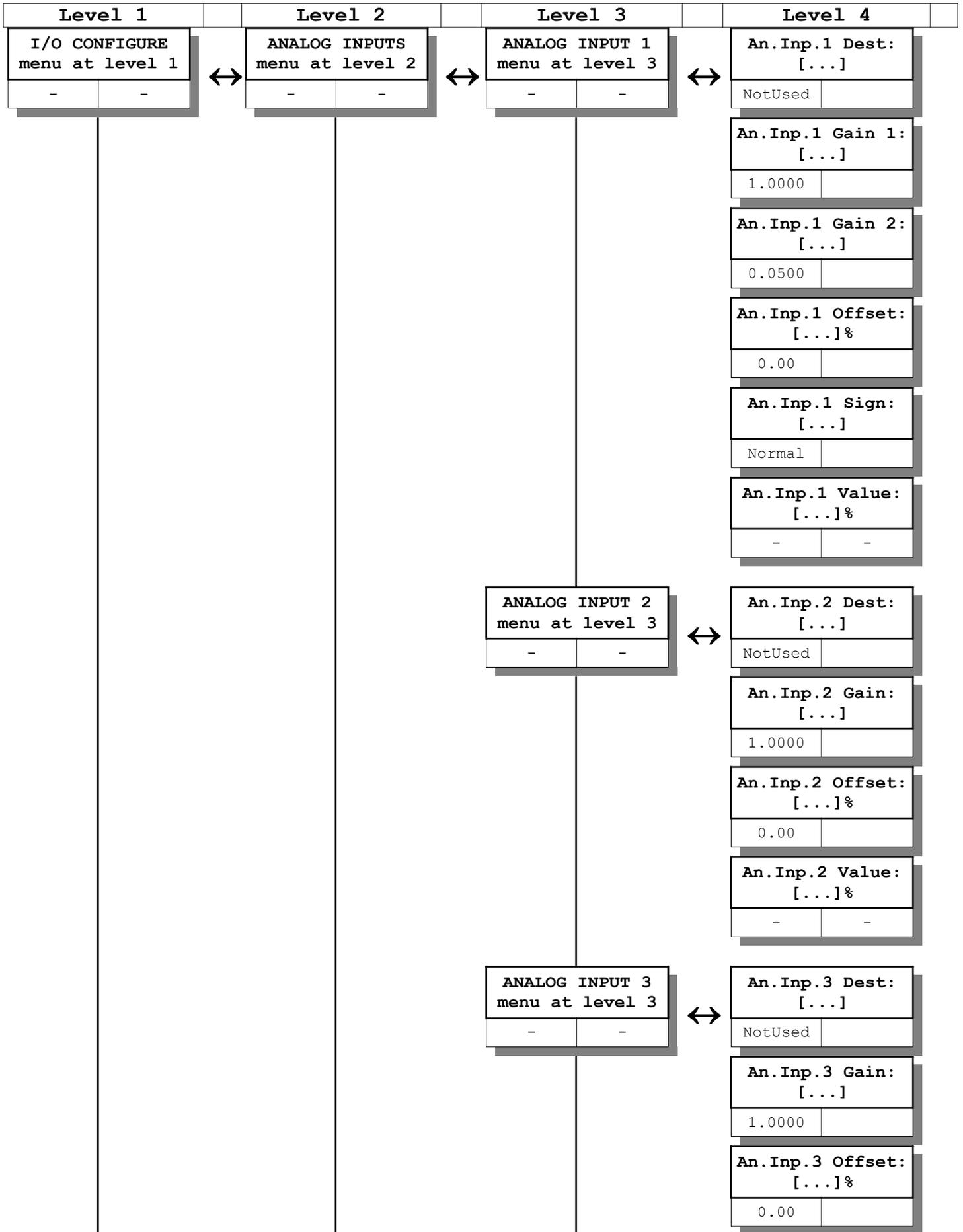
**NOTE:** If an indent "-" is present in the zones indicated in points 2 and 3, it means that that parameter is not modifiable.

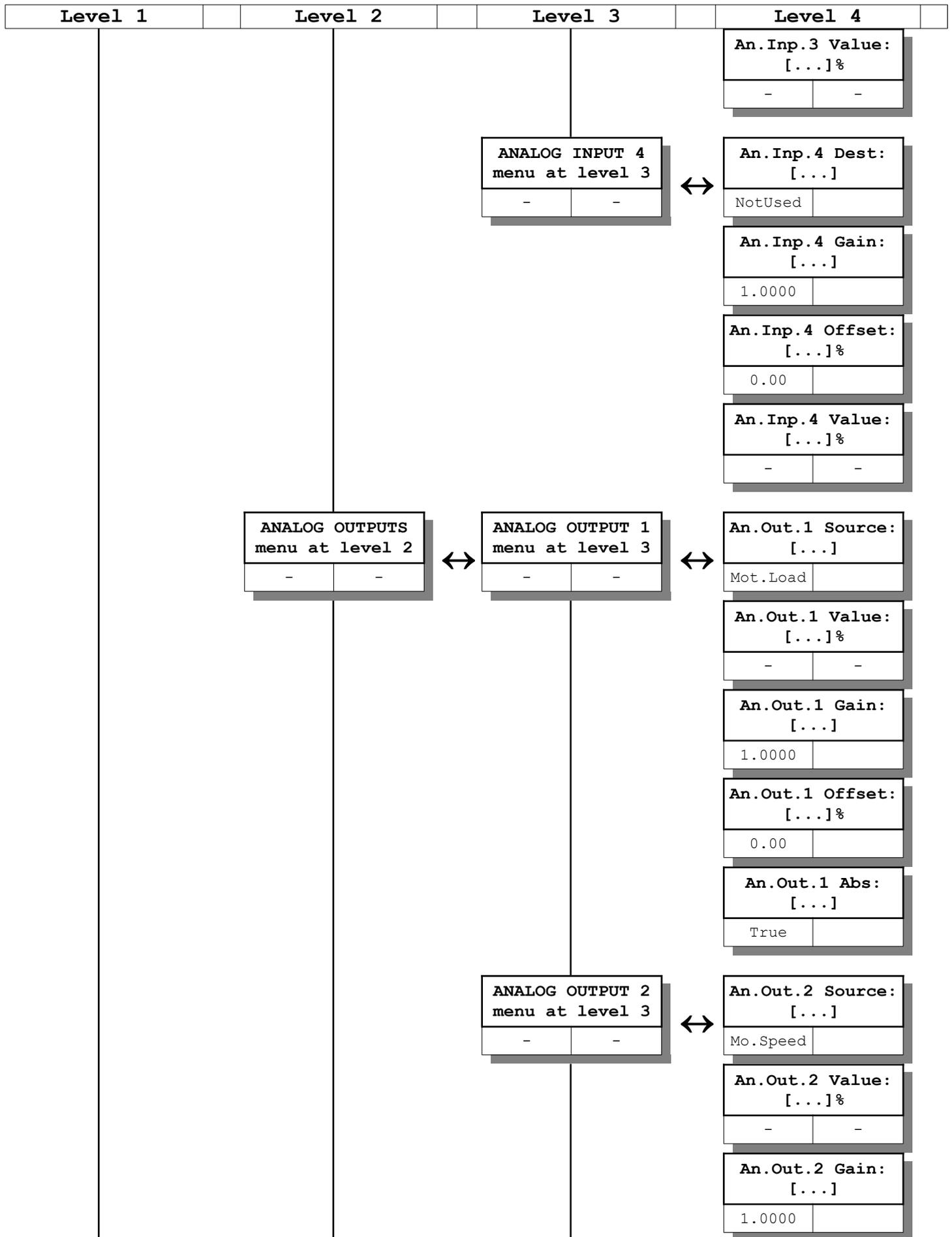
**NOTE:** Menus with an asterisk (\*) on the side indicate a parameter that may have different values depending on the selected speed range (Stage 0 or Stage 1). If you use the "Electronic Gear Change" function, the parameter value for each selected range can be noted in the appropriate table on page 69.

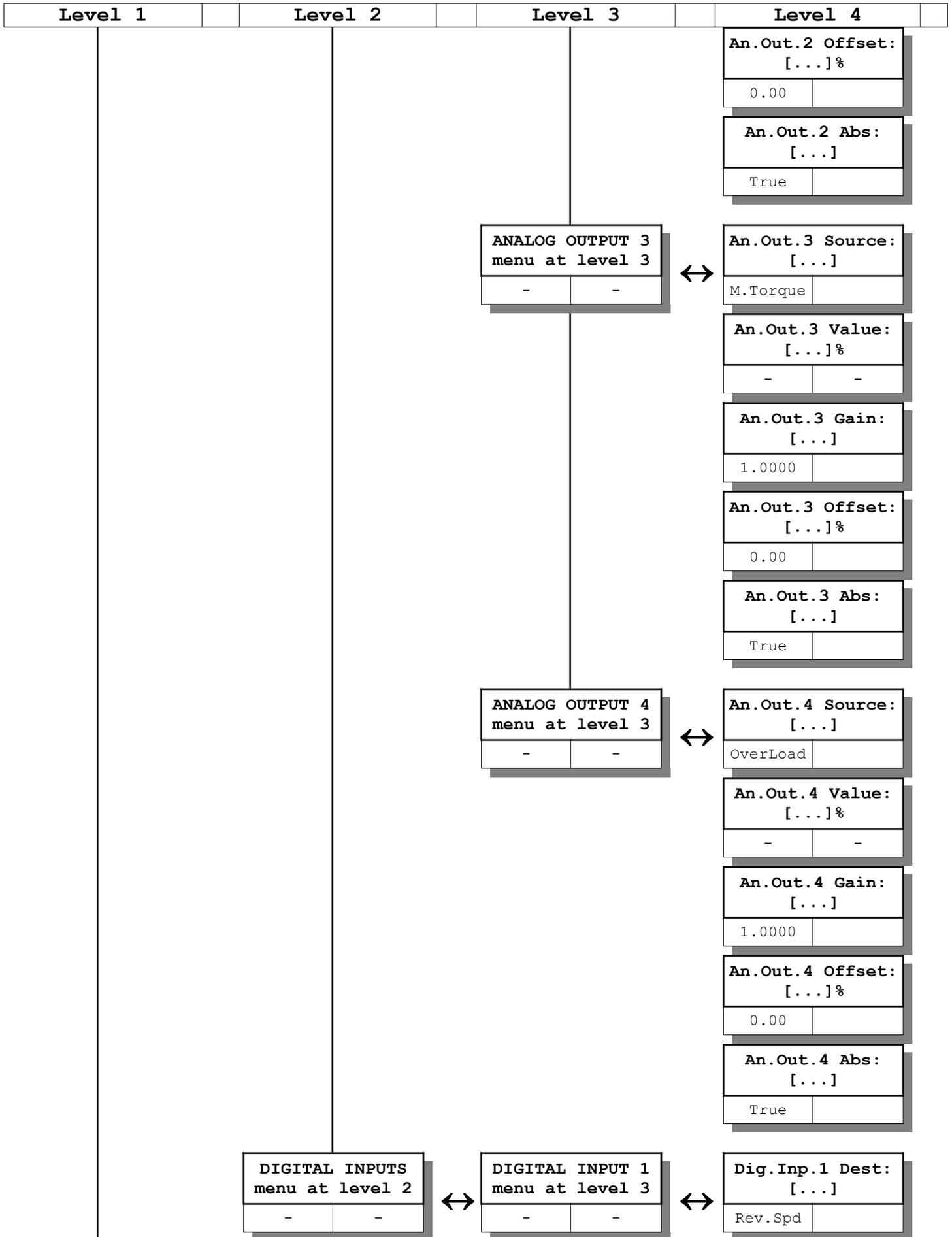


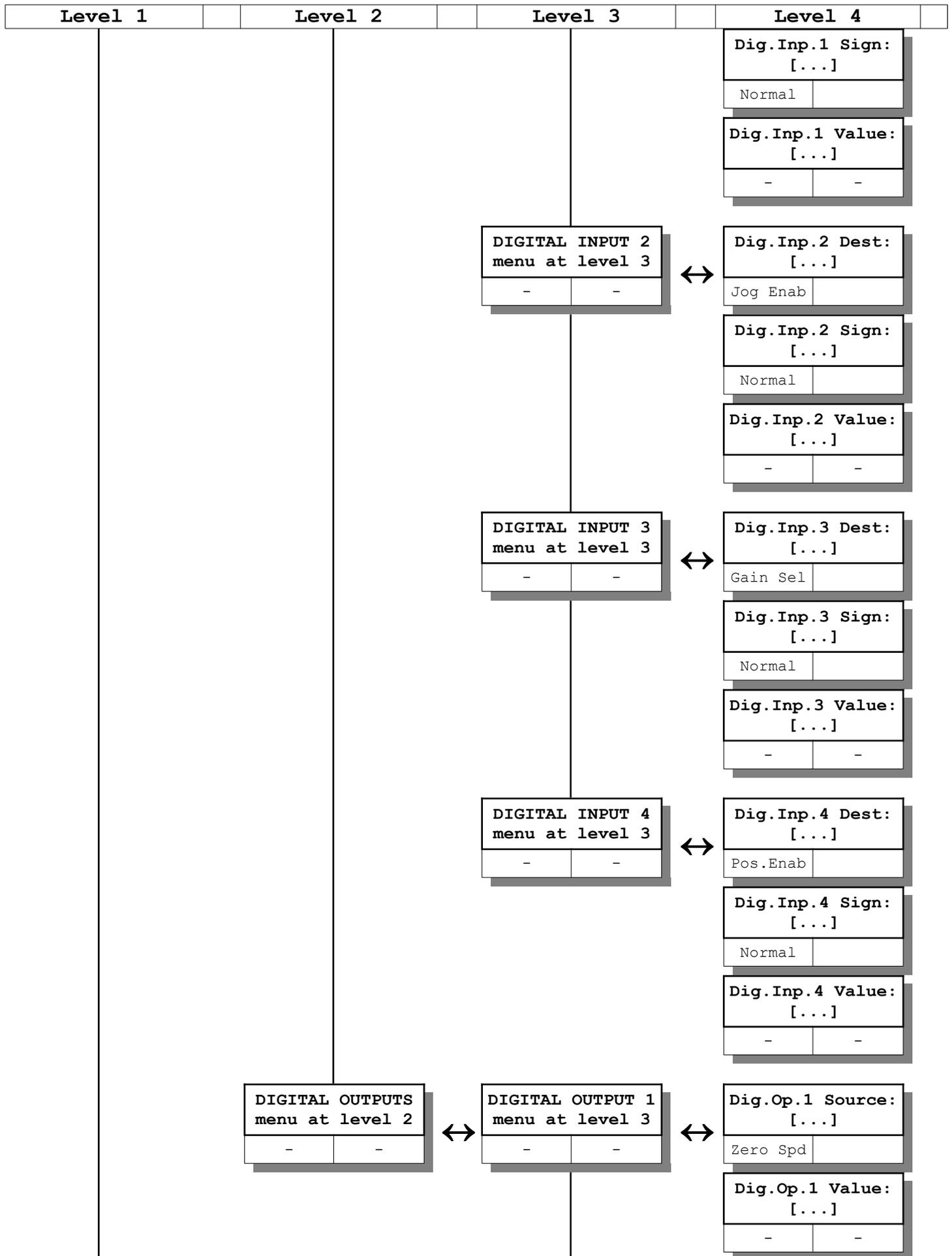
Level 1	Level 2	Level 3	Level 4								
		<table border="1"> <tr> <td><b>MAXIMUM SPEED</b> [...]<b>RPM</b></td> <td>*</td> </tr> <tr> <td>0.0</td> <td></td> </tr> </table>	<b>MAXIMUM SPEED</b> [...] <b>RPM</b>	*	0.0						
<b>MAXIMUM SPEED</b> [...] <b>RPM</b>	*										
0.0											
		<table border="1"> <tr> <td><b>MAXIMUM VOLTAGE:</b> [...]<b>V</b></td> <td>*</td> </tr> <tr> <td>0</td> <td></td> </tr> </table>	<b>MAXIMUM VOLTAGE:</b> [...] <b>V</b>	*	0						
<b>MAXIMUM VOLTAGE:</b> [...] <b>V</b>	*										
0											
		<table border="1"> <tr> <td><b>MAX.SPEED at Pn</b> [...]<b>RPM</b></td> <td>*</td> </tr> <tr> <td>0</td> <td></td> </tr> </table>	<b>MAX.SPEED at Pn</b> [...] <b>RPM</b>	*	0						
<b>MAX.SPEED at Pn</b> [...] <b>RPM</b>	*										
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		<table border="1"> <tr> <td><b>FEEDBACK TYPE</b> [...]</td> <td></td> </tr> <tr> <td>Not sel.</td> <td></td> </tr> </table>	<b>FEEDBACK TYPE</b> [...]		Not sel.						
<b>FEEDBACK TYPE</b> [...]											
Not sel.											
		<table border="1"> <tr> <td><b>ENCODER LINES</b> [...]<b>ppr</b></td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> </table>	<b>ENCODER LINES</b> [...] <b>ppr</b>		0						
<b>ENCODER LINES</b> [...] <b>ppr</b>											
0											
		<table border="1"> <tr> <td><b>ABS SIGNAL C&amp;D?</b> [...]</td> <td></td> </tr> <tr> <td>YES</td> <td></td> </tr> </table>	<b>ABS SIGNAL C&amp;D?</b> [...]		YES						
<b>ABS SIGNAL C&amp;D?</b> [...]											
YES											
		<table border="1"> <tr> <td><b>RESOLVER POLE PAIR:</b> [...]</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> </table>	<b>RESOLVER POLE PAIR:</b> [...]		0						
<b>RESOLVER POLE PAIR:</b> [...]											
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		<table border="1"> <tr> <td><b>AUTOTUNE MODE</b> [...]</td> <td></td> </tr> <tr> <td>Disabled</td> <td>-</td> </tr> </table>	<b>AUTOTUNE MODE</b> [...]		Disabled	-					
<b>AUTOTUNE MODE</b> [...]											
Disabled	-										
		<table border="1"> <tr> <td><b>Optional param. menu at level 3</b></td> <td></td> </tr> <tr> <td>-</td> <td>-</td> </tr> </table>	<b>Optional param. menu at level 3</b>		-	-	<table border="1"> <tr> <td><b>NOMINAL SPEED</b> [...]<b>RPM</b></td> <td>*</td> </tr> <tr> <td>0</td> <td></td> </tr> </table>	<b>NOMINAL SPEED</b> [...] <b>RPM</b>	*	0	
<b>Optional param. menu at level 3</b>											
-	-										
<b>NOMINAL SPEED</b> [...] <b>RPM</b>	*										
0											
			<table border="1"> <tr> <td><b>FDBK DIRECTION</b> [...]</td> <td></td> </tr> <tr> <td>normal</td> <td></td> </tr> </table>	<b>FDBK DIRECTION</b> [...]		normal					
<b>FDBK DIRECTION</b> [...]											
normal											
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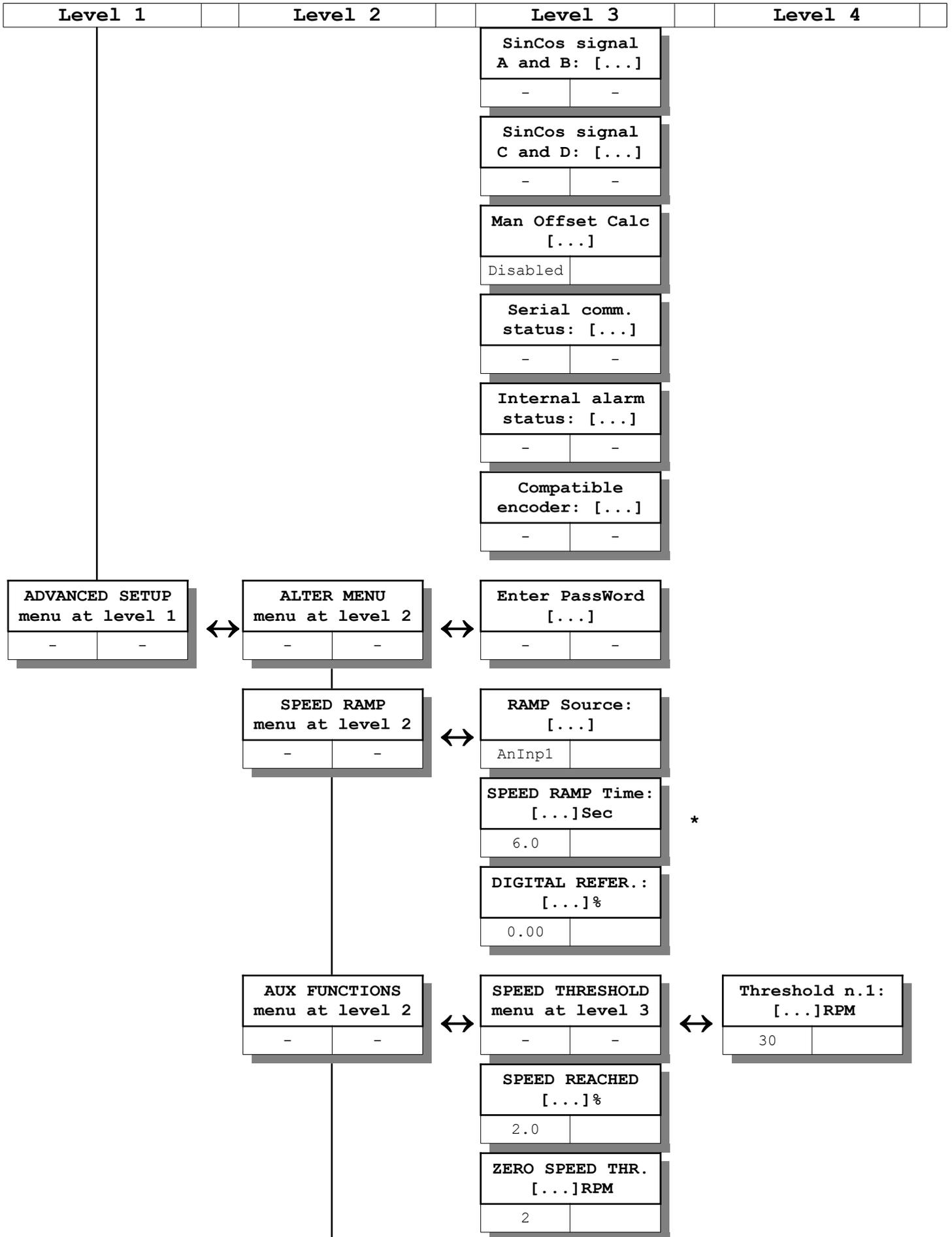


