

DMBL

DMBL

User's manual

TDE MACNO

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1. GENERAL SAFETY INFORMATION

All the drives manufactured by TDE MACNO S.p.A. which belong to the **DMBL** series are comply with the Low Voltage Directive (LVD) **CEE 2006/95/CE**



In their manufacture parts and articles have been applied which comply with the harmonising legislation **EN 60204-1**.

Important safety norms

For the manufacturer, control and valuation, parts and articles of the following standards have been applied:

- CEI EN 60204-1 Ed. 2006
- CEI EN 60800-3 Ed. 2005
- CEI EN 61800-5-2 Ed. 2007

1.1. WARNINGS

- **Carefully read the manual before installing and using the equipment.**
- **The manufacturer declines any liability for any improper use of the equipment different from that set out in the manual.**
- **No alteration or operation not prescribed by the manual is permitted except with the express authorisation of the manufacturer, and must be carried out by qualified personnel. Failure to observe this rule will mean that the manufacturer shall decline any liability for any possible consequences and the guarantee will cease to have effect.**
- **The setting up and installation may only be carried out by qualified personnel who are responsible for observance of the safety rules imposed by the laws in force.**
- **If the drive is installed without the proper E.M.C. filter and plugged in low voltage public mains supply, it can cause radio frequency noises or interferences.**
- **In the specific case for which the equipment is being used it is necessary to take into account the safety regulations for the prevention of accidents. The installation, cabling and opening of the equipment and the drive must all be done with the voltage supply cut off.**
- **Equipment and drives must be installed in a contact proof case with IP grade protection which complies with the norms.**
- **Position the equipment in such a way that access for maintenance operations is easy and that there is no danger of interference with moving parts.**
- **Ensure that there is always sufficient ventilation to discharge what is lost from the drive.**
- **Do not use extinguishers containing water when there is fire in proximity to the equipment.**
- **Avoid at all times the penetration of water and other fluids into the equipment.**
- **Any work carried out within the equipment must be done with the supply of voltage cut off. As there are condensers wait at least 8 minutes before accessing the inside of equipment to work on it.**

2. TECHNICAL DATA

2.1. TECHNICAL POWER CHARACTERISTICS

Caratteristiche DMBL-MODEL		03	07	10	12	15	20
Nominal output current $I_n^{(1)}$	[Arms]	3	7	10	12	15	20
Transient overload 2,5s $f > 2,5\text{Hz}$	[Arms]	6	14	20	24	30	40
Output voltage	[Vrms]	Vout max = Vi x 0,94					
Frequency output	[Hz]	0 ÷ 400					
Ingresso rete / Main supply							
Main supply voltage (Vi)	[Vrms]	180 ÷ 240 Vac					
Mains frequency	[Hz]	45 ÷ 65					
D.C. link voltage (accessible)	[Vdc]	254 ÷ 340 Vdc					
Input current at rated power ($\Delta V=3\%$)	[Arms]	3	7	10	12	15	20
Controllo / Control							
Modulation system		Vector PWM					
PWM frequency		5 ÷ 10kHz					
Speed reference signal		<ul style="list-style-type: none"> ● n.1 speed analog input -10V...0...+10V ● n.3 programmable internal digital references (15bit resolution) ● 2 channel frequency input (A,/A, B,/B) or FREQ. and UP/DOWN 					
Circuito di frenatura / Braking circuit							
Continuous clamping current	A	2.5	5	5	6	10	10
Max peak current	A	5	10	10	12.5	15	15
Braking resistor (suggested)	Ω (W)	82 (100)	47(100)	47(100)	39(100)	27 (200)	27 (200)
Camping Voltage	[Vdc]	380 Vdc					
Controllo / Control							
Modulation system		Vector PWM					
PWM frequency		5 ÷ 10kHz					
Speed reference signal		<ul style="list-style-type: none"> ● n.1 speed analog input -10V...0...+10V ● n.3 programmable internal digital references (15bit resolution) ● 2 channel frequency input (A,/A, B,/B) or FREQ. and UP/DOWN 					
Circuito di frenatura / Braking circuit							
Continuous clamping current	A	2.5	5	5	6	10	10
Max peak current	A	5	10	10	12.5	15	15
Camping Voltage	[Vdc]	380 Vdc					

2.2. TECHNICAL CHARACTERISTICS OF REGULATION

<p>TECHNICAL CHARACTERISTICS</p>	<ul style="list-style-type: none"> • Full digital regulation (digital speed and current loop) • Four quadrant independent ramps • Motor speed and position feedback from resolver • Speed reference options : <ul style="list-style-type: none"> ◆ analog ($\pm 10\text{ V}$) on the connector ◆ digital from keypad or serial line ◆ frequency input as pulses and sign ◆ frequency input as bidirectional encoder (two channel at 90°) • Torque and current limit analog references ($\pm 10\text{ V}$) on the connector or digital references programmed in memory from keypad or from serial line. • Enabling inputs insulated with optocouplers • Simulated encoder output , two channels and zero signal, number of pulses per revolution selectable by keypad from 64 to 4096 • Resolver phase self-tuning • Current loop gain automatic calibration (self acquisition of motor inductance) • Resolver reading automatic change in order to maintain the max. resolution with the working speed • Different PI gain setup relative to different speed rates • Protections activation shown on keypad display and through the serial lines • On board clamping circuit (except clamping resistor) • Self supplied cooling fan (if necessary) • Built-in current insertion limitation circuit • Transitory overloading (up to 2.5sec) to twice the nominal current, with automatic reentry to the nominal current. • Regulation auxiliary power supply input (with transformer). • E.M.C. filter included.
<p>SIGNALS</p>	<p>N.8 digital opto-insulated outputs (L.I.1...L.I.8) (sample time: 1ms)</p> <ul style="list-style-type: none"> • n.1 predefined RUN input • n.7 programmable inputs <p>N.3 digital opto-insulated outputs (L.O.1...L.O.3) (sample time: 1ms)</p> <ul style="list-style-type: none"> • programmable outputs <p>N.3 types of speed reference</p> <ul style="list-style-type: none"> - analog speed reference ($\pm 10\text{V}$) - frequency speed reference (2 channel or frequency and direction) - 3 digital internal references (JOG) <p>N.2 programmable analog outputs (sample time: 1ms)</p> <ul style="list-style-type: none"> • configurable outputs. <p>N.2 analog references</p> <ul style="list-style-type: none"> • analog torque reference T.REF • analog current limit reference I.LIM <p>Tacho output</p> <p>Voltage reference output +10V $\pm 2\%$, max current = 10mA</p>
<p>PROTECTIONS</p>	<ul style="list-style-type: none"> • Drive overheating protection (thermal block on radiator) • Motor overheating protection (thermal block) • Motor overload protection (I^2t) with re-entry of current limit at nominal value of the motor or with drive block • Protection against power short circuit • Minimum and maximum voltage protection in DC intermediate circuit • Protection in case of mains failure
<p>REGULATION POWER SUPPLY</p>	<p>achieved using a fly-back circuit directly from the intermediate continuous current circuit.</p> <p>possibility of using auxiliary power supply at one-phase 220Vac (with insulation transformer max.30VA) to provide the supply the regulation without three-phase power mains.</p>
<p>OPTIONS</p>	<p>Signal levels of simulated encoder from +5V÷+24V with external supply (not opto-insulated) One-phase supply 180-240Vac (only for DMBL-03, -07)</p>

3. INSTALLATION

3.1. DRIVE INSTALLATION INSTRUCTIONS

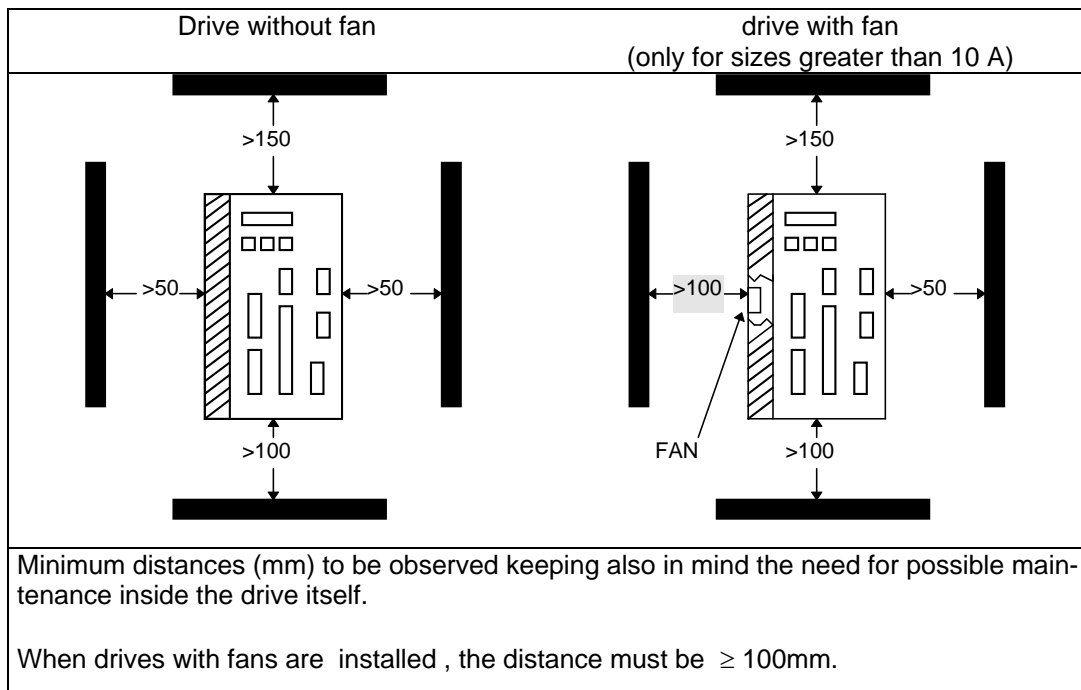
The drive must be installed in a **vertical** position. If It was installed slantly or horizontally, heat convection would be not regular, and it could lead to a drive damaging. All of the control elements must remain well accessible.



The life and proper working of the drive depend on the maintenance of the ambient temperature between the allowed values of 0°C to +45 °C. The temperature must thus be checked regularly
Relative air humidity must be below 90% with no condensation formation .

The drive must be installed in a dust-free and well-ventilated place. Avoid environments where there are aggressive gases insofar as the presence of abrasive dusts, steam, nebulised oils and salt air could prejudice the long life of the equipment.

Other equipment should be mounted at sufficient distance from the drive to avoid any metallic residues from drilling or electrical cables falling into the drive. The drive should never be installed near to easily inflammable materials.



The drive must not be installed in an ambient which is subject to strong vibrations ; if the equipment upon which it is installed is mobile suitable cushioning systems must be provided.

3.2. ENCLOSED ENVIRONMENT, DISSIPATED POWER

The power dissipated by the drive working under nominal load, including losses from ventilation and regulation is shown in the following table.

POWER LOSSES at nominal output current, $V_{in}=220Vac$, f switching=5kHz	
DRIVE-TYPE	Watt
DMBL-03	50
DMBL-07	90
DMBL-10	120
DMBL-12	140
DMBL-15	160
DMBL-20	160

In the case of installation in an enclosed environment, e.g. in a cabinet, it is necessary to take care that the internal temperature does not exceed the ambient temperature allowed for the drive (+ 45 °C). The environment may, if necessary, be ventilated with sufficient air flow to take away the heat generated by the drive and other components.

3.3. VENTILATION

A drive may not be installed in the air cooling flow of another drive or other plant. The fans of the servo-ventilated drive must be installed considering the optimal cooling air flow (see figure).

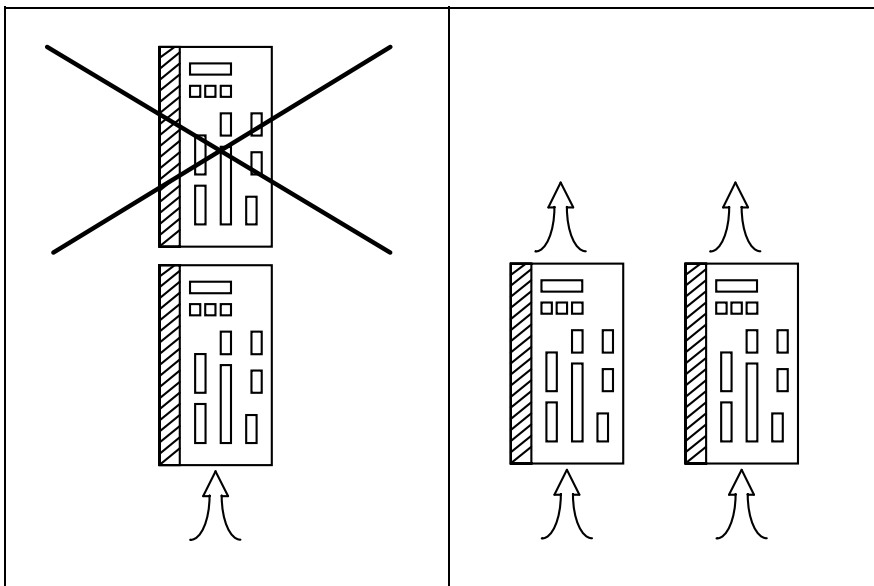
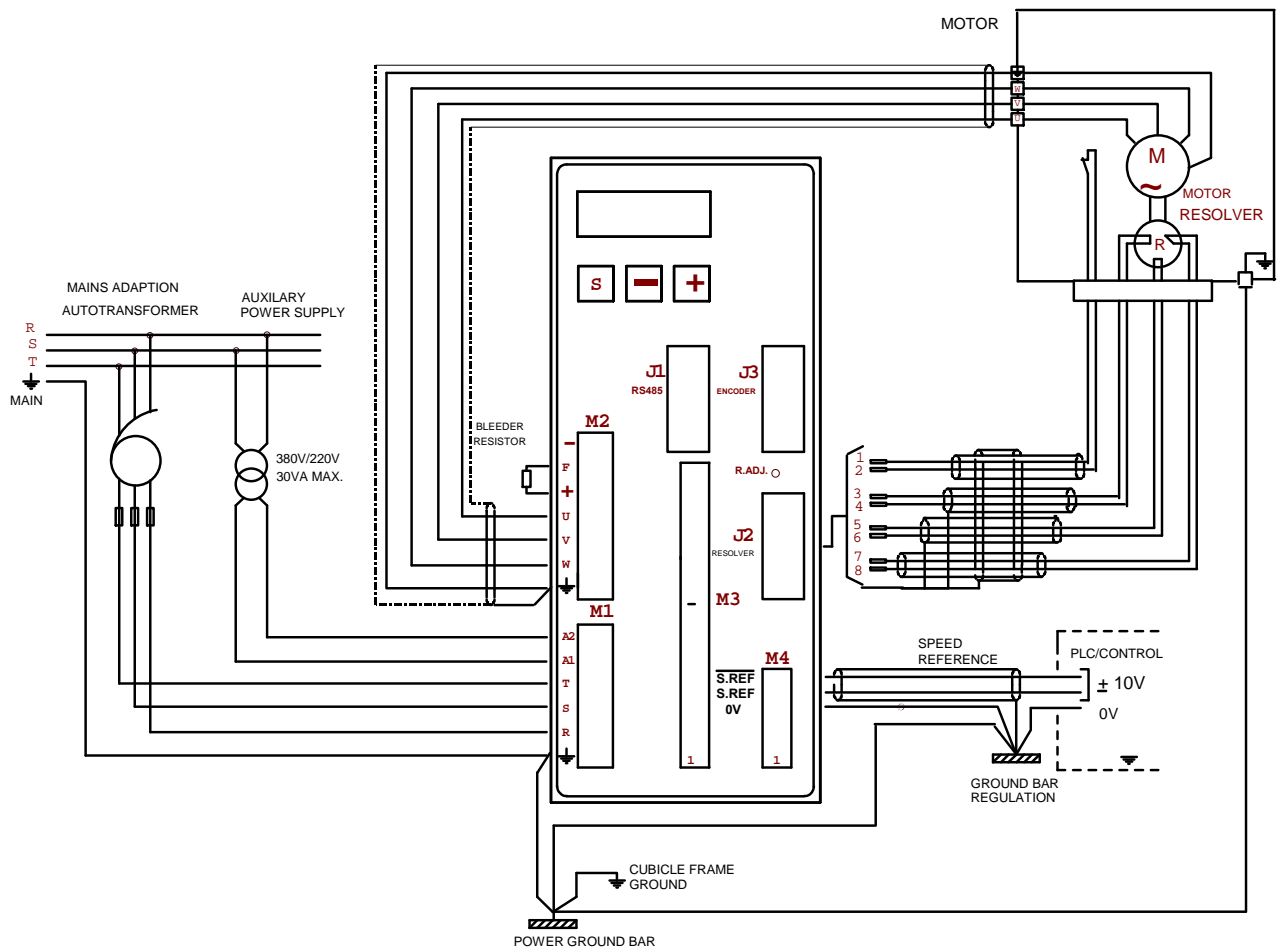


Fig. 1

4. POWER: CONNECTIONS AND SIZING



4.1. MAINS CONNECTION

To ensure compliance with safety restrictions drive mains connection must be carried out in accordance with the law currently in force governing electrical equipments. The connection to the mains may be made with either a transformer or an autotransformer.

Connection to the drive must be stable and with cables of sufficient diameter for the three-phases, the terminals marked R S T and the ground and the PE \perp .

The 3A and 7A drives can be supplied with single-phase 220Vac voltage, connecting the mains to two of the R,S,T pins. The selected couple is influent. When the drive is ordered it is strongly recommended to specify "single-phase", to have increased capacity in the DC bus.

4.2. CONNECTION WITH MOTOR

Make the connections as shown in the above figure .

The choice of the line cables shall take account of the current absorbed by the motor (see rating plate) and the current required by the single drive, calculated according to the required power multiplied by 1.1 (current form factor) . The motor must connected to the terminals marked U, V and W with the ground cable connected to the PE \perp .

The U,V,W phases short circuit causes the drive block.

In case of interruption between the motor and the drive by means of electromagnetic switches (remote switches, thermal relays etc.) it is necessary to ensure the drive being disabled before the interruption in the motor-drive connection.

The advance time on the blocking of the drive can be obtained by simply playing on the delay of the opening of the electromechanical parts; however a minimum time of 30 ms is required.

4.3. DRIVE GROUND CONNECTION

The leakage current is the current that the drive discharges to the ground connection. The amount of this leakage current depends on the length of cable, the presence or otherwise of the shield, being greater in the former case, and on the motor and the PWM frequency value.

Any anti-disturbance filters present can also increase the current leakage. The leakage current contains high frequency disturbance variables. To avoid electromagnetic compatibility problems with other equipment, the drive's ground connection must, as far as possible, use its own cable with proper diameter.



The drive cannot work without a protection conductor surely connected to ground.

4.4. TRASFORMER AND PROTECTIVE FUSES SIZING

Power need of each single drive, considering that the drive efficiency is about 97% and that the motor efficiency is about 93%, is equal to the motor power divided by the efficiencies and it can be obtained by the formula below :

Power delivered by the motor

$$P_{kw} = \frac{T \cdot N \cdot 6.28}{0.9 \cdot 60 \cdot 1000} = \frac{T \cdot N \cdot 0.1163}{1000}$$

where:

N = max. working r.p.m. with the torque considered

T = working torque in Nm

For the transformer power, consider:

$$kVA = P_{kw} \cdot 1.1$$

with 1.1 = current form factor

With more drives in parallel, the power of the autotransformer or the transformer can be calculated knowing the sum of the powers of all the motors, multiplied by a coefficient <1 , that reminds the contemporary use ; this coefficient depends on the type of machine and must be evaluated case by case.

