PHASE
MOTION CONTROL

AxM II

CONFIGURABLE MOTION CONTROL PLATFORM

User Manual

Conformities

Declaration of Conformity
For PMC components there are declarations of conformity available. These declarations confirm that the components are designed according to valid EC directives. If required, you can ask your sales representative for these declarations.

Low-Voltage Directive
The PMC products of a drive system mentioned in this documentation comply with the requirements of the EC Directive (see page 67).

EMC Directive
The PMC products of a drive system mentioned in this documentation comply with the requirements of the EC Directive (see page 67).

CE Label

Safety Instruction

Please read before the initial startup. See page 73.

PHASE
MOTION CONTROL

AxM II

CONFIGURABLE MOTION CONTROL PLATFORM

User Manual 

Supported Models

(Rev. 1 - Nov. 2011)

Size 1	Size 2	Size 3	Size 4	Size 5
AxP 02.05.2	AxM II 20.40.4	AxM II 70.140.4	AxM II 90.150.4	AxM II 160.320.4
AxP 04.09.2	AxM II 35.70.4		AxM II 110.180.4	AxM II 200.400.4
AxP 06.14.2				
AxM II 04.09.4				
AxM II 06.14.4				
AxM II 09.20.4				

SUMMARY

MARY

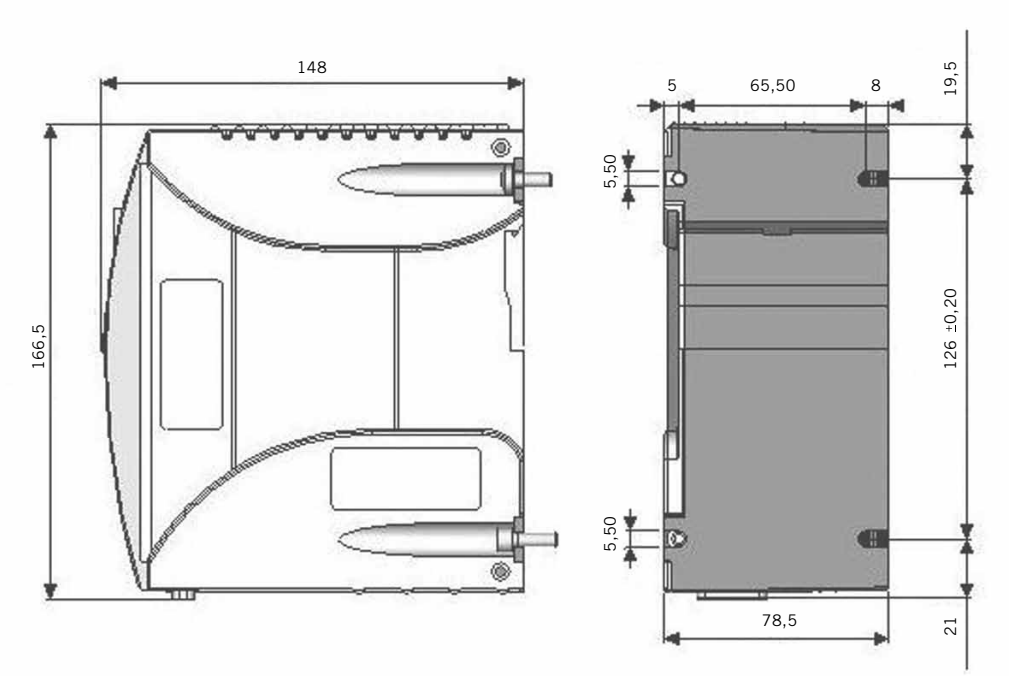
1

OVERALL **DIMENSION** AND TECHNICAL **SPECIFICATIONS**

Phase Motion Control
AxM II / AxP Configurable Motion Control Platform

1.1 AxM II - **SIZE 1**

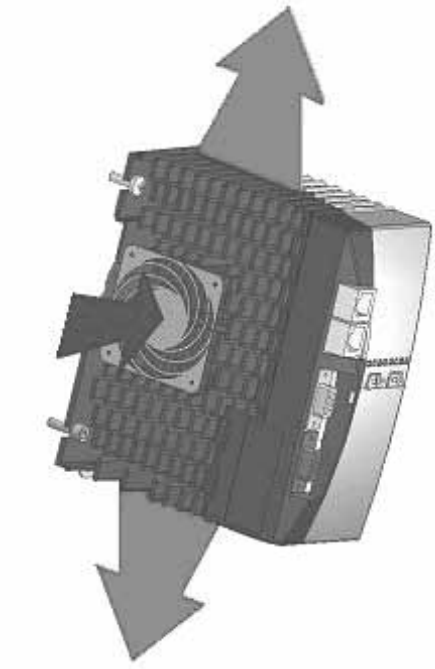
Overall dimensions and space required for installation



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.

The inner temperature of the switchboard must doesn't exceed 40°C.

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.

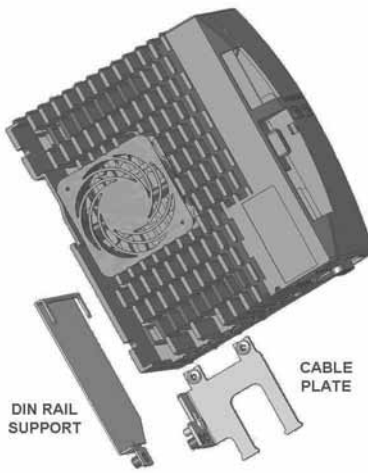
The fan is automatically switched on when the heat sink temperature reaches 50° C.

Mounting options

Two mounting options are available:

A) Cable fastening PM.03822.0
B) DIN rails support (otional) PM.03821.0

The option B include both the ***DIN rail support*** and the ***cable plate*** necessary to hold back the rail support. 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. (For more details please contact: sales@phase.eu)



Technical Specifications

Phisical specifications	Value	Unit
Average braking power with internal resistor	10	W
Maximum braking energy applied at once	1700	J
Thermal capacity	720	J/C
Cooling	Forced ventilation	- -
Dimensions (LxPxH)	78.5 x 148 x 167	mm
Mass	1.32	Kg
Ingress Protection	IP20	- -
Vibrations	0.5 g all directions, 0-10 Hz	- -
Shock	1	g
Operative temperature	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	- -

Technical specifications	AxP 02.05.2	AxP 04.09.2	AxP 06.14.2	AxM II 04.09.4	AxM II 06.14.4	AxM II 09.20.4	Units
Voltage supply	0 - 240 ± 10%			0 - 460 Vac ± 10%			Vac 3 phase
Auxiliary feeeding voltage	22 - 30			22 – 30			Vdc
Input current	8,6			9	14	20	Arms
Frequency	40 - 65						Hz
Nominal power	0,58	1,16	1,74	2,3	3,3	4,3	KW
Current output, axis < 100 rpm, S1	2	4	6	4,5 (6*)	6 (8,5*)	9 (10*)	Arms
Current output, max speed, S1	1.27	2.5	3.9	3,5 (4*)	4,5 (5*)	6,5 (7*)	Arms
Peak current	5	9	14	9	14	20	Arms
Power loss with nominal current	60	75	85	85	95	110	W
Maximum voltage output	Vin x 0.95						Vac
PWM	8						KHz
Current ripple frequency	16						KHz
Efficiency at nominal power 3)	97	97	98	96	96,5	97,5	%
Input form factor	0,9						Vac 3 phase
Maximum braking current	100% of peak current						- -

* If supplied with 230 Vac.
1) Peak value, 2) Input bridge losses included, 3) Vin = 380 Vac, Tamb = 40C, Comm. Freq. 8kHz, Vout = Vin 0.95

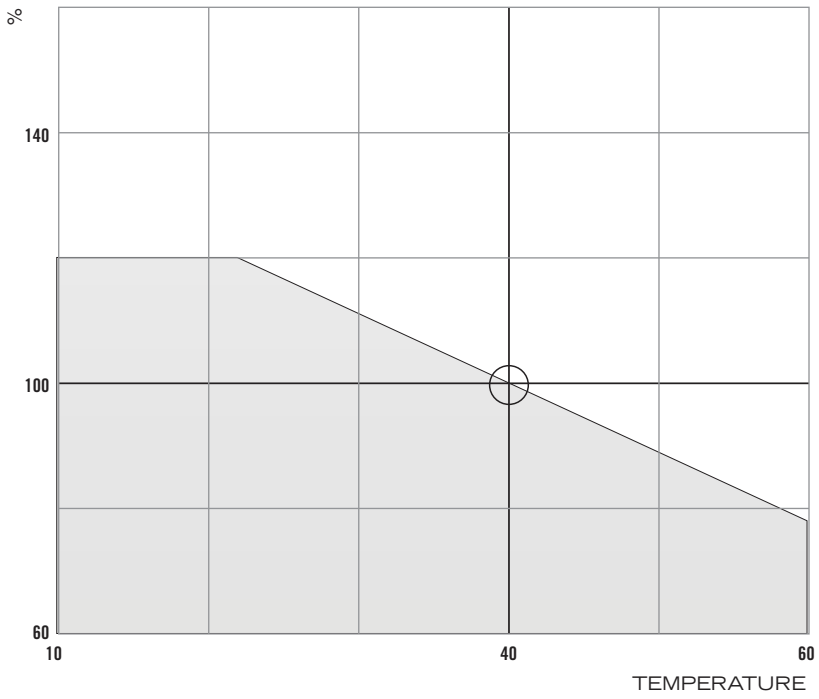
Motor Feedback options (2 indipendent high speed inputs,main and secondary)	**Main Encoder (500kHz)**	Sincos encoder 5 channels (2 absolute analog tracks/2 incremental analog tracks/index)
		Incremental encoder (sinusoidal/digital)
		Sensorelss algorithm (w/o feedback)
		Endat serial encoder (default)
		Resolver
	Secondary Encoder (500kHz)	Incremental digital encoder without commutation tracks (500kHz)
		Endat serial encoder

