



# AxM

Configurable  
**Motion  
Control  
Platform**



## *User Manual*

Doc. n. 02490-0-B-M

Release 1.4

English



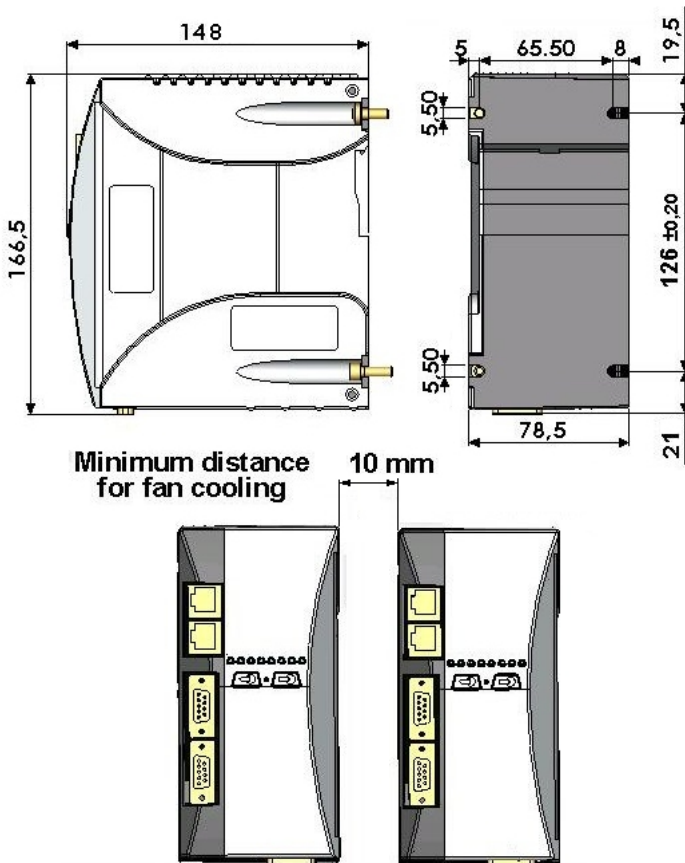
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## 1 Drive's overall outline

### 1.1 Overall dimensions and space required for installation



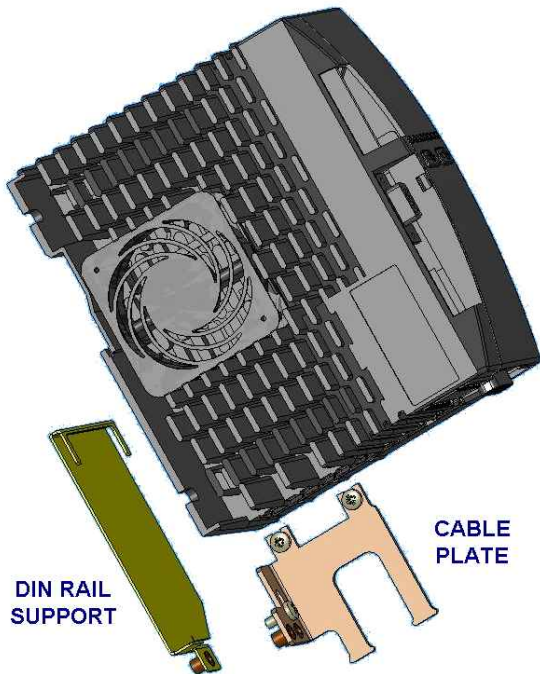
Install inside a switchboard avoiding any obstacle for cooling fan air flux. To avoid any derating of the product performance, do not place objects less than 10 mm from the cooling plateside. (see par. 4.3, Performances derating)

Always check that inner temperature of the switchboard doesn't exceed 40° C (see par. 6.1, Derating diagrams)

## 1.2 Mounting options

Two mounting options are available:

- A) screws fastening
- B) DIN rails fastening (optional)



When option B is chosen is necessary to mount both the "cable plate" (code PM.03822.0) and the "DIN rail support" (code PM.03821.0). When the drive is engaged on the DIN rail it is enough to slide up the support and stop the screw on the cable plate.



## 2 Content of the package

### 2.1 The standard package contains

The AxM Digital Programmable Drive including:

Firmware for standard application of motor torque and speed control, and pre-defined parameters table with default settings.

Connectors' Set:

User Connectors (U1 and U2) with identifiers and polarity keys,  
Power connectors (P1 and P2),  
Encoder connector (E1),  
CAN connector Gender changer (C1).

User's Manual:

The manual containing AxM installation and use instructions.  
*Read it thoroughly to the end!*

A CD with a copy of the Phase Motion Control Internet Site where You will find:

Cockpit configuration tool with Control Panel e GPLC  
Standard application sets  
User's, Software and GPLC Manuals  
Firmware and Software copy  
Other P.M.C. Drives and Motors Documentation

### 2.2 Software supplied

Configuration Utility *«Cockpit»*:

The Configuration Utility allows to create, analyze, modify and copy all parameters useful for applications and regulations of the drive.

This Utility must be installed on the same Pc further used for AxM drive installation. The **«Cockpit»** operates as drive center of control during the installation: it gives access to all drive functions and parameters: it can identify the unit and its working life and it allows to copy data in and out the memory in order to duplicate the installation data. Moreover **«Cockpit»** is a powerful diagnostic tool: interfaced with the real time drive recording function, it allows, by "Control Panel" and "Oscilloscope", the drive troubleshooting without any physical operation on the drive's terminals.



The software loaded on AxM drives is composed of: **Firmware and Application**.

### **Firmware:**

The **Firmware** runs the operative system and all basic drive's resources: current, speed and position control rings, protections and diagnostics. A "basic" running mode is integrated in the firmware: it allows to control motor's current and speed without any particular application loaded.. This special "basic application", planned for usual classic drive control current, turns AxM in a versatile brushless servomotors digital control.

Main features are:

- Choice between current or speed control;
- Standard analog differential (+/-10V) interface use;
- Internal ramp generator.

The configuration parameters of the basic features are specified beginning from the paragraph 3.4.

Further peculiar features of the firmware are:

- Full digital control of the direct and quadratic current, updated at 8 kHz frequency, and 2 kHz bandwidth.
- Digital speed ring with zero real speed, PII<sup>2</sup>D controller<sup>1</sup> with generalized feedforward.
- Analog encoder interpolation to increase resolution.
- Encoder simulation output configuration enabled from applications.

The firmware is originated in the Phase Motion Control Labs and it cannot be altered by the end user. Periodically firmware updates are released and they are made allowable on the Internet site <http://www.phase.eu> Compatibility of new updates with previous applications is always assured.

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<sup>1</sup> PII<sup>2</sup>D controller: 4 compensation terms are available: proportional (speed), differential (acceleration), integral (position) and integral of position (to obtain a zero position error).



## Application:

The **Application** includes the motion program and the logics runs. Global PLC is the applications' development tool. This tool allows the customer to make his own automation programs. Within the limits of the allowable I/O and program memory, standard automation functions of IEC 1131-3 PLC can be used: but they are usable in a so fast tool that a very refined real-time motion control can be accomplished; moreover a data acquisition function from two separate encoders is included. The PLC software performs in cycle two different tasks: one "fast", used for the motion control functions, with a 4 kHz cycle frequency; the other "slow" with 125 Hz cycle frequency for all general auxiliary uses. The GPLC language is so powerful that very fast functions as positioners, electronic path control, are easily executable by the end user. Which can therefore upgrade the AxM to be a control center of the whole driven system, using his proprietary software entirely protected against imitation and competition..

## Standard applications:

Together with AxM drives, a set of **Standard Applications** is supplied with source code: they can be loaded by "**Cockpit**" (see Software Manual).

In details following applications are supplied:

### Speed-V

It is an extended form of the "basic" mode, moreover implementing:

- Store capacity till **8 complete series of parameters** (*tasks*); enabling to shift from one set of parameters to another set in running time by digital inputs;
- Electric shaft;
- Encoder simulation: allows to emulate a step-motor running with the simulated encoder resolution, programmable from the application itself.

### Positioner

This application allows the use of the AxM drive as programmable multi-position positioner. The main features of Positioner are:

- 32 positions to be selected by digital inputs. Every position can be configured: Position unit is chosen by the final user.
- Choice between absolute and incremental offset.
- Speed, acceleration and deceleration to be used during motion.





- Space and time units chosen by the user.
- Zero cycle carried out by zero sensor and encoder pulses to get the best precision and repeatability of the cycle itself.
- Jogging.
- Limit switch inputs.

### The “Basic” Application

Is a starting program suitable for teaching the user to develop its own dedicated applications. The main features of “Basic” are:

- Digital and analog encoder support.
- Drive enable and control selection through digital inputs (D10: Enable, D16: control selection).
- Standard analog differential references +/- 10V.
- Parameters’ setting in running time. The parameters allow the configuration of:
  - ◆ current and speed limits, clockwise and counterclockwise.
  - ◆ Different linear ramps for accelerations and decelerations, CW and CCW.
  - ◆ Digital speed ring gain with zero real speed, PII2D controller.

For a detailed description of the features and I/O, please refer to HTML configuration pages to be opened through “**Cockpit**” configuration software.

Everything strictly related to the software, (ring philosophy and implementation, variables’ and parameters’ tables) you can find in the Software Manual.



## 3 First installation and tests

### 3.1 What you need for first tests

- AxM drive and motor.
- Triphase supply 198-465 Vac (not needed for applications programming and loading, but necessary for drive testing).
- 22-30 Vdc > 0,6 A supply;
- (if drive option "R" is chosen, the 24V feeding is required in case of mains failure only).
- PC with Windows 9x, Me, 2000, NT 4.0 or better, with a RS 232 serial line
- RS232 serial cable female-female, null modem
- The PC must have installed the Internet Explorer 4.0 browser (present on the CD) or better;
- Minimum 15 Mbyte free space on hard disk.

Software installation:

- Insert the supplied CD-Rom in the PC;
- If the autorun function is active in the PC, the main application self activates automatically; if not, open page "index.htm" in the CD root directory with any Internet browser (e.g. Internet Explorer);
- Setup can be activated too by opening the "setup.exe" file present in the folder d:\setup\axvsetup\disk1;
- When setup is finished and PC restarted, the folder "AXV Cockpit" will be added to the Windows menu "Start->Windows Programs".

### 3.2 Minimum connections outline:

Programming and configuration:

- Connect the 24 V supply on "+24 V" and "0 V" of the terminal board (see par. 8.1 for connections outline of user connector U1).
- Connect the RS 232 line to PC. In this condition the drive can be asked and programmed. So far it is not necessary any power feeding.



Power connections:

- Connect the motor terminals to the the A, B and C terminals of the drive's power terminal board, according to the sequence specified in the connection outline supplied with the motor. Connect the power supply to the R, S and T of the power terminal board (see par. 8.4 for power connection outline P1). **The cable shield must be grounded on both sides, motor and drive, connecting it to the special screw provided for.**

NOTE:

The AxM drives are designed to work with 3 phase supply only, the voltage value must be less than 460V (+10%). (In case of the "R" option is chosen and the main voltage is lower than 340 V, an auxiliary 24 V supply is anyhow needed).

**WARNING:**

**Correct performance of the drive requires a braking resistor connection. The internal braking resistor, normally connected to the power terminal board, can dissipate 10W only. When a higher dissipation is required, an external suitable resistor must be connected on the same terminals where the internal one is connected. Minimum and maximum ohmic values for the external resistor are shown in the par. 4.1.**

Position sensor connection:

- Connect the position sensor to E1 port, through a suitable multipolar shielded cable. **The shield must be grounded on motor side and to connector body on drive side.**

### 3.3 Start up

After switched on, the drive lights briefly all leds: then, in sequence, led 0 lights about 1 second and led 7 keeps flashing at 1 Hz frequency, thus indicating the correct operation of the drive.

