INSTRUCTION MANUAL

R- SERIES

0,37 kW - 2,2 kW

Inverter general purpose

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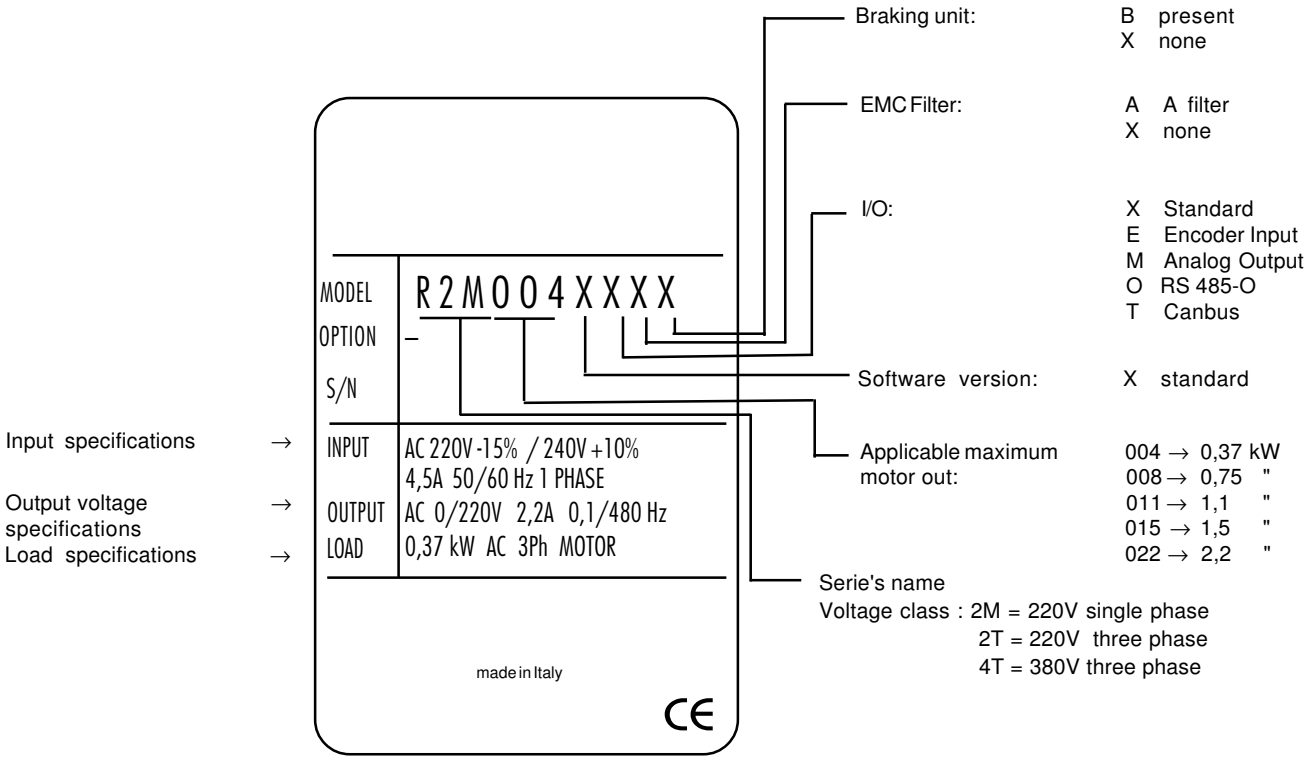
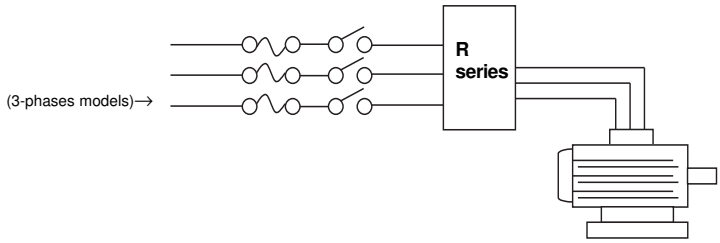
IDENTIFICATION LABEL



Introduction

The **R series** Inverters allow an efficient and flexible control of motor speed. In this way, the asynchronous motor can be used in a wider range of applications.



- **R series** single-phase and 3-phases, with a torque vector control.

The R series inverter series can be used not only for industrial application machinerys, but in many of general building applications too.

Noise disappearance:
The noiseless operation of the inverter is due to a proper method of creating the waveform of the voltage that supplies the motor.

Continuity of operation in power failure state:
In case of temporary power failure, the R series Drive inverter stops and starts again, and keeps the preset control characteristics without having to stop the motor.

Easy operation with the extractable keypad:
The functioning interface is made of a panel consisting of four keys, one display with four 7-segment digits and three leds. The display and the keys allow you to change all the inverter parameters so as to make it suitable to all applications. The drive display allows the monitoring of controlled variables as frequency, current, output voltage, cos phi, power and the storage of the last 4th alarms attempted.

Serial connection:
Besides being controlled from panel, the R series Drive inverter can be easily remote controlled and programmed through serial connection by means of a proper communication protocol, or with remotable keypad.
However, the run, stop, speed reversal and change operations are performed, as usual, through terminal board.

The R series drive inverter supplies high torques at low revolution numbers without discontinuity thanks to the current automatic control. It assures a safe start of the motor.

General safety instructions

Before the drive installation, connections or any other operation, read carefully its instruction manual to respect correctly all safety instructions.

Throughout the text, the following **Danger symbols** indicate paragraphs containing particular instructions that must be carefully read so as to assure safety conditions to users:

This warns the user about the presence of a dangerous voltage. It indicates the presence of High Voltage conditions that can cause serious damages or even death.

This indicates a general danger or very important operation notes.

Warnings

- Electrical devices can represent a **risk source for personnel safety.** It is therefore necessary to know all usage methods and unit control devices perfectly before using the machine.
- The machine should then be used by skilled personnel only, aware of the installation and operation rules, in compliance with the safety and protection standards, and able to interpret all danger warnings.
- In particolari condizioni di programmazione della regolazione, dopo una mancanza di rete, la macchina potrebbe avviarsi automaticamente.

UL normative instructions

- The inverter must be installed in ambient with protection pollution degree no. 2.
- Risk of electric shock. Disconnect drive power supply before any drive operation.
- High Voltage level is still present after drive power off. Device is live up to 5 minute after removing input Voltage, so do not perform any drive operation during this period. All the drive terminals are under risk of electric shock: PE, L1, L2, (L3 for 3-phases type), U, V, W, R, +DC.
- Use exclusively copper cables with working temperature equal and above 60/75 °C.
- Make terminal connections of regulation section using a correct nipple cable.
- Use appropriate tools to screw down drive terminals regulation section.
- Tightening torque and cables cross section for all drive sizes are listed below.

Tightening torque of drive terminals ans cables cross section allowed

Inverter model	Input voltage	Cables cross section AWG [mm^2]	
		Power	Regulation
R2M-004-...	220 Vac -15% 240 Vac +15% 50/60Hz Single-Phase Terminals: L1 - L2	24 - 16 (0.2 - 1.5)	26 - 18 (0.2 - 1)
R2M-008-...			
R2M-011-...			
R2M-015-...			
R2M-022-...			
R2T-004-...	220 Vac -15% 240 Vac +15% 50/60Hz 3-Phase Terminals: L1-L2-L3		
R2T-008-...			
R2T-011-...			
R2T-015-...			
R4T-004-...	380 Vac -15% 460 Vac +15% 50/60Hz 3-Phase Terminals: L1-L2-L3		
R4T-008-...			
R4T-011-...			
R4T-015-...			
R4T-022-...			

Warranty notes

The warranty conditions are scheduled by the supplier at the moment drive purchased.
The supplier decline his responsibility from drive damaging during shipping or unpacking.

The unit is designed for motor speed control only. Do not use it for other applications.
The manufacturer is not responsible for damages deriving from improper use or installation or inadeguate ambient conditions, as well as for damages due to improper rated values.
Nor will, the manufacturer be responsible for consequential or accidental damages.

No intervention has to be perfomed on parts inside the machine: when installing, just remove the terminal board cover panel. Any tampering or use of spare parts or other parts not supplied by the manufacturer, besides making the warranty void, may cause damages and/or serious accidents.

Starting from drive startup its warronty period is 24 months or no more than 36 months (refer to the soles conditions agreed).

The technical data contained in this manual are to be considered correct at printout time. The manufacturer, however, reserves the right to change, without notice, both the contents and the technical data of the product.

Product description

The R series Drive inverters are converters with D.C. intermediate circuit. When connected with a common single or threephase mains, they produce a threephase, variable-frequency, A.C. voltage, used to control the speed of three-phase asynchronous motors.

The control circuit has a properly programmed microprocessor.

The control keyboard allows the user to easily and quickly enter any parameter necessary for the required working conditions.

The three-phase, variable frequency, alternate voltage, controlled by microprocessor, is delivered to the motor through a power module which uses the most recent IGBT technology.
The use of microprocessor, IGBT technology and modulation frequency programming, assures an extremely accurate and silent operation.

The software, properly developed for power electronics, allows an accurate and quick control of motor speed, start and stop times which can be independently adjusted, and other operation conditions:

- Speed control via the current adjustment according to the load, thus allowing the automatic adjustment to the process. (available in the R series version).
- Automatic boost that allows a safe start of the motor by acting on the torque as a function of the load. Presence of high torques and rotation evenness at very low frequencies too. (available in the R series version).
- Direct current braking, with programmable duration and value, allowing a comfortable motor stop.
- Presence of a PID-type inner regulator, which can be freely configured, to control the motor speed and/or torque.
- Presence of a standard series line, with programmable transmission modes, to remote program and/or control the converter.

Further, the unit is provided with a programmable relay output and an analog output that indicates, through selection, the trend of the main values of the inverter.

Guide to the choice

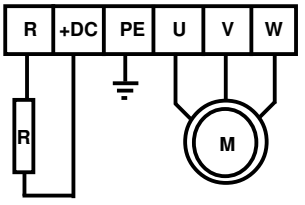
Inverter model	Input voltage	Inverter output [kVA]	Rated output current [A]	P_N motor recom-mended [kW]	P_V heat inverter dissipation [W]	Min. value of external resistor [ohm]
R2M-004-...	220 Vac -15% 240 Vac +15% 50/60Hz Single-Phase Terminals: L1 - L2	1.0	2.2	0.37	20	100
R2M-008-...		1.6	3.9	0.75	30	100
R2M-011-...		2.2	5.5	1.1	40	100
R2M-015-...		2.9	7.0	1.5	50	50
R2M-022-...		3,8	9,0	2,2	90	50
R2T-004-...	220 Vac -15% 240 Vac +15% 50/60Hz 3-Phase Terminals: L1-L2-L3	1.0	2.2	0.37	20	100
R2T-008-...		1.6	3.9	0.75	30	100
R2T-011-...		2.2	5.5	1.1	40	100
R2T-015-...		2.9	7.0	1.5	50	100
R2T-004-...	380 Vac -15% 460 Vac +10% 50/60Hz 3-Phase Terminals: L1-L2-L3	0,9	1,3	0,37	20	100
R2T-008-...		1.6	2,2	0.75	30	100
R2T-011-...		2.1	2,8	1.1	40	100
R2T-015-...		2.9	4	1.5	50	100
R2T-022-...		3,8	5,5	2,2	90	100

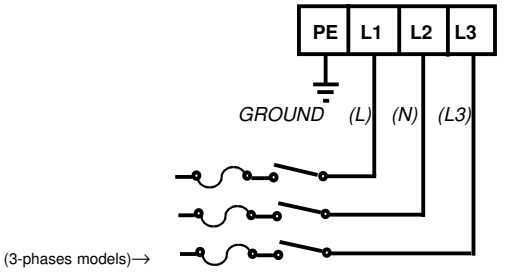
Protection degree **IP 20**

<table>
<tr><td>Input voltage</td><td colspan="5">single-phase, 220/240 V, tolerance -15%+10%; frequency from 47 Hz to 63 Hz.</td></tr>
<tr><td rowspan="4">Output</td><td colspan="2">voltage</td><td colspan="3">three-phase from 0V to input voltage.</td></tr>
<tr><td colspan="2">frequency</td><td colspan="3">from 0.1 to 480 Hz; resolution 0.1 Hz (0,01 Hz if set via serial line).
(switching frequency : from 1kHz to 18 kHz, programmable).</td></tr>
<tr><td colspan="2">current</td><td colspan="3">continuous output: nominal current of the inverter type .
overload capacity : to 150% for 30" every 20'.</td></tr>
<tr><td colspan="2">accel./decel.</td><td>acceleration time: 0.01" to 9999"
deceleration time: 0.01" to 9999"
" S " characteristic: 0.0" to 10.0"</td><td colspan="2">via the terminal board it is possible to select up to 4 previously programmed ramp torques</td></tr>
<tr><td>Environment conditions</td><td colspan="5">ambient temp.: from 0°C [32°F] to +40°C [104°F] (temperture close to the inverter);
storage temp.: from -20°C [-4°F] to +60°C [140°F]
ventilation: self or forced cooling according to the power; free of dust or corrosive gases
humidity: from 20% RH to 90% RH, non-condensing
installation: max. 2000 meters [3280 feet] on the sea level (for higher levels, the features have to be derated)
protection degree: IP 20</td></tr>
<tr><td rowspan="4">External connections</td><td rowspan="2">Inputs</td><td>Digital optoisolated NPN or PNP</td><td>Operation signals</td><td colspan="2">start (forward run) or programmable,
direction (reverse run) or programmable,
external alarm (the action is programmable).

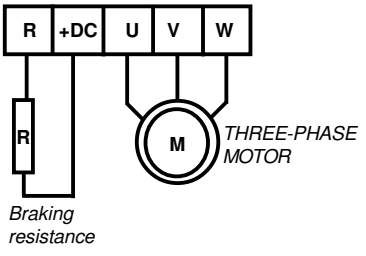
2 other signals selectable between:
alarm reset; frequency selector: F1, F2, F3; ramp selector: T1, T2; inverter enabling; d.c. braking enable; start or d.c. braking; flying restart.</td></tr>
<tr><td>Analog</td><td>Frequency reference</td><td colspan="2">selectable according to the voltage: 0/10V , -10V/+10V
or to the current: 0/20 mA or 4/20mA with programmable gain and offset</td></tr>
<tr><td rowspan="2">Outputs</td><td rowspan="2">Indications</td><td>Relay</td><td colspan="2">configurable for: alarm, inverter, frequency, ramp condition etc.</td></tr>
<tr><td>Analog</td><td colspan="2">-10/10V 10 bit (optional) or 0/10V 8 bit (standard): programmable gain and offset; the signal value can be proportional to: frequency, voltage, output current or torque, cos φ or output power.</td></tr>
<tr><td>Serial</td><td colspan="2">RS-485</td><td colspan="2">2-wire operation: max. 32 inverters can be parallel-connected; the transmission parameters are programmable; it can be used to replace the keyboard panel</td></tr>
<tr><td>Protections</td><td colspan="5">limits: overcurrent, overvoltage, undervoltage (with programmable threshold), inverter overtemperature; inverter overload, motor overload, braking resistance overload, inner fuse cutoff, phase to phase and phase to ground shortcircuit, error in the values of the stored parameters.</td></tr>
<tr><td>Standard functions</td><td colspan="5">programmable V/f characteristic, slip compensation , autoreset (programmable intervention time and retry number), jump frequency, upper and lower frequency limits, flying restart , power "dips" prevention , PID regulator, motor stall or inverter fault prevention, overmodulation, potentiometer function.</td></tr>
</table>

Power Section





POWER SUPPLY:
-Single-phase (3-phases)
frequency: 50 Hz - 60 Hz +/- 5Hz;
voltage: 220 V (-15%) - 240 V (+10%).
-3-phase (380V)
frequency: 50 Hz - 60 Hz +/- 5Hz;
voltage: 380 V (-15%) - 460V (+10%).



Attention!

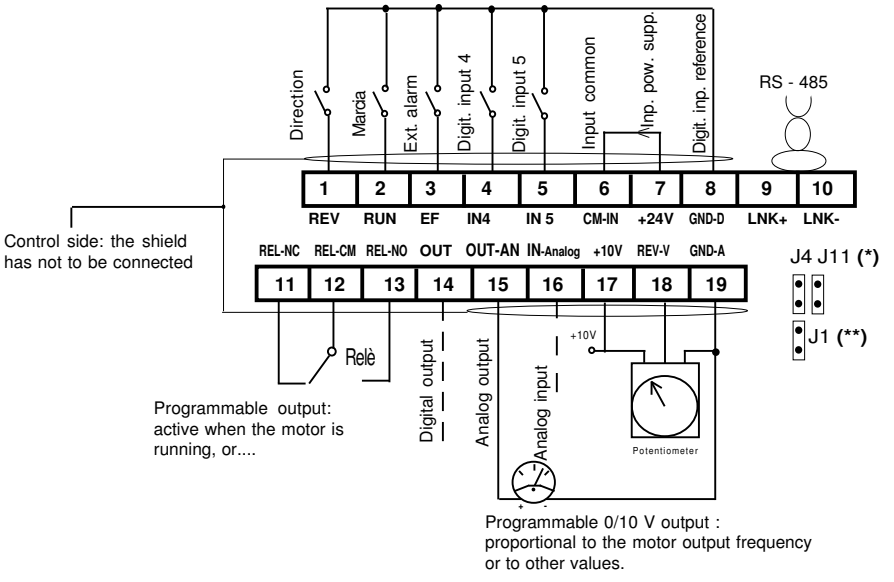
For the single-phase 1,1kW and 1,5 kW sizes, the ground connection of motor side must be connected to the M3 screw heatsink. For all the 3-phases 380V sizes, the ground connection of line supply and motor side must be connected to the M3 screw heatsink.

Power connections

TERMINALLS	FUNCTION	
PE	GROUND CONNECTION	
L1 L2	Single-phase	MAINS POWER SUPPLY: 220V
L3	Three-phases	
R	BRAKING RESISTANCE	**Note: The external braking resistor drive terminals are NOT protected by short circuit and minimum resistor value not allowed.**
+DC	Positive of the d.c. circuit	
PE	POWER GROUND	(1,1kW and 1,5kW single phase and in 3-phases 380V are not included)
U V W	THREE-PHASE OUTPUT (TO THE MOTOR)	

Connect only one cable to the Ground terminal ⏚
Other connections to the ground must be done on main ground terminal of the cabinet or system where the inverter is installed.