The size of protection fuses can be calculated through the autotransformer or transformer nominal current value multiplied by a factor just greater than one. The section of the line cables must guarantee a correct intervention of the fuses.

4.5. SOFT-start circuit

The DMBL series is provided of on board soft-start circuit for firing current limitation; this circuit is on during the switching on; after few seconds will be automatically excluded.

4.6. AUXILIARY POWER SUPPLY

The system internal supply is generated by means of a switching drive (SMPS). If there is a power cut, SMPS autonomy is given by the charge of the BUS filter capacitors.

As the autonomy time is short internal electronic circuitry cannot be kept working beyond this time. It is thus not possible to save the drive parameters. To overcome this problem the TDE drives have a second input for auxiliary power supply through M1 connector (terminal A1-A2).

The auxiliary supply must be provided by means of a maximum 30VA single-phase insulating transformer with a 220V +10% -20% secondary voltage.



If more drives are supplied with single-phase voltage, the auxiliary power supply of each drive must be provided with an insulating transformer.

5. START-UP

WARNING: Execute this procedure only if motor type has changed from the order specification: the drive is already adapted to the motor specified in the order form.

5.1. PROCEDURE

- 1) Check the connections and especially the junctions are made properly, the terminals being tight and cables suitable for the resolver used.
- 2) Disconnect the motor power terminals temporarily.
- 3) Feed the module and after some time the flashing message "stop" will appear on the display, if there are some alarms.
- 4) Configure the module for the inputs, outputs, the mode of operation and the parameters, motor current (P56), motor poles(P53), resolver poles(P54), etc.. If the configuration has already been made, check that it is correct.
- 5) Set internal limits **P35 P36** to a low value (5%), and set the speed reference to zero.
- 6) Check **c21=1** (output stage software enabling) .
- 7) Reconnect the motor power terminals and put on line.
- 8) The motor should remain still if the reference is digital or move very slowly if it is analog.
- 9) Raise limits **P35 P36** and calibrate the offset (P4) if necessary.
- 10) Give some reference and check correct response, especially that the speed is correct and, if necessary, alter the drive dynamic response parameters to obtain better performance (P23,P24,P25).
- 11) Perform some work cycles and see that everything is correct.
- 12) Save the parameters in the EEPROM (**c43=1**).
- 13) The enable inputs are programmed as default (see per. 9.1)

WARNING: default customer code number is **P50 = 95**.

Note: When operating like explained above (expecially at points 8 and 10), if malfunctioning like motor running out or remaining still or stepping occurs, please check if power and resolver connections are correct. If the problem persists, please check the power cables and resolver connections and eventually make the self calibration of the resolver phase (c44) (see chapter 13).

5.2. MALFUNCTIONING WITHOUT ANY ALARM SIGNALS: DIAGNOSIS

MALFUNCTIONING	POSSIBLE CAUSES	REMEDIES
The motor does not turn	The R ,S and T terminals are not properly wired or the power voltage is absent	Connect up the cabling properly and check the mains and motor connections. Check the closing of any contacts before and after the drive
	The U,V and W terminals are not properly wired.	
	Logic inputs or resolver cable are not correctly connected	
	A fault is signalled	See the following paragraph
The acceleration process and motor braking is irregular	The parameters are not correctly programmed.	Check the values of the parameters by the keypad and correct any errors
	The time/times of acceleration-deceleration is/are too low	Check parameters and modify them if necessary
The number of rpm of the motor is too high or too low	The load is too high ...	Reduce the load
	The setting max.motor speed (P52) is not correct	Check the parameters and compare the setting with the motor registration plate

MALFUNCTIONING	POSSIBLE CAUSES	REMEDIES
The motor does not turn regularly	The load is too high	Reduce the load
	The speed regulator gains (P23,P24,P25) are not correctly set	Reduce the load peaks. Increase the motor size or use a higher size drive

5.3. MALFUNCTIONING WITH ALARM SIGNAL : DIAGNOSIS

ALARM		DESCRIPTION	REMEDIES
A2	RAM , EEPROM alarm	The drive reads wrong parameter values from the internal EEPROM	If the problem remains after turning on/off the drive, it is necessary to make the C41 configuration (reloading default values) or C42 (reloading EEPROM values) and then use C43 (EEPROM writing)
A3	Power alarm	Overcurrent on the output I.G.B.T. stage; this overcurrent may be caused by dispersion in the cables or in the motor or by a short circuit between the drive output phases. The alarm may be due also to an internal breakdown.	Check the connection cables particularly on the motor side of the terminal block to remove any dispersion or short-circuit; check the insulation of the motor itself, doing a dielectric rigidity test, and if necessary replace it. Check the integrity of the drive power circuit making it run after disconnecting the motor (U,V,W) and resetting alarms (c30=1); if the alarm becomes active the drive must be replaced.
A4	Radiator thermal switch alarm	The radiator temperature sensor is measuring a too high radiator temperature. (that sensor is a normally closed contact)	Check the drive cooling circuit, the ventilator, its feed and the slits and filters for the entry of air into the cabinet; if necessary replace them or clean them and ensure that the ambient temperature (near to the drive) is within the allowed limits (see the technical characteristics).
A5	Motor thermal switch alarm	The motor temperature sensor is measuring an excessive temperature inside the motor. (that sensor is a normally closed contact)	Check the motor cooling circuit; check that the ambient temperature (near to the motor) is within the allowed limits (see the technical characteristics). If everything is in order and the alarm signal is still on even when the motor is cold, check the connector wires of the thermal probe and of every auxiliary devices.
A6	Motor in thermal overload	The motor overload safety electronic device has been activated by excessive current absorption for prolonged period.	Check the motor load and consider if its reduction may stop the intervention of the safety function. Check the motor rated current parameter P56 and also the thermal time constant P57. Check if the power of the motor is adequate to the load and if necessary increase it.
A7	Resolver failure	Resolver failure indicates that the drive does not find its proper resolver connection	Check the resolver connections, the integrity of all the wires, and ensure that the connections have been made according to the (see motor user's manual and connection scheme page 3-4). Check the resolver shield and grounds being connected properly (in particular the resolver shield must be wired to pin 9 in J2).
A8	Intervention of the external alarm	External enable signal failure: this signal (normally to +24V) enables the the working of the drive	The external safety has disabled the drive: put it back to +24V and reset the alarm (c30=1). The wire is interrupted: check and remove the fault.
A9	Overspeed	Motor speed has been above the max. allowed (P42).	Check the parameters that change the motor dynamics (P23, P24, P25).

ALARM		DESCRIPTION	REMEDIES
A10	Minimum voltage in the DC bus	The voltage of the DC bus has fallen below the minimum level.	Undervoltage may occur when the main transformer power is not sufficient to support the current loads, or when there is a failure in the 220Vac mains voltage (for instance one phase is not powered). Check the voltage in RST and in the DC bus (see terminals +/- in M2).
A11	Overtoltage in the DC bus	The voltage of the intermediate voltage circuit is strongly increased due to excessive regenerative energy coming from the motor, e.g. in slow down phase, and the limit of maximum voltage is exceeded	The entry of the safety function mostly occurs because of too short braking times. In this case the remedy is to lengthen the braking time. Even overvoltage on the mains side can lead to the intervention of this safety function. If the drive has a braking circuit check that the value of the resistor is not too high to absorb the peak power. Check, if the resistor is not heating up, its continuity, the connections and functionality of the circuit itself.
A12	Logic inputs configuration error	Two digital input were set with the same function.	Check digital inputs configuration (c1-c6, c15, c16).
A13	pole setting error	The drive has been set with a poles number (P53, P54) different from the real one.	Check poles motor poles number on the motor plate and set P53, then check resolver poles and set P54. Ensure that P53 and P54 have even values.
A14	Mains connections error	Motor phases U,V,W are inverted.	Check the sequence of motor phases and eventually swap two phases (U,V) and execute a resolver autotuning (c44=1)
A15	Mains supply not present	Power failure at input R, S, T drive phases. The alarm is enabled only if c53 = 1.	Check the presence of the correct mains voltage at the connections.

Warning: DMBL15 and DMBL20 are provided with a different circuit for Bus Voltage measuring compared with DMBL03, DMBL07, DMBL10, DMBL12.

DMBL15 and DMBL20 measure the real Bus voltage, even if only the auxiliary power supply is present. This causes a different behaviour in case the auxiliary power supply without Bus Voltage is applied.

Setting C63=0 (software version 4.22 and following), causes the Alarm 'Minimum Bus Voltage' (A10) to be hidden. As a result the same behaviour of DMBL03, DMBL07, DMBL10, DMBL12 is achieved.

C63=0: 'Minimum Bus Voltage' Alarm (A10) is hidden.

C63=1: 'Minimum Bus Voltage' Alarm (A10) causes the Drive Fault signal to become ON. At power on, the driver requires an 'Alarm Reset'. The signal: 'Dr_ready' stays OFF during all the time of A10 Alarm.

6. ANTI-INTERFERENCE MEASURES

Electrical and electronic equipment can interfere each other through the mains connections or other metal connections between each other. In order to minimise or eliminate this reciprocal interference it is necessary the drive being correctly installed in conjunction with anti-interference devices (if required).

The following advice regards a mains power supply which is not disturbed. If interference exists other measures must be taken to reduce the interference itself.

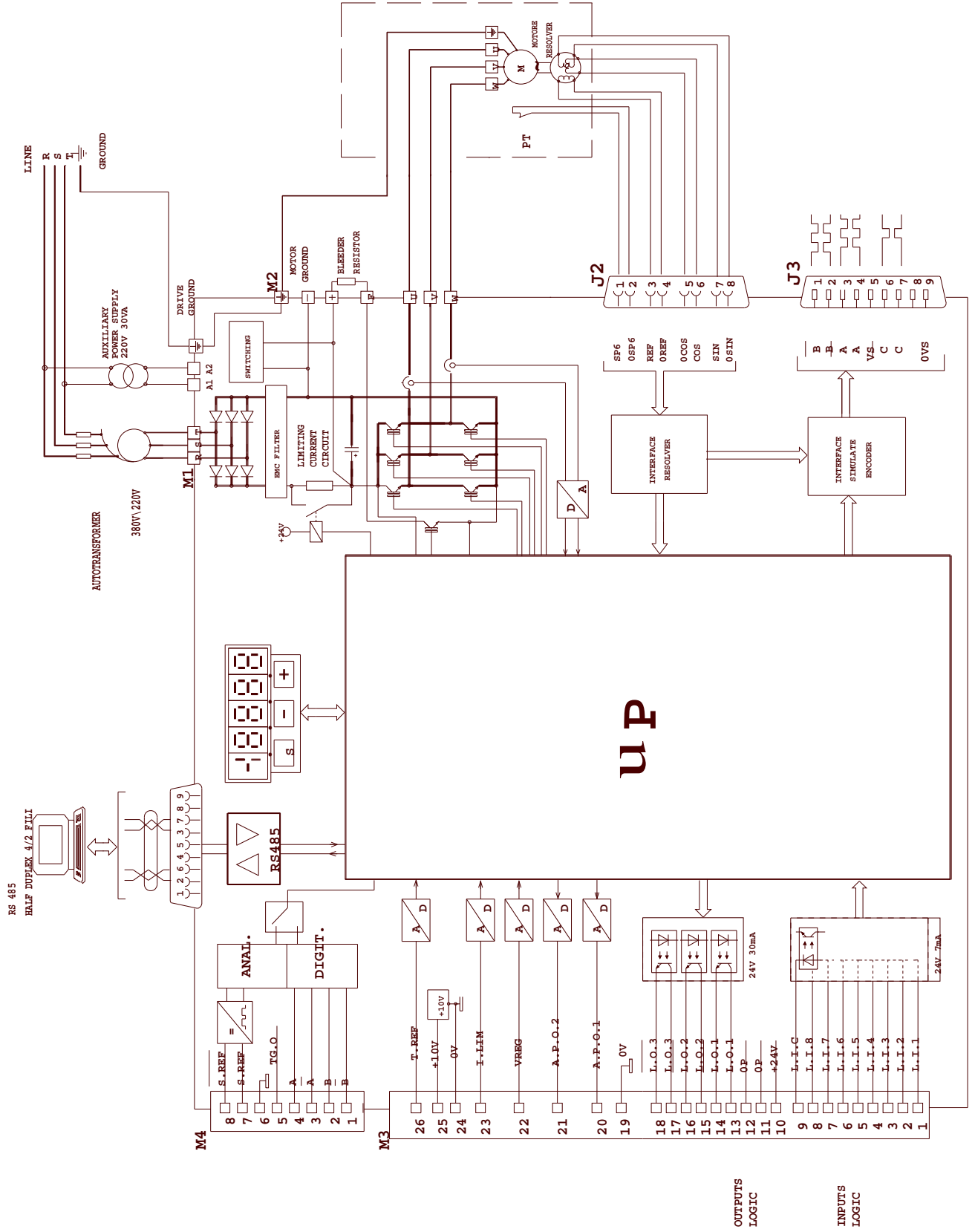
In these latter cases giving general advice is not possible and if the anti-interference measures do not lead the desired results we would kindly ask you please to contact TDE MACNO.

- Ensure that all the equipment in the cabinet is well connected to the ground bar using short cables with starconnections. In particular, it is important that any control equipment connected to the drive, e.g. PLC, is grounded by using short wires.
- The drive must be fixed with screws and washers to ensure a good electrical connection between the external container and the metallic support, connected to ground, and to the switchboard. If necessary remove the paint to ensure a good contact.
- For the motor connection use only shielded or armoured cable and connect the shielding to ground both at the drive end and at the motor end. If it is not possible to use shielded cable the motor cables should be placed in a metal channel which is connected to ground.
- Keep the motor connection, drive and control connection cables separate from each other and at a distance from each other.
- For the braking resistance cable connection use shielded cable connecting the shield to ground on both sides, the drive side and the resistor side.
- Lay the control cables at a distance of at least 10 cm from any parallel power cables. In this case too it is advisable to use a separate metal channel which is also connected to ground. If the control cables should cross over the power cables maintain a cross-over angle of 90°.
- Ensure that any RC groups or flywheel diode for coils for the remote switches, relays and other electromagnetic switches installed in the same cabinet as the drive are mounted directly onto the coil connections themselves.
- Make all connections of control, measuring and regulation external systems with shielded cables.
- Cables which can radiate interference must be placed separately and distant from the drive control cables.

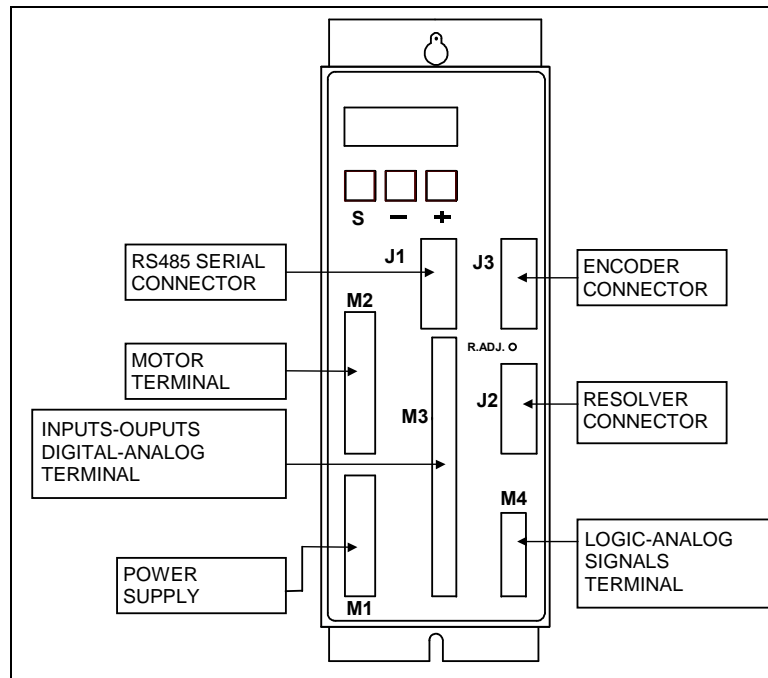
If the drive operates in a particularly noise sensitive environment it is also necessary to take the following measures to reduce the conducted and radiated interference:

- Take all necessary measures with regard to the cabinet thus to block radiated emissions, like grounding all metal parts, the use of minimum hole openings in the external walls and the use of conducting gaskets.

7. LAYOUT OF THE PHYSICAL BLOCKS



8. TERMINAL BLOCKS



8.1. POWER TERMINALS M1 - M2

M1 TERMINAL	FUNCTIONS	DESCRIPTIONS
A1	Auxiliary supply	one-phase 220 Vac
A2		
T	Three phase power supply	Standard 180÷240 Vac (220Vac +10% -15%)
S		
R		
⊥	Mains ground	Drive and accessories must be connected to the ground bar.
M2 TERMINAL	FUNCTIONS	DESCRIPTIONS
F	External clamping resistor	One end of external clamping resistor connected, the other end goes to the +
+	Bus DC	Direct current intermediate circuit
-		
U	Motor power supply	Motor connection terminals
V		
W		
⊥	Mains grounds	Motor and accessories must be connected to the ground bar.



Inverting the power supply connections on “ U, V, W “ and motor cables on “ R,S,T “ can seriously damage the drive.