Start the "Cockpit" configuration tools in order to basic parameters configure (SysAxM\_02\_eng.par parameters table), such as those regarding the motor, the encoder type and specifications, inputs and outputs, speed and acceleration limits.

**NOTE: only if the motor is a PMC Ultract II type (except Minact) with ENDAT encoder you can control the motor without any configuration of the drive.**



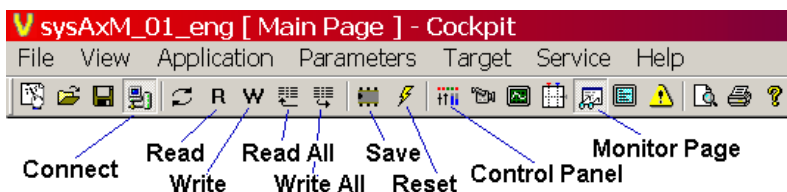
### 3.4 Basic Parameters Configuration

If the motor isn't a ultract II 4, 5, 7, 10 o 13 or the encoder is different from the sincos, is necessary to configure the principal parameters to obtain any motor operation.

To setting this parameters the connection with the drive must be enabled (232 interface, port S1);



Initially all the parameters are displayed on red, because they are modified only in the PC side, you can now "read" the actual configuration or "write" the modified parameters to activate the new settings, in both case the parameters are now displayed on black.



To confirm the modifications and to maintain new parameters use the "save" button.

NOTE: The "Write All" selection enable the tranfer of the visualized parameters only, but the "save" selection enable the storing of all the parameters.

The main parameters you must set are the poles number of the motor, the type and pulse number of the encoder. You have also the nominal and limit current.

Menu selection

- AX-M Drive
- Main Page
  - Motor and encoder
  - I/O conf.
  - Settings



This is the example for UL T motor with Endat encoder

**Motor and encoder configuration:**

	<input type="text" value="1024"/>		<b>Main encoder</b>	Number of pulses per turn
?	<input type="text" value="Endat"/>		Encoder type	
	<input type="text" value="20"/>		<b>Motor</b>	Motor poles number
?	<input type="text" value="3.00"/>	Arms	Main current limit	
?	<input type="text" value="2.00"/>	Arms	Nominal current limit	

To activate the encoder simulation, on the C1 port, select SYS\_SE\_ENABLE = ON; in the "default mode" it can repeat only 1024 pulses per turn.

A detailed description of the drive parameters see Software manual Cap. 4

To verify the motor to drive connections and the settings there is the "Monitor Page":



AxM
MONITOR PAGE

Power Stage			
DC-Link Voltage	19	V	Heat Sink Temperature 27 °C
Encoder Section			
	Main Encoder		Auxiliary Encoder
Virtual Position (65535 = 1 turn)	49538		0
Turn Number	11		0
Index Position	0		0
Current Loop			Arms
Current Limit	3	Current Reference	DISAB
Speed Loop			rad / s
Clockwise Limit	299.9	CounterClockwise Limit	299.9
Speed Reference	0	Actual Speed	0

In this page you have the DC-link voltage value, the heat-sink temperature and the encoder reading values: position and turn number. Turning clockwise the motor shaft (drive disabled)

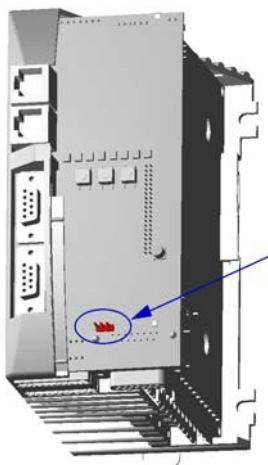
You must read a position increment, up to 65535 that is the maximum. When one turn is completed you must read the initial value in the position number and the initial value +1 in the turn number.

### 3.5 Encoder Supply Setting

The new AxM drives product starting from the second half of the 2006, with serial number type 20XXXX, are able to automatically select the encoder supply. If the main encoder parameter (SYS\_ENC1\_TYPE, IPA 18230) is set to ENDAT the encoder supply voltage is set to 7,5V.

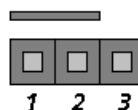
**WARNING:** Do not connect any other encoders when the SYS\_ENC1\_TYPE parameter is set to ENDAT.

For the older drive, with serial number of 4 number, It is possible to set the value of the encoder supply at 5 or 10V by a jumper inside the drive.

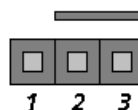


To modify the configuration it is necessary to open the plastic cover removing the two screws in back side of the drive and set the jumper as follow:

Setting for 5V supply:



Setting for 10V supply:

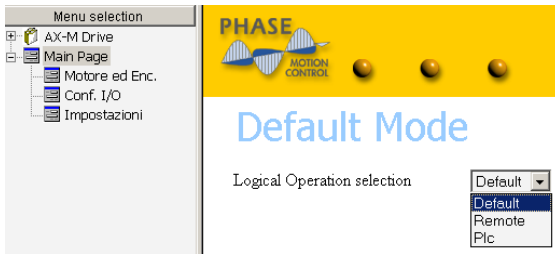


**NOTE:**

Using an auxiliary supply of 10V with a sincos or digital encoder or any other sensor with 5V supply can damage the sensor.

### 3.6 "Default" Mode

The "Default" mode allows the use of the drive avoiding any dedicated application loading.



Phase Motion Control supplies the AxM drive set for "default" mode run. This mode allows the current and speed motor control.

Commands and controls are given by activation of proper signals to digital inputs, while the current and speed values by analog inputs. The following table resumes all the input configurations.

Input	Mark	Function	Description
Digital 0	DIO	Drive enabling	Drive is enabled on the input rise edge.
Digital 1	DI1	Digital zero	All analog references are put to zero if this input is high
Digital2	DI2	Inversion	The reference settings are reversed If this input is high.
Digital 6	DI6	Control Selector	If this input is high the speed control is selected; if not the current control is selected.
Analog 0	AI0	Speed reference	When the speed control is selected this analog input changes the speed reference.
Analog 1	AI1	Current Reference	When the current control is selected this analog input changes the current reference.

Tab. n. 1

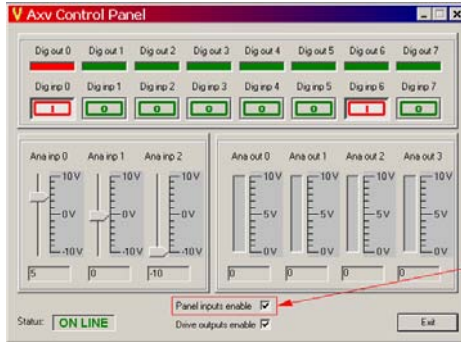
The drive activates the digital outputs related to its run state.

Output	Mark	Function	Description
Digital 0	DO0	Drive Ok	This output is enabled when the drive is on and no alarms is present.
Digital 1	DO1	Run	This output is enabled when the drive activates the set references.

Tab. n. 2



Selecting "Control Panel" you can command the analog and digital input by software



When you take the control by control panel the real input are not used.

### 3.7 Settings

It is now possible that you need some parameters modification to obtain a right behaviour; in the "settings" window you can find the main speed loop parameters:

Menu selection

- AX-M Drive
- Main Page
- Motor and encoder
- I/O conf.
- Settings**

PHASE ACTION CONTROL
Settings

## Settings

*Default Mode*

Ramps:

	Clockwise	Counter Clockwise
Acceleration	2500.00 rad/s <sup>2</sup>	2500.00 rad/s <sup>2</sup>
Deceleration	2500.00 rad/s <sup>2</sup>	2500.00 rad/s <sup>2</sup>

Speed limits:

Cw speed limit: 310.000 rad/s

Ccw speed limit: 310.000 rad/s

Speed Loop Gain:

Integral position gain: 0

Position gain: 1000

Speed gain: 2000

Acceleration gain: 0

Current Loop Gain:

Proportional gain: 4000

Integral gain: 2000

Differential gain: 0

Help

The current loop parameters depend from motor type only. You can have a good settings following the specification in table n. 3.



Gain	Value per UL II	Value per UL T
SYS_IC_P_FAK	L x 700	3000
SYS_IC_I_FAK	L x 350	6000
SYS_IC_D_FAK	0	500

Tab. n. 3

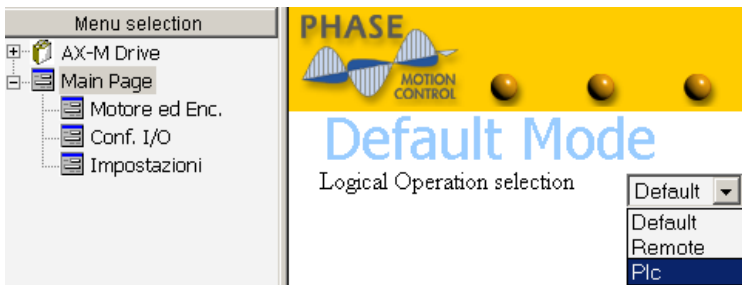
L is the fase inductance value of the motor

The speed loop parameters depend from the load and the transmission type therefore is possible that you need some settings. For this you can begin increasing the speed gain. When the motor becomes noisy or instable set this gain near at one half of the actual values. Use the same procedure for the position gain, looking the positioning overshoot. The integral gain is needed to keep the position reached with zero speed

NOTE: Instead of the Html pages you can use the parameters tables.

### 3.8 Use of the PLC Application

In addition to the basic functions of the drive, it could be useful to develop additional features. Regarding to this Phase Motion Control supplies some standard applications that generally satisfying the most common control requests. The use of dedicated applications implies their downloading into the drive and the setting to "PLC" of the "SYS\_SEL\_MODE" system parameter.



To looking if an application is now loaded inside the drive select the AxM link, from the main page of the cockpit, by a click on the picture:



**Welcome in Cockpit II**

**Cockpit II** is the configuration and diagnostic tool for all Phase Motion Control digital drives of **AX-V**, **AX-M** and **UL-TW** family. By means of this software you will be able to load into the drive and configure any application developed with **GPLC** programming software. Cockpit II also embodies some useful functions for the testing and diagnostic of your drive. With The integrated **Control Panel** you will be able to take direct "software" control of all I/Os of your drive to test the operation of the system.

For AX-V and AX-m family drives, also some base applications are supplied which satisfy the most common requirements of motion control automation. All these applications are developed with **GPLC** programming software and the source code is available for simple customisation.

**SELECT YOUR PRODUCT**

**AX-V**



**AX-M**



**ULTRACT-TW**



In this page are indicated the installed firmware and PLC application releases.

In the same page there are the links to the applications supplied from Phase Motion Control. Selecting the desired application you will have a new window where you can directly download the PLC code (press "LOAD" button and follow the instruction).

**PHASE MOTION CONTROL**

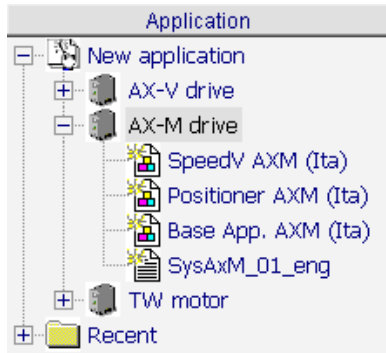
**AxM**      **Main Page**

	Name	Major Ver.	Minor Ver.
<b>Existing Firmware:</b>	<b>MPLC</b>	<b>2</b>	<b>0</b>
<b>Existing Application:</b>	<b>POSIZ</b>	<b>1</b>	<b>2</b>

**SELECT THE APPLICATION YOU WANT TO CREATE**

[→ Base App.](#)     
 [→ Speed V](#)     
 [→ Positioner](#)

Otherwise choosing the menu “**New application / Ax-M drive**” from the main page window all the standard applications are displayed.