Control section



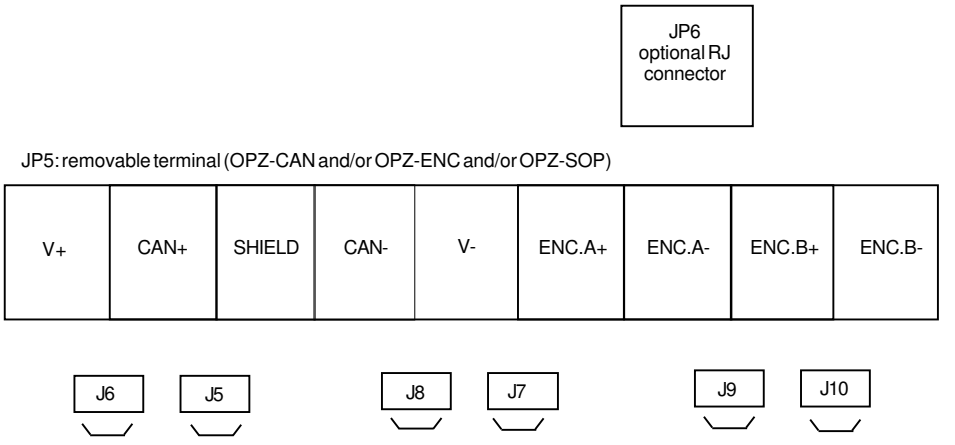
(*) Analog Inputs jumper configuration (16 and 18 terminals)

J4 configuration of **REF-V** (18 terminal)		**J11** configuration of **REF-AUX** (16 terminal)		(**) **J1** configurat. of connection ground (PE terminal)	
0-10V or -10V/10V	0-20mA 4-20mA	0-10V or -10V/10V	0-20mA 4-20mA	GND floating	GND-D on PE (8 terminals)

Control connections

TERMINALS	N.	FUNCTION				SIGNAL TYPE
REV	1	Reversal	If **b-00=1:**	Backward run		Optical couplers: 24 V, 6 mA
RUN	2	Run		Forward run		
EXTFLT	3	Alarm from outside				
IN4	4	Configurable digital input			**P-42**	
IN5	5	Configurable digital input			**P-43**	
CM-IN	6	Digital input common				
+24 V	7	Aux. power supply for digit. inputs				24 V +/- 5% 300 mA
GND-D	8	Reference ground for digit. inputs				
LNK+	9	**RS-485** serial line inputs				
LNK-	10					
OUT1-NC	11	Contacts of the configurable output relay			**P-44**	120 V ac with 0,5 A or 24 V dc with 1 A
OUT1-CM	12					
OUT1-NO	13					
OUT	14	Open collector digital output			**P-46**	50 V 50 mA
OUT-AN	15	Configurable anal. output			**P-48**	0 / 10 V 8bit (standard) or -10 / +10V 10bit (opz.)
REF-AUX	16	Auxiliary progr. analog input: AUX-V			**P-47**	0 - 10 V or -10 +10V Ri= 20 KOhm / 0 - 20mA Ri= 500 Ohm
+10V	17	Potentiometer voltage for speed reference				10V +/-5% 10mA
REF-V	18	Programmable analog input: REF-V				0 - 10 V or -10 +10V Ri= 20 KOhm / 0 - 20mA Ri= 500 Ohm
GND-A	19	Common for analog input/output circuit				

OPTIONAL TERMINAL FEATURES



Depending by customer request, the drive regulation board can be equipped with different optional configurations. The request must be present in the phase order.

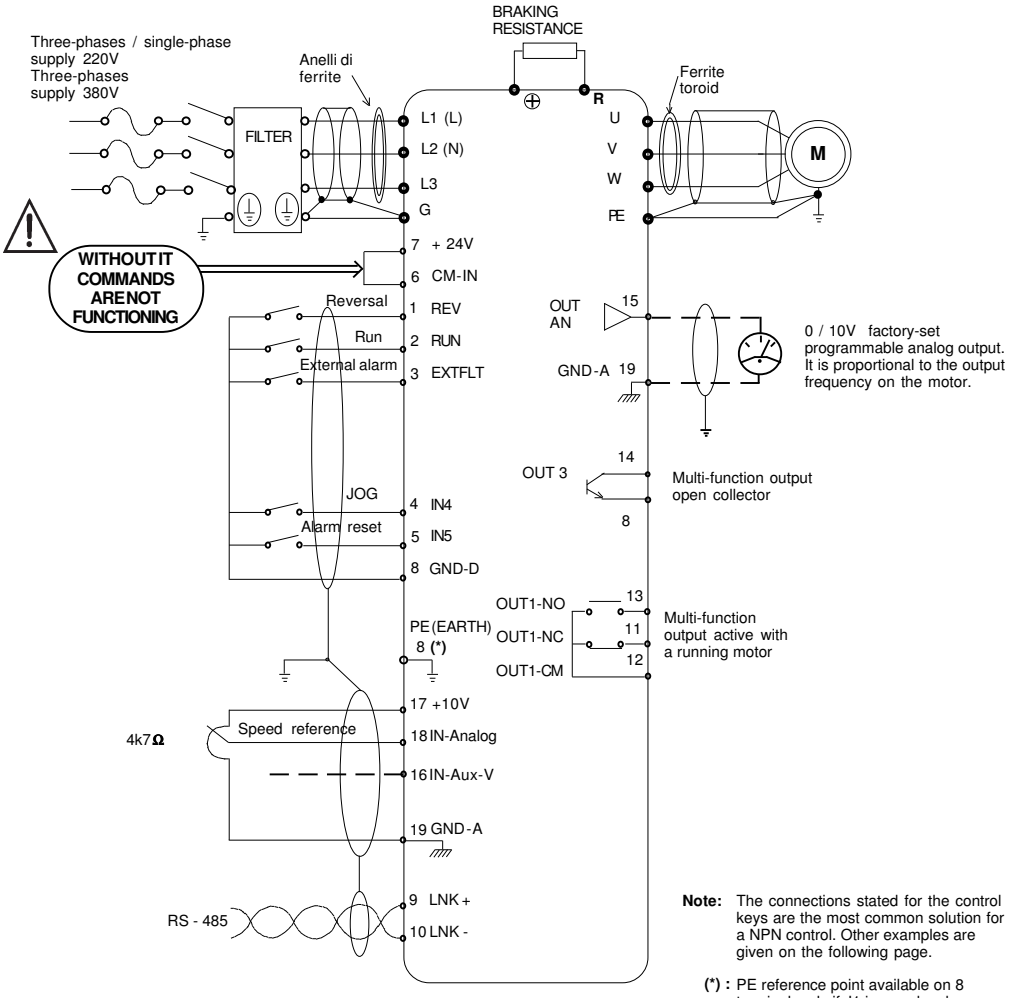
OPTO-COUPLED SERIAL LINE (OPZ-SOP): refer to page 43 for details.

CANBUS PROTOCOL (OPZ-CAN): the power supply range of this circuit is 12-30V, so it can be applied on V+ and V- terminals, JP5 connector. CAN+, CAN- and SHIELD terminals are also available for CANOPEN and/or DEVICENET protocol.

ENCODER (OPZ-ENC): reading of encoder signal. JP5 connector is assigned as encoder input, defaulted to 24V logic level (J9 and J10 jumpers not inserted) . For 5V encoder logic level, J9 and J10 jumpers must be inserted.

OPTIONAL BOARDS (OPZ-ESE): through RJ JP6 connector it is possible to interface different optional board, as PROFIBUS card.

Connections



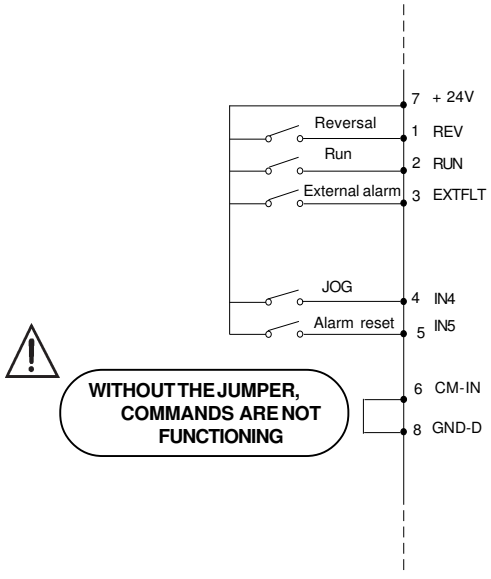
Note: The connections stated for the control keys are the most common solution for a NPN control. Other examples are given on the following page.

(*) : PE reference point available on 8 terminal, only if J1 jumper has been inserted.

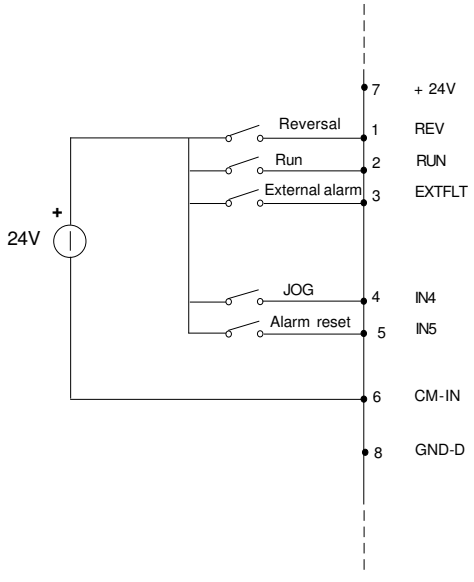
EMC filter

Inverter model	0.37 - 0.75kW Single-phase	1.1 - 2,2kW Single-phase	0.37 - 1.1kW 3-phase 220V 3-phase 380V	1.5-2,2kW 3-phase 220V 3-phase 380V
R series	optional internal	external	external	external

PNP connections controls:



Control connections opto-isolated by the inverter:



INSTALLATION GUIDELINES

In order to obtain a safe operation of the unit, assembly and start-up should be performed by skilled personnel only, according to the general regulations concerning safety conditions when working with high currents or voltages.

• Mechanical installation

Removal of the heat produced by the inverter is performed by ventilating with natural air flow, in low power models, and by means of fan in all other models.

When assembling, leave a space of at least 40 mm (1.6"). from the sides and, on the heatsink side, 150 mm (6"). above and below the inverter, soas to assure a free circulation of the cooling air. In case of stacking of more units, leave a vertical space of at least 300 mm (12"). between them.

The site should assure the ventilation air is free from dust or corrosive gases, otherwise a regular cleaning of the cooling surfaces must be performed. Avoid, in any case, the condensation of the sprayed fluids. The ambient humidity should never exceed 90%.

In working conditions, the temperature inside the cabinet should never exceed **40° C (104° F)**. If it should, it will be necessary to perform a derating of the unit or a forced ventilation so as to avoid air stagnation.

Warning: When calculating the overall dimensions, also consider the space required for installation of anti-noise filters.

• Electrical installation

The inverters are designed to operate in an industrial environment where high levels of electro-magnetic disturbance (EMI) must be expected. Good installation practice usually ensure trouble-free operation, however it is suggested that a good ground connection and RFI filters should be used. The RFI filters ensure a reduction of radiated or conducted interference when the inverter is in a interference sensible environment. The instructions on the following page show how to perform the wiring in order to be in compliance with the EMC norms.

In order to connect the inverter, just remove the cover which protects the power and control terminal boards; it can be removed by acting on the clip placed on the front upper side of the cover itself.

The **R** series is foreseen for a single-phase or three-phases 220/240V and 380Vpower supply.

As for the power supply cables, we recommend to use two or three-wire shielded cables where the ground cable is external and parallel to the shield; their dimensions must follow the values listed on page 3.

The same cable can be used for motor connection too. The cable length should never exceed **30 m (98")**. If it should, use additional inductances, series-connected with cables, to balance the parasitic capacities. In this case, a reduction of motor voltage can be noticed.

Warning: The inverter power supply must be protected by means of fuses or automatic switches. Make sure the cables are properly connected and, in particular, check that the ground connection is correctly locked.

In case of shielded power supply cables, ground connect the shield on both sides.
The power cables must be kept separate from the signal cables. The standards require the use of separate raceways.
For control cables, use a shielded cable with a section of at least 0.5 mm^2 (0.0008 spuare inches). The **shield** should be connected to the **terminal 19** on drive side only.
For connection of reference signals or serial line, use twisted cables.
Connect spark quenching units in parallel to relay coils, solenoid valves, remote control switches located near the unit, as suggested on the following table:

REMOTE CONTROL SWITCH OR SOLENOID VALVE		CHARACTERISTICS OF SPARK QUENCHING UNIT	
220 V, 240 V	>30 A	0.5uF + 100Ohm 1/2 W	250 V
220 V, 240 V	<30 A	0.1uF + 100Ohm 1/2 W	250 V
380 V, 460 V		0.5uF + 100Ohm 1/2 W	1000 V

Warning: The failure protection circuit towards earth must **ONLY** protect the inverter against failures towards earth, occurring on the motor cable or on the motor itself. It is **NOT** designed to protect people who accidentally touch the motor or the corresponding supplying cable.

It is forbidden: to connect PFC devices to output terminals between inverter and motor;
to connect capacitors between output terminals or output terminals and earth;

Note: It is not advisable to connect remote control switches to output terminals between inverter and motor if, while their functioning phase, both the motor and the inverter are running.

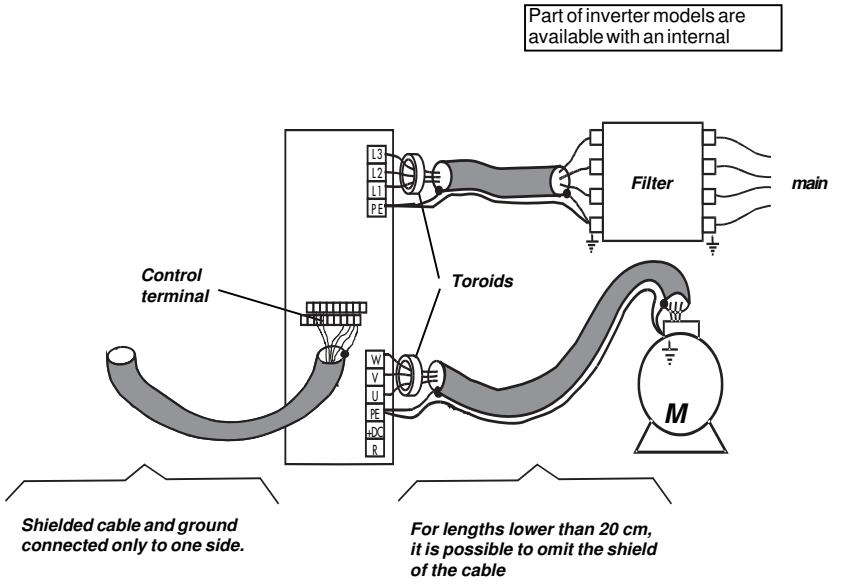
Cables

NB.: To connect the inverter it is necessary to conform to the following indications:

1 - As for the power connections, the shielding must include only the two power conductors; the ground wire, **which is obligatory,** must be external to the shield and run parallel to it.
2 - Both the inverter side and the motor or filter side of the shield must be grounded.
3 - The ferrite toroid must be put on the inverter side of the cable in a way to cover the part of the cable uncovered from the shield.
4 - The power cables must be kept separated from the signal cables; it is forbidden to install power and signal cables in the same conduit or duct. It is important to hold motor wiring as far as possible from the power supply wiring.
5 - Use high quality motors, with low parasitic capacities towards ground.

The input filter increases leak currents towards ground; so it is advisable use a overcurrent switch with a tripping current not lower than 100 mA .

The figure shows the wiring method in compliance with the stated standards by using an external filter. Part of inverter models are available with an internal EMC filter (class A type).



If the system where the inverter is installed is provided with overcurrent switch, this one should be calibrated for a tripping current not lower than 100 mA and for a time not lower than 0.1 sec. Furthermore, it must be able to support high frequency disturbance events.

External fuses of power section

The external fuses of power section must be provided by the inverter user on AC input side.
In the table below are listed the recommended types for each inverter size.

F1 - Fuses type							
Drive type	Connections without three-phase reactor on AC input						
	R/C Fuses manufactured by						
	Bussmann Div. Cooper (UK) Ltd (200 KA A.I.C.)			Gould Shawmut (50 KA A.I.C.)			Qty
	Mod. No.	Ratings		Mod. No.	Ratings		
		Amps	Vac		Amps	Vac	
R2M004	10 LCT	10	240	A25X10-1	10	250	2
R2M008	12 LCT	12		A25X12-1	12		2
R2M011	16 LCT	16		A25X15-1	15		2
R2M015	20 LCT	20		A25X20-1	20		2
R2T004	6 LCT	6		A25X6-1	6		3
R2T008	10 LCT	10		A25X10-1	10		3
R2T011 R2T015	16 LCT	16		A25X15-1	15		3
R4T004	10 LCT	10	420	A25X10-1	10	430	3
R4T008	10 LCT	10		A25X10-1	10		3
R4T011 R4T015	10 LCT	10		A25X10-1	10		3

Inverter protections

L'inverter ha le seguenti protezioni interne:

Overvoltage: DC-Link voltage level protection. The inverter trips when the internal voltage of DC capacitors exceed overvoltage threshold level.

Overcurrent: overcurrent protection. The inverter trips when the output current exceed for one instant its preset maximum level.

Overload: overload protection. The inverter trips when the output current exceed the overload max. allowed: 150% for 30 sec. each 20 min.

⚠ **Overspeed: the inverter is not provided by overspeed protection.**

Braking unit

The internal braking unit is available as option. The external resistor must be mounted if the braking unit is used. Refer to the chapter of parameters section for the correct settings.

Inverter Type	Max Duty Cycle %	P_{NBR} [W]	Min. R_{BR} [Ohm]
R2M004	20 %	300	100
R2M008	25 %	380	100
R2M011	25 %	380	100
R2M015	25 %	741	50
R2M022	25 %	741	50
R2T004	20 %	300	100
R2T008	25 %	380	100
R2T011	25 %	380	100
R2T015	25 %	741	100
R4T004	20 %	300	100
R4T008	25 %	380	100
R4T011	25 %	380	100
R4T015	25 %	741	100
R4T022	25 %	741	100

Operation

WARNING **Before turning the inverter on, make sure the cover is locked in position. After each turning off, wait 3 minutes before opening the unit so as to allow the capacitors to discharge. To avoid inverter damagings, wait 2 minutes before power on.**

For safety reasons, at power on or after a reset due to an alarm, the inverter is factory-preset not to start even with run control in active state. To start the motor, you should set the control first to OFF and then to ON (this safety precaution can be intentionally cancelled through **b-03** parameter).

- **Turning on**

The inverter is not provided with an ON/OFF switch. This operation is performed by appliying the mains voltage. After voltage application, the inverter performs a test.
If an error is encountered during this test, the display will show the message C Err

The display, consisting of four 7-segment digits, shows both letters and numbers. When turned on, it shows the output frequency value (00 Hz if the motor is stopped).

The inverter is factory-preset to control three-phase asynchronous motors which operate with voltages and currents having values corresponding to the inverter size.

- **Run**

1 - Connect a 4.7 kOhm potentiometer for the speed reference(terminals 13,14,15)
2 - Power supply the digital inputs (terminal 5) with +24V. If the inputs have not to be isolated, it is possible to use the power supply available on the terminal 6.
3 - Connect two contacts for forward and backward run control (terminals 2, 1, and 7/8) as shown on page 8.
4 - Close the run contact to start the motor . The motor is started at the frequency selected through the preset ramp (default P-05= 5 seconds).

WARNING If the factory - preset values should be modified to adapt the inverter to the application, it can be made through the control panel where the actual values can be displayed, then modified, and then permanently stored.
In case it is needed, the default values can be reset via the C02 function

- **Stop**

To stop the motor, act as follows:
- Disable the run control. In this way, the motor is stopped with factory-preset ramp (P-06= 5 seconds from max. frequency to 0 Hz).
- Or set to zero the speed reference potentiometer, so that the user has control over the motor stop.
  Caution: in this case the motor, even though it is stopped, is still under voltage.

- **The motor does not start**

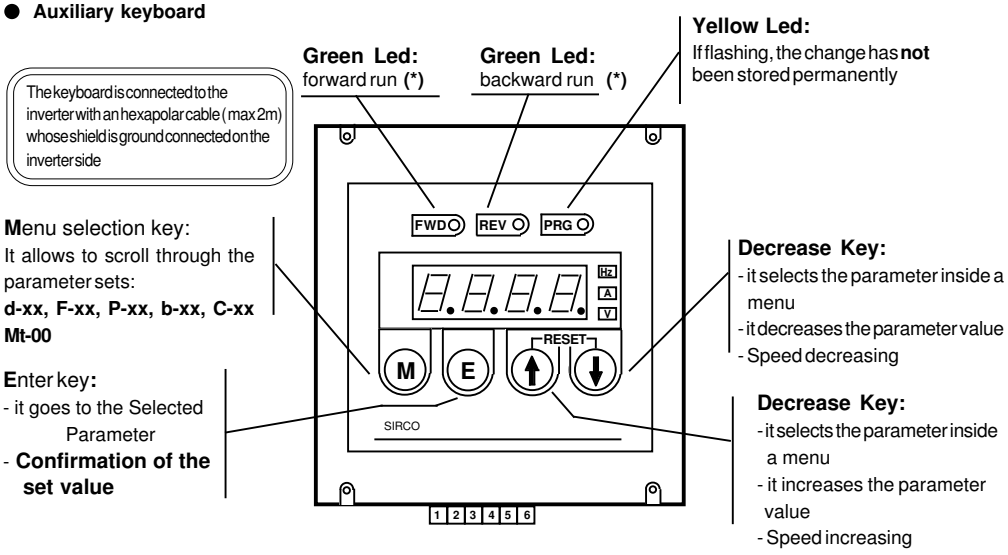
If after enabling the run control, the motor does not start, first check that the connections shown on the previous pages have been performed, then check that the factory-preset parameters meet the motor characteristics.
The parameter check is performed by using the keypad: press the **M** key until the P menu appears , then, throung the ⇑, ⇓ keys select the code of the parameter with the value to be checked and press the **E** key to read its value. The data of the motor rating characteristics are important; they can be set via the parameters P-01, P-02, P-09 , P-11, P-12.