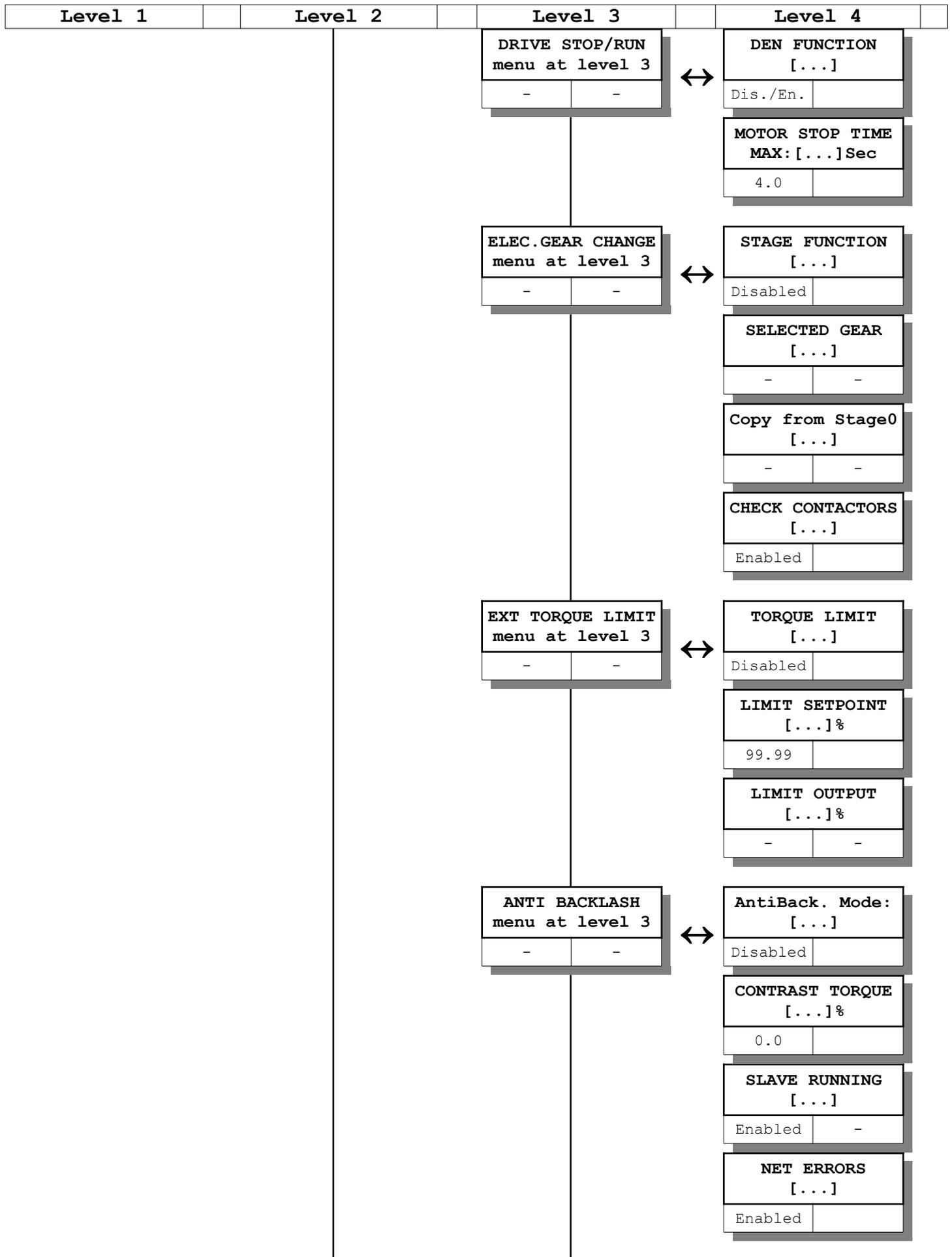


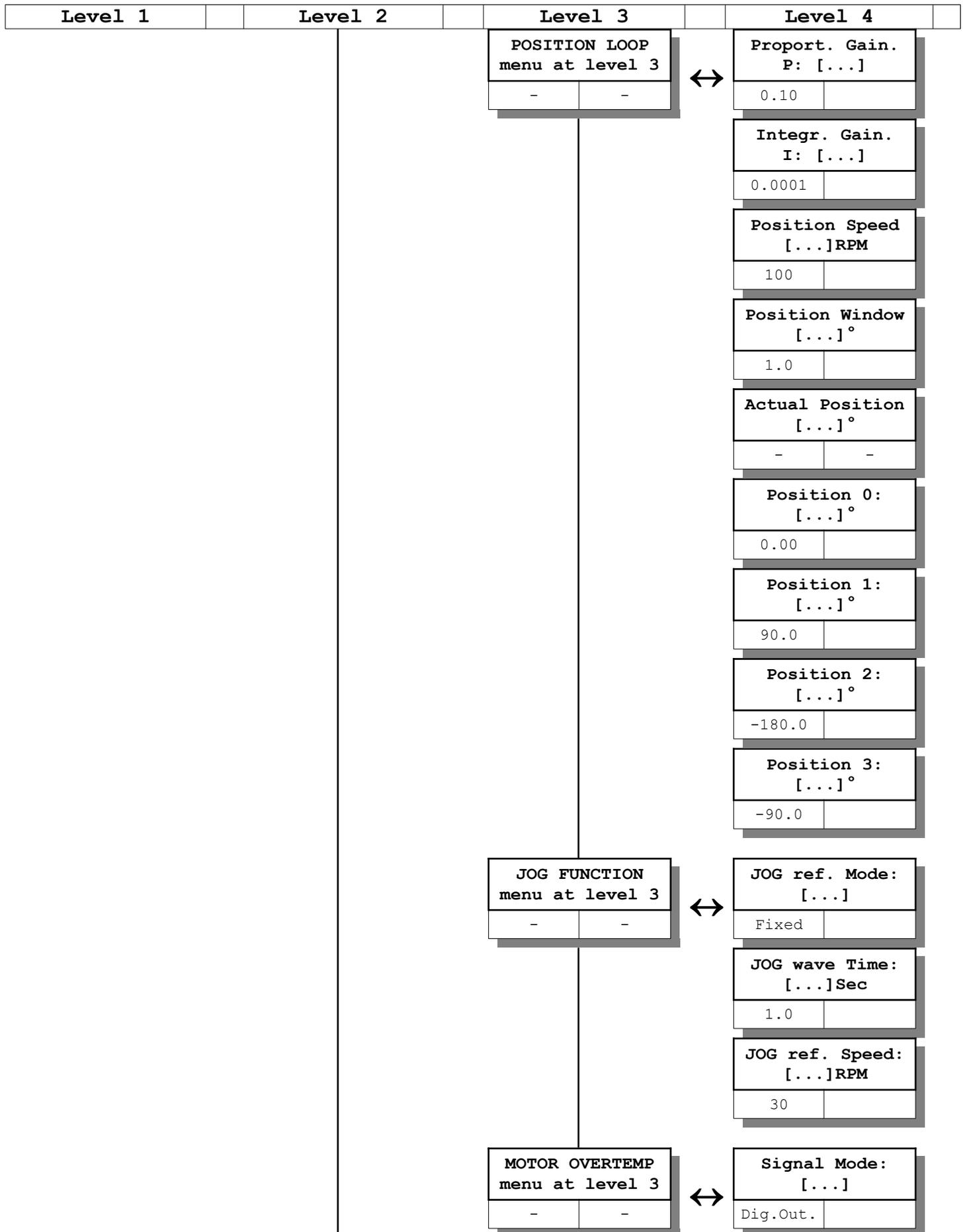


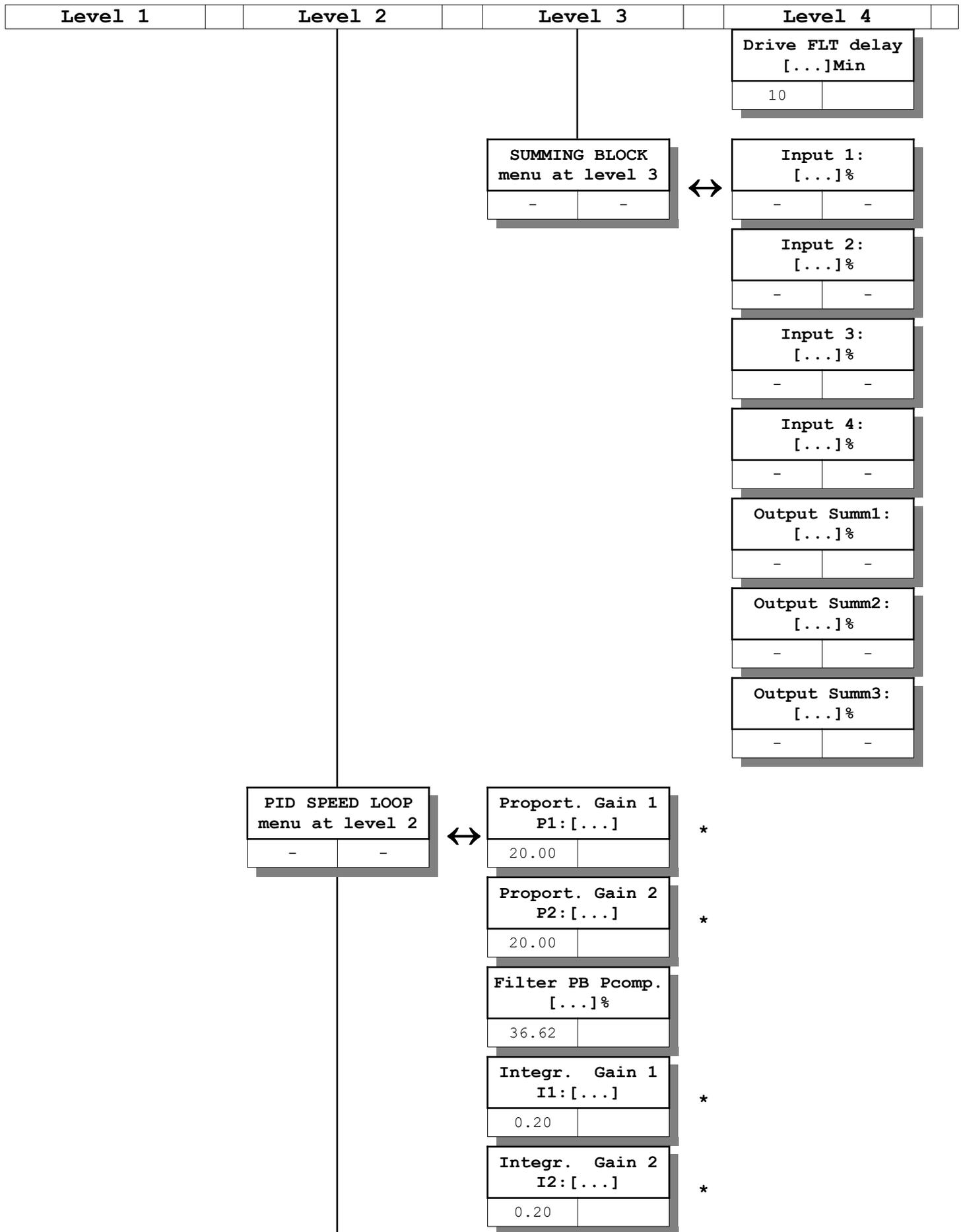


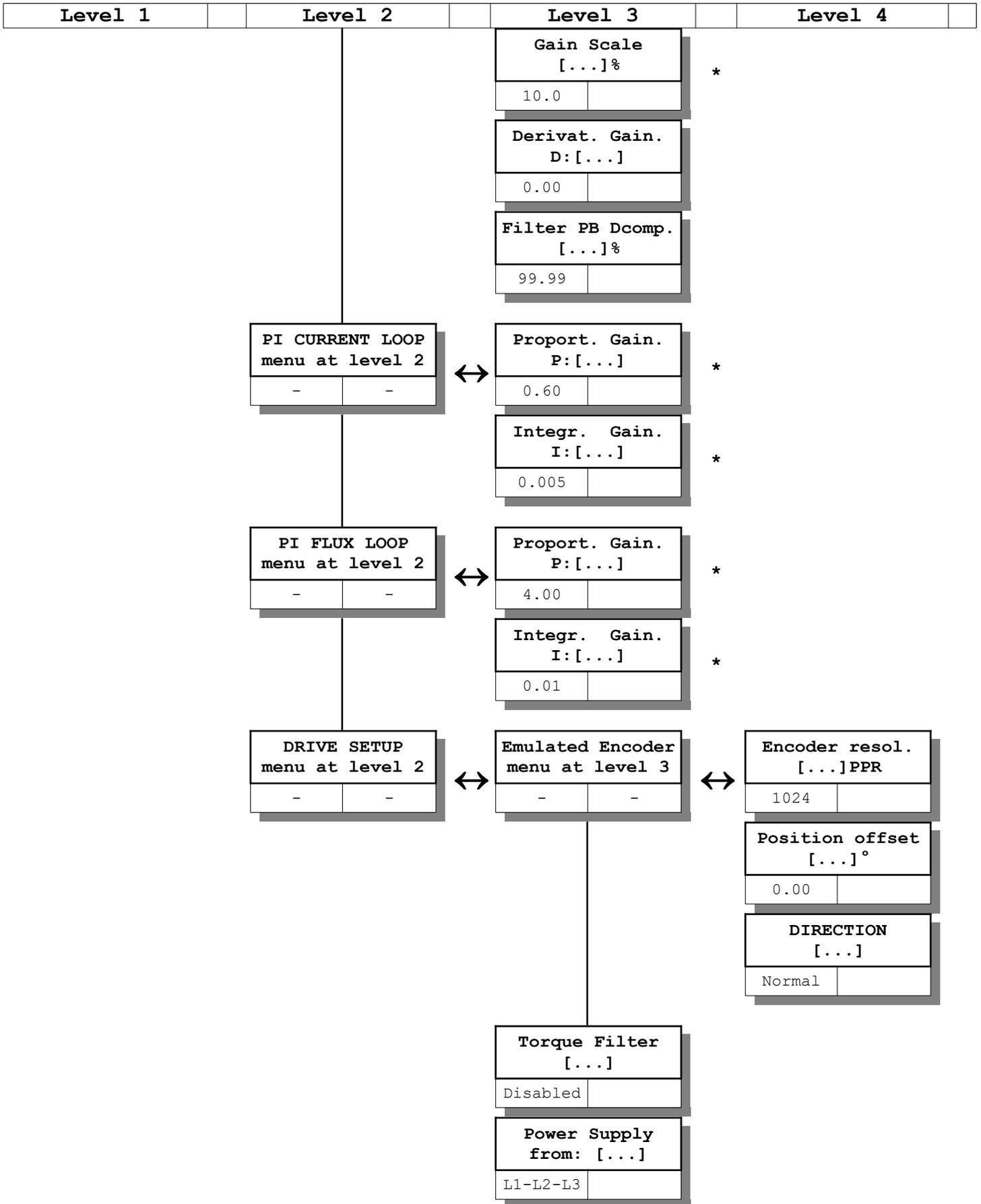
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## 5.2 Navigation in the menus

Pressing one of the 4 buttons located on the front of the PWM3D you can move between the various menus listed in the structure of the paragraph "Menu structure" from page 21.

With reference to the above structure, the keys have the following functions to move between the menus:

- Key “▲”: inside the same level, slide in vertical direction the various menus contained in the same group, upwards.
- Key “▼”: inside the same level, slide in vertical direction the various menus contained in the same group, downwards.
- Key “▶”: button: go up to one level and display the 1st menu of the top level of that group.
- Key “◀”: drops one level and returns to the previous menu of the lower level.

When you reach a menu that contains an editable parameter and after pressing the “▶” key, you enter the “change parameter” mode that is identified by the appearance of a “→” character in the bottom left corner of the display. If there is the character “=” in this position, it means that the parameter displayed is read-only and therefore it is not possible to modify it.

In “Change Parameter” mode, the key function changes as follows:

- Key “▲”: increases the value of the parameter of a unit. Keeping it pressed increases the rate of increase.
- Key “▼”: decreases the value of the parameter of a unit. Keeping it pressed increases the speed of decrease.
- Key “◀”: exits the “change parameter” mode.

**NOTE:** *after changing a parameter it is essential to store it in the internal Flash memory, otherwise when the power supply voltage of the auxiliary services is missing, the change is lost and the previous value returns. To do this, refer to the appropriate paragraph “Memo Parameters” on page 40.*

**Example:** suppose we want to change the maximum speed of the motor that is in the menu “Maximum Speed” which is part of the group “Motor Parameters” which in turn is in the group “Quick Setup”, you have to do the following steps:

1. Press the button “◀” until you see any menu in Level 1 (see the lettering in the 2nd line of the display).
2. Look for the “Quick Setup” group by scrolling the various menus upwards by pressing the button.
3. Press the button “▶” to switch to the 2nd level. You will see the group “Motor Parameters” which is what interests us.
4. Press the “▶” button again to switch to the 3rd level. The parameter “Motor Type” will be displayed as it is the 1st menu of the “Motor Parameters” group.
5. Press the “▼” button until you see the “Maximum Speed” menu.
6. To change this parameter you need to switch to “Edit Parameter” mode. Therefore, you must press the “▶” button once again, which causes a “→” to appear in the bottom left corner.
7. Press the key “▲” to increase the value or the “▼” key to decrease it. The change is used immediately by the drive.
8. When you read the desired value you have to press the key “◀” to exit the “Edit Parameter” mode.
9. At this point you can go back to level 1 by pressing the “◀” button 2 times, or switching to another parameter.
10. You can make all the necessary changes to the various parameters, but you have to remember to store the changes on the Flash memory before removing the power of the services to the drive otherwise all changes are lost.

## 5.3 Description of functions in the menus

After supplying the auxiliary services on the display, an initial menu containing the following information appears:

1. The first line shows the product code.
2. The second line shows the version of Firmware loaded into the DSP (the software that runs the drive).

Both of these information must be communicated to our technical office, in case of request for advice or malfunctions.

Below is the explanation of the parameters that can be set from the menus, divided into the various groups.

### Quick Setup

Group of menus that contain the minimum parameters that need to be set in order to make the drive work.

It also contains the most used calibration parameters.

### Motor Parameters

Menu group to set the motor parameters. Without these data the drive cannot function properly and therefore all must be written following the indications of the plate on the motor. The parameters indicated in this group must be placed in the order as displayed as some of them are linked to each other and one may limit the range of the other.

#### Selected gear

Indicates the currently selected speed range (Stage 0 or Stage 1). This menu is only visible if the “Electronic Gear Change” function is active. With the switching of the speed range, some parameters (those indicated with \* in the menu list from page 21) are switched. For more information see the appropriate paragraph “Electronic gamma change” from page 67.

#### Motor Type

Set the type of motor used:

- **Async. LowSpd:** asynchronous low speed motor. This type is usually set with normal asynchronous.
- **Async. HighSpd:** asynchronous high speed motor. This type is usually set with electro-spindles.

## Nominal Voltage

Minimum	Maximum	Units of measure
24	440	Volts (RMS)

Set the nominal motor voltage as read on the plate at the type of connection (star or triangle) achieved. If the motor does not differentiate the two voltages, the following formula can be used to calculate the missing data:

$$V_T = \frac{V_S}{\sqrt{3}} \quad \left| \begin{array}{l} V_T = \text{Voltage for Triangle Connection} \\ V_S = \text{Voltage for connection to Stella} \end{array} \right.$$

## Continuous service Current

Minimum	Maximum	Units of measure
$\frac{\text{Corrente serv. cont. convertitore}}{10}$	<i>Corrente serv. cont. convertitore</i>	Amperes (RMS)

Set the motor 's continuous service current as read on the plate at the type of connection (star or triangle) made. If the motor does not differentiate the two currents, the following formula can be used to calculate the missing data:

$$I_T = I_S \cdot \sqrt{3} \quad \left| \begin{array}{l} I_T = \text{Current for connection to Triangle} \\ I_S = \text{Current for connection to Star} \end{array} \right.$$

## Maximum Current

Minimum	Maximum	Units of measure
<i>Continuous service Current</i>	$2 \cdot \text{Nominal Current}$ o <i>Corrente picco convertitore</i>	Amperes (RMS)

Set the maximum current that the motor can withstand during its operation as indicated on the plate or by the motor manufacturer. Too high a value can cause the motor to overheat and cause a failure.

Note that the above parameter is set automatically equal to the "Continuous service Current" whenever the latter parameter is changed.

## Nominal Frequency

Minimum	Maximum	Units of measure
10	499,9	Hz

Set the rated motor frequency as indicated on the plate (usually between 50 and 60 Hz).

Normally this value is written on all motor plates, but if it is not present it is possible to calculate it using other data always reported on the motor: rated speed (max load), number of motor poles, sliding. In case of need, we recommend that you contact our technical office by providing all available data to help you calculate the missing data that is indispensable.

**Example:** The motor plate indicates the Nominal Speed (unladen) = 1590 RPM and the number of motor poles = 4. The nominal frequency can be calculated with the following formula:

$$f = \frac{n \cdot Pm}{120} \quad \left| \begin{array}{l} f = \text{Nominal frequency [Hz]} \\ n = \text{Nominal speed (empty) [RPM]} \\ Pm = \text{Motor pole} \end{array} \right.$$

By substituting the plate data in the formula you get that the nominal frequency is 53 Hz.

## Motor pole

Minimum	Maximum	Units of measure
2	16	n.

Set the number of poles of the motor as indicated on the plate.

If this data is not written on the motor plate, it can be calculated from the rated frequency and rated speed (if indicated on the motor plate) using the following formula:

$$X = \frac{f \cdot 120}{n} \quad \left| \begin{array}{l} n = \text{Nominal speed [RPM]} \\ f = \text{Nominal frequency [Hz]} \\ X = \text{Number to be rounded to the nearest equal to calculate the number of poles} \end{array} \right.$$

**Example:** The motor plate shows the following data: Rated speed at maximum load = 1532 RPM, Nominal frequency = 53 Hz. With the above formula  $X = 4,15$  is calculated and rounded to the nearest integer we get that: number of poles = 4.

## Maximum speed

Minimum	Maximum	Units of measure
100	25000	RPM

Set the maximum speed that the motor must achieve when the speed reference is at most.

Normally this speed corresponds to the 10Vcc reference on analogue input 1 (AI1) if configuration or scaling has not been changed. To check the value of the speed reference (analog or digital), you can check the parameter "Diagnostic → Speed Demand" (see page 45) while the drive is enabled and the motor runs regularly. On page 59 paragraph "Motor speed adjustment" there is a complete explanation of the precise calibration procedure of this parameter.

## Maximum Voltage

Minimum	Maximum	Units of measure
Nominal Voltage	440	Volts (RMS)

Set the maximum motor voltage as read on the plate. If a maximum voltage above the rated voltage is not specified, it is advisable not to change this parameter and leave it equal to the rated voltage.

## Max. speed at Pn

Minimum	Maximum	Units of measure
100	25000	RPM

Set the **maximum speed up to which the motor can reach at the Nominal Power** (plated data). This parameter must be written on the motor plate or supplied by the manufacturer otherwise the motor may be damaged or not functioning properly.

In case this data is unknown, then it is advisable to leave the standard parameter that the drive calculates automatically. If during motor operation you see that the power delivered at high speed is not enough for machining, you can try to increase this value little at a time until you find the right value. In any case it is advisable to contact our technical office.

**NOTE:** Each time you change one of the following parameters: Nominal Voltage, Nominal Frequency, Motor Pole, Maximum Voltage, the above parameter is automatically set to the value calculated by the drive.

## Feedback Type

Select the type of transducer mounted in the motor, choosing from the available ones:

- TTL encoder: always available (input on X4 connector).
- Resolver: selection possible only with optional 01/324 card (input on X14 connector).
- Sin-Cos: selection possible only with optional 01/325 card (input on X14 connector).
- Phonic Wheel: selection possible only with optional 01/326 card (input on X14 connector).
- EnDat: selection possible only with optional 01/327 card (input on X14 connector).

**NOTE:** The selection of a certain transducer with this parameter involves the appearance or disappearance of some menus depending on the utility or not with the selected transducer (see NOTE on page 21 "Menu structure").

## Encoder Lines

Minimum	Maximum	Units of measure	Displayed only with
100	10000	PPR	Encoder, Sin-cos, phonic wheel.

Set the number of pulses per revolution (ppr) of the encoder mounted in the motor.

## ABS signal C&D?

This parameter is only visible with SinCos transducer. It is used to indicate the type of SinCos encoder connected to the X14 connector. The possible selections are as follows:

- YES. The SinCos encoder has absolute channels, so there are the wires with the signal called C,  $\bar{C}$ , D,  $\bar{D}$  connected to the relative pins of the X14 connector (see section 5.5.2 on page 60).
- NO. the SinCos encoder does not have absolute channels, but only incremental signals + zero signal.

## Resolver Pole Pair

Minimum	Maximum	Units of measure	Displayed only with
1	36	Number of pole pairs	Resolving

Set the number of polar pairs of the transducer resolver.

**NOTE:** The "number of resolver poles" is generally indicated; since this parameter indicates the number of "pole pairs" it is necessary to divide the given data in half. **EXAMPLE:** Pole resolver  $n^{\circ}4$ , the data "Resolver Pole Pair" = 2.

## Autotune mode

Enabling the self-learning function of the electric parameters of the motor indicated in the group "Optional param". Activate this mode to power drive but without enabling (Green LED RUN off), then you can enable the drive and the measurement phase takes place (the RUN green LED flashes).

For more information on Autotune mode, see page 58.

## Optional Param

Menu group with optional parameters that can be measured automatically by the "Autotune " procedure. If this procedure is not possible or if the motor parameters are known (provided by the manufacturer), they can be entered manually using the above menu group.

### Nominal speed

Minimum	Maximum	Units of measure
$\frac{\text{Nominal Frequency} \cdot 120}{\text{Motor pole}} \cdot 0,95$	$\frac{\text{Nominal Frequency} \cdot 120}{\text{Motor pole}}$	RPM

Set the rated motor speed as indicated on the plate. This value is the motor speed when powered by a three-phase network at the rated frequency with the maximum load applied to the shaft. This parameter is optional and can be calculated automatically by the "Autotune" procedure.

### Feedback Direction

With this parameter you can reverse the direction of counting of the transducer connected to the motor. The possible selections are as follows:

- NORMAL: The signal from the transducer is NOT inverted by sign.
- REVERSE: The signal from the transducer is reversed by sign.

This parameter is optional and can be calculated automatically by the "Autotune " procedure.

### Magnet current

Minimum	Maximum	Units of measure
0,1	$\text{Nominal Current} \cdot 0,9$	Amperes (RMS)

Set the motor magnetising current or the unladen current that corresponds to the effective current required by the line when the motor is powered by a three-phase line at a frequency equal to the "Nominal Frequency " in the absence of load connected to the shaft. This parameter is optional and can be calculated automatically by the "Autotune " procedure.

### Stator resists

Minimum	Maximum	Units of measure
0,01	99,99	Ω

Set the static motor resistance indicated by the manufacturer which corresponds to the equivalent resistor of a measured star connection between a phase and the star centre. This parameter is optional and can be calculated automatically by the "Autotune " procedure.

### Magnetic induct

Minimum	Maximum	Units of measure
0,01	999,99	mH

Set the magnetic inductance of the motor indicated by the manufacturer. This parameter is optional and can be calculated automatically by the "Autotune " procedure.

### Leakage induct

Minimum	Maximum	Units of measure
0,01	99,99	mH

Set the motor leakage inductance indicated by the manufacturer. This parameter is optional and can be calculated automatically by the "Autotune " procedure.

## Drive Parameters

Menu group to set the main parameters of the drive grouped for faster adjustment. For a normal operating calibration with average performance it is sufficient to adjust the parameters grouped here.

### Speed LP prop. 1 / 2

Minimum	Maximum	Units of measure
0	999,99	-

Set the proportional gain of the speed loop: the larger the number is, the faster the motor is in response, but the instability of the regulator is at risk. For the adjustment of this parameter it is recommended to start from a low number (2.0, 3.0) and then, after enabling the motor and rotating it, gradually increase it until it is possible without making the system unstable.

**NOTE:** To select the gain in use (Gain 1 or Gain 2) the digital input to "Gain Selection" is used; the Gain 1 is used if the input that controls the switching of the gain is at level 0, instead the Gain 2 is used if it is level 1. The digital input that controls switching is set in the "Dig.Inp. X Dest" menu (see page 43); under standard conditions this input is the DI3.

### Speed loop int. 1 / 2

Minimum	Maximum	Units of measure
0	999,99	-

Set the additional gain of the speed loop: the larger the number, the more the motor quickly resets the speed error (difference between the required speed and the actual speed), but the instability of the regulator is at risk. For the adjustment of this parameter it is recommended to start from a low number (0.01, 0.02) and then, after enabling the motor and rotating it, gradually increase it until it is possible without making the system unstable.

**NOTE:** To select the gain in use (Gain 1 or Gain 2) the digital input to "Gain Selection" is used; the Gain 1 is used if the input that controls the switching of the gain is at level 0, instead the Gain 2 is used if it is level 1. The digital input that controls switching is set in the "Dig.Inp. X Dest" menu (see page 43); under standard conditions this input is the DI3.

### Speed loop gain scale

Minimum	Maximum	Units of measure
0,1	99,9	%

This parameter is displayed only in "Async.HighSpd" mode (see parameter "Motor Type" on page 35), and is used to scale the additional gain of the speed loop when the motor runs at a frequency above the rated one (parameter "Nominal Frequency" on page 36). When the inverter is set to "Async.HighSpd" mode and the motor is running at high speed if you notice a speed instability (pecking after a change) then you have to reduce this value. Conversely, if you want more accuracy of response and the motor can respond well, you can increase the value.

**Example:** If this parameter is set to 10 % it means that at high speed the additional component (parameter "Speed loop int. 1 / 2") will have a value of 10 % compared to the number set in its parameter.

### An.Inp.1 Gain 1

Minimum	Maximum	Units of measure
-2.00	+2.00	-

Set the multiplication factor of the signal coming from the analog input 1. With this parameter it is possible to scale the voltage signal connected to the analog input in order to adapt it to reach the maximum speed. This gain parameter is active when the digital input dedicated to switching the gain of AI1 is logically "0". Under standard conditions this input is the DI3; For more information see paragraph "Dig.Inp. X Dest" on page 43.

**Example:** suppose we want to reach a maximum speed of 3000 RPM when the speed signal connected to the analog input 1 is at its maximum value; unfortunately, the speed signal coming from the CNC has a full scale of 8.5 Vcc. You can calculate the scale value to amplify it and thus get the maximum speed with 8.5V instead of 10V:

$$Gain = \frac{10}{V_{MAX}} \quad \left| \begin{array}{l} V_{MAX} = \text{Maximum voltage of the speed reference.} \\ Gain = \text{Gain of the analog input.} \end{array} \right.$$

Substituting in the formula the bottom scale value of the example (8,5V) is calculated that the gain to be set in this parameter is 1.17.

### An.Inp.1 Gain 2

Minimum	Maximum	Units of measure
-2.00	+2.00	-

The function of this parameter is identical to that described in the previous paragraph; The only difference is that this gain parameter is active when the digital input dedicated to switching the gain of AI1 is logically "1". Under standard conditions this input is the DI3; For more information see paragraph "Dig.Inp. X Dest" on page 43.

### An.Inp.1 Offset

Minimum	Maximum	Units of measure
-10.00	+10.00	%

Set the offset of the analog signal 1. For the adjustment of this parameter it is recommended to give a speed reference "0" and then to enable the drive; if the motor rotates slowly, act on this parameter to stop the rotation.

## An.Inp.1 Sign

With this parameter you can select whether to reverse the sign of the analog input 1 or to leave it as originally. The possible selections are:

- NORMAL: The "Value " signal indicates exactly the value of the analog input 1.
- REVERSE: The "Value " signal indicates the value of the analog input 1 inverted of sign.

See Drawing 15 on page 41 for clarity.

## An.Inp.1 Value

Minimum	Maximum	Units of measure
-100.00	+100.00	%

Read-only parameter indicating the output signal from the analog input compensation block 1. See drawing 15 on page 41 to figure out where this parameter works in the calculation.

**NOTE:** A value of 100 % does not mean that the analog input is 10V; this also depends on the value of the gain and the offset. In the example above given that the gain is set to 1.17 then the "Value " will indicate 100 % when the analog input is 8.5V as calculated.

## Speed Ramp Time

Minimum	Maximum	Units of measure
0.1	650.0	Sec

Parameter to set the up/down time of the speed ramp. Assuming an input of 0 to 100 % of the value is given, this parameter is defined as the time it takes ("Speed Demand ") to go from 0 % to 100 %.

Therefore if the input step goes from 0 % to 50 % it will mean that the time taken to finish the ramp will be half the time set on this parameter.

## Memo Parameters

Menu group to store or restore changes made to parameters.

Please note that before disconnecting the services you have to store the modified parameters otherwise they will be lost and at the next restart there will be the previous parameters.

### Save

Menu to start saving (storage) the modified parameters. Follow these points to accomplish the operation:

1. Using the buttons on the front, reach the menu "Memo Parameters → Save".
2. In the bottom line is the words "UP to confirm". Press the "▶" button to enter the "change parameter" mode.
3. The "→" character appears in the lower left corner of the display. At this point press "▲" (i.e. UP).
4. Start the memorisation phase indicated by the words "Wait...". At the end appears the inscription "OK" indicating that the operation is finished correctly.
5. At this point, you can press "◀" to confirm and exit the "Edit Parameter mode". The data is stored and you can remove services power without any problems.

### Restore

Menu to start restore of the modified parameters. If during the various parameter changes you want to return to the previous general situation (i.e. to the last storage), you can use this menu to restore all the parameters. Follow these points to do this:

1. Using the buttons on the front, reach the "Memo Parameters → Restore" menu.
2. In the bottom line is the words "UP to confirm". Press the "▶" button to enter the "change parameter" mode.
3. The "→" character appears in the lower left corner of the display. At this point press "▲" (i.e. UP).
4. Start the recovery phase indicated by the words "Wait...". At the end appears the inscription "OK" indicating that the operation is finished correctly.
5. At this point, you can press "◀" to confirm and exit the "Edit Parameter mode". The parameters have been changed and brought back to the situation of the last memorisation.