In both cases a new application and a new directory will be created inside your PC. Two windows will ask  
 You to check the connections and verify the address of the drive therefore the PLC project will be compiled and downloaded in the drive.

If You want download a old application just created inside your PC, You can open the parameters table of this application and select “**Rebuild application**” from the menu “**Application**”.

In the application table there are some parameters copied from the System table (Ex. Current limit, Encoder type, ...) and some specifical parameters of the application.

A detailed description of the applications supplied is available in the chap. 6 of the Software Manual.

**NOTE:**

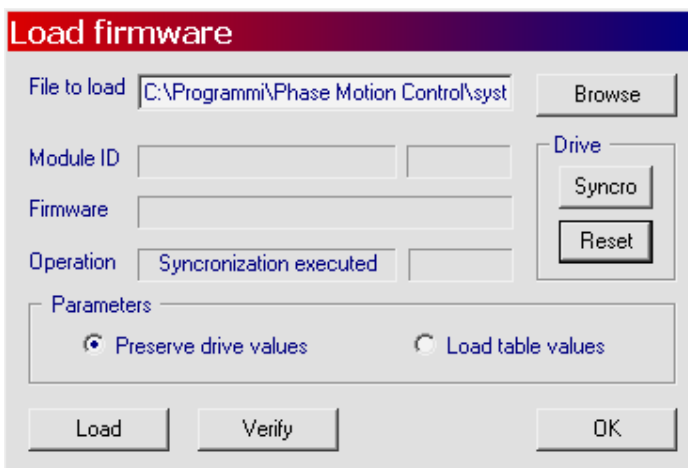
Using “**Cockpit**” configuration interface, it is ever possible to activate/de-activate the “default” running mode, entering the system parameter SYS\_SEL\_MODE, IPA 18051 (“Default” activated, “PLC” default de-activated; see also par. 4.3 of the Software Manual). Any application loaded on the drive will be de-activated until such parameter is reset to “PLC”.

### 3.9 Firmware uploading

Firmware upgrades are periodically available on the web site [www.phase.eu](http://www.phase.eu).

New functionality and/or software evolution, processing from Phase Motion Control laboratories, are fuse and a new firmware version is released.

To upload this, open a system table and select "**Load firmware**" from "**Service**" menu; the follow window will appear:



**Load firmware**

File to load:

Module ID:

Firmware:

Operation:

Drive

Parameters

Preserve drive values  Load table values

With "**Browse**" button select the firmware file to download (Ex. "**MPic2\_0.sre**").

Press before "**Syncro**" and after "**Reset**" to synchronize the drive.

When "**Synchronization executed**" appear press "**Load**" to star the downloading.

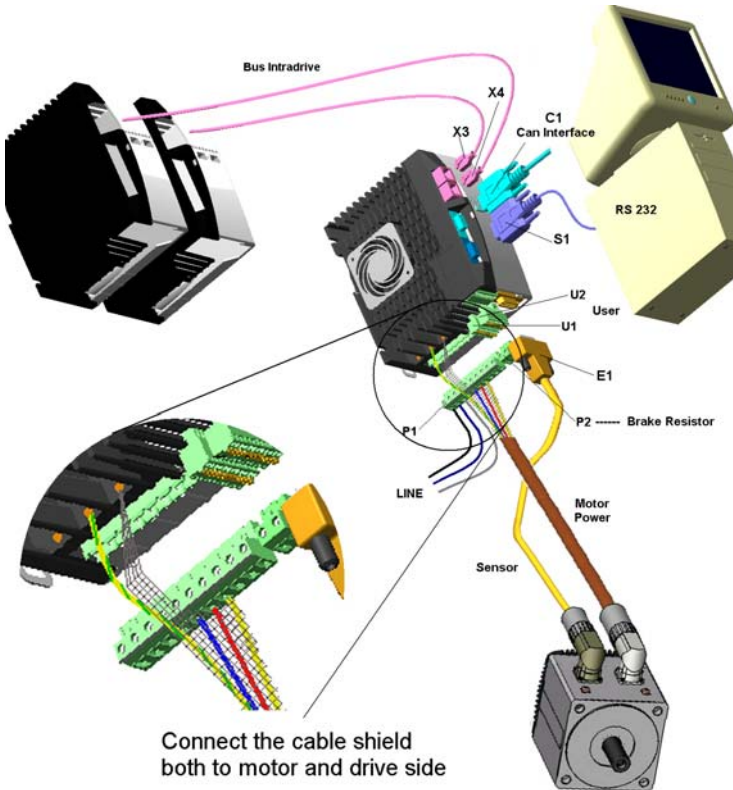
#### NOTE:

The drive will be unusable if any troubles occurs during this operation (Ex. Lost of 24V supply, PC connection problem, ...). You have to repeat the firmware upload in order to bet back the drive working.

If is not possible connecting the drive with the PC, synchronize it pressing "**Syncro**" button, then remove the 24V supply and connect now them.

## 4 Electric Installation

### 4.1 Connections general outline



#### *Power connections:*

Connect power supply to the R S and T terminals of the power connector using a 3 + 1 shielded cable; use one GND screw of the drive to connect the shield.

**NOTE:** AxM drives are designed for tri-phase supply only; voltage must be lower than 460V (+10 %).

*Braking resistor connection:*

The internal braking resistor, connected to the power terminal board (P2) can dissipate a maximum 10W braking power. If the power to dissipate is higher, it becomes necessary the use of an external resistor of adequate power. To do this, disconnect the internal resistor and connect the external one on the same terminals. The min and max ohmic values for such external resistor are:

Model	Min	Max
AX-M 04094	60 $\Omega$	80 $\Omega$
AX-M 06144	38 $\Omega$	50 $\Omega$
AxM 09204	26 $\Omega$	34 $\Omega$

Tab. n. 4

If an external braking resistor is used, the following system parameters must be configured: **SYS\_R\_BRAKE** (resistance values expressed in ohm, IPA n°18106) and **SYS\_PBRAKE\_MAX** (nominal power values expressed in Watt, IPA n°18107). The firmware will use these values to activate the thermal protection of the resistor itself. For further details see chap. 4 of the Software Manual.

*Power connection of the Motor:*

Connect the **phase windings of the motor** to the **A, B** and **C** terminals of the power connector (P1) according to the sequence specified in the connection diagram supplied with the motor and the connection outline shown in par. 8.4.

Use a shielded cable with section suitable for the motor nominal current.

When the connection cable is longer than 15 m, the use of damping inductances in series with the cable is recommended.

**WARNING:**

**The cable shield must be grounded on both sides, motor and drive, connecting it to the special screw provided for.**

*Auxiliary supply connection:*

Connect a 24V (22-30V) stabilized voltage, minimum current 0,6A to the connector U1 according to the diagram of par. 8.1.



*Position sensor connection:*

Connect the signals required by the used sensor to the Encoder connector (E1) according to the relative correspondence specified in the wiring table of par. 8.2.

Use a shielded cable with twisted duplexes, possibly of high flexibility type.

When the connection cable is longer than 25 m, the use of adequate cable section is recommended in order to avoid excessive voltage drops.

**WARNING:**

The cable shield must be grounded both to the motor and connecting it to the drive connector frame.

**NOTE:**

If the chosen sensor is a Resolver, the cable to be used must have the duplexes twisted and individually shielded, in addition to the whole cable shield. Connect the individual shields to the pin 1 of the encoder connector E1, and the whole cable shield to the frame of the connector.

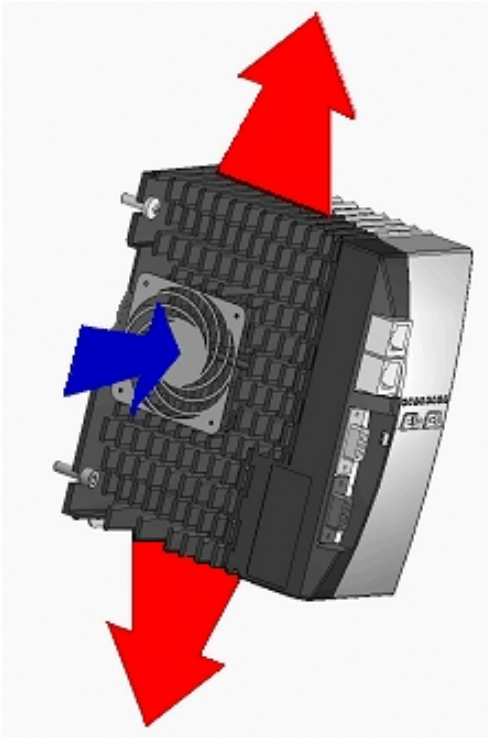
## 4.2 EMC Filter

AxM has an internal EMC filter not enough by itself to comply with the EN 55011: but it allows the choice of a very simple and cheap external filter.

The suggested filter is the FN 251-8-07 of the Shaffner list.

Connect such a filter between mains and drive or drives in case more drives should be used together.

### 4.3 Causes of derating



Cooling air flux

To assure to the fan the requested “breathing” and thus the proper cooling of the heat sink, the distance between the heat sink edge and the nearest flat surface (e.g. other drives, cabinet wall,...) must be at least 10mm, as shown in the following table.

Distance	Derating
0mm	40%
5mm	20%
10mm	0%

The fan is automatically switched on when the heat sink temperature reaches 50° C.



#### 4.4 Physical specifications

Physical specifications	AxM - 04094	AxM - 06144	AxM - 09204	Units
Average braking power with internal resistor	10			W
Power loss with nominal current	1700			J
Thermal capacity	85	95	110	W
Cooling	720			J/C
Dimensions (LxPxH)	Forced ventilation			--
Mass	78.5 x 148 x 167			mm
Ingress Protection	1.32			Kg
Vibrations	IP20			--
Shock	0.5 g all directions, 0-10 Hz			--
Operative temperature	1			g
Physical specifications	0-40 0-50 with 20% derating			°C
Stock temperature	-20 / +70			°C
Relative humidity	0 - 95%			--
Altitude	0-1000 m; over 1000 m, current derating 3% every 100 m			--

## 5 Technical specifications

Technical specifications	AxM - 04094	AxM - 06144	AxM - 09204	Units
Voltage supply	0 - 460			Vac 3 phase
Auxiliary feeding voltage 1)	22 – 30			Vdc
Current required 2)	9	14	20	Arms
Frequency	0 – 400			Hz
Nominal power 3)	2.3	3.3	4.8	KW
Current output, axis < 100 rpm, S1 4)	4.5 (6*)	6 (8.5*)	9(10*)	Arms
Current output, max speed, S1 4)	3.5 (4*)	4.5 (5*)	6.5(7*)	Arms
Peak current	9	14	20	Arms
Maximum voltage output	$V_{in} \times 0.95$			Vac
PWM frequency	16			KHz
Efficiency at nominal power 5)	96	96.5	96.5	%
Input form factor	9			Vac 3 phase
Maximum braking current	100 % of peak current			--

\* If supplied with 230 Vac.