- **Caption of the function leds mounted behind the front cover**

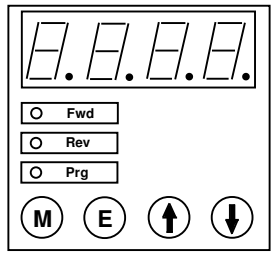
yellow : POWER
green : RUN
red : ALARM

Control panel

● **Auxiliary keyboard**



● **Removable keyboard**



The Leds and the Keys of the Extractable Keypad have the same meaning and perform the same functions of the Auxiliary Keyboard, with exception of the indication of the unit of measures.

Caution: the changes made to parameter values have an immediate effect but are not automatically stored. The storage is performed through the **C- 00** control**.**

(*) NOTE: the **flashing of Green Leds** indicates the action of the motor stall or inverter fault prevention.

- **The display** is used to show both letters and numbers, e.g.:

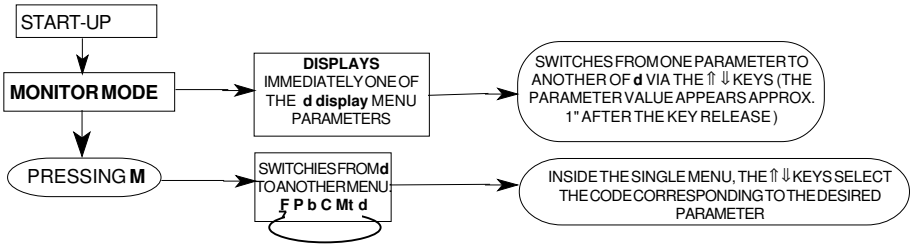
  P-xx means: **P** = letter indicating the selected menu
  xx = numeric code indicating the parameter progressive number
  xxx.x means: number, also decimal, indicating the value of the selected parameter

- The parameter sets, or **MENUS,** have the following meaning:

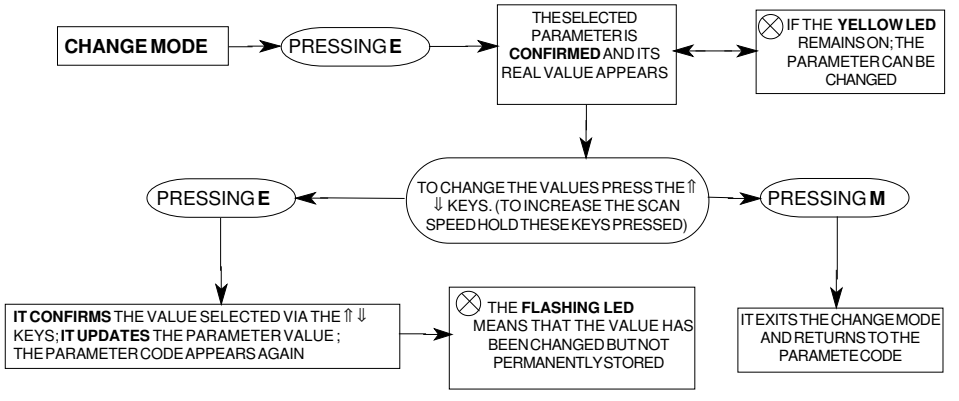
  Mt-xx menu for potentiometer function
  d-xx menu of the read-only parameters (display)
  F-xx menu of the read/write parameters of the terminal board selectable frequencies
  P-xx menu of the read/write parameters
  b-xx menu of the read/write parameters, ON/OFF type (they can be changed with a stopped motor only)
  C-xx menu of control-type parameters

Control panel

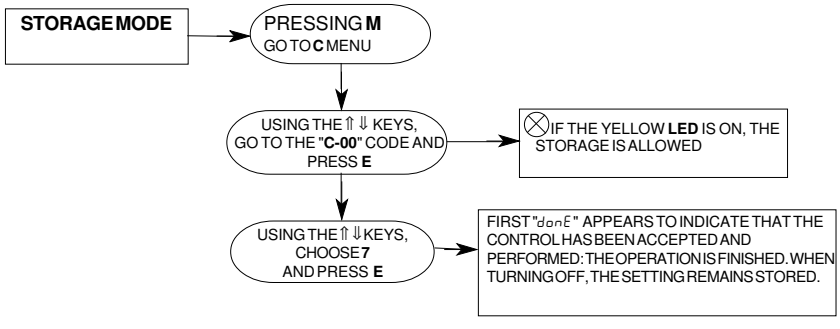
At the start-up, the control panel enters the MONITOR mode thus allowing to read the values assumed by the **d** parameters. The chart shows how to switch from one menu to the other and how to act on the parameters inside the menus.



To **CHANGE** a parameter value: **DISPLAY** the corresponding code, then confirm via the **E** key as stated by the following chart:



Act as follows to **STORE permanently** the performed changes:



Parameters changing

- **Procedure for a parameter change:**

Let us assume we turn the inverter on and we want to change the value of the max. working frequency from 50 Hz (factory-preset value) to 100 Hz.

At start-up: ..... ON DISPLAY 

1 - Press **M** repeatedly until the **P** menu is displayed**:** ..... ON DISPLAY 

2 - Through the ⇑ ⇓ keys select the code **01** ..... ON DISPLAY 
and press **E**;
the value of the **P-01** parameter is displayed (max. frequency) ..... ON DISPLAY 

3 - Note the state of PRG LED (page 17): if it is permanently lit, the parameter can be modified. Press ⇑ to increase the number, ⇓ to decrease it;
(if the key is held down, the digit scan speed is increased).
Now, press ⇑ till the display shows **100.0** ..... ON DISPLAY 
Press **E** to confirm and enable the value;
(the parameter is displayed again)..... ON DISPLAY 

NOTE*:* In this way, the value of max. frequency has been changed, but not stored in a permanent way (Yellow LED is flashing).

4 - Press **M** until the **C** menu is displayed; through the ⇑ ⇓ keys select the code **00**; ..... ON DISPLAY 
press **E** to confirm the selection;
the PRG LED, if permanently lit, indicates the storage enabling.
Through the⇑ ⇓ keys enter the code **7** ..... ON DISPLAY 
Press **E** to confirm the value;
the message "donE" is displayed for 2 seconds to confirm the operation..... ON DISPLAY 
The storage operation is completed.

Parameter display:

At the start-up the inveter enters the monitor mode: the **d MENU** is active, which allows to read the values acquired by the different unit of measures, as stated in the table; first, the output frequency parameter is displayed. The same action is obtained by selecting the **d MENU** via the **M** key.

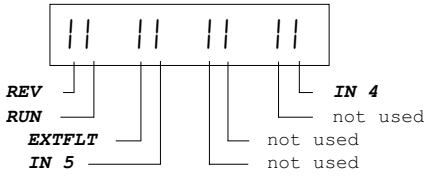
CODE	DESCRIPTION	CHANGE RANGE	UNIT RANGE	MEASUREMENT UNIT
d-00	output frequency		0.1	Hz
d-01	reference frequency	Fmin.to Fmax.	0.1	Hz
d-02	output current (rms)		0.1	A
d-03	output voltage (rms)		1	V
d-04	continuous voltage (dc)		1	V
d-05	output speed **(d-00)*(P-16)**		0.01 /0,1/ 1	
d-06	reference speed **(d-01)*(P-16)**		0.01 /0,1/ 1	
d-07	cos φ		0.01	
d-08	power		0.01	kW
d-09	inverter overload (100% = alarm threshold)		0.1	%
d-10	motor overload (100% = alarm threshold)		0.1	%
d-11	braking resistance overload (100% = alarm threshold)		0.1	%
d-12	last alarm memory	to reset the alarms use the C-03 control		
d-13	second to last alarm memory			
d-14	third to last alarm memory			
d-15	fourth to last alarm memory			
d-16	digital input state	11 11 11 11	each vertical segment corresponds to an input or output state, as shown in the table on next page	
d-17	digital output state			
d-18	16bit parallel port state			
d-19	encoder pulses (updating time)		1/10	
d-20	encoder frequency		0,1	Hz
d-21	encoder speed **(d-20)*(d-16)**		0,01/0,1/1	
d-22	pid reference		0.1	%
d-23	pid feedback		0.1	%
d-24	pid error		0.1	%
d-25	pid integral component		0.1	%
d-26	pid output		0.1	%
d-27	inverter rated current		0.1	A
d-28	software version	xx.xx		
d-29	identification code (config. file)	xxxx		
d-30	display test	all segments lit		

I/o digital state

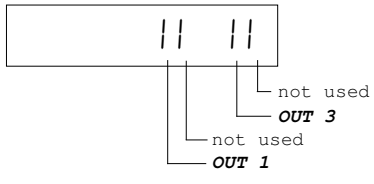
CODE	DESCRIPTION	CHANGE RANGE	UNIT RANGE	MEASUREMENT UNIT
d-31	software type (related to d-28)	xx.xx		
d-32	not used		/	
d-33	identification file code of parameters configuration	xxxx		
d-34	identification file code of regulation configuration	xxxx		
d-35	identification code of power size	xx		
d-36	internal device temperature		1	°C

NOTE.: Each segment, when lit, indicates that the corresponding input or output are active

- Input:



- Output:



Parameters quick guide (**F** menu**, C** menu**)**

F menu: it sets and/or reads the frequencies that can be selected through the terminal board

CODE	DESCRIPTION	CHANGE RANGE	UNITÀ	PRESET VALUE	PAG
F - 00	Reference frequency 0	0,0 / 500,0	0,1 Hz	0,0	28
F - 01	Reference frequency 1	" "	" "	" "	"
F - 02	Reference frequency 2	" "	" "	" "	"
F - 03	Reference frequency 3	" "	" "	" "	"
F - 04	Reference frequency 4	" "	" "	" "	"
F - 05	Reference frequency 5	" "	" "	" "	"
F - 06	Reference frequency 6	" "	" "	" "	"
F - 07	Reference frequency 7	" "	" "	" "	"
F - 08	Jogging frequency	" "	" "	1.0	32

C menu: it sets and executes some controls: to execute them, select value **7** and confirm via **E.**

CODE	PERFORMED ACTION	
C - 00	Permanent storage of all parameters	(*)
C - 01	Recall of previously stored parameters (the currently used parameters are replaced by the previously stored ones)	(*)
C - 02	Recall of the factory-set parameters (the storage depends on the operator's choice)	(*)
C - 03	Zero setting of the alarm memory	
C - 04	Recall and storage of the parameters contained in the external programming key **[from key to Inv.]**	(*)
C - 05	Storage of the inverter parameters on the external programming key **[from Inv. to key]**	
C - 06	Measure of motor phase resistance and corresponding initialization of parameter **P - 12** (page 23) (FOXPM)	(*)

(FOXPM) : parameter available in the FOXPM version

Caution: all parameters or part of them can be write-protected through **P - 19** parameter;
In case of a non-authorized modification attempt or with a running motor, the following message will be displayed: Prot .
NOTE: All parameters, which are not listed in the tables, are reserved for future developments; as a consequence, they must be always set to 0.

PARAMETER	VAL	PERFORMED ACTION
P - 19	**0**	no protection
P - 19	**1**	**F non-protected parameters,** the others are protected
P - 19	**2**	***all parameters are protected***
P - 19	**3**	no protection; storage possibility with running motor too; **not recommended**

NOTE: The sign (*) means that the controls can not be executed with running motor

For safety reasons the **P** parameters, which can be changed, are divided into three groups or levels. Whether the parameters of a given level (accessibility) can be changed or not depends on the presetting of the **P-20** parameter**:**

P-20=1 → 1st level (factory setting)
P-20=2 → 2nd level
P-20=3 → 3rd level

P menu: it sets all the values of the inverter parameters; they are divided into three groups or LEVELS; their access depends on the code (1, 2, 3) set via the **P - 20** parameter.

CODE	DESCRIPTION	RANGE	UNIT	PRESET VALUE		PAGE
	Level 1					
P - 00	reference setting	0 - 5 ; 9	1	0		28
P - 01	maximum frequency	50.0 - 500.0	0.01/0.1 Hz	50.0	(*)	"
P - 02	maximum output voltage	(P-72) - (**)	1 V	(**)	(*)	31
P - 03	V/F characteristic type	0 - 4	1	1	(*)	"
P - 04	torque boost at low revolutions (boost)	0 - 30	1% di (P-02)	3		"
P - 05	acceleration time 1	0.01 - 9999	0.01 / 0.1 / 1 s	5.0		32
P - 06	deceleration time 1	0.01 - 9999	0.01 / 0.1 / 1 s	5.0		"
P - 07	"S" curve characteristic (S)	0.0 - 10.0	0.1 s	0,0		"
P - 08	modulation frequency	0 - (**)	1	(**)	(*)	"
P - 09	motor rated current	(20% -150%)Inom	0.1 A	Inom		33
P - 10	motor thermal constant	1 - 120	1 min.	20		"
P - 11	rating of motor cos φ	0.01 - 1.00	0.01	(**)		"
P - 12	motor stator resistance	0.0 - 99.99	0.01 ohm	0,0		"
P - 13	motor efficiency	0 - 100%	1	100		"
P - 14	min. frequency (offset) for frequency analog reference	-500 /+500	0,1 / 1 Hz	0		29
P - 15	gain for frequency analog reference	0.000 - 9.999	0.001	1.000		"
P - 16	conversion constant **(***)**	0.01 - 99.99	0.01	1.00		20
P - 17	display message setting at start-up (value of **d-xx**)	0 - 36	1	0		
P - 19	parameter protection code	0 - 3	1	0		
P - 20	programming level	1 - 3	1	1		
	Level 2					
P - 21	acceleration time 2	0.01 - 9999	0.01 / 0.1 / 1 s	5.0		32
P - 22	deceleration time2	0.01 - 9999	0.01 / 0.1 / 1 s	5.0		"
P - 23	acceleration time 3	0.01 - 9999	0.01 / 0.1 / 1 s	5.0		"
P - 24	deceleration time 3	0.01 - 9999	0.01 / 0.1 / 1 s	5.0		"
P - 25	acceleration time 4 / jogging accel. time	0.01 - 9999	0.01 / 0.1 / 1 s	5.0		"
P - 26	deceleration time 4 / jogging decel. time	0.01 - 9999	0.01 / 0.1 / 1 s	5.0		"
P - 27	resolution for accel. / decel. ramps	0=0.01 1=0.1 2=1	1s	1		"
P - 28	DC braking level	0 - 100	1%	0		38
P - 29	frequency for DC braking enabling	0.0 / 500.0	0.1 Hz	0.0		"
P - 30	DC braking time at start	0.0 - 60.0	0.1 s	0.0		"
P - 31	DC braking time at stop	0.0 - 60.0	0.1 s	0.0		"
P - 32	slip compensation	0.0 - 25.0	0.1 %	0.0		34
P - 33	time constant of slip compensation	0.0 - 10.0	0.1 s	0.1		"
P - 34	jump frequency 1	0.0 / 500.0	0.1 Hz	0.0		32
P - 35	jump frequency 2	0.0 / 500.0	0.1 Hz	0.0		"
P - 36	jump amplitude	0.0 - 100.0	0.1 Hz	0.0		"
P - 37	output frequency upper limit	(P-38) + 1	1% di (P-01)	100		"
P - 38	output frequency lower limit	0 - (P-37)	(P37) -1	0		"
P - 39	parameter not used					
P - 40	parameter not used					
P - 41	parameter not used					
P - 42	IN4 input configuration	0 - 17	1	4		28/35
P - 43	IN5 input configuration	0 - 17	1	0		"

NOTE: (*) the controls can be executed with stopped motor only (**) the parameter values depend on the inverter size (*) the coefficient allows to convert the frequency displayed in d-00 into output speed for P-05 and P06**

P menu:

CODE	DESCRIPTION	RANGE	UNIT	PRESET VALUE		PAGE
	Level 2					
P-44	OUT-1: output configuration (relais)	0 - 39	1	2	(*)	36
P-45	parameter not used					
P-46	analog output 3 configuration (OUT3)	0-39		5	(*)	36
P-47	IN-analog : analog input configuration	0 - 14	1	0	(*)	39
P-48	analog output configuration	0 - 30	1	0	(*)	37
P-49	analog output offset	-9.99 / +9.99	0.01 V	0.00		"
P-50	analog output gain	-9.99 / +9.99	0.01	1.00		"
P-51	analog output time constant	0.00 - 2.50	0.01 s	0.00		"
P-52	max. amplitude of frequency correction by AUX-V	0 - 100	1% di (P-01)	0		"
P-53	signalling frequency	0.0 - 500.0	0.1 Hz	0.0		36
P-54	hysteresis amplitude related to **P-53**	0.0 - 100.0	0.1 Hz	0.5		"
P-55	current limit for overload	20 - (**)	1%(mot.)	110		36
P-56	delay time for overload signalling	0.1 - 25.0	0.1 s	0.1		34
P-57	autoreset time	0.1 - 60.0	0.1 s	5.0		42
P-58	number of autoreset attempts	1 - 250	1	1		"
P-59	encoder updating time	0.0(=0.01)-25.0	0.1s	0,1		36
P-60	encoder pulses per Hz	1 - 9999	1	100		"
P-61	multiply factor related to P-60	0.01 - 99.99	0.01	1.00		"
P-62	ohmic value of the braking resistance	1 - 250	1 ohm	(**)		36
P-63	braking resistance power	0 - 25.00	0.01 Kw	(**)		"
P-64	braking resistance thermic constant	5 - 1250	5 s	(**)		"
P-65	input setting by serial line enabling	0 - 255	1	0		36
P-66	output setting by serial line enabling	0 - 15	1	0		"
P-67	serial line configuration	0 - 19	1	1		44
P-68	serial line address	0 - 99	1	0		"
P-69	response delay time on serial line	0 - 250	1 ms	1		"
	Level 3					
P-70	basic frequency	(P-71) - 500.0	0.1 Hz	50.0	(*)	31
P-71	V / F intermediate frequency	0 - (P-70)	0.1 Hz	25.0	(*)	"
P-72	V / F intermediate voltage	0 - (P-02)	1 V	(**)	(*)	"
P-73	ramp start/stop frequency	0 - 25.0	0.1 Hz	0.0	(*)	"
P-74	output voltage reduction	0 - 100	1%(P02)	100		"
P-75	undervoltage threshold	40 - 80	1%(P02)	50	(*)	34
P-76	max. time of short mains blackout	0.1 - 25.0	0.1 s	1.0	(*)	"
P-77	accel. (if b-35=1in dec.) current limit for f<f_base	20 - 150	1%(Inom)	150		33
P-78	accel. (if b-35=1in dec.) current limit for f>f_base	20 - 150	1%(Inom)	150		"
P-79	current limit at constant speed	20 - 150	1%(Inom)	150		"
P-80	current limit for motor pickup	20 - 150	1%(Inom)	150		34
P-81	demagnetization time	0.01 - 10.00	0.01 s	(**)		"
P-82	decel. speed to prevent stall at constant speed	0.1 - 25.0	0.1 s	1.0		33
P-83	frequency scan time during motor pickup	0.1 - 25.0	0.1 s	1.0		34
P-84	voltage reset time	0.1 - 25.0	0.1 s	0.2		31/34
P-85	tolerance at constant speed	0.1 - 25.0	0.1 Hz	0.5		33
P-86	ramp end delay/constant speed	0.1 - 25.0	0.1 s	1.0		"
P-87	compensation gain of magnetizing current	0 - 100	1	0		
P-88	magnetiz. current compens. time constant	0 - 3	1	0		
P-89	reception time out (serial communication) [off if 0,0]	0.0 - 25.0	0.1	0.0		44

NB. : (*) the controls can be executed with stopped motor only; (**) the values depend on the inverter size.