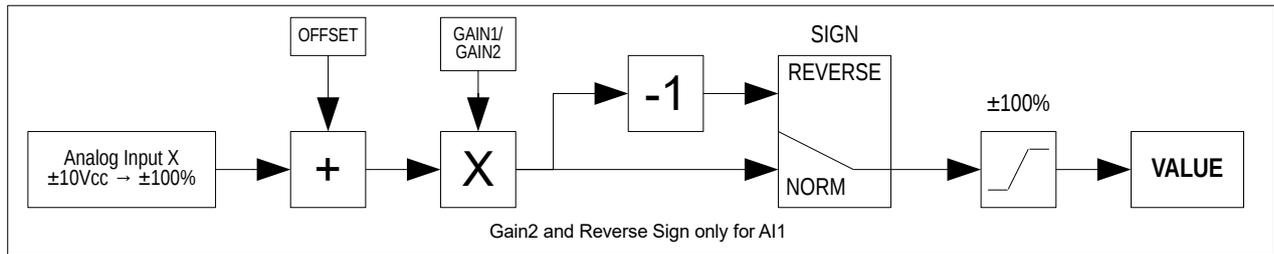
**NOTE:** If it is necessary to return all the parameters to the factory values (Global Reset), the buttons "▲" and "▼" must be pressed simultaneously before supplying the services; by holding down the buttons, power the services and when the writing appears on the LCD display you can release the buttons. At this point you have restored the factory parameters but still have to be stored using the menu "Memo Parameters → Save".

## I/O Configure

Menu group to configure and calibrate analog or digital inputs and outputs.

## Analog inputs

Menu group to configure and calibrate analog inputs. For simplicity it is advisable to see the following figure showing the internal calibration structure of a generic analog input.



Drawing 15 Analog input structure

The voltage value on the input terminals is measured and represented by a value between -100 % and +100 % corresponding to the voltage of -10Vcc and +10Vcc. Then the percentage value is added to a set value called "Offset" to eliminate the analog signal offset error. The result is multiplied by a setable value called "Gain"; In the analog input called AI1 there are two different Gain values (Gain1 and Gain2) that can be set separately and switched with a digital input to select. In addition, the AI1 input also has the possibility to reverse the sign with a setting in the menu; this can be useful when the motor rotates contrary to the desired. The result is then limited as full scale to ±100 % and indicated as the output value of the "Value " block. By means of these parameters it is possible to compensate for any errors of gains and offsets that are present in the signal provided from the outside.

## Analog input X

Menu group to configure the analog input X. Changes to the calibration values made in this group, act only on the indicated analog input and not on the others.

### An.Inp. X dest

Parameter that allows you to select the destination of the input analogue reference. Using the keys you can select the destination among these:

- **NOT USED:** the analog input is not used. The "Value " indicates the value of the input signal, but it is not actually used for any function.
- **Torque Limit:** The analog input is used by the function "External torque limit" as the maximum torque reference (see section "limit" on page 70).
- **Inp.1 SummBlock:** The analog input is sent to entry 1 of the summing block (see section 5.6.14 on page 75).
- **Inp.2 SummBlock:** The analog input is sent to entry 2 of the summing block (see section 5.6.14 on page 75).
- **Inp.3 SummBlock:** The analog input is sent to entry 3 of the summing block (see section 5.6.14 on page 75).
- **Inp.4 SummBlock:** The analog input is sent to entry 4 of the summing block (see section 5.6.14 on page 75).
- **Position 0:** The analog input is sent as a "position 0 " reference to the positioning block (see section 5.6.13 on page 74).

### An.Inp. X Gain

Minimum	Maximum	Units of measure
-2.00	+2.00	-

Set the multiplication factor of the signal coming from the analog input to be calibrated. With this parameter you can amplify or reduce the input signal to suit your needs. See drawing 15 to figure out where this parameter works in the calculation. Remember that for the analog input called AI1 there are two different values of preset gain (Gain 1 and Gain 2); If the input that controls the switching of the gain is at level 0, the Gain 1 is used instead if it is level 1 the Gain 2 is used. The digital input that controls switching is set in the "Dig.Inp. X Dest" menu (see page 43); Under standard conditions this input is the DI3.

### An.Inp. X Offset

Minimum	Maximum	Units of measure
-10.00	+10.00	%

Set the value to be added to the measured signal to compensate for any offset errors. See Drawing 15 to figure out where this parameter works in the calculation.

### An.Inp.1 Sign

This parameter is present only for the analog input AI1. With it you can select whether to reverse the sign of the analog input 1 or to leave it as originally. The possible selections are:

- **Normal:** The "Value " signal indicates exactly the value of the analog input 1.
- **Reverse:** The "Value " signal indicates the value of the analog input 1 inverted of sign.

See Drawing 15 for more clarity.

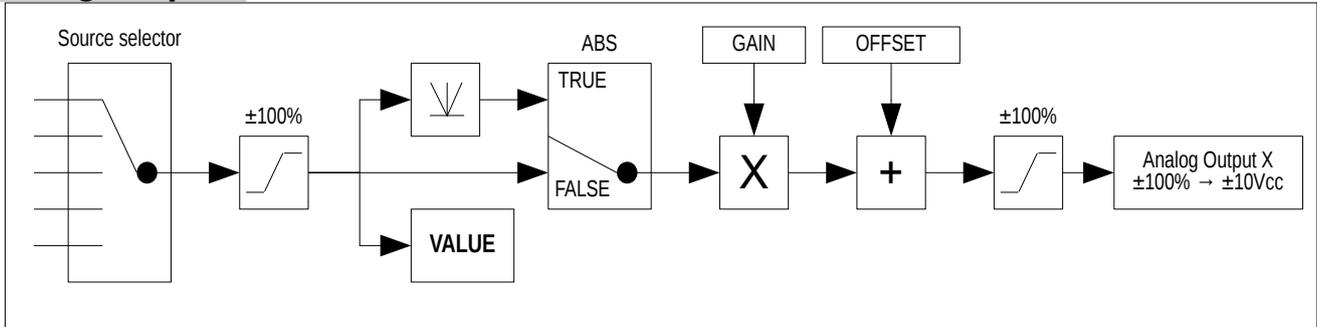
### An.Inp. X Value

Minimum	Maximum	Units of measure
-100.00	+100.00	%

Read-only parameter indicating the output signal from the analog input compensation block. See drawing 15 to figure out where this parameter works in the calculation.

**NOTE:** A value of 100 % does not mean that the analog input is 10V; this also depends on the value of the gain and the offset.

### Analog outputs



Drawing 16 Analog output structure

Menu group to configure and calibrate analog outputs. For simplicity it is advisable to see the following figure showing the internal calibration structure of a generic analogue output.

The voltage value on the analog output TERMINALS can be controlled by several selectable sources. The calibration block of the analogue output after reading the value of the selected source limits it as full scale to  $\pm 100\%$  and indicated as the parameter “Value” which in this case corresponds to the source value. Then another selector allows you to choose whether to send the absolute value of “Value” (i.e. always positive) in the block if ABS = True, or the value identical to “Value” if ABS = False. The selected value is multiplied by a set parameter called “Gain” and then added to another setting parameter called “Offset”. The result is then limited as full scale to  $\pm 100\%$  and sent to the analog output scaled with  $-100\% = -10V_{cc}$  and  $+100\% = +10V_{cc}$ . By means of these parameters it is possible to read some internal data and transfer them to the output of the drive properly scaled and modified to adapt them to the external circuits.

### Analog Output X

Menu group to configure the analog output X. Changes to the calibration values made in this group, act only on the indicated analog output and not on the others.

### An.Out. X source

Parameter that allows you to select the source of the outgoing analog reference. Using the keys you can select the source from among these:

- **NOT USED:** the analog output is not used and the “Value ” is always at 0 %.
- **Motor load:** the analog output (standard on AO1) indicates the motor load in percent. When the parameter “Value ” reaches 100 % it means that the motor is subjected to the rated load and that it may lose speed if it is charged further.
- **Motor speed:** the analog output (standard on AO2) indicates the motor speed with this scale:

$$Speed = \frac{Value}{100} \cdot Maximum\ Speed$$

*Value = Value shown in the parameter “Value ” of the analog output under consideration (see drawing 16).  
Maximum Speed = Maximum speed of the motor as inserted in the parameter “Maximum speed” on page 37.  
Speed = Speed of the motor in RPM.*

- **Motor torque:** the analog output (standard on AO3) indicates the motor torque in percentage value. When the parameter “Value ” reaches 100 % it means that the motor has reached the nominal torque. It should be noted that the nominal torque is obtained only when the motor is not defluxed, i.e. when the rotation speed is lower than the rated speed.
- **DC bus voltage:** the analog output indicates a value proportional to the voltage of the bus dc. If the parameter “Value ” is 100 % means that the voltage on the DC BUS is 881Vcc.
- **AI1 value:** the analog output indicates the value measured by the analog input n.1. The parameter “Value ” of the analog output has the same value as the parameter “Value ” of the analog input 1, so it is not possible to define an exact scale as it depends on the calibration parameters of the analog input 1. It is as if the calibration block of the analog input of drawing 15 of page 41 is connected to the block of the analog output of drawing 16.
- **SumBlock Summ1:** The analogue output indicates the value of the sum 1 (Summ1) output of the summing block (see section 5.6.14 on page 75).

- **SumBlock Summ2:** The analogue output indicates the value of the sum 2 (Summ2) output of the summing block (see section 5.6.14 on page 75).
- **SumBlock Summ3:** The analogue output indicates the value of the sum 3 (Summ3) output of the summing block (see section 5.6.14 on page 75).

### An.Out. X Value

Minimum	Maximum	Units of measure
-100.00	+100.00	%

Read-only parameter indicating the input signal of the analog output compensation block. See drawing 16 to see where this value is read.

### An.Out. X Gain

Minimum	Maximum	Units of measure
-2.00	+2.00	-

Set the multiplication factor of the "Value " signal in input to the calibration block. With this parameter you can amplify or reduce the input signal to suit your needs. See drawing 16 to figure out where this parameter works in the calculation.

### An.Out. X Offset

Minimum	Maximum	Units of measure
-10.00	+10.00	%

Set the value to add to the "Value " signal to create an outgoing offset. See drawing 16 to figure out where this parameter works in the calculation.

### An.Out. X Abs

With this parameter you can select whether to take the "Value " or its value without sign as input of the calibration block of the analog output. The selections available are:

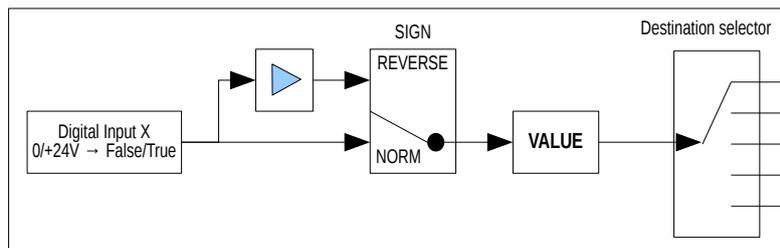
- FALSE: The "Value " signal is used directly with the positive or negative sign.
- TRUE: The "Value " signal is used as an absolute value (without sign), so always positive.

By activating this function it is possible to have an analog output always positive (or negative, just set the "Gain " with a negative number), in case of use with unmarked display tools. See Drawing 16 to figure out where this parameter works in the calculation.

## Digital inputs

Menu group to configure and calibrate digital inputs. For simplicity it is advisable to see the following figure showing the internal calibration structure of a generic digital input.

The logical state of the terminal associated with the digital input is read and then you can then select whether to send the direct or logically reversed value out of the block.



Drawing 17: Digital input structure

### Digital Input X

Menu group to configure the digital input X. Changes to the calibration values made in this group, act exclusively on the indicated digital input and not on the others.

### Dig.Inp. X Dest

Parameter that allows you to select the destination of the digital input. Using the keys you can select the destination among these:

- **NOT USED:** digital input is not used.
- **Rev.Speed Ref.:** the digital input (standard on DI1) controls the reversal of the motor direction.
- **Stage bit 0:** the digital input indicates the desired speed range. If the inversion of sign has not been activated, the meaning is as follows:
  - 0V: Selection STAGE 0 (Slow Range).
  - 24V: Selection STAGE 1 (Quick Range).
- **Check STAGE 0:** the digital input controls the effective closing of the remote control of the connections of stage 0 (i.e. slow range).

- **Check STAGE 1:** the digital input monitors the effective closing of the contactor of the connections of stage 1 (i.e. Quick Gamma).
- **Posit. Enable:** The digital input (standard on DI4) enables motor positioning at the selected position (see section "Positioner" on page 74).
- **Posit. BIT 0:** The digital input sets the "Bit 0" of the position selector to be reached with the positioner (see section "Positioner" on page 74).
- **Posit. BIT 1:** The digital input sets the "Bit 1" of the position selector to be reached with the positioner (see section "Positioner" on page 74).
- **Gain Selection:** the digital input (standard on DI3) switches the following parameters:
  - Analog input gain AI1 (see paragraph "An.Inp. X Gain" on page 41).
  - Proportional gain speed loop (see paragraph PID Speed Loop on page 53).
  - Integral gain speed loop (see paragraph PID Speed Loop on page 53).
 If the inversion of sign has not been activated, the meaning is as follows:
  - 0V: GAIN 1 selection (in the parameters written just above).
  - 24V: GAIN 2 selection (in the parameters written just above).
- **Jog Enable:** digital input (standard on DI2) enables motor jog operation. For the explanation of this function, please refer to the appropriate paragraph "JOG function" on page 71.
- **Spindle Lock:** the digital input enables the "spindle shaft locking" function. See paragraph 5.6.12 on page 73.
- **Disable Summ1:** The digital input controls the input of "deactivation sum 1" into the summing block (see paragraph 5.6.14 on page 75).
- **Disable Summ2:** The digital input controls the input of "deactivation sum 2" into the summing block (see paragraph 5.6.14 on page 75).

**NOTE:** If two or more different digital inputs are accidentally assigned to the same function, the one that has priority over the others is the one with the highest number (e.g.: input DI3 has priority over input DI1).

### Dig.Inp. X Sign

With this parameter you can select whether to reverse the read logical state from the associated digital input or to leave it as originally. The possible selections are:

- **NORMAL:** The "Value" signal indicates exactly the logical state of the associated digital input.
- **REVERSE:** The "Value" signal is logically reversed with respect to the logical state of the associated digital input.

See Drawing 17 for more clarity.

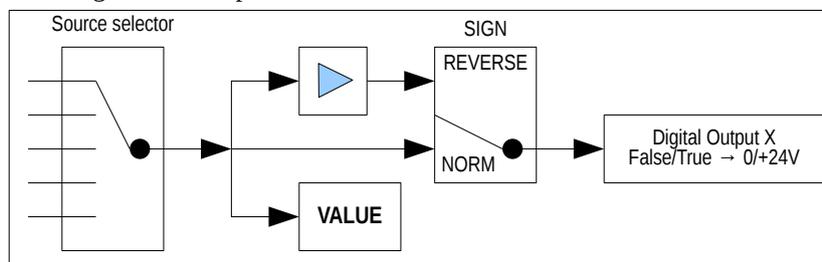
### Dig.Inp. X Value

Read-only parameter that indicates the logical state outgoing from the compensation block of the digital input. See Drawing 17 for more clarity.

## Digital outputs

Menu group to configure and calibrate digital outputs. For simplicity it is advisable to see the following figure showing the internal calibration structure of a generic digital output.

The logical status on the terminals of the digital output can be controlled by several selectable sources. The calibration block of the digital output after reading the value of the selected source allows you to select whether to send out the same selected logical state or to reverse it logically before transferring it to the output.



Drawing 18 Digital Output Structure

## Digital Output X

Menu group to configure the digital output X. Changes to the calibration values made in this group, act only on the indicated digital output and not on the others.

### Dig.Op. X source

Parameter that allows you to select the source of the digital output. Using the keys you can select the source from among these:

- **NOT USED:** the digital output is not used and the "Value" is always FALSE.

- ZERO SPEED: the digital output (standard on DO1) indicates when the motor is stationary.
- MOTOR BRAKE: the digital output controls the release of the motor brake.
- MOTOR TEMP: The digital output signals the intervention of the PTC probe mounted inside the motor and connected to the appropriate terminals of the drive (see paragraph "Connector X3" on page 14).
- DRIVE RUNNING: the digital output indicates that the drive is enabled and is running and therefore the motor is powered.
- DC BUS CHARGED: the digital output indicates that the DC BUS has reached the right voltage and that the precharge of the capacitors is finished.
- SPEED THRESH. 1: the digital output (standard on DO2) indicates that the motor has exceeded the speed set in threshold 1. To change the value of the threshold see paragraph "Speed threshold" on page 66.
- PEAK MOT. LOAD: the digital output (standard on DO3) indicates that the load on the motor is more than 90 % of the rated and that if it increases further the speed could drop.
- SPEED REACHED: the digital output indicates that the motor speed is the same as that required. For this report you can set a reporting tolerance with the parameter indicated in paragraph "Speed reached" on page 48.
- STAGE BIT 0: The digital output controls the switches to make the electronic gamma change (see section "Electronic gamma change" on page 67. The digital output signal shall be used to control a 24Vcc relay coil with exchange contact; the logical state of this output indicates:
  - 0V: Close the switch for Stage 0 (i.e. slow range).
  - 24Vcc: Close the switch for Stage 1 (i.e. Quick range).
- POSITION REACH: the digital output (standard on DO4) indicates that the required position has been reached. For this report you can set a reporting tolerance with the parameter indicated in paragraph "Position Window" on page 50. For more information see paragraph "Positioner" on page 74.

### **Dig.Op. X Value**

Read-only parameter that indicates the logical state of the selected source in the compensation block of the digital output. See drawing 18 for more clarity.

### **Dig.Op. X Sign**

With this parameter you can select whether to reverse the read logical state from the source of the block or to leave it as originally. The possible selections are:

- NORMAL: The digital output is identical to the logical state of the associated source.
- REVERSE: The digital output is logically reversed with respect to the logical state of the associated source

See Drawing 18 for more clarity.

## **Diagnostic**

Menu group with read-only parameters for diagnostics or other information.

### **Speed Demand**

It indicates the percentage value of the reference that exits the ramp block and enters the speed loop as a speed setpoint. For more information see drawing 20 on page 53 with the speed loop scheme.

### **Speed Error**

It indicates the percentage value of the difference between the speed setpoint and the actual motor speed.

### **Speed Feedback %**

It indicates the percentage value of the actual motor speed relative to the maximum set on the parameter "Maximum speed" (see page 37).

### **Speed Feedback RPM**

Indicates the value in revolutions per minute of the actual motor speed.

### **Motor frequency**

Indicates the current frequency of the supply voltage on the motor.

### **Motor load**

Indicates the percentage value of the load on the motor. A value very close to 100 % indicates that the load on the motor is excessive and that it must be reduced in order not to lose speed.

### **Motor voltage %**

It indicates the percentage value of the motor's supply voltage relative to the maximum possible with the power supply voltage present on the DC BUS.

### **Motor voltage V**

Indicates the power supply voltage of the motor in Volt.

## Motor torque

Indicates the percentage value of the torque delivered by the motor. Remember that the nominal torque can only be delivered up to the rated speed; beyond that point the torque decreases due to field weakening of the motor.

## DC Bus Voltage

Indicates the voltage in Volt of the DC BUS inside the drive. This value depends on the three-phase supply voltage (if powered on terminals L1, L2, L3) and can be calculated using the following formula:

$$V_{BUS} = V_{LINE} \cdot \sqrt{2} \quad \left| \begin{array}{l} V_{LINE} = \text{Power supply voltage on L1, L2, L3 (Vac)} \\ V_{BUS} = \text{DC BUS voltage (on DC+ and DC- terminals) (Vdc)} \end{array} \right.$$

## Heat Sink Temp

Indicates the temperature in degrees centigrade of the heat sink inside the drive. This temperature must be below 75 °C otherwise the drive goes in block indicating the anomaly on the display. If the temperature tends to be too high, the causes may be due to lack of ventilation.

## Capacitor Temp

Indicates the temperature in degrees centigrade of the capacitors inside the drive. This temperature must be below 60 °C otherwise the drive goes in stop indicating the anomaly on the display. If the temperature tends to be too high, the causes may be due to the lack of ventilation or the need to mount an additional set of external capacitors due to the type of use done with the drive (ALTER module 13/007).

## DSP Temp

Indicates the temperature in degrees centigrade of the DSP that controls the drive. This temperature must be below 70 °C otherwise the component can be damaged. In case of higher temperature, contact the ALTER Technical Office.

## Transducer board

Menu group grouping some parameters to control the optional transducer card type and the status of the connected transducer.

### Transducer board for

Indicates the type of transducer that can be connected to the X14 connector.

### Firmware version major

Larger version number of the optional transducer card that is installed inside the drive.

### Firmware version minor

Minor version number of the optional transducer card that is installed inside the drive.

### Resolver signal

Indicates the status of the voltage signal coming from the connected resolver on X14. The available statuses are:

- LOW: The resolver's signal is low. Rotate the trimmer next to the X14 connector in the hourly direction.
- OK: The resolver's signal is correct.
- HIGH: The resolver's signal is high. Rotate the trimmer next to the X14 connector in the anticlockwise direction.

### SinCos signal A and B

Indicates the status of the voltage signal coming from SinCos or EnDat connected to X14 pin 3-4-6-7. The available statuses are:

- LOW: The transducer signal is low. The cable or wires could be interrupted or short-circuited.
- OK: The transducer signal is correct.
- HIGH: The transducer signal is high. The transducer may not be compatible or the connections are wrong.

### SinCos signal C and D

Indicates the state of the voltage signal coming from SinCos connected to X14 pin 19-20-21-22. The available statuses are:

- LOW: The transducer signal is low. The cable or wires could be interrupted or short-circuited.
- OK: The transducer signal is correct.
- HIGH: The transducer signal is high. The transducer may not be compatible or the connections are wrong.

### Man Offset Calc

This menu appears only with the optional boards for SinCos (01/325), phonic Wheel (01/326), EnDat (01/327).

With the drive disabled (Led RUN off) you can change the parameter in ENABLED, to activate the calibration function automatically the offset of the incremental sinusoidal signal of the encoder.

For the calibration procedure, see the explanation of paragraph "5.5.5 " on page 65.

### Serial comm. status

Indicates the status of the serial connection of the EnDat encoder connected to X14 pin 9-10-11-12. The available statuses are:

- **FAULT:** serial communication problem with the encoder. Check the status of the wires and connections on X14 pin 9-10-11-12, the shielding of the cable, the presence of noise sources near of the cable.
- **OK:** The signal from the transducer is correct.

### Internal alarm status

Indicates the state of the internal alarms of the EnDat encoder connected to X14. The available statuses are:

- **FAULT:** the encoder reports an internal failure. Replace the encoder with a working one.
- **OK:** the encoder has no faults.

### Compatible encoder

Whether the EnDat encoder connected to X14 is compatible with the 01/327 card. The available statuses are:

- **NO:** the encoder isn't compatible. Check the 5.5.4 page paragraph 63 with the list of compatible encoders.
- **YES:** the encoder is compatible.

## Advanced Setup

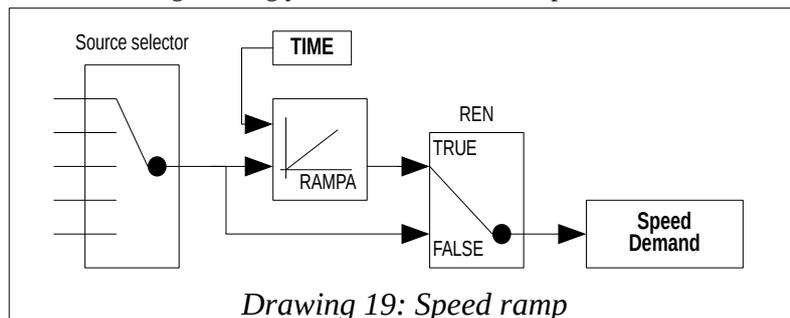
Menu group for advanced configurations. Normally these parameters do not serve for normal use of the drive and the variation of these can cause adjustment instability or make the motor speed control characteristics worse. Before changing the parameters of this menu group it is necessary to know the product in depth or contact the ALTER technical office for advice and possible clarifications.

### Alter Menu

Password protected menu for internal use. It is not recommended to try to access this menu because the modification of these parameters can cause internal damage of the drive with consequent need of repair.

### Speed Ramp

Menu group for adjusting the parameters of the speed ramp that can be inserted with the external command "REN" (see paragraph "Connector X12" on page 19). In the following drawing you can see how the ramp block is structured.



### Ramp Source

Parameter that allows you to select the source of the ramp and then the origin of the speed reference. Using the keys you can select the source from among these:

- **NOT USED:** the speed reference is always fixed at zero.
- **ANALOG INPUT 1:** the speed reference is taken from the analog input 1. The parameter "Value " relative to this analog input becomes the source of the ramp block.
- **DIGITAL REFER:** the speed reference is a digital value that can be set manually for testing or calibrating the motor. This reference can also be digitally provided by a communication network (CAN BUS or other). To manually change this value, see paragraph "Digital Refer." just below.
- **SumBlock Summ1:** The speed reference is taken from the "Summ1 " output of the summing block (see paragraph 5.6.14 on page 75).
- **SumBlock Summ2:** The speed reference is taken from the "Summ2 " output of the summing block (see paragraph 5.6.14 on page 75).
- **SumBlock Summ3:** The speed reference is taken from the "Summ3 " output of the summing block (see paragraph 5.6.14 on page 75).

### Speed Ramp Time

Minimum	Maximum	Units of measure
0.1	650.0	Sec

Parameter to set the up/down time of the speed ramp. Assuming an input of 0 to 100 % of the value is given, this parameter is defined as the time it takes ("Speed Demand ") to go from 0 % to 100 %.

Therefore if the input step goes from 0 % to 50 % it will mean that the time taken to finish the ramp will be half the time set on this parameter.

## Digital Refer.

Minimum	Maximum	Units of measure
-100.00 %	+100.00 %	-

With this parameter you can give a digital speed reference to the drive. This value can be changed manually via the keyboard or modified via a communication network (CAN BUS or other).

## Aux Function

Menu group with parameters to adjust the auxiliary functions implemented within the drive.

## Speed Threshold

Menu group with parameters to adjust the speed thresholds that generate a signal for the outside.

### Threshold No. 1

Minimum	Maximum	Units of measure
0	9999	RPM

Set the speed of the motor beyond which the associated digital output is switched.

## Speed reached

Minimum	Maximum	Units of measure
0.0 %	+10.0 %	-

Set the percentage difference between the set speed and the actual motor speed, to switch the digital output associated with the "Speed reached" function.

## Zero speed thr.

Minimum	Maximum	Units of measure
1	50	RPM

Set the speed threshold below which the motor is considered "stop " and signals the output "Stop motor " (see paragraph 5.6.1 on page 65). Normally with the standard parameter you get the best results, but in case of need it is possible to increase it.

## Drive Stop/Run

Menu group with parameters to set the "Stop/Run " function of the motor by controlling the digital input "DEN " (see page 19). Under standard conditions, the DEN input enables and disables the drive but does not brake the motor; the reference and DEN control must be managed by the CNC or the PLC to bring the motor up to zero speed. Instead, using the following parameters you can change the DEN input function and make sure that, when this input is removed, the motor brakes until it stops and then disables the drive.

## Den Function

With this menu you can change the operation of the DEN digital input. The possible settings are:

- **DRIVE DIS/ENAB:** This is the standard mode. When the DEN input is at the logical level "1 " the drive is enabled and follows the set speed reference; when it is logically "0 " the drive is disabled and remains free, so it stops by inertia if the speed reference has not been reset when enabled.
- **DRIVE STOP/RUN:** This is a new mode that allows you to stop the motor before disabling the drive. When the DEN input is at the logical level "1 " the drive is enabled and follows the set speed reference. When "0 " is logical, the drive brakes by following the speed ramp, if it is active (see REN input on page 19 and menu "Speed Ramp Time" on page 40), or by blocking the motor with the maximum available current (emergency brake) if the ramp is disabled. When the motor is stationary or when the maximum time set in the next parameter is exceeded, the drive is disabled.