1) Peak value

2) Input bridge losses included

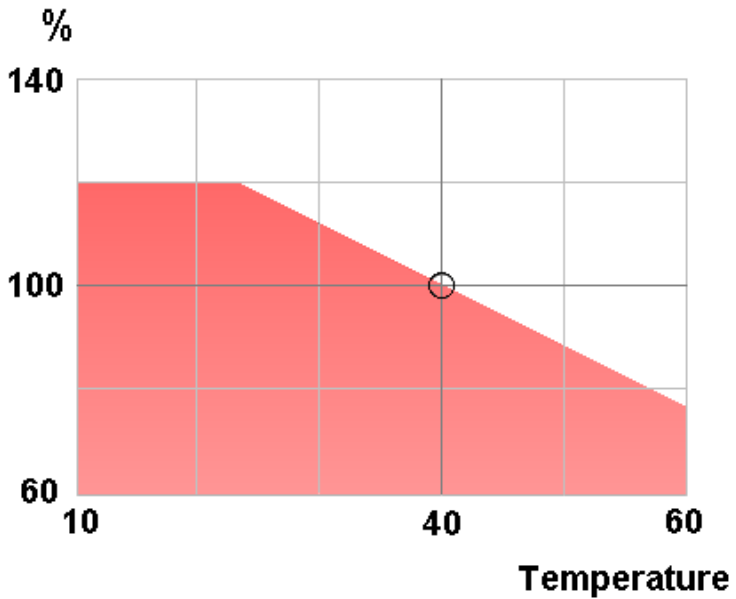
3)  $V_{in} = 380$  Vac,  $T_{amb} = 40$  C, Comm. Freq. 8kHz,  $V_{out} = V_{in} \times 0.95$

4) Auxiliary supply (losses not included)

5) Not stabilized (1 Vpk-pk ripple) > 0.6 A

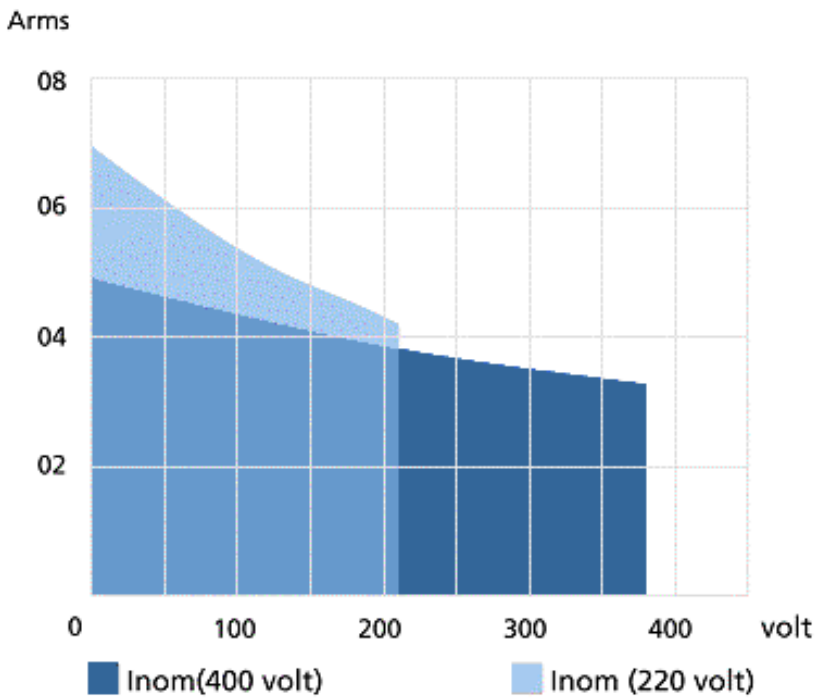
## 6 Electrical Performances

### 6.1 Output current derating, vs. room temperature



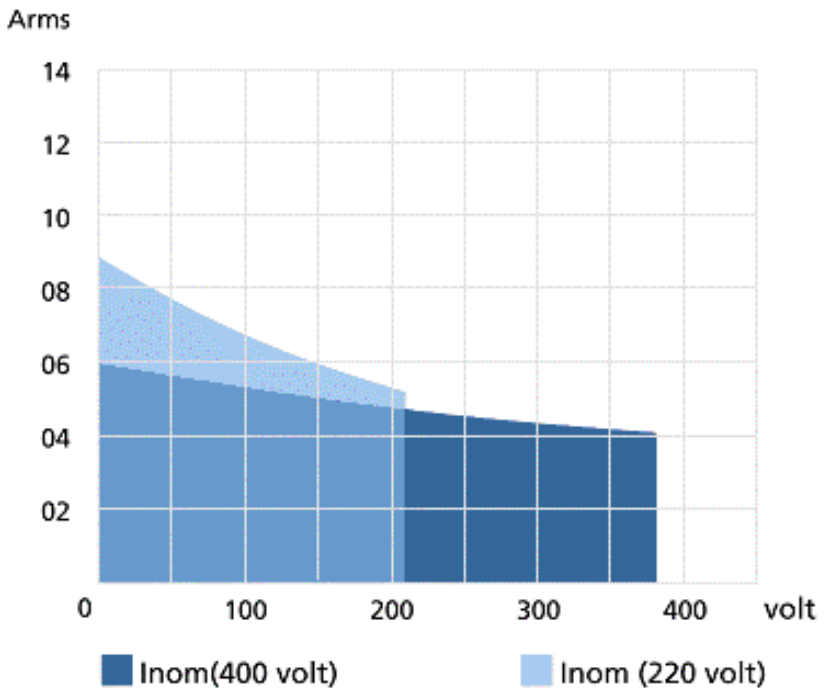
% output current variation versus room temperature

## 6.2 Operating area AX-M 04094



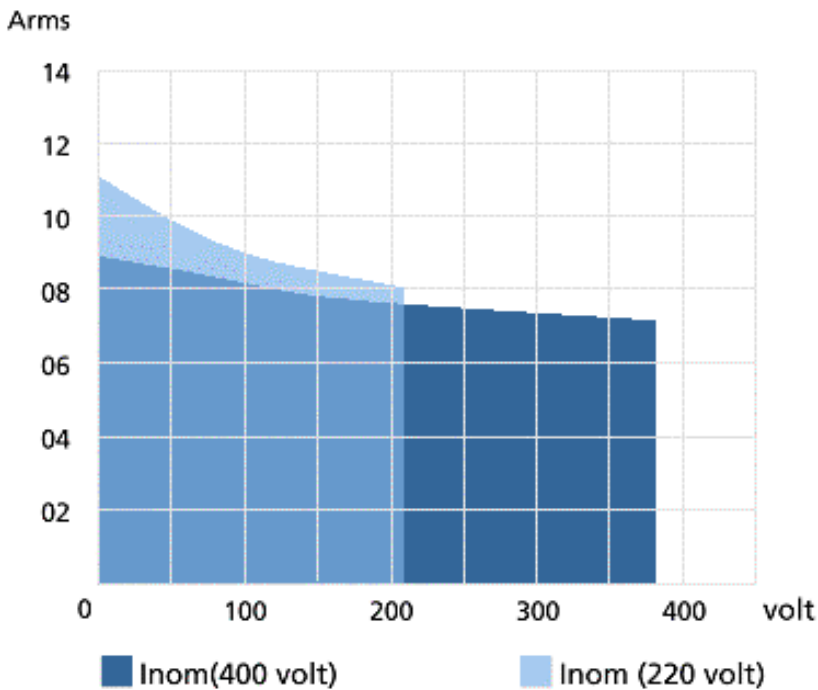
Operating area of AxM 04094 drive as function of output voltage, with voltage supply 220V e 380V.

### 6.3 Operating area AX-M 06144



Operating area of AxM 06144 drive as function of output voltage, with voltage supply 220V e 380V.

#### 6.4 Operating area AX-M 06144



Operating area of AxM 09204 drive as function of output voltage, with voltage supply 220V e 380V.

## 7 Hardware description

### 7.1 Power stage:

- Innovative Ac-Ac converter without DC bus electrolytic capacitor, which provides instant availability at power-on and correct input current waveform, in line with the future IEC 555 norm;
- Auto tuning of current limit vs. supply voltage and ambient temperature; single drive for 198-465 Vac supply;
- 16 kHz carrier power IGBT stage, 16 kHz ripple frequency, built-in full power, limited duty cycle brake resistor; full power braking chopper;
- Forced ventilation controlled by the drive temperature (the fan is turned on only above 50 °C) to limit dust accumulation; the drive temperature is monitored and available for programmable cycle self-limiting;
- Full power stage intrinsic protection (overtemperature, short circuit to ground and between motor wires) with fault condition non volatile storage.
- Control and power stages have separate and independent power supplies for emergency shutdown and debugging
- Real time temperature observer for each power chip, with adaptive current limit.

### 7.2 Connectors

#### *High speed sensor interface (E1 and C1)*

- two independent inputs, configurable
- a main analog/digital encoder input (E1-200 kHz BW) which can be programmed to receive the following signals:
  - ENDAT serial Encoder (default encoder)
  - SINCOS 5 channel encoder (2 absolute analog tracks, 2 incremental analog tracks, index)
  - Digital 6 track encoder (3 Hall commutation + 2 incremental + index)
  - Resolver
- A secondary encoder I/O (C1-500 kHz) which can be programmed as incremental digital encoder without commutation tracks.

**WARNING:**

The encoder supply can be programmed to 5V or 10V by internal jumper (JP5). A wrong connection of the encoder may cause its damage. See par. 3.5 for the correct configuration.

Phase Motion Control recommends the 10V choice and the use of a 7-10V Encoder supply in order to avoid voltage drop.

- Encoder simulation output, line driver, with programmable conversion rate with reference to the main one (allowable on C1 connector)

NOTE: the encoder simulation output can be used alternately with the auxiliary encoder input.

The C1 connector can also be used for Can interface.

See the connection list on par. 8.3

### 7.3 Overall connections diagram

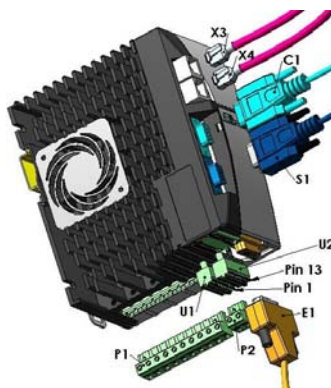
*User Interface (connectors U1, U2 and P1):*

- 2 analog differential programmable inputs
- 2 analog programmable outputs
- 8 digital programmable inputs
- 4 digital programmable outputs
- 1 Watch-dog relay with N.O. and N.C. contacts 1A, 250V

See connection tables beginning on Cap. 8

*Communications (connectors S1, C1, X3 e X4):*

- serial synchronous interface RS232
- CanOpen field bus interface



### 7.4 Hardware

- IP 20 Cabinet protection, with internal RFI shield,
- Control and power interfaces with removable terminals and connectors,
- Encoder and serial interface with D standard connectors,
- Integrated ground bar (4xM4) for shields and groundings.



## 7.5 Architecture

### *Dual processor architecture*

Non volatile programmable memory area: 256 Kbyte

Processors' speed: 40 MIPs (DSP) + 25 MIPs (microcontroller)

### *Task frequency:*

- Current and drive monitoring cycle: 8 kHz - Position and speed ring: 4kHz
- Fast task (user programmable): 4 kHz - Slow task (user programmable): 125 Hz
- Position and position target register: 32 bit word

## 7.6 Led display

### *Led meaning*

During the drive's normal run, the following operating conditions are monitored on the led display (more than one led can light together).