8.2. ANALOG AND LOGIC SIGNALS (M3 TERMINAL)

PIN	FUNCTION	DESCRIPTION	PAR.
1	L.I.1	Programmable logic inputs (L.I.2 is not programmable = RUN) All the inputs are optoisolated from the regulation. L.I.C. is the common connection for all the inputs.	9.1
2	L.I.2		
3	L.I.3		
4	L.I.4		
5	L.I.5		
6	L.I.6		
7	L.I.7		
8	L.I.8		
9	L.I.C	Common connection for all the inputs; to be connected with the negative of the inputs supply .	9.1
10	+24V	+24V supply output, insulated from the regulation. I _{max} = 100mA	
11	0P		
12	0P		
13	L.O.1	Programmable logic outputs All the outputs are optoisolated from the regulation Transistor is in conduction when output is ACTIVE.	9.2
14	/L.O.1		
15	L.O.2		
16	/L.O.2		
17	L.O.3		
18	/L.O.3		
19	0V	0V of the regulation (see pin M3-24)	
20	A.P.O.1	Programmable analog output Output: ± 5V /2mA	9.3
21	A.P.O.2		
22	VREG	not available	
23	I.LIM	Analog input: current limit I.LIM: 0÷10V <0.5mA	14.6
24	0V	Stabilized supply: Pin M3-24 is in common with M3-19, M4-6 +10V / 10mA max.	
25	+10V		
26	T.REF	Analog input: torque reference Voltage : ±10V <0.5mA	14.5

8.3. Speed signals (M4 TERMINAL)

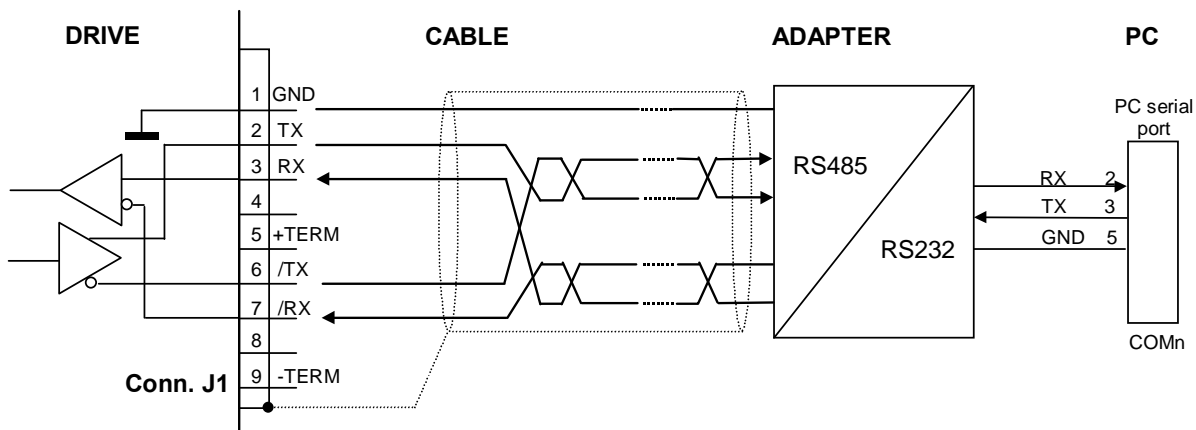
PINS	FUNCTION	DESCRIPTION	PAR.
1	/FB(UP)	Frequency channel /B input or direction (UP).	16
2	FB	Channel B input if differential (else not connected).	
3	/FA (F)	Frequency channel /A input or frequency input (F).	
4	FA	Channel A input if differential (else not connected)	
5	TG.O	Motor speed analog output ±10V <2mA	14.5
6	0V	0V of the regulation (see pin M3-24)	
7	S.REF	Analog speed reference differential input. Min ±2.5V ÷ Max ±10V <0.5mA	14.3
8	/S.REF		

8.4. TG.O SIMULATED TACHOGENERATOR OUTPUT

The maximum range of the tachometric output depends on the maximum speed value set in **P52** according to the table:

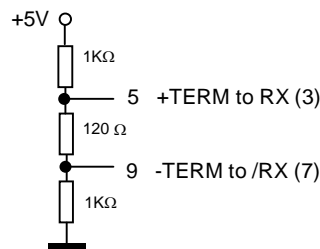
P52 ≤ 1500	10V ⇒ 1500 rpm
1500 < P52 ≤ 6000	10V ⇒ 6000 rpm
6000 < P52 ≤ 24000	10V ⇒ 24000 rpm

8.5. SERIAL LINE CONNECTION (J1 CONNECTOR)



The serial line communicates in half duplex with four wires: RX+ and RX- are receiving wires for the drive while TX+ and TX- are the transmission wires. Connection can be made with only two wires connecting RX+ and TX+ and RX- and TX-.

Inside the converter are provided impedance to 'terminate' (120Ω) and to polarise the line, like in the figure. To use this termination connect 5 with 3 and 9 with 7.

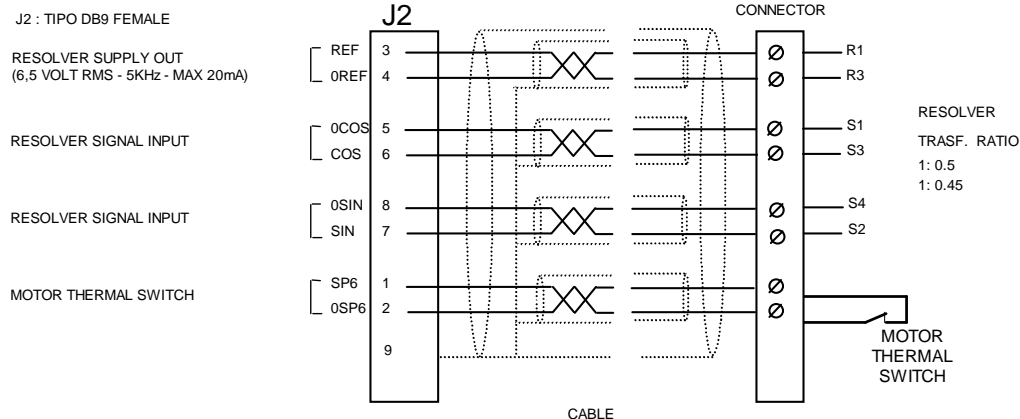


The communication wires must be twisted. The shield can be connected to the metallic body of the connector, because this part is connected to earth inside the converter.

For further informations on the serial line and the communication protocol see "appendix A" in this manual.

TDE MACNO supplies on request a "serial package" composed of demo supervision software and RS232/RS485 adapter with cable.

8.6. RESOLVER CONNECTION (J2 CONNECTOR)



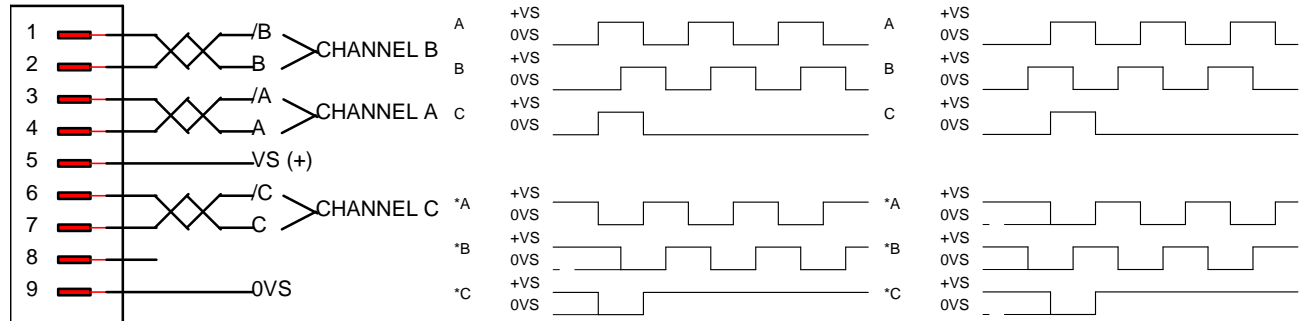
Use 4-couples twisted and shielded cable with external shield.

Pin J2-9 and the metallic body of connector J2 are connected to the earth inside the converter.

8.7. SIMULATED ENCODER (J3 CONNECTOR)

The frequency of the signals depends on the motor revolutions, the number of resolver poles and the selection made (see connection **c10**, **c11** and **c12**) and their behaviour in time depends on the tachometer signal and on **c10** as shown in the figures below

MALE DB9 CONNECTOR
J3



5V ≤ VS ≤ 30V

Fmax=500KHz for channel

The encoder simulated outputs are all driven by a “LINE DRIVER” type ET7272. Their level in the standard drive version is referred to +5V and then it is connect to the internal supply (TTL +5V). In option there is the possibility to refer the signal level to an external supply whose value must be between +5V and +24V (connection on terminals 5 and 9, (TTL 24V)).

For the immunity it is better to use a differential input (where the signal arrives) in order to avoid loops with zero reference; to limit noise effects it is better to load this input (10mA max).

It is necessary to use a twisted shielded cable to make a proper connection.



Attention, the external power supply zero is connected with the drive zero; (it is not optoisolated).



Attention, for the encoder simulation with external supply (standard drive version) you must not connect the terminal 5 (VS) because it could seriously damage the drive.

9. CONFIGURATIONS

9.1. MEANING OF THE TABLES

The programmable inputs and outputs L.I.1-L.I.8, L.O.1-L.O.3, A.P.O.1-A.P.O.2 can be "connected" to a function through the "c" connections (selector).

In the following tables are listed the functions available to inputs and outputs.

Some of the logic input functions can be executed from software, setting to "0" or to "1" same connections. In this way the drive can be used remotely through serial line.

Column "**N**" shows the selector position.

Column "**Available functions**" describes the function.

Column "**def**" shows the default status of the function when it is not programmed on any input.

The "ab" column specifies when the function is enabled:

- "**pos**" : the **positioner** must be enabled
- "**if**" : the **frequency** input must be enabled

Column "display" shows the name displayed in the keypad.

Column "connection" shows, where available, the "c" connection that has the same function of the input:

- "**S**" specifies that the connections is in series
- "**P**" specifies that the connections is in parallel

The effect of the functions on the drive behaviour is described in chapter 14.

9.2. CONFIGURATION OF LOGIC INPUTS

Logic inputs L.I.1-L.I.8 can be "connected" to a logic function through the connections **c01-c06** and **c15,c16**. L.I.2 can not be changed, and is programmed to logic function 0: drive run (output stage enable).

Default programming of L.I.1 - L.I.8	
L.I.1	c01 = 1
L.I.2	c02 = 0
L.I.3	c03 = 3
L.I.4	c04 = 8
L.I.5	c05 = 2
L.I.6	c06 = 4
L.I.7	c15 = 13
L.I.8	c16 = 12

H level = 24Vcc
max current 10mA

The following table contains the available logic functions. If a logic function is not programmed on any logic input, it assumes his default value. The actual value of these functions is displayed on the keypad in the "i" displays.

	Available logic functions	def	ab	display	connection
0	Drive on line (output stage enabled)			i9	c21 S
1	Speed control excluded (only torque control)	L		i10	/
2	External enable	H		i11	c29 S
3	REF. 1 enable (REF1EN)	L		i12	c22 P
4	REF. 2 enable (REF2EN)	L		i13	c21 P
5	Limit switch 1 (LS1)	H		i14	c24 S
6	Limit switch 2 (LS2)	H		i15	c25 S
7	External current limit enable (EXT.LIMIT)	H		i16	c31 S
8	Alarms reset	L		i17	c30 P
9	Start movement 1	L	pos	i18	c26 P
10	Start movement 2	L	pos	i19	c37 P
11	Normal working / Positioner selector	L		i20	c35 P
12	CW/CCW direction selector	L		i21	c09 P
13	Linear ramp stage enable	L		i22	c26 P
14	Alternate start mov.1/mov.2	L	pos	i23	/
16	External ref. selector (see chapter "frequency input")	H		i25	/
17	End of movement external sensor	L	pos	i26	c52 P
18	External sensor for double speed positioning	L	pos	i27	/
19	"-" pushbutton for digital potentiometer	L	if	i28	/
20	"+" pushbutton for digital potentiometer	L	if	i29	/
21	Internal absolute position counter reset	L		i30	/

9.3. LOGIC OUTPUTS CONFIGURATION

Logic outputs L.O.1-L.O.3 can be "connected" to a logic function through the connections **c07-c08** and **c18**.

POSSIBLE CONNECTIONS

Default programming of L.O.1 - L.O.3	
L.O.1	c07 = 0
L.O.2	c08 = 3
L.O.3	c18 = 4

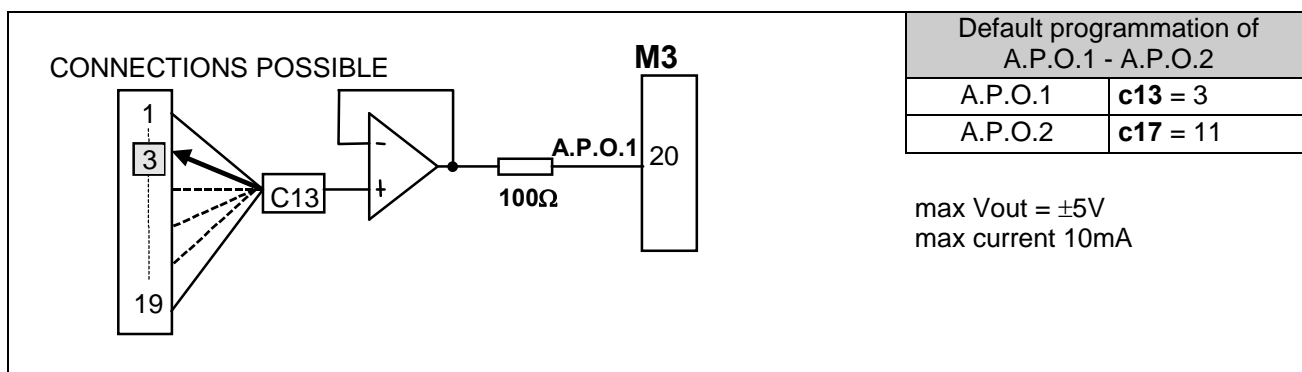
max current 30mA

The following table contains the available logic functions. The actual value of these functions is displayed on the keypad in the "o" displays.

	Available logic functions	ab	display
0	Drive ready		o09
1	Motor thermal alarm		o10
2	Speed greater than minimum		o11
3	drive on-line (output stage enabled)		o12
4	CW/CCW		o13
5	Speed regulator in saturation		o14
6	Ramp end		o15
7	Speed in range relay		o16
8	Current in range relay		o17
9	Motor blocked		o18
10	Stop in position	pos	o19
11	Ramp active		o20
12	Deceleration area	pos	o21
13	Stop in position 1	pos	o22
14	Stop in position 2	pos	o23
15	Soft-start relay status		o24
16	End of movement signal	if	o25

9.4. ANALOG OUTPUT CONFIGURATION

By means of connections **c13**, **c17**, some of the internal variables can be read on the programmable analog outputs of terminals M3-20 and 21.



	Available internal variables	display
1	External speed reference	d01
2	Speed reference before the linear ramp block	d02
3	Speed reference after the linear ramp block	d03
4	Speed feedback	d04-d05
6	Integral part of the speed regulator	d06
7	External torque reference	d07
11	Current reference	d11
15	Iq current (torque)	d15
16	Id current (direct)	d16
17	Vq torque voltage	d17
18	Vd direct voltage	d18
19	Motor total voltage	d19

9.5. CONFIGURATION OF THE ENCODER SIMULATION OUTPUT

Connector J3 has two differential encoder simulation channels with a number of pulses per motor revolution which can be set by means of **c11** according to the following table:

c11	puls/mot. revolution (2-poles resolver)	puls/mot. revolution (4-poles resolver)	puls/mot. revolution (6-poles resolver)
0	0	0	0
1	64	128	192
2	128	256	384
3	256	512	768
4	512	1024	1536
5	1024	2048	3072
6	2048	4096	6144
7	4096	8192	12288

The default value is c11=4.

The pulse output is controlled by a line driver, however choose a number of pulses such that the maximum frequency for channel does not exceed 500 kHz.

Maximum output frequency is computed as follows:

$$Fr = \frac{P52}{60} \cdot N, \text{ where } N \text{ is the number of encoder pulses (see above).}$$

Example :

P52 = 3000 c11=5 (1024 pulses per rev.)
Resolver 6 poles

$$Fr = \frac{3000}{60} \cdot 3072 = 153600 \text{ Hz}$$

The third channel generates a number of zero pulses in phase with channel A, equal to the number of resolver poles divided by two (**P54/2**); in particular, there is one zero pulse per motor revolution with a two-pole resolver.

The position of the zero pulse depends on the fit of the resolver on the drive shaft; with reference to the original position, which corresponds to the resolver zero, an offset can be added by steps of 90 electrical degrees according to the following table:

c12	displacement
0	+0°
1	+90°
2	+180°
3	+270°

The default value is 0.

These electrical degrees correspond to the mechanical degrees if the resolver has two poles.

Connection **c10** inverts the encoder B channel, thus inverting its phase with respect to channel A, with the same motor rotation direction (see chapter 8).

By default **c10** = 0.

10. DIAGNOSTICS

10.1. DISPLAYS

There are many analog and logic values which may be displayed either on the keypad or by means of the serial line. This can help to diagnostic when relays or protective devices block the drive or when an incorrect operation is made. A detailed list is given in chapter 12.

10.2. ALARMS AND EXCLUSIONS

When an alarm occurs, the drive stops and the DR.READY signal becomes not-active 'L'.

When there is an alarm on the drive, the keypad blinks, showing the word “**Stop**” in alternation with the first alarm occurred; all the alarms can be seen by scrolling the alarm indications (**Axx**) to see which are active (H); the inactive ones are low (L).

To deactivate the alarms, first deal with the cause and then reset the alarms (fault reset) on the programmed input by passing from a not-active to an active state or by means of the keypad **c30=0→1**.

Connection **c19** can be used to exclude the following alarms blocking the drive:

- c19=0** no alarm excluded
- c19=2** heat sink thermal switch (**A4**) excluded
- c19=4** motor thermal switch (**A5**) excluded
- c19=8** overspeed (**A9**) excluded
- c19=16** resolver failure excluded (**A7**)

Several alarms can be excluded at the same time by setting in **c19** a number between 1 and 31 calculated as follows:

$$c19 = 2 \times A4 + 4 \times A5 + 8 \times A9 + 16 \times A7$$

The alarms set in c19 avoid the blocking of the drive, but are however displayed in the keypad and in particular **A9** makes the display blink.

The motor thermal alarm (**A6**) is configurable through **c34** connection:

c34 = 0 (default)	Max. current limit reduced to nominal current
c34 = 1	Stops the drive

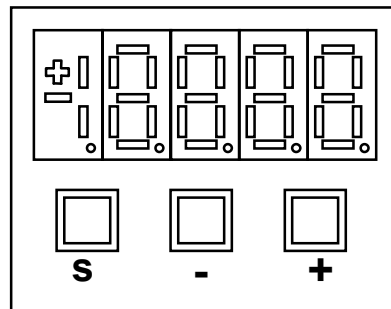
c53 connection allows the user to manage the Power Failure:

c53 = 0 (default)	Power Failure ⇔ Inserts Pre-Charge Resistor.
	Power On ⇔ Shunts the Pre-Charge Resistor after 100 ms.
c53 = 1	Power Failure ⇔ A15 Alarm.
	Power On ⇔ Alarm re-setting required.

11. KEYPAD

11.1. DESCRIPTION OF KEYPAD OPERATION

The keypad has three keys: 'S' (selection), '+' (increase) and '-' (decrease), and it has a display with four and a half digits plus the decimal points and the minus sign '-'.
-



11.2. IDLE STATE

When the equipment is switched on, the keypad displays "Stop"; if any alarm is detected, the keypad blinks, displaying "Stop" intermittently with the first alarm that has occurred. When the drive is working, the quantity set by **c51** is displayed. The keypad automatically returns to idle state ten seconds after the last operation, provided that it is not displaying an internal quantity or a digital state.

11.3. SETTING AND READING OF PARAMETERS AND CONNECTIONS

Press push-button 'S' and the keypad will display the last parameter or magnitude selected, then, by using the '+' and '-' keys, scroll the menu up and down until you find the address of the parameter (P) or of the connection (c) to be read and, if necessary, corrected. Next to the number of the parameter or connection the letter 'r' appears if the parameter is reserved, 't' if it is TDEMACNO-reserved and 'n' if it is a parameter that can be modified only when the drive is not running; all the reserved parameters are 'n'-type parameters which may be modified only when the drive is not running (off-line).

Pressing 'S' key, the parameter value is displayed and can therefore be read; press 'S' again to go back to the menu and the system also automatically goes back to the menu 10 seconds after the beginning of the display; to correct the parameter or connection value, when this is displayed, press the '-' and '+' keys at the same time; the decimal point of the first figure or the left then starts flashing, which means that, from that moment on, pressing the '-' and '+' keys changes the value set. The value is changed only from stop if the parameter is OFFLINE or only after the access code, **P50**, has been set, if the parameter is reserved, or **P80** for TDEMACNO-reserved parameters.