## Motor Stop Time Max

Minimum	Maximum	Units of measure
0	65.5	Sec

Set the maximum time available to stop the motor with the DEN input, if the "Drive Stop/Run " operation has been selected (see previous parameter). This time starts as the speed ramp has reached Zero and serves as a safety in case for some reason the motor fails to slow down until it stops. After the set time the drive disables and the motor stops by inertia (or with a mechanical brake).

## Elec. Gear Change

Menu group with parameters to adjust the electronic gamma change function (see section "Electronic gamma change" on page 67).

## Stage Function

This menu is used to enable the "electronic gamma change " function. The possible selections are as follows:

- **DISABLED:** The function is deactivated. The drive works with only one set of parameters.

- **ENABLED:** The function is activated. The drive can switch a set of parameters based on the selected range with the appropriate digital input (see section "Electronic gamma change" on page 67).

### Selected Gear

This menu only appears if the "Stage Function " function is activated and indicates which speed range is currently selected with the digital input. The possible indications are as follows:

- **STAGE 0:** The STAGE 0 parameter group that corresponds to the SLOW speed range is activated. The digital output will also be controlled to activate the right contactor and controlled the actual closure.
- **STAGE 1:** The STAGE 1 parameter group that corresponds to the speed range FAST is activated. The digital output will also be controlled to activate the right contactor and controlled the actual closure.

### Copy from Stage 0

This menu is used to copy parameters from the Stage 0 range (Slow Range) to the range that is currently selected.

To start copying the parameters from Stage 0 you have to follow these points:

1. Using the buttons on the front, reach the "Copy from Stage 0 " menu.
2. In the bottom line is the words "UP to confirm ". Press the "▶" button to enter the "change parameter" mode.
3. The "→" character appears in the lower left corner of the display. At this point press "▲" (i.e. UP).
4. Start the copying phase indicated by the inscription "Wait... ". At the end appears the inscription "OK " indicating that the operation is finished correctly.
5. At this point, you can press "◀" to confirm and exit the "Edit Parameter "mode. The parameters of the currently selected Stage (see "Selected Gear " Menu) were overwritten by those of Stage 0.

### Check Contactors

This menu is used to enable the function to control the effective closing of the power switches on the connections of the motor. Normally this function is enabled to make it safer, but if the digital inputs are not available then you can turn it off but the user must make sure that the drive is not enabled if the switches have not been closed. The possible selections are as follows:

- **DISABLED:** Digital inputs with the "Check STAGE " function are not used and are therefore available for other functions. The drive cannot know if contactors work regularly, so they must be checked by the PLC or CNC before enabling the drive.
- **ENABLED:** Digital inputs with the "Check STAGE " function are used to control the effective closing of the switches for the STAGE 0 or STAGE 1 connection. If this does not happen correctly, the drive does not enable and signals an alarm message on the display.

### Ext Torque Limit

Menu group with parameters to adjust the external torque limit function (see section "limit" on page 70).

#### Torque Limit

This menu is used to enable the maximum torque limitation function provided by the motor. The possible selections are as follows:

- **DISABLED:** The torque limit is fixed at the maximum value and cannot be modified from the outside.
- **ENABLED:** The torque limit varies with a value proportional to the selected analogue reference or the value of the parameter "Limit Setpoint ".

#### Limit Setpoint

Minimum	Maximum	Units of measure
0.0	+100.0	%

This parameter limits the torque delivered by the motor and can be changed manually using the LCD display and keypad, or can be modified from the outside with a selectable analog input.

#### Limit Output

This menu indicates the current torque limit value as a percentage of the motor maximum. When the maximum torque limitation function is deactivated, this parameter remains fixed at 100 %, otherwise it indicates the currently valid limit value.

### Anti Backlash

Menu group with parameters to enable and adjust the anti backlash function with two drives (see section "Anti-backlash system" from page 71).

#### AntiBack Mode

This menu is used to enable the "anti backlash" function and to select the drive mode: operation from "Master" motor or "Slave" motor. The possible selections are as follows:

- **DISABLED:** The "anti-backlash" function is disabled and the drive normally works as a single motor.
- **MASTER 1:** The "anti-backlash" function TYPE 1 is active and the drive works as a MASTER motor. All references and commands coming from the CNC or PLC will be connected to this drive.

- SLAVE: The “anti-backlash” function is active and the drive works as a SLAVE motor. Only signals from the motor transducer and the connection cable to the master drive must be connected to this drive.
- MASTER 2: The “anti-backlash” function TYPE 2 is active and the drive works as a MASTER motor. All references and commands coming from the CNC or PLC will be connected to this drive.

### Contrast Torque

Minimum	Maximum	Units of measure
0.0	+50.0	%

This menu appears only in the “Master” drive. The parameter is used to set the contrast torque in anti-backlash mode with a value proportional to the maximum torque that can be delivered from the motor to the current speed. Normally a value between 5 and 30 % is used.

### Slave Running

This menu appears only in the “Master” drive. The parameter is used to enable or disable the operation of the motor “Slave” and you can only change it when the master drive is disabled. Normally it is set to "Enabled" and automatically returns to this setting each time you drop voltage to auxiliary services or when you switch the ”AntiBack Mode“ parameter (see page 49). The purpose of this parameter is to allow the master motor to run even when it is not mechanically connected to the slave motor, when you want to optimise the adjustment loops.

### Net Errors

This menu is used to disable the control of any short communication errors between master and slave. If the alarm appears during operation Anti backlash data error (see page 77) the cause may be due to disturbances that are generated by unshielded cables or other equipment nearby on the twisted double of the communication bus.

Disabling error control on the communication bus shall not affect the safety of operation: in fact, other controls are still active that come into operation if the communication between master and slave is interrupted or that the data exchanged is not consistent within a time of 1 ms.

If, despite the disabling of these controls, the alarm "Anti backlash data error“ continues to appear, then it is necessary to make sure that the disturbances are reduced.

### Position Loop

Menu group with parameters relative to the position loop that is activated with the input assigned to the “Position Zero ” function.

#### It's Proport. Gain

Minimum	Maximum	Units of measure
0	9.000	-

This parameter modifies the response speed to the angular position change when positioning the motor shaft is controlled. Too high a value can create instability and vibration; in this case try to reduce it until you get the right positioning but without oscillations.

#### Integr. Gain

Minimum	Maximum	Units of measure
0	2.0000	-

This parameter modifies the accuracy with which the motor reaches the controlled position. Too high a value can create instability and vibration; in this case try to reduce it until you get the right positioning but without oscillations. In most cases the standard value is sufficient; in some cases it may be better to set it to the ZERO value.

#### Position Speed

Minimum	Maximum	Units of measure
10	999	RPM

This parameter modifies the motor’s maximum rotation speed during the positioning phase. A higher value makes the positioning more “nervous ” and stressful for the mechanics but could trigger vibrations or inability to position correctly if the motor inertia is high.

#### Position Window

Minimum	Maximum	Units of measure
0	2.00	Degrees

With this parameter you set a tolerance on the position to be reached to signal on a digital output the signal of “Position reached ”.

## Current Position

This parameter indicates the current position of the transducer in degrees and cents of degree. The actual resolution depends on the type of transducer mounted in the motor and the resolution of it. This parameter can be useful to read the position and then set it to one of the 4 available quotas and then command positioning.

**NOTE:** In case of use of a multipolar resolver (from 4 poles upward), the indicated position is **NOT** the actual position of the motor shaft, but that of the sinusoid currently generated by the resolver. For example, if a 6-pole resolver is used, it generates 3 complete sinusoids for each revolution of the transducer; so for every revolution of the motor shaft you will see on this parameter a signal that goes 3 times from 0 to 360°.

### Position 0

Minimum	Maximum	Units of measure
-180.00	180.00	Degrees

Set the position to reach and maintain the motor shaft when "quota 0" is selected and motor positioning enabled.

**NOTE:** This value can be changed via an analog input connected to Connector X11 (see page 17) after selecting this parameter as the destination (see parameter "An.Inp. X dest" on page 41).

### Position 1

Minimum	Maximum	Units of measure
-180.00	180.00	Degrees

Set the position to reach and maintain the motor shaft when "quota 1" is selected and motor positioning enabled.

### Position 2

Minimum	Maximum	Units of measure
-180.00	180.00	Degrees

Set the position to reach and maintain the motor shaft when "quota 2" is selected and motor positioning enabled.

### Position 3

Minimum	Maximum	Units of measure
-180.00	180.00	Degrees

Set the position to reach and maintain the motor shaft when "quota 3" is selected and motor positioning enabled.

## Jog Function

Set of parameters to adjust the function of JOG (see paragraph "JOG function" on page 71).

### Jog ref. Mode

With this parameter you can select the mode of the Jog function. The possible selections are as follows:

- **FIXED REFER:** When you enable the Jog function with the selectable input (standard on DI2), the motor rotates at a fixed speed that is set to the parameter "JOG ref. Speed". When you disable the Jog function with the digital input, the motor "locks" the normal speed reference.
- **SQUARE WAVE:** When you enable the Jog function with the selectable input (standard on DI2), the function generates a "Square Wave" with a period that can be set in the parameter "JOG wave Time" and with an amplitude of  $\pm$  the speed set in the parameter "JOG ref. Speed"; so the motor rotates at the speed set for a certain time and then reverses the direction and turns backwards and continues in this way until the JOG control is removed.
- **TRIANGULAR WAVE:** When you enable the Jog function with the selectable input (standard on DI2), the function generates a "Triangular Wave" with a period that can be set in the "JOG wave Time" parameter and with an amplitude of  $\pm$  the speed set in the parameter "JOG ref. Speed"; therefore the motor gradually accelerates to the speed set with the set time and then slows down gradually until it reverses the direction and reaches the set speed (inverted sign). Then it slows down again and continues like this until the JOG command is removed.

### Jog wave Time

Minimum	Maximum	Units of measure
0.1	25.0	Seconds

This parameter sets the period of the waveform that has been selected with the "JOG ref. Mode" menu.

### Jog ref. Speed

Minimum	Maximum	Units of measure
-999	+999	RPM

This parameter sets the speed (and direction) of the motor during JOG operation. When using “Fixed ” jog mode, you can change the direction of the motor by reversing the sign of this parameter. Instead, when using a waveform to move the motor, this parameter is taken as “absolute value ”, therefore without a sign.

The maximum absolute value of this parameter is however limited to the maximum motor speed set in the parameter "Maximum speed“ (see page 37).

### Motor overtemp

Set of parameters to set the signal or block of the drive in case of overheating of the motor. For further explanations see paragraph "Motor temperature“ on page 65.

### Signal Mode

With this parameter you set the type of signal you want to do when the motor overheats. The motor temperature control is carried out with a PTC sensor installed inside the motor. The possible selections are as follows:

- **DIG.OUT ONLY:** This is the standard setting that was made to have compatibility with previous versions. In this case, when the motor PTC contact opens (overheated motor), the drive does NOT DO NOT NULL and continues to operate regularly at infinite time. On a selectable digital output (see paragraph "Dig.Op. X source“ on page 44) you can send a signal to the CNC or PLC so that it can make the necessary decisions for this anomaly: stop the machining or continue for a certain time.
- **DRIVE FAULT:** By setting this mode the drive can disable the operation and signal the anomaly outside. As soon as the motor PTC contact opens (overheated motor) the drive causes a signal to appear on the display (see message "Warning!!! Motor Overtemp.“on page 83) and indicates on a selectable digital output (see section "Dig.Op. X source“ on page 44) the overheating of the motor, but continues to operate regularly. From that moment the CNC or PLC must decide whether to stop the machine or continue the machining; After the time set in the “Drive FLT delay ” parameter, the drive locks and disables the motor, signaling the alarm "Motor Overtemperature“ and bringing to the logical level "0" the digital output "DOK ".

### Drive FLT delay

Minimum	Maximum	Units of measure
0	120	Minutes

This parameter sets the delay with which the drive crashes to protect the motor’s overheating. This delay starts when the PTC sensor installed in the motor opens; when the delay is over, the drive will disable and the motor stops by inertia. The display of the drive displays the alarm "Motor Overtemperature“ and the digital output "DOK" is brought to the logical level "0 ".

### Summing block

Group of parameters to verify the value of inputs and outputs from the summation function (see paragraph 5.6.14 on page 75).

#### Input 1

Minimum	Maximum	Units of measure
-100,00	+100,00	%

Percentage value of input 1 of the summing block. This number follows the associated analog input signal via the appropriate I/O analog input configuration menu.

#### Input 2

Minimum	Maximum	Units of measure
-100,00	+100,00	%

Percentage value of input 2 of the summing block. This number follows the associated analog input signal via the appropriate I/O analog input configuration menu.

#### Input 3

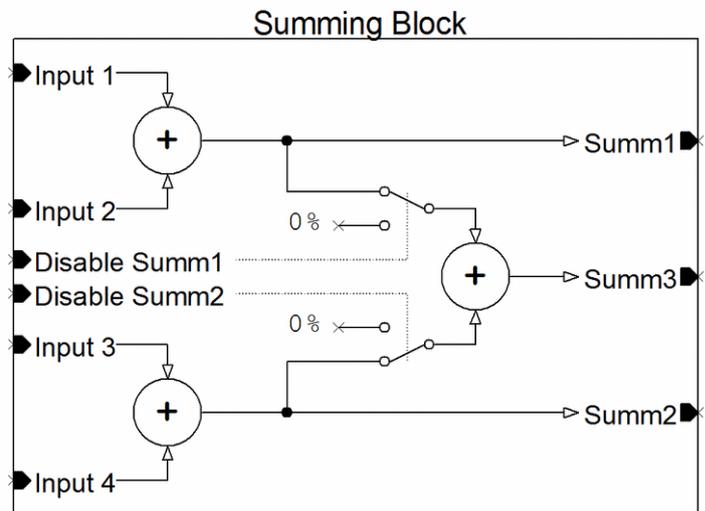
Minimum	Maximum	Units of measure
-100,00	+100,00	%

Percentage value of input 3 of the summing block. This number follows the associated analog input signal via the appropriate I/O analog input configuration menu.

#### Input 4

Minimum	Maximum	Units of measure
-100,00	+100,00	%

Percentage value of input 4 of the summing block. This number follows the associated analog input signal via the appropriate I/O analog input configuration menu.



### Output Summ1

Minimum	Maximum	Units of measure
-100,00	+100,00	%

Percentage value of the summation output 1 of the summing block. This number represents the sum of entry 1 and entry 2.

### Output Summ2

Minimum	Maximum	Units of measure
-100,00	+100,00	%

Percentage value of the summation output 2 of the summing block. This number represents the sum of entry 3 and entry 4.

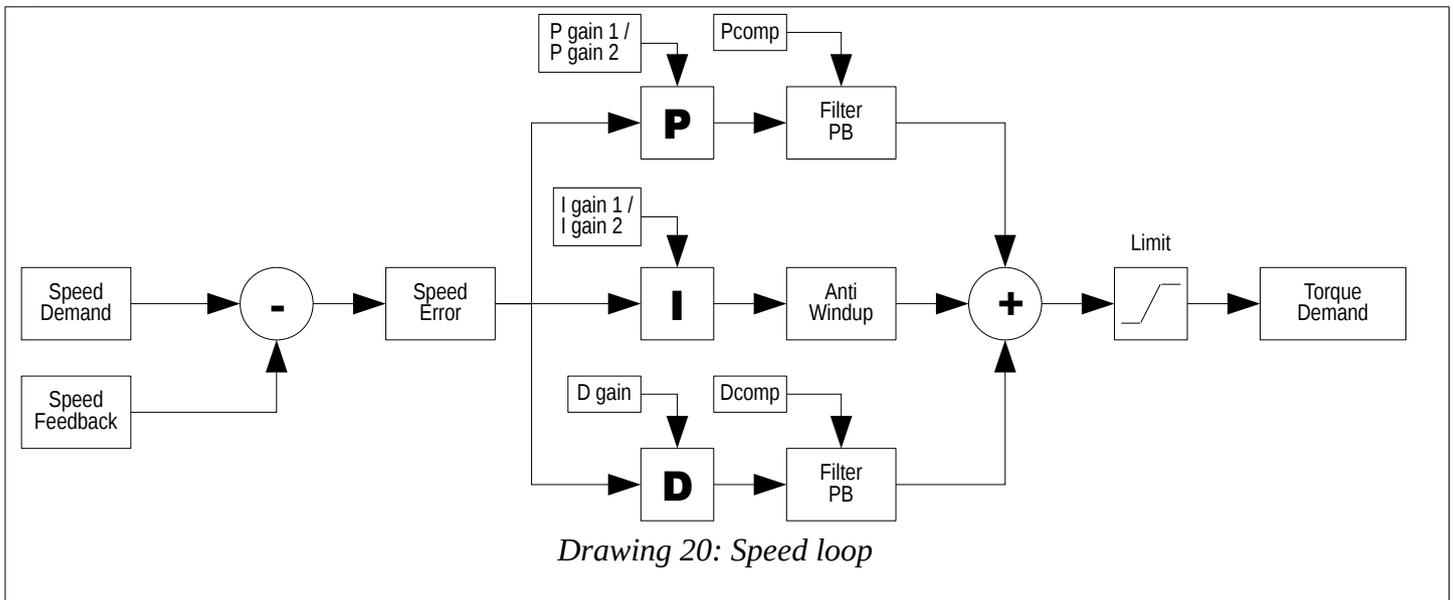
### Output Summ3

Minimum	Maximum	Units of measure
-100,00	+100,00	%

Percentage value of the summation output 3 of the summing block. This number represents the sum of the summation output 1 and the summation output 2 (if they have not been deactivated with the digital input).

### PID Speed Loop

Set of parameters to adjust the time constants of the PID adjustment loop on the speed.



**NOTE:** random change in these parameters can lead to a worsening of the drive's performance. It is advisable not to change these values unless strictly necessary and possibly to contact the ALTER technical office for explanations and clarifications. Please note that it is possible to return the parameters to the value prior to the change simply by removing the voltage from the services and then returning it or using the "Restore" menu (see page 40), always allowed to NOT have already saved the parameters with the "Memo Parameters" menu (see page 40).

### Proport. Gain 1 / 2

Minimum	Maximum	Units of measure
0	999.00	-

This parameter modifies the Proportional time constant of the speed loop (see drawing 20). Increasing this value makes the motor speed more precise than the reference from the outside, but the loop can become unstable (you can hear the motor vibrate). Conversely, by decreasing this parameter the motor is more stable but becomes slower in following the speed reference that is given from the outside.

It is recommended to change this parameter in small steps and test the motor reaction before further changes. When you have found the right parameter that meets your needs, you can memorise the variations with the "Memo Parameters" menu (see page 40) and not before; in this way it will always be possible to return to the previous situation.

**NOTE:** To select the gain in use (Gain 1 or Gain 2) the digital input to "Gain Selection" is used; the Gain 1 is used if the input that controls the switching of the gain is at level 0, instead the Gain 2 is used if it is level 1. The digital input that controls switching is set in the "Dig.Inp. X Dest" menu (see page 43); Under standard conditions this input is the DI3.

### Filter PB Pcomp

Minimum	Maximum	Units of measure
0 %	100.00 %	-

This parameter modifies the time constant of the Low Pass filter that is outgoing the P component of the speed loop (see drawing 20). Increasing this value moves to higher frequencies the cut point of the filter; conversely, by decreasing the value, the cutting frequency is moved to lower frequencies.

In practical use it can be seen that a high value (i.e. around 100 %) makes the filter transparent, i.e. as if it were not there. Instead, reducing the value makes the motor movement more "soft" and with less noise due to adjustment. In certain situations it is possible to increase the value of the proportional gain and insert this filter to make the loop stable.

### Integr. Gain 1 / 2

Minimum	Maximum	Units of measure
0	99.00	-

This parameter modifies the Integrative time constant of the speed loop (see drawing 20). Increasing this value makes the motor's reaction to speed variations faster, but the loop can become unstable (you can hear the motor vibrating). The adjustment of this parameter brings benefits especially at low speeds or with a power stationary grip.

It is recommended to change this parameter in small steps and test the motor reaction before further changes. When you have found the right parameter that meets your needs, you can memorise the variations with the "Memo Parameters" menu (see page 40) and not before; in this way it will always be possible to return to the previous situation.

**NOTE:** To select the gain in use (Gain 1 or Gain 2) the digital input to "Gain Selection" is used; the Gain 1 is used if the input that controls the switching of the gain is at level 0, instead the Gain 2 is used if it is level 1. The digital input that controls switching is set in the "Dig.Inp. X Dest" menu (see page 43); Under standard conditions this input is the DI3.

### Gain scale

Minimum	Maximum	Units of measure
0,1	99,9	%

This parameter is displayed only in "Async.HighSpd" mode (see parameter "Motor Type" on page 35), and is used to scale the additional gain of the speed loop when the motor runs at a frequency above the rated one (parameter "Nominal Frequency" on page 36). When the inverter is set to "Async.HighSpd" mode and the motor is running at high speed if you notice a speed instability (pecking after a change) then you have to reduce this value. Conversely, if you want more accuracy of response and the motor can respond well, you can increase the value.

**Example:** If this parameter is set to 10 % it means that at high speed the additional component (parameter "Speed loop int. 1 / 2") will have a value of 10 % compared to the number set in its parameter.

### Derivative. Gain

Minimum	Maximum	Units of measure
0	999.00	-

This parameter modifies the derivative time constant of the speed loop (see drawing 20). Increasing this value tends to anticipate the motor's reaction to changes in speed, but the loop can become unstable (you can hear the motor vibrate). Changing this parameter can be useful in a few cases; generally it is possible to obtain a good functioning of the regulation by modifying appropriately the Proportional and the Integrative parameter.

It is recommended to change this parameter in small steps and test the motor reaction before further changes. When you have found the right parameter that meets your needs, you can memorise the variations with the "Memo Parameters" menu (see page 40) and not before; in this way it will always be possible to return to the previous situation.

### Filter PB DComp

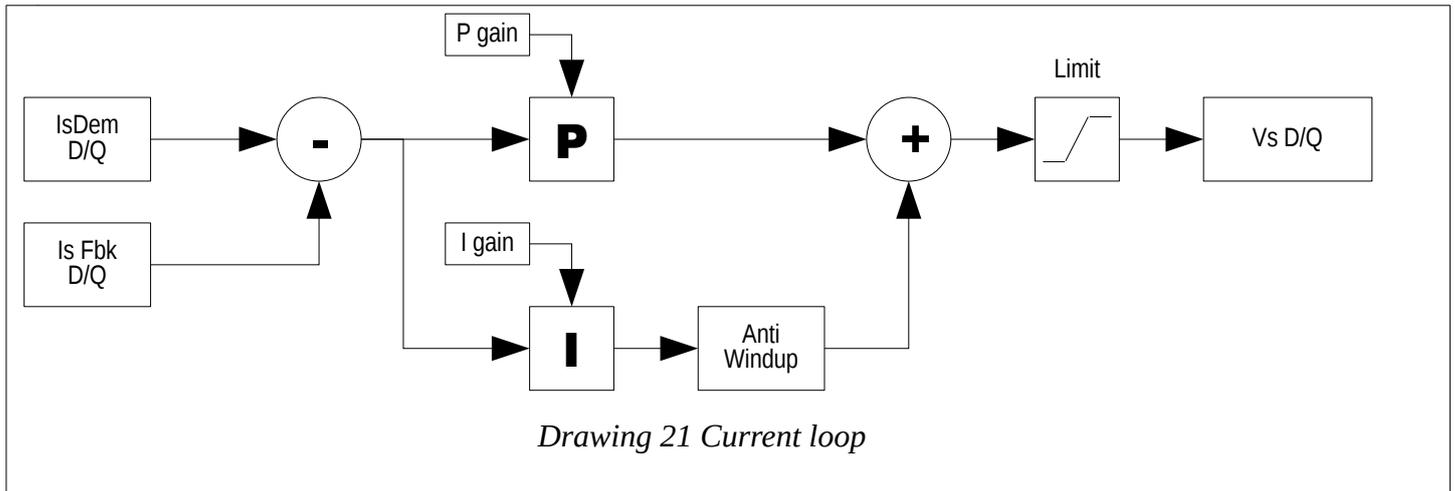
Minimum	Maximum	Units of measure
0 %	100.00 %	-

This parameter modifies the time constant of the Low Pass filter that is outgoing the D component of the speed loop (see drawing 20). Increasing this value moves to higher frequencies the cut point of the filter; conversely, by decreasing the value, the cutting frequency is moved to lower frequencies.

In practical use it can be seen that a high value (i.e. around 100 %) makes the filter transparent, i.e. as if it were not there. Instead, reducing the value makes the motor movement more "soft" and with less noise due to adjustment. When there is a need to increase the gain of the D component, then it is also advisable to go down with the cutting frequency of this filter (i.e. reduce the value) to make the operation quieter.

### Pi Current Loop

Set of parameters to adjust the time constants of the PI adjustment loop on the current.



**NOTE:** random change in these parameters can lead to a worsening of the drive’s performance. It is advisable not to change these values unless strictly necessary and possibly to contact the ALTER technical office for explanations and clarifications. Please note that it is possible to return the parameters to the value prior to the change simply by removing the voltage from the services and then returning it or using the ”Restore“ menu (see page 40), always allowed to NOT have already saved the parameters with the ”Memo Parameters“ menu (see page 40).

**Proport. Gain**

Minimum	Maximum	Units of measure
0	99.00	-

This parameter modifies the Proportional time constant of the current loop (see drawing 21). The modification of this parameter is useful in case of stop of the drive due to the “Overcurrent” alarm; in this case it means that the adjustment is too fast (or too slow) and the current is not properly controlled by the above alarm. To enter the right parameter it is essential to use the PC connected to the serial port of the drive and use the software to display the signals of the current loop while the motor is working and decide what to do.

It is recommended to change this parameter in small steps and test the motor reaction before further changes. When you have found the right parameter that meets your needs, you can memorise the variations with the ”Memo Parameters“ menu (see page 40) and not before; in this way it will always be possible to return to the previous situation.

**Integr. Gain**

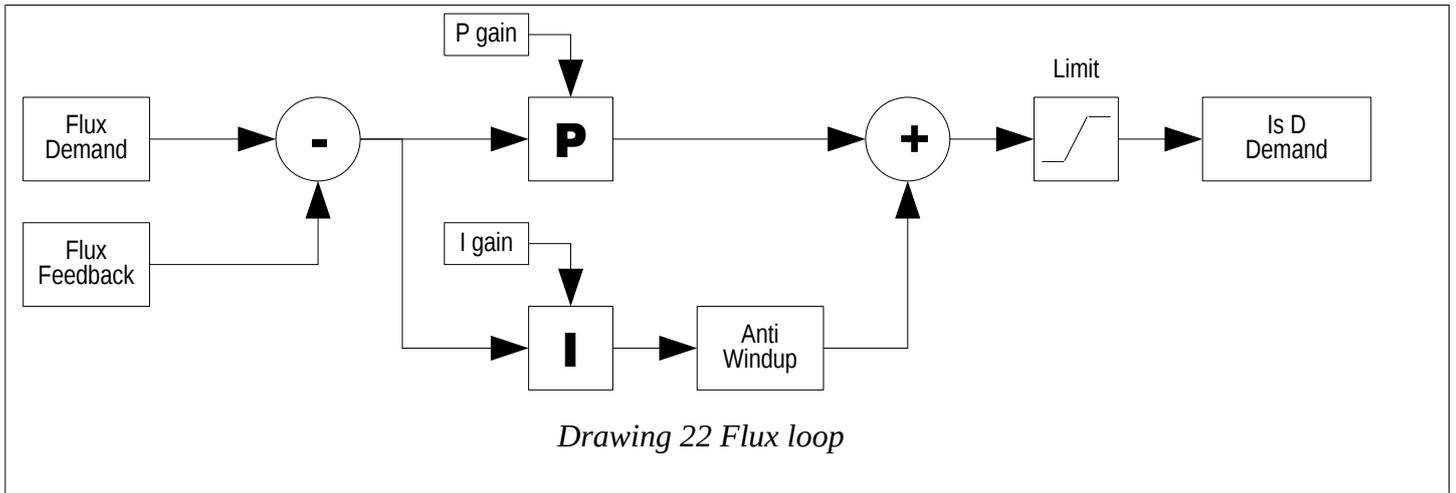
Minimum	Maximum	Units of measure
0	99.00	-

This parameter modifies the Integrative time constant of the current loop (see drawing 21). The modification of this parameter is useful in case of stop of the drive due to the “Overcurrent” alarm; in this case it means that the adjustment is too fast (or too slow) and the current is not properly controlled by the above alarm. To enter the right parameter it is essential to use the PC connected to the serial port of the drive and use the software to display the signals of the current loop while the motor is working and decide what to do.