Drive condition	Led on	Lighting mode	Description
Drive Disabled	7	1Hz flashing	Drive's normal run. <b>Disabled</b> .
		Always on	Drive's normal run. <b>Enabled</b> .
SERIAL Communication	6	Variable frequency flashing	The drive is connected to a remote PC through the serial line
CAN interface communication *		Always ON	Drive in OPERATIVE state
		Flashing	Drive in PRE-OPERATIVE state
		Always OFF	Drive in ERROR Hardware – Bus Off
Current limit	5	Variable frequency flashing	Drive is supplying the maximum current.

\* The enable of the CANopen interface select also the Led 6 mode.



When the drive is in “alarm” or “error” condition, all run condition signals are cancelled: the leds show the alarm codes only.

*Alarm conditions*

Drive condition	Leds on	Lighting mode	Description
Alarm	0, 1, 2, 3, 4	1 Hz flashing	The drive is in alarm condition: the binary code of the active alarm is displayed. Refer to chap. 10 for codes description.
System fault	0, 1, 2, 3, 4, 5, 6, 7	1Hz flashing	System fault due to a control firmware error. <b>Check the ground connection and correct closure of the plastic cover of the drive.</b> Ask Phase Motion Control Service.
Boot error	6	Fix	Starting the system an initialization error of the control firmware occurred. Ask Phase Motion Control Service.

A detailed description of all AxM drive alarms is shown on chap. 10.

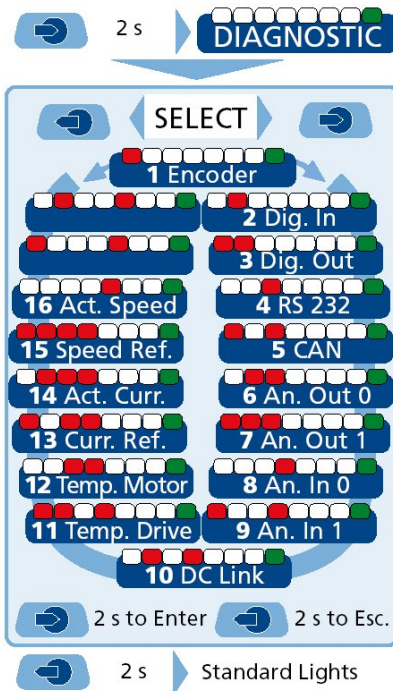
**NOTE:**

Moreover the led 6 can be flashing or lighted fix in case of synchronisation and/or firmware updating.

## 7.7 Diagnostic

### General description


The "diagnostic" function enables a test control sequence and allows the setting of drive's fundamental parameters avoiding the use of software interfaces.



The use of diagnostic takes place by pressing the command push buttons (Symbol Arrow IN) and (Symbol Arrow OUT)




on the drive.

To have access to the diagnostic press the  push button for about 2s.

This mode is marked by the led 7 lighted fix.

We have now two operative phases.

Selection phase: allows to select the desired diagnostic test. Press the  key to scroll the

list of allowable diagnostics ascending mode, the key descending mode. The selection is shown by led 0÷6 in binary code. 

e.g.: if diagnostic Nr. 2 is selected (Digital input diagnostic), this should be shown as follows:



The diagnostics presently available are:

Nr	Type
1	Encoder diagnostic
2	Digital input diagnostic
3	Digital output diagnostic
4	RS-232 serial baud rate diagnostic
5	Can baud rate diagnostic
6	Analog output 0 diagnostic
7	Analog output 1 diagnostic
8	Analog input 0 diagnostic
9	Analog input 1 diagnostic
10	Dc-bus voltage diagnostic
11	Power module temperature diagnostic

To exit from diagnostic, keep pressed "minus" key for at least 2 s.

Execution phase: carries out the selected diagnostic test.

Being in the selection phase, keep pressed the key  for at least 2s. The selected diagnostic is carried out. The led display depends from diagnostic type chosen.

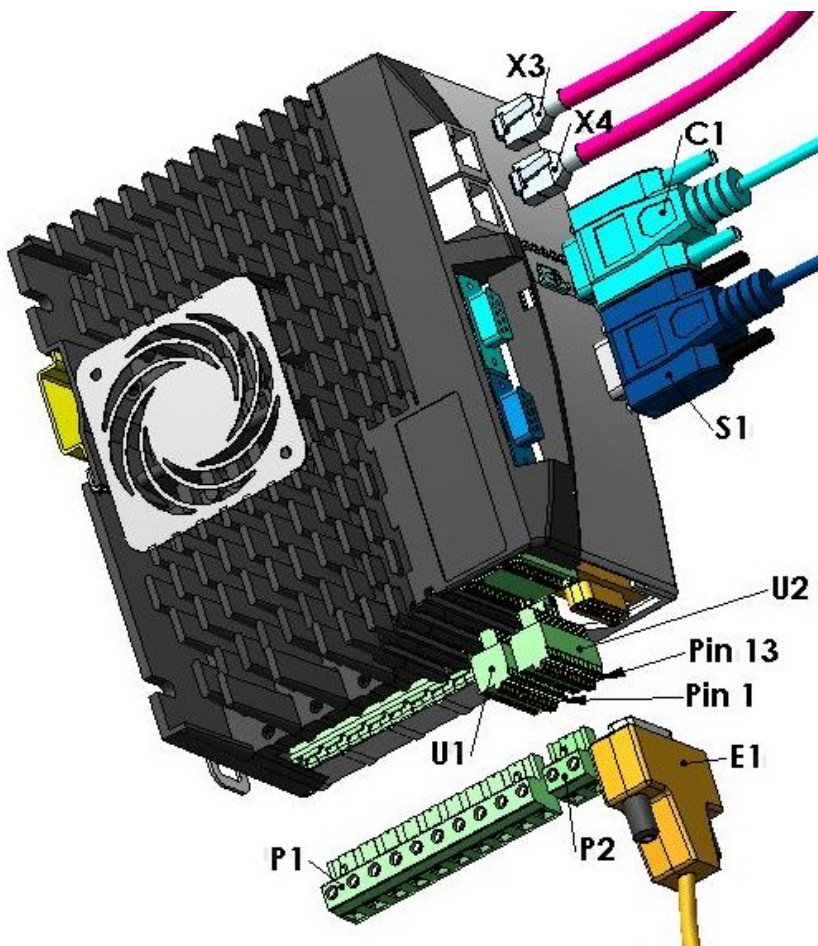
To come back to the selection phase keep pressed the key  2s long. This enables the parameters changes, if needed, by saving and drive's reset.

To exit from diagnostic pressing both command keys together. The display will come back to that of drive's normal run. In this case **the parameters change will not be saved.**

**NOTE:**

The center key allows the drive's hardware reset.

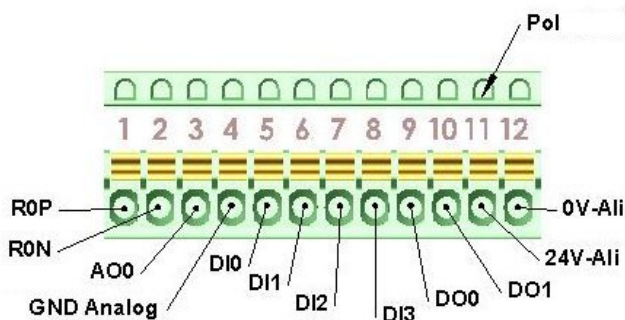
## 8 Electrical Connections



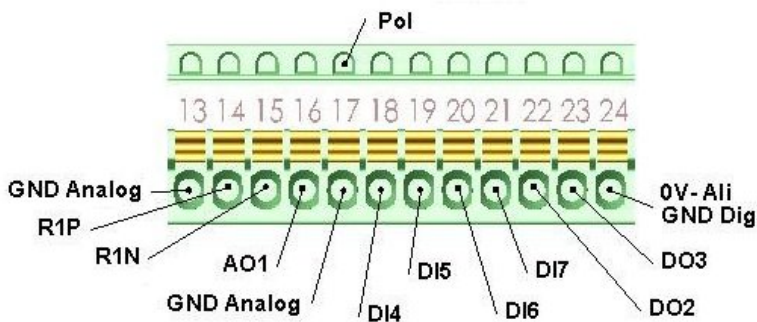
## 8.1 User Connectors (U1 /U2)

*Removable Terminal Board, Phoenix 12 pin - cod. FK-MC 0.5/12-ST-2.5*

### U1



### U2



#### NOTE:

To obtain a good performance of the analog input connect the RxN pin to the reference (source side) and apply the  $-10/+10V$  to the RxP pin.

USER CONNECTOR U1				
N	Name	Type	Function	Signal description
1	R0P	Analog input	Direct differential input	+/-10V, Zin = 10Kohm, if not used connect to GND
2	R0N	Analog input	Denied differential input	+/-10V, Zin = 10Kohm, if not used connect to GND
3	A00	Analog output	Programmable output	+/-10V f.s., 5 mA
4	GND	Analog ground	Reference ground	Analog signals reference
5	DI0	Digital input	Programmable input	6.6 kOhm to ground, 20-30 V
6	DI1	Digital input	Programmable input	6.6 kOhm to ground, 20-30 V
7	DI2	Digital input	Programmable input	6.6 kOhm to ground, 20-30 V
8	DI3	Digital input	Programmable input	6.6 kOhm to ground, 20-30 V
9	DO0	Digital output	Programmable output	PNP open collector, 24 V, 100mA max
10	DO1	Digital output	Programmable output	PNP open collector, 24 V, 100mA max
<u>11</u>	24V	Auxiliary supply	Auxiliary supply of control circuits	Voltage: 22-30 V Referred to Pin 12 ( 0V) Requested current: 500mA.
12	0V	Auxiliary supply	Auxiliary supply negative	Digital signal reference

— key position

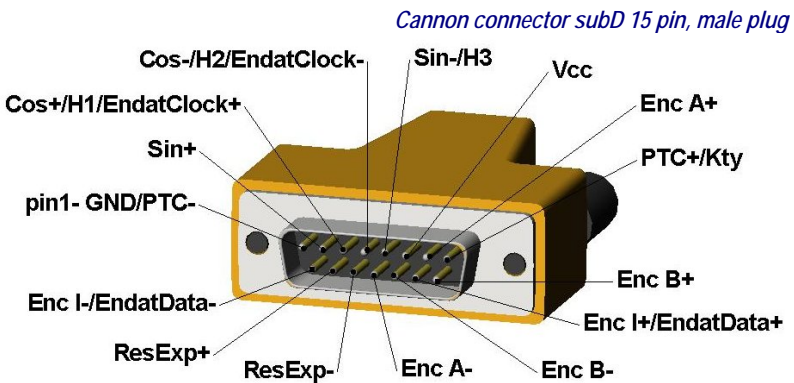
USER CONNECTOR U2				
N.	Name	Type	Function	Signal description
13	GND	Analog ground	Reference ground	Analog signals Reference
14	R1P	Analog input	Direct differential input	+/-10V, Z <sub>in</sub> = 10Kohm, if not used, connect to GND
15	R1N	Analog input	Denied differential input	+/-10V, Z <sub>in</sub> = 10Kohm, if not used, connect to GND
16	AO1	Analog output	Programmable output	+/-10V f.s., 5 mA
<u>17</u>	GND	Analog ground	Reference ground	Analog signals Reference
18	DI4	Digital input	Programmable input	6.6 kOhm to ground, 20-30 V
19	DI5	Digital input	Programmable input	6.6 kOhm to ground, 20-30 V
20	DI6	Digital input	Programmable input	6.6 kOhm to ground, 20-30 V
21	DI7	Digital input	Programmable input	6.6 kOhm to ground, 20-30 V
22	DO2	Digital output	Programmable output	PNP open collector, 24 V, 100mA max
23	DO3	Digital output	Programmable output	PNP open collector, 24 V, 100mA max
24	0V	Auxiliary supply	Auxiliary supply negative	Digital signal reference

— key position



## 8.2 Encoder Connector (E1)

To allow the connection of different encoders some pins of this connector have more than one function. Select the connection corresponding to your encoder and set the parameters `SYS_ENC1_TYPE` and `SYS_ENC1_CY_REV` in the system table (see par. 3.4)



### Shield Connection:

To obtain a good connection without noise problems it is necessary to connect the shield of the encoder cable both on motor and drive side.