P menu:

CODE	DESCRIPTION		RANGE	UNIT	PRESET VALUE	PAG
	Livello 3					
P-90	PID reference		0,0 - 100,0	0,1 %	0,0	40
P-91	PID max. positive error		0,1 - 100,0	0,1 %	5,0	"
P-92	PID max. negative error		0,1 - 100,0	0,1 %	5,0	"
P-93	PID updating time		0,00(=0,005) - 2,50	0,01 s	0,00	"
P-94	proportional term gain	set 1	0,00 - 99,99	0,01	0,00	"
P-95	integral action time	set 1	0,00 - 99,99	0,01	99,99	"
P-96	derivative action time	set 1	0,00 - 99,99	0,01	0,00	"
P-97	proportional term gain	set 2	0,00 - 99,99	0,01	0,00	"
P-98	integral action time	set 2	0,00 - 99,99	0,01	99,99	"
P-99	derivative action time	set 2	0,00 - 99,99	0,01	0,00	"
P-100	parameter not used					
P-101	parameter not used					
P-102	parameter not used					
P-103	parameter not used					
P-104	REV-V analog input offset		-9,99 / +9,99	0,01V	0,00	29
P-105	REV-V analog input gain		-9,99 / +9,99	0,01	1,00	"
P-106	AUX-V analog input offset		-9,99 / +9,99	0,01V	0,00	"
P-107	AUX-V analog input gain		-9.99 / +9,99	0,01	1,00	"
P-108	parameter not used					
P-109	parameter not used					
P-110	inverter nominal input voltage		110-220-380-460	1V	(**) (*)	31
P-111	TOP deceleration time (3-wire control commands)		0,00 a 9999	0,01/01/1s	0,0	30
P-112	mask of direction rotation (3-wire control commands)		0 a 255	1	0	"
P-113	automatic DC braking level		0 a 100,0	1% P02	0	37
P-114	automatic DC braking frequency level enabling		0,0 a 50,0	0,1Hz	0,0	30/37
P-115	P-114 hysterisis		0,1 a 25,0	0,1Hz	0,2	37
P-116	acceleration time of DC braking output		0,01 a 250	0,01/01/1s	0,1	"
P-117	deceleration time of DC braking input		0,01 a 250	0,01/01/1s	0,1	"

NB. : (*) the controls can be executed with stopped motor only;
(**) the values depend on the inverter size.

b menu:

It sets the values of ON / OFF parameters; they are divided into three groups, or LEVELS, access to which depends on the code (1, 2, 3) set via the **P - 20** parameter. **They all can be modified with stopped motor only**

CODE	DESCRIPTION	RANGE	UNIT	PRESET VALUE		PAGE
	Level 1					
b-00	run/reversal input configuration	0=RUN/REV	1=FWD/REV	0		27
b-01	stop mode	0=in ramp	1=coast	0		30/35
b-02	reversal enabling	0=off	1=on	1		"
b-03	protection	0=off	1=on	1		30/29
b-04	reference input reversal (input max ⇒ output min)	0=off	1=on	0		25/29
b-05	current input	0=0/20mA	1=4/20mA	1		"
b-06	enabling of motor overload protection	0=off	1=on	1		25/29
b-07	motor type	0=standard	1=servoventilated	0		"
b-08	configuration of external alarm input	0=NO(nor. open)	1=NC(nor.closed)	0		35
b-09	external alarm tripping mode	0=alarm/lock	1=inverter disabl.	0		"
b-10	external alarm detection mode	0=always	1=run only	0		"
	Level 2					
b-11	autoreset handling in case of external alarm	0=off	1=on	0		35
b-12	autoreset enabling	0=off	1=on	0		30/35
b-13	enabling of autoreset attempt limitation	0=off	1=on	0		35
b-14	enabling of autoreset of auto zero-setting attempts	0=off	1=on (10 min.)	0		"
b-15	autoreset alarm contact	0=off	1=on	1		35
b-16	voltage reduction tripping mode	0=always	1=con. sp. only	0		26
b-17	enabling of momentary overload control	0=off	1=on	0		29
b-18	tripping mode of momentary overload control	0=always	1=con. sp. only	0		"
b-19	enabling of momentary overload alarm	0=off	1=on	0		"
b-20	enabling of braking resistance overload protection	0=off	1=on	0		36
b-21	encoder enabling	0=off	1=on	0		36
b-22	encoder channels configuration	0=off	1=on	0		
b-23	encoder input used as flying restart	0=off	1=on	0		34/36
	Level 3					
b-24	stall prevention during acceleration	0=off	1=on	1		36
b-25	stall prevention at constant speed	0=off	1=on	1		"
b-26	stall prevention during deceleration	0=off	1=on	1		"
b-27	overvoltage prevention	0=off	1=on	0		"

	feedback switches				reference switches		
	b-55	b-54	b-53		b-52	b-51	b-50
	-	-	-	ref. frequency	0	0	0
/ not used	0	0	1	/ not used	0	0	1
AUX-V	0	1	0	AUX-V	0	1	0
REF--V	0	1	1	REF--V	0	1	1
REF--I	1	0	0	REF--I	1	0	0
	-	-	-	parameter P-90	1	0	1
	-	-	-	freq. after ramp	1	1	0
current	1	0	1	generator	-	-	-
torque	1	1	0		-	-	-
power	1	1	1		-	-	-
set to 0	0	0	0	set to 0	1	1	1

b MENU:

CODE	DESCRIPTION	RANGE	UNIT	PRESET VALUE	PAGE
	Level 3				
b-28	prevention of short mains blackout	0=off	1=on	0	34
b-29	motor pickup enabling (flying restart)	0=off	1=on	0	"
b-30	scan start frequency for pickup control	0=freq. reference	1=freq. max	0	"
b-31	motor pickup at start-up	0=off	1=on	0	"
b-32	automatic adjustment of output voltage	0=off	1=on	1	33
b-33	dead times compensation	0=off	1=on	1	33
b-34	automatic boost enabling	0=off	1=on	0	33
b-35	stall prevention to overload in deceleration	0=off	1=on	1	33
b-36	enabling of switching frequency reduction under 5 Hz	0=off	1=on	0	33
b-37	enabling of undervoltage alarm storage	0=off	1=on	1	34
b-38	overmodulation (torque increase)	0=off	1=on	0	
b-39	terminal board control enabling	0=off	1=on	1	35/43
b-40	PID regulator enabling	0=off	1=on	0	40
b-41	regulator tripping mode	0= running	1= running speed cost.	0	"
b-42	enabling encoder synchronizing / PID	0=off	1=on	0	40
b-43	variable adjusted by PID regulator	0=frequecy	1=voltage	0	40
b-44	error sign reversal	0=off	1=on	0	"
b-45	adjustment mode	0=direct	1=sum (feed/forw.)	0	"
b-46	suppression of PID regulator positive output	0=off	1=on	0	"
b-47	suppression of PID regulator negative output	0=off	1=on	0	"
b-48	suppression of positive or negative integral term	0=off	1=on	0	"
b-49	integral term initialization at start	0=off	1=on	0	"
b-50 b-51 b-52	PID reference input switches	see following table			40/41
b-53 b-54 b-55	PID feedback input switches	see following table			40/41
b-56	reserved				
b-57	configuration of the logic allarm relais	0=allarm active	1=active withoout allarm	0	
b-58	serial line termination	0=no character	1=automatic enabling	0	43
b-59	display menu modality	0=display menu	1=motorpot. menu	0	28
b-60	DC braking based on JOG function	0=not enabled after jog	1=enabled after jog	0	38
b-61	reserved				
b-62	dead time compensation	0=normal compensation	1=advanced comensation	1	32
b-63	PID reverse rotation enabling	0=foward rotation with pid neg.	1= reverse rotation with pid neg.	0	40
b-64	overtemperature prevention at low speed	0=disabled	1=enabled	1	
b-65	derivative PID selection	0=error calculated	1= feedback calculated	0	40
b-66	current clamp enabling	0=disabled	1=enabled	1	
b-67	3-wire control command enabling	0=off	1=on	0	28
b-68	automatic DC braking enabling	0=off	1=on	0	37
b-69	modulation type	0= continuous	1=discontinuous	1	32

Function description:

Frequency reference

PARAMETER	FUNCTION	RANGE [DEFAULT]	VALUES	DESCRIPTION	ASSOCIATED PARAMETERS
P-00	Determines the inverter operation frequency	0 - 5; 9 [0] the values 6,7,8 are not used	Each parameter value correspond to a different reference:		
			0	analog input: REF-V (0/10V with J4 not inserted)	P-01 P-14 P-15 b-04
			1	analog input: REF-V (-/+10V with J4 not inserted)	
			2	analog input: REF-AUX with J4 inserted (0/20mA [b-05=0] or 4/20mA [b-05=1])	
			3	it selects the frequency set by the **F-00** parameter	
			4	input from serial line with 0.01 Hz resolution	
			5	encoder input (only with option OPZ-ENC)	
			9	motorized potentiometer reference	
P-01	Indicates the max. operation frequency	50.0 - 500.0 [50,0] (Hz)	The set value is the full scale value for the analog inputs and for the variables of the F menu.		

Digital input reference

By configuring the two digital inputs as frequency switches (P-42=1 and P-43=2), it is possible to recall the frequencies set via the **F** parameters:

INPUT		DESCRIPTION
In 4	In 5	
0	0	la frequenza di riferimento è letta secondo P00
1	0	the frequency reference is the frequency F-01
0	1	the frequency reference is the frequency F-02
1	1	the frequency reference is the frequency F-03

NOTE:
in the table: 1 = means closed contact, 0 = means open contact; a non-used input is considered as 0.

Motorpotentiometer reference by keypad

As alternative of digital/analog input reference can be selected the Motorpotentiometer function, increasing and decreasing the frequency reference by the using of up and down bottoms on the drive keypad.

Follow the procedure below to enable the function:

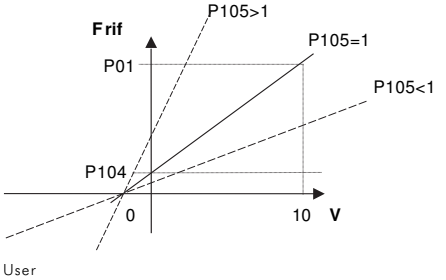
- Set P00=9 (frequency reference through motorpotentiometer)
- Access to "Mt" menu pushing "M" bottom
- Increase and decrease the frequency reference through ⇑, ⇓ bottoms. This function allows to storage the reference step, sets by the user before the drive power-off.
- Optional: with b59=1 the motorpotentiometer menu, "Mt", will be displayed at drive power on.

N.B.* For the function of the motor potentiometer it's need the looking command running *(RUN: terminal 2).

Main analog input reference: REF-V

When the analog input REF-V is selected (voltage or current), it is possible to manage its signal through the following parameters:

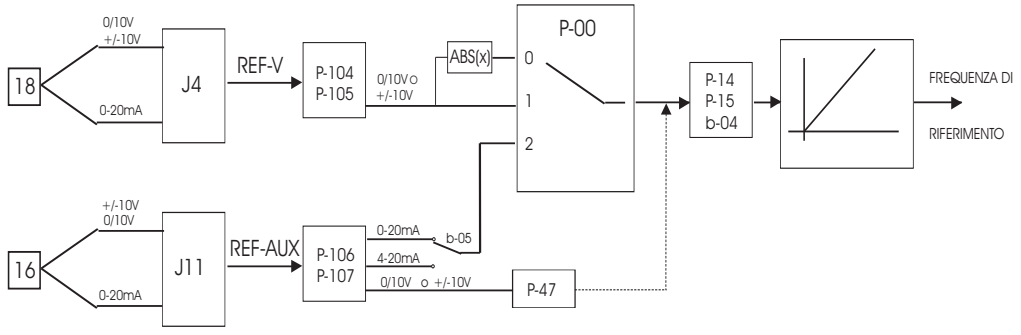
P-104 analog input REF-V offset (positive or negative values)
P-105 analog input REF-V gain (positive or negative values)
P-106 analog input AUX-V offset (positive or negative values)
P-107 analog input AUX-V gain (positive or negative values)



$$Frif = \left(\frac{(P01 - P104)}{10} * P105 \right) * Vrif$$

In case of negative input voltage the motor rotation assumes negative sign.

MAIN REFERENCE SELECTION DRAWING:

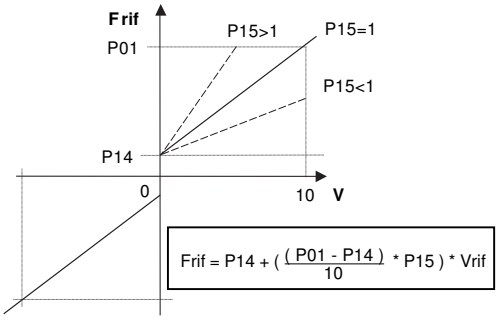


When the analog input REF-V or REF-AUX (voltage or current) are selected, it is possible to manage through the following formula the frequency input signal (P-104, P-105, P-106, P-107 parameters):

P - 14	determines the minimum frequency (offset); it can assume negative values too.
P - 15	it is a gain multiplicative factor G= P15* (P01-P14)/10.
b - 04	enables the formula reversal (a minimum signal corresponds to a maximum frequency).

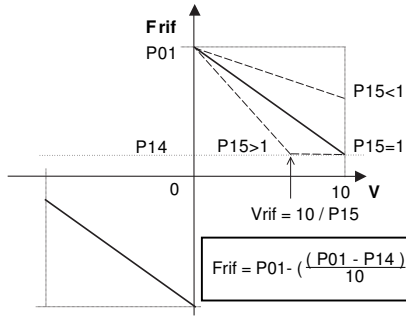
Example: with P-00 = 1 the reference is the voltage analog signal type -10/+10 V:

Direct formula: **b-04=0** with **P14 > 0**



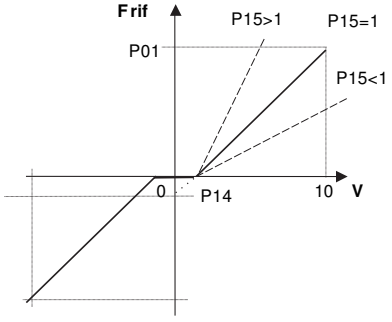
$$Frif = P14 + \left(\frac{P01 - P14}{10} * P15 \right) * Vrif$$

Inverse formula: **b-04=1** with **P14 > 0**



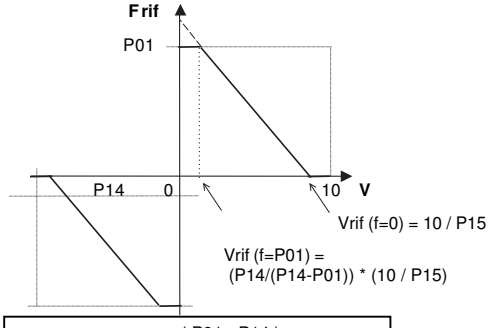
$$Frif = P01 - \left(\frac{P01 - P14}{10} * P15 \right) * Vrif$$

Direct formula: **b-04=0** with **P14 < 0**



Vrif (f=0) = (10 / P15) * (P14 / (P14 - P01))

Inverse formula: **b-04=1** with **P14 < 0**



$$Frif = (P01 - P14) - \left(\frac{P01 - P14}{10} * P15 \right) * Vrif$$

In any case Frif is always limited between P-73 and P-01.

3-wire control commands function

This function can be activade by B-67 = 1.

It allows to give Run command and select one of the frequency steps programmed with F-01 - F-07 and P-112, only if 3-wire control commands enabled.

REV, RUN and IN5 inputs become frequency selectors (positive/negative direction) according to the following table:

Terminals			Reference	Function
REV	*RUN*	*IN5*		
off	off	off	-	STOP
off	off	on	F-01	RUN – direction bit1 of P-112
off	on	off	F-02	RUN – direction bit2 of P-112
off	on	on	F–03	RUN – direction bit3 of P-112
on	off	off	F–04	RUN – direction bit4 of P-112
on	off	on	F–05	RUN – direction bit5 of P-112
on	on	off	F–06	RUN – direction bit6 of P-112
on	on	on	F–07	RUN – direction bit7 of P-112

"ON" means contact closed; "OFF" means contact open

For Run command activation, it is necessary to give one of 3 input; the selection of frequency step programmed depends by the combination of 3 inputs control.

P-112 parameter determines the frequency sign, so the motor direction. It is a 8 bit value, where each bit assumes a digital frequency step: 0 means forward direction and 1 means reverse direction.

	P-112							
Posizione	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
F associata	F-07	F-06	F-05	F-04	F-03	F-02	F-01	-
Peso	128	64	32	16	8	4	2	1

To calculate P-112 parameter value, it is necessary to sum each bit value that has been set to 1.
Example: if it is necessary to use F-01 and F-05 as REV direction and all the others as FWD: bit 1 and bit 5 of P-112 must set to 1; all the others must be set to 0.
P-112 value will be 2 + 32 = 34 (sum of F-01 and F-05 values).
P-112 defult value is 0; it means FWD direction for all the digital frequency reference.

From STOP to RUN and during multi frequencies selection are executed the standard acceleration/deceleration ramps; from RUN to STOP (when there are not any command applied to the terminals) the deceleration ramp is determined by P-111 parameter.
If P-111 is 0 (default) the deceleration ramp is not executed; the motor will coast to stop.

PARA METER	FUNCTION	VALUE [DEFAULT]	DESCRIPTION
P-111	stop deceleration time	0,00 / 9999 [0s]	RUN/STOP deceleration time of 3-wire commands control
P-112	mask of direction rotation	0 /255,0 [0]	3-wire commands control frequency mask of direction rotation (positive/negative directions)
b-67	3-wire commands control enabling	0 / 1 [0]	0 = disabled 1 = enabled

.