It is recommended to change this parameter in small steps and test the motor reaction before further changes. When you have found the right parameter that meets your needs, you can memorise the variations with the ”Memo Parameters“ menu (see page 40) and not before; in this way it will always be possible to return to the previous situation.

**Pi Flux Loop**

Set of parameters to adjust the time constants of the control loop PI of the motor flow.



**NOTE:** random change in these parameters can lead to a worsening of the drive’s performance. It is advisable not to change these values unless strictly necessary and possibly to contact the ALTER technical office for explanations and clarifications. Please note that it is possible to return the parameters to the value prior to the change simply by removing the voltage from the services and then returning it or using the "Restore" menu (see page 40), always allowed to NOT have already saved the parameters with the "Memo Parameters" menu (see page 40).

**Proport. Gain**

Minimum	Maximum	Units of measure
0	99.00	-

This parameter modifies the Proportional time constant of the flow loop (see drawing 22). It may be necessary to change this parameter when the motor runs at speeds higher than its nominal plate speed and then it is weakened field. To enter the right parameter it is essential to use the PC connected to the serial port of the drive and use the software to display the signals of the flow loop while the motor is working and decide what to do.

It is recommended to change this parameter in small steps and test the motor reaction before further changes. When you have found the right parameter that meets your needs, you can memorise the variations with the "Memo Parameters" menu (see page 40) and not before; in this way it will always be possible to return to the previous situation.

**Integr. Gain**

Minimum	Maximum	Units of measure
0	99.00	-

This parameter modifies the Integrative time constant of the flow loop (see drawing 22). It may be necessary to change this parameter when the motor runs at speeds higher than its nominal plate speed and then it is weakened field. To enter the right parameter it is essential to use the PC connected to the serial port of the drive and use the software to display the signals of the flow loop while the motor is working and decide what to do.

It is recommended to change this parameter in small steps and test the motor reaction before further changes. When you have found the right parameter that meets your needs, you can memorise the variations with the "Memo Parameters" menu (see page 40) and not before; in this way it will always be possible to return to the previous situation.

**Drive setup**

Set of parameters to adjust or activate some particular functions in the drive that are rarely used.

**Emulated encoder**

Set of parameters to adjust the type of emulated encoder to be generated on the X4 and X5 connectors. The emulated encoder is only available if you use a transducer connected to the X14 connector.

**ATTENTION:** in case of use with a resolver connected to the X14 connector you will get the number of PPRs set for each "electric revolution" of the resolver and consequently a zero pulse (Z channel). This means that using a multipolar resolver (2 or more polar pairs) you will get a zero pulse for each revolution of the motor equal to the number of polar pairs of the resolver. The same situation is valid for the obtained PPRs that will be multiplied by the number of resolver pole pairs.

**Encoder resol.**

Minimum	Maximum	Units of measure
8	8192	PPR

The selected number indicates the number of "pulse/revolution" (ppr) of an encoder equivalent to tracks A, B and Z.

### Position offset

Minimum	Maximum	Units of measure
-180	+180	degrees

This parameter allows to offset the position of the simulated encoder with respect to the true position of the motor.

### Direction

With this parameter you can reverse the count direction of the simulated encoder. The possible selections are as follows:

- NORMAL: positive direction
- REVERSE: negative direction.

### Torque filter

In this menu you can activate or disable a special filter inserted after the speed loop that allows to reduce vibrations due to speed transducers not perfectly calibrated and undulating in resolver transducers.

### Power supply from

Menu to select the source of the power supply (**only for model PWM3D-001**). The selections available are:

- DC+ DC-: The voltage is given directly on the DC+ and DC- terminals by an external power supply which must precharge the capacitors on the DC Bus and check the voltage so as not to exceed the maximum accepted by the drive (750Vcc) using a clamp circuit or an in-line recovery system. The internal clamp circuit is NOT used.
- L1-L2-L3: The voltage is given on the terminals L1, L2, L3 and the internal rectifier bridge is used. The drive performs the precharge of capacitors on the DC Bus when it receives the input voltage. When the voltage on the DC Bus exceeds a certain threshold, the Clamp circuit enters into operation that inserts the braking resistance.
- L1-L2: (Only for drive size 1). The single-phase voltage is given on the L1, L2 terminals and the internal rectifier bridge is used. The drive performs the precharge of capacitors on the DC Bus when it receives the input voltage. When the voltage on the DC Bus exceeds a certain threshold, the Clamp circuit enters into operation that inserts the braking resistance.

## 5.4 Calibration and adjustments

Operations to be carried out:

1. Give 230Vac service power supply on the X10 connector.
2. Check that the LCD display lights up and that the letters indicating the drive model and firmware revision appear, otherwise check the correct service voltage.
3. Check that no red LEDs are on.

Then make the adjustments indicated in the following paragraphs with reference to the paragraph "Menu structure" from page 21 and "Navigation in the menus" from page 34 to enter the indicated data.

### 5.4.1 Setting motor parameters

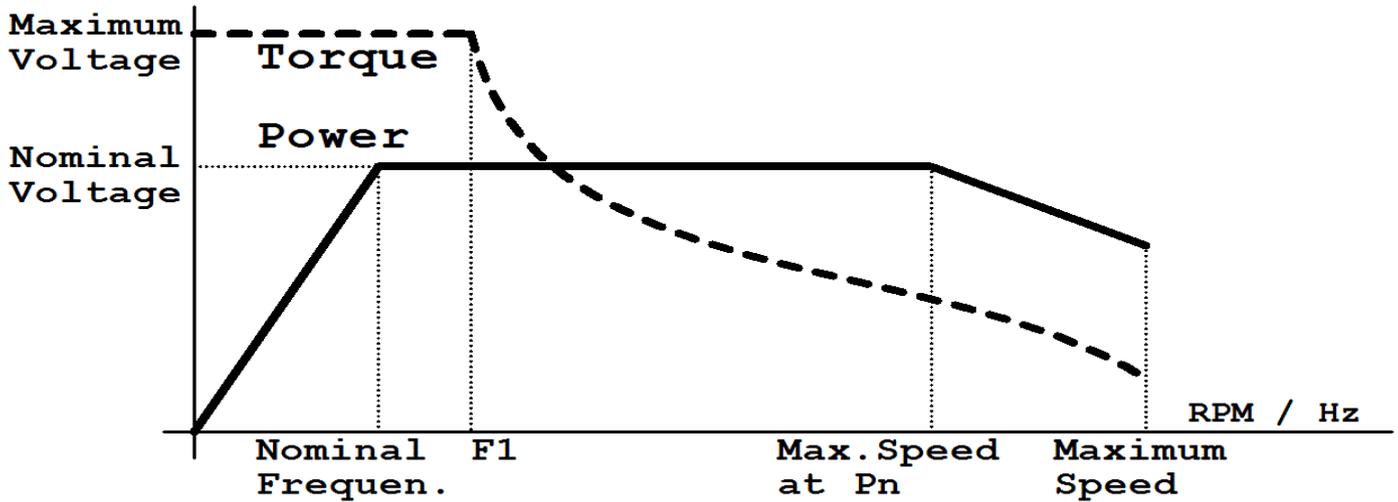
In the case of use of the drive with an asynchronous motor, the necessary data to know are the following:

1. The motor nominal voltage.
2. The continuous service current that circulates in the motor when it is powered by the nominal voltage and delivers the nominal torque.
3. The maximum current that can withstand the motor (serves only if you want to overload the motor during accelerations).
4. The nominal frequency at the voltage indicated in point 1.
5. The number of poles of the motor.

6. The maximum speed of the motor with the maximum reference. If the speed is greater than 11000 RPM, the mode must be set to "Async. HighSpd."
7. The maximum voltage that can be applied to the motor: this data must be higher than the nominal voltage. In case of doubt you can set this value equal to the rated voltage.
8. The type of speed transducer mounted on the motor and its technical data.

Sometimes it may happen that not all these data are available on the license plate of the motor but that others are supplied with which you can obtain the necessary parameters; some formulas for obtaining missing data are given in the paragraphs related to the description of the various motor setting menus ("Motor Parameters" from page 35). In case of need you can contact the ALTER technical office for clarifications.

To clarify how the various parameters change motor operation, see Drawing 23:



Drawing 23: Power and torque curve / RPM

With reference to drawing 23 you can see a point called "F1" that corresponds to the frequency (or RPM) of field weakening start (i.e. when the torque begins to drop). This point is automatically calculated by the drive and is not accessible by the customer: it depends on the ratio between the parameter "Maximum Voltage" and "Nominal Voltage".

At this point you can access the "Quick Setup → Motor Parameters → Motor Type" menu and start entering the above parameters one by one: the data must be inserted in the order as they are in the structure of the menu because they are linked to each other and some entered first must limit those inserted later.

The parameters of the menu group "Optional Param" (see page 38) are not indispensable as they can be calculated automatically by the Autotune procedure explained a little later.

## 5.4.2 Autotune for the calculation of optional parameters

In the event that the optional motor data (i.e. those contained in the menu group "Optional Param" on page 38) are not available on the motor plate, they must be automatically detected by the PWM3D drive.

To do this it is necessary to have first executed all the following points:

- Entered ALL motor data indicated in the previous paragraph.
- Have mechanically disconnected the motor shaft from the machine, as the motor will rotate without the control of the external speed reference.
- Have saved the motor parameters on Flash memory.

Since the supply of auxiliary services should already be present, follow these steps to complete the Autotune procedure:

1. Enable the function from the "Quick Setup → Motor Parameters → Autotune Mode" menu on "ENABLED".
2. When the DOK output switches to ON and the green LED DOK turns on, you can give the three-phase/monophase power supply on the terminals L1, L2, L3 or D.C. power supply on the DC-BUS if this mode has been selected (see Drawing 2 on page 12 and menu "Power supply from" on page 57). After the charge of the capacitors on the DC-BUS, the RDY output switches to the ON state and the green LED RDY turns on. From this point the drive is ready to be enabled for operation.
3. When the RDY output switches to ON status, you can enable the drive with the DEN command.
4. When the drive is enabled and works regularly in Autotune mode, the green RUN LED flashes and the DOK and RDY outputs remain in ON status.
5. If the motor accelerates and rotates at the rated speed and the "Autotune" procedure does not end within 30 seconds, it means that the continuous service current value set in the motor parameters is too low.

- When the procedure of "Autotune" is finished the green LED RUN turns off. At that point you can remove the power rating to the drive (DEN command = OFF) and remove the three-phase/monophase power supply (L1, L2, L3) or the D.C. power supply on the DC-BUS. The RDY output is brought into the state of OFF and the green LED RDY turns off.

If at the end of the procedure there are no alarms on the display and the red FLT LED is off, then you can store the calculated data on the Flash memory with the appropriate menu and mechanically reconnect the motor to the machine.

**NOTE:** during operation of the motor in "Autotune" mode it is normal if it rotates clockwise and counter clockwise a few times and then accelerates to the rated speed and then stops.

### 5.4.3 Motor speed adjustment

Do the following:

- Set a zero speed reference and act on the menu parameter "Quick Setup → Drive Parameters → An. INP. 1 Offset" to stop motor rotation.
- Provide the drive with a speed reference on the AI1 input equal to 10 % of that corresponding to the maximum speed.
- By following the points in paragraph "Commands starting sequence" on page 20, enable the drive and measure the speed of the motor shaft or spindle with a speedometer.
- Check on the menu "Diagnostic → Speed Feedback RPM" that the indicated speed is about equal to the one measured; if it is not the same probably the transducer data that have been entered are incorrect.
- If the motor's movement is contrary to the expected one, stop the motor (see "Commands shutdown sequence" on page 20) and reverse the AI1 analog input sign with the menu parameter "Quick Setup → Drive Parameters → An. INP. 1 Sign", or using the digital input associated with the direction reversal (standard on DI1).

Repeat the procedure from point 2.

- If the motor speed is not the one expected, follow these points:
  - Check that in the menu "Quick Setup → Drive Parameters → An. INP. 1 Value" writes the percentage value corresponding to the speed that the motor it should do according to the reference given in paragraph 2. For example, if the motor should make 10 % of the maximum speed, then the above menu should read 10 %. If the read value is incorrect, you should change the parameter in the menu "Quick Setup → Drive Parameters → An INP. 1 Gain 1" (or Gain 2 if that is in use) little at a time until the exact value is obtained in the parameter "An. INP. 1 Value".
  - If the previous point is in place, change the "Quick Setup → Motor Parameters → Maximum Speed" menu parameter to reach the required speed.
- Set a higher speed, up to the expected maximum and check each time the speed reached; in the event that the speed is not correct, the controls indicated in paragraph 6 should be repeated.
- Set a speed approximately equal to the nominal speed of the motor (see "Quick Setup → Motor Parameters → Optional Param → Nominal Speed" menu). Increase the parameter "Quick Setup → Drive Parameters → Speed Loop Prop" little at a time to the point where you don't hear any acoustic or mechanical vibrations of the motor; then reduce the value a little until the vibrations are damped.
- By following the points of paragraph "Commands shutdown sequence" on page 20, disable the drive.
- Save the motor parameters on Flash memory.

**NOTE:** Without a space control it is not possible for the motor to remain stationary for a long time if the drive is enabled; If necessary, use the built-in positioner (see section "Positioner" on page 74).

## 5.5 Optional transducers

The PWM3D drive provides the standard input of a TTL encoder on the X4 connector. Optionally, you can order a type of board to insert inside the drive that adds a new external connector (X14) to which you can connect a different type of transducer. Depending on the type of board installed, different menus and selectable parameters may appear.

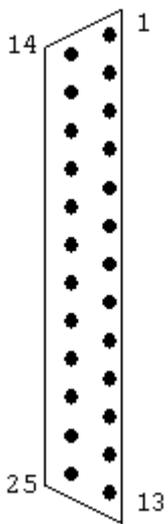
The available cards combined with the transducers are as follows:

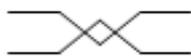
- Resolver transducer (2 poles or multipolar): card 01/324.
- Sinusoidal encoder transducer: card 01/325.
- Phonic wheel transducer: card 01/326.
- EnDat encoder transducer: card 01/327.

## 5.5.1 Resolver card 01/324

This card makes it possible to connect a resolver to 2 or more poles on the X14 connector and to use it to control the motor.

Assigning connector PINs:



DRIVE (Connector X14)		CONNECTION	MOTOR	
SIGNAL	N. PIN		N. PIN	SIGNAL
Input sine+ (terminal 1 of the secondary winding 1)	19			
Input sine- (terminal 2 of the secondary winding 1)	20			
Input Cosine+ (terminal 1 of the secondary winding 2)	21			
Input Cosine- (terminal 2 of the secondary winding 2)	22			
Output Resolver supply (terminal 1 of the first winding)	23			
Output Resolver 0V (terminal 2 of the first winding)	24			
0V (cable shield) – Connector case				

View connector from the soldering side (Connector type "D" 25 pole female).

### 5.5.1.1 Settings

Follow these points for proper commissioning of the transducer card:

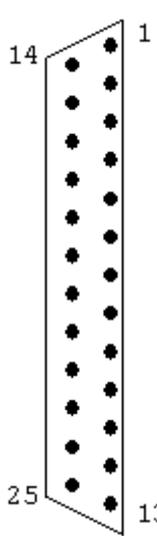
1. Check that the X4 connector has no connection.
2. Plug the transducer connector onto X14.
3. Provide service power to the drive and perform all standard settings (paragraph "Calibration and adjustments" on page 57 and paragraph "Setting motor parameters" on page 57).
4. Navigate the drive menu to the "Quick setup → Motor Parameters → Feedback Type " parameter. Use the keys to change setting and select "Resolver ". If you cannot select this transducer, see step 6 just ahead to check if the card is working properly.
5. Scroll through the menu to the parameter "Quick setup → Motor Parameters → Resolver Pole Pair ". Set the number of pole pairs resolver. **ATTENTION:** the number of "pole pairs " is half the number of "poles" of the resolver; generally, the number of poles is indicated on the plate, so the data to be set in this parameter is half the value written on the plate.
6. Check if the card is compatible and if it has been recognised by moving to the menu "Diagnostic → Transduc. Board → Transduc. Board for...." and verify that the words "Resolver" are present. If this does not occur, please contact the ALTER Technical Office for some verifications.
7. Check the amplitude of the signals and the connection of the electrical wires of the transducer by moving to the menu "Diagnostic → Transduc. Board → Resolver Signal" and verify that there is "OK", otherwise make these adjustments:
  - Written "LOW ": Rotate the trimmer next to the X14 connector in the clockwise direction, until the inscription changes and becomes "OK ". If you reach the trimmer limit switch and the writing remains unchanged, you must check the cable connections to the resolver or the compatibility of the signal with the card.
  - Written "HIGH": Rotate the trimmer next to the X14 connector in the anticlockwise direction little at a time, until the inscription changes and becomes "OK". If you reach the trimmer limit switch and the writing remains unchanged, you must check the cable connections to the resolver or the compatibility of the signal with the board.
8. If all previous verifications are positive, autotune of motor parameters can be performed as explained in paragraph "Autotune for the calculation of optional parameters" on page 58.
9. At the end of the autotune procedure, the parameters must be stored in order to complete the commissioning of the transducer card.

**NOTE:** Using a resolver with 4 or more poles you get 2 or more sinusoids per revolution of the motor. For this reason the signal of the Simulated Encoder or that of the motor position are referred to the single sinusoid. For example, with a 6-pole resolver you get 3 sinusoids per motor revolution; so if the simulated encoder is set to 1024 PPR (pulse/revolution) you will actually get  $1024 \times 3 = 3072$  Impulses per motor lap, and 3 pulses of passage over zero (ZERO tick).

## 5.5.2 Sin-Cos card 01/325

This card makes it possible to connect a sinusoidal encoder on the X14 connector and to use it to control the motor.

Assigning connector PINs:



DRIVE (Connector X14)		CONNECTION	MOTOR	
SIGNAL	N. PIN		N. PIN	SIGNAL
+5V (Transducer Positive Power Supply)	1			
0V (Transducer 0V Power supply)	2			
Channel "A" encoder (Track 1 incremental signal)	3			
Channel "A" encoder (Track 1 incremental signal)	4			
0V (sock shield pair A + A)	5			
Channel "B" encoder (Track 2 incremental signal)	6			
Channel "B" encoder (Track 2 incremental signal)	7			
0V (sock shield pair B + B)	8			
PTC probe in the motor (signal)	13			
0V (sock shield pair R + R)	16			
Channel "R" encoder (signal at zero position)	17			
Channel "R" encoder (signal at zero position)	18			
Channel "C" encoder (Track 1 absolute signal)	19			
Channel "C" encoder (Track 1 absolute signal)	20			
Channel "D" encoder (Track 2 absolute signal)	21			
Channel "D" encoder (Track 2 absolute signal)	22			
PTC probe in the motor (0V)	25			
0V (cable shield) – Connector box				

View connector from the soldering side (Connector type "D" 25 pole female).

### 5.5.2.1 Settings

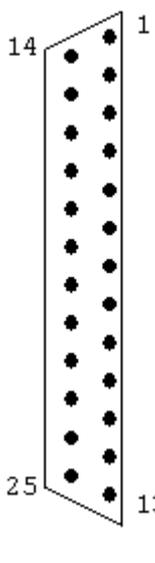
Follow these points for proper commissioning of the transducer card:

1. Check that the X4 connector has no connection.
2. Plug the transducer connector onto X14.
3. Provide service power to the drive and perform all standard settings (paragraph "Calibration and adjustments" on page 57 and paragraph "Setting motor parameters" on page 57).
4. Navigate the drive menu to the "Quick setup → Motor Parameters → Feedback Type" parameter. Use the keys to change setting and select "SIN-COS". If you cannot select this transducer, see step 7 just ahead to check if the card is working properly.
5. Scroll through the menu to the parameter "Quick setup → Motor Parameters → Encoder Lines". Set the number of sinusoids/revolution as reported on the plate or technical data of the transducer.
6. Move to the next menu "Quick setup → Motor Parameters → Abs Signal C&D?" and select if the absolute channels of the SinCos encoder are present: they are the 4 wires connected to pins 19, 20, 21, 22 of the X14 connector?
7. Check if the card is compatible and if it has been recognised by moving to the "Diagnostic → Transduc. Board → Transduc. Board for..." and verify that the wording "SIN-COS" is present. If this does not occur, please contact the ALTER Technical Office for some verifications.
8. Check the amplitude of incremental signals connected on the X14 connector to pins 3, 4, 6, 7 and the connection of the transducer's electrical wires by moving to the "Diagnostic → Transduc Board → SinCos signal A and B" and verify that there is "OK", otherwise perform these verifications:
  1. Written "LOW": check that you've connected the cable from both sides. Check the cable and welding of wires on the X14 connector at pins 3, 4, 6, 7.
  2. Written "HIGH": check the cable and welding of wires on the X14 connector at pins 3, 4, 6, 7 that are not short-circuited with other signals.
9. Check the amplitude of the absolute signals connected on the X14 connector to pins 19, 20, 21, 22 and the connection of the transducer's electrical wires by moving to the "Diagnostic → Transduc Board → SinCos signal C and D" and verify that there is "OK", otherwise perform these verifications:
  1. Written "LOW": check that you've connected the cable from both sides. Check the cable and welding of wires on the X14 connector at pins 19, 20, 21, 22.
  2. Written "HIGH": check the cable and welding of wires on the X14 connector at pins 19, 20, 21, 22 that are not short-circuited with other signals.
10. If all previous verifications are positive, autotune of motor parameters can be performed as explained in paragraph "Autotune for the calculation of optional parameters" on page 58.
11. At the end of the autotune procedure, the parameters must be stored in order to complete the commissioning of the transducer card.

### 5.5.3 Phonic wheel card 01/326

This card makes it possible to connect a phonic wheel on the X14 connector and to use it to control the motor.

Assigning connector PINs:



DRIVE (Connector X14)		CONNECTION	MOTOR	
SIGNAL	N. PIN		N. PIN	SIGNAL
+5V (Transducer Positive Power Supply)	1			
0V (Transducer 0V Power supply)	2			
Channel "A" transducer (or "PA") – Sinusoid	3			
Channel "A" transducer (or "RA") – constant reference	4			
0V (sock shield pair A + A)	5			
Channel "B" transducer (or "PB ") – Sinusoid	6			
Channel "B" transducer (or "RB") – constant reference	7			
0V (sock pair B + B)	8			
PTC probe in the motor (signal)	13			
0V (socket shield pair Z + Z)	16			
Channel "Z" transducer (mark zero position, or "PZ ")	17			
Channel "Z" transducer (Reference zero position, or "RZ")	18			
PTC probe in the motor (0V)	25			
0V (cable shield) – Connector case				

View of the connector type "D " 25 poles female on the soldering side.

#### 5.5.3.1 Settings

Follow these points for proper commissioning of the transducer card:

1. Check that the X4 connector has no connection.
2. Plug the transducer connector onto X14.
3. Provide service power to the drive and perform all standard settings (paragraph "Calibration and adjustments" on page 57 and paragraph "Setting motor parameters" on page 57).
4. Navigate the drive menu to the "Quick setup → Motor Parameters → Feedback Type " parameter. Use the keys to change setting and select "Phonic W ". If you cannot select this transducer, see step 6 just ahead to check if the card is working properly.
5. Scroll through the menu to the parameter "Quick setup → Motor Parameters → Encoder Lines ". Set the number of sinusoids/revolution as reported on the plate or technical data of the transducer.
6. Check if the card is compatible and if it has been recognised by moving to the "Diagnostic → Transduc " menu. Board → Transduc. Board for..." and verify that the wording "Phonic W " is present. If this does not occur, please contact the ALTER Technical Office for some verifications.
7. Check the amplitude of incremental signals connected on the X14 connector to pins 3, 4, 6, 7 and the connection of the transducer's electrical wires by moving to the "Diagnostic → Transduc Board → SinCos signal A and B" and verify that there is "OK", otherwise perform these verifications:
  1. Written "LOW": check that you've connected the cable from both sides. Check the cable and welding of wires on the X14 connector at pins 3, 4, 6, 7.
  2. Written "HIGH": check the cable and welding of wires on the X14 connector at pins 3, 4, 6, 7 that are not short-circuited with other signals.
8. If all previous verifications are positive, autotune of motor parameters can be performed as explained in paragraph "Autotune for the calculation of optional parameters" on page 58.
9. At the end of the autotune procedure, the parameters must be stored in order to complete the commissioning of the transducer card.

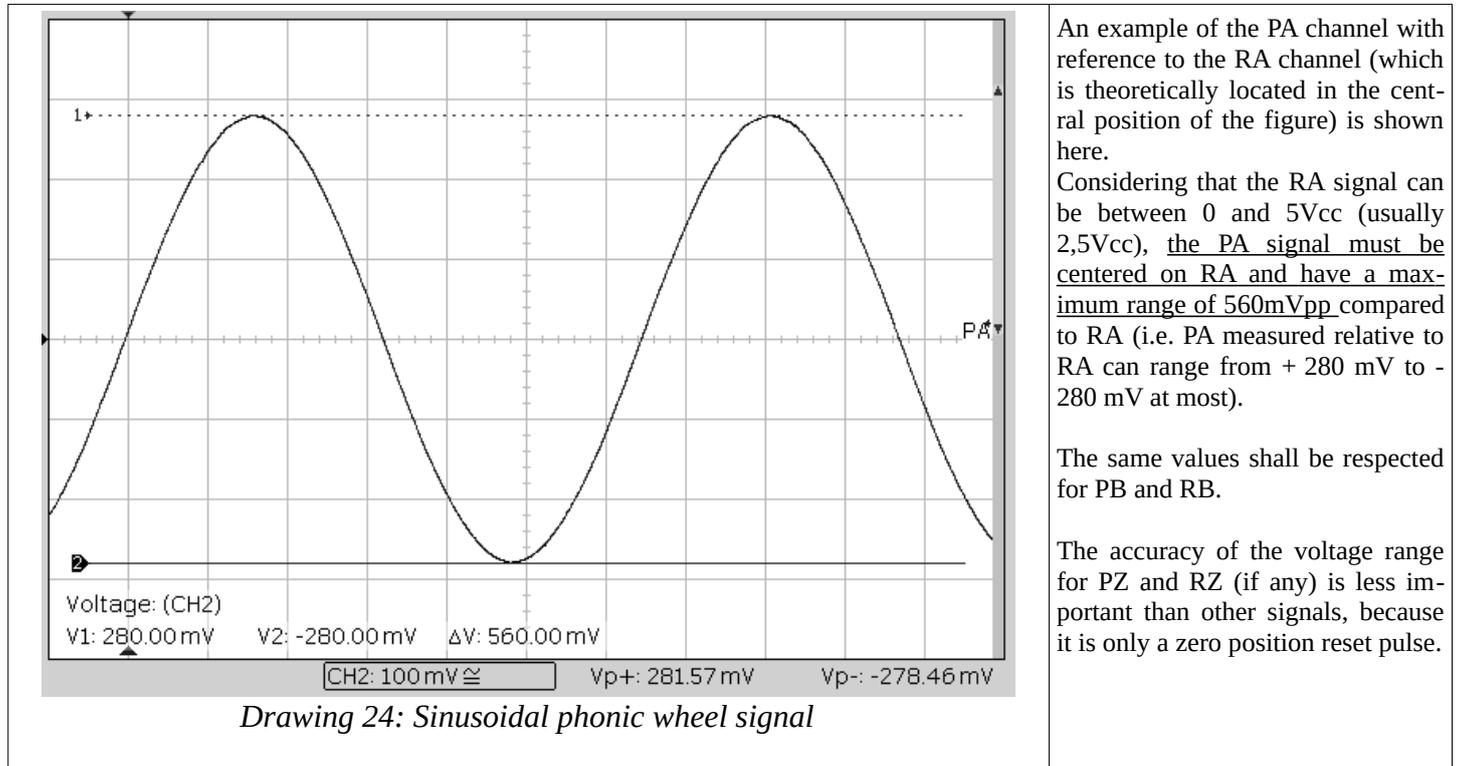
#### 5.5.3.2 Phonic wheel input signal range

The signals provided by the phonic wheel are 2 pairs (or sometimes 3 pairs):

1. Channel A:
  1. PA: Sinusoidal signal of the channel A centred to RA channel that must be between 100 mV and 560 mVpp measured compared to RA.
  2. RA: Channel A constant reference; it's a voltage of about 2.5V.
2. Channel B:

1. PB: Sinusoidal signal of the channel B centred to RB channel that must be between 100 mV and 560 mVpp measured compared to RB.
2. RB: Channel B constant reference; it's a voltage of about 2.5V.
3. Z channel (optional):
  1. PZ: Impulsive signal indicating the passage on the transducer's ZERO position, which must be between 160 mV and 1200 mVpp measured compared to RZ.
  2. RZ: Constant reference of the Z channel; it's a voltage of about 2.5V.