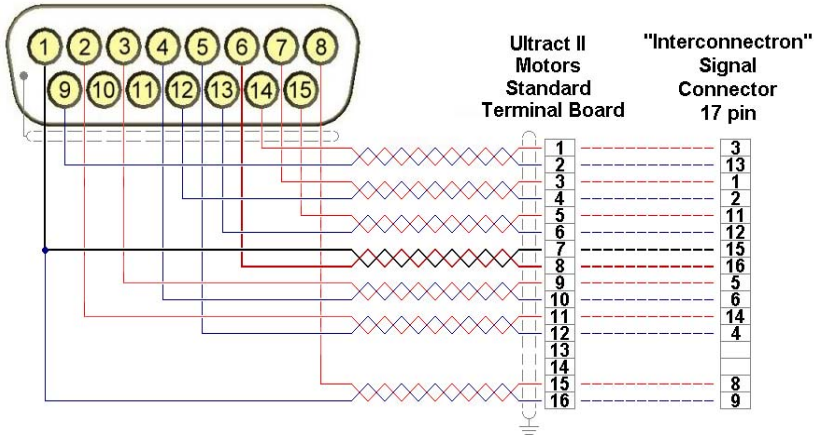
Motor side: connect the shield to the opposite screws or in the terminal board  
 Drive side: connect the shield to the connector body.

If You are using a Resover sensor, adopt a cable with individually shielded twisted pairs and connect all the internal shields to the pin 1 of the connector; connect the external shield to the connector body.

### NOTE:

check paragraph 3.5 for the encoder supply selection

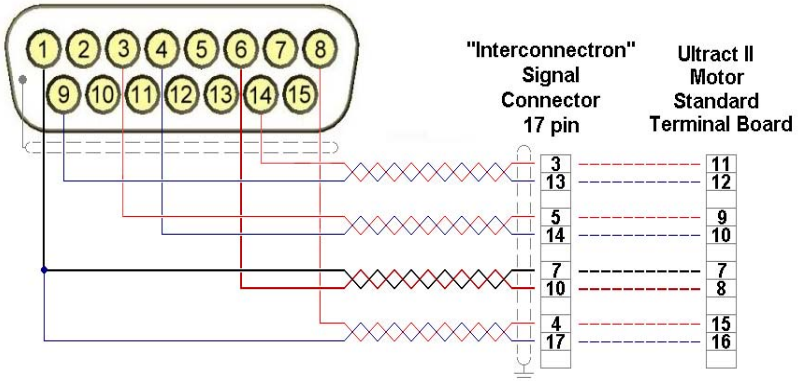
Sincos Encoder Connections Table:



Pin	Name	Type	Function	Signal description
1	GND / PTC -	Supply 0V	Supply ground and thermal sensor	Encoder ground
2	SIN +	Analog input	Encoder absolute channel	1 Vpp differential
3	COS +	Multifunction input	Encoder absolute channel	1 Vpp differential
4	COS -	Multifunction input	Encoder absolute channel	1 Vpp differential
5	SIN -	Multifunction input	Encoder absolute channel	1 Vpp differential
6	+ VCC	5V / 7.5V Auxiliary supply	Encoder supply	Positive supply voltage
7	ENC A +	Multifunction input	Encoder incremental channel	1 Vpp differential

8	PTC / KTY	Multifunction input	Thermal sensor	PTC or KTY ground connected
9	ENC_I -	Multifunction input	Encoder index	1 Vpp differential
10	---			
11	---			
12	ENC A -	Multifunction input	Encoder incremental channel	1 Vpp differential
13	ENC B -	Multifunction input	Encoder incremental channel	1 Vpp differential
14	ENC_I +	Digital input	Encoder index	1 Vpp differential
15	ENC B +	Multifunction input	Encoder incremental channel	1 Vpp differential

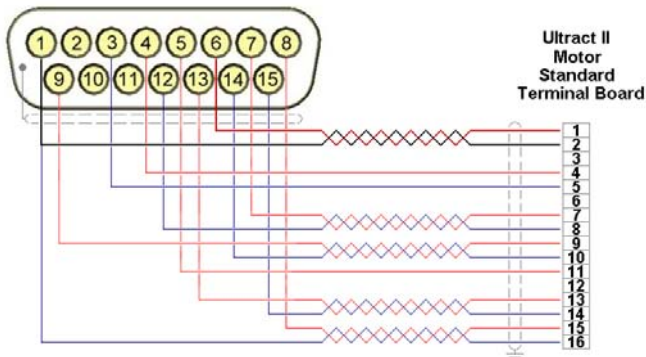
Endat Encoder Connections Table:



**WARNING:** Maximum cable length with ENDAT encoder 40 mt

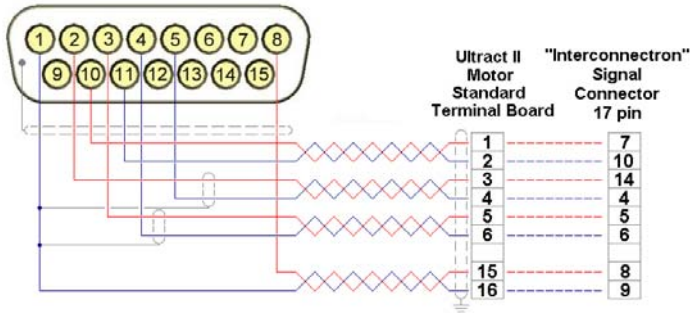
Pin	Name	Type	Function	Signal description
1	GND / PTC -	Supply 0V	Supply ground and thermal sensor	Encoder ground
2	---			
3	ENDATCLK+	Multifunction input	ENDAT clock	TTL
4	ENDATCLK -	Multifunction input	ENDAT clock	TTL
5	---			
6	+ VCC	5V / 7,5V Auxiliary supply	Encoder supply	Positive supply voltage
7	---			
8	PTC / KTY	Multifunction input	Thermal sensor	PTC or KTY ground connected
9	ENDAT DATA -	Multifunction input	ENDAT data	TTL
10	---			
11	---			
12	---			
13	---			
14	ENDAT DATA +	Digital input	ENDAT data	TTL
15	---			

Digital Line Driver Encoder Connections Table:



Pin	Name	Type	Function	Signal description
1	GND / PTC -	Supply 0V	Supply ground and thermal sensor	Encoder ground
2	---			
3	H1	Multifunction input	Hall sensor	TTL
4	H2	Multifunction input	Hall sensor	TTL
5	H3	Multifunction input	Hall sensor	TTL
6	+ VCC	5V / 7,5V Auxiliary supply	Encoder supply	Positive supply voltage
7	ENC A +	Multifunction input	Encoder incremental channel	TTL
8	PTC / KTY	Multifunction input	Thermal sensor	PTC or KTY ground connected
9	ENC_I -	Multifunction input	Encoder index	TTL
10				
11				
12	ENC A -	Multifunction input	Encoder incremental channel	TTL
13	ENC B -	Multifunction input	Encoder incremental channel	TTL
14	ENC_I +	Digital input	Encoder index	TTL
15	ENC B +	Multifunction input	Encoder incremental channel	TTL

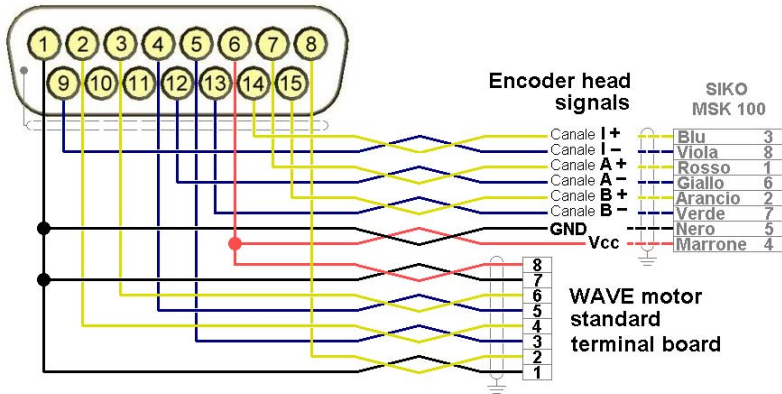
**Resolver Connections Table:**



Adopt a cable with individually shielded twisted pairs and connect all the internal shields to the pin 1 of the connector; connect the external shield to the connector body.

Pin	Name	Type	Function	Signal description
1	GND / PTC -	Supply 0V	Supply ground and thermal sensor	Encoder ground
2	SIN +	Analog input	Absolute channel	1 Vpp: differential
3	COS +	Multifunction input	Absolute channel	1 Vpp: differential / TTL
4	COS -	Multifunction input	Absolute channel	1 Vpp: differential / TTL
5	SIN -	Multifunction input	Absolute channel	1 Vpp: differential / TTL
6				
7				
8	PTC + / KTY	Multifunction input	Thermal sensor	PTC or KTY
9				
10	RESEXP +	Analog output	Resolver energising +	8 kHz sinusoidal wave
11	RESEXP -	Analog output	Resolver energising -	8 kHz sinusoidal wave
12				
13				
14				
15				

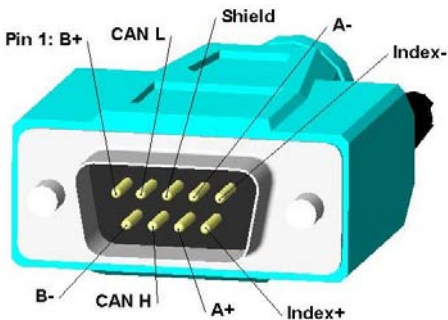
**Schema di Connessione per Motore Lineare WAVE:**



pin	Name	Type	Function	Signal description	Coming from
1	GND / PTC-	Supply 0V	Supply ground and thermal sensor	Encoder ground	Hall sensor board and encoder head
2	SIN+	Analog input	Encoder absolute channel	1 Vpp differential	Hall sensor board
3	COS+	Multifunction input	Encoder absolute channel	1 Vpp differential	Hall sensor board
4	COS-	Multifunction input	Encoder absolute channel	1 Vpp differential	Hall sensor board
5	SIN-	Multifunction input	Encoder absolute channel	1 Vpp differential	Hall sensor board
6	+ VCC	5V / 7,5V Aux. supply	Encoder supply	Positive voltage	Hall sensor board and encoder head
7	ENC A +	Multifunction input	Encoder incremental channel	TTL	Encoder head
8	PTC + / KTY	Multifunction input	Thermal sensor	PTC or KTY	Hall sensor board
9	ENC_I-	Multifunction input	Indice encoder	TTL	Encoder head (if available)

10	---				
11	---				
12	ENC A -	Multifunction input	Encoder incremental channel	TTL	Encoder head
13	ENC B -	Multifunction input	Encoder incremental channel	TTL	Encoder head
14	ENC_I +	Digital input	Indice encoder	TTL	Encoder head (if available)
15	ENC B +	Multifunction input	Encoder incremental channel	TTL	Encoder head

### 8.3 CAN connector (C1)



Cannon connector sub D 9 pin,  
Male plug

C1 connector can be used alternatively for CAN line or to the auxiliary encoder signals; You can connect either the CANopen net or pick up the encoder emulation or use the inputs for auxiliary encoder.