V / F characteristic

PARAMETER	FUNCTION	RANGE [DEFAULT]	VALUE	DESCRIPTIION	ASSOCIATED PARAMETERS
P-03	Determines the voltage to be applied to the motor as a function of the frequency	0 - 4 [1]	Each parameter value correspond to a different characteristic:		
			0	user-defined characteristic	P-02 P-04 P-70 P-71 P-72 P-73 P-74 P-84 b-16 b-32
			1	linear characteristic for 50 Hz motors	P-02 P-04 P-73 P-74 P-84 b-16 b-32
			2	linear characteristic for 60 Hz motors	
			3	quadratic characteristic for 50 Hz motors	
			4	quadratic characteristic for 60 Hz motors	

PARAMETER	FUNCTION	RANGE [DEFAULT]	DESCRIPTION
P-70	To customize the characteristic:	(P-71) - 500.0 [50.0] (Hz)	Selects the motor base frequency (rated); this frequency is associated to the motor max. voltage (max. V set via **P-02** and P74) .
P-71	**the change is possible only if P-03 = 0**	0 - (P-70) [25.0] (Hz)	Selects the intermediate frequency.
P-72		0 - (P-02) [(**)] (V)	Selects the voltage applied to the motor as regards the intermediate frequency.
P-02	Selects the max. voltage applied to the motor. Rating value of the motor V.	(P-72) - (**) (V) [(**)]	To make this value independent from the inverter supply voltage fluctuation enable the automatic adjustement function of the output voltage by setting **b-32=1**. In this case, the inverter can be supplied through a voltage higher than the motor rated one. If **b-32=0** then the voltage value set by P-02 must match the motor rated voltage.
P-110	Inverter nominal input voltage	110-220-380-460 (V)	Select the choice between nominal input voltage expected. Automatic setted D27,P02, P09, P72 in function of nominal voltage.
P-04	Increases the output voltage at 0 Hz (% of P-02) and the torque.	0 - 30 [3]	The set voltage increase is added to the V/F characteristic in a decreasing way, until it is annulled at F= Fintermedia. (figure A)
P-73	Selects the freq. applied to the motor at start.	0 - 25.0 [0.0] (Hz)	It is the ramp begin frequency at the start and the ramp end frequency at the stop.
P-74	Limits the voltage applied to the motor(% of P-02).	0 - 100 [100]	The max. output voltage is limited to the value (**P-74*****P-02**)/100.
b-16	Controls the voltage reduction set by P-74 parameter.	0=always; 1=con. speed only [0]	If **b-16=0** the reduction is always active; if **b-16=1** the reduction is not active during the ramps, so that the torque is completely available both in acceleration and deceleration state (figure B)
P-84	States the max. speed of voltage change	0.1 - 25.0 (s) [0.2]	Time needed to go from 0% to 100% of V and viceversa **NOTE : too short times cause excessive current peaks.**

[(**)] = The default value depends on the inverter size.

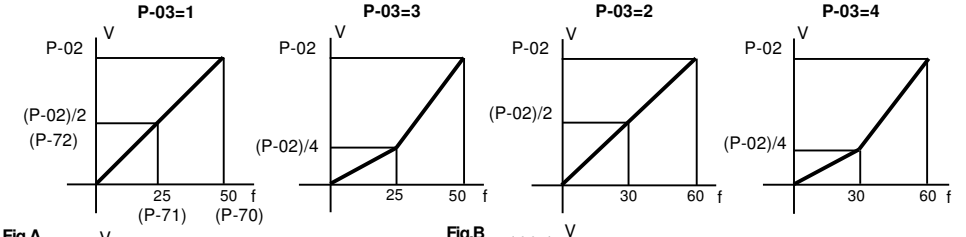


Fig.A

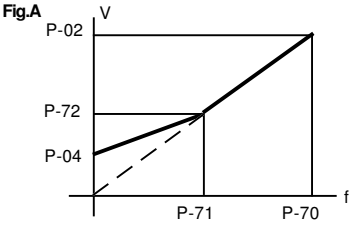
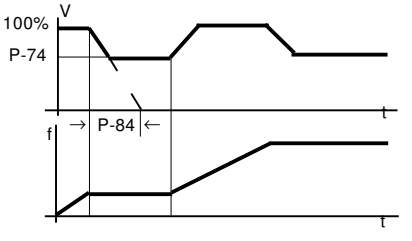


Fig.B



Freq. jumps - Output freq. limitations - Jogging - Switching freq. - Accel./decel. ramps

PARA METER	FUNCTION	RANGE [DEFAULT]	DESCRIPTION
P-34	Jump frequency N. 1	0.0 - 500.0 [0.0] (Hz)	Particular inverter frequencies can cause mechanical vibrations. The parameters **P-34 P-35** and **P-36** set two frequency bands which are crossed during the ramp phase but which can not be accepted as a normal frequency. If Fref decreases inside a prohibited area, the inverter uses a frequency set at the limit of the area defined via P-36. Ex.: the interval of the N.1 freq. goes from (**P-34**)-(**P-36**) to (**P-34**)+(**P-36**). **To disable an interval set at 0 Hz the frequency of P-34 or P-35 The two intervals can overlap.**
P-35	Jump frequency N. 2	0.0 - 500.0 [0.0] (Hz)	
P-36	Frequency interval Δf on the left or right of the jump frequency	0.0 - 100.0 [0.0] (Hz)	
P-37	Upper limit of the output frequency (% of P-01)	(P-38) + 1 / 1% di (P-01) [100]	The output frequency can be limited independently of the maximum and minimum values defined by parameters **P-01** and **P-14**. The output frequency can exceed the maximum frequency set by **P-01** up to the max. value of 110%. This is done by using the slip compensation function or the speed feedback with the PID regulator.
P-38	Lower limit of the output frequency (% of P-01)	0 - (P-37) / (P-37) - 1 [0]	
b-00	Selects the sequence followed by the **RUN** and **REV** togheter with the input **Ix-JOG**	0 = off - 1 = on [0]	**JOGGING** is a run control to advance the motor by small amounts. It applies preset freq. to the motor via param. **F-08** with acc. and dec. ramps set via param. **P-25, P-26.** It does not allow DC current braking at startup or in stop condition If **b-00 = 0**: RUN = run, REV = reversal, and the input **Ix-JOG** handles the jogging control. If RUN and **Ix-JOG** are simult. enabled the first one enabled will override the other one. If **b-00 = 1**: RUN = forward run, REV = backward run, the **Ix-JOG** enables the jogging control that overrides the normal run control.
P-08	Switching freq. selection (executable with stopped motor only)	0 - (**) (**)	0 = 1kHz; 1 = 2 kHz; 2 = 3 kHz; 3 = 6 kHz; 4 = 9 kHz; 5 = 12 kHz; 6 = 15 kHz; 7 = 18 kHz. High values of the switching frequency reduce or eliminate the electric "noise" generated by the motor; viceversa, low values give a higher rotation fluidity at low speed, especially if high torques are required.
b-33	Dead time comp.	0 = off - 1 = on [1]	Dead time compensation: it improves the torque and fluidity actions at low speed.
b-62	Dead time compensation	0 = off - 1 = on [1]	"0" means standard dead time compensation; "1" means advanced dead time compensation, which performs sinusoidal signal of output current at low speed rotation.
b-69	Optimization of high frequency commutation	0 = off - 1 = on [0]	"0" means standard sinusoidal modulation; "1" means flat sinusoidal modulation, which optimize the inverter heatsink temperature with high frequency commutation.
b-36		0 = off - 1 = on [0]	Frequency automatic commutation to 3 kHz, when output frequency goes below 5 Hz.
b-64	Overtemperature prevention at low speed	0 = off - 1 = on [1]	"1" means overtemperature prevention at low speed rotation; the inverter will have in general a better efficiency, fluid motor rotation and low electromagnetic emission.
P-42	It configures the IN4 input	0-17	In order to use IN 4 and IN 5 as ramp selectors, P-42 and P-43 must acquire the value 5 (selector In T1) and 6 (selector In T2). The input state combined to the selectors In T1 In T2 defines one of the four possible ramp couples
P-43	They configure the IN 5 input	0-17	
P-07	It selects the ramp form	0.0 = linear 0.1s - 10.0 s= " S " shaped ramp	
P-27	It selects the resolution through which the ramp times are defined	0 = 0.01 s - 99.99 s 1 = 0.1 s - 999.9 s 2 = 1 s - 9999 s [1]	

In T1	In T2	DESCRIPTION
0	0	accel./decel.ramp 1 (**P05** = accel. time -**P06** = decel. time)
1	0	accel./decel. ramp 2 (**P21** = accel.time -**P22** = decel. time)
0	1	accel./decel. ramp 3 (**P23** = accel. time -**P24** = decel. time)
1	1	accel./decel. ramp 4 (**P25** = accel. time -**P26** = decel. time)

Note: a) **1**= closed contact; the controls not used are considered in **0** state**.**

b) When the jogging control **Ix-JOG** is active (page 28), the ramp pair 4 is automatically chosen. The acceleration and deceleration times are necessary to switch from zero Hz to the max. frequency, (P-01), and viceversa.

c) The modification of **P-27** can affect the values entered on **P-01, P-02, P-21, P-22, P-23, P-24, P-25, P-26** so these values must be rechecked.

d) Connecting a signal 0/10V to the input REF-AUX the ramps can be lengthenned in function (proportional) at the signal, with P-47; es. the ramp of 2 sec. and 8V of a amplitude signal: 2(s)x8(v)=16s of lengthening.

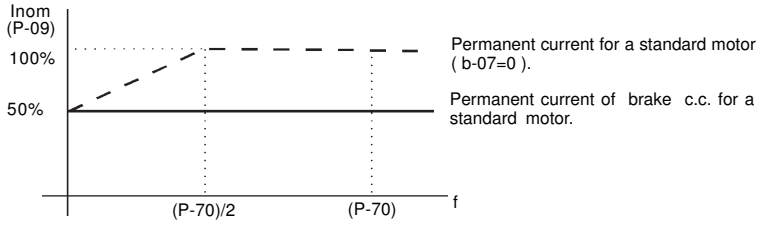
e)**The ramp extension can also be generated if the functions of motor stall and inverter lock are enabled. This actuation is signaled by a flashing GREEN LED and also on terminal board by properly programming OUT1.**

(**) the values depend on the inverter size.

Motor data setting - Motor thermal protection - Prevention of motor stall - inverter lock

PARA METER	FUNCTION	RANGE [DEFAULT]	DESCRIPTION
P-09	Motor rated current (from the rating) (*)	(20% - 150%) Inom. [Inom] (A)	To take advantage of the inverter/motor system features, it is necessary to set the characteristics of the motor used, through the parameters. **P-10** can be calculated, (necessary only if the motor thermal protection function is enabled, par. **b-06**). The higher the value set, the higher the motor capacity of supporting currents higher than the rated one. The value of **P-12** represents the motor phase resistance in case of star connection, or 1/3 of the phase resistance in case of delta connection. To get the proper value of **P-12**, use the function **C-06:** - 1) Use **M** to select the **C** menu ..... ON DISPLAY: C-00 - 2) Use the ⇑, ⇓ keys to select the code C-06 ..... ON DISPLAY: C-06 and press **E:** the code **C-06** is displayed ..... ON DISPLAY: 0 - 3) Use the ⇑, ⇓ keys to select the code 07 ON DISPLAY: 7 and press **E:** the stator resistance is automatically measured. The display will confirm that the operation has been executed .(To see the measured value, read the value of P-12 that, if necessary, can be manually modified).
P-10	Sets the motor thermic constant (*)	1 - (120) [30] (min)	
P-11	Motor cos φ (obtained from the rating) (*)	0.01 - 1.00 [(**)]	
P-12	Equivalent stator resistance (*)	0.0 - 25.0 [(**)] (Ω)	
b-06	Enables the termal protection of the motor (*)	0 = off - 1 = on [1]	**b-07=0** : motor natural ventilation (at low speed there is a derating of drive nominal current). **b-07=1** : motor assisted ventilation. Both cases are considered by the drive internal algorithm to calculate the overload. The level reached by the protection can be read in **d-10,** measured in % of the max. thermic overload allowed for the motor. When this level reaches 100%, the protection trips and the inverter is locked.
b-07	Standard or assisted ventilation	0 = standard 1=assisted ventilation	
b-24	Limits the acceleration current. (*)	0 = off - 1 = on [1]	Excessive current or voltage can cause motor stall or inverter lock conditions due to protections tripping.The aim of the parameter is to set thresholds that, when exceeded, trip some actions that limit currents and voltages: **b-24:** if the threshold programmed through **P-77** (in acceleration state and if **f<P-70**, constant torque zone), or through **P-78** (in acceleration state and if **f>P-70**, constant power zone) is exceeded, the ramp is stopped until the current remains over this threshold. **b-25:** if the threshold programmed through **P-79** is exceeded (constant speed operation) the output frequency is reduced at a rate controlled by **P-82;** as soon as I falls below the theshold the frequency start to increase with the selected ramp. **b-26:** the ramp is stopped when the voltage on filter capacitors is near the overvoltage threshold; when the V falls under the threshold the ramp starts again; **NOTE:** the function can be unable to prevent the inverter lock in case of high-inertia loads and short ramps. **b-27:** if the voltage on filter capacitors exceeds the overvoltage threshold, the output voltage is set to zero (corresponding to a coast-to-stop). As soon as the voltage reaches safety levels,a free rotation motor pickup is executed and the deceleration ramp is restarted. **NOTE: too short ramps can lock the inverter by overvoltage.**
b-25	Limits the current at constant speed. (*)	0 = off - 1 = on [1]	
b-26	Limits the voltage during deceleration.	0 = off - 1 = on [1]	
b-27	Prevents overvoltage. (*)	0 = off - 1 = on [0]	
b-35	Stall prevention to overload in decel.(*)	0 = off - 1 = on [1]	
P-77 P-78 P-79	The parameters set the current threshold as a % of Inom (*)	20 - 150 [(150)]	
P-82	Set the deceleration ramp when **b-25** is active (*)	0.1 - 25,0 [1] (s)	
P-85	Set max. ref. Δf after wich start the ramp state.	0.1 - 25,0 [0,5] (Hz)	The parameters allows to distinguish between the acceleration or deceleration state and the constant speed state . In fact, too short accel. ramps asregards the motor capacity, or slight reference variations, either intentional or not, does not mean the motor to be considered in constant acceleration or deceleration. The switching from one state to the other can be controlled through P-85, P-86: **P-85** set the indifference range to reference change as regards the constant speed; **P-86,** instead, set the time after which, starting from ramp completion, the motor is in constant speed state.
P-86	Set the delay after wich the motor is considered in constant speed state.	0.1 - 25,0 [0,1] (s)	

(*) **: parameter available in the FOXPM version; (**) the values depend on the inverter size.**



Slip compensation - Instantaneous overload signalling - Prevention of short mains blackout - Pickup of motor in free rotation (flying restart) - Automatic boost

PARAMETER	FUNCTION	RANGE [DEFAULT]	DESCRIPTION
P - 32	Defines value of the motor rated slip (%) s=(no-nnom)*100/no	0.0 - 25.0 [0.0]	The parameters compensate for the motor speed reduction when increasing the applied load (slip), changing the inverter output frequency proportionally to the applied load. **Note**: a too quick response (**P-33** too short) can cause fluctuations in the output frequency. To obtain a good compensation properly set **P-09, P-11, P-12** and if the reference frequency is close to the maximum frequency, it is advisable to set on P-37 a value beyond 100%.
P - 33	Compensation time constant	0.0 - 10.0 [0.1] (s)	
b - 17	Enable the overload detection function	0 = off - 1 = on [0]	The aim of the function which detects the overload is to signal or avoid excessive efforts on the load, causing the istantaneous locking of the inverter and the allarm signalling. The threshold defined by **P-55** is in % of the motor rated load as obtained through parameters **P-09, P-11.** The threshold exceeding can be signalled through terminal board by configuring the **Ox-GTT** output. The parameter **P-12** must be accurately set too. **P-56** Set how long the overload can exceed the tripping threshold before the signalling and the inverter lock functions are enabled
b - 18	Select when the detection function is active	0=always - 1= con. speed [0]	
b - 19	Set the overload locked state	0 = off - 1 = on [0]	
P - 55	Set the tripping level of the protection	20 - 200 [110] (%)	
P - 56	Set the delay before the protection trip	0.1 - 25.0 [0.1] (s)	
b - 28	Enables the prevention of short mains blackout	0 = off - 1 = on [0]	The parameters avoid locking the inverter when a short mains blackout happens.The mains cut off is stated on the display and on the terminal board by configuring one of digital outputs **OUT1**. **Note:on single phase inverter it is advisable to reduce the P-75 value to the minimum to prevent excessive start-up currents. Otherwise it is possible that the inverter locks by undervoltage.** The alarm is always enabled if the voltage falls under a given value that depends on the inverter size; the tripping of the prevention function sets the output voltage to zero, (coast-to-stop). In this way, the filter capacitors are not completely discharged thus keeping the control logic active. As soon as the voltage exceeds the threshold (hysteresis of 6%), a pickup phase of motor in free rotation is performed, thus resetting the speed in force before the tripping.
P - 75	Determines the undervoltage protection tripping threshold	40 - 80 [50] (% di P-02)	
P - 76	Set the max. duration of the short mains blackout before the alarm is enabled	0.1 - 25.0 [1] (s)	
b - 29	Enables the tripping of the motor pickup	0 = off - 1 = on [0]	The aim of the pickup function of motor in free rotation is to avoid too high start-up currents generated when, for some causes the inverter cuts the voltage to the motor, then a subsequent run command makes a start from zero Hz with the motor still rotating. This function generates an initial frequency, **b-30**, equal to or higher than the motor one, by gradually increasing, **P-84**, the output voltage to 100 % and controlling that the current does not exceed a preset threshold set by **P-80**, (it is advisable that this value should be slightly higher than the current absorbed by the motor) otherwise the output frequency would be reduced and the voltage would be limited. The delay between the cut off of the motor voltage and when the motor pickup phase start can be controlled by **P-81** (demagnetization time)**.** The motor is considered frequency-locked when a given frequency is reached so that, at full voltage, the current is under the threshold.The motor can then be accelerated or decelerated until the reference is reached. **b-23** enables the use of a frequency obtained from an encoder as initial frequency for motor pickup. The motor pickup function can be enabled through terminal board by configuring one of the inputs as **Ix-FLY** input. If the Ix-FLY input is active, every time the run control is pressed the motor pickup is performed.
b - 30	Selects the initial scanning frequency	0=ref. freq. 1=max. freq. [0]	
b - 31	Enables the function with the first run control after startup	0 = off - 1 = on [0]	
P - 80	Sets the max. current threshold during the motor pickup phase	20 - 150 [150] (% di Inom)	
P - 81	Demagnetizing time	0.01 - 10.00 (s)	
P - 83	Sets the rate of change of the frequency during the lock search	0.1 - 25.0 [1] (s)	
P - 84	Set the max. rate of change of the voltage	0.1 - 25.0 [0.2] (s)	
b - 23	Enable the use of encoder for the function.	0 = off - 1 = on [0]	
b - 34	Enables the automatic boost.	0 = off - 1 = on [0]	This function is an alternative to the voltage (and torque) boost obtained through parameter **P-04** (pag. 23).The output voltage is automatically increased as regards the motor and the connected load characteristics. The efficiency of the action depends on the accuracy applied when setting the parameters **P-09, P-11, P-12**. If the programming phase is not performed in the right way, some oscillations may occur.