Input signals	**2 Differential analog inputs (programmable)**	± 10V (12 bits) / Rin = 10kΩ
		Programmable
	8 digital inputs (programmable)	20-30V / Rin = 6.6kΩ to GND
		Programmable

Output signals	**2 analog outputs (programmable)**	± 10V (12 bits) FS (5mA)
	4 digital outputs (programmable)	PNP open collector 24V (100mA)
		Programmable
	1 watch dog relay	1A/250Vac NO/NC contacts

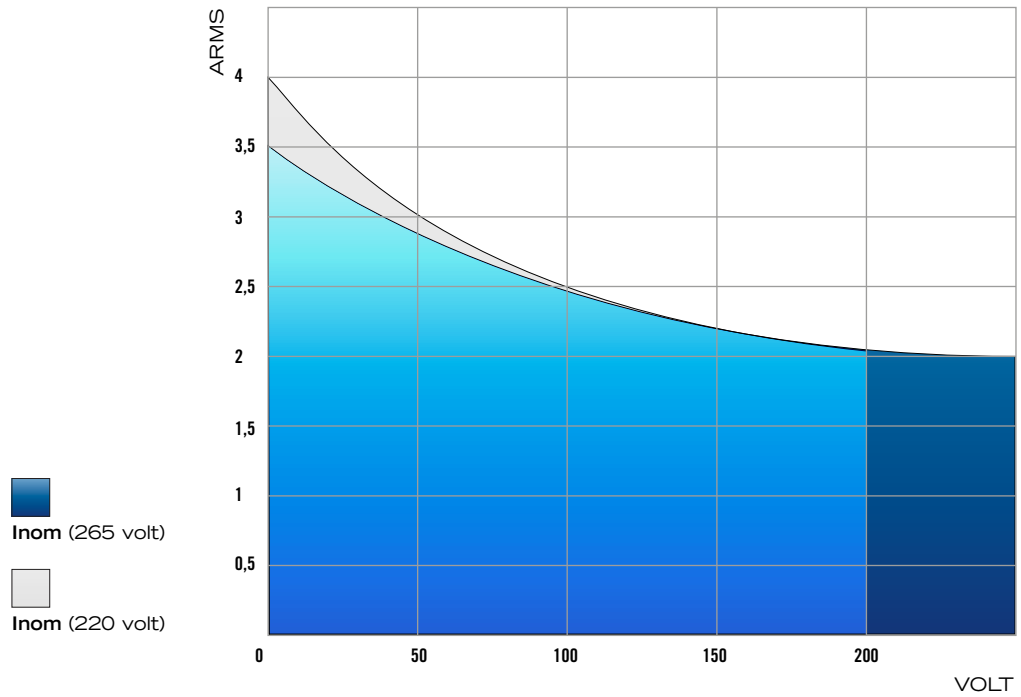
Hardware configuration	Processor speed: 80 MIPS µC + FPGA Task frequency: - current /drive monitoring: 1 MHz - position/speed loop: 8 kHz - PLC fast task: 8 kHz - PLC slow task: 15.625 Hz to 1 kHz user-programmable Position/target position register: 32 or 64 bits Full digital control Id/Iq, updated 16 kHz

Output Current Derating vs. Room Temperature



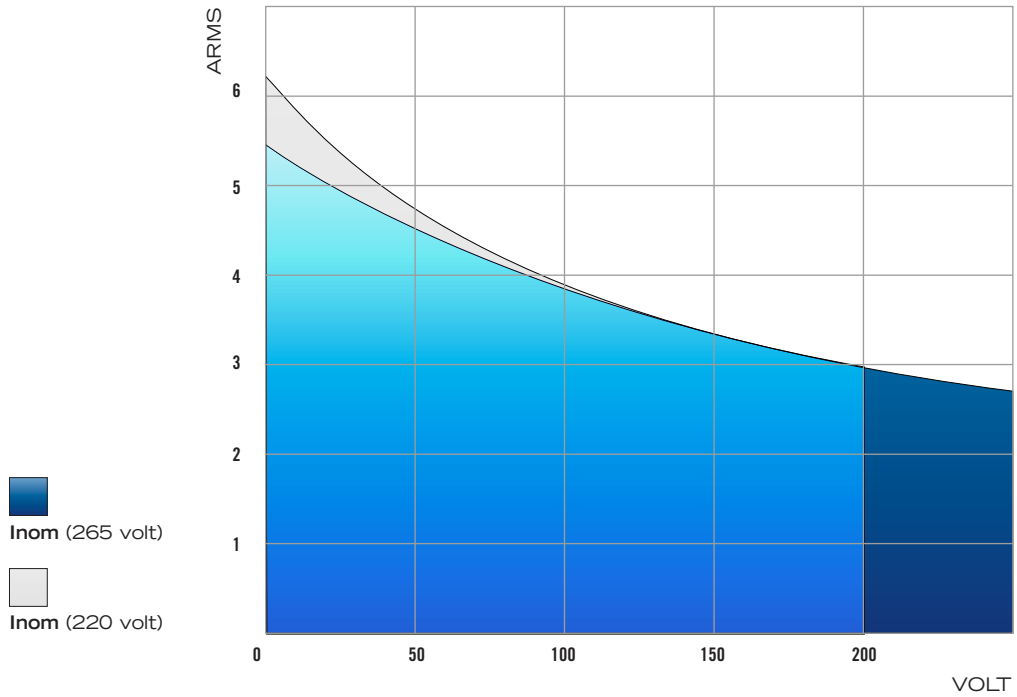
% output current variation versus room temperature

Operating Area AxP 02.05.2



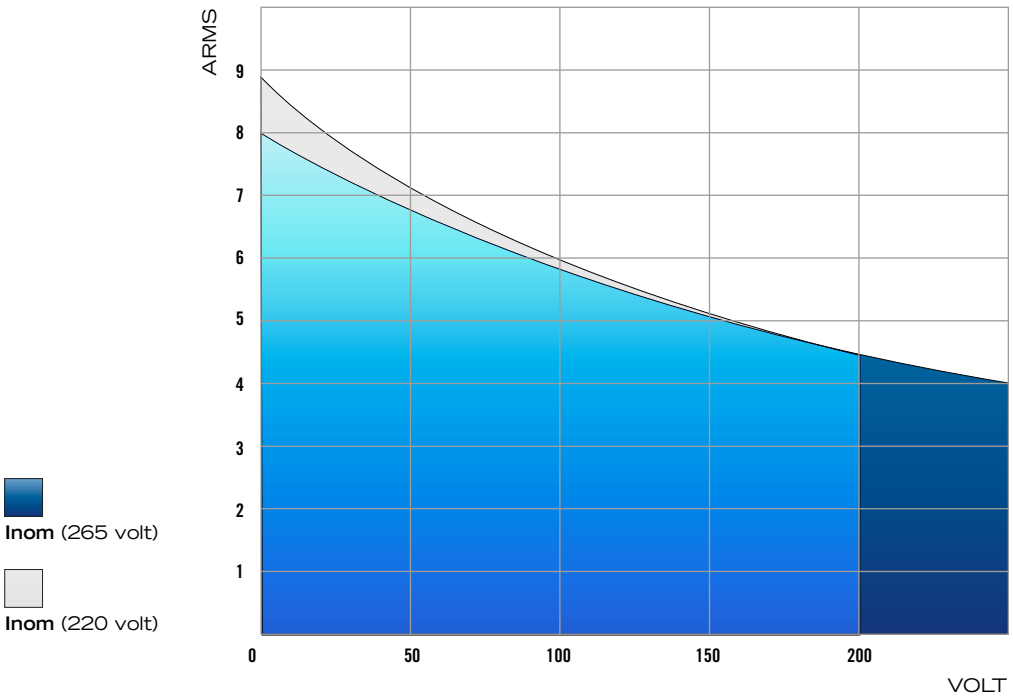
Operating area of AxP 02.05.2 drive as function of output voltage, in case of 220V or 265V power voltage supply.