The selection and the configuration is made by some system parameters.

Pin	Name	Type	Function	Signal description
1	B +	Digital I/O	Encoder incremental channel	TTL Differential line driver
2	CAN L	Digital I/O	CAN interface	CAN positive signal
3	Schermo	Gnd	CAN cable Shield	Logic Ground
4	A -	Digital I/O	Encoder incremental channel	TTL Differential line driver
5	I -	Digital I/O	Encoder index	TTL Differential line driver



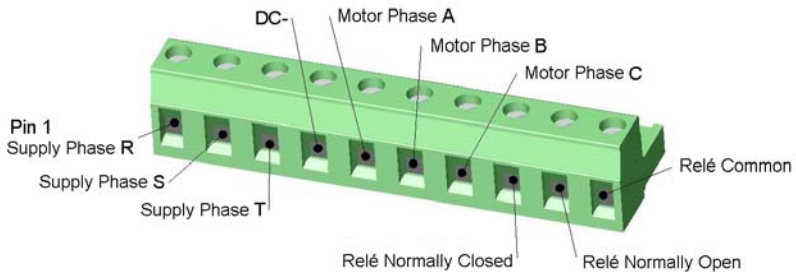
6	B -	Digital I/O	Encoder incremental channel	TTL Differential line driver
7	CAN H	Digital I/O	CAN interface	CAN negative signal
8	A +	Digital I/O	Encoder incremental channel	TTL Differential line driver
9	I +	Digital I/O	Encoder index	TTL Differential line driver

**NOTE:** Connect the shield of the encoder cable to the connector body.

#### 8.4 Power Connectors (P1 / P2)

*P1*

*Phoenix terminal board 10 pin – cod. GMSTB 2.5/10-ST*



pin	Name	Type	Function	Description
1	R	Mains phase	Triphase power supply	Triphase power supply 0 – 460V
2	S	Mains phase	Triphase power supply	
3	T	Mains phase	Triphase power supply	
4	DC-	DC bus negative	DC-bus parallel connection possible	Rectified power supply
5	A	Motor phase A	Motor power supply	Blu / A
6	B	Motor phase B	Motor power supply	Red / B
7	C	Motor phase C	Motor power supply	Yellow / C

8	N.C.	NC relay	Relay normally closed contact	Use it as Drive Ok signal or to manage the emergency braking
9	N.O.	NO relay	Relay normally open contact	
10	Com	Relay Common	Common relay contact	

**P2**

*Phoenix terminal board 2 pin – cod. GMSTB 2.5/10-ST*



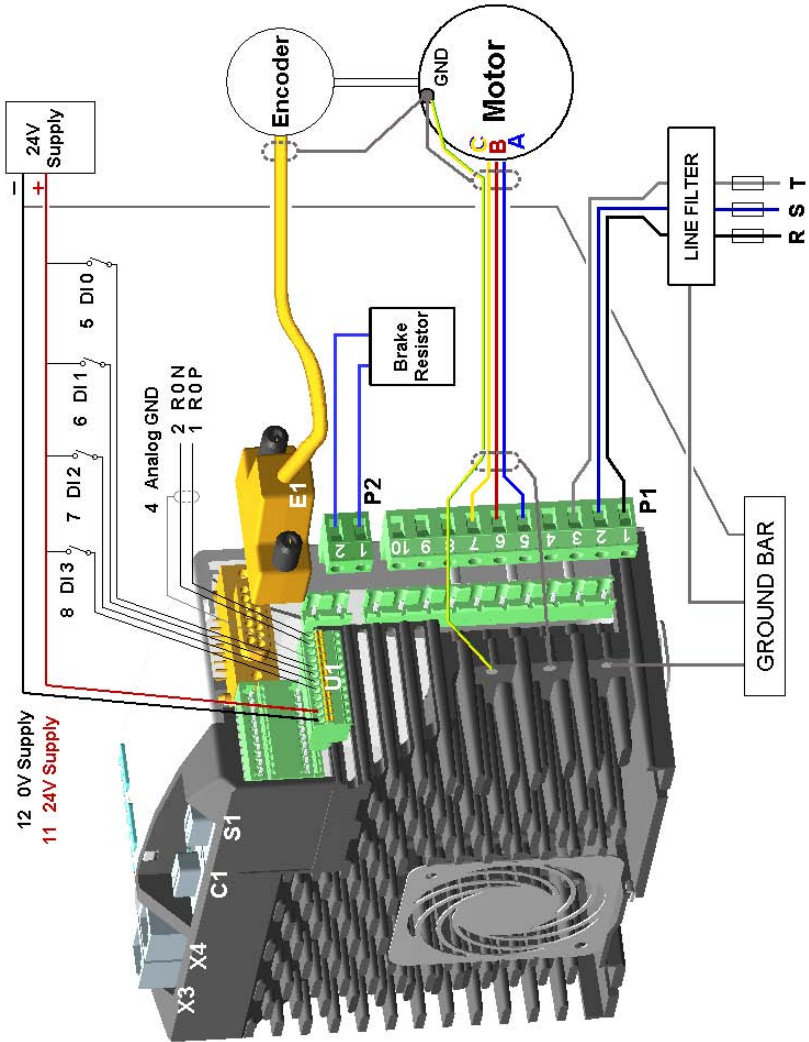
pin	Name	Description / Function
1	BR-	Connect to the internal or external braking resistor
2	BR+ / DC+	Connect to the internal or external braking resistor / DC-bus parallel connection possible

**8.5 RS232 Serial Connector (S1)**

*Cannon connector sub D 9 pin, female plug*

pin	Description	Function
1	---	---
2	Rx	Data line
3	Tx	Data line
4	DTR	
5	GND	Ground
6	---	---
7	RTS	
8	---	---
9	---	---

### 8.6 Connection Example



## 9 Emergency and power fail condition handling

### 9.1 General Informations

The AxM platform has been designed with two completely separate power supplies. The power circuit is fed by the mains voltage, without preload timing; while the control circuit needs to be fed by a separate unregulated 24 V supply. This is converted, by the internal switching regulator, in order to supply all internal services and motor encoders at the appropriate voltages.

This design solution overcomes all uncertainties of timing and synchronisation between drive and main control cabinet, by unifying the same power supply for all services, such as sensors, PLCs, switches and latches. In this way, all data are memorised and reset at the same time, and a simple back-up is possible for all machine information without backing up the main power too.

The power stage without preload (and without storage capacitors) ensures that the main power is available to the drive without delay whenever the mains power switch is operated. We suggest anyway to connect an external auxiliary supply, also with "R" option, when emergency stop can occur in case of mains failure.

### 9.2 Emergency stop with inertial loads; safety brakes

Many applications involving brushless servo drives move high inertia loads in short, fast cycles (typical example are Cartesian robots or pick and place machines). When the load is moving at top speed, a significant amount of energy is stored in the load, so that a sudden deenergization of the brake could be dangerous. It is therefore essential that, in the event of an emergency, the load is braked as quickly as possible.

To resolve this problem, the use of a servo motor with a safety brake is sometimes considered. The simple use of a safety brake, however, is wrong and dangerous for the following reasons:

- Safety brakes designed for servo motors are stationary brakes. They are designed exclusively to hold a motor still when deenergized, typically for vertical translations. They are not designed to absorb any significant energy, also because their torque to size ratio is extreme. If used to stop a motor, instead of keeping it at standstill, they would wear quickly and eventually seize.
- The braking torque of an electrically driven brushless motor is always higher than that of the brake and the corresponding braking time is shorter.

Consequently, the function "emergency stop" must be realized as follows:



the emergency condition, because of safety regulation, must turn off the mains power to the drive; however, the auxiliary 24 V must be maintained, so that the drive is alive and can brake;

at the same time, the emergency condition must generate a 0 speed reference that brakes the motor at maximum torque, using the kinetic energy of the motor.

The drives regenerates energy from the motor to the DC bus until the motor speed is so low that the motor back EMF is less than approximately 10 V. At this speed, the DC Bus voltage falls, the drives locks in undervoltage and the motor is abandoned.

If the translation is vertical, and the motor is equipped with safety brake, only in this moment, the safety brake can be released. To time the release, the relay contacts in the drive can be used. The relay is switched by the DC Bus undervoltage, that corresponds to motor almost at standstill. When the emergency stop logic is realised as described, the machine encoders are kept alive and no index search or initialisation is required when normal operation is resumed.

### 9.3 Power fail with high energy load

Mains power failure with a high kinetic energy load requires special control provisions. In this case, the auxiliary 24 V supply may not be available for a time long enough to stop the load. Two solutions are possible:

To back up the 24 V supply with a small battery system. This is the highest quality solution; all encoders and sensors ride through the power failure and no reinitialization is required when the power supply is again available.


When the back-up solution is not possible, the auxiliary 24 V should be generated with a switching power supply fed from the drive DC Bus. The drive is equipped with a special power fail routine that, irrespective of reference, when the DC bus falls, regenerates energy from the motor to keep the DC bus just above the undervoltage level. In this way, the auxiliary power is made available to the system as long as there is kinetic energy in the load. A 0 speed reference or a braking ramp can be programmed as needed. Once more, a safety brake can be safely released only at the end of the braking cycle. The 24 V supply of the brake should be thus derived from the same switching power supply feeding the drive. The drive relay can be used to release the brake when all the kinetic energy has been dissipated.

### 9.4 Thermal protection delay






When a load carries a high kinetic energy, an untimely deenergization due to a protection tripping can be dangerous. For this reason, the thermal protection of drive and motor is delayed (approx. 2 s) from the onset and the setting of the appropriate terminal signal, so that the load can be braked safely before the drive trips.











## 10 Error codes

### 10.1 AxM drive's alarm list

The shorter the code, the higher the alarm importance. If more alarms are simultaneously activated the drive displays the more important one only; e.g. if the alarms activated are Nr 9 "Fan stop" and Nr 22 "Endat alarm" the first one only "Fan stop" is displayed. To have a full list of active alarms, use the monitor  function of the "Cockpit" configurator (see Software Manual).







In the table second column the error code is shown referred to the object 603Fh Device Control, according to the Can Open DSP-402 specifications..

Code	Alarm type	Emergency Code (DSP-402)	Description	Suggested action
1	DSP communication error	0x6188	An internal error occurred in the regulation and control firmware.	Call the Phase Motion Control service.
				
2	Short circuit	0x2110	A short circuit occurred in the motor windings or into the drive power module.	Check the motor connections and possible short-circuits phase to phase and phase to ground into the motor.
				
3	Overcurrent	0x2280	The current reached a peak value higher than that supported by the drive.	Check the current loop gain settings, possible mechanical obstacle, and the correct motor size for the use.
				
4	DC-BUS overvoltage	0x3200	A too high voltage level has been detected on the D.C. Link.	Check presence and connection of braking resistor.
				
5	IGBT module overtemperature	0x4200	The power module reached an excessive temperature.	Too heavy work cycle.
				
6	IGBT brake desaturation	0x4300	Guasto nel circuito di frenatura.	Resistenza di frenatura valore troppo basso o in corto oppure guasto nell'IGBT di

				frenatura.
7	DSP synchronization error	0x7113	Si è verificato un errore interno nel firmware di regolazione e controllo.	Contattare l'assistenza Phase Motion Control.
				
8	Heat sink overtemperature	0x6180	Il dissipatore ha raggiunto una temperatura eccessiva.	Ciclo di lavorazione troppo pesante.
				