The number of sinusoids/revolution obtained on PA and PB wires depend on the resolution of the transducer and is an indispensable plate data.



An example of the PA channel with reference to the RA channel (which is theoretically located in the central position of the figure) is shown here.

Considering that the RA signal can be between 0 and 5Vcc (usually 2,5Vcc), the PA signal must be centered on RA and have a maximum range of 560mVpp compared to RA (i.e. PA measured relative to RA can range from + 280 mV to - 280 mV at most).

The same values shall be respected for PB and RB.

The accuracy of the voltage range for PZ and RZ (if any) is less important than other signals, because it is only a zero position reset pulse.

**NOTE:** You can adjust the amplitude of the signals provided by the phonic wheel by adjusting the mechanical position of the pick-up inside the transducer, but in any case it is not an easy job and that guarantees constancy over time. In case of calibration problems it is recommended to replace it with a classic TTL Line driver encoder that is more reliable and safer over time.

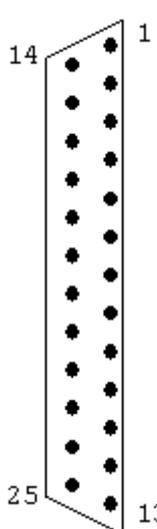
#### 5.5.4 Card EnDat 01/327

This card makes it possible to connect an EnDat encoder to the X14 connector and to use it to control the motor.

Encoders compatible with this card must have the following features:

- **Interface:** EnDat 2.1 or EnDat 2.2.
- **Ordering abbreviation:** EnDat01 or EnDat02 (with incremental 1Vpp signals).
- **Incremental pulses/revolution signals:** less than 16384 PPRs.
- **Type of encoder:** single revolution absolute rotary.

Assigning connector PINs:



DRIVE (Connector X14)		CONNECTION	MOTOR	
SIGNAL	N. PIN		N. PIN	SIGNAL
+5V (Transducer Positive Power Supply)	1			Up
0V (Transducer 0V Power supply)	2			0V
Channel "A" encoder (Track 1 incremental signal)	3			A+
Channel "A" encoder (Track 1 incremental signal)	4			A-
0V (sock shield pair A + $\bar{A}$ )	5			
Channel "B" encoder (Track 2 incremental signal)	6			B+
Channel "B" encoder (Track 2 incremental signal)	7			B-
0V (sock shield pair B + $\bar{B}$ )	8			
PTC probe in the motor (signal)	13			
"CLOCK" signal encoder (serial interface)	9			CLOCK
"CLOCK" signal encoder (serial interface)	10			$\overline{\text{CLOCK}}$
"DATA" signal encoder (serial interface)	17			DATE
"DATA" signal encoder (serial interface)	18			$\overline{\text{DATE}}$
PTC probe in the motor (0V)	25			
0V (cable shield) – Connector case				

View Flying connector from the soldering side (Connector type "D" 25 pole female).

### 5.5.4.1 Settings

Follow these points for proper commissioning of the transducer card:

1. Check that the X4 connector has no connection.
2. Plug the transducer connector onto X14.
3. Provide service power to the drive and perform all standard settings (paragraph "Calibration and adjustments" on page 57 and paragraph "Setting motor parameters" on page 57).
4. Navigate the drive menu to the parameter "Quick setup → Motor Parameters → Feedback Type". Use the keys to change setting and select "EnDat". If you cannot select this transducer, see the next point to check if the card is working properly.
5. Check if the card is compatible and if it has been recognised by moving to the menu "Diagnostic → Transduc. Board → Transduc. Board for...." and verify that the word "EnDat" is present. If this does not occur, please contact the ALTER Technical Office for some verifications.
6. Check the amplitude of incremental signals connected on the X14 connector to pins 3, 4, 6, 7 and the connection of the transducer's electrical wires by moving to the "Diagnostic → Transduc Board → SinCos signal A and B" and verify that there is "OK", otherwise perform these verifications:
  1. Written "LOW": check that you've connected the cable from both sides. Check the cable and welding of wires on the X14 connector at pins 3, 4, 6, 7.
  2. Written "HIGH": check the cable and welding of wires on the X14 connector at pins 3, 4, 6, 7 that are not short-circuited with other signals.
7. Check the correctness of the serial data connected on the X14 connector to pins 9, 10, 11, 12 and the connection of the transducer's electrical wires by moving to the "Diagnostic → Transduc Board → Serial comm status" and verify that there is "OK", otherwise carry out these checks:
  - Written "FAULT": check that you've connected the cable from both sides. Check the wiring and soldering of wires on the X14 connector at pins 9, 10, 11, 12. Check the connection of the shield to ground on both sides of the cable. The cable shall be of the braided pair type and the pairs shall be used as indicated in the connection table of the X14 connector. The length of the cable may not exceed 150 meters.
8. Check for alarms inside the encoder by moving to the "Diagnostic → Transduc Board → Internal alarm status" and verify that there is "OK", otherwise carry out these checks:
  - Written "FAULT": the encoder has internal problems. Replace it with a working one.
9. Check if the encoder is compatible with the card by moving to the "Diagnostic → Transduc Board → Compatible encoder" and verify that it is written "YES", otherwise carry out these checks:
  - Written 'NO': the encoder isn't compatible. Verify that it has the characteristics indicated at the beginning of the paragraph.
10. If all previous verifications are positive, autotune of motor parameters can be performed as explained in paragraph "Autotune for the calculation of optional parameters" on page 58.
11. At the end of the autotune procedure, the parameters must be stored in order to complete the commissioning of the transducer card.

## 5.5.5 Manual offset calibration

When the following transducer cards are used: 01/325, 01/326, 01/327, it is possible to calibrate the offset to compensate for incremental sinusoidal analog signals.

This offset, if present, causes problems in the speed signal that is wavy and during operation makes the motor vibrate or makes the adjustment unstable. To solve this problem, the drive automatically calculates the offset of the two incremental sinusoidal signals (signals on X14 pins 3,4,6,7), after manual activation of the function.

To manually start the offset calibration, you can follow these points:

1. The drive **MUST** be disabled (Led RUN off).
2. Move to the menu "Diagnostic → Transduc. Board → Man Offset Calc".
3. Switch to "Edit Parameter" mode. So you have to press the "►" button once again, which shows a "→" in the bottom left corner, press the key "▲" to enable the calibration cycle: the inscription becomes "ENABLED".
4. Spin the motor (at a speed above 50 RPM), then stop turning the motor and let it stop for inertia.
5. When the motor stops, the above menu will automatically become DISABLED.
6. At this point the calibration is over. You don't need to save the parameters.

## 5.6 Special functions

### 5.6.1 Zero speed motor signalling

#### 5.6.1.1 Generality

This function is used to signal on a selectable digital output (usually matched to the DO1 output), when the motor is still. If the motor speed is less than 2 RPM for a time greater than 500 mSec the signaling occurs and the associated output changes logical status and leads to +24V or 0V if the inversion of sign is activated (see "Dig.Op. X Sign" on page 45).

#### 5.6.1.2 Calibration

This function does not need calibration. To use it you have to go to the configuration menu "I/O Configure → Digital Outputs" and from the selection menu of the source of the desired output go to select the item "Zero Speed" (see paragraph "Dig.Op. X source" on page 44). If you want to change the logical state of the output when the motor is still, you must enable (or disable) the logical reversal setting of the output (see paragraph "Dig.Op. X Sign" on page 45).

If the speed reference signal has an unstable offset, it may happen that the signaling does not occur; In this case you can change the parameter "Zero speed thr." (see page 48) and increase it until you turn on the LED of the set digital output.

### 5.6.2 Motor brake control

#### 5.6.2.1 Generality

This function is used to control the release of the parking brake of the motor using any digital output (usually combined with the DO2 output). If the drive is disabled and the motor is stationary (following the same conditions as in the previous paragraph) the signaling occurs and the associated output changes logical status and leads to 0V or +24V if the inversion of sign is activated (see "Dig.Op. X Sign" on page 45).

*NOTE: This output is not used to control an "emergency brake" but a "parking brake". For this reason, the brake is controlled only when the motor is stationary. A digital output associated with the "Drive Running" source may be used to activate an emergency brake (see section "Dig.Op. X source" on page 44).*

#### 5.6.2.2 Calibration

This function does not need calibration. To use it you have to go to the configuration menu "I/O Configure → Digital Outputs" and from the selection menu of the source of the desired output go to select the item "Motor Brake" (see paragraph "Dig.Op. X source" on page 44). If you want to change the logical state of the brake control output, you must insert (or disconnect) the logical reversal setting of the output (see paragraph "Dig.Op. X Sign" on page 45).

Normally when the motor brake is to be inserted, the output goes to 0V, so it removes power to the brake coil.

### 5.6.3 Motor temperature

#### 5.6.3.1 Generality

This function is used to signal on a selectable digital output or to block the drive, when the motor has exceeded its maximum operating temperature, connecting a PTC probe internally mounted to the appropriate connectors (see paragraph "Connector X3" on page 14). This probe must have a low resistance (some ohms) when the motor temperature is in the correct range of use; on the other hand, if it exceeds its maximum temperature, the probe must increase the resistance (greater than 3Kohm).

### 5.6.3.2 Calibration

1. First of all you have to decide whether the motor over-temperature signal must be managed by the CNC or the drive and set the parameter in the “Advanced Setup → Aux Function → Motor Overtemp → Signal Mode” menu in one of the following ways:
  1. DIG.OUT ONLY: The drive does not stop, but only signals the intervention of the PTC on the digital output. It must be the CNC or PLC that stops the motor when it considers it possible.
  2. DRIVE FAULT: The drive reports PTC intervention on the digital output and with a message on the display (see message “Warning!!! Motor Overtemp.” on page 83). If the CNC or PLC does not stop the motor within the time set in the “Drive FLT delay” parameter, the drive locks and disables the motor, signaling the alarm “Motor Overtemperature” and take the digital output “DOK” to the logical level “0”.
2. Set on which digital output you want to exit the over-temperature signal of the motor; In the configuration menu “I/O Configure → Digital Outputs” and from the selection menu of the source of the desired output go to select the input “Motor Temp.” (see paragraph “Dig.Op. X source” on page 44). If you want to change the logical state of the temperature signaling output, insert (or disconnect) the logical reversal setting of the output (see paragraph “Dig.Op. X Sign” on page 45). Normally when the motor is overheated, the associated output goes logically “0”.
3. If the “Drive Fault” mode has been selected in point 1, then you must also set the parameter “Advanced Setup → Aux Function → Motor Overtemp → Drive FLT delay”. With this value you set the delay from the over-temperature signal (i.e. when the PTC opens) to when the drive stops and stops the motor signaling the alarm “Motor Overtemperature”.

## 5.6.4 Speed threshold

### 5.6.4.1 Generality

This function is used to signal on a selectable digital output (usually matched to the DO2 output), when the motor has exceeded a certain set speed. If the motor speed is above the threshold for a time greater than 500 mSec the signaling and the associated output changes logical status and leads to +24V or 0V if the inversion of sign is activated (see “Dig.Op. X Sign” on page 45).

### 5.6.4.2 Calibration

The only calibration to do is setting the speed threshold you want to have (standard: 30 RPM) by going to the menu “Advanced Setup → Aux Function → Speed Threshold → Threshold n.1” and changing the number written for the threshold to be changed (see paragraph “Threshold No. 1” on page 48).

To use it you have to go to the configuration menu “I/O Configure → Digital Outputs” and from the selection menu of the source of the desired output go to select the item “Speed Thresh. X” (see paragraph “Dig.Op. X source” on page 44). If you want to change the logical state of the output when the motor exceeds the threshold, you must enter (or disconnect) the logical reversal setting of the output (see paragraph “Dig.Op. X Sign” on page 45).

## 5.6.5 Maximum load reporting

### 5.6.5.1 Generality

This function is used to signal on a selectable digital output (usually matched to the DO3 output), when the motor has almost reached the maximum load: in this case it is advisable to reduce the load otherwise the speed of the motor shaft could be lowered and no longer controlled. When the load applied on the motor exceeds 90 % of the maximum load, the associated signaling and output changes logical status and leads to +24V or 0V if the inversion of sign is activated (see “Dig.Op. X Sign” on page 45).

### 5.6.5.2 Calibration

This function does not need calibration. To use it you have to go to the configuration menu “I/O Configure → Digital Outputs” and from the selection menu of the source of the desired output go to select the item “Peak Mot. Load” (see paragraph “Dig.Op. X source” on page 44). If you want to change the logical state of the output when the motor is at the maximum torque, you must insert (or disconnect) the logical reversal setting of the output (see paragraph “Dig.Op. X Sign” on page 45).

## 5.6.6 Speed reached

### 5.6.6.1 Generality

This function is used to signal on a selectable digital output, when the motor has reached the required speed. If the speed difference between the actual motor and the required speed is lower than the threshold for a time greater than 500 mSec the signaling and the associated output changes logical state and leads to +24V or 0V if the inversion of sign is activated (see “Dig.Op. X Sign” on page 45).

### 5.6.6.2 Calibration

The only calibration to do is setting the speed difference threshold you want to have (standard: 2 %) by going to the “Advanced Setup → Aux Function → Speed Reached” menu and changing the written number (see paragraph “Speed reached” on page 48).

To use it you have to go to the configuration menu "I/O Configure → Digital Outputs" and from the selection menu of the source of the desired output go to select the item "Speed Reached" (see paragraph "Dig.Op. X source" on page 44). If you want to change the logical state of the output when the motor has reached speed, you must insert (or disconnect) the logical reversal setting of the output (see paragraph "Dig.Op. X Sign" on page 45).

## 5.6.7 Drive Stop/Run

### 5.6.7.1 Generality

This function is used to change the operation of the digital input "DEN " so that when it goes to the logical level "0 " the drive can disable itself (standard mode) or brake the motor (with or without ramp) until it stops and then disables.

If the DEN mode is set to "Drive Dis/Enab" (see section "Den Function" on page 48), the "DEN " input is used to enable or disable the drive and therefore it will stop for inertia. This is the standard mode.

Instead, if the DEN mode is set to "Drive Stop/Run ", the "DEN " input is used to start or stop the motor; in this case the motor will be slowed down until it stops and then the drive disables and the motor is no longer powered (so it is free to move). If the speed ramp is active (REN = ON), the motor slows down following the time set in the "Speed Ramp Time " parameter. If the speed ramp is NOT active (REN = OFF) the motor slows down with the maximum available torque (emergency stop). For safety it is possible to set a maximum time to stop the motor, after which the drive is disabled even if the motor is not stationary (menu "Motor Stop Time Max "). To restart the motor, simply return the "DEN " command at the desired moments (if the RDY = 1). The motor will accelerate to the reference speed.

### 5.6.7.2 Calibration

Normally this function is disabled and therefore the digital input "DEN " is used to enable and disable the drive; in this way the CNC must reduce the speed reference to "0 " before removing DEN, otherwise the motor is no longer controlled and stops by inertia.

Instead, if you want to use the "DEN " input to drive and stop the motor without forcing the CNC to change the speed reference, you can do this:

1. In the configuration menu "Advanced Setup → Aux Functions → Drive Stop/Run → Den Function ", select the mode: "Drive Stop/Run ".
2. Set the "maximum time to stop motor ": go to the configuration menu "Advanced Setup → Aux Functions → Drive Stop/Run → Motor Stop Time Max " and set the maximum time in seconds. This time is measured since the speed reference (after any ramp) reaches the value "0 ". If within this time the motor is not stopped, the drive will disable automatically and the motor stops by inertia.

## 5.6.8 Electronic gamma change

### 5.6.8.1 Generality

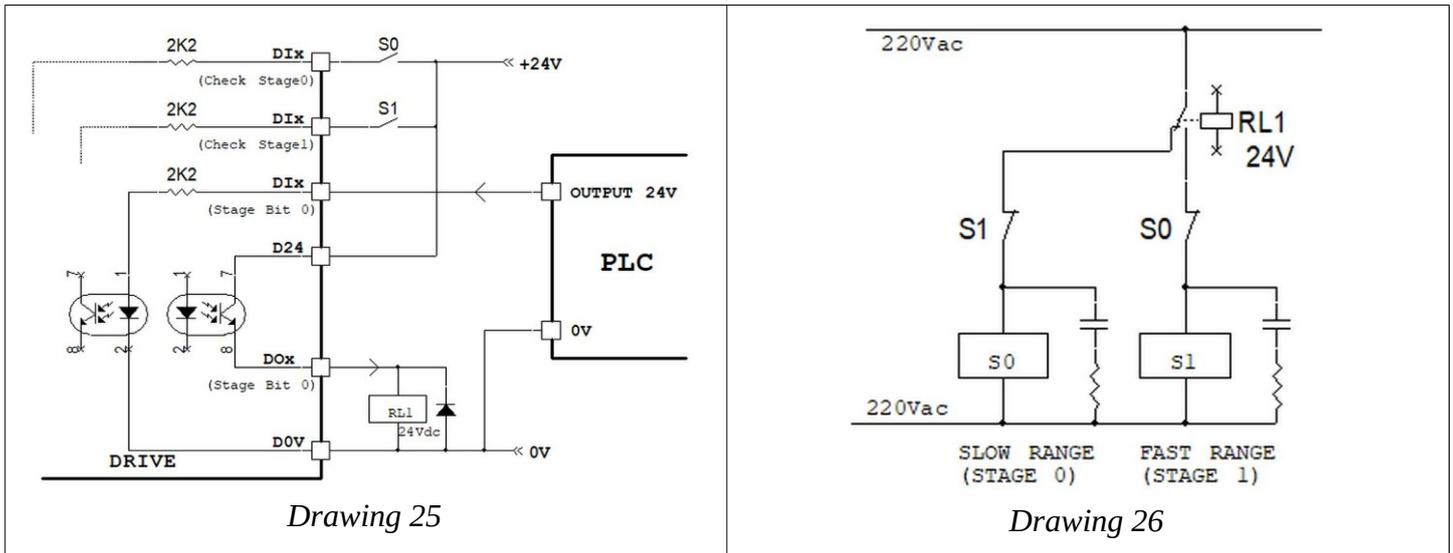
This function is used to change some parameters inside the drive when external switching of the motor windings takes place. A digital input is used to control the switching of parameters inside the drive and the meaning is as follows:

- Input = 0V (false): Switching on the set of parameters for slow range (Stage 0).
- Input = 24V (true): Switching on the group of parameters for Fast Range (Stage 1).

If you have activated the sign reversal (see "Dig.Inp. X Sign" on page 44), the above logical states should be reversed.

The parameters that will be switched when controlling the associated digital input are highlighted by an asterisk (\*) in the Menu structure page paragraph 21 and are listed in table 3 to page 69 where you can write the value of the modified parameter using the menu.

The drive also controls the actual switching of contactors; in the event that this does not happen, it signals an alarm on the LCD display and does not allow the motor to be enabled to avoid faults. To do this you need to connect a normally open contact of each contactor (See drawing 25 and drawing 26) to a specific digital input of the drive and enable the control function in the "Check Contactors" menu.



Drawing 25

Drawing 26

### 5.6.8.2 Calibration

1. Set the digital input to be used for switching the speed range: You should go to the "I/O Configure → Digital Inputs" menu and from the destination selection menu on the desired input select the item "Stage bit 0" (see paragraph "Dig.Inp. X Dest" on page 43). For safety it is better to check that there are no other inputs for this function.
2. Set the digital input to use for slow range contactor control (Stage 0): You should go to the "I/O Configure → Digital Inputs" menu and from the destination selection menu on the desired input select the item "Check STAGE 0" (see paragraph "Dig.Inp. X Dest" on page 43). For safety it is better to check that there are no other inputs for this function.
3. Set the digital input to be used for fast range contactor control (Stage 1): You should go to the "I/O Configure → Digital Inputs" menu and from the destination selection menu on the desired input select the item "Check STAGE 1" (see paragraph "Dig.Inp. X Dest" on page 43). For safety it is better to check that there are no other inputs for this function.
4. Set the digital output to be used for the control of contactors that switch the motor windings. Use the "I/O Configure → Digital Outputs" menu and from the source selection menu on the desired output select the item "Stage bit 0" (see paragraph "Dig.Op. X source" on page 44). For safety it is better to check that there are no other outputs intended for this function.
5. Enable the electronic gamma change function with the menu: "Advanced Setup → Aux Function → Elec.Gear Change → Stage Function ", set the parameter to "Enabled".
6. Check that the gamma change function is working properly:
  - Control the digital input to select the fast range parameters (see point 1).
  - Move to the "Advanced Setup → Aux Function → Elec.Gear Change → Selected Gear " menu and check for "Stage 1 ".
  - Check that the digital output set to control the motor contactors (the one set in point 4) has the LED on and its logical state is 1 (24Vcc present). Check that the quick range contactor is switched correctly (contactor S1 in drawing 26).
  - Check that the digital input set to check the status of the fast range contactor has the LED on. This input has been set to step 3.
  - Check that the digital input set to check the status of the slow range contactor has the LED turned off. This input has been set to step 2.
  - **ATTENTION:** if the points listed above are not correct, check the electrical connections, settings or power supply of contactors' coils. If everything is in order you can continue with the test.
  - Control the digital input to select slow range parameters (see point 1).
  - Check on the menu "Advanced Setup → Aux Function → Elec.Gear Change → Selected Gear " that there is the words "Stage 0 ".
  - Check that the digital output set to control the motor contactors (the one set in point 4) has the LED off and its logical state is 0 (floating output). Check that the slow range contactor is switched correctly (contactor S0 in drawing 26).
  - Check that the digital input set to check the status of the fast range contactor has the LED turned off. This input has been set to step 3.
  - Check that the digital input set to check the status of the slow range contactor has the LED on. This input has been set to step 2.
  - **ATTENTION:** if the points listed above are not correct, check the electrical connections, settings or power supply of contactors' coils. If everything is in order you can continue with the test.
7. Keep the Slow Range (Stage 0) selected with the digital input and start the normal commissioning procedure.
8. Set the parameters and follow all the steps indicated in paragraph "Calibration and adjustments" from page 57.

9. When you have finished all the procedure indicated and the motor runs well with the Slow Range (Stage 0), you must stop the motor and disable the drive (DEN = off). Save parameters in FLASH memory.
10. Select the Fast Range (Stage 1) with the digital input. Check the switching of contactors.
11. Set the parameters individually or copy the parameters of the Slow Range as a starting base. To copy the parameters from Stage 0 to Stage 1, use the menu "Advanced Setup → Aux Function → Elec.Gear Change → Copy from Stage0": Press the button "▶" which shows a "→" in the bottom left corner, then press the Key "▲", and after a few moments the inscription "OK" appears to indicate that the copy has been made. Now you can only change the different parameters between slow range and fast range.
12. Follow once more the procedure indicated in paragraph "Calibration and adjustments" from page 57.
13. When you have finished all the procedure indicated and the motor runs well also with the Speed Range (Stage 1), you must stop the motor and disable the drive (DEN = off). Save parameters in FLASH memory.
14. At this point the drive is calibrated on both speed ranges.

### 5.6.8.3 Table of parameters

The following table is used to annotate the value of the parameters that change when selecting Stage 0 or Stage 1. The parameters that will be written here should not be written in paragraph "Menu structure" from page 21. The empty fields mean that the parameter is equal to the value of "default", so it has not been modified.

PARAMETER NAME	DEFAULT	STAGE 0	STAGE 1
Motor type	Async. LowSpd		
Nominal Voltage (V)	0		
Continuous service Current (A)	0		
Maximum Current (A)	0		
Nominal Frequency (Hz)	0		
Maximum Speed (Rpm)	0		
Maximum Voltage (V)	0		
Max. Speed at Nominal Power (Rpm)	0		
Nominal Speed (Rpm)	0		
Magnetic current (A)	0		
Stator resistance (ohm)	0		
Magnetic inductance (mH)	0		
Leakage inductance (mH)	0		
Speed loop P gain 1	20.0		
Speed loop P gain 2	20.0		
Speed loop I gain 1	0.20		
Speed loop I gain 2	0.20		
Speed loop gain scale (%)	10.0		
Current loop P gain	0.60		
Current loop I gain	0.005		
Flux loop P gain	4.0		
Flux loop I gain	0.01		
Speed ramp time (Sec)	60.0		

Table 3: Parameters modified with the electronic gear change

### 5.6.8.4 Tips for contactors' command

As indicated in drawing 25 and drawing 26, contactors used to switch motor windings can be controlled directly by the drive using a 24Vcc relay with exchange contact connected to the digital output set in paragraph 4. In this way the PLC or CNC only has to control the digital input that controls the speed range change (the one set in point 1).

It is also necessary to connect a normally open contact of these contactors to two digital inputs of the drive.

### 5.6.8.5 Sequence of commands for gamma change

When you reach the gamma change point, you must execute this sequence of commands to perform the operation correctly:

1. Disable the drive (DEN = OFF).
2. Command the digital input "Stage Bit 0 " in an appropriate way (if there is no turn on the sign, the 0V input means Slow Range and the 24Vcc input means Fast Range).
3. Change the speed reference (the one entering the AI1 input) to align with the new setting.

**NOTE:** If the parameter of "Maximum Speed " is the same in both speed ranges, then there is no need to change the reference since the signal scale is the same. However, if the above two parameters are different it is necessary that the CNC or the PLC vary the analog output with this formula:

$$V_{REF1} = \frac{V_{REF2} \cdot Max_2}{Max_1} \quad \text{or} \quad V_{REF2} = \frac{V_{REF1} \cdot Max_1}{Max_2} \quad \text{with } Max_1 \text{ and } Max_2 \text{ are the values of the parameter "Maximum Speed "}$$

at Gamma 1 and Gamma 2 respectively. From the formule you can calculate the speed references in the various ranges with respect to each other.

**Example:** having set the parameter "Maximum Speed " for the Gamma 1 to 2000 RPM and for the Gamma 2 to 7500 RPM, we admit that we are at a reference of 8V and want to do the gamma change from 1 to 2. What reference will I have to generate from the CNC to have a linear ramp?

With the 2nd formula substituting  $V_{REF1} = 8V$ ,  $Max_1 = 2000 \text{ RPM}$ ,  $Max_2 = 7500 \text{ RPM}$ , I can calculate that  $V_{REF2} = 2,1V$ .

4. Check with two digital CNC inputs that the contactors are switched correctly.
5. Enable the drive (DEN = ON). The drive may not be enabled immediately due to the residual flow in the motor. In this case a message appears on the LCD display. As soon as the flow returns to the minimum value, the drive is enabled and powered by the motor.
6. From now on the drive "Lock" the motor speed and follows the input reference with the selected new speed range.

After selecting the desired range it is possible to stop and restart the motor following the normal procedure indicated in paragraph "Commands starting sequence" from page 20.

## 5.6.9 External torque limit

### 5.6.9.1 Generality

This function allows you to adjust the motor torque using a selectable analog input, or with a fixed value set on the LCD display. It should be pointed out that in any case it is essential to have a speed reference connected to the analog input AI1 as in normal mode.

The use of this function can be in several fields: by the use of the asynchronous motor as an axle wrapper of a printing machine, or to limit the torque in certain machining on a machine tool.

### 5.6.9.2 Calibration

Before activating this function it is necessary to calibrate the motor as indicated in paragraph "Calibration and adjustments" from page 57.

When the motor has been adjusted correctly, you can follow these points to calibrate the function:

- If an external analogue reference is used to change the torque limit, the shielded cable must be connected to one of the analogue inputs of the drive (see section "Connector X11" on page 17). The "external torque limit " function shall then be assigned to the analog input used; To do this see the paragraph "An.Inp. X dest" on page 41.
- The torque limit can be adjusted with the analog input configured just above, or by changing the parameter "Advanced Setup → Aux Functions → Ext Torque Limit → Limit Setpoint" with the keypad. In any case, this parameter indicates the external limit set to it: if it varies by itself, it means that an analog input is connected.
- Use the "Advanced Setup → Aux Functions → Ext Torque Limit → Torque Limit" menu enable the function by changing the parameter to ENABLED.
- In the menu "Advanced Setup → Aux Functions → Ext Torque Limit → Limit Output" if the function is active, you can see the current value of the torque limit. If the function is not active, this parameter will always be 99.99 % and will not change even by changing the associated analog input.