Operating Area AxP 04.09.2



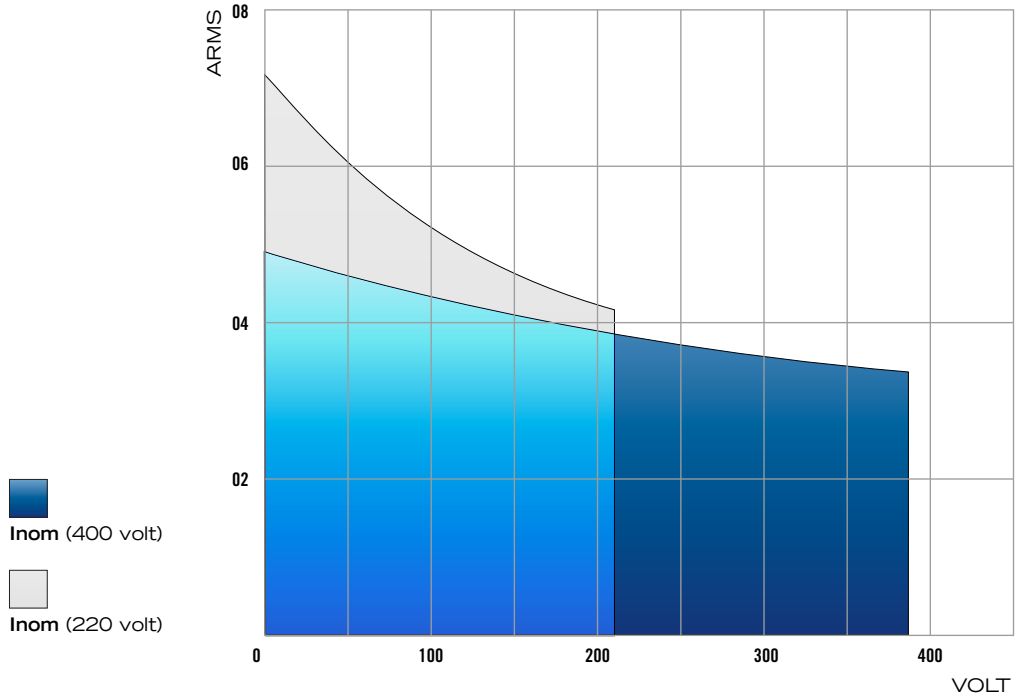
Operating area of AxP 04.09.2 drive as function of output voltage, in case of 220V or 265V power voltage supply.

Operating Area AxP 06.14.2



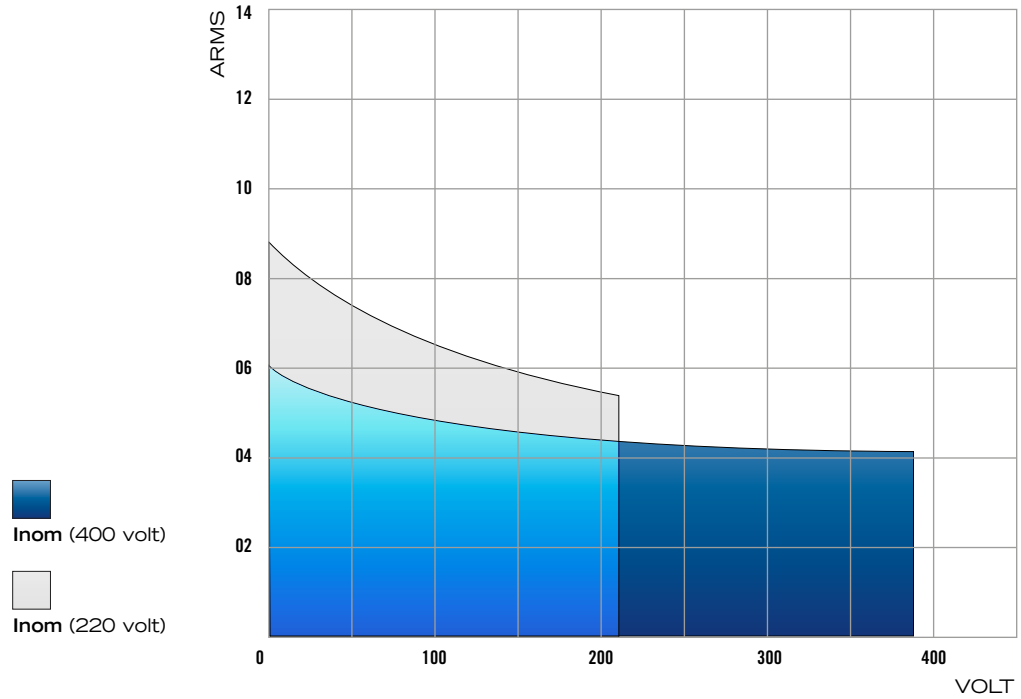
Operating area of AxP 06.14.2 drive as function of output voltage, in case of 220V or 265V power voltage supply.

Operating Area AxM II 04.09.4



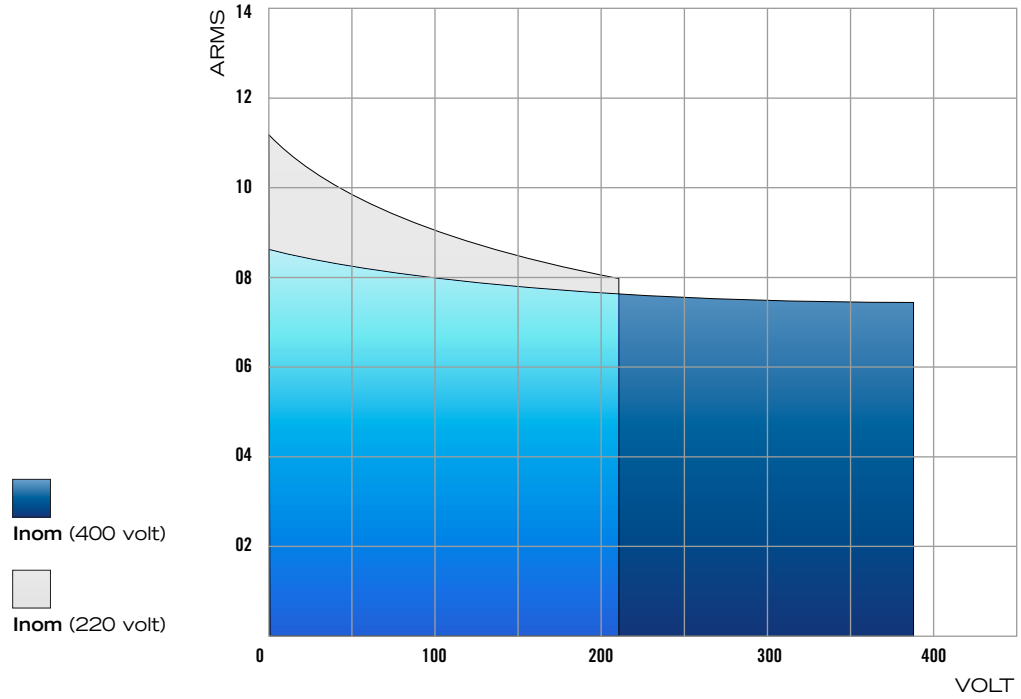
Operating area of AxM II 04.09.4 drive as function of output voltage, in case of 220V or 380V power voltage supply.

Operating Area AxM II 06.14.4



Operating area of AxM II 06.14.4 drive as function of output voltage, in case of 220V or 380V power voltage supply.

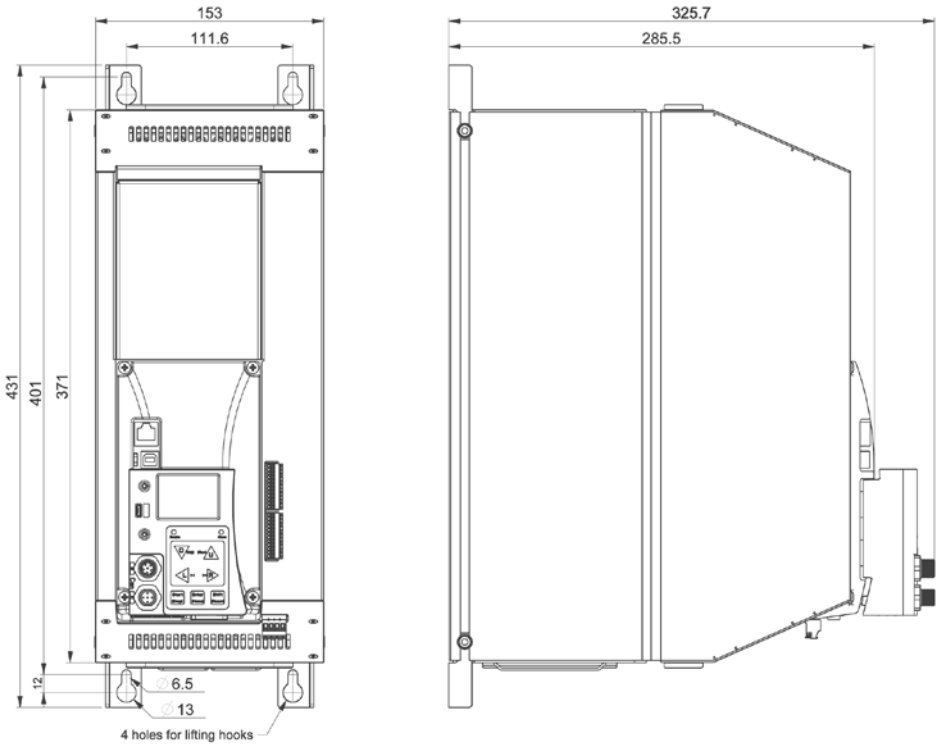
Operating Area AxM II 09.20.4



Operating area of AxM II 09.20.4 drive as function of output voltage, in case of 220V or 380V power voltage supply.