Programmable and non-programmable control inputs

INPUT TERM.NO.	NAME	FUNCTION				DESCRIPTION
1	REV	Se **b-00=0**	Run reversal	Se **b-00=1**	Back. run	Terminals 1, 2, 3, have pre-defined functions; the other five can be configured through parameter **P-42, P-43.** If the forward and backward run controls are simultaneously executed **(b-00=1)** a stop control effect is generated: the rotation reversal is obtained by decelerating, with selected ramp, up to a zero frequency, then accelerating up to the preset reference frequency.
2	RUN		Run		For. run	
3	EXTFLT	Alarm coming from outside				
5	IN5	Configurable digital inputs				
4	IN4					

Configuration of the configurable digital inputs via: **P-42** (IN 4) and **P-43** (IN 5)**:**

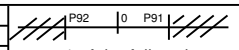
PARAMETER VALUE	NAME	CONTROL DEFAULT STATE	PERFORMED ACTION	
0	In RES	Not active	Resets the alarms (default function for **P-43** on the **IN 5** input)	**NOTE:** If no input is configured to enable (disable) a control, this control is automatically considered as active (inactive) as shown on the column DEFAULT STATE.
1	In SF1	"	Reference frequency selectors as set by **F-xx** (page 17)	
2	In SF2	"		
3	/	/	must not be used	
4	In JOG	Not active	Jogging control (default function for **P-42** on the **IN 4** input)	
5	In T1	"	Acceleration/deceleration ramp selectors (page 24)	
6	In T2	"		
7	In DD	Not Active	Motor output disabling (if enabled, causes a coast-to-stop)	
8	In DE	Active	Motor output enabling (if disabled, causes a coast-to-stop)	
9	In ENB	Active	D.C. braking enabling	
10	In DCB	Not active	D.C. braking control	
11	In FLY	Not active	Enables the motor pickup function in free rotation	
12	In INC	Active	Enables the ramp execution	
13	In DEC	Not active	Enables the ramp deceleration till zero Hz	
14	In PID	Active	PID regulator enabling	
15	In P12	Not active	Selector of PID regulator coefficients	
16	In IM	"	Motorized potentiometer value increase	
17	In DM	"	Motorized potentiometer value decrease	

The combined parameters, corresponding to single controls, are active through the following actions:

PARAMETER	FUNCTION	VALUE [DEFAULT]	DESCRIPTION
b-01	Sets stop condition	0 1 [0]	The control causes a ramp deceleration up to zero Hz The control cuts off the voltage to the motor so that it coasts-to-stop
b-02	Enables motor reversal	0 1 [1]	Disables the control for motor rotation reversal Enables the control for motor rotation reversal
b-03	Safety	0 1 [1]	The safety command for run control is disabled Enables the safety command for run control (*)
b-08	Set the state of external alarm IN Set	0 1 [0]	Sets the input as normally open (N.O.).The contact closure generates the alarm state Sets the input as normally closed (N.C.).The opening generates the alarm state
b-09	external alarm action	0 1 [0]	The alarm state caused by EXTFLT locks the inverter (released only through a reset) The alarm state caused by EXTFLT disables the motor while the control is active
b-10	External alarm detection mode	0 1 [0]	Allows the inverter to detect the external alarm at any moment Allows the inverter to detect the external alarm only if the motor is running
b-11	Extern. alarm reset management	0 1 [0]	If EXTFLT causes the inverter lock, a manual reset only can be executed If EXTFLT causes the inverter lock, an automatic reset can be executed if **b-12=1**
b-39	Term. board control management	0 1 [1]	Ignores the controls from terminal board (except **EXTFLT**, **Ix-DE**, **Ix-DD**) Enables the control from terminal board
b-60	DC braking enabl. at the STOP, by the JOG command	0 1 [0]	It allows enabling/disabling of DC braking function, when JOG command is released.

(*) If the "Safety" command is active, the inverter, before starting, has to detect a switching from a non-active to an active state of the run command.

Relay output - Dynamic braking - Encoder input

P-44 VALUE	FUNCTION NAME	EVENT DISPLAYED BY THE DIGITAL OUTPUT (ACTIVE OUTPUT)			NOTES
0	Out OK	Inverter in ready state			The available output on relay (OUT1) terminals 11,12,13 can be configured, via the meanings listed in the table, through the parameter **P-44 - P-46** **The output is active when the event listed in the table occurs.**
1	Out AL	Inverter in alarm state			
2	Out RUN	The motor is running			
3	Out STP	The motor is not running			
4	Out REV	Counter-clockwise rotation (in the opposite case, the output is not active)			
5	Out STD	Inverter in steady state (end of ramp)			
6	Out RMP	Ramp in progress			
7	Out EQF	Output frequency **=** programmed frequency **P-53,** with hysteresis **P-54**			
8	Out NEF	Output frequency **≠** programmed frequency **P-53**, with hysteresis **P-54**			
9	Out GTF	Output frequency **>** programmed frequency **P-53**, with hysteresis **P-54**			
10	Out LTF	Output frequency **<** programmed frequency **P-53**, with hysteresis **P-54**			
11	Out RN1	Ramp end (disabled when the output freq. is **<** programmed freq. **P-53**)			
12	Out RN2	Output frequency **<** programmed frequency **P-53** (disabled at ramp end)			
13	Out UV	Undervoltage with running motor (not depends from short mains blackout)			
14	Out GTT	Output torque **>** the torque set via **P-55**			
15	Out IL	In case of ramp extension for limitation of:		current	
16	Out VL			voltage	
17	Out IVL			current or voltage	
18	Out FLY	When the motor pickup occurs			
19	Out BRK	The dynamic braking circuit is faulty			
20	Out CFI	The cos φ sign is negative			
21	Out ERP	the PID regulator error is	> (**P-91**) e < -(**P-92**)		
22	Out EPP		> (**P-91**)		
23	Out EPN		< -(**P-92**)	as a % of the full scale	
24	Out ERP(*)	the PID regulator error is	> (**P-91**) e < -(**P-92**)	as a % of the full scale	**(*) Means that during start-up the outputs are inactive:** the outputs will be active not before that the PID regulator error comes into the tolerance limits at least once**.**
25	Out EPP(*)		> (**P-91**)		
26	Out EPN(*)		< -(**P-92**)		
27	Out ERV	reverse encoder rotation			
28	Out EFW	forward encoder rotation			
29	Out EST	encoder stopped			
30	Out ERN	encoder rotation			
31	Out EF	States the intervention of external alarm			
32	Out EFN	Denied value of Out EF			
33	Out SIU	Detects the current signal in the U phase			
34	Out SIV	Detects the current signal in the V phase			
35	Out SIW	Detects the current signal in the W phase			

b-57	configuration of the logic allarm rele'	0 = off 1 = on [0]	This parameter configures the fault rele logic; state of fault of the allarm contact

Encoder input

b-21	Frequency measurement	0 = off 1 = on [0]	If the encoder option is installed, it is possible to use its signal according to the settings of the following parameters: **b22=1** allows the connections of two channels encoder type, which determines a better accuracy of encoder pulses acquired; moreover it is possible determines the encoder rotation. For single channel encoder use ENC A+ input. **b-23=1** set the f-encoder as initial frequency during the free rotation motor restart.s **P-59** sets the counter encoder pulses updating time; it determines the accuracy of the speed measurement ans updating time. Using two channe encoder, at the maximum speed P-59 value must not be higher than 65536.d.
b-22	Select double or single input	0 = off 1 = on [0]	
b-23	Allows use of f-encoder	0 = off 1 = on [0]	
P-59	Sets the pulses count time	0,0(=0,01)-25,0 [1] (s)	
P-60	Encoder pulses per polar pairs.	1 - 9999 [100]	
P-61	Correction factor for P-60	0,01 - 99,99 [1,00]	

Dynamic braking

PARA METER	FUNCTION	VALUE [DEFAULT]	DESCRIPTION
b-20	Thermic protection of the braking resistor	0 = off 1 = on [0]	**b-20=1** enables the thermic protection of the braking resistor**.** The protection efficiency depends on the accuracy of parameters **P-62, P-63, P-64.** The reached protection level can be displayed through parameter **d-11**,expressed in %. When the level reaches 100%, the protection locks the inverter. During the braking phase, in case of shortcircuit of the inner braking device, the corresponding signalling can be displayed through terminal board by properly configuring the **Ox-BRK** output. The only action to be performed in case of shortcircuit is to cut the inverter supply off.
P-62	Ohmic value of the braking resistor (Ω)	1 - 250 [(**)]	
P-63	Resist. power of the braking resistor (W)	0,01 - 250 [(**)]	
P-64	Thermic constant of the braking resistor	5 - 1250 [(**)]	

(**) the values depend on the inverter size.

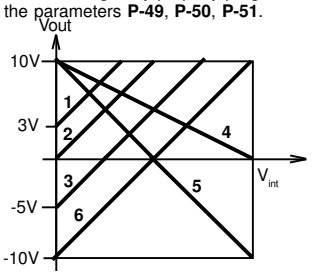
Analog output (OUT-AN) - Direct current braking

P-48 VALORE	TYPE AND MEANING OF THE ANALOG OUTPUT
0	Voltage proportional to the output frequency; full scale value set by **P-01**.
1	10V-amplitude square wave with frequency equal to the output frequency.
2	10V-amplitude square wave with frequency twice the output frequency.
3	Voltage proportional to the output current; the full scale value is twice the rated I. (*)
4	Voltage proportional to the output voltage; full scale value set by **P-02**.
5	Analog voltage proportional to the output torque (positive only); the full scale value is twice the rated T.
6	Analog voltage proportional to the output torque (absolute value); the sign can be obtained by one of the digital outputs.
7	Analog voltage proportional to the output power (positive only); the full scale value is twice the motor rated power
8	Voltage proportional to the output power (absolute only);sign obtainable by one of the digital outputs; the full scale value is twice the motor rated power .
9	Voltage proportional to the output cos φ (only positive); the full scale value is 1
10	Voltage proportional to the output cos φ (absolute value); the sign can be obtained by the digital output.
11	Voltage proportional at the freq. encoder; the full scale is determined P01
12	Voltage proportional to the reference frequency
13	Voltage proportional to the current in the U phase
14	Voltage proportional to the current in the V phase
15	Voltage proportional to the current in the W phase
16	Voltage proportional to the active current I*cos φ
17	Voltage proportional to the magnetizing current I*sen φ
18	PID output
19	DC link voltage
20	Output frequency absolute value (-10..+10V)
21	Output torque, positive/negative values (-10..+10V)
22	Output power, positive/negative values (-10..+10V)
23	Output cos j, positive/negative values (-10..+10V)
24	Encoder frequency, positive/negative values (-10..+10V)
25	Frequency reference, positive/negative values (-10.+10V)
26	"U" phase output current, positive/negative values (-10..+10V)
27	"V" phase output current, positive/negative values (-10..+10V)
28	"W" phase output current, positive/negative values (-10..+10V)
29	Icosj (load current), positive/negative values (-10..+10V)
30	Isinj (load current), positive/negative values (-10..+10V)

PARAMETER	FUNZIONE	VALORE [DEFAULT]
P-49	Adds a variable offset to the signal chosen by **P-48**	- 9,99 / +9,99 [0,00] (V)
P-50	Controls the gain of the analog output	- 9,99 / +9,99 [1,00]
P-51	Changes the time constant of the analog output filter	0,00 / 2,50 [0,00] (s)

NOTES

The output voltage at terminal N.° 18 of the control terminal board can vary between 0 and 10V. The meaning assumed by this voltage depends on the value assigned to parameter **P-48.** The value of the voltage can be changed by properly programming the parameters **P-49**, **P-50**, **P-51**.



1: offset (**P-49**) = 3; gain (**P-50**) = 2
2: offset (**P-49**) = 0; gain (**P-50**) = 2
3: offset (**P-49**) = -5; gain (**P-50**) = 2
4: offset (**P-49**) = 10; gain (**P-50**) = -1
5: offset (**P-49**) = 10; gain (**P-50**) = -2
6: offset (**P-49**) = -10;gain (**P-50**) = 2

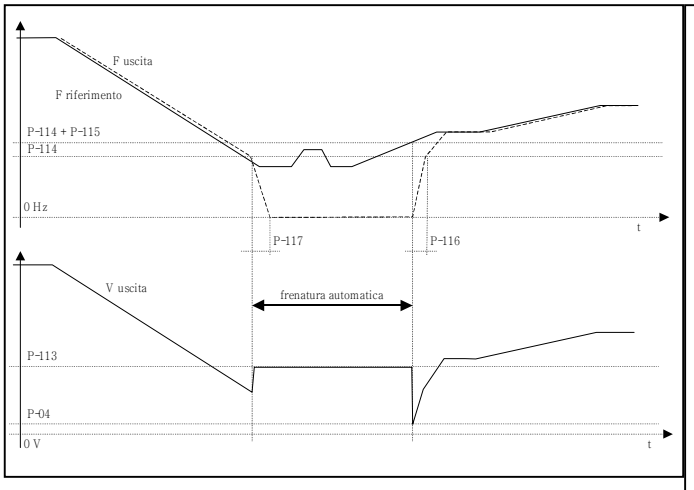
$$Vout = 10\left[\left(\frac{Sint}{Sfsc}\right)(\textbf{P-50})\right]+\textbf{P-49}$$

Sint: internal signal;
Sfsc: full scale signal.

(*): parameter available in the FOXPM version

Automatic DC braking function

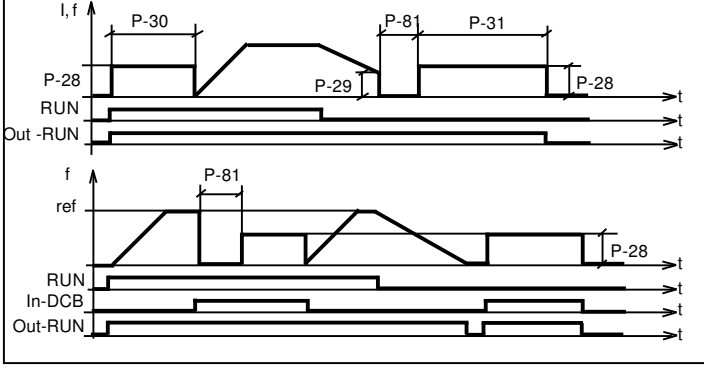
PARAMETER	FUNCTION	VALUE [DEFAULT]	DESCRIPTION
b-68	enabling automatic DC braking	0 / 1 [0]	0: disable; 1: enable
P-113	automatic DC braking level	0 - 100%P02 [0]	Automatic DC braking level (%of P02), according to P-114
P-114	automatic DC braking frequency enabling (Hz)	0,0 / 50,0 [0,0]	When the frequency level goes below the threshold sets P114 parameter, the output frequency is automatically forced to 0Hz.
P-115	Hysterisis of P114 parameter	0,1 /25,0 [0,1s]	Hysterisis of P114 [Hz]
P-116	acceleration time of DC braking output	0,1 / 25,0 [0,1s]	Output frequency acceleration time from 0 Hz to the frequency threshold set with P114.
P-117	deceleration time of DC braking input	0,1/ 25,0 [0,1s]	Output frequency deceleration time from the frequency threshold sets with P114 to 0 Hz.



If at the START command the frequency reference is higher than P-114, it is normally active the standard acceleration ramp time: other ways the automatic DC brake becomes active.
If at the STOP command the frequency reference (and output) is above P-114 value, it is normally active the standard deceleration ramp time: other ways if the output frequency is 0 Hz, the STOP command becomes immediately active.

When the frequency reference (and output) decrease under a value sets with P-114, the output frequency is automatically sets to 0 Hz, following P-117 ramp time; contemporary the output voltage is automatically sets to a value equal P113 (% of P02).
Therefore the inverter gives a DC current to the motor with an effect similar to the DC brake programmed at the start, with the difference that in this case its control is automatically managed following the output frequency behavior.
The DC current effect remain active until the frequency reference do not return to a value higher than P-114 (with hysterisis equal to P-115): at this point the DC current effect will be cut and the output frequency will return to the value sets with P-114, following P-116 ramp time; than the frequency set will reach following the standard acceleration ramp time.

PARAMETER	FUNCTION	VALUE [DEFAULT]	DESCRIPTION
P-28	DC brake level	0 - 100 [0]	(FOXPM) DC current in % of **P-09**. (FiXPM) DC voltage in % of **P-02**.
P-29	Limit frequency below which the braking is forced (Hz)	0,0 / 500,0 [0,0]	Defines the frequency below which the decel. ramp is locked and the braking current is forced. Before forcing the current, Vout is set to zero for a time defined by parameter **P-81** (demag. time).
P-30	Set the braking duration at start-up (s)	0,0 / 60,0 [0,0]	Defines the braking duration at start-up; if **P-30 = 0** → no braking is made at startup.
P-31	Set the braking duration in stop phase (s)	0,0 / 60,0 [0,0]	Determines the braking duration in stop phase; if **P-31 = 0** → no braking is made in stop phase.
b-60	DC brake with JOG command	0 - 1 [0]	It allows the enabling or disabling of DC brake with JOG command. 0= disable 1= enable



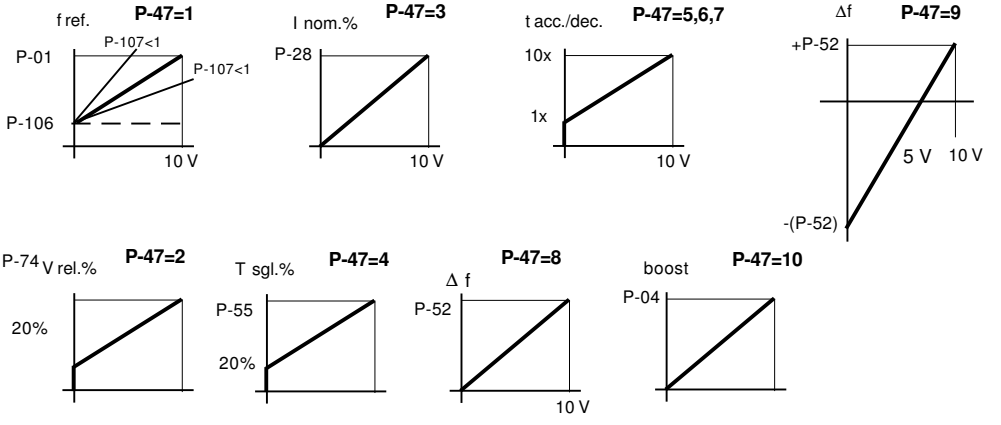
The aim of D.C. braking is to keep the motor locked in a fixed position, it is not an alternative to the ramp deceleration. The D.C. braking consist in forcing a direct current that depends from the voltage set by **P-28** and the electrical characteristics of the motor into a motor phase.
With D.C. braking, the deceleration time is shorter than in case of coast to stop. Sometimes, at start-up, it may be useful to lock the motor for a preset time before starting the acceleration ramp.
The function can also be enabled or disabled through terminal board by configuring one of the programmable inputs (**Ix-ENB**) as a control.
It is always possible to force a direct current on the motor, independently of the values assumed by the parameters, by configuring one of the terminal board programable inputs (**Ix-DCB**) as control of D.C. braking.
During the D.C. braking, at parameter **d-00** the display shows the message " **dcb** " instead of the frequency.

Auxiliary analog input (REF-V) - Analog output (OUT-AN)

P-47 VALUE	ACTION PERFORMED
0	No action
1	Frequency reference (active if **InSF1**=on, **InSF2**=off); the frequency changes in a linear way from 0 Hz to **P-01**. With negative voltage can be changed the direction of rotation
2	Adjusts the output voltage reduction by a proportional value ranging between 20% and **P-74**.
3	Adjusts the braking direct current, whose level proportionally changes between 0 and **P-28**.
4	Sets the torque threshold; the threshold value proportionally changes between 20 and **P-55**
5	Extension factor of acceleration/deceleration ramps; proportionally changes between 1 and 10.
6	Extension factor of acceleration ramps only; proportionally changes between 1 and 10.
7	Extension factor of deceleration ramps only; proportionally changes between 1 and 10.
8	Changes the frequency reference in a positive way only: to the reference is added a frequency that proportionally changes between 0 and **P-52**.
9	Changes the frequency reference: to the reference is added a frequency that proportionally changes between **-P-52** and **+P-52**. (NOTE! The sum remain always positive or null).
10	Adjusts the boost level; the level proportionally changes between 0 and **P- 04**.
11	Gain of the frequency reference (**REF-V**)
12	Function is the same as selection "1" but with a -10V..+10V signal (the signal determines the sense of rotation)
13	Corrects the frequency reference with an input signal -10V...+10V. If the result of the correction is negative, the speed is limited to zero.
14	Corrects the frequency reference with an input signal -10V...+10V. If the result of the correction is negative, the rotation is reversed.

Note:The action generated by the analog voltage, variable from 0 and 10 V, applied to terminal 16 depends on the value assigned to parameter **P-47.**

PARA METER	FUNCTION	VARIATION RANGE [DEFAULT]	DESCRIPTION
P-104	Analog input offset REF-V	-9,99 / +9,99V[0,00]	Offset and gain have action on REF-V analog input, according to the configuration of P-47 parameter.
P-105	Analog input gain REF-V	-9.99 / +9.99[1,00]	
P-106	Analog input gain REF-AUX	-9,99 / +9,99V[0,00]	Offset and gain have action on REF-AUX analog input, according to the configuration of P-47 parameter.
P-107	Analog input gain REF-AUX	-9,99 / +9,99[1,00]	



For the main input REF-V and auxiliary input REF-AUX can be defined a offset and a gain provide bythe parameter in the upper table. These parameters are usefull for conditioning the two analog channel toghether the PID. The parameter P-14 (offset) and P-15 (gain) are valid only when REF-V and REF-AUX are utilized how speed reference, while the parameters P104, P105, P106 and P107 are always effected. REF-AUX analog input can be configured as voltage or current type (see page 8). Offset and gain parameters are valid for both cases.