The scale of this torque limit is as a percentage of the maximum torque of the motor. If the analog input has the standard gain values (Gain) the value of 10Vcc on the terminals corresponds to the maximum torque of 100 %; in proportion, a voltage of 5Vcc on the terminals corresponds to 50 % of the maximum torque. As always, you can change the scale of the analog input to adapt it to the signal (see section Analog input X from page 41).

## 5.6.10 JOG function

### 5.6.10.1 Generality

The JOG function is used to move the motor at a fixed or variable speed depending on a certain waveform. It is mainly used in machine tools to facilitate the grafting of the mechanical gearbox. In this function you can select 3 different types of Jog to be able to adapt it to your needs.

The rating to the Jog function is done with a digital input that can be set at will; the DI2 input is set in standard configuration.

### 5.6.10.2 Calibration

These calibrations can be made with the drive enabled and the motor in rotation; however, it must be borne in mind that during the changes of the following parameters, the motor may change its speed abruptly or reverse the direction.

1. Set the digital input to use to enable the function (standard is already on DI2). See paragraph "Dig.Inp. X Dest" on page 43. If necessary, you can enable the function with the enabled drive to see the various movements.
2. Move to the "Advanced Setup → Aux Functions → Jog Function → Jog Ref Mode" menu (paragraph "Jog ref. Mode" on page 51) and select the mode of generating the speed reference for the jog function. You can choose between:
  - **FIXED REFER:** When you enable the Jog function with the appropriate input, the motor rotates at a fixed speed. When you disable the Jog function with the digital input, the motor "locks" the normal speed reference.
  - **SQUARE WAVE:** When you enable the Jog function with the input, the function generates a "Square Wave" with a period and with an adjustable amplitude, so the motor rotates at the speed set for a certain time and then reverses the direction and turns backwards and continues in this way until the JOG command is removed.
  - **TRIANG. WAVE:** When you enable the Jog function with the selectable input (standard on DI2), the function generates a "Triangular Wave" with an adjustable period and amplitude, so the motor accelerates gradually to the speed set with the time set and then slows down gradually until you reverse the direction and reach the set speed (sign reverse). Then it slows down again and continues like this until the JOG command is removed.
3. If the mode "Square Wave" or "Triang.Wave" has been selected in point 2, you can set the waveform period: Move to the menu "Advanced Setup → Aux Functions → Jog Function → Jog Wave Time" (paragraph "Jog wave Time" on page 51) and write the period in seconds (with resolution to 1/10 sec).
4. Now you can change the rotation speed to the desired value, using the menu "Advanced Setup → Aux Functions → Jog Function → Jog ref. Speed" (paragraph "Jog ref. Speed" on page 51). This parameter can also vary while the motor is spinning to see the result obtained.

**NOTE:** It should be remembered that using the JOG function the motor moves without CNC or PLC control and the speed reference is generated within the drive according to a default function. For this reason you must always be careful not to do harm to the machine or people during its use.

## 5.6.11 Anti-backlash system

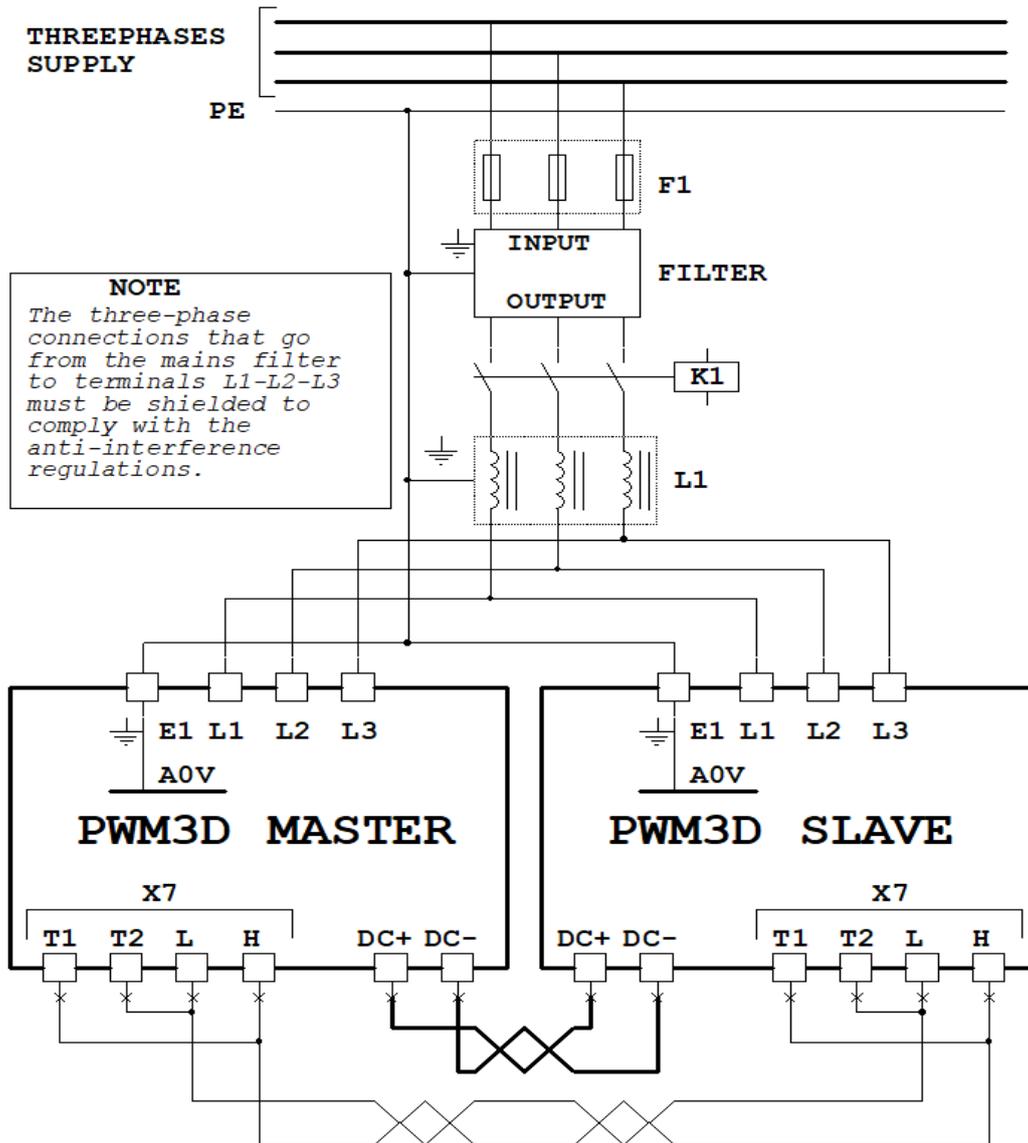
### 5.6.11.1 Generality

The task of the electric anti backlash is to eliminate the mechanical play present in the kinematic chain when gearboxes and sprocket-gear groups are used. The electric anti backlash uses two equal units, each consisting of a drive and an electric motor. The two drives ensure that the torque generated by the two motors is equal but of the opposite sign. In this way the gear teeth are in contact and the kinematic chain plays are cancelled. When the system is in motion the torque dispensed by one motor increases while that of the other diminishes keeping the play of the kinematic chain always null. The anti-backlash system uses two equal drives (same rated current). One drive is called *Master* and the other *Slave*. The *Master drive* receives all the controls from the outside and controls the system while the *Slave drive* is driven by the *Master*.

### 5.6.11.2 Connection diagram

1. Follow the connection scheme of Drawing 1 on page 11 (for THREE-PHASE power supply) or as indicated in Drawing 2 on page 12 (for DC BUS D.C. power supply) with regard to the connection of the motor, the transducer, the power supply auxiliary services and possibly the external braking resistance for both the MASTER drive and the SLAVE drive.
2. For links specific to the anti-backlash system, please follow Drawing 22 on page 56. All commands and signals coming from the CNC or PLC must be be connected exclusively to the MASTER drive. The DOK and RDY signals must be used in the MASTER drive.
3. Connect DC+ and DC- of the MASTER drive with the corresponding DC+ and DC- of the SLAVE drive, as shown in Drawing 22 on page 56. In the case of three-phase power supply the power cables must be connected to the L1-L2-L3 terminals as indicated in the drawing, in the case of direct power supply on the DC-BUS these terminals must remain empty.
4. Connect the MASTER and SLAVE drives with a twisted cable inserted on the X7 connectors of the two drives, as indicated in Drawing 22 on page 56.
5. Fuse backhoes indicated with F1 should be sized following Table 2 on page 7 (with "ultra rapid" fuses), but the current must be suitable for the dimensions of the network filter (see next point).

6. The “Network Filter” and the L1 Inductance shall be sized at a value equal to the sum of the nominal currents L1-L2-L3 of the two drives as shown in table 2 on page 7.
7. The line switch indicated with K1 can only be closed if the DOK output of the MASTER drive is +24Vcc.



Drawing 27: Connections between Master and Slave in anti backlash

### 5.6.11.3 Calibration

1. Remove the fuses indicated with F1, or disconnect the power supply of the K1 contactor reel so that the three-phase power is not given to the drives. If a DC-BUS power supply is used, it must be kept off.
2. Give the service power on both drives, check that the writings appear on the display and that no red LEDs are on.
3. On the MASTER drive you should go to the menu "Advanced Setup → Aux Functions → Anti Backlash → Anti Back Mode" (see section "AntiBack Mode" on page 49) and set the parameter by selecting "MASTER 1".
4. On the SLAVE drive you should go to the "Advanced Setup → Aux Functions → Anti Backlash → Anti Back Mode" menu (see section "AntiBack Mode" on page 49) and set the parameter by selecting "SLAVE".
5. Set the motor parameters on both the Master drive and the Slave drive one at a time, following the instructions in paragraph "Setting motor parameters" on page 57. At the end of the settings it is advisable to save the parameters for both drives (see section "Memo Parameters" on page 40).
6. It is now possible to insert the F1 fuse term, or connect the power supply to the coil of the K1 contactor to provide the three-phase power to the L1-L2-L3 inputs of the two drives. In case of use of a DC-BUS power supply, from this point it is possible to power it and make it supply the voltage on DC+ and DC-.
7. The "Autotune" function shall be used for the calculation of the motor parameters; It will be run simultaneously on both motors which must therefore have been disconnected from the mechanics and must be both free to move.

8. Follow the paragraph "Autotune for the calculation of optional parameters" from page 58, but before enabling the Master drive with the DEN command, you must also have activated the autotune function on the Slave drive.
9. Always following the above paragraph if everything has been done on a regular basis, you should see both motors rotating and autotune as indicated. At the end of the procedure, the parameters must be saved on both drives.
10. To calibrate the performance of the motors and the response of the various adjustment loops it is convenient to do the tests on the Master motor alone; when you have found the ideal parameters you can insert into the Slave drive using the keypad and LCD display.
11. In order to run the Master motor alone, you need to disable the Slave motor with the "Slave Running" menu (see page 50) on the Master drive display, setting it to "Disabled".

**NOTE:** If the motors have been mechanically disconnected you cannot enable the Slave motor otherwise it could go on speed escape since it does not have a mechanical connection to the Master motor.

12. After deactivating the Slave motor, you can continue following the instructions of paragraph "Motor speed adjustment" from page 59 in order to obtain the desired operation of the Master motor.
13. At this point you must disable the Master motor and copy the modified parameters also to the Slave drive using the LCD display of the drive.
14. Rehabilitate the Slave motor with the "Slave Running" menu (see page 50) of the Master drive by setting it to "Enabled". Save the parameters on the Master and Slave drives.
15. Switch off the switchboard and mechanically reconnect the motors to the machine transmission
16. Turn on the electrical panel and prepare all the equipment for operation. By enabling the Master motor, the Slave motor is also enabled at the same time (the RUN LEDs of both drives must be switched on).
17. With a zero speed reference, the motors must stand still. If this is not the case, change the "An.Inp.1 Offset" parameter (see page 39) of the Master drive.
18. Move to the parameter "Contrast Torque" (see page 50) to adjust the contrast torque of the two motors. Enable the system and move the motors; change the above parameter until you get a smooth axis movement at all speeds and in both directions. Generally, a value of 5 to 30 % is sufficient.
19. If the axis has not a smooth motion, you can use the "MASTER 2" mode, which uses a different algorithm.

At the end of all adjustments it is essential to save the parameters before turning off the services.

## 5.6.12 Spindle lock

### 5.6.12.1 Generality

This function is used to keep the motor shaft locked in space control, so the motor will always remain still even if the speed reference has offset or even if the motor shaft is subjected to a torque of torsion.

The drive must be enabled (DEN=ON) and the digital input associated with the function (Spindle Lock) must be active.

### 5.6.12.2 Calibration

1. Set the digital input to use for the "Spindle Lock" command from the "I/O Configure → Digital Inputs" menu and from the destination selection menu on the desired input select the item "Spindle Lock" (see paragraph "Dig.Inp. X Dest" on page 43). If you want to change the logical state of command to activate the function, you must enter (or disconnect) the logical reversal setting of the input (see paragraph "Dig.Inp. X Sign" on page 44). For safety it is better to check that there are no other inputs for this function.
2. Set the digital signal output "Reached Position" (if needed); the DO4 digital output is normally already set. To check, go to the configuration menu "I/O Configure → Digital Outputs" and from the selection menu of the source of the desired output go to check the item "Position Reach" (see paragraph "Dig.Op. X source" on page 44). If you want to change the logical state of the output when the motor is in position, you must insert (or disconnect) the logical reversal setting of the output (see paragraph "Dig.Op. X Sign" on page 45).
3. Use of the function:
  - Suppose the motor is spinning at a certain speed.
  - The CNC slows the motor down to zero speed (Zero Speed output = true) reducing the speed reference.
  - At this point the CNC activates the digital input associated with "Spindle Lock" to keep the shaft locked.
  - The drive signals the output "Reached position" to indicate that the motor is in space control.
  - At this point the motor shaft does not even move by applying a torque of torsion.
  - If the motor is to be rotated again, the "Spindle Lock" control shall be removed and the speed reference shall be brought to the required value.

**NOTE:** This function uses the space loop of the positioner function (see paragraph 5.6.13 ) then the parameters "Proport.Gain" and "Integr. Gain" are the same. If the input associated with the "Spindle Lock" function and the one associated with "Position Enable" are activated at the same time, priority is given to the positioner function.

## 5.6.13 Positioner

### 5.6.13.1 Generality

This function is used to control (with a digital input) the positioning of the motor in 4 different positions that can be selected with a combination of digital inputs.

For this function it is necessary to use a position transducer with zero reference signal (Z channel), or a resolver: positioning cannot be performed with an encoder provided with only incremental channels A and B.

If the drive is enabled (DEN = ON) and this command is provided, the drive slows the motor down to the “positioning speed” using the set ramp, if it is active (REN=ON), and then moves the motor shaft to the selected position, activating a position loop that keeps the motor locked.

When the motor shaft has reached the set position and is stationary, the signal of “Reached Position ” is indicated on a specific digital output that can be set.

The positioning control (POSITION ENABLE = OFF) must be removed to restart the motor when it is not necessary to keep it in position: The motor will accelerate to the reference speed using the set ramp, if it is active (REN=ON).

### 5.6.13.2 Calibration

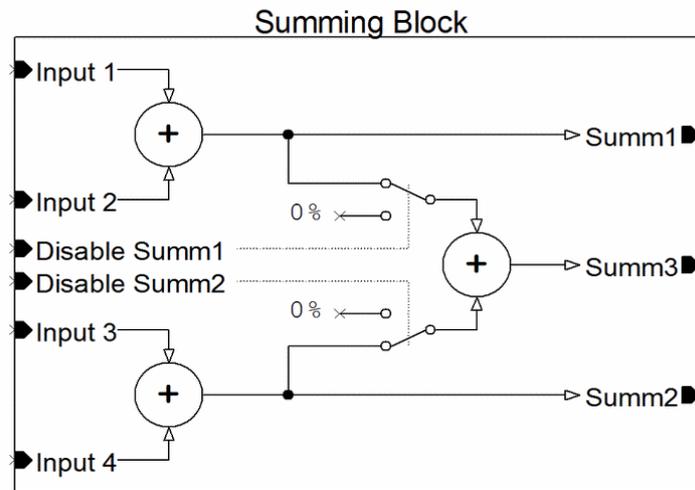
1. Set the digital input to use for the “Position Enable ” command. Normally digital input 4 (DI4) is already associated to perform this function. You can check if this is true by going to the "I/O Configure → Digital Inputs" menu and from the destination selection menu on the desired input select the item "Posit. Enable“ (see paragraph "Dig.Inp. X Dest“ on page 43). If you want to change the logical state of command to activate the function, you must enter (or disconnect) the logical reversal setting of the input (see paragraph "Dig.Inp. X Sign“ on page 44). For safety it is better to check that there are no other inputs for this function.
2. If there is a need to have more than one working position, you must set the digital inputs to use to select one of the 4 positions. If the necessary positions are only 2, you can use a digital input, otherwise 2 digital inputs are needed. To set the digital inputs to be used you can go to the "I/O Configure → Digital Inputs" menu and from the destination selection menu on the desired input select "Posit. Bit0“ or "Posit. Bit1“ (see paragraph "Dig.Inp. X Dest“ on page 43). If you want to change the logical state of command to activate the function, you must enter (or disconnect) the logical reversal setting of the input (see paragraph "Dig.Inp. X Sign“ on page 44). For safety it is better to check that there are no other inputs for this function. The table on the side shows the combination of BIT 0 and BIT 1 to select the positioning quota.
 

BIT 1	BIT 0	POSITION
0	0	Position 0
0	1	Position 1
1	0	Position 2
1	1	Position 3
3. Set the digital signal output “Position Reached” (if needed); the DO4 digital output is normally already set. To check, go to the configuration menu "I/O Configure → Digital Outputs" and from the selection menu of the source of the desired output go to check the item "Position Reach" (see paragraph "Dig.Op. X source“ on page 44). If you want to change the logical state of the output when the motor is in position, you must insert (or disconnect) the logical reversal setting of the output (see paragraph "Dig.Op. X Sign“ on page 45).
4. Setting up positions:
  - Enable the drive (DEN = ON) and give a speed reference so that the motor shaft rotates.
  - Select “Position 0 ”. This is done using the combination of the two inputs set in point 2. If only one position is used, the two inputs should be left unconnected or set to do other functions.
  - Enable positioning (POSITION ENABLE = ON).
  - The motor must slow down and then stop in the selected position without commutes or vibrations. If the motor is unstable, the proportional gain of the position loop must be reduced from the configuration menu “Advanced Setup → Aux Functions → Position Loop → Proport Gain”.
  - Remove and place the positioning command (POSITION ENABLE) for a few times until a good response is obtained.
  - At this point, keeping positioning enabled (POSITION ENABLE = ON), go to the configuration menu “Advanced Setup → Aux Functions → Position Loop → Position 0” and change the position until you move the spindle to the desired position as “Position 0”.
  - If there are other locations to store, you have to change the combination of the two digital inputs set to step 2 and then repeat the procedure as indicated in the previous step until you set all the necessary positions.
  - At the end disable the drive (DEN = OFF) and save the parameters in the Flash memory.
5. Analogue reference position: when you need more than 4 positions or if you need to change the position in real time you can use an analog input set to send its signal to “position 0 ”. In this way, by changing the analog signal you can change the position set at any time, provided you have selected the use of “position 0 ” as the current position reference.

To check the actual position that the motor has reached, you can read the position indicated by the parameter "Current Position“ (see page 51).

**NOTE:** In case of use of a multipolar resolver (from 4 poles upward), the position is NOT the actual position of the motor shaft, but that of the sinusoid currently generated by the resolver. For example, if a 6-pole resolver is used, it generates 3 complete sinusoids for each revolution of the transducer; so for every revolution of the motor shaft you get 3 times the same position. In practice in the case of a 6-pole resolver (for example), every 120° of the motor shaft will get the same position; From this you can deduce that it is not recommended the use of multipolar resolver if you want to position the motor exactly in the revolution.

### 5.6.14 Summing block



Drawing 28: Summing block

#### 5.6.14.1 Generality

This function is used to add 4 analog signals to groups of two, and to output the 3 sum values. With reference to drawing 23 we can find:

- **Input 1 ÷ 4:** It is the input signals to the block that come from the sources that have been selected. These values are added together as shown in the drawing.
- **Disable Summ1:** it can be controlled by a digital input to disable the sending of the sum 1 result to the summation 3 (as can be seen from the drawing). In rest condition (or with no associated digital input) the sum 1 value is sent to the summation 3.
- **Disable Summ2:** it can be controlled by a digital input to disable the sending of the sum 2 result to the summation 3 (as can be seen from the drawing). In rest condition (or with no associated digital input) the sum 2 value is sent to the summation 3.
- **Summ1 ÷ 3:** They are the output signals from the relative summaries, as can be seen from the drawing, and can be associated with analog outputs or with the ramp input to generate the speed reference to the motor (see paragraph "Ramp Source" on page 47).

#### 5.6.14.2 Calibration

This function does not need calibration. To use it you have to set the analog inputs that will have to provide the signals in the inputs of the summaries from the configuration menu "I/O Configure → Analog Inputs" and from the selection menu of the destination of the desired input go to select the entry "Inp.X SumBlock" (see paragraph "An.Inp. X dest" on page 41).

Each analog input has an Offset and Gain parameter that can be used to adapt the signal to the summing block as needed.

The sum results (Summ1, Summ2, Summ3) can be sent to analog outputs or to the input of the speed ramp to control the motor.

If you need to reset an external command reference, you can use one of the "DisableSumm" inputs by associating them with a digital input.

## 6 Diagnostics

### 6.1 Yellow LEDs – Commands

#### 6.1.1 Den (Drive Enable)

Display of the DEN external command status that enables the drive. For more information see the section Connector X12 on page 19.

#### 6.1.2 Ren (Ramp Enable)

Display of the external REN control status to obtain a ramp on the speed reference. For more information see the section Connector X12 on page 19.

#### 6.1.3 RTD (Reset Alarms)

Display of the external RST command status to restore normal operation of the drive after eliminating the cause that caused the alarm status. For more information see the section Connector X12 on page 19.

#### 6.1.4 DI1 (Digital Input 1)

Display the status of the external command DI1 to control a certain programmable function associated with this input. For more information see the section Connector X12 on page 19.

#### 6.1.5 DI2 (Digital Input 2)

Display the status of the external command DI2 to control a certain programmable function associated with this input. For more information see the section Connector X12 on page 19.

#### 6.1.6 DI3 (Digital Input 3)

Display the status of the external command DI3 to control a certain programmable function associated with this input. For more information see the section Connector X12 on page 19.

#### 6.1.7 DI4 (Digital Input 4)

Display the status of the external command DI4 to control a certain programmable function associated with this input. For more information see the section Connector X12 on page 19.

### 6.2 Green LEDs – Internal states and outputs

#### 6.2.1 RUN (RUN)

Signals that the drive works properly, performs the commands and powers the motor.

#### 6.2.2 DOK (Drive OK)

This led is turned on if there are no alarms and the drive gives the consent to close the power contactor on the power line (L1, L2, L3 or DC+, DC-).

#### 6.2.3 RDY (Ready)

This led is turned on if the DOK LED is on and the drive has finished the charging phase of the capacitors on the DC BUS. The drive is ready to receive the enable command (DEN) and to power the motor for operation.

#### 6.2.4 DO1 (Digital Output 1)

Display of digital output status 1. The lighting of this led means that on the corresponding digital output there is the 24V. The function of this output depends on the programming performed, but in standard configuration indicates when the motor is stopped.

#### 6.2.5 DO2 (Digital Output 2)

Display of digital output status 2. The lighting of this led means that on the corresponding digital output there is the 24V. The function of this output depends on the programming performed, but in standard configuration it indicates when the motor speed is higher than threshold 1 set.

## 6.2.6 DO3 (Digital Output 3)

Display of digital output status 3. The lighting of this led means that on the corresponding digital output there is the 24V. The function of this output depends on the programming performed, but in standard configuration indicates that the load on the motor is greater than 90 %.

## 6.2.7 DO4 (Digital Output 4)

Display of digital output status 4. The lighting of this led means that on the corresponding digital output there is the 24V. The function of this output depends on the programming performed, but in standard configuration indicates that the motor has reached the requested position.

## 6.3 Red LEDs – Alarms

### 6.3.1 FLT (Fault)

Signal that the drive is on alarm. On the LCD display you can read the cause of the alarm in order to eliminate it.

## 6.4 Alarm messages

- When the drive goes to alarm, the red FLT LED flashes and the DOK output goes to 0V.
- The cause of the alarm is clearly written on the LCD display.
- All alarms are stored if the drive is enabled (DEN command = ON).
- If the drive is disabled, alarms cease when the cause that generated them is no longer present.
- The recovery is done with the RST command (see section Connector X12 on page 19) or by pressing one of the buttons on the front.
- In case of alarm, the drive will automatically disable and no longer control the motor (motor free).

### 6.4.1 ADCB not ready

If this alarm appears, turn off the drive and notify the ALTER technical service.

### 6.4.2 ADC for AI1 fault

If this alarm appears, it means that the A/D drive relative to the analog input 1 has problems. You can try to remove the service voltage and after a few minutes restore it and see if the message disappears. Otherwise, notify the ALTER Technical Service.

### 6.4.3 Anti backlash data error

This alarm only appears with the anti-backlash function activated (see section "Anti-backlash system" from page 71). The causes of the alarm are:

- Incorrect setting of the "AntiBack Mode" parameter (see page 49) on the master and/or slave drive.
- The master and/or slave drive does not update the data exchanged on the bus or is switched off or faulted.
- There are communication errors on the bus that connects the master drive to the slave drive (X7 connector).

Operations to be carried out:

- The parameter "AntiBack Mode" (see page 49) must be set "MASTER" in the drive that controls the master motor and set "SLAVE" in the drive that controls the slave motor.
- Check that both the master drive and the slave drive that there is the illuminated display, that the writings are present and that by pressing the buttons on the front you can navigate the menu.
- Check that the twisted double connecting the X7 connectors of the two drives is connected as shown in 25 on page 68. In the presence of severe disturbances it is advisable to use a shielded cable with the two ends of the screen connected to the drive case.
- If the alarm only appears when the motor is running, you can try to disable the control of communication errors on the bus using the menu "Net Errors" on page 50.

### 6.4.4 Anti backlash slave fault

This alarm only appears with the anti-backlash function activated (see section "Anti-backlash system" from page 71) on the master drive display and indicates that the slave drive have an alarm. If you look at the front of the slave drive you should see the green LED DOK off and possibly an alarm message or a signal on its lcd display. The cause of this alarm should be sought in the slave drive and not in the master drive.

### 6.4.5 Auxiliary Supply Fault

This alarm appears when auxiliary power voltages are lower than allowed.

The causes that generate this alarm are:

1. Reductions in the supply voltage of the services.
2. Overload or short circuits on the output 24Vc.c.

In this case check:

- Control the supply voltage of the services.
- Check the current on the 24Vcc output.

### 6.4.6 Charge Fault Bus

This alarm appears when the DC BUS voltage does not reach the right value within a certain time. In this case check:

- After eliminating all power voltages (services and power), disconnect any electrical cables connected between DC+ and DC- terminals and check that they are not short circuited.
- If the DC+ and DC- terminals have no cable connected, there is likely to be an internal failure of the drive. Contact the ALTER Technical Office.

### 6.4.7 Capacitor Over Temperature

This alarm appears when the temperature of the capacitors on the D.C. Bus higher than allowed.

The causes of the alarm are:

1. Temperature inside the electrical panel too high.
2. Insufficient internal ventilation of the drive.
3. Heavy use of the motor.

In this case check the proper functioning of the cooling fans or air conditioners of the electrical panel.

**NOTE:** If the motor is used harshly, it may be necessary to mount an optional "capacitive module" outside the drive (our module 13/007).

### 6.4.8 Clamp Overload

This alarm appears when the resistance of the internal clamp to the drive has exceeded the temperature of 135 °C.

The causes of the alarm are:

1. High number of consecutive motor stops.
2. Stop times too short.
3. Load inertia too high.
4. High number of consecutive accelerations and decelerations of the motor.
5. Incorrect defect or fitting of the transducer mounted on the motor.
6. Speed loop instability.