The TDEMACNO-reserved parameters and connections are not listed, unless access code **P80** is set.

Once the value has been corrected, press 'S' to go back to the menu saving the modified parameter or connection; to exit without saving, just wait for ten seconds and then the keypad will display the address without saving the changed value; if the value is not touched, just press 'S' to exit (the previous value will be saved). Once in the menu, the keypad automatically returns to the idle state.

11.4. DISPLAY OF INTERNAL ANALOG VARIABLES

Move from the menu with '+' or '-' keys until the address of the variable to be displayed 'dxx' appears; on pressing 'S' the address disappears and the value is displayed.

Return to the menu from this state by just pressing 'S'; return from the menu to the rest state is automatic after 10 seconds.

11.5. DISPLAY OF I/O AND ALARMS

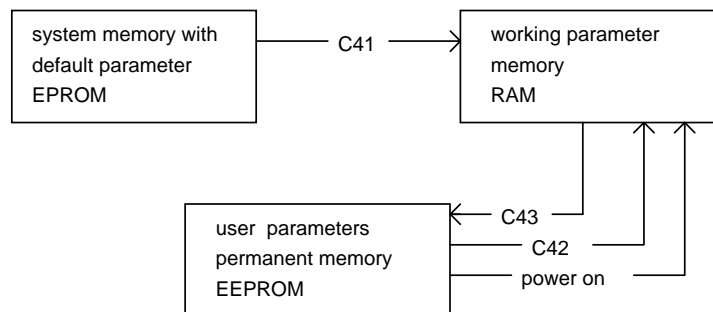
From the menu use the '+' and '-' keys to move to the address required for the digital inputs (i), the outputs (o) and the alarms (A); the box to the right shows this and the state: 'H' = active (high), 'L' = not active (low). To return to the idle state from this state, just press 'S'.

11.6. SAVING AND RESETTING PARAMETERS

When the drive is switched on, the drive transfers the parameters from the user permanent memory (EEPROM) to the working memory (RAM). All the parameter changes are stored in the working memory (RAM); to save these changes in the user permanent memory (EEPROM), activate the connection (c43=1). If there is an EEPROM alarm (A2=H), the permanent values will not be found in the working memory; to recover the system, write new values on the permanent memory and then reset. To do this use the default parameters, which are written in the system memory (EPROM); these are first transferred to the working memory (c41=1) and then saved in the user permanent memory (c43=1), then the recovering, which usually takes place when there is a permanent failure, is carried out.

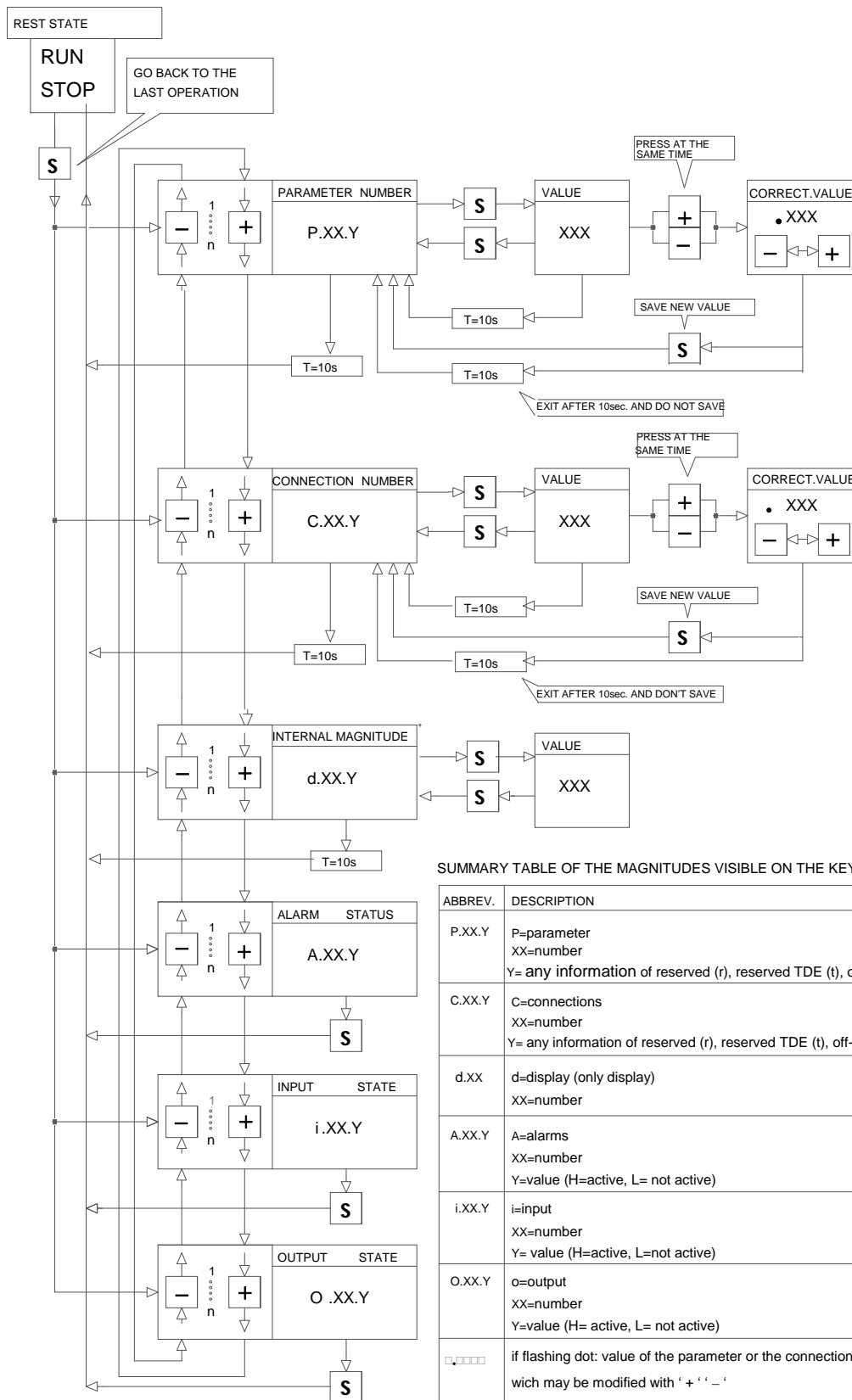
To return to the initial parameters in the permanent memory (EEPROM) after the changes in the working memory (RAM) have been made, without switching off and on again, just activate connection c42 (c42=1).

These procedures are explained below :



N.B. As default parameters are standard parameters which are certainly different from the customised parameters, it is important to save the parameters of the user permanent memory carefully after the installation for each drive, thus, if necessary, they can be copied in a spare drive, or if the memory is reset with the default parameters.

11.7. KEYPAD WORKING DIAGRAM



SUMMARY TABLE OF THE MAGNITUDES VISIBLE ON THE KEYBOARD

ABBREV.	DESCRIPTION
P.XX.Y	P=parameter XX=number Y= any information of reserved (r), reserved TDE (t), off-line (n)
C.XX.Y	C=connections XX=number Y= any information of reserved (r), reserved TDE (t), off-line (n)
d.XX	d=display (only display) XX=number
A.XX.Y	A=alarms XX=number Y=value (H=active, L= not active)
i.XX.Y	i=input XX=number Y= value (H=active, L=not active)
O.XX.Y	o=output XX=number Y=value (H= active, L= not active)
□.□□□□	if flashing dot: value of the parameter or the connection wich may be modified with '+' '-'

12. TABLES OF PARAMETERS AND DISPLAYS

12.1. TYPES OF PARAMETERS

	Type	Description
P	Parameters	Numerical values
c	Connections	Logic switches with 2 or more contacts. They are used to select among more possibilities.
d	Displays	Internal drive values (voltage, current, speed,...)
A	Alarms	Diagnostics of the drive
i	Inputs	State of logic inputs and of logic functions
o	Outputs	State of logic outputs and of logic functions

12.2. MEANING OF THE TABLE FIELDS

Column "**PAR**" contains the parameter number as it is displayed on the keypad.

Column "**DESCRIPTION**" contains a brief description of the parameter.

Column "**RANGE**" contains maximum and minimum limits, and the units of the parameter.

Column "**DEFAULT**" contains default values. These values are loaded through command **c41 = 1**.

Column "**BS**" contains a letter or a number to explain how parameter values are stored inside the converter:

- A letter means that the internal value is a number "x" in percent of a base scale number.

from internal value to percent value	from percent value to internal value
percent value = $100 * x / \text{base scale}$	$x = \text{percent value} * \text{base scale} / 100$

base scale table

letter	description
A	Base scale = 16383
B	Base scale = 4095

- A number means that the internal value is a number "x" scaled by a power of 10 :

from internal value to real value	from real value to internal value
real value = $x/10^n$	$x = \text{real value} * 10^n$

conversion ratio table, where x = internal number

number	description
0	n = 0 par=x
1	n = 1 par=x/10
2	n = 2 par=x/100

Column "**Note**" contains the informations about the writing protections of parameters:

- n = parameter value can be changed only if drive is off-line
- r = parameter value can be changed only if the customer code number is set in **P50**
- t = parameter value can be changed only if the TDE MACNO code number is set in **P80**

Parameter **P99** contains the customer code number (**P50**). On demand this code can be customized.

WARNING: default customer code number is P50 = 95.

12.3. PARAMETERS

PAR	DESCRIPTION	RANGE	DEFAULT	BS	NOTE
P01	JOG 1 speed	±100.0%	0.0%	A	
P02	JOG 2 speed	±100.0%	0.0%	A	
P03	JOG 3 speed	±100.0%	0.0%	A	
P04	Analog speed reference offset, 1/100000 parts of speed reference	±19999	0	0	
P05	Max CW speed limit	0÷105.0%	100.0%	A	
P06	Max CCW speed limit	0÷105.0%	100.0%	A	
P07	Position for curve 1 (encoder pulses)	±19999	0	0	
P08	Position for curve 2 (encoder pulses)	±19999	0	0	
P09	Offset (encoder pulses) with respect to resolver zero	±19999	0	0	
P10	Gain for positioning (kv)	0÷100	4	0	
P11	CW acceleration time	50÷19999 ms	400 ms	0	
P12	CW deceleration time	50÷19999 ms	400 ms	0	
P13	CCW acceleration time	50÷19999 ms	400 ms	0	
P14	CCW deceleration time	50÷19999 ms	400 ms	0	
P15	Displ. for curve 1 with external sensor (encoder pulses)	±19999	0	0	
P16	Displ. for curve 2 with external sensor (encoder pulses)	±19999	0	0	
P17	Position for curve 1 (revolutions)	±19999	0	0	
P18	Position for curve 2 (revolutions)	±19999	0	0	
P19	Time for emergency switch off ramp	0÷2000 ms	0	0	
P20	Level for enabling P23, P24	0÷200.0 %	0.0%	B	
P21	Speed loop proportional gain when speed + REF < P20	0.5÷100.0	4.0	1	
P22	Speed loop lead time constant when speed + REF < P20	4.0÷150.0 ms	40.0 ms	1	
P23	Speed loop proportional gain speed + REF ≥ P20	0.5-100.0	4.0	1	
P24	Speed loop lead time constant when speed + REF ≥ P20	4.0-150.0 ms	40.0 ms	1	
P25	Speed loop filter constant time	0.4÷20 ms	0.4 ms	1	
P27	Starting value of speed regulator integral	±100.0%	0.0%	B	n
P30	Time for the inertia compensation	0÷19999	0 ms	0	
P31	Torque signal offset (T.REF)	±100.0%	0.0%	B	
P32	Torque signal correction coefficient (T.REF)	±400.0%	100.0%	B	
P33	Current limit signal offset (I.LIM)	±100.0%	0.0%	B	
P34	Limit signal correction coefficient (I.LIM)	±400.0%	100.0%	B	
P35	Max CW current limit	0÷100.0%	100.0%	B	
P36	Max CCW current limit	0÷100.0%	100.0%	B	
P37	Position relay for mov.1(enc.p.)	±19999	0	0	
P38	Position relay for mov.1(resolver turns)	±19999	0	0	
P39	Position relay for mov.2(enc.p.)	±19999	0	0	
P40	Position relay for mov.2(resolver turns)	±19999	0	0	
P41	Minimum speed level	0÷100.0%	0.2%	B	
P42	Maximum allowed speed level	0÷120.0%	110.0%	B	
P43	Lower speed value for speed relay	±100.0%	-100.0%	B	n
P44	Upper speed value for speed relay	±100.0%	100.0%	B	n
P45	Lower current value for current relay	±100.0%	-100.0%	B	n
P46	Upper current value for current relay	±100.0%	100.0%	B	n
P49	Sample time (scope function)	1÷1000 ms	2	0	
P50	Customer code number for reserved parameters (r)	0÷9999	(P99)	0	n
P51	Drive identification number for the serial line	1÷255	255	0	r
P52	Maximum motor speed (rpm)	375÷19000	2500	0	r
P53	Number of motor poles	2÷12	6	0	r
P54	Number of resolver poles	2÷12	2	0	r
P55	Resolver phase	±180.0°	0.0°	1	r
P56	Motor rated current in % of drive rated current	10.0%÷100.0%	90.0%	B	r
P57	Motor thermal time constant	1.0÷600.0 sec.	30.0 sec.	1	r
P58	Motor inductance in mH x motor rated current / motor voltage	0.0-100.0%	20.0	B	r
P59	Ti=Lff/Rff	1-100 ms	20	0	r
P60	External voltage reference corresponding to the maximum motor speed	2500÷10000 mV	10000	0	r
P61	Encoder frequency reference coefficient	0÷16383	4096	0	
P62	Vnmot/Vnaz	0.0%-100.0%	60.0%	B	r
P63	Kq1 e Kd1 correction coefficient	0.0%-400.0%	73.3%	B	r
P70	Serial line answer delay (ms)	0÷1000	20	0	r
P71	Enc. pulse ratio numerator	19999	1	0	
P72	Enc. pulse ratio denominator	19999	1	0	
P73	Start pos.1 delay time (ms)	0÷5000	0	0	
P72	Start pos.1 delay time (ms)	0÷5000	0	0	
P75	o22 advance (enc. pulses)	0÷19999	0	0	r
P76	o23 advance (enc. pulses)	0÷19999	0	0	r
P77	Final speed for curve 1	1.0%÷100.0%	100.0%	A	
P78	Final speed for curve 2	1.0%÷100.0%	100.0%	A	

P79	Serial line Baud Rate	1 stop bit: 0 9600 baud 1 19200 baud 2 38400 baud 3 57600 baud 4 115200 baud 2 stop bit: 5 9600 baud 6 19200 baud 7 38400 baud 8 57600 baud 9 115200 baud	0 = 9600	0	r
P80	code number for TDEMACNO reserved parameter (t)	0÷9999	-	0	n
P81	Analogue ref. correction coefficient	50.0%÷199.0%	100.0%	A	T
P82	Current correction coefficient	100.0%÷200.0%	111.0%	B	T
P83	Drive rated current in % of the current limit	20.0%÷100.0%	50.0%	B	T
P84	Drive limit reenter time constant	1.0÷10 sec.	2.5 sec.	1	T
P85	DC bus voltage measurement coeff.	50.0%÷200.0%	100.0%	B	T
P86	DC bus minimum voltage	60.0%÷130.0%	70.0%	B	T
P87	DC bus maximum voltage (% P92)	50.0%-120.0%	110.0%	B	t
P92	Clamping Voltage (% DC BUS rated voltage)	65.0%÷150.0%	127.0%	B	t
P94	Choice 0=Vel/ 1=Corr	0-1	0	0	t
P95	Torque current (P64=1)	0.0%÷100.0%	25.0%	B	t
P96	Dead time compensation	0÷400	80	0	t
P99	Customer code number for reserved parameters (r)	0÷9999	95	0	t

12.4. CONNECTIONS

CON.	DESCRIPTION	RANGE	DEFAULT	Notes
c01	Logic input 1 meaning	1÷21	1	r
c02	Logic input 2 meaning	0	0	r
c03	Logic input 3 meaning	1÷21	3	r
c04	Logic input 4 meaning	1÷21	8	r
c05	Logic input 5 meaning	1÷21	2	r
c06	Logic input 6 meaning	1÷21	4	r
c07	Logic output 1 meaning	0÷16	0	r
c08	Logic output 2 meaning	0÷16	3	r
c09	External speed ref. Inversion	0 not inverted 1 inverted	0	r
c10	Simulated encoder channel B inversion	0 not inverted 1 inverted	0	r
c11	Choice pulse/rev. Resolver for simulated encoder	0÷7	4	r
c12	Choice of zero simulated encoder phase	0÷3	0	r
c13	A.P.O. 1 meaning	0÷19	3	
c14	Choice external reference	0 (analog) 1 (freq. 2 channels) 2 (freq. and up / down)	0	r
c15	Meaning logic input 7	1÷21	13	r
c16	Meaning logic input 8	1÷21	12	r
c17	Meaning A.P.O. 2	0÷19	11	r
c18	Meaning logic output 3	0÷16	4	r
c19	Excl. alarms A3-A4-A5-A7-A9	0÷31	0	r
c20	Integral excl. in the speed regulator	0 not excluded 1 excluded	0	n
c21	Run command	0 stop 1 run	1	
c22	connection in parallel of REF1	0 OFF	0	
c23	connection in parallel of REF2	1 ON		
c24	connection in series with LS1	0 Open	1	
c25	connection in series with LS2	1 closed		
c26	Ramp inclusion	0 excluded 1 included	0	
c27	Stop with or without min. speed	0 disabled 1 enabled	1	
c28	Stop on limit switches with or without ramp	0 without 1 with	0	

c29	Software drive consent	0 alarm 1 no alarm	1	
c30	Reset alarms	0→1 reset	0	
c31	External current limit enable	0 disabled 1 enabled	0	
c32	Enable torque input	0 disabled 1 enabled	0	
c33	relative or absolute speed data	0 relative 1 absolute	1	
c34	Motor thermal devices causes drive block	0 no block 1 block	0	
c35	Position / Speed	0 Speed 1 Positioner	0	r
c36	Start Pos.1	0→1 start	0	
c37	Start Pos.2	0→1 start	0	
c38	Zero search direction	0 CCW, LS2 1 CW, LS1	0	n
c39	Incremental/absolute positioning	0 incremental 1 Absolute	0	
c40	SW Zero search command	0→1 start	0	
c41	Reset to default values	0→1 reset to default	0	n
c42	Reset to EEPROM values	0→1 reset to eeprom	0	n
c43	save RAM into EEPROM	0→1 save	0	n
c44	Resolver phase auto-tuning command	0→1 start	0	r
c45	Current regulator auto-tuning command	0→1 start	0	r
c51	Value displayed in run state	1÷19	5	
c52	Sensor	0→1 active	0	
c53	Mains supply failure managing switch	0÷2	0	r
c54	Double speed positioning	0÷2	0	n
c55	Zero search starting mode	0÷1	0	n
c56	Zero search mode	0÷2	0	n
c57	Serial protocol	0 TDEMACNO 1 MODBUS	0	n
c59	No fieldbus / Canopen / Profibus choice	0 No fieldbus 1 Canopen 2 Profibus	0	r
c60	Output signal configuration for mov 1 relay	0÷2	0	
c61	Output signal configuration for mov 2 relay	0÷2	0	
c62	Data process enabling (Profibus)	0÷1	0	