1.2 AxM II - **SIZE 2**

Overall dimensions and space required for installation



Technical Specifications

Technical specifications [1]	AxM II 20.40.4	AxM II 35.70.4	Units
Voltage supply	0 - 460 ± 10%		Vac 3 phase
Auxiliary feeeding voltage	22 - 30 / 2A		Vdc
Input current	40	70	Arms
Frequency	0 - 400		Hz
Nominal power	12	20	KW
Current output, axis < 100 rpm, S1	20	35	Arms
Current output, max speed, S1	18	31	Arms
Peak current [2]	40	70	Arms
Power Losses total [3]	330	580	W
Maximum voltage output	Vin x 0,95		Vac
PWM	8 / 16		KHz
Efficiency at nominal power 3)	97,8	97,8	%
Input form factor	0,9		Vac 3 phase
Maximum braking current	100% of peak current		- -
Cooling	1 fan 92x92x38 / flow rate: 280		m^3/hour
Dimensions (WxHxD)	285,5 x 371 x 153		mm

(1) Test performed with full option control card and firmware 1.4.291 - (2) Peak rms current - (3) Including input rectifier losses

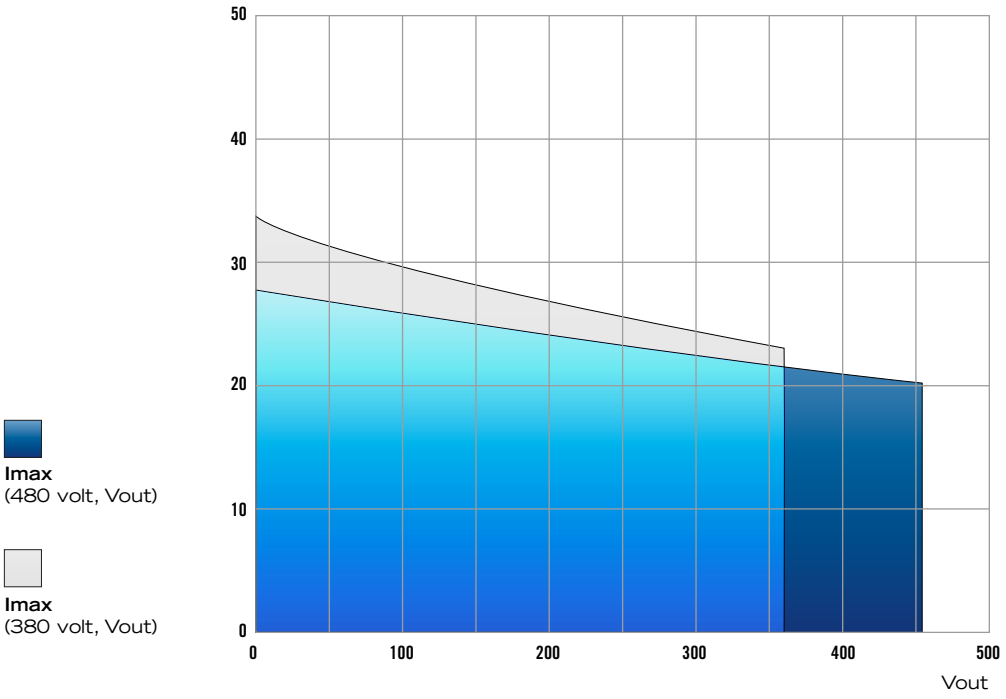
Motor Feedback options (2 indipendent high speed inputs,main and secondary)	**Main Encoder (500kHz)**	Sincos encoder 5 channels (2 absolute analog tracks/2 incremental analog tracks/index)
		Incremental encoder (sinusoidal/digital)
		Sensorelss algorithm (w/o feedback)
		Endat serial encoder (default)
		Resolver
	Secondary Encoder (500kHz)	Incremental digital encoder without commutation tracks (500kHz)
		Endat serial encoder

Input signals	**2 Differential analog inputs (programmable)**	± 10V (12 bits) / Rin = 10kΩ
		Programmable
	8 digital inputs (programmable)	20-30V / Rin = 6.6kΩ to GND
		Programmable

Output signals	**2 analog outputs (programmable)**	± 10V (12 bits) FS (5mA)
	4 digital outputs (programmable)	PNP open collector 24V (100mA)
		Programmable
	1 watch dog relay	1A/250Vac NO/NC contacts

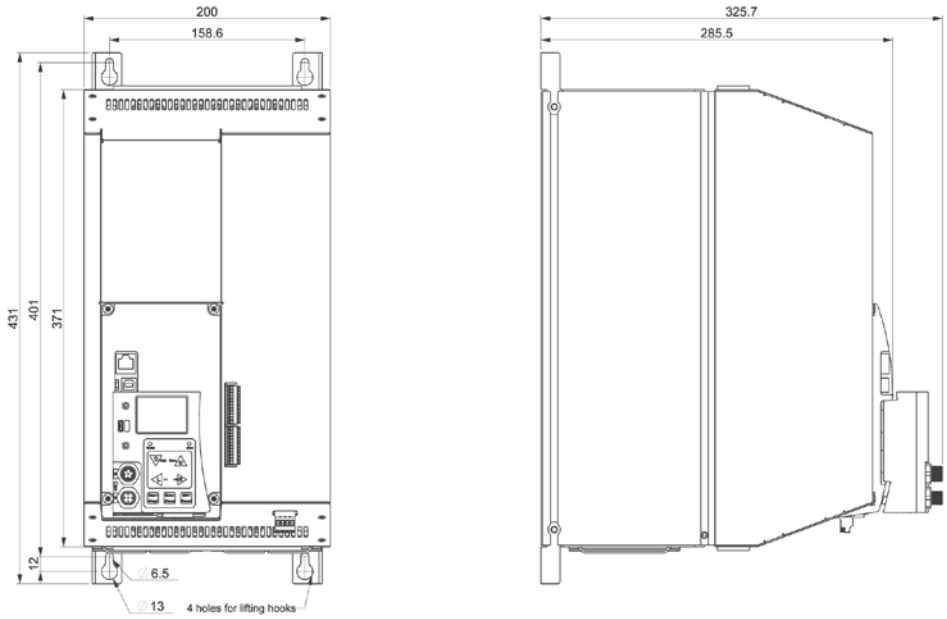
Hardware configuration	Processor speed: 80 MIPS µC + FPGA Task frequency: - current /drive monitoring: 1 MHz - position/speed loop: 8 kHz - PLC fast task: 8 kHz - PLC slow task: 15.625 Hz to 1 kHz user-programmable Position/target position register: 32 or 64 bits Full digital control Id/Iq, updated 16 kHz

Drive Operational Area (Iout vs Vout) AxM II 20.40.4 / AxM II 35.70.4



1.3 AxM II - **SIZE 3**

Overall dimensions and space required for installation



Technical Specifications

Technical specifications (1)	AxM II 70.140.4	Units
Voltage supply	0 - 460	Vac 3 phase
Auxiliary feeeding voltage	22 - 30 / 4A	Vdc
Input current	140	Arms
Frequency	0 - 400	Hz
Nominal power	39	KW
Current output, axis < 100 rpm, S1	70	Arms
Current output, max speed, S1	61	Arms
Peak current (2)	140	Arms
Power Losses total (3)	1240	W
Maximum voltage output	Vin x 0,95	Vac
PWM	8 / 16	KHz
Efficiency at nominal power	96,4	%
Input form factor	0,9	Vac 3 phase
Maximum braking current	100% of peak current	- -
Cooling	2 fan 92x92x38 / flow rate: 560	m^3/hour
Dimensions (WxHxD)	285,5 x 371 x 200	mm

(1) Test performed with full option control card and firmware 1.4.291 - (2) Peak rms current - (3) Including input rectifier losses