PID regulator

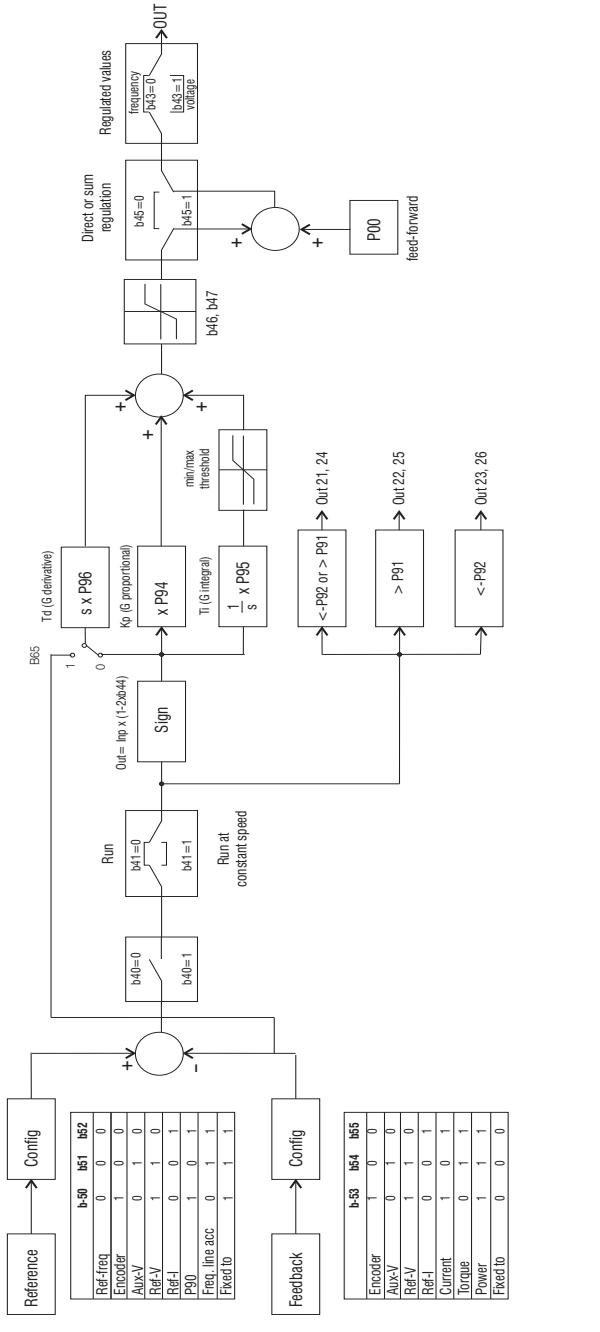
PARAMETER	FUNCTION	VALUE [DEFAULT]	DESCRIPTION
b-40	PID regulator enabling	0 = off 1 = on [0]	The regulator is active with running motor only.
b-41	Disables the regulator in ramp phase	0=off 1=on [0]	**1** interrupts the regulator action during the ramp phase.
b-42	Enabling encoder synchronizing / PID	0=off 1=on [0]	The up- to-date period of the output regulator are engaged to thatof the encoder (P-59), only if the one is used how the refernce signal or feedback.
b-43	Select the controlled parameter	0=frequency 1=voltage [0]	**0:** the regulator controls the output frequency; full scale value defined by **P-01**; **1:** controls the output voltage; full scale value defined by **P-02**;
b-44	Reverts the error sign	0 = off 1 = on [0]	The sign of the error signal between reference and feedback is reversed (and the adjustment effect too).
b-45	Regulation mode	0=direct 1=sum (feed/forw) [0]	**1:**the reg. output is added to the freq. reference value or to the voltage value provided by the V/F characteristic; **0:** the output act as set by **b-43**.
b-46	Suppress the regulator positive output	0 = off 1 = on [0]	Limits the regulator output in the positive direction; **0** allows the output to assume positive values too.
b-47	Suppress the regulator negative output	0 = off 1 = on [0]	Limits the regulator output in the negative direction; **0** allows the output to assume negative values too.
b-48	Suppress the integral term	0 = off 1 = on [0]	Allows the integral term to match the limits set to the output by **b-46** and **b-47.**
b-49	Initialisation of the integral term at start-up	0 = off 1 = on [0]	Allows the initialization by means of the run control. **NOTE:** this could cause a very slow response of the regulator, even with high gains.
b-63	PID reverse rotation enabling	0 = off 1 = on [0]	If 0-state the versus of rotation don't change only if the PID output is negative if 1-state the versus of rotation is reversed only if the PID output is negative
b-65	derivative PID selection	0 = off 1 = on [0]	If 0-state the derivative part of PID is calculated on the error signal. if 1-state the derivative part of PID is calculated on the feedback.
P-90	PID reference (%)	0.0 - 100.0 [0.0]	The reference value is derived through the setting of the selector parameters shown on the following table.
P-91	PID maximum positive error (%)	0.1 - 100.0 [5.0]	Defines the max. positive excursion of the regulator error expressed in % of the full scale value.
P-92	PID maximum negative error (%)	0.1 - 100.0 [5.0]	Defines the max. negative excursion of the regulator error expressed in % of the full scale value
P-93	PID update time(s)	0.00(=0.005s) - 2.50 [0.00]	Defines the regulator update time.
P-94	Proportional term gain Kp1	0.00 - 99.99 [0.00]	The regulator enabling and the coefficients selection can be made through terminal control board by configuring two out of the five control inputs as **Ix-PID** and **Ix-P12** input respectively: **Ix-PID = 1** the PID regulator is controlled from the terminal board. **Ix-P12 = 1** selects the coefficient set N. 1; **0** refers to set 2. When enabling the regulator or changing the coefficients set, the integral term is used according to the present output and coefficients, by taking into account possible limits applied to the output and to the integral term; this avoid sudden output changes ("bumpless" operation). If the coefficient change occurs when the error is significant, the system response speed is affected by the integral action weight, as the proportional and derivative term weight is compensated by the integral term. A max. tolerance interval can be defined for the error that, if exceeded, actuates a signalling available on the terminal board by properly configuring one of the digital output **OUT1.** The error tolerance control is enabled when the error falls within the preset interval for the first time (P91 and P92) such a condition can be displayed via P46= 21,22, 23. During start-up transient (that is: not before the regulator error falls within the tolerance limits at least once), it is possible to disable the outputs through **P-46** value 24, or 25, or 26. The possible sign reversal made by setting **b-44=1** has no importance for tolerance control. The out-of-tolerance signalling available on the digital outputs can be enabled when exceeding one of the two limits (**Ox-ERP**), or the positive (**Ox-EPP**) or negative (**Ox-EPN**) limit only. To facilitate the parameters setting, the following items can be displayed: reference signal: code **d-22** on display, feedback signal: code **d-23,** " error: code **d-24**, " integral component: code **d-25**, " output: code **d-26,** "
P-95	Integral action time Ti1	0.00 - 99.99 [99.99]	set N. 1
P-96	Derivative action time Td1	0.00 - 99.99 [0.00]	set N. 1
P-97	Proportional term gain Kp2	0.00 - 99.99 [0.00]	set N. 2
P-98	Integral action time Ti2	0.00 - 99.99 [99.99]	set N. 2
P-99	Derivative action time Td2	0.00 - 99.99 [0.00]	set N. 2

	feedb. switches		
	b-55	b-54	b-53
set at 0	0	0	0
/	0	0	1
AUX-V	0	1	0
REF-V	0	1	1
REF-I	1	0	0
I out (10V=2*Inom)	1	0	1
T out (10V=2*Tnom)	1	1	0
P out (10V=2*Pnom)	1	1	1

PID REGULATOR

	ref. switches		
	b-52	b-51	b-50
ref. frequency	0	0	0
/	0	0	1
REF-AUX	0	1	0
REF-V	0	1	1
REF-I	1	0	0
P - 90 parameter	1	0	1
freq. downstr.r. gen.	1	1	0
set at 0	1	1	1

NOTE: The integral term is set to zero if the integral action time is set to the max. value, i.e. 99.99. The derivative term is null if the derivative action time is set to zero.



Reset - Autoreset - Protections and alarms

FUNCTION	DESCRIPTION
Reset	**Operation to be executed when the inverter is in alarm state. Three possibilities are available:** a) Keyboard reset: simultaneously press the ⇑ and ⇓ keys; the action will have effect when the keys are released. b) Terminal board reset: it can only be performed if one of the programmable control inputs has been configured as **Ix-RES**. In this case, the reset operation is enabled when switching from active to inactive control. c) Cut the inverter supply off wait until it is completely off, supply the inverter again.
Autoreset	As an alternative to manual reset, this function allows an automatic restart in case of lock due to protection tripping. It can only be enabled if the lock is due to: overcurrent, overvoltage, undervoltage, momentary overload, external alarm (**b-11**) and is controlled by the parameters defined on the following table:

PARAMETER	FUNCTION	VALUE [DEFAULT]	DESCRIPTION
b - 12	Autoreset enabling	0 = off 1 = on [0]	In case of lock, it automatically restarts the inverter.
b - 13	Enable autoreset attempts limitation	0 = off 1 = on [0]	Allows to limit the number of attempts made by the inverter to execute the autoreset.
b - 14	Enable the automatic set at zero the number of attempts	0 = off 1 = on (10min.) [0]	Sets to zero the number of attempts performed, if no further locks occur within 10 min.
b - 15	Set the state of the alarm contact during the autoreset.	0 = off 1 = on [1]	During autoreset, it disables the lock signalling contacts on the terminal board if allowed, through parameter setting, to perform the alarm function.
P - 57	Delay to start the autoreset function (s)	0.1 - 60.0 [5]	Defines the time, as regards the lock enabling moment, after which the autoreset (restart) is executed.
P - 58	Set the max. number of restart attempts	1 - 250 [1]	Sets the max. number of restart attempts after which the inverter remains in lock state. To restart, execute a manual reset.

CODE ON DISPLAY	FUNCTION	DESCRIPTION	CODE
C .Err	**Full lock**	Configuration memory error. It is enabled at inverter startup if the configuration memory is not working properly. To avoid this, try to turn the inverter off and restart it after some minutes.	
P .Err		Parameter memory error. It is enabled if the memory contains inconsistent parameters. Causes: accidental loss of parameters (turning off during storage phase), memory failure. In case of accidental loss: turn the inverter off and restart it after some minutes. The factory-preset parameters will be stored.	
FU		Fuse breakage protection: enabled in case of inner fuse breakage. Autoreset is not allowed.	11
S-OH		Temperature Heatsink sensor broken. Autoreset alarm not allowed.	13
EF	**Lock that can be reset** (alarm contact enabling and storage of alarm type, the display is flashing)	External protection: enabled by the EXTFLT input on terminal board. Autoreset can be enabled only if parameter **b-11=1.**	1
OC		Overcurrent protection: enabled when the output current exceeds, even momentary, the max. allowed threshold to protect the inverter. It signals shortcircuits between phases and to ground too.	2
OU		Overvoltage protection: enabled when the voltage at the filter capacitor ends exceeds the max. programmed threshold to protect the inverter.	3
UU		Undervoltage protection: enabled when the voltage at the filter capacitor ends falls below the min. threshold programmed to avoid troubles due to torque reduction. Autoreset is allowed. If **b-37=0**, the alarm storage is disabled.	4
OH		Overtemperature protection: enabled when the heat sink temperature exceeds the max. threshold programmed to protect the inverter. Autoreset is not allowed.	5
OL I		Inverter overload protection: enabled when the direct current exceeds the max. threshold for the max. allowed time (**IxT)** to protect the inverter. Autoreset is not allowed (FOXPM).	6
OLM		Motor overload protection: enabled when the direct current exceeds the max. threshold for the max. allowed time (I^2xT), to protect the motor. The levels and times depend on setting of the motor characteristic data. Autoreset is not allowed (FOXPM).	7
OLr		Braking resistor overload protection: enabled when the power dissipated by the braking resistor exceeds the max. threshold for the max. allowed time. The levels and times depend on setting of the resistor characteristic. Autoreset is not allowed.	8
Ot		Protection for momentary motor overload: it is active, after enabling (**b-17=1**), when the torque delivered by the motor exceeds the programmed level for the preset time, to protect the connected mechanical parts or the worked material (FOXPM).	9
Ph		Protection for lack phase supply (it's valid for 3-phase supply): It's active after 30s from the disconnecting of one between the phase supply. Autoreset isn't possible.	10

(*) **: parameter available in the FOXPM version**

CODE ON DISPLAY	FUNCTION	DESCRIPTION	CODE
OCH		Protection overcurrent: it's active (in option to OC) for higher current-spike or short circuit .	12
OHr		Overtemperature of regulation card (switch-of the device and waiting the cooling)	14

RS 485 SERIAL INTERFACE

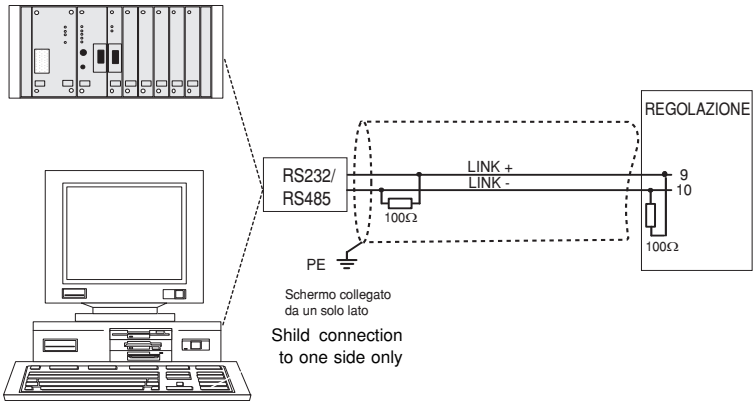
The RS 485 serial line allows the data transmission through a loop made of two symmetrical conductors, which are twisted with a common shield. The RS 485 serial line is available on 9 and 10 (LINK+ and LINK-) della regulation drive terminals. The resistor terminationis determined by J7 and J8 jumpers: not inserted termination not available; inserted termination available.
For a correct serial line connection make sure that:

- shielded cables have used
- power cables and controlling board cables ar located into different panduits
- must be present the termination to the bus extremity.

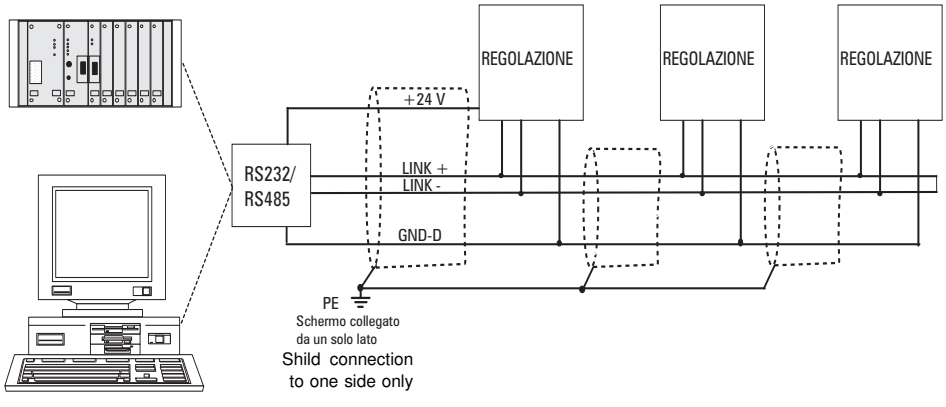
Available as option it is possible an opto-coupled serial line, which guarantee a reliable serial communication.
The external supply voltage to provide for the serial line is within a range of 12-30V and it must be applied on JP5 connector, V+ and V- terminals (V- becomes the potential ref. of serial line: No jumper on J5 - J6).
In the standard drive configuration the serial line is not opto-coupled; in this case the power supply is internally provided and the J5 - J6 jumper must be inserted (termination resistor not available: J7 - J8 jumper not inserted).
If it is necessary a termination resistor (example for multidrop connection), J7 - J8 jumper must be inserted.

The FOXLINK protocol has been improved to have an error message in case of not allowed writing parameter modified.

SINGLE CONNECTION



MULTIDROP CONNECTION



PARA METER	FUNCTION	VALUE [DEFAULT]	DESCRIPTION
P-65	Enables the input control via serial line	0 - 255 [0]	The parameter value is a decimal equivalent of the current value of the 8 bit input register **SX8** (see the serial comunication handbook)
P-66	Enables the output control via serial line	0 - 15 [0]	The parameter value is a decimal equivalent of the current value of the 8 bit ooutput register **SX8** (see the serial comunication handbook)
P-67	Defines the transmission param.	0 - 19 [1]	See the following table
P-68	Assign an address to each inverter	0 - 99 [0]	Assign the unique address between 0 - 99 to each inverter
P-69	Set the response delay time of the inverter	0 - 250 [1] (ms)	The delay time between the receipt of the comand and the emission of the answer
b-39	Enables the terminal board control	0 = off 1 = on [1]	The scope of the parameter is to disable the control of the inverter from the terminal board to avoid conflicts with the serial line.
P-89	Serial link time-out	0,0-25,0 [0,0]	If set at 0,0 it disables the function. If they aren't received the correct messages between withinthe the setted time, automatically b39 assume the 1 state (b39=1).
b-58	Termination character of serial line	0 - 1 [1]	It allows to insert a termination character of serial line protocol. 0= none / 1= inserted

The R series inverter can comunicate with the proprietary FOXLINK protocol (see following table) else with MODBUS protocol (pg.48). The parameter P-67 defines the comunication characteristics.

Value P-67	Protocol	Baudrate (speed trasmission)	Data Bit	Parity	Stop Bit
0	Foxlink	9600	7	even	1
1	Foxlink	9600	7	odd	1
2	Foxlink	9600	7	none	2
3	Foxlink	9600	8	none	1
4	Foxlink	4800	7	even	1
5	Foxlink	4800	7	odd	1
6	Foxlink	4800	7	none	2
7	Foxlink	4800	8	none	1
8	Foxlink	2400	7	even	1
9	Foxlink	2400	7	Odd	1
10	Foxlink	2400	7	none	2
11	Foxlink	2400	8	none	1
12	Foxlink	1200	7	even	1
13	Foxlink	1200	7	odd	1
14	Foxlink	1200	7	none	2
15	Foxlink	1200	8	none	1
16	Foxlink	19200	7	even	1
17	Foxlink	19200	7	odd	1
18	Foxlink	19200	7	none	2
19	Foxlink	19200	8	none	1
20	Modbus	9600	8	none	1
21	Modbus	4800	8	none	1
22	Modbus	2400	8	none	1
23	Modbus	1200	8	none	1
24	Modbus	19200	8	none	1
25	Jbus	9600	8	none	1
26	Jbus	4800	8	none	1
27	Jbus	2400	8	none	1
28	Jbus	1200	8	none	1
29	Jbus	19200	8	none	1

Here below are listed specification of the proprietary FOXLINK protocol, while it is referef to the MODBUS description for the instruction concerning such protocol.
All the transmitted characters are 7 bit ASCII characters.
The value are expressed always with integer numbers in the decimal notation, with measure unit equal to the max resolution than expected, without different indication (see the manual).