12.5. DISPLAYS

	DESCRIPTION	RANGE	BS
D00	Software version		2
D01	External speed reference %	±100.0%	A
D02	Speed ref. before the ramp %	±100.0%	A
D03	Speed ref. after the ramp %	±100.0%	A
D04	Speed feedback %	±100.0%	B
D05	Motor speed in r.p.m. %	0÷19000	0
D06	Integral part of the speed regulator %	±100.0%	B
D07	Value of the external torque signal %	±100.0%	B
D08	External current limit %	0÷100.0%	B
D09	Current limit CW %	0÷100.0%	B
D10	Current limit CCW %	0÷(-100.0)%	B
D11	Actual current %	±100.0%	B
D12	DC BUS Voltage (V)	0÷999	0
D13	Actual position (encoder pulse)		0
D14	Resolver position (encoder pulse)	± ½ revolution (c11 e.p.)	0
D15	Torque current Iq	±100.0%	B
D16	Direct current Id	±100.0%	B
D17	Torque voltage Vq	±100.0%	B
D18	Direct voltage Vd	±100.0%	B
D19	Motor voltage Vm	0÷100.0%	B
D20	Actual position (High word)		0
D21	Actual position expressed by ratio P71/P72		0

12.6. ALARMS

	DESCRIPTION	STATE (H=ON L=OFF)
A2	RAM, EEPROM alarm	L-H
A3	Power failure	L-H
A4	Radiator thermal switch	L-H
A5	Motor thermal switch	L-H
A6	Motor thermal protection	L-H
A7	Resolver failure	L-H
A8	External alarm	L-H
A9	Overspeed	L-H
A10	DC bus minimum voltage	L-H
A11	DC bus overvoltage	L-H
A12	Inputs configuration error	L-H
A13	Pole setting error	L-H
A14	Motor connections error	L-H
A15	Mains supply failure	L-H

12.7. LOGIC INPUTS AND OUTPUTS

	DESCRIPTION	STATE (H=ON L=OFF)
1	Logic input LI1 state	L-H
2	Logic input LI2 state	L-H
3	Logic input LI3 state	L-H
4	Logic input LI4 state	L-H
5	Logic input LI5 state	L-H
6	Logic input LI6 state	L-H
7	Logic input LI7 state	L-H
8	Logic input LI8 state	L-H
9	On-line signal state	L-H
10	Torque enable signal state	L-H
11	External enable signal state	L-H
12	Ref 1 enable signal state	L-H
13	Ref 2 enable signal state	L-H
14	Limit switch 1 signal state	L-H
15	Limit switch 2 signal state	L-H
16	External current limit enable signal state	L-H
17	Alarm reset signal state	L-H
18	Start pos. 1 signal state	L-H
19	Start pos. 2 signal state	L-H
20	Pos./Speed signal state	L-H
21	Reference direction from volt./freq. conv. signal state	L-H
22	Enable ramp signal state	L-H
23	Alternative Start Pos.1 / Pos.2	L-H
24	Main supply state	L-H
25	External reference selection 0= analog, 1= frequency	L-H
26	State of external sensor for positioning	L-H
27	External sensor for double speed positioning state	L-H
28	Digital potentiometer "+" button state	L-H
29	Digital potentiometer "-" button state	L-H
30	Absolute position counter reset state	L-H
	DESCRIPTION	STATE (H=ON L=OFF)
1	Logic output LO1 state	L-H
2	Logic output LO2 state	L-H
3	Logic output LO3 state	L-H
9	Drive ready signal state	L-H
10	Motor thermal protection signal state	L-H
11	Speed over minimum signal state	L-H
12	Drive on line signal state	L-H
13	CW rotation signal state	L-H
14	Saturation of speed regulator signal state	L-H
15	Ramp end signal state	L-H
16	Speed in range signal state	L-H
17	Current in range signal state	L-H
18	Motor blocked signal state	L-H
19	Stop in position signal state	L-H
20	Ramp signal state	L-H
21	Deceleration area	L-H
22	Stop in Pos.1	L-H
23	Stop in Pos.2	L-H
24	Power relay state	L-H
25	End of movement	L-H

13. SELF TUNINGS

13.1.1 ADAPTATION WITH THE MOTOR

Set or check :

- P52** maximum speed of the motor in r.p.m. ; (revolutions are shown on the motor rating-plate).
- P54** number of resolver poles (see resolver catalogue)
- P53** number of motor poles (see motor catalogue)
- P55** resolver phase displacement (depends on the motor: see the value table for some motors at the end of the chapter)
- P56** motor rated current /drive rated current
(e.g. if motor 12A drive 20A **P56** = 12/20*100=60.0%)
- P57** thermal time constant; if not known leave the default value (30 sec.)
- P58** motor inductance x rated current / motor voltage; from the motor catalogue read the values.
(e.g. $I_{motor} = 12A$ $L = 6mH$ $V_m = 150$ **P58**=48%). if the values are not known leave the default parameter or auto-tune the current loop (**c45**) later in the chapter.
- P59** motor winding time constant; time constant calculated as ratio of winding inductance (mH) and resistance (Ω) $\frac{L_{motore}}{R_{ff}}$; read the value in the motor catalogue; if not known leave the default (20sec.)
- P62** motor voltage / drive voltage (220V); % value.
Eg. 132V/220V =62%
- c34** set the thermal alarm function, leave on 0 if the operation is to continue although with lower limit, set 1 if it is to stop immediately if an alarm is given.

WARNING: Usually the drive is already tuned for the assigned motor.
follow what described above only in case of modifications.

WARNING: default customer code number is **P50 = 95**.

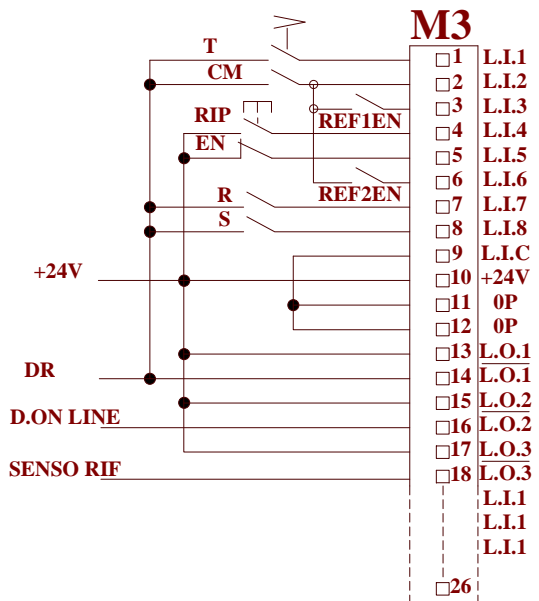
13.1.2 LOGIC INPUTS AND LOGIC OUTPUTS SETTING

The connections are set with **c01,c03,c04,c05,c06,c15,c16,c07,c08,c18** to choose the digital connection of the inputs and outputs to the desired functions. By default the inputs(1÷5) are configured as in the TDE DSC series.

The external values and connections in case of default configurations and in case of a terminal board configuration that utilises all the available speed references and limit switches, are shown below.

A) DEFAULT CONFIGURATION

c01=1 c02=0 c03=3 c04=8 c05=2 c06=4 c15=13 c16=12
c07=0 c08=3 c18=4



T = selector switch for the selection of operation :
open (absent) = speed
closed = torque

CM = start contactor (closed for start)

REF1EN, REF2EN = reference selection contacts

EN = External enable contact (open on external emergency)

RIP = alarm reset push-button

DR = logic signal that is +24V when the drive is ready to start

D. ON LINE = +24V when the motor is on-line

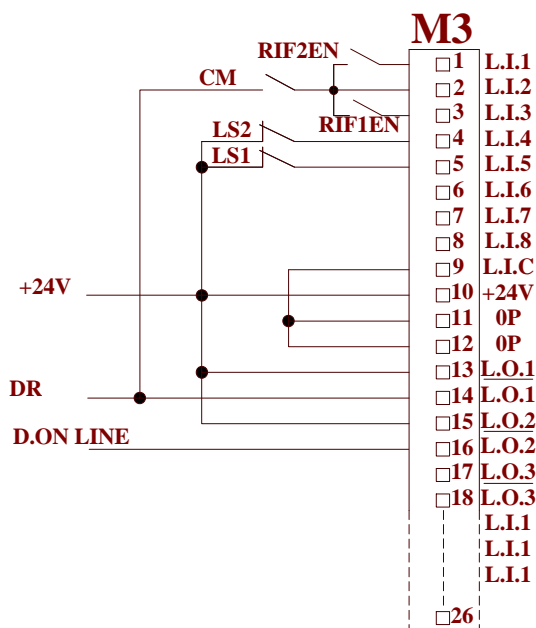
R = ramp insertion

S = contact for CW/CCW

The +24V supply can be taken from the inside as in the figure, and it can also be a separate feeding (es. from PLC)

B) CONFIGURATION WITH LIMIT SWITCH

c01=1 c02=0 c03=3 c04=5 c05=6 c07=0 c08=3



CM = start contactor (closed for start)

REF1EN, REF2EN = reference selection contacts

LS1 = limit switch for CW, when it opens it blocks the motor in CW direction

LS2 = limit switch for CCW, when it opens it blocks the motor in CCW direction

DR = logic signal that is +24V when the drive is ready to start

D. ON LINE = +24V when the motor is on-line

This terminal configuration does not have an alarm reset. The alarms can only be reset via software with connection **c30**.

13.2. SETTING REFERENCES AND SPEED LIMITS

The maximum speed equal to $\pm 100.0\%$ of the internal references and $\pm 10V$ of the analogue reference is set at parameter **P52** directly in revolutions per minute.

All the percentage values set on the speed references, on the speed limits and on the thresholds refer to this value. This is valid especially for parameters **P01, P02, P03, P05, P06, P41, P42....** and is also valid for the 'dxx' display signals.

Ex 1) if **P52**=2000 r.p.m. and a JOG1 speed of 150 r.p.m. is desired, set:

$$P01 = 150/2000 * 100 = 7.5\%$$

Ex 2) if on **d1** is displayed a reference of 79.2%, this means that a motor speed reference is :

$$79.2/100 * 2000 = 1584 \text{ r.p.m.}$$

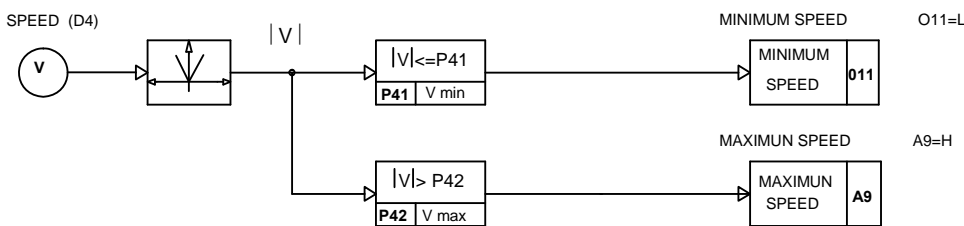
13.3. SETTING MINIMUM SPEED, MAXIMUM SPEED AND SPEED RANGE SIGNAL LEVEL.

The settings are all percentages and refer to **P52**. The minimum speed logic signal is a signal which is active when the motor speed in absolute value is greater than the value set at parameter **P41**.

e.g., if Min speed = 6 r.p.m. and **P52**=2000 r.p.m. is wanted, set:

$$P41 = 6/2000 * 100 = 0.3\%$$

The maximum speed alarm occurs when the motor speed exceeds in absolute value the speed set at parameter **P42** as a percentage of **P52**.



The SPEED RANGE logic signal is a signal which is active when the speed is between the two percentage values set at parameters **P44** and **P43** if connection **c33** is set to 1, while if the connection is set to 0 the output becomes active when the real speed is around the reference signal within the band set in the two parameters, i.e.:

$$P43 * P52 \leq V_{rif} - V_{real} \leq P44 * P52 \quad c33=0$$

If the output is to be active when the motor runs CCW at a speed between 1200 and 1300 r.p.m. set:

$$c33=1$$

$$P44 = (-1200)/2000 * 100 = -60.0\%$$

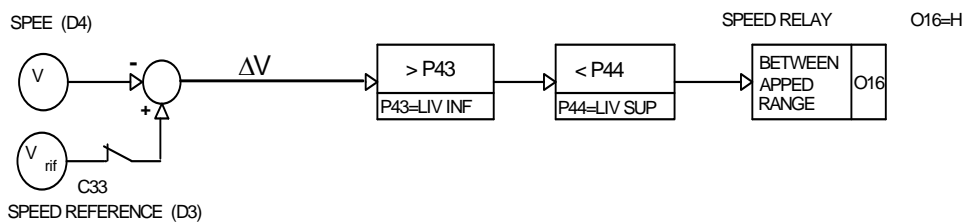
$$P43 = (-1300)/2000 * 100 = -65.0\%$$

If the output is to be active whenever the motor speed is equal to the requested speed ± 20 r.p.m. the following is set:

$$c33=0$$

$$P43 = (-20)/2000 * 100 = -1\%$$

$$P44 = +20/2000 * 100 = 1\%$$



13.3.1 PEEK CURRENT LIMITS AND CURRENT RANGE SETTING

Parameters **P35** and **P36** set the maximum allowed value for the effective peak current that can be delivered by the drive, they are expressed in percentage of the maximum value allowed by the size, e.g.:

If drive I_{max} is 40A and I_n motor = 11A and one wants to limit the maximum current which can be delivered to a value not greater than 33A (three times I_n motor), set:

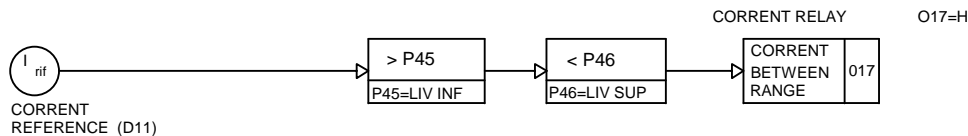
$$P35 = P36 = 33 / 40 * 100 = 82.5\%$$

Likewise the same calculations are performed if one wants to use the current range logic function. This function is active (level H) when the current is between the two values set in **P45** and **P46**, while it is disabled (level L) when the current rises these values. E.g. with the drive and the aforesaid motor, if one wants a logic signal that signals that the current demand for the motor is greater than the rated one, in the two torque directions, set:

$$P45 = -11/40 * 100 = -27.5\%$$

$$P46 = 11/40 * 100 = 27.5\%$$

c10 = 08, and output **oL2** will be active (24V) for current values within $\pm 11A$, while for current values higher than 11A in absolute value, it will be set to zero.



13.4. CURRENT LOOP AUTO-TUNING

This auto-tuning calculates the value $L \cdot I_n / V_m$ of the connected motor and saves it on parameter **P58** thus to optimise the response of the current (torque) loop. To do this correctly, before starting the auto-tuning set at least the following parameters:

P52 : maximum motor speed (r.p.m.)

P53 : number of motor poles

P54 : number of resolver poles

P56 : rated motor current in % of drive rated current

The motor must be free to rotate because during auto-tuning it makes a full polar rotation. To start the auto-tuning you must:

- 1) be in STOP
- 2) set access key **P50=95** (see P99)
- 3) enter **c45** programming, write "1" and press S

Once started the system reads the inductance for the first time, injecting a current equal to I_n into the motor and then moves 30 electrical degrees 11 times, performing the measurement for each position. At the end the system calculates the average value of the readings and then saves the value $L \cdot I_n / V_m$ calculated in parameter **P58** and stops (the auto-tuning lasts about 30 seconds)

Before switching off the mains, remember to store the parameters on the permanent memory c43=1

13.5. RESOLVER PHASE AUTO-TUNING

This auto-tuning calculates the phase displacement between the resolver and the motor so as to have the maximum possible torque and saves this on parameter **P55**.

To do this correctly, before starting the auto-tuning set at least the following parameters:

- P52** : maximum motor speed (r.p.m.)
- P53** : number of motor poles
- P54** : number of resolver poles
- P56** : rated motor current in % of drive rated current

The motor must be free to rotate because during auto-tuning it makes a full polar rotation.

To start the auto-tuning you must:

- 1) be in STOP
- 2) set access key **P50=95** (see P99)
- 3) enter **c44** programming, write "1" and press S

Once auto-tuning has started, the system performs the following operations in succession:

- 1) checks that the ratio between motor poles and resolver poles is correct
- 2) checks that the direction of rotation of the motor and the resolver is consistent
- 3) it moves in steps of 120° electrical degrees until one full rotation is completed. It then calculates the value to be set in **P55** and saves it.

If during the auto-tuning the system stops in an alarm state, read the type of alarm, take the necessary action, reset and start the auto-tuning again. In particular if:

- 1) **A13** (wrong pole setting) blinks, verify which of the **P53** (motor poles) or **P54** (resolver poles) parameters is not correctly set and correct it.
- 2) **A14** (wrong power connections) blinks, swap two wires of the motor connection, e.g. U and V, and then start the auto-tuning again.

At the end of the auto-tuning the displacement in degrees calculated by the system can be read in **P55**; this value, for known motors with resolver, should differ only by a few degrees from the typical value of the table given below. If not some connections are wrong with respect to the standard; e.g. if the difference is of the order of $\pm 120^\circ$ or $\pm 240^\circ$, the connection of the drive with the motor power is probably wrong, while if the difference is of the order of $\pm 60^\circ$ or $\pm 180^\circ$ the resolver connection is probably wrong with or without errors in the power.

Before switching off the mains, remember to store the parameters on the permanent memory c43=1

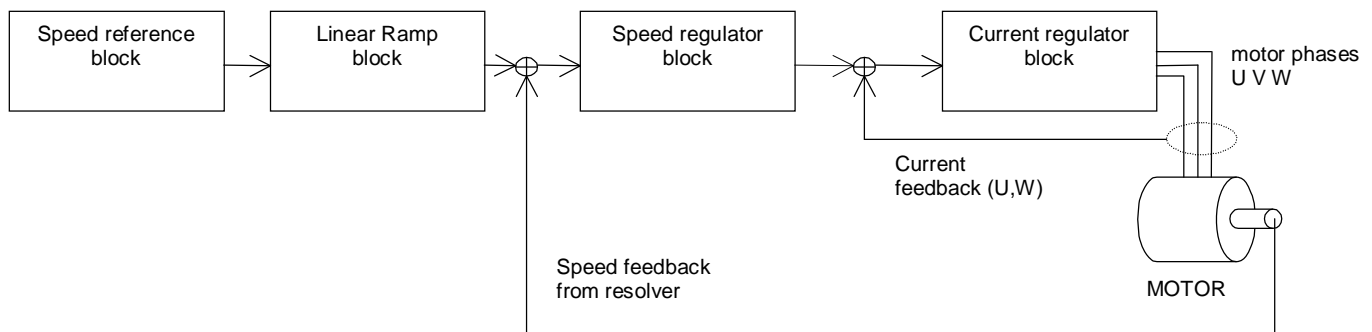
MOTOR	MOTOR POLES	RESOLVER POLES	P55
MAGNETIC	6	2	0
ULTRACT	8	2	-117.4
ACM	6	2	0
ACM	8	2	-117.4
LAFERT	6	2	+149
LAFERT	4	2	-120

14. DESCRIPTION OF THE SPEED REGULATION

14.1. EXPLANATION OF THE BLOCK-DIAGRAMS

- The rectangular blocks with **Pxx** represent functions with parameters whose value can be set from the keypad or from the serial line.
- The switches, open or closed, indicated with **cxx** represent the internal connections settable by the keypad or by the serial line, and are indicated in the state corresponding to value "0"
- The connections that can have more than two positions are indicated like commutators whose positions correspond to the allowed values (the one indicated on the closed line is the default value).
- The open or closed contacts identified with a name (for example REF1) indicate functions operated by logic inputs or internal logic programmable functions (see ch. "Configurations").
- Internal logic functions normally indicated with a rectangular block
- The circle blocks identified with **dx** represent the displayed values.