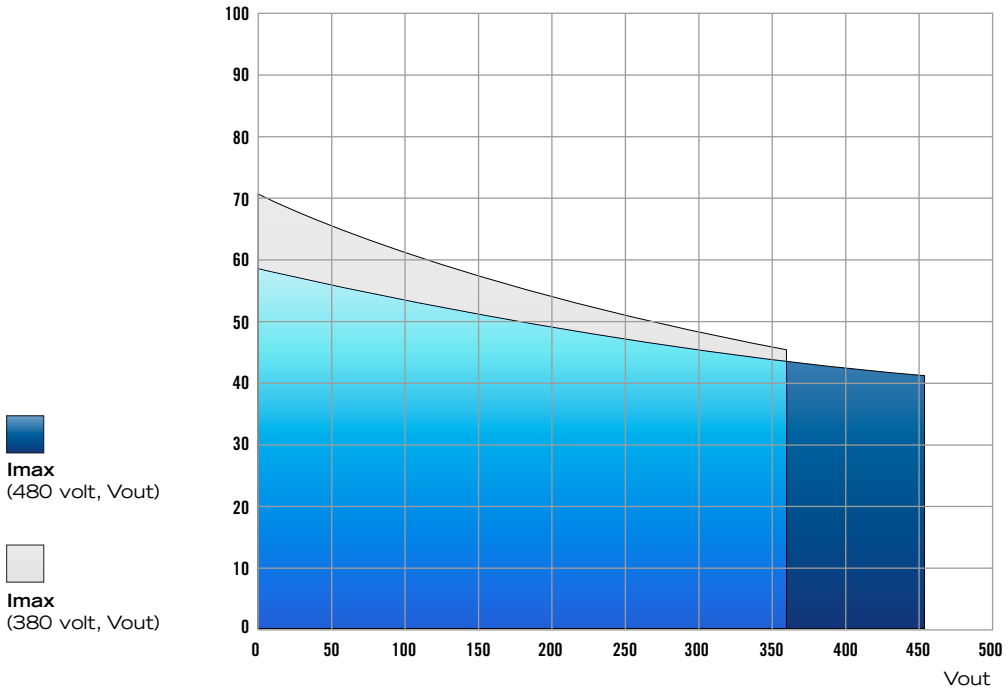
Motor Feedback options (2 indipendent high speed inputs,main and secondary)	**Main Encoder (500kHz)**	Sincos encoder 5 channels (2 absolute analog tracks/2 incremental analog tracks/index)
		Incremental encoder (sinusoidal/digital)
		Sensorelss algorithm (w/o feedback)
		Endat serial encoder (default)
		Resolver
	Secondary Encoder (500kHz)	Incremental digital encoder without commutation tracks (500kHz)
		Endat serial encoder

Input signals	**2 Differential analog inputs (programmable)**	± 10V (12 bits) / Rin = 10kΩ
		Programmable
	8 digital inputs (programmable)	20-30V / Rin = 6.6kΩ to GND
		Programmable

Output signals	**2 analog outputs (programmable)**	± 10V (12 bits) FS (5mA)
	4 digital outputs (programmable)	PNP open collector 24V (100mA)
		Programmable
	1 watch dog relay	1A/250Vac NO/NC contacts

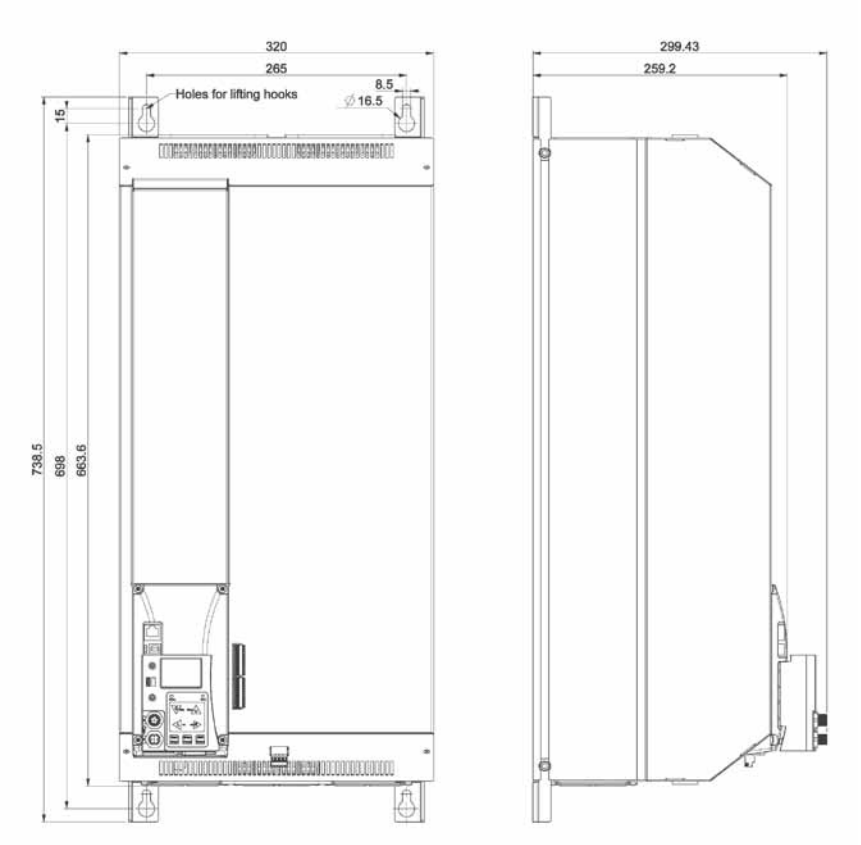
Hardware configuration	Processor speed: 80 MIPS µC + FPGA Task frequency: - current /drive monitoring: 1 MHz - position/speed loop: 8 kHz - PLC fast task: 8 kHz - PLC slow task: 15.625 Hz to 1 kHz user-programmable Position/target position register: 32 or 64 bits Full digital control Id/Iq, updated 16 kHz

Drive Operational Area (Iout vs Vout) AxM II 70.140.4



1.4 AxM II - **SIZE 4**

Overall dimensions and space required for installation



Technical Specifications

Technical specifications [1]	AxM II 90.150.4	AxM II 110.180.4	Units
Voltage supply	0 - 460 ± 10%		Vac 3 phase
Auxiliary feeding voltage	22 - 30 / 6A		Vdc
Input current	150	180	Arms
Frequency	0 - 400		Hz
Nominal power	45	55	KW
Current output, axis < 100 rpm, S1	90	110	Arms
Current output, max speed, S1	78	94	Arms
Peak current [2]	150	180	Arms
Power Losses total [3]	1750	2130	W
Maximum voltage output	Vin x 0,95		Vac
PWM	8 / 16		KHz
Efficiency at nominal power	97,4	97,4	%
Input form factor	0,9		Vac 3 phase
Maximum braking current	100% of peak current		- -
Cooling	3 fan 92x92x38 / flow rate: 840		m^3/hour
Dimensions (WxHxD)	259,2 x 698 x 320		mm

(1) Test performed with full option control card and firmware 1.4.291 - (2) Peak rms current - (3) Including input rectifier losses

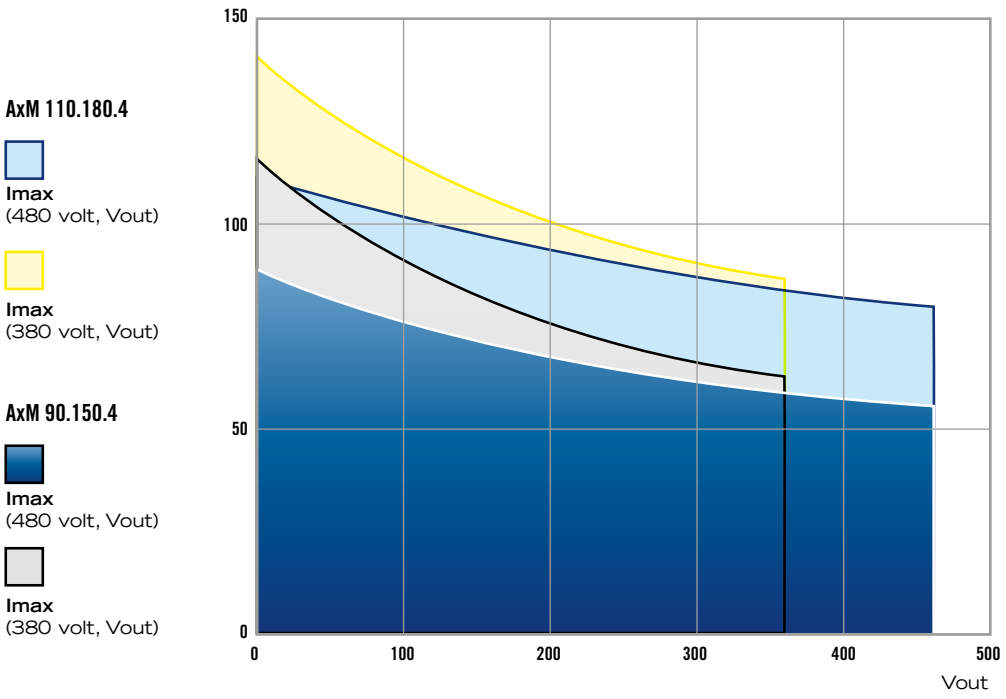
Motor Feedback options (2 indipendent high speed inputs,main and secondary)	**Main Encoder (500kHz)**	Sincos encoder 5 channels (2 absolute analog tracks/2 incremental analog tracks/index)
		Incremental encoder (sinusoidal/digital)
		Sensorelss algorithm (w/o feedback)
		Endat serial encoder (default)
		Resolver
	Secondary Encoder (500kHz)	Incremental digital encoder without commutation tracks (500kHz)
		Endat serial encoder