9	Fan locked	0x4140	Il drive segnala un cattivo funzionamento del sistema di raffreddamento	Verificare eventuali impedimenti/restrizioni del flusso d'aria di raffreddamento e dalla ventola.
				
10	Braking always on	0x7110	The braking circuit is always active.	The supply voltage is too high or the clamp level voltage is too low. Check the parameter *SYS_OV_CLM_LIM*IPA 18108.
				
11	Brake Overpower	0x0x7112	The power loss in the braking resistor is higher than allowed.	Connect an external resistor of higher power.
				
12	Braking resistor error	0x7111	Temporary warning preceding the "Brake Overpower" signal. It is to allow braking motor before drive disabling.	See "Brake Overpower"
				
13	Fast task overtime	0x6181	The fast task time is longer than its activation period (250us).	If a user application is active, try to optimize the Fast task performance time.
				
14	Invalid system parameters	0x6320	During a user program saving or a drive turn off, the drive's parameters have not been correctly saved.	Try to repeat the saving and reset the drive. If the problem appears again contact the Phase Motion Control service.
				
15	Flash device error	0x5520	The flash sector where the parameters are saved is damaged.	If the problem appears again contact the Phase Motion Control service.
				
16	Fpga programming error	0x6128	An error occurred during the drive's onboard Fpga programming.	If the problem appears again contact the Phase Motion Control service.

0 1 2 3 4 5 6 7				
17	Dsp programming error	0x6183	An error occurred during the downloading of the drive's power module firmware code.	If the problem appears again contact the Phase Motion Control service.
0 1 2 3 4 5 6 7				
18	Lock Drive	0x7600	The drive is locked after a parameters saving.	Reset the drive from the configurator, or use the "reset" button.
0 1 2 3 4 5 6 7				
19	Encoder counting error	0x8500	The drive found an uncorrect index position.	Check the encoder wiring and the shields connection.
0 1 2 3 4 5 6 7				
20	Application not loaded	0x6200	The drive has been started up in application mode without loading any executable application.	Load a valid application into the drive.
0 1 2 3 4 5 6 7				
21	Motor overtemperature or PTC disconnected	0x4310	The PTC sensor has detected a too high temperature of the motor.	Check the motor PTC connection to drive terminals and the real temperature of the motor.
0 1 2 3 4 5 6 7				
22	Endat alarm	0x6186	Error in endat communication or device in alarm condition.	Check connections between endat and AxM drive.
0 1 2 3 4 5 6 7				
23	Error in encoder analog levels	0x6189	In the encoder analog channels, a ripple occurred higher than the maximum limit set by parameter 18234 SYS_AD_RIPPLE_LIM.	Check the encoder and shields connection.
0 1 2 3 4 5 6 7				
24	Auxiliary encoder counting error	0x8500	The drive found an uncorrect index position of auxiliary encoder.	Check the configuration of the SYS_ENC2_CY_REV par. and verify the encoder wiring and the shields connection.
0 1 2 3 4 5 6 7				
25	Electric shaft position error	0x8600	The difference between the position read by the driver and the position of the master shaft has exceeded the maximum value allowed.	Check the Auxiliary Encoder configuration and verify that the shaft controlled by the drive is free to follow the master shaft.
0 1 2 3 4 5 6 7				
26	Reserved	0x1000		



				
27	Medium task overtime	0x6184	The 2ms task time is longer than its activation period.	If a user application is active, try to optimize the Medium task performance time.
				
28	Slow task overtime	0x6185	The Slow task time is longer of its activation time (8ms).	If a user application is active, try to optimize the Medium task performance time.
				
29	Reserved	0x1000		
				
30	Fieldbus devices alarm	0x8100	Incorrect CanOpen network configuration or protocol mistake.	Refer to specific alarm code (Software Manual) for detailed informations. Check the configuration parameters.
				
31	Endat initialization error	0x6187	Error in the initial phase of endat configuration.	Check the encoder and shields connection.
				

## 11 CE conformity



*Declaration of conformity – Manufacturer's  
declaration Installation instructions*

EC1.8.1.96

Wiring recommendations and CE-typical system for conformity to EMCD and LVD  
EC Declaration of Conformity for the purposes of EMCD e LVD

### 11.1 Introduction: EC directives

The EC Directives are manufacturing prescriptions intended to guarantee a standard level of quality, reliability and safety for all industrial goods produced and marketed across the European Union. The EC Directives are general documents that establish base specifications for the certifications, which are subsequently converted into national laws by all member states. A certification issued by a member state is valid automatically in all other member states.

Technical details are not included in the directives. They are determined by the relevant European harmonized standards (EN).

After verification, affixing a CE mark certifies the conformity to the CE directives. Within the EU there are no commercial barriers for a product with the CE mark. A conformity certificate, however, is generally not required for most directives. Consequently, it is not always evident which of the (so far) 21 EC directives is considered in the CE mark of a product and which standards are considered in the conformity verification.

In the field of Brushless motor drives, the CE mark is referred exclusively to the Low Voltage Directive. As for the EMCD directive, a drive is only a component and not a system, and the conformity of the system to the EMCD remains the sole responsibility of the system designer or user. In order to assist their Customers, Phase Motion Control have already proved and certified the conformity of a CE-typical system to the EMC directive (see following chapter) with the AXV digital platforms and the ULTRACT II brushless motors.

## 11.2 LVD Directive

The LVD directive deals with all electrical machines operating in usual environments between 50 and 1000 V AC, and between 75 and 1500 V DC. This directive does not apply to applications in particular atmospheres and/or anti-explosion machines; also it does not refer to lifting equipment.

The directive's general purpose is to guarantee a uniform electrical safety level from the point of view of user's risk and of possible damage to objects; the directive dictates the product to be supported from the point of view of safety and of application prescriptions.

## 11.3 Product safety

1. Transport, installation and use of the drives is reserved to qualified staff (IEC 364)
2. The opening of the drive's enclosure or motors protections, or a defective installation, can lead to personal or material damage
3. Drives and motors can have hot, rotating and live internal parts; this can be the case even with power supply turned off.

## 11.4 Application as directed – Scope of application

1. AXV, AX4 drives are intended for variable speed motion control application, inside the entire machine control cabinets.
2. When integrating the drives into machines, they may only be commissioned (i.e. operation as directed) if the correspondence to the EC EMC directive 89/336/EWG is proved, EN 60204 must be observed
3. The technical data on the units nameplates must be observed
4. The drives correspond to the LVD 73/23/EWG

## 11.5 Installation

1. The units must be installed and cooled according to the regulations stated in the corresponding documentation
2. Ensure that no components are bent or insulation distances changed during transport. The electronic components and contacts must not be touched.
3. When working on an energized controller the valid national requirements for the prevention of accidents must be observed.



4. The electrical installation must comply with applicable regulations (cable cross sections, fuses, protective conductor connections)
5. All control inputs and outputs of the drives are insulated with a “basic” insulation (functional). Another level of protection must be implemented for personal safety against electrical contact..
6. When using current-operated protective devices, please note that:  
The controller have internal DC rectification. A DC fault current is therefore possible. Some differential current protection systems are made inoperative by DC current leakage. Use only “universal” or pulse operated protection devices.  
The RFI filter which is built into the drives cause a certain amount of leakage current to flow in the ground wires. This current may cause tripping of too sensitive differential device and need to be taken into account while sizing differential devices.
7. Irrespective of the CE mark on both drives and motors, it is reminded that the compliance of the required limit values with the legal EMC regulations remain the responsibility of the manufacturer of the system or machine.

## 11.6 EC Declaration of Conformity and Directive EMCD

Ref. to EC Low Voltage Directive 72/23/EWG

ULTRACT and MINACT series motors and AxV / AxM series brushless amplifier are designed, manufactured and tested in conformity with the EC Low Voltage Directive 72/23/EWG and under the responsibility of

*Phase Motion Control s.r.l., Lungobisagno Istria 27r, 16141 Genova*

The applied standards are the following:

IEC 34-1, 34-5,34-6, 34-11, 34-14 e IEC 72;  
EN 60529  
IEC 249/1 10/86,  
IEC 249/2 15/12/89  
IEC 326/1 10/90,  
EN 60097/9.93

### *The EMCD Directive (89/336EWG)*

The EMCD directive relating to electromagnetic compatibility is effective for "equipment" which may either cause electromagnetic disturbances or be affected by such disturbances. The aim is the limitation of the generation of electromagnetic disturbances so that the operation of radio and telecommunication systems and other equipment is possible and that a suitable immunity of the equipment against electromagnetic disturbances is ensured so that the operation can be achieved.

Controllers cannot be driven in stand-alone operation and therefore the controllers themselves cannot correspond to the EMC directive. The controllers must be integrated into a drive system to check the compliance with the EC directive relating to EMC of the "Regulation about the electromagnetic compatibility of devices".

Phase Motion Control has verified the conformity of controllers integrated into a "typical" drive system (see below). The user can use this example as a reference to design a system in according to EMCD.

#### **11.7 Installation as specified**

1. The RFI filter needs a ground connection. The typical application is not operable without ground connection.
2. The drives are not domestic appliances and are not intended for domestic use.
3. For installations different from the typical application (e.g.: use of unscreened cables, use of multiple drives, etc.) the conformity to the CE-EMC directive requires a check of the machine or system regarding EMC limit values.
4. The user of the machine is responsible for the compliance with the EMC directive.
5. Screen all power cables from filters to drive and from drive to motor with a shield coverage greater than 85%
6. Signal cables must always be shielded as above.
7. In order to reduce the interference caused by the motor cable and the induced noise in the encoder connection cable, such wiring must be shorter than 15 meters. This limitation is necessary also for the protection of the drive itself. For longer cables, use appropriate snubber inductors.
8. For shield and ground connections, refer to fig. 1.
9. It is important that the power wires are inserted in wire ways different from the signal and supply one and that any cross between the power and signal cables is carried out at right angle.
10. A ground cable between the motor and the drive is always necessary with a layout similar to that of the power cables.

11. If sensitive instruments are used (for example analogue, non preamplified transducers, load cells, thermocouples etc.) keep a safe distance between the instrumentation ground and the power ground.
12. The RFI filter which is built into the drives, as well as the high chopper frequency, cause a certain amount of leakage current to flow in the ground wires. This current may cause tripping of sensitive differential device and need to be taken into account while sizing differential protection devices. For the same reason, high frequency noise is normally conducted through the ground wire; all sensitive devices or cables should be wired at a distance from the ground wire and cross the same wire at a right angle.
13. All devices (drives, filters, motors) must be grounded on a single ground bar, with ground wires as straight and short as possible.

NOTE: As specified in the EMC IEC-22G-21/CDV norm, AXV drives are not domestic appliances and can cause interference to radio and tv reception.

### 11.8 EC Declaration of conformity

Ref. to EC Directive Electromagnetic Compatibility (89/336/EWG)

NOTE: ULTRACT and MINACT series motors and AXV brushless drives series are not stand-alone systems, and are specified to application fields 2 and 3 in accordance with IEC-22G-21/CDV. The conformity with EMC directive cannot be verified on such components.

To assist its own customers, Phase Motion Control declares that AXV drives running Ultract or Minact motors assembled in accordance with the instructions above and completed with the filter SHAFFNER FN251/16/07 or something equivalent, with up to 100 meters of shielded-conductor cable between the drive and the motor, following the cabling normative explained in the user manual, allows the active system (PDS) to satisfy the requirements of the IEC-EN 55011 norm Class A and EN 50022 Class B.

As Components the AXV drives comply with the IEC 1000-4-2 (IEC 801-2) and IEC 1000-4-4 (IEC 801-4), without any accessory or protection.