14.2. BLOCK DIAGRAM OF THE REGULATION



14.3. SPEED REFERENCE BLOCK

- For the external reference from encoder type frequency option, see chapter "Frequency input".
- Up to four speed references are possible, one analog and three digital.
- The analog reference, $\pm 10V$ for the maximum speed, is applied to terminals 7 and 8 of connector M4, (differential input); if the signal has an offset (maximum $\pm 1,9999V$) it can be compensated by means of parameter **P04** whose value is given in hundreds of microvolts, resolution 1/100000 of the base scale.
- If the maximum speed (set in **P52**) must be reached with an external reference voltage value $< 10V$, this value can be set in mV in parameter **P60** (default P60=10000); it should be remembered however that this operation reduces the reference resolution.
- The three digital references can be set in parameters **P01**, **P02** and **P03**, with base scale $\pm 100.0\%$ for the maximum speed; the external reference can be inverted via software by means of connection **c09** (0= not inverted, 1=inverted, default=0).
- The choice between the various references is made by means of inputs REF1EN, REF2EN or connections **c22** and **c23** according to the following table:

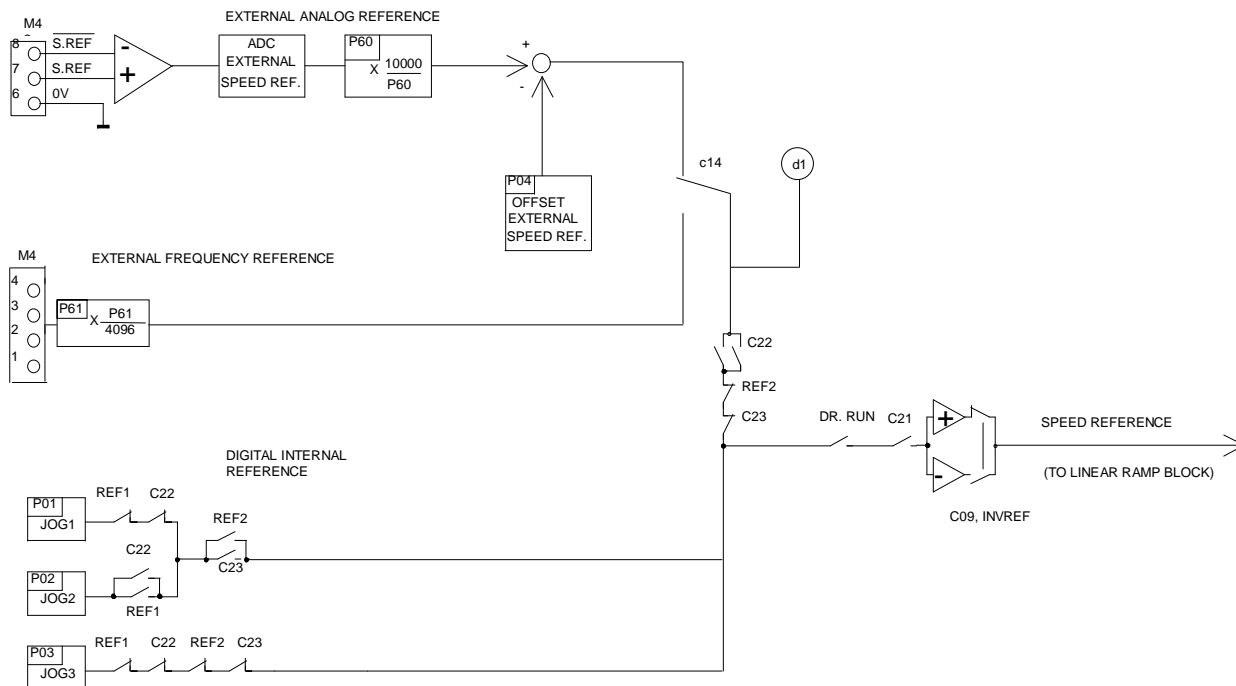
	REF1EN	REF2EN
Analog REF.	H	L
JOG1	L	H
JOG2	H	H
JOG3	L	L

(valid if c22=c23=0)

	c22	c23
Analog REF.	1	0
JOG1	0	1
JOG2	1	1
JOG3	0	0

(valid if REF1EN=REF2EN=L)

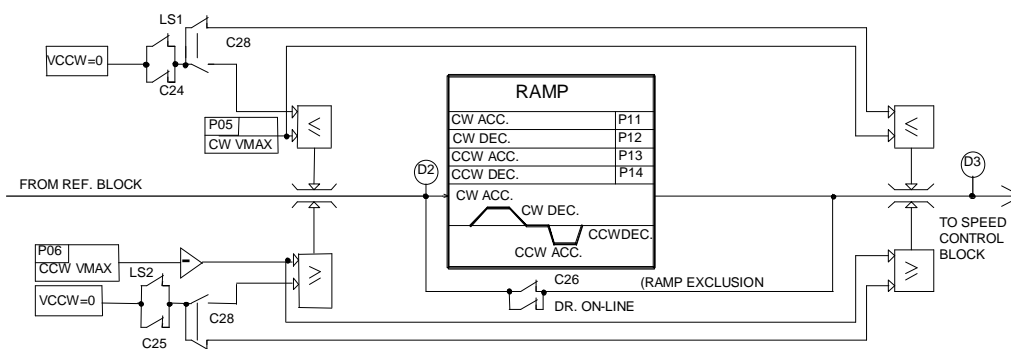
As can be seen from the table the functions of REF1EN and **c22** are the same as for REF2EN and **c23**; **c22=c23=0** are set by default so that REF1EN and REF2EN can be used; **c22** and **c23** are useful if you desire select the reference signal by serial line or by the keypad; in this case REF1EN and REF2EN, must not be configured in the logic inputs, and are both in the not active state (L).



14.4. RAMP AND SPEED LIMITS BLOCK

Parameters **P05** and **P06** are used to limit the maximum speed reference in the two directions of movement and can be programmed in the range 0-105.0%; it should be remembered that as the regulation is digital, the actual speed of the motor will never exceed the limit set in **P05** and **P06**.

A linear ramp can be included in the speed reference by programming **c26=1**. (default value **c26=0**). The acc. cw, dec. cw, acc. ccw and dec. ccw times from speed=0 to max speed = **P52** are set directly in msec. in parameters **P11**, **P12**, **P13** and **P14**.



The LIMIT SWITCHES LS1, LS2, or the equivalent connections **c24**, and **c25** are used to limit the range of movement of the motor. If used, they act directly on the speed reference. If the motor turns CW, at LS1 opening or **c24=0** the reference is set to zero; If the motor turns at LS2 opening or **c25=0** the reference is set to zero. The motor can stop without ramp if **c28=0** or with ramp if **c28=1** and **c26=1**. By default LS1, LS2, if not used, and **c24** and **c25** are equal to 1 (no limitation).

Once the motor has reached the limit switch it stops and does not continue any further in the same direction. If the reference is inverted it can return in the opposite direction.

14.4.1. STOP IN PLACE

This function is enabled by keeping the motor on-line with digital reference zero; this can be done in two ways:

- 1) set **P03=0** (JOG3=0) and at the same time remove REF1EN and REF2EN (or set **c22=0** and **c23=0** if used)
- 2) use LS1 and LS2 opening both contacts after programming both **c24** and **c25** to 1 (default values).

14.5. SPEED REGULATOR AND CURRENT LIMITS

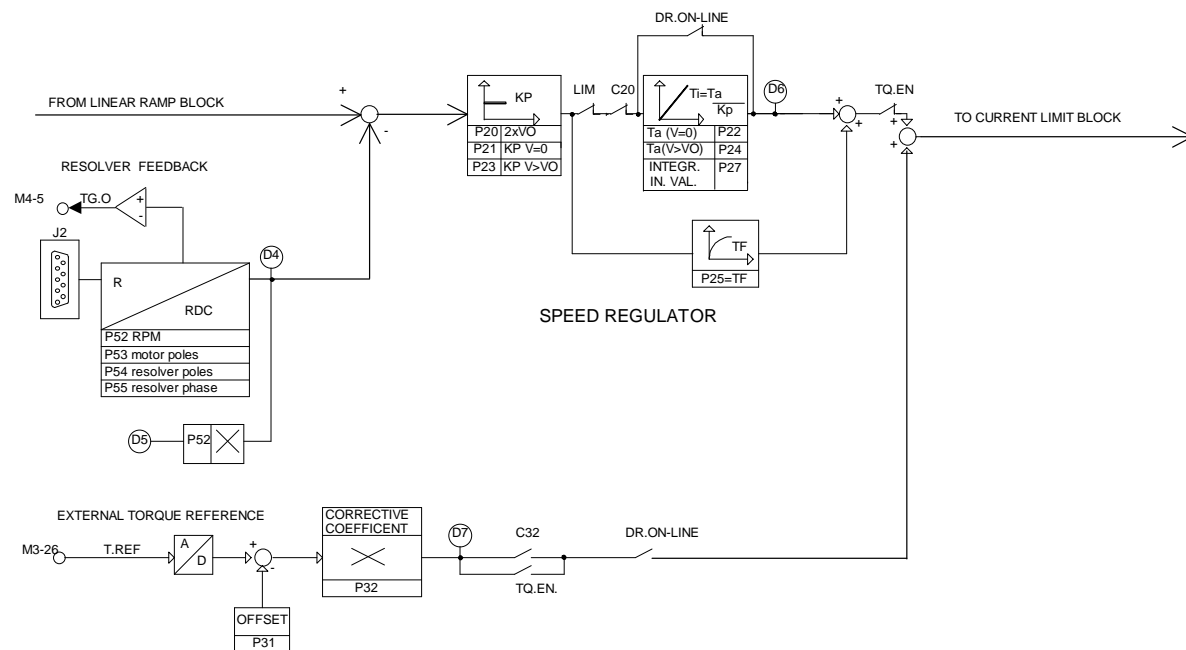
The speed regulator receives the reference from the reference block, and reads the speed feedback from the resolver connected to the motor shaft. The maximum speed in r.p.m. is set in parameter **P52**.

You can have an analog picture of the speed with base scale $\pm 10V$ at output TG.O (terminal 5 of connector M4).

The drive has three working modes:

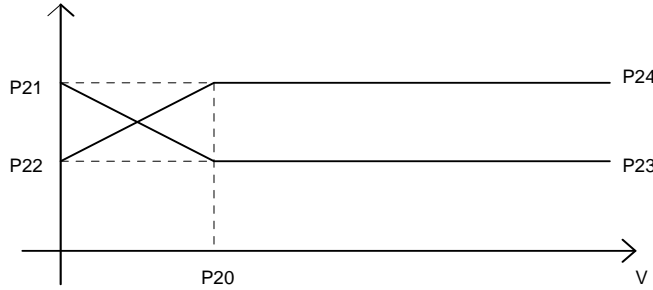
1. Speed control
2. Speed + torque control
3. Torque control

The input TQ EN select between modes 1 and 3: the drive works in "Speed control" mode if TQ EN = L otherwise if TQ EN=H (input active) the whole speed stage is excluded and the system works with the external torque reference signal (analog input TQREF, terminal 26 of connector M3). **P31** ($\pm 100.0\%$) can eliminate the offset and **P32** ($\pm 400.0\%$) is a multiplicative coefficient.



The SPEED REGULATOR is a standard PI (Proportional-integral) with a first-order filter on the speed error. Parameter settings are possible for the proportional gain K_p , the advance constant T_a (equal to the integration time constant multiplied by K_p) and the filter time constant T_f . Two values can be set for the parameters, one valid for $|\text{speed}| + |\text{reference}| = 0$ (**P21**, **P22**) and one valid for $|\text{speed}| + |\text{reference}| \geq P20$ (**P23**, **P24**); in the range between 0 and **P20** the system practices a linear interpolation function of the $|\text{speed}| + |\text{reference}|$ between the set parameters.

In practice the speed regulator operates with the constants calculated according to the following equations:



$$K_p = P23 + (P21-P23) * (|V| + |V_{rif}|) / P20 \quad \text{Proportional gain}$$

$$T_a = P24 + (P22-P24) * (|V| + |V_{rif}|) / P20 \quad \text{Advance constant of the speed stage}$$

with: $(|V| + |V_{rif}|) / P20 \leq 1$

where $|V|$ is the absolute value of the speed and $|V_{rif}|$ is the absolute value of the reference and $P20$ is the double value of the speed to which the constants are to be set.

In this way for special machines the regulator may behave differently at low speed, when the machine friction may dominate, than at high speed when the inertial torque may be more important. However putting **P20=0** only **P23** and **P24** are working (default value).

Proportional gains (**P21**, **P23**) are referred to the limit current of the drive: they express the ratio between current command and speed error; the integral constant and the filter constant are expressed in msec. The integral action of the speed regulator, which can be seen in the display **d6**, can be excluded by setting the connection **c20=1** (default **c20=0** integral inserted).

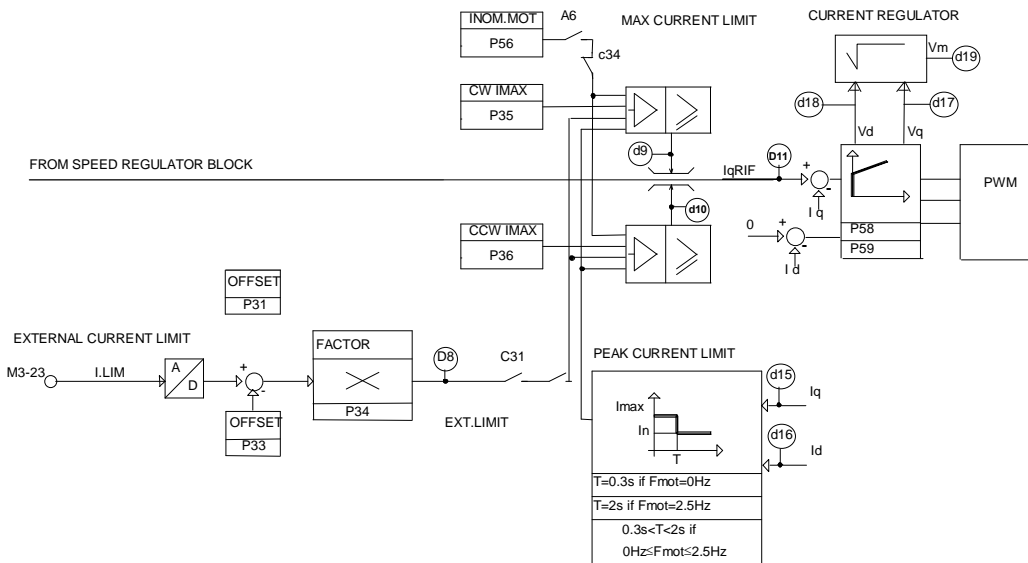
With a function generator in the analog reference input the response can be optimised (after the ramp has been excluded) checking the output TG.O.

The initial value of the speed regulator integrator can be set to parameter **P27** (scale $\pm 100.0\%$): this set the initial current value when the drive is started, to start against brake or with unbalanced loads.

If an analog signal proportional to the unbalance is available, it may be used by connecting it to terminal 26 of connector M3 (Torque ref) and programming **c32=1** ("Torque + speed control" working mode).

14.6. CURRENT LIMITS

The current reference, after the speed stage output and the torque input, pass through the limiter circuit.



The purpose of which is to limit this value within the lowest level of all the following values :

- parameters **P35** and **P36**
- the analog signal at input M3-23 (I lim) corrected if necessary with **P33** and **P34** if the external limit is enabled **c31=1** and EXT.LIMIT=H; this circuit is normally excluded (default **c31=0**).
- the value given by the peak current limitation circuit
- the value given by the motor thermal protection circuit.

Parameters **P35** and **P36** have a regulation range 0-100.0% of the maximum value (limit current) and can independently limit the torque value required in the two directions of rotation CW, CCW.

The external limitation signal (I lim) must be a positive analog signal between 0 and 10 V from which an off-set value **P33** ($\pm 100\%$) can be subtracted and which can then be multiplied by the value of parameter **P34** (field $\pm 400.0\%$)/100 before making it the current limit in both the CW and CCW direction.

The maximum current is limited within curve $I_{max} \cdot T$ compatible with the safety of the semiconductors. In particular an integration $I^2 \cdot t$ is made and when this value tends to exceed the maximum allowed, which is a function of the working frequency, the maximum current level which can be required is reduced to a little more than the rated drive current.

The value curve is such that with motor stopped the overload of twice the rated current I_n can be maintained for about 0.1 sec., when the motor turns at a number of revs corresponding to a frequency greater than 2.5Hz (revs which depend on the number of poles of motor **P53**) this value can be maintained for 2.5sec; frequencies between 0 and 2.5Hz have intermediate values.

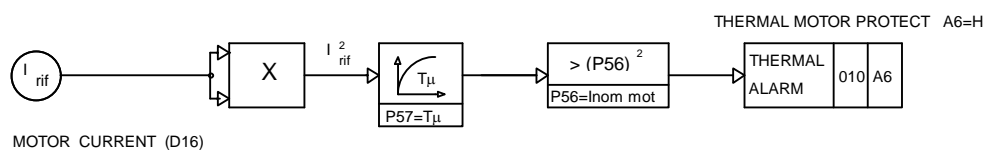
The motor current regulation is of traditional type with PWM with however adaptation of the gain to optimise the response as a function of the motor features.

14.7. THERMAL MOTOR PROTECTION

The motor protection circuit acts by calculating the square of the value of the current absorbed by the motor and integrating it over time according to the motor thermal constant. The result is a value which simulates the heating in the motor windings, which must not exceed the maximum allowed value, otherwise alarm **A6** becomes active.

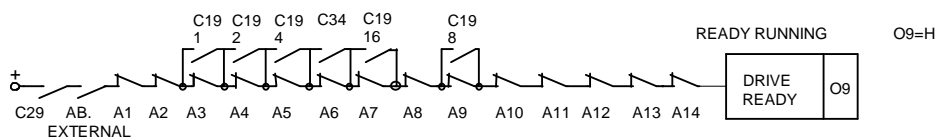
For correct operation of the circuit the motor current value must thus be set in ratio to the rated drive **P56** (0-100%) and the value of the motor thermal constant **P57** (10-600 sec.).

Circuit operation causes the drive to stop immediately deactivating DR.READY if **c34=1**: if **c34=0** it allows continuation of the drive operation, but however the maximum current limit is reduced to the motor rated current until the temperature is below the limits allowed.