Input signals	**2 Differential analog inputs (programmable)**	± 10V (12 bits) / Rin = 10kΩ
		Programmable
	8 digital inputs (programmable)	20-30V / Rin = 6.6kΩ to GND
		Programmable

Output signals	**2 analog outputs (programmable)**	± 10V (12 bits) FS (5mA)
	4 digital outputs (programmable)	PNP open collector 24V (100mA)
		Programmable
	1 watch dog relay	1A/250Vac NO/NC contacts

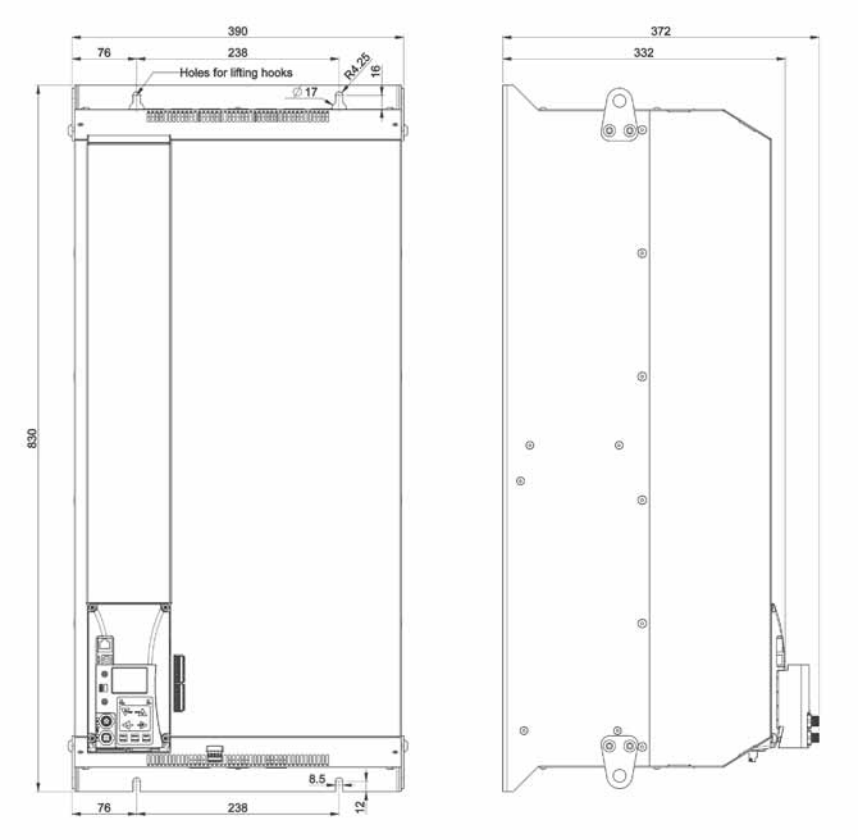
Hardware configuration	Processor speed: 80 MIPS µC + FPGA Task frequency: - current /drive monitoring: 1 MHz - position/speed loop: 8 kHz - PLC fast task: 8 kHz - PLC slow task: 15.625 Hz to 1 kHz user-programmable Position/target position register: 32 or 64 bits Full digital control Id/Iq, updated 16 kHz

Drive Operational Area (Iout vs Vout) AxM II 90.150.4 / AxM II 110.180.4



1.5 AxM II - **SIZE 5**

Overall dimensions and space required for installation



Technical Specifications

Technical specifications [1]	AxM II 160.320.4	AxM II 200.400.4	Units
Voltage supply	0 - 460 ± 10%		Vac 3 phase
Auxiliary feeding voltage	22-30/10A		Vdc
Input current	320	400	Arms
Frequency	0 - 400		Hz
Nominal power	90	110	KW
Current output, axis < 100 rpm, S1	160	200	Arms
Current output, max speed, S1	142	177	Arms
Peak current [2]	320	400	Arms
Power Losses total [3]	3100	3872	W
Maximum voltage output	Vin x 0,95		Vac
PWM	8 / 16		KHz
Efficiency at nominal power	98	98	%
Input form factor	0,9		Vac 3 phase
Maximum braking current	100% of peak current		- -
Cooling	3 fans 119x119x42 / flow rate: 1200		m^3/hour
Dimensions (WxHxD)	332 x 830 x 390		mm

(1) Test performed with full option control card and firmware 1.4.291 - (2) Peak rms current - (3) Including input rectifier losses

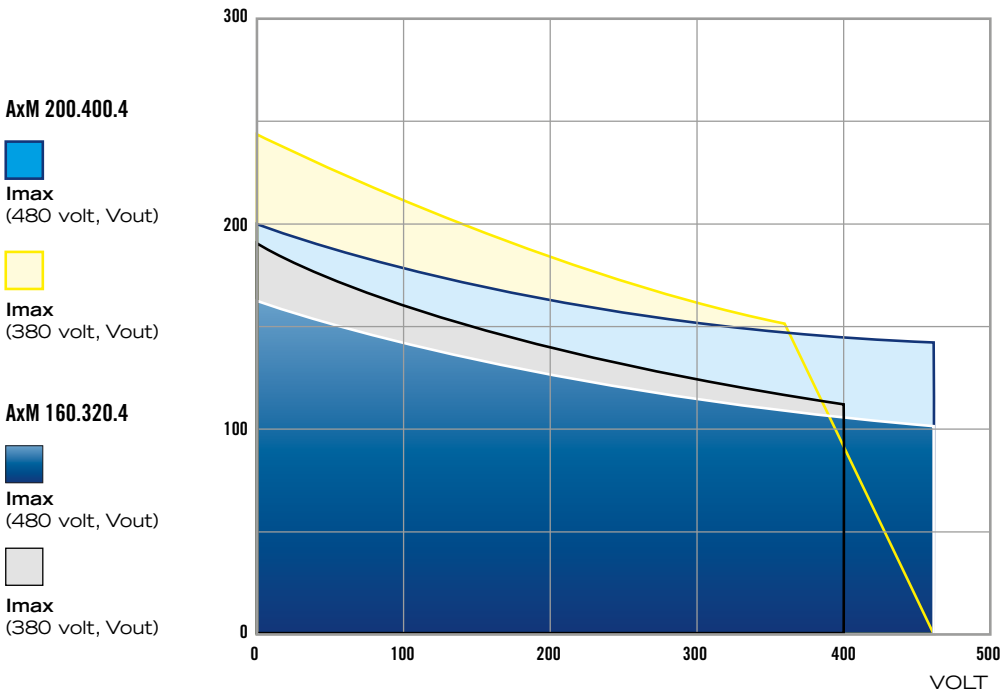
Motor Feedback options (2 indipendent high speed inputs,main and secondary)	**Main Encoder (500kHz)**	Sincos encoder 5 channels (2 absolute analog tracks/2 incremental analog tracks/index)
		Incremental encoder (sinusoidal/digital)
		Sensorelss algorithm (w/o feedback)
		Endat serial encoder (default)
		Resolver
	Secondary Encoder (500kHz)	Incremental digital encoder without commutation tracks (500kHz)
		Endat serial encoder

Input signals	**2 Differential analog inputs (programmable)**	± 10V (12 bits) / Rin = 10kΩ
		Programmable
	8 digital inputs (programmable)	20-30V / Rin = 6.6kΩ to GND
		Programmable

Output signals	**2 analog outputs (programmable)**	± 10V (12 bits) FS (5mA)
	4 digital outputs (programmable)	PNP open collector 24V (100mA)
		Programmable
	1 watch dog relay	1A/250Vac NO/NC contacts

Hardware configuration	Processor speed: 80 MIPS µC + FPGA Task frequency: - current /drive monitoring: 1 MHz - position/speed loop: 8 kHz - PLC fast task: 8 kHz - PLC slow task: 15.625 Hz to 1 kHz user-programmable Position/target position register: 32 or 64 bits Full digital control Id/Iq, updated 16 kHz

Drive Operational Area (Iout vs Vout) AxM II 160.320.4 / AxM II 200.400.4



2

CONTENT OF THE PACKAGE

Phase Motion Control
AxM-II / AxP Configurable Motion Control Platform

2.1 THE **STANDARD PACKAGE** CONTAINS

The AxM-II / AxP Digital Programmable Drive including:
Proprietary Phase Motion Control system firmware with pre-installed standard application for torque and speed motor control and pre-configured parameters table with default settings.