The general transmittion string has the following form:

<EOT>, <HAD>, <HAD>, <LAD>, <LAD>, <STX>, X, x,x,=,n,...,n, <ETX>, <CKS>,<CR> **(*)**

starting code — inverter address — data start — DATES — data end — control code — termination character

where:

- **<EOT>** = **04H**
- **<STX>** = **02H**
- **<ETX>** = **03H**
- **<ACK>** = **06H**
- **<NAK>** = **15H**
- **<HAD>** = most significant digit of the inverter address;
- **<LAD>** = less significant digit of the inverter address;
- **<CKS>** = **XOR** of the characters **<STX>** e **<ETX>** (eventually added to 20H if XOR should be minor than 20H)
- **<CR>** = **0DH (13)** the ending character for all strings; **(*) (selectionable with b-58)**
- **X** = character reppresenting the parameter that is object of the transmittion;
- **x,x** = numeric code of the interested parameter;
- **n,...,n** = present value of the interested sizes in writing or reading mode.

Respect to the previous versions the transmittion of a parameter out of the range cause the response 'E' (not accepted command).

FUNCTION	Reading string	Writing string	Respons
Display reading	**...,<STX>, D, x,x, <ETX>,...**		accepted command: **<STX>, D, x,x,=,n,...,n, <ETX>, <CKS>,<CR>** not accepted command: **(*)** **<STX>, E, <ETX>, <CKS>,<CR>** wrong receiving: **(*)** **<NAK>,<CR> (*)**
	NotE: The values related to d-00, d-01, d-20, are express in 0.01 Hz; the ones related to d-05, d-06, d-21 are expressed in 0,01; For the codes related to the code allarms d-12, d-13, d-14, d-15, see the inverter manual. The values related to d-16, d-17, d-18, are the decimal equivalent of the binary code shown by the display. The values related d-28, d-29, d-31, d-33, d-34, d-35 is decimal equivalent of the exadecimal code shown by the display. It isn't foreseen the possible accepted command d-30.		
PARAMETERS F-xx	**...,<STX>, F, x,x, <ETX>,...**		accepted command: **<STX>, F, x,x,=,n,...,n, <ETX>, <CKS>,<CR>** not accepted command: **(*)** **<STX>, E, <ETX>, <CKS>,<CR> (*)** wrong receiving: **<NAK>,<CR> (*)**
		..,<STX>, F, x,x,=,n,...,n, <ETX>,..	accepted command: **<ACK>,<CR> (*)** not accepted command: **<STX>, E, <ETX>, <CKS>,<CR>(*)** wrong receiving: **<NAK>,<CR> (*)**

FUNCTIONS	Reading string	Writing string	Response
PARAMETERS Pxxx	**...,<STX>, P, x,x, <ETX>,...**		accepted command: **<STX>,P,x,x,x=,n,...,n,<ETX>,<CKS>, <CR>** not accepted command : **<STX>, E, <ETX>, <CKS>,<CR>** (*) wrong receiving: **<NAK>,<CR>** (*) (*)
		..,<STX>, P, x,x,x=,n,...,n, <ETX>,..	accepted command: **<ACK>,<CR>** (*) not accepted command : **<STX>, E, <ETX>, <CKS>,<CR>** wrong receiving : **<NAK>,<CR>** (*) (*)
PARAMETERS b-xx	**...,<STX>, b, x,x, <ETX>,...**	**Nota:** n indicates the value(0 / 1) of the parameter	accepted command: **<STX>, B, x,x,=,n, <ETX>, <CKS>,<CR>** not accepted command : **<STX>, E, <ETX>, <CKS>,<CR>** (*) wrong receiving : **<NAK>,<CR>** (*) (*)
		..,<STX>, B, x,x,=,n, <ETX>,.. **Nota:** n indicates the value(0 / 1) of the parameter	accepted command: **<ACK>,<CR>** (*) not accepted command : **<STX>, E, <ETX>, <CKS>,<CR>** wrong receiving: **<NAK>,<CR>** (*) (*)
REFERENCE (resolution 0,01Hz)	**...,<STX>, H, <ETX>,...**		accepted command: **<STX>, H, =,n, <ETX>, <CKS>,<CR>** not accepted command : **<STX>, E, <ETX>, <CKS>,<CR>** (*) wrong receiving: **<NAK>,<CR>** (*) (*)
		..,<STX>, H, =,n,...,n, <ETX>,..	accepted command: **<ACK>,<CR>** (*) not accepted command : **<STX>, E, <ETX>, <CKS>,<CR>** wrong receiving: **<NAK>,<CR>** (*) (*)
REGISTERS Sxx	**...,<STX>, S, x,x,<ETX>,..**	**Nota:** x,x indicates the register or the register bit; n indicates the present value of the register (0/255) or the bit (0 / 1).	accepted command: **<STX>, S, x,x,=,n,...,n, <ETX>, <CKS>,<CR>** not accepted command : **<STX>, E, <ETX>, <CKS>,<CR>** (*) wrong receiving: **<NAK>,<CR>** (*) (*)
		..,<STX>, S, x,x,=,n,...,n,<ETX>,.. **Nota:** x,x indicates the register or the register bit; n indicates the valueto be written in the register (0/255) or in bit (0 / 1) the registers S08, S28, S38, S58 aren't accessible writing reachable.	accepted command: **<ACK>,<CR>** (*) not accepted command : **<STX>, E, <ETX>, <CKS>,<CR>** wrong receiving : **<NAK>,<CR>**(*) (*)

FUNCTIONS	Reading string	Writing string	Response
COMMANDS C-xx		..,<STX>, C, x,x, <ETX>,..	accepted command: **<ACK>,<CR>(*)** not accepted command: **<STX>, E, <ETX>, <CKS>,<CR>(*)** wrong receiving: **<NAK>,<CR>(*)**

Nota:
The commands C-04, C-05, C-06, are not available.
If the terminal board commands are disabled it's possible to execute, through serial line, the following commands:

CODE xx	MEANING
10	reset hardware
11	reset allarm
12	stop by inertia
13	ramp stop
14	clockwise start
15	counterclockwise start
16	clockwise jog
17	counterclockwise jog in
18	clockwise flying restart
19	counterclockwise flying restart
20	DC braking

Management Input - Output

Through the serial line it is entered a series of 8 bit registers which allow to manage the input and the output. The access to the registers can be bit or byte types: to enter m bit of the register it is enougth to substitute the digit " 8 " with the "n" digit of the register: S10 locates the bit 0 of the register S18; S15 locate always the 5-th bit of the register S18.

REGISTER	CODE	DESCRIPTION
Input	**S08**	it contains the map of the terminal board inputs (only reading)
	S18	it contains the map of the terminal board inputs (only reading) of the inputs set by serial line (reading and writing)
	S28	it contains the map of the inputs actually seen from the inverter (only reading). The contents of **S28** derive from: **S28 = (S08 AND NOT(P-65)) OR (S18 AND P-65)**
Output	**S38**	it contains the map of the output, programmed, of the inverter (only reading)
	S48	it contains the map of the output set by the serial line (reading and writing)
	S58	it contains the map of the output actual from by the terminal board (only reading). The contents of the **S58** derive from: **S58 = (S38 AND NOT(P-66)) OR (S48 AND P-66)**

BIT NUMB	INPUTS MAP	OUTPUTS MAP
0	IN4	-
1	-	OUT3
2	-	-
3	-	OUT1
4	IN5	-
5	INFLT	-
6	INRUN	-
7	INREV	-

PARAMETER	DESCRIPTION
b-39=0	The terminal board controls are disabled; the management of the inputs and outputs happens through serial line. **P-65=0:** the indicated input isn't considered; **P-65>0:** the indicated input is seen from the inverter; **P-66=0:** the output is controlled from the program; **P-66>0:** the output is controlled by the serial line;
b-39=1	The terminal board controls are disabled; the management of the inputs and outputs happens through serial line or through contacts of the terminal board. **P-65=0:** the indicated input comes from the terminal board; **P-65>0:** the indicated input is manage from the serial line; **P-66=0:** the output is controlled from the program; **P-66>0:** the output is controlled from the serial line;

The value in decimal base set in P-65 e P-66 reppresent the equivalent of binary code thet result when the bit of the parameters are setted "0" or "1" in function how they are managed the inputs and the outputs.
ex.: if P-65 = 01000000(b), (64d), and b-39=1, the input INRUN is controlled through serial line, while all the other inputs are managed by the comands coming from to the terminal board as programmed.

Modbus RTU Protocol for T0 series

INTRODUCTION

In the chapter the Drive parameters are referred to as 16-bit Modbus registers; a 32-bit Drive parameter covers therefore two Modbus registers.

See chapter 7 for the following correspondences: parameter index and Modbus register.

THE MODBUS PROTOCOL

The MODBUS protocol defines the format and the communication modes between a system controlling “master” and one or more “slaves” aimed at answering to the master requests. The protocol states how the master and the slaves start and stop their communication, how the messages can be exchanged and how the errors can be detected. A common line can host one master and 247 slaves; this is a protocol logic limit, the device number can be further limited by the physical interface; the present implementation foresees a maximum number of 64 slaves to be line-connected.

A transaction can be started exclusively by the master. A transaction can have a direct demand/response format or a broadcast format. The former is addressed to a single slave, the latter to all the line slaves, which, on their turn, give no response. A transaction can have a single demand/single response frame or a single broadcast message/no response frame.

Some protocol features have not been defined. They are: interface standard, baud rate, parity, stop bit number. The protocol allows also to choose between two communication “modes”: ASCII and RTU (Remote Terminal Unit). The RTU mode, which is the most efficient, is implemented in the Drives.

The JBUS protocol is similar to the MODBUS protocol; the only difference is given by the address numbering system: in MODBUS the numbering system starts from zero (0000 = 1st address) while in JBUS it starts from one (0001 = 1st address); this variance is maintained throughout the whole system. The following descriptions, if not otherwise stated, refer to both protocols.

MESSAGE FORMAT

In order to communicate between the two devices, the message has to be contained into a “casing”. The casing leaves the transmitter via a “port” and it is “brought” along the line to a similar “port” on the receiver. MODBUS states the format of the casing, which, both for the master and for the slave, contains:

- The slave address for the master stated transaction (the address 0 corresponds to a broadcast message sent to all the slaves).
- The code of the function (already performed or to be performed).
- The data to be exchanged.
- The error control according to the CRC16 algorithm.

If a slave detects an error in the received message (a format, parity or CRC16 error), the message is invalid and therefore rejected; when a slave detects an error in the message, it does not perform the required action and does not answer to the demand as if the address does not correspond to an on-line slave.

ADDR	FUNC	DATA 1		DATA n	CRC HI	CRC LO
8bit	8bit	8bit		8bit	8bit	8bit

The address

As stated above, the MODBUS transactions always involve the master (which controls the line) and one slave at the time (with the exception of broadcast messages). In order to detect the message receiver, the first sent character is a byte containing the numeric address of the selected slave. Each slave owns therefore a different address number for its identification. The legal addresses go from 1 to 247, while a master message starting with the address 0 means that this is a “broadcast” message simultaneously addressed to all the slaves (the address 0 can not be allocated to a slave). Broadcast messages are those messages which do not need a response to perform their function, i.e. the allocations.

The function code

The second character of the message states the function to be performed by the master message; the slave response contains the same code, thus stating that the function has been performed.

An implemented subset of the MODBUS functions contains:

- 01 Read Coil Status
- 02 Read Input Status
- 03 Read Holding Registers
- 04 Read Input registers
- 05 Force Single Coil
- 06 Preset Single register
- 07 Read Status
- 15 Force multiple Coils
- 16 Preset Multiple Registers

The 01 and 02 functions, so as the 03 and 04 functions, are similar and interchangeable. See chapter 3 for a complete and detailed description of the functions.

CRC16

The last two characters of the message contain the cyclic redundancy code (Cyclic Redundancy Check) calculated according to the CRC16 algorithm.

Message synchronization

The message synchronization between the transmitter and the receiver is obtained by interposing a pause between the messages, such pause being equal to 3.5 times the character period. If the receiver does not receive for a period equal to 4 characters, the message is considered to be over; as a consequence the following received byte is treated as the first byte of a new message: an address.

Serial line setting

The communication foresees the following settings:

- 1 start bit
- 8 data bits (RTU protocol)
- 1 stop bit
- no parity

The baud rate can be selected among the following values:

Baudrate **byte**	Timeout **byte (ms)**
1200	33
2400	16
4800	8
9600	4
19200	2

Registers and coils numbering

The parameters already presents in the drive are ordered to compose the registers list and the Mod bus input / output.
The parameters present in the menu “d” , “F”, “P”, “H” are considered Registers.
The parameters present in the menu “B”, “C” , “S” are considered Coils.

Register

Drive parameter registers	Register Modbus
d00 .. d36 valore a 16 bit	1000 .. 1036
d00 .. d36 valore a 32 bit	2000 .. 2072
F00 .. F08	3000 .. 3008
P00 .. P117	5000 .. 5117
H00	7000

Coil

Drive parameter registers	Coil Modbus
b00 .. b69	1000 .. 1069
c00 .. c20	2000 .. 2020
S00 .. S58	3000 .. 3058

The value at 32 bit are avaiable through two adjacent 16 bit registers wich the less significant 16 bit are contained in the lower address register. The couple of registers mast be read (or write) with a single message.

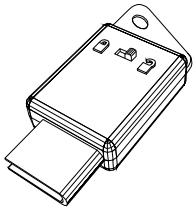
Exception codes

This protocol implementation foresees only four exception codes:

Code	Name	Meaning
01	ILLEGAL FUNCTION	The received function code does not correspond to a function allowed on the addressed slave.
02	ILLEGAL DATA ADDRESS	The address number, which the data field refers to, is not a register allowed on the addressed slave.
03	ILLEGAL DATA VALUE	The value to be allocated, which the data field refers to, is not allowed for this register.
07	NAK - NEGATIVE ACKNOWLEDGEMENT	The function can not be performed with the present operating conditions or attempt to write an only-reading parameter.

For more information to the message formats, make reference to the specific documentation or directly to the MODBUS standard.

Programming key



[code KM-PRG]

The programming key device allows to transfer parameters from and to the T0 Drive inverter or between inverters.
The data are stored in a E²PROM type memory, so battery backup is not necessary.
The switch put on the key upper front side allows to protect the stored data against possible writing procedures. To copy the data from an inverter to the key or viceversa the keypad panels are used.

Programming key: Use method

- Parameter transmission from the key to the inverter:

- plug the key into the suitable connector (see page 19)
- select, via the keypad, the **C - 04** parameter**,** choose the code **7** and press **E**

If the key contains invalid parameters, the factory-preset parameters will be used and the message " Err", will be displayed for 4 sec. Otherwise, data will be permanently stored and the confirmation message " donE" will be displayed for 2 sec.

- Parameter transmission from the inverter to the key:

- plug the key into the suitable connector (see page 19)
- select, via the keypad, the **C - 05** parameter**,** choose the code **7** and press **E**

If the key is write-protected, the control is interrupted and the message " oFF" is displayed for 4 sec. Otherwise, the inverter parameters are stored on the key and, at the end of the operation, the message " donE" will be displayed for 2 sec. to confirm the operation.

The T0 drive inverters are designed in accordance to all provisions of the **89** / **336** / **EEC Directive** and **CE** Marking requirements.

The aim of the Directive is to avoid the products causing harmful interference and, at the same time, to ensure that the products will perform adequately and safely under electromagnetic interference.

The T0 drive inverters are electrical equipments designed to control the speed of A.C. motors and they can be installed in cabinets or inside a machinery.

The T0 drive inverters can be powered by an industrial AC mains source or by a residential one, but the inverter is not to be considered as a household tool; therefore it cannot be installed near other household appliances.

The end user is responsible, when installing the inverter, for the compliance with the EMC directives.

If the indicated prevention measures are implemented, the inverter can be normally installed withouth problems concerning EMI.

Standard or norms which R series drive inverters are compliant to:

- Immunity

IEC 801 - 2	electrostatic discharge	8 kV contact 14 kVin air	**IEC 1000 - 4 - 3**	high frequency EM fields	10 V/m
			IEC 1000 - 4 - 5	surge phase to phase	1 kV
IEC 801 - 4	burst on power supply cables	4 kV 5 kHz		surge phase to ground	2 kV
	burst on control cables (capacitive coupling)	2 kV 5 kHz	**IEC 1000 - 4 - 8**	50 Hz EM field	200 A/m
IEC 801 - 4	burst on connection cables keyboard FXX-TST.	2 kV 5 kHz			

- High frequency emissions

- Voltage disturbance on power supply cables:

The Size 0 inverter can be equipped with an internal filter (as option), which allows the compliance with the EN 55011 (CISPR11) class A normative within frequency range of 150 kHz ..30 MHz.

The compliance to the **EN 55011 (CISPR11) class B** requires:
a) the use of an external filter (see table) to be connected in series to power supply the cables
b) the connections between inverter-motor, and inverter-supply system must be shielded
c) a toroid must be put on each cable

- EM emitted disturbance:

As for this parameter:

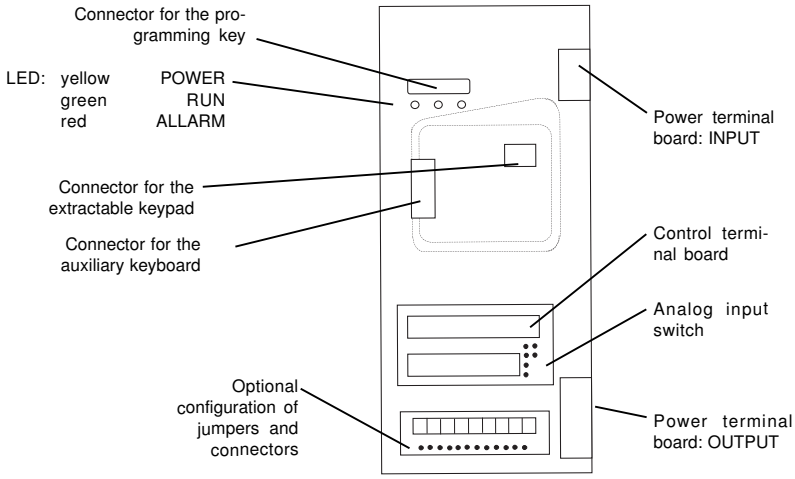
- those devices with an internal filter are compliant to **EN 55011 (CISPR11) group 1 class A** in the following frequency range: 30 MHz, 1 GHz.

- the devices supplied with an external filter are compliant to **EN 55011 (CISPR11) group 1 class B** in the following frequency range: 30 MHz, 1 GHz.

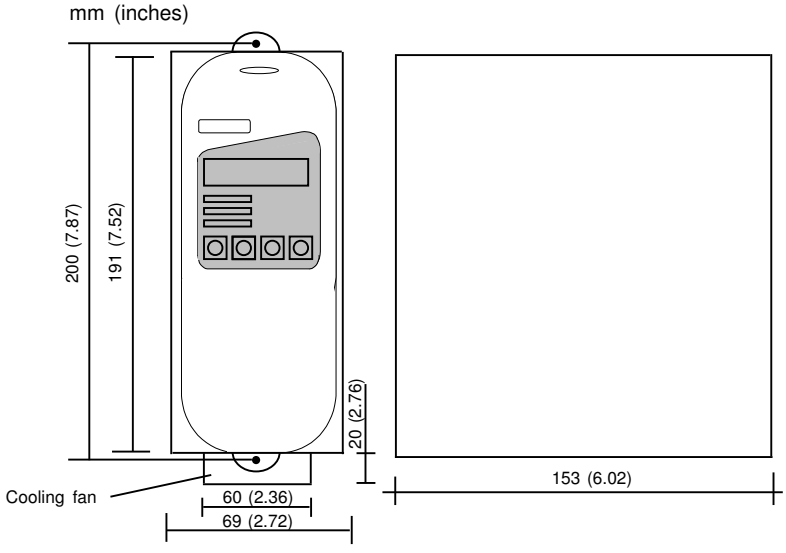
- Internal filter

The inverterof R series can be equipped with an optional internal filter, which allows the compliance with the class A normative.

Installation description



External dimensions



T0 ventole	Taglie			
	004	008	011	015
220 monofase	\	\	40x40x20	60x60x20
220 trifase	\	\	40x40x20	40x40x20
380 trifase	60x60x20	60x60x20	60x60x20	60x60x20