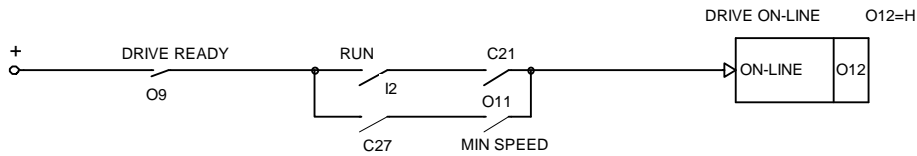


14.8. LOGIC SEQUENCES

The on line ready active condition, **o9=H**, occurs when no alarm appears, and the external enabling and the enabling via software, **c29=1** are present.



The drive thus can go online if **o9**=H, **c21**=1 and digital input **i2** (on line) is active; If the on-line command becomes inactive the power will be instantaneously interrupted (**c27**=0) or will be interrupted only when the motor has been slowed down to a minimum speed by the controller (**c27**=1).
This minimum speed can be with parameter **P41** (if $|V| < P41 \Rightarrow o11=L$).

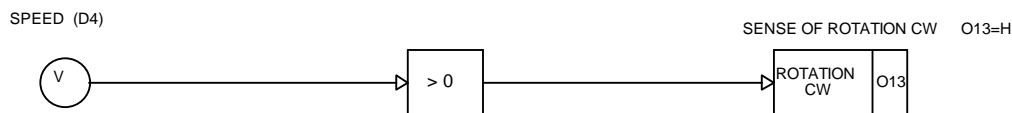


If **c27**=1 there are two ways to stop the motor:

- **c26** = 1 -> standard deceleration ramp
- **c26** = 0 -> switch-off ramp set by parameter **P19** (0-:-2000 ms)

L'allarme per max. velocità **A9** diventa attivo se la velocità del motore supera in valore assoluto quella imposta nel parametro **P42**.

The direction of rotation becomes active, **o13**=H, if the rotation is clockwise and thus $V > 0$.



The "speed in range" relay becomes active, **o16**=H, when speed **V** is $P43 < V < P44$ if **c33**=1; or when speed error **Err** is $P43 < Err < P44$ if **c33**=0.

The "current in range" relay becomes active, **o17**=H, when the current reference **I** is $P45 < I < P46$.

15. POSITIONER

The drive can be used as positioner, with with a maximum of two independent point-to-point movements. Through the serial line the parameters can be modified continuously.

Both movements have trapezoidal profile and can be completely programmed: position, velocity and ramps can be set independently for each movement.

To use the drive as positioner set connection **c35=1** (or activate the input function "Normal /Positioner" through logic inputs, see chap. 9) and connection **c26=1** (or activate the input function "ramp" through logic inputs, see chap. 9).

The positions can be set in encoder pulses in the range ±19999 revolutions ± 19999 e.p.

	revolutions	encoder pulses
movement 1	P17	P07
movement 2	P18	P08

WARNING: "revolutions" are resolver revolutions (to see the difference from motor revolutions see chap. 9)

Example:

Setting:

$$P17=5 \quad P07=1000 \text{ with } C11=4 \text{ (512 e.p./revolution)}$$

following value is obtained:

$$Q = 5 \times 512 + 1000 = 2560 + 1000 = 3560 \text{ e.p.}$$

That value can be used as distance (for incremental movements) or as position (for absolute movements). Connection c39 is used to select between these working modes:

selection	description
c39 = 0	incremental: the value in P07, P17 (P08, P18) represent the distance from the actual position (read in the internal absolute position counter) and the target position
c39 = 1	absolute: the value in P07, P17 (P08, P18) is referred to the zero position of the internal absolute position counter

In case of incremental mode the direction of the movement is due to the sign of the distance value, and not to the velocity sign.

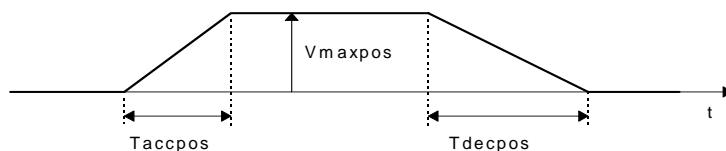
In the case of absolute mode the direction of the movement is due to the sign of the difference between actual position and target position.

15.1. PARAMETER SETTINGS

Some parameters used in the speed regulator are overridden by the positioner, as follows in the table:

	Pos. 1	Pos. 2
Position value in encoder pulses	P07	P08
Max speed in % of P52	P01	P02
Tacc	P11	P13
Tdec	P12	P14
Positioning gain KV	P10	

WARNING: Tacc and Tdec are acceleration and deceleration times to the maximum drive speed (P52): to calculate the time in respect to the speed in P01 (or P02) use the following formulas:



$$T_{accpos} = T_{acc} \frac{V_{maxpos\%}}{100} \quad T_{decpos} = T_{dec} \frac{V_{maxpos\%}}{100}$$

In the above graph are explained the parameters for the trapezoidal profile. The space covered in the movement is the area below the trapezoid. These parameters can be updated during the movements through the serial line, and the new values are considered at the next start command.

Setting P01 = 0 (P02 = 0) Vmaxpos is read from the **analog reference** (SREF, /SREF); that analog reference is sampled at the positive edge of the start command. The analog reference signal can change during the movement, but the movement speed Vmaxpos is not affected; at the next start the new value of Vmaxpos is sampled from the analog reference.

15.2. CONVERSION RATIO

The displacement values are normally expressed encoder pulses. However a conversion ratio can be set in the parameters **P71** (numerator) and **P72** (denominator). Thus the distance covered from the motor is calculated as follows:

$$D = Dset \times P71/P72$$

Where Dset is the value set in P07, P17 (P08, P18 for movement 2).

Example:

Suppose that 1mm = 1 motor revolution (512 enc. pulses). To express the distance value in millimeter tenths:

$$P71=512 \quad P72=10$$

Now the movement value can be set in P07, P17 (P08, P18) in millimeter tenths.

WARNING: make sure that the converted value D (encoder pulses) is not greater than ± 81935903 i.e.

15.3. START COMMAND

The start command can be given through a logic input (programmed as “start movement 1” or “start movement 2”, see chapter 9). The movement starts only on the positive edge of the start command; the transition of the start command can happen during a movement, but the command is acquired only at the end of the movement (only if the command is still in “High” state).

The start command can be given also through serial line, setting c36=1 (c37=1 for movement 2). That command is acquired at the 0→1 transition, and is automatically reset from the converter.

15.4. DISPLAYS AND OUTPUT SIGNALS

The internal position counter can be read on the keypad display (parameters d13 and d20): the value is split in two parts because only 4 cifre e ½ can be displayed at the same time:

$$d20 = \text{counter} / 20000 \text{ (integer division)}$$

$$d13 = \text{remainder of the integer division (enc. pulses)}$$

Example:

$$\text{counter} = 235476 \text{ enc. pulses}$$

$$d20 = 235476 / 20000 = 11$$

$$d13 = 235476 - (20000 \times 11) = 235476 - 220000 = 15476$$

The internal position counter can be read through serial line, reading d13 and d20; in this case the parameters have a slightly different meaning: the internal position counter is a 32 bit register, so d13 is the low word, in d20 the high word. When d13 is read, d20 is sampled at the same time, to allow consistent data reading.

Example:

counter = 235476 enc. pulses. = 397D4H

from serial line is read:

d13 = 97D4H = 38868

d20 = 3H = 3

To recast the real value in the PC : counter = d20*65536 + d13 = 3*65536 + 38868 = 235476

The following logic output are available for the monitoring of the positioner:

Available logic functions	
10	Stop in position
12	Deceleration area
13	Stop in position 1
14	Stop in position 2

Function 10 is active when the motor is still, after a movement (and when the "run" is enabled).

Function 12 is active during the deceleration ramp at the end of a movement.

Functions 13, 14 are active when motor is still, after movement 1 and movement 2 respectively.

15.5. STOP FROM EXTERNAL SENSOR

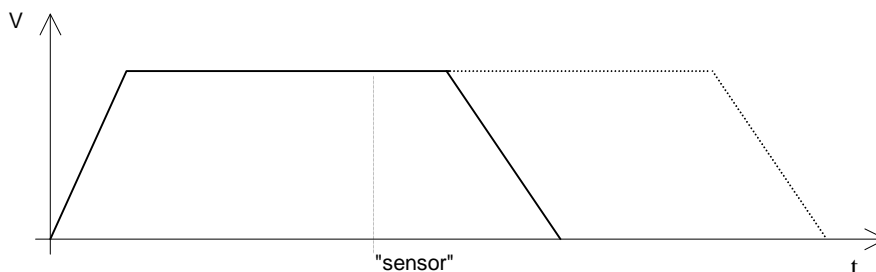
Sometimes the application working cycle combines two phases: run-in (of indefinite length), and precise stop after triggering with a reference sensor. To obtain this behaviour, a very long movement (longer than the total movement) can be programmed; at the triggering of the sensor the drive interrupts the movement and covers a preset distance.

This sensor can be connected to the logic inputs: the corresponding connection (c1÷c6, c15, c16) must be programmed to 17 (see chapter 9). The sensor is active on the positive edge, and the sampling time of the logic inputs is <1ms.

The distance to cover after the sensor triggering is set in P15 (P16 for movement 2) in encoder pulses.

WARNING:

- the movement can be interrupted only in the constant-speed part.
- The value set in P15, P16 in encoder pulses is not multiplied by the conversion ratio, so this conversion must be made by the user.
- The sensor is acquired in the positive edge; but if the sensor is already in the "High" state when a start command is given, the sensor is acquired together with the start, and the drive behaves incorrectly.
- The distance programmed in P15 (P16) must be reater than the distance covered during the deceleration ramp



Example:

Vmaxpos P01 = 50%

Deceleration ramp P12 = 400ms

Encoder pulses /motor revolution (c11) N = 512

Use the following formula to calculate the distance covered in the deceleration ramp:

$$N_{ie} = (T_d * N_g * N) / 2$$

Td is the deceleration time and is calculated as specified in the previous page:

$$T_d = 50\% * 400ms = 200ms = 0.2 \text{ s}$$

Ng is the speed in revolution per second at the Vmaxpos speed:

$$N_g = (2500 \text{ rpm} * 50\%) / 60 = 20.83$$

Finally:

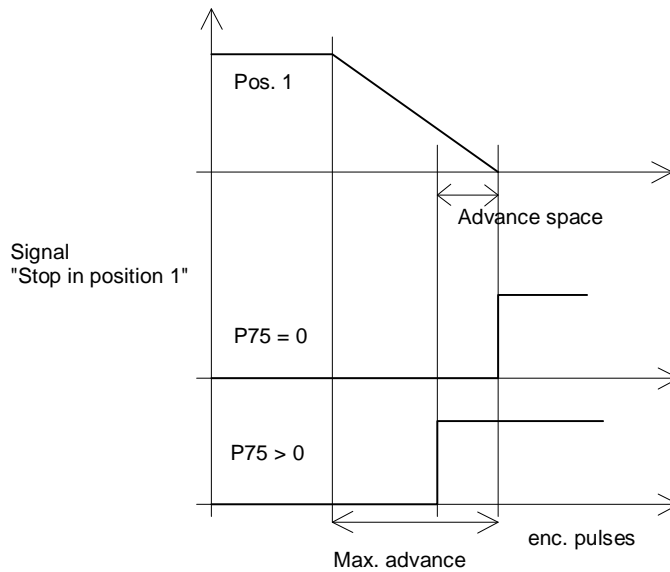
$$N_{ie} = (0.2 * 20.83 * 512) / 2 = 2133 \text{ encoder pulses}$$

15.6. "STOP IN POSITION" SIGNAL

At the end of a positioning, the *stop in position* function is activated.

To have this function as active signal on the logic outputs LO1 program **c07** = 10 (on LO2 program **c08** = 10). This signal changes to the non-active state as soon as a new positioning starts.

Signals "stop in position 1" and "stop in position 2" and "stop in position" can be advanced. The advance space can be set in parameters P75, P76 (encoder pulses):



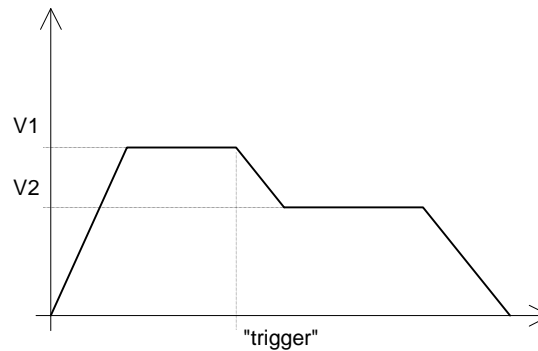
P75	Advance space for signal "stop in pos. 1"
P76	Advance space for signal "Stop in pos. 2"

Warning: this advance space must not be greater than the space made by the motor in the deceleration ramp.

15.7. DOUBLE SPEED POSITIONING

The speed/time curves in the positioning are always of trapezoidal type (see figure at the beginning of the chapter). However the drive can execute double-speed movements: start at speed P01 (P02) and transition to a slower speed through a trigger (see figure below).

Pos. 1	Pos. 2	description
P1	P2	Speed V1
P77	P78	Speed V2 (in % of V1)
P15	P16	Trigger displacement



The "trigger" can be selected through c54:

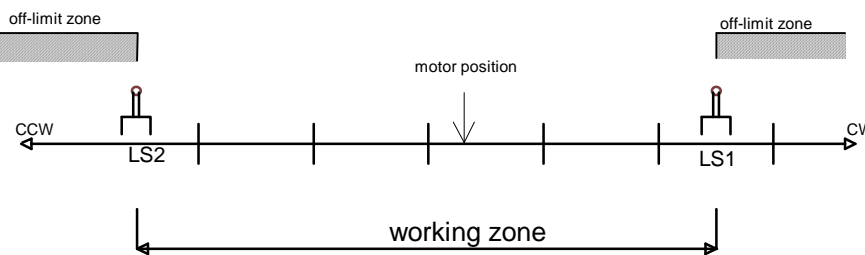
c54	description
0	normal positioner
1	external sensor "trigger"
2	"trigger" at the displacement set in P15, P16

The external sensor is given from one of the logic inputs L.I.1 - L.I.8 configured to function 18.

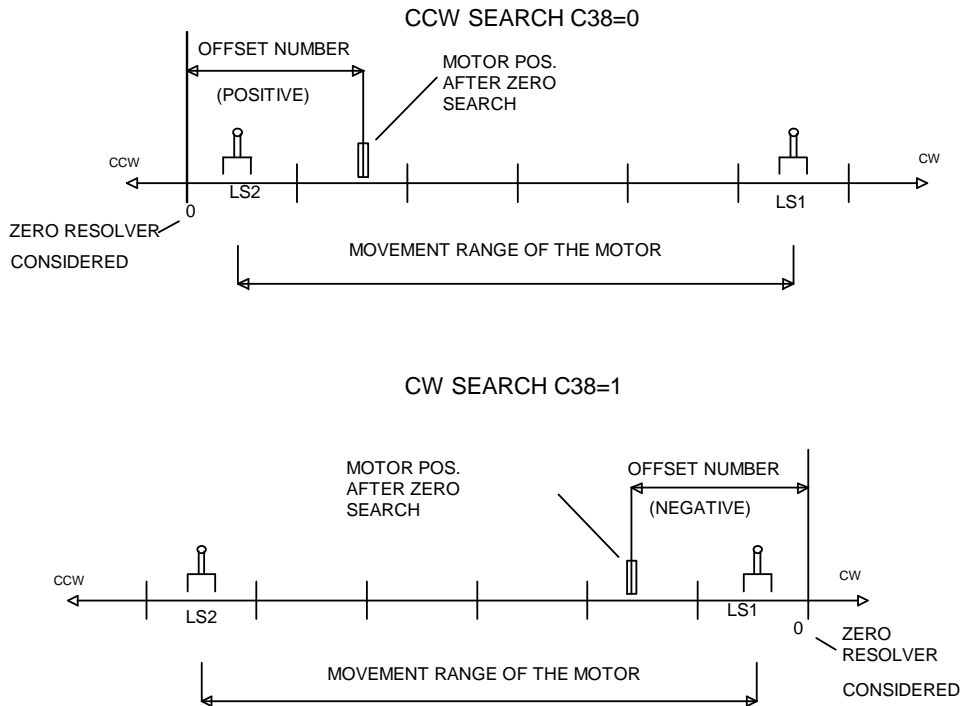
Warning: speed V2 must be greater than 1% of P52.

15.8. ZERO-POSITION SEARCH

Sometimes the machine where the drive is mounted should execute movements referred to a reference position (Zero-position). For these cases is provided in the drive an automatic "Zero-position search" procedure. This procedure is suited for machines moving in a "working zone" between two "off-limits zones" limited by limit-switches :



If the limit-switches are used only as "zero-position sensor" for the "zero-position search" procedure and are not used in the normal working, they must be connected to the drive only during this procedure, and then disconnected from the drive in the normal working. This can happen in a circular-movement machine: a machine without off-limit zones.



If **c38=0** the search direction is CCW and the "zero-position sensor" is LS2. If **c38=1** the search direction is CW and the "zero-position sensor" is LS1. The motor must be initially in the working zone. The "zero-position search" procedure is as following:

Parameter settings	description
P03	search speed (% of P52)
P09	displacement offset (enc. pul.)
c38	search direction

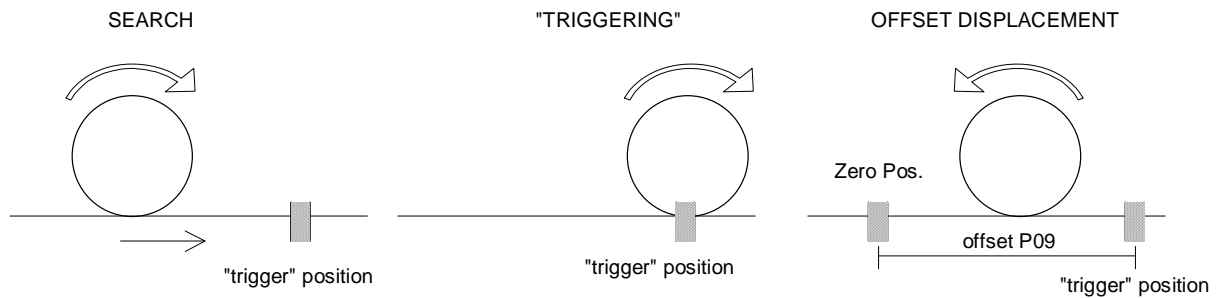
1. Start the procedure.
2. The motor moves in the direction specified by c38 at speed specified by P03 versus the extremity of the working zone. The sign of P03 is not considered, because the direction is determined only by c38.
3. The motor reach the off-limit zone; here is triggered by a limit-switch and stops.
4. The motor moves in the opposite direction (versus the working zone) until the offset position (set in P09) is reached. This offset is used to move the motor to a zero position lying in the working zone.
5. The absolute position counter of the drive (displayed in d13) is thus set to zero and the procedure is complete.