Connectors' Set:

User Connectors (U1 and U2) with identifiers and polarity keys,
Power connectors (P1),
Relay connector (R1),
Encoder connector (E1),

User's Manual:

The manual containing AxM-II / AxP installation and use instructions.
Read it up to the end.

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

Phase configuration tools
Standard application sets
User's, Software 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-II / AxP 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 powerfull diagnostic tool: interfaced with the real time drive recording function, it allows, by ***Control Panel*** and ***Oscilloscope***, the drive troubleshoouting without any phisical operation on the drive's terminals.
The software loaded on AxM-II / AxP 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, fields bus managent, protections and diagnostics.

Further peculiar features of the firmware are:
» Full digital control of the direct and quadratic current, updated at 16 kHz frequency.
» Digital speed ring with zero real speed, PII²D controller[1] with generalized feedforward.

PII²D controller 4 compensation terms are available: proportional (speed), differential (acceleration), integral (position) and integral of position (to obtain a zero position error).

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 allways assured.

Application:

The Application includes the motion program and the logics runs. Logic LAB is the applications' developement 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 8kHz cycle frequency; the other ***slow*** with user-programmable cycle frequency ranging from 15.625Hz to 1kHz for all general auxiliary use. The Logic LAB language is so powerfull that very fast functions as positioners, electronic, path control, are easily executable by the end user. Which can therefore upgrade the AxM-II / AxP to be a control center of the whole driven system, using his proprietary software entirely protected against imitation and competition.

Standard Phase applications:

Together with AxM-II / AxP drives a set of Standard Applications are supplied with source code. In details following applications are supplied:

Basic

The ***"basic"*** application allows the user to control motor's current and speed like needed in the usual classic drive control, it turns AxM-II / AxP in a versatile brushless servomotors digital control.

Main features are:

» Choice between current or speed control;
» Drive enable and control selection trough digital inputs (DI 0: Enable, DI 6: control selection, optional).
» Standard analog differential (+/-10V) interface use;
» Internal ramp generator.

Speed-V

It is an extended form of the ***basic*** application, moreover implementing:

» Store capacity **till 4 complete sets of parameters** (tasks); enabling the user to shift from one set of parameters to another in running time by digital inputs;
» Electric shaft;
» Encoder simulation

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 configurated: Position unit is chosen by the final user.
» Choice between absolute and incremental offset.
» Speed, acceleration and deceleration to be used during motion.

3

ELECTRIC INSTALLATION

Phase Motion Control

AxM II / AxP Configurable Motion Control Platform

3.1 CONNECTIONS GENERAL OUTLINE

Power connections:

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

Connect tri-phases power supply to the ***R***, ***S*** and ***T*** terminals of the power connector ***P1*** using a 3 + 1 shielded cable. Use one GND screw of the drive to connect the cable shield.
Connect single phase power supply to two pins of ***R***, ***S*** or ***T*** using a shielded cable as well.

Braking resistor connection:

AxP drives are designed for tri-phase or single-phase supply; voltage must be lower than 230V (+10 %).

The internal braking resistor is able to dissipate a maximum of 10W braking power. If the power dissipation is higher, it becomes necessary the use of an external resistor. To activate the internal brake resistor short-circuit the pins ***BR+*** and ***DC+*** of ***P1*** connector. Connect the external resistor on the ***BR-*** and ***DC+*** terminals of the same connector. Check also par. 7.4 and 7.5. The minimum and maximum ohmic values for such external resistor are:

Model	Min	Max
AxP 02.05.2	43	56
AxP 04.09.2	24	32
AxP 06.14.2	15	20
AxM II 04.09.4	58	75
AxM II 06.14.4	37	48
AxM II 09.20.4	26	34
AxM II 20.40.4	15	19
AxM II 35.70.4	8,8	11
AxM II 70.140.4	4,4	5,5
AxM II 90.150.4	3,5	4,5
AxM II 110.180.4	2,9	3,7
AxM II 160.320.4	1,6	2,1
AxM II 200.400.4	1,3	1,6

If an external braking resistor is used, the system configuration must be modified: you need to set at least the Brake resistor value and power. The firmware will use these values to activate the thermal protection of the resistor itself.

Motor Power connections:

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. 7.4.
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. 7.1.

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. 7.2.
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.

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.

3.2 **EMC** FILTER

AxM-II / AxP 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 filters are the FN 351-8-29 or FN 258-7-29 of the Shaffner list.

Connect such a filter between mains and drive inputs; if more drives are used in the same machine a bigger filter should be used.

4

HARDWARE DESCRIPTION

Phase Motion Control

AxM II / AxP Configurable Motion Control Platform

4.1 **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 0-240 Vac (AxP) or 198-460 Vac (AxM) supply;
» 8 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.

4.2 CONNECTIONS

High speed sensor interface (E1 and C1)

» two independent inputs, configurable
» a main general pourpose encoder input (E1) which can be programmed to receive the following signals:

ENDAT serial encoder (ENDAT 2.1 and 2.2 supported)
SINCOS 5 channel encoder (2 absolute analog tracks, 2 incremental analog tracks, index)
Resolver
Incremental Encoder

» A secondary encoder I/O (C1 - 2 MHz) wich can be programmed as incremental digital encoder without commutation tracks or Endat serial encoder.

The encoder simulation output can be used alternatevely with the auxiliary encoder input.

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

On the C1 connector there is also the Can interface. See the connection list on par. 7.3

User Interface (connectorsi 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. 5

Communications (connectors S1, C1, X1 e X2):

» serial asynchronous interface RS232 / RS422 / RS485
» CiA CANOpen DS301 / DSP402 V4.02 fieldbus interface
» EtherCAT (COE) real-time ethernet fieldbus

4.3 HARDWARE

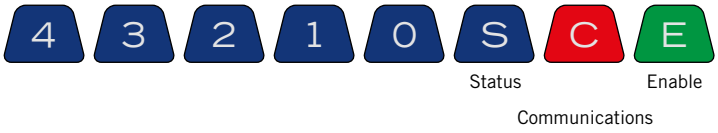
» IP 20 Cabinet protection, with internal RFI shield,
» Control and power interfaces with removable terminals and connectors,
» Encoder and serial interface with D standard connectors,
» Integrated ground bar (3xM4) for shields and groundings.

4.4 LED DISPLAY

Led meaning

During the drive's normal work, 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 Ok	E	1Hz flashing	Drive's normal run. **Disabled.**
		2 fast flashing every 500ms	Drive's normal run. **Enabled.**
Field Bus Communication	C	Variable frequency flashing	The drive is connected to a field bus line. Flashing every data received.



Normal work conditions

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

Alarm conditions

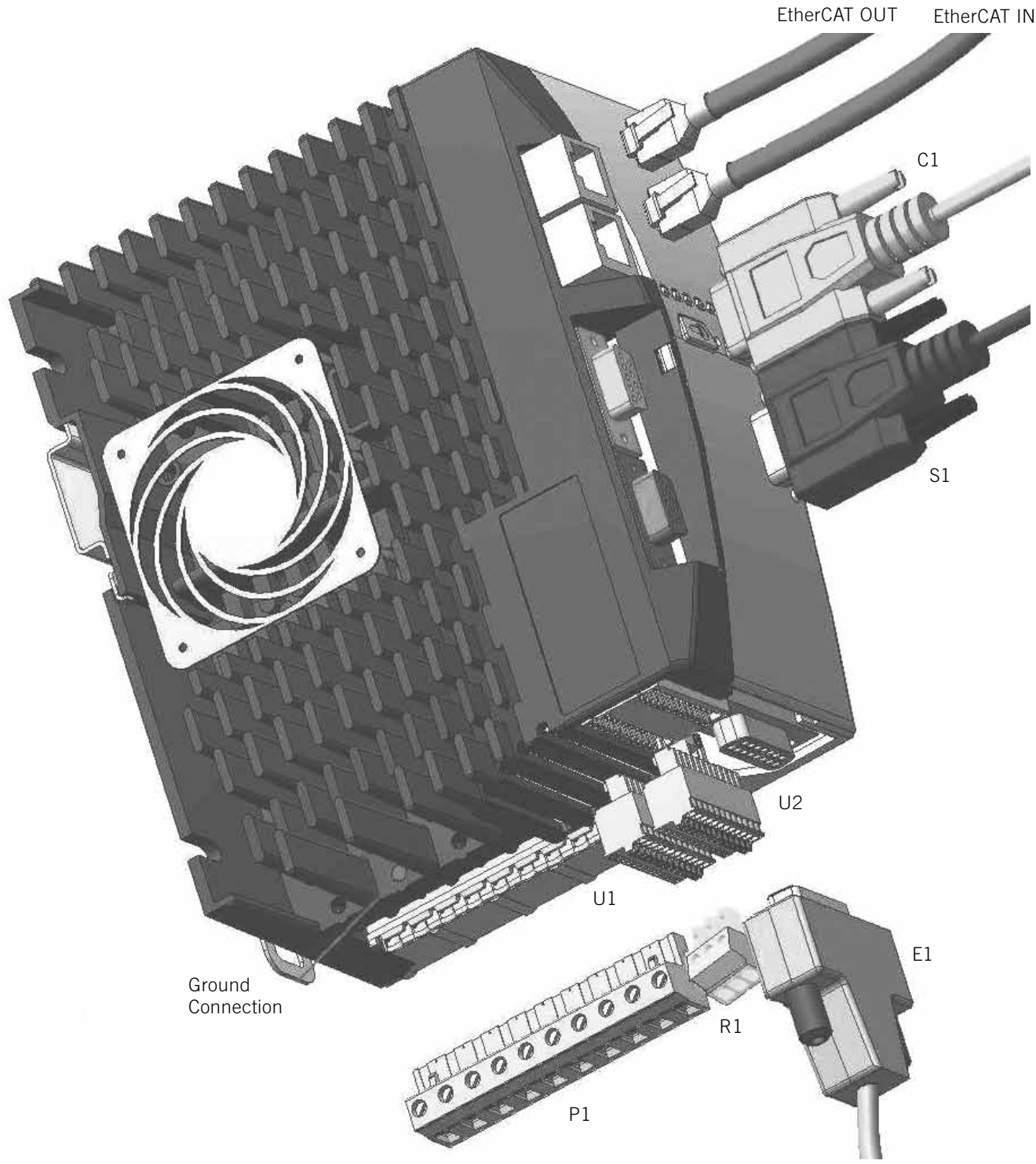
Drive condition	Leds on	Lighting mode	Description
Alarm	0, 1, 2, 3, 4	Fix	**Display the binary code of the active alarm. Refer to chap. 9 for codes description**
	S	1 Hz flashing	