Operations to be carried out:

- Reduce the performance of the machine.
- Check the size of the drive.
- Use a larger drive.
- Use external resistance to the drive.
- Adjust the time constants of the speed loop.
- Check the X3 connector (see paragr. 4.4.1 at page 14):
  - There must be a bridge between PINs 1 and 2, if you do not use a thermistor on the external clamp resistance.
  - Any thermal probe in the motor must be connected between PINs 3 and 4, or these pins may be left empty.

**Notes:** More information is available in paragraph "Clamp resistor" on page 14. In case of need contact the technical service ALTER to size the external resistance.

### 6.4.9 D.C. Bus overvoltage

This alarm appears when the DC BUS voltage exceeds the maximum allowed. In this case check:

- If an external clamp resistance is used, check that the circuit between the Rest+ and R- terminals is not interrupted.
- In case of use of the internal clamp resistance to the drive, check that the bridge between the Rint+ and R- terminals is mounted (see drawing 1 on page 11).

- In the case of power supply on DC+ and DC- terminals (as in drawing 2 on page 12), check that the power supply unit functions regularly without alarms and that the voltage does not exceed 800Vcc.
- If all the previous controls have not given any results, then there may be an internal failure of the drive: contact the ALTER Technical Office.

#### 6.4.10 D.C. Bus under voltage

This alarm appears when the DC BUS voltage drops below the minimum allowed. In this case check:

- If the power supply is on L1, L2, L3 check the right size of the cables and any transformers upstream of the drive according to the power required by the motor to operate.
- If the power supply is on DC+ and DC- check that it is not less than 50Vcc.

#### 6.4.11 Digital Output Over load

This alarm appears when an overload or short circuit occurs on one or more digital outputs. The causes that generate this alarm are:

1. Overload or short circuits on one or more outputs.
2. Capacitive load on one or more exits.

Operations to be carried out:

- Check the insulation of the connection cables between the drive outputs and the relays or PLC inputs
- Check the feed data and the absorption of relay or PLC coils
- Insert a resistance of 100 Ohm 1/2 W in series at each output that drives a capacitive load.

#### 6.4.12 Drive Over current

This alarm appears when the current output from the drive is higher than the maximum allowed value.

The causes of the alarm are:

1. Short circuit on the connecting cables or on the motor windings.
2. Short-circuit or dispersal to the ground of the connecting cables or the windings of the motor.
3. Bad contacts on terminals (oxidised or loose TERMINALS)
4. Susceptible interruptions of the motor connection cables.
5. Current loop time constants too fast.

In this case check:

- Check the continuity and isolation of the connecting cable between the motor and the drive.
- Check the status of the TERMINALS and their clamping
- Check the windings of the motor.
- Reduce the proportional gain of the current loop (see section "Pi Current Loop" from page 54).

**Note:** Cable failures are more frequent in the case of mobile installation. motor failures are more likely if they reach high operating temperatures.

#### 6.4.13 Feedback fault

This alarm appears when the drive detects the failure or error in the signals provided by the transducer mounted in the motor.

The causes of the alarm are:

1. Transducer failure mounted in the motor
2. Incorrect setting of type, data or direction of the transducer
3. Error in transducer and drive links
4. Interruption or short circuit in the connection cable between transducer and motor
5. False contact or failure to insert connectors mounted on the motor and on the drive.
6. Disturbances on the connection cable between transducer and motor.
7. Failure in the power circuit that feeds the motor (if the alarm intervenes a few seconds after lighting of the RUN LED and the motor does not move).

Operations to be carried out:

- Run the AutoTune to check the direction of the transducer.
- Check the continuity and isolation of the conductors inside the shielded connection cable of the transducer.
- Check the welds and shield continuity on the motor, intermediate and drive connectors.
- Check that the cable shield is connected to the ground both on the motor and on the drive.
- In case of failure in the power circuit you must contact our service service for repair.

### 6.4.14 Feedback X14 Fault

This alarm appears when the drive detects the failure or error in the signals provided by the transducer connected to the X14 connector and mounted in the motor.

The causes of the alarm are:

1. Transducer failure mounted in the motor
2. Incorrect setting of type, data or direction of the transducer
3. Error in transducer and drive links
4. Interruption or short circuit in the connection cable between transducer and motor
5. False contact or failure to insert connectors mounted on the motor and on the drive.
6. Disturbances on the connection cable between transducer and motor.
7. Signal level too low or high (in the case of resolver, SinCos, phonic wheel or EnDat).

Operations to be carried out:

- Run the AutoTune to check the direction of the transducer.
- Check the continuity and isolation of the conductors inside the shielded connection cable of the transducer.
- Check the welds and shield continuity on the motor, intermediate and drive connectors.
- Check that the cable shield is connected to the ground both on the motor and on the drive.
- See paragraph "Optional transducers" from page 59 to check the transducer's operation.

### 6.4.15 Heat sink Over Temperature

This alarm appears when the heat sink temperature of the drive bridge is greater than that allowed.

The causes of the alarm are:

1. Temperature inside the electrical panel too high.
2. Insufficient internal ventilation of the drive.
3. Material deposited on the radiator that prevents cooling.

In this case check the proper functioning of the cooling fans or air conditioners of the electrical panel.

### 6.4.16 Lack of one supply phase

This alarm appears when the drive detects the lack of ONE power supply phase on L1, L2, L3. The causes that generate this alarm when the drive is enabled (led DEN) are:

1. An interrupted fuse on the power line.
2. Power line strongly disturbed or with "net holes".
3. Opening the switch on the three-phase power line before disabling the drive (led DEN off).

Operations to be carried out:

- Check the power fuses.
- Make the right command sequence of the contactor on the three-phase line (see section 4.6 on page 20).

### 6.4.17 Lack of three supply phase

This alarm appears when the drive detects the lack of at least TWO power supply phase on L1, L2, L3. The causes that generate the alarm when the drive is enabled (led DEN) are:

1. Three-phase/monophase supply voltage too low.
2. Lack of two or more stages of three-phase/monophase feeding.
3. Opening the switch on the three-phase power line before disabling the drive (led DEN off).

Operations to be carried out:

- Check the power fuses.
- Check the power supply voltage with a tester.
- Make the right command sequence of the contactor on the three-phase line (see section 4.6 on page 20).

### 6.4.18 Motor Overtemperature

This alarm appears if the motor is overheated, if the drive block is enabled in case of motor over-temperature and if the set time has elapsed. motor temperature control shall be carried out using the PTC probe to be integrated into the motor under construction; it shall be like a closed contact when the temperature range is correct and shall be like an open contact when the maximum motor temperature is exceeded. To disable this alarm or change some signaling modes, see paragraph "Motor temperature" on page 65.

### 6.4.19 Power supply frequency error

This alarm appears when the drive detects a wrong power frequency on the three-phase power line (L1, L2, L3). In this case check the frequency of the network which must be 50 Hz or 60 Hz.

**NOTE:** This alarm can also appear in the case of mounting the three-phase filter after the contactor installed on the three-phase supply line. The network filter **MUST** be installed before the contactor, as indicated in drawing 1 on page 11.

### 6.4.20 Presence of L1-L2-L3

This alarm appears when you have selected the power mode via DC+ and DC- terminals (see paragraph "Power supply from" on page 57), but the drive detects the presence of voltage on the terminals L1, L2, L3. This is a wrong situation because power the drive directly on the DC BUS (as from drawing 2 to page 12) there must be no voltage on the terminals L1, L2, L3. So there is some setting error or electrical connection on the terminals.

### 6.4.21 Temper. Sens. Damaged

This alarm appears when the drive detected a fault to a temperature sensor mounted inside it: turn off the drive and notify the ALTER technical service.

### 6.4.22 Three-phase supply High

This alarm appears when the three-phase/monophase power supply voltage on the L1, L2, L3 is beyond the maximum permitted (see the drive plate). In this case, immediately remove the power supply voltage and check its value with a tester.

### 6.4.23 Trans board firmware wrong

If this alarm appears, it means that the optional card mounted at the X14 connector is not compatible with the drive. You can try to remove the service voltage and after a few minutes restore it and see if the message disappears. Otherwise, notify the ALTER Technical Service.

### 6.4.24 Trans board missing

If this alarm appears, it means that the optional card mounted at the X14 connector was previously working but is now no longer visible to the drive. You can try to remove the service voltage and after a few minutes restore it and see if the message disappears. Otherwise, notify the ALTER Technical Service.

### 6.4.25 Trans board watchdog

If this alarm appears, it means that the optional card mounted at the X14 connector does not work properly. You can try to remove the service voltage and after a few minutes restore it and see if the message disappears. Otherwise, notify the ALTER Technical Service.

### 6.4.26 Type jumper error

If this alarm appears, turn off the drive and notify the ALTER technical service.

### 6.4.27 Watchdog timeout

If this alarm appears, turn off the drive and notify the ALTER technical service.

## 6.5 Reporting messages

- When the drive writes a signal message, the DOK output does not change its logical state, but the drive is not enabled by giving the DEN command.
- The message is clearly written on the LCD display.
- The message disappears when providing the RST command (see section on Connector X12 page 19) or by pressing one of the buttons on the front.
- Normally, these messages only appear during commissioning or when auxiliary services are powered.

### 6.5.1 Drive Overload Limit activated

This message appears when the drive has delivered a higher current than that of continuous service and the heat sink has reached its maximum temperature under those conditions. **The output current is gradually reduced** to that of continuous service to avoid damaging the drive.

The causes that generate the message are:

1. Mechanical load greater than expected.
2. Acceleration times too short.
3. Load inertia too high.
4. High number of consecutive accelerations and decelerations of the motor.

5. Temperature in the high electrical cabinet.

Operations to be carried out:

- Reduce the performance of the machine.
- Check the lubrication of the machine.
- Check the size of the drive.
- Use a larger drive.

### 6.5.2 Elec. Gear change defective

This message may appear if the function of "Electronic gamma change" (see section "Stage Function" on page 48) is active and the contactors control function is also active (see section "Check Contactors" on page 49).

It indicates some problems in switching or detecting the actual closing of remote switches connected to the motor power circuit. Below are the possible causes:

1. There is no connection of the wires and auxiliary contacts on the contactors.
2. The auxiliary contacts of the contactors are connected to the wrong digital input.
3. The contactors do not close due to the interruption of the coil supply circuit.
4. The auxiliary relay that is controlled by the drive does not work.

In this case check:

- Connect the electrical wires to the auxiliary contacts of the contactors following the diagram of drawing 25 and drawing 26 on page 68.
- Check that the auxiliary contact of the "Stage 0" contactor is connected to the digital input set as "Check Stage 0" and that the auxiliary contact of the "Stage 1" contactor is connected to the digital input set as "Check Stage 1". If necessary, follow the paragraph "Calibration" on page 68.
- Visually check if contactors close when changing the selection of the speed range. When on the "Advanced Setup → Aux Function → Elec.Gear Change → Selected Gear" menu there is the words "STAGE 0" you have to close the contactor STAGE 0 (slow range), instead when there is the word "STAGE 1" you have to close the contactor STAGE 1 (fast range).
- Check the contact in exchange of the auxiliary relay.

### 6.5.3 Enter the motor date

This message appears when you try to enable the drive to work with the DEN command, but you have not introduced the necessary motor parameters (see paragraph "Setting motor parameters" on page 57).

Operations to be carried out:

- Enter ALL motor data as indicated in paragraph "Setting motor parameters" on page 57.

### 6.5.4 Full scale of FBK X14 inputs

This message appears when the drive detected too high a voltage signal on one of the pins of the X14 connector connected to the transducer mounted in the motor. If the signaling occurs occasionally and giving the alarm reset command (RST) this message disappears, then it is a disturbance that occurred on the transducer connection cable. Instead, if the writing remains, it means that the transducer actually has too high a signal. Depending on the type of transducer card installed, you can try to fix the problem:

- Resolver card (01/324): try turning the visible trimmer next to the X14 connector, in the anticlockwise direction and give the alarm reset command (RST) to see if the message disappears.
- SinCos card (01/325): check the wire wiring between the X14 connector and the transducer in the motor. If the problem is not solved, the cause could be an incompatible or faulty transducer. Contact the ALTER Technical Service.
- Phonic wheel card (01/326): in some cases of transducers with signals not calibrated correctly, this alarm may occur. To solve the problem you need to add a suitable resistance in series to the RA and RB wires (X14 pin 4 and 7). Contact the ALTER Technical Service.
- EnDat card (01/327): check the wire wiring between the X14 connector and the transducer in the motor. If the problem is not solved, the cause could be an incompatible or faulty transducer. Contact the ALTER Technical Service.

### 6.5.5 L1 – L2 – L3 Offset calc.

This message may appear after providing auxiliary services, if there is voltage on the L1, L2 and L3 terminals. To avoid this problem it is recommended to do the control circuit of the line switch as recommended in drawing 3 on page 13.

### 6.5.6 Low bus voltage for this motor

This message indicates that the voltage of the DC Bus is low in order to power the motor with its nominal voltage parameters. The appearance of this message does not indicate an anomaly or failure of the drive, but only indicates that the motor cannot deliver the rated power. The causes of this alert may be:

- Wrong maximum voltage parameter "Maximum voltage ".
- Power supply voltage on L1,L2,L3 or DC+, DC- too low to power that type of motor.
- Three-phase connection cables of small section that make voltage fall.

In this case check:

- The voltage on the DC BUS with the parameter "DC Bus Voltage"(see page 46), while the motor is under load.
- Calculate the maximum power supply voltage of the motor with:  $\frac{V_{bus}}{\sqrt{2}}$
- Consider keeping a certain margin between the voltage set in the parameter "Maximum voltage " and the value calculated at the previous point (at least 10 %), due to the increase in the voltage on the motor when it delivers the maximum power.
- In extreme cases where the motor does not provide sufficient power for machining, it can be tried to improve the situation by switching the operation to HighSpeed (see parameter "Motor Type" on page 35).

### 6.5.7 Memoria Flash non protetta

If this message appears, the drive must be returned to the ALTER for a check.

### 6.5.8 Memory Flash error

This message appears after storing parameters on the flash memory if the system realises that the written data is not right. In this case you can try again the storage, but if the message continues to appear you must contact the technical service ALTER.

### 6.5.9 Missing motor param. option

This message appears when you try to enable the drive to work with the DEN command, but you have not entered the optional motor parameters or you have not yet run the Autotune (see paragraph "Autotune for the calculation of optional parameters" on page 58).

Operations to be carried out:

- Enter the optional motor parameters or perform the Autotune procedure as indicated in paragraph "Autotune for the calculation of optional parameters" on page 58.

### 6.5.10 Overrun Control Loop

If this message appears, the drive must be returned to the ALTER for a check.

### 6.5.11 Warning!!! Motor Overtemp.

This message appears if the motor is overheated and if the drive stop is enabled in case of motor over-temperature; When the message appears it means that the PTC probe installed in the motor has just taken, when the time set in the "Drive FLT delay" menu has elapsed (see page 52), the drive will go in bulk. motor temperature control shall be carried out using the PTC probe to be integrated into the motor under construction; It must be like a closed contact when the temperature range is correct and must be like an open contact when the maximum motor temperature is exceeded (see section "Motor temperature" on page 65). To disable this alarm or change some signaling modes you can use the "Motor overtemp" menu (see page 52).

### 6.5.12 Wrong feedback PPR/Pole setup

This message may appear during the Autotune procedure (see paragraph "Autotune for the calculation of optional parameters" on page 58), and indicates that there is some incorrect setting in one or more of the following parameters:

- Setting pulses/revolution encoder (see paragraph "Encoder Lines" on page 37).
- Pole motor (see paragraph "Motor pole" on page 36).
- Poli resolver (see paragraph "Resolver Pole Pair" on page 37).

## 6.6 Diagnostic menu

On the LCD display there is a menu group called "Diagnostic " which brings together some important parameters that can be displayed in case of need.

For more information please refer to the appropriate paragraph "Diagnostic" from page 45 with the full list of parameters.

# 7 Annexes

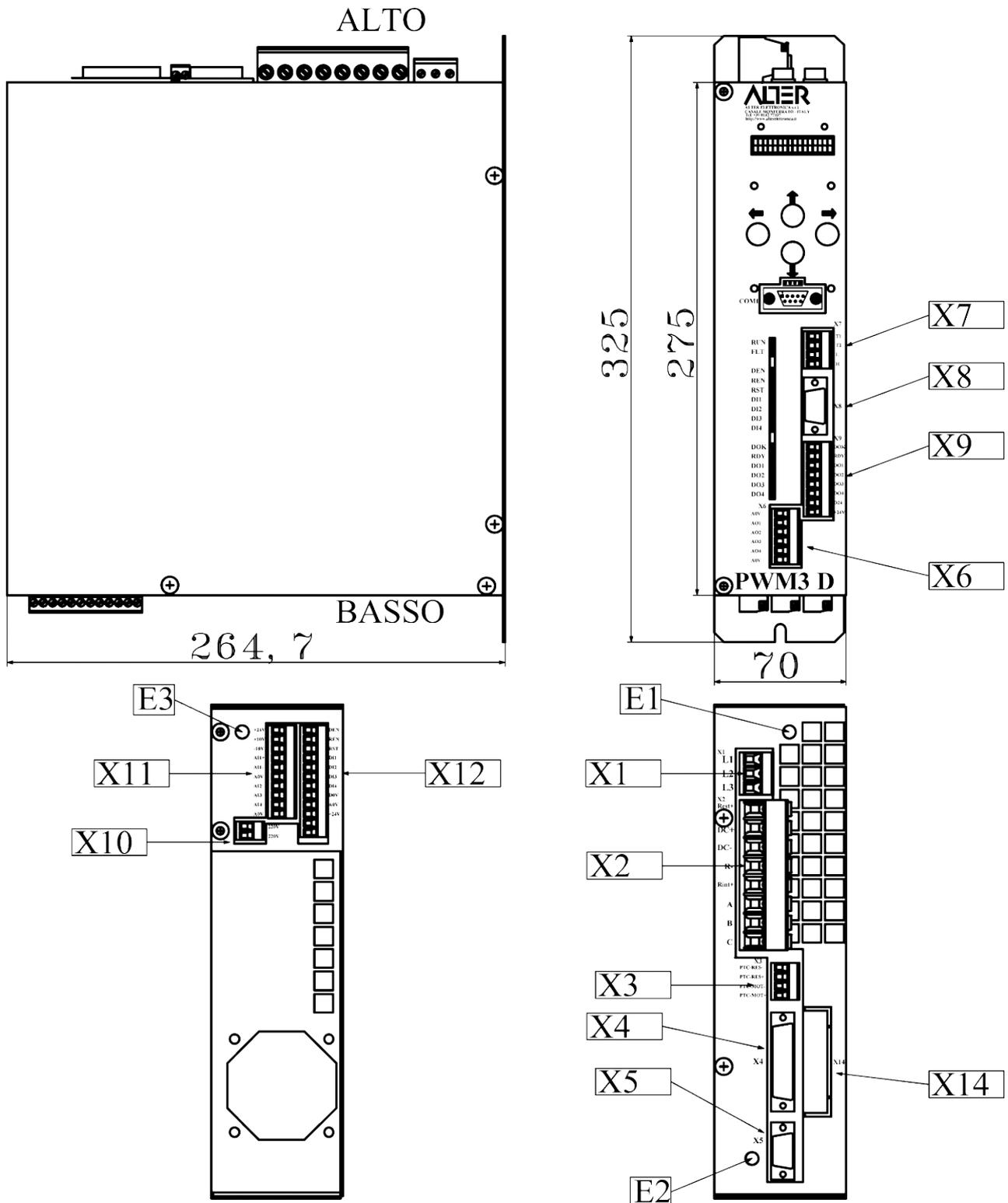
## 7.1 Led Summary Table

*The following table lists the components as they appear on the front of the drive, starting from the top left edge.*

NAME		DESCRIPTION	Reference page
RUN	Run	Drive running	76
FLT	Fault	Alarm drive	77
DEN	Drive Enable	Drive enable command	76
REN	Ramp Enable	Ramp Enable Command	76
RTD	Reset	Alarm reset command	76
DI1	Digital Input 1	Digital input control n.1	76
DI2	Digital Input 2	Digital input control n.2	76
DI3	Digital Input 3	Digital input control n.3	76
DI4	Digital Input 4	Digital input control n.4	76
DOK	Drive OK	Digital output DOK status	76
RDY	Ready	Digital output RDY status	76
DO1	Digital Output 1	Digital output 1 status	76
DO2	Digital Output 2	Digital output 2 status	76
DO3	Digital Output 3	Digital output 3 status	77
DO4	Digital Output 4	Digital output 4 status	77

# 8 Mechanical characteristics

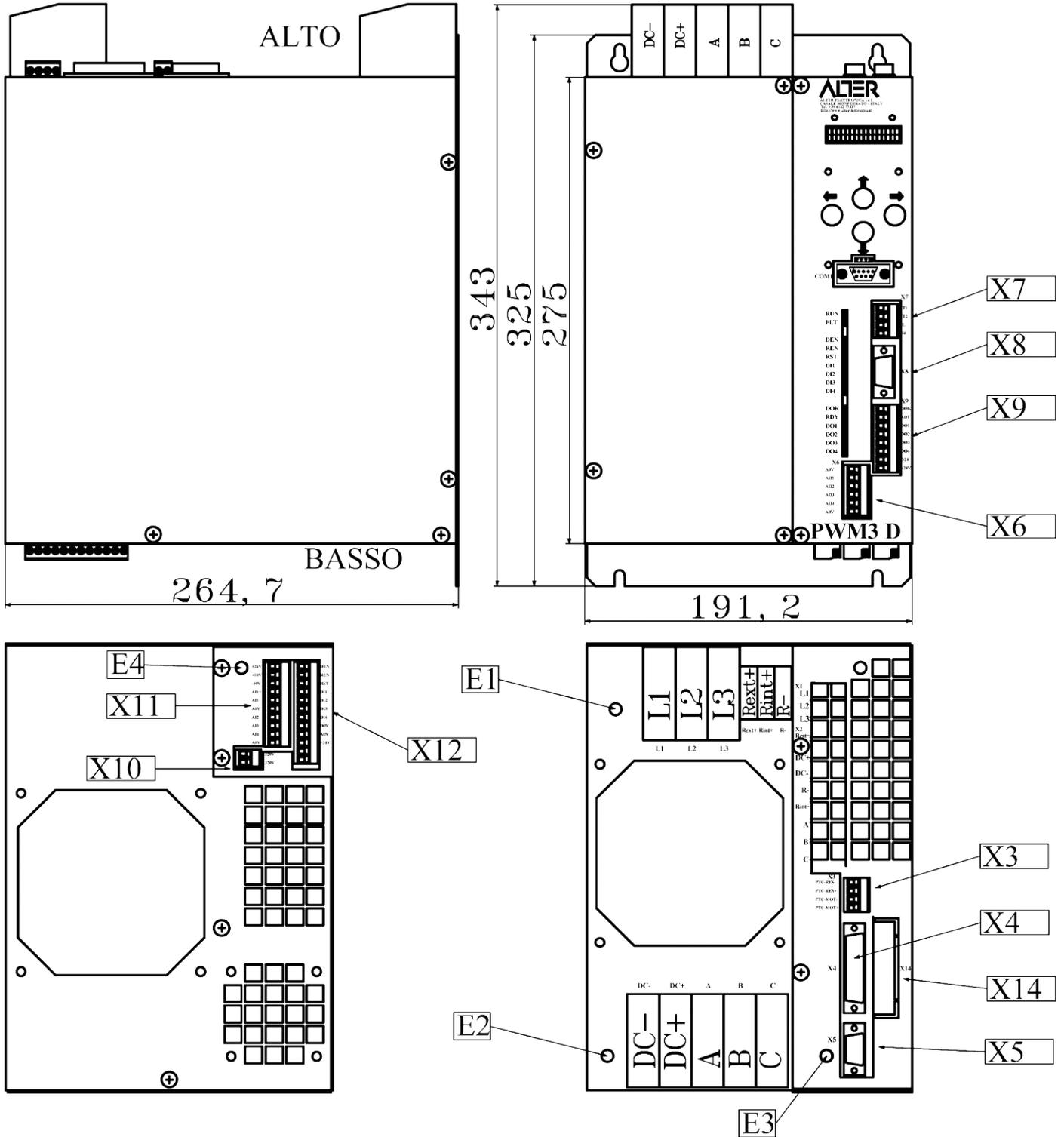
## 8.1 Size 1



Drawing 29

Mass: 4,6 Kg

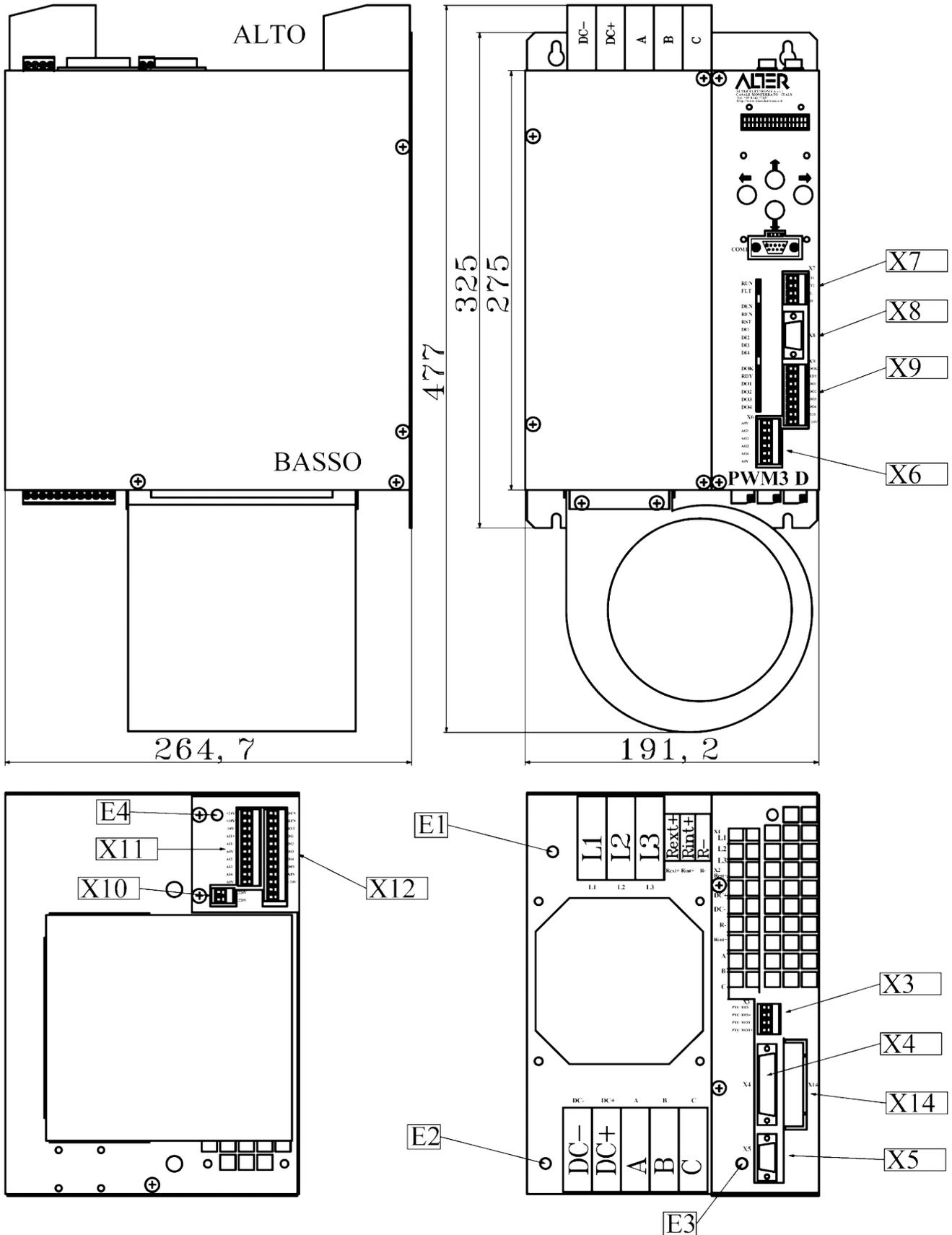
**8.2 Size 2**



Drawing 30

Mass: 12 Kg

### 8.3 Size 3



Drawing 31

Mass: 14 Kg

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