The connection c55 can select how to give the "search start" command:

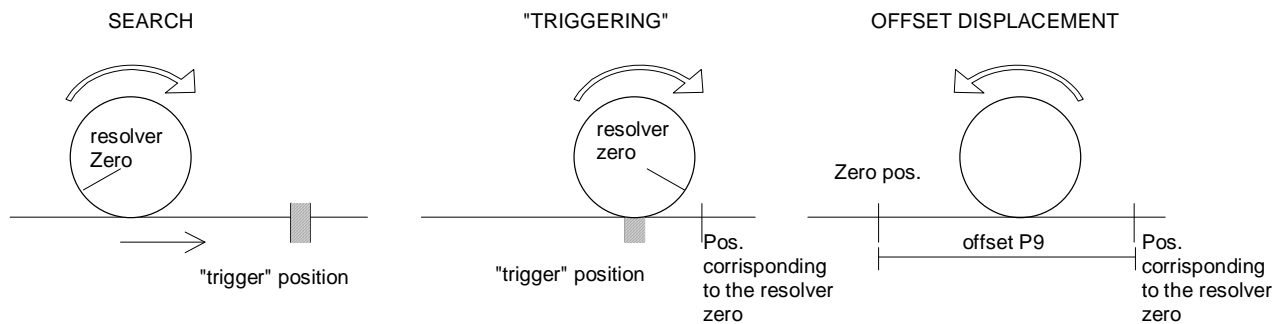
c55	mode
0	setting c40 =1 or opening at the same time both LS1 and LS2
1	same as above and every time the drive goes on-line

The "trigger" in the phase 3 can be :

- A limit-switch (LS1 or LS2, depends on the search direction).
- c24= 0 or c25=0, depends on the search direction.
- Zero crossing of the resolver (see below c56 table)



In the above figure can be seen that the trigger of a limit-switch is not instantaneous: between the trigger and his acquisition by the drive can lap a few milliseconds. So the motor stops in an unspecified point in the shadowed zone, and the offset displacement (offset P09) can be uncertain and non-repetitive (c56=1).



The precision can be sufficient for most application. If a more accurate precision is needed the offset displacement can be calculated from the position corresponding to the nearest resolver zero (c56=0). In this way the positioning precision is 0,005/CP degree, where CP is the number of resolver polar couples. To find the desired offset displacement it is suggested to set in P09 a displacement of exactly one motor revolution:

$$P9 = \text{Number of enc. puls. set in } c11 \times P54/2,$$

and then, looking at the position where the motor stops, adjust the value of P09 until the motor stops in the desired position.

WARNING: if c56=0 or c56=2 the offset displacement set in P09 must be not less than one resolver revolution (see chapter 9).

Conention c56 can select between the following options:

c56	mode
0	"trigger" = limit switch offset: calculated from the resolver zero
1	"trigger" = limit switch offset: calculated from where the motor stops
2	"trigger" = the first resolver zero crossed offset: calculated from the resolver zero

Instead of the automatic zero search it is possible to execute a manual zero position acquisition:

- configure one of the logic inputs L.I.1- L.I.8 to function 21.
- move manually the machine in the desired zero position (offline)
- reset the absolute position counter setting the configured logic input to H state.

15.9. FINAL TABLE FOR THE POSITIONER

Initial settings:

P1	max speed for pos. 1	Positive
P2	max speed for pos. 2	Positive
P3	zero search speed	Positive
P7	Pos. 1 displacement	Positive
P8	Pos. 2 displacement	Negative

C9	C38	C39	Pos. 1	Pos. 2	zero search	P9 sign
0	0	0	CW	CCW	CCW (LS2)	+
0	0	1	CW	CCW	CCW (LS2)	+
0	1	0	CW	CCW	CW (LS1)	-
0	1	1	CW	CCW	CW (LS1)	-
1	0	0	CCW	CW	CW (LS1)	+
1	0	1	CW	CCW	CW (LS1)	+
1	1	0	CCW	CW	CCW (LS2)	-
1	1	1	CW	CCW	CCW (LS2)	-

NOTES:

- P9 sign (offset for the zero search) depends on c38.
- The zero search direction depends on c9 and c38.
- If c39=0 the direction of the movements depends on c9 and on the distance values, if c39=1 depends only on the distance values.

15.10. POSSIBLE USES

15.10.1 TWO SPEEDS AND TWO POSITIONS

Movements in speed and in position with movements not referred to any initial absolute position.

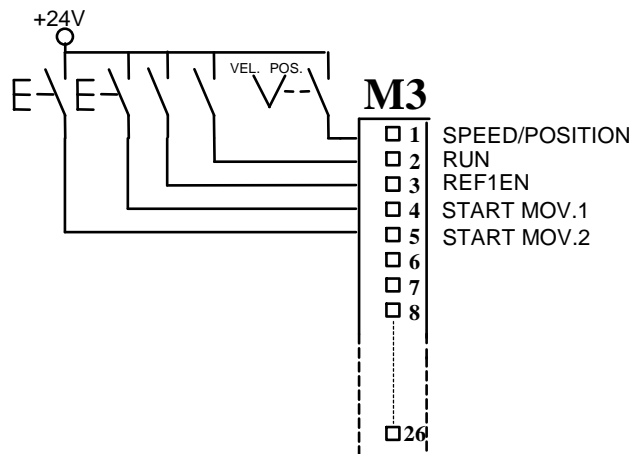
Definition of inputs

C1	= 11	input 1 = position/speed
C2	= 0	run
C3	= 3	enabling external reference
C4	= 9	start movement 1
C5	= 10	start movement 2
C35	= 0	speed mode
C26	= 1	ramp ON
P03	= xx.x%	slow speed

movement 1	movement 2
P01	P02
P07	P08
P11	P13
P12	P14

With input 1 not active (speed mode) and input 2 active (run) the motor works in speed control mode with internal reference **P03** and the ramps on; switch on logic input 3 to select the external speed (potentiometer).

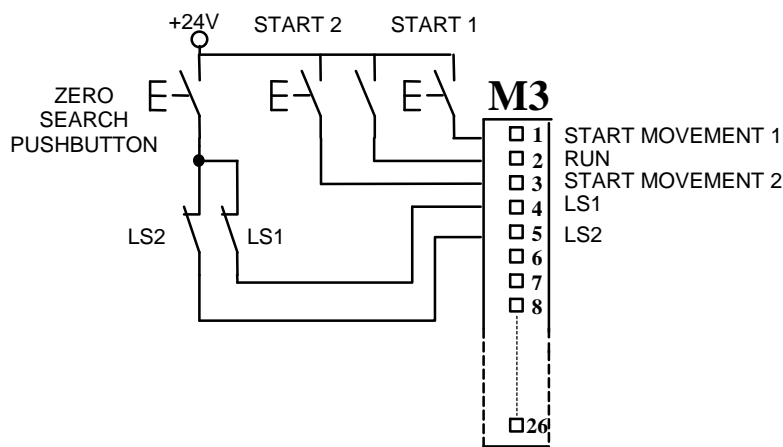
With input 1 active (position mode) and input 2 active (run), the motor stays still until a pulse is given to input 4 (start movement 1); when the start command is given to input 4 the motor performs movement 1, when the start command is given to input 5 the motor performs movement 2.



15.10.2 TWO ABSOLUTE POSITIONS WITH LIMIT SWITCH

C1	= 9	start movimento 1
C2	= 0	on line
C3	= 10	start movement 2
C4	= 5	LS1
C5	= 6	LS2
C26	= 1	ramp ON
C35	= 1	position mode
P03	= xx	zero search speed

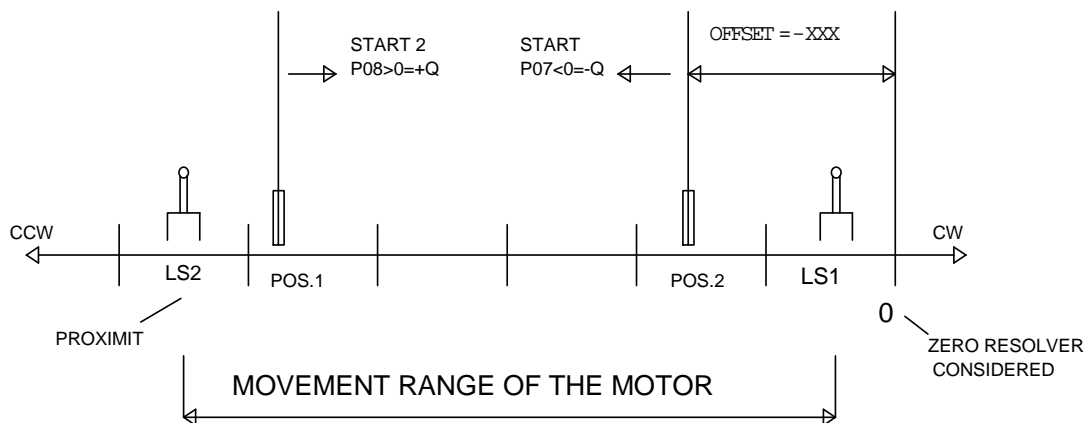
c38	= 0	search '0' counterclockwise LS2	= 1	search '0' clockwise LS1
P09	= +xxxx	offset	= -xxxx	offset
Displacement 1	CW		CCW	



When input 2 (run) is active the motor stays still waiting for commands. If the zero-search pushbutton is pressed the drive performs the zero search procedure and stops on the position specified in **P09**. This position is assumed as zero position.

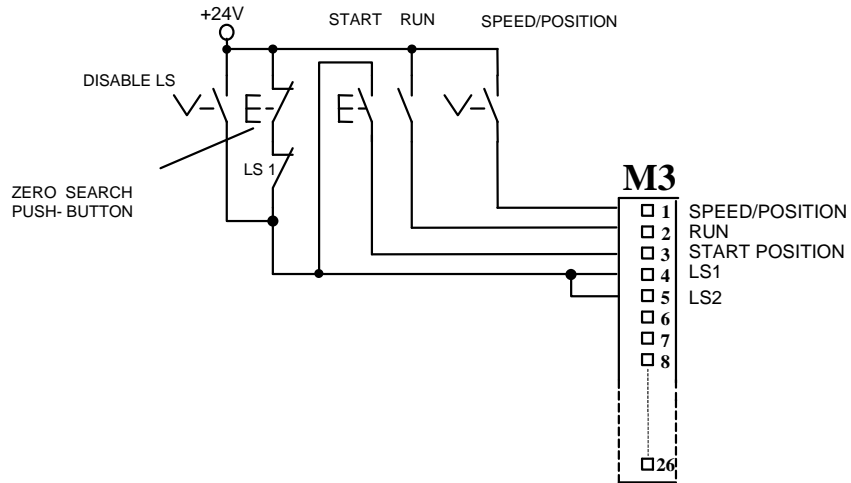
From here one can give start 1 or start 2.

SEARCH CW c38=1



15.10.3 SPEED, POSITION WITH INITIAL ABSOLUTE NUMBER

c1	= 11	position/speed
c2	= 0	on line
c3	= 9	start pos. 1
c4	= 5	limit switch LS1
c5	= 6	limit switch LS2



The limit switch needed to the zero search blocks the motor movement in the search direction; if the movement in that direction must be free (for example in circular movements), the "DISABLE LS" selector switch is needed: that switch excludes the limit switch in the normal working cycle: when it is open the "start" movement is disabled and the zero search pushbutton can be pressed to perform the zero search procedure; when it is closed the limit switch is disabled and the start button is enabled for the normal operations.

16. FREQUENCY INPUT

The drive can have an analog reference speed (M4/8, M4/7) or a frequency reference speed (connector M4). By setting one of the eight digital inputs L.I.1 –L.I.8 to 16 and depending on the value of c14, the external speed reference can be selected as follows:

L.I.	c14	External reference
0	X	Analog Reference
1	0	analog reference (default)
	1	4 channels frequency reference (A,A/,B,B/)
	2	frequency reference (freq. and up/down)

X = not considered

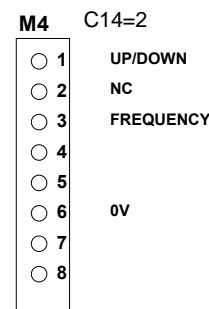
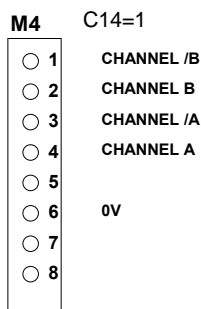
With **P10=0** the motor speed is proportional to the input frequency.

With **P10>0** the motor speed is proportional to the input frequency and an internal space control loop is activated (proportional gain=P10) so every input pulse corresponds to a partial motor rotation.

With **P10>0** the slave is in electric gearing with the master. **The memory of the pulse counter is 32750 pulses**

Two different frequency speed modes are possible as frequency input :

- frequency input encoder type: 2 differential channels (0V÷+24V). Maximum frequency speed reference: 300khz.
- frequency input by only one single channels and up/down selector (unipolar signals with amplitude from 5V to 24V)
Maximum frequency speed reference: 300khz.



With UP/DOWN = 0V a positive speed has shown (D5>0) and the motor turns clockwise sense of rotation

With 0V< UP/DOWN≤24V a negative speed has shown (D5<0) and the motor turns counterclockwise sense of rotation.

The desired drive speed can be obtained from an input frequency Fr by setting **P61** as follows:

$$P61 = RPM_{slave} \cdot \frac{4096 \cdot N}{60 \cdot Fr} \cdot c14,$$

RPM_{slave}

desired speed of the slave at the frequency Fr

N

number of encoder pulses/electrical rev. (set in c11)

Fr

input frequency

c14

connection c14

If the input frequency is generated from a DMBL as master drive (the following parameter are in the master drive):

$$Fr = N \frac{P52}{60} \frac{P54}{2}$$

Examples of a DMBL SLAVE connected to a DMBL MASTER with frequency input as standard encoder.

From a DMBLx MASTER we have considered the simulated encoder signals A,/A,B,/B and we have connected them to a DMBLx SLAVE frequency input. By programming the parameter P61 it's possible to select the sliding between two DMBLx (P61=4096 => 100%).

MASTER	SLAVE
c11=4 (512)	c11=4 (512)
P52=2500rpm	P52=2500 rpm
	P61=4096
The SLAVE run at the same MASTER speed	

MASTER	SLAVE
c11=4 (512)	c11=4 (512)
P52=2500rpm	P52=2500 rpm
	P61=2048
The SLAVE run at half of MASTER speed	

MASTER	SLAVE
c11=4 (512)	c11=4 (512)
P52=2500rpm	P52=2500 rpm
	P61=8192
The SLAVE run double of MASTER speed	

To obtain good performances at low speed, it's necessary to select a sufficient high encoder resolution (C11 in DMBLx MASTER).

Note. The max allowed error is 32750 pulses. Greater errors are not managed.

Example: With the drives set as in the following table, the desired speed of the slave is 1/4 of the master.

MASTER	SLAVE
c11=7 (4096)	c11=7 (4096)
P52=3000rpm	c14=1 (A, A/,B,/B/)
P54=2	

Input frequency of the slave is : $Fr = 4096 \frac{3000}{60} \frac{2}{2} = 204800Hz$

the above formula for P61 is:

$$P61 = RPM_{slave} \cdot \frac{4096 \cdot N}{60 \cdot Fr} \cdot c14,$$

and with the real parameters yields:

$$P61 = 750 \cdot \frac{4096 \cdot 4096}{60 \cdot 204800} \cdot 1 = 1024$$

With 4096 enc. pulses/electrical rev. each motor shaft rev. corresponds to 4096 reference pulses (with 2 pole resolver), and each reference pulse corresponds to 1/4096 rev. of the motor shaft.

16.1. "END OF MOVEMENT" LOGIC OUTPUT

When the frequency input is active, it is available an indication "end of movement". This indication is available only when c14=1 and c14=2 and the space loop is enabled (P10>0); it is displayed in o25 or in one of the logic outputs, programmed to function 16.

This indication is active "H" when both following conditions are verified:

1. The motor speed is less than minimum (P41)
2. Space loop error is less than 1 enc. pulse (if c14=4) or space error less than 2 (if c14=5) etc...

Thus when the drive has covered the distance corresponding to the pulse burst, it signals the end (as a step motor)

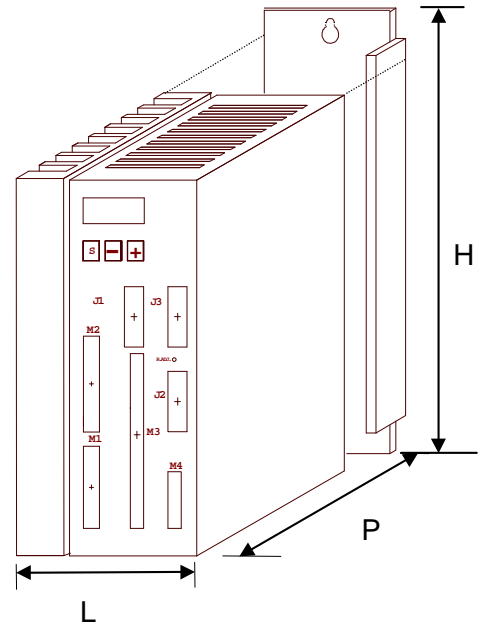
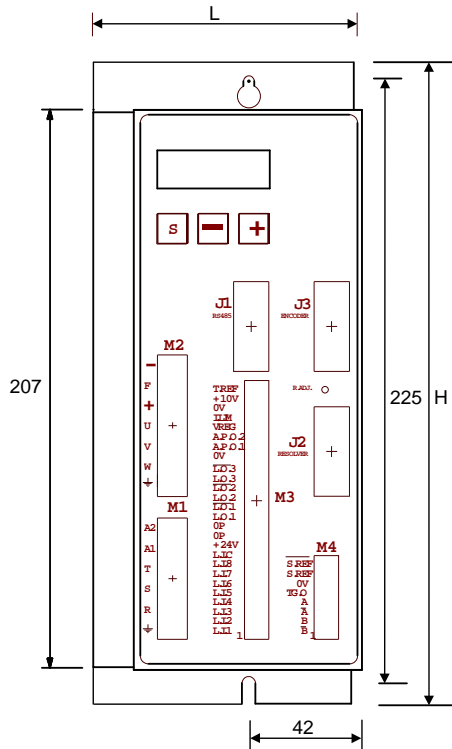
16.2. DIGITAL POTENTIOMETER FOR P61

Parameter P61 (frequency speed reference coefficient) can be set through two logic programmable inputs (digital potentiometer). Follow the sequence to use this function:

- Set two logic inputs (for ex. L.I.7, L.I.8) to function 19, 20: c15=19, c16=20
- Connect the two inputs to two normally open push-buttons.
- Press one button: at the first hit is shown the actual value of P61 .
- If You keep pressed the button for more than 2 sec. You enter the setting phase. (the dot is blinking)
- Pressing L.I.8 P61 decrements and pressing L.I.7 P61 increments.

If the drive is off-line, press both the buttons for more than 3 sec. to save the new value of P61 in the EEPROM.

17. DIMENSIONS



Fixing holes for M4 screws

MODEL			DMBL-03	DMBL-07	DMBL-10	DMBL-12
Size						
Lenght	L	mm	108	108	128	128
Height	H	mm	236	236	236	236
Depth	P	mm	153	153	153	153
Weight		Kg	2.7	2.7	3.4	3.4

MODEL			DMBL-03	DMBL-07
Size				
Lenght	L	mm	148	148
Height	H	mm	236	236
Depth	P	mm	153	153
Weight		Kg	3.5	3.5

This manual contents is updated on software version 4.22

*If you have any questions about equipment installation or working,
do not hesitate to contact us:*

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