5

ELECTRICAL CONNECTIONS

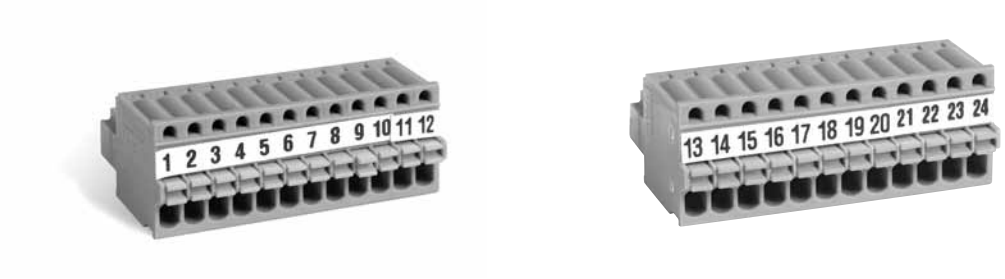
Phase Motion Control

AxM II / AxP Configurable Motion Control Platform


EtherCAT OUT
EtherCAT IN
C1
S1
U2
U1
E1
R1
P1
Ground
Connection

5.1 USER CONNECTORS (U1 /U2)

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



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	**AO0**	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
11	**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

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, Zin = 10Kohm, if not used, connect to GND
15	**R1N**	Analog input	Direct differential input	+/-10V, Zin = 10Kohm, if not used, connect to GND
16	**AO1**	Analog output	Programmable output	+/-10V f.s., 5 mA
17	**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

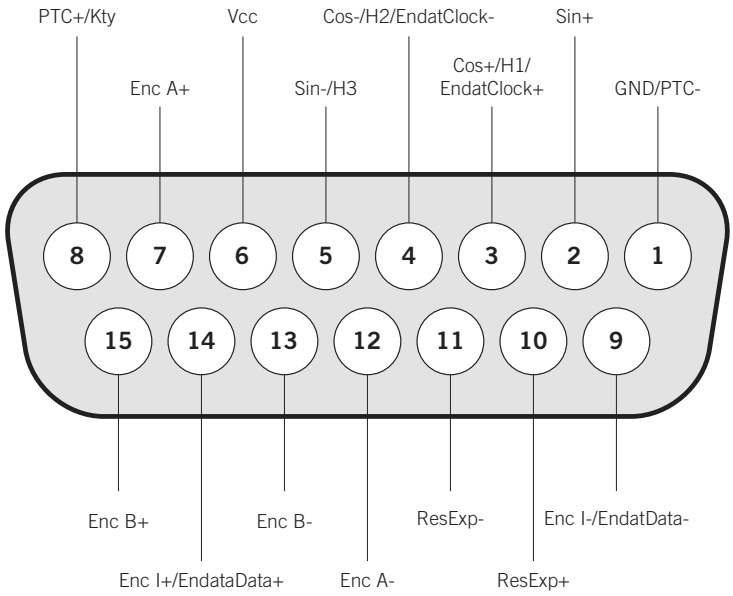
To obtain a good performance of the analog input connect the RxN pin to the reference (suorce side) and apply the –10/+10V to the RxP pin.

5.2 ENCODER CONNECTOR (E1)

To allow the connection of different encoders some pins have more than one function. Select the encoder type in the system table to activate the right connection.

Cannon connector subD 15 pin, male plug

Drive Connector seen from insertion side



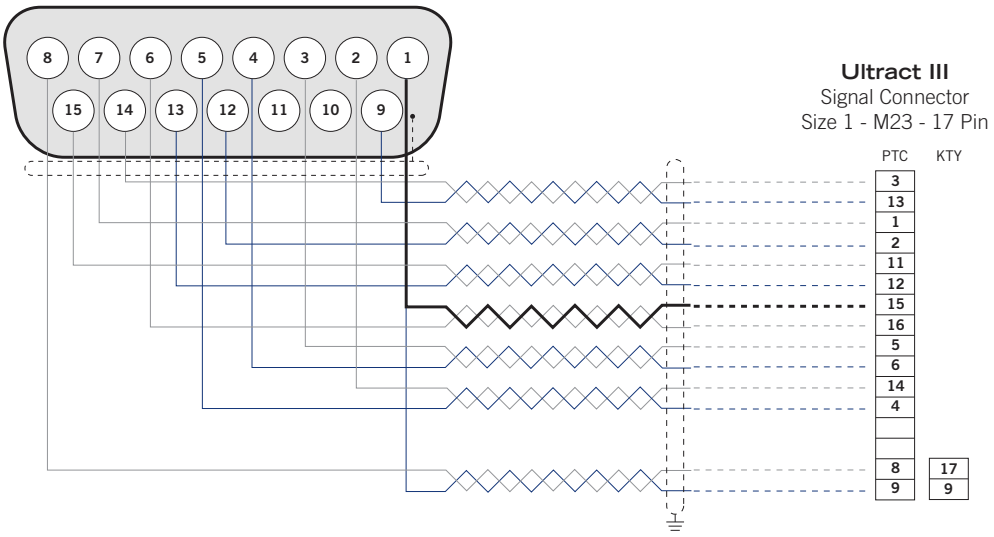
Shield Connection:

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 connector frame or to the apposite screws or of the terminal board

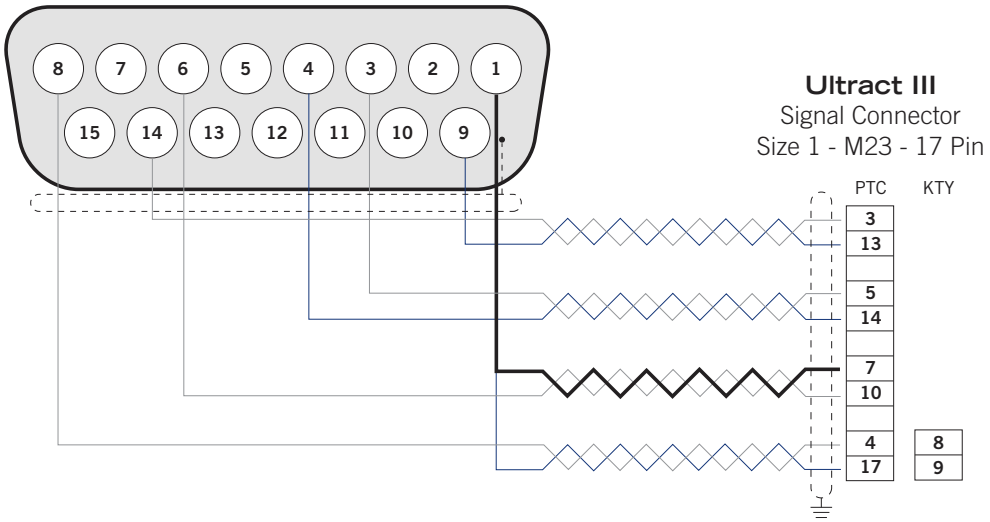
Drive side: connect the shield to the connector body.

Sincos Encoder Connections Table



Pin	Name	Type	Function	Signal description
1	**GND / PTC- / KTY-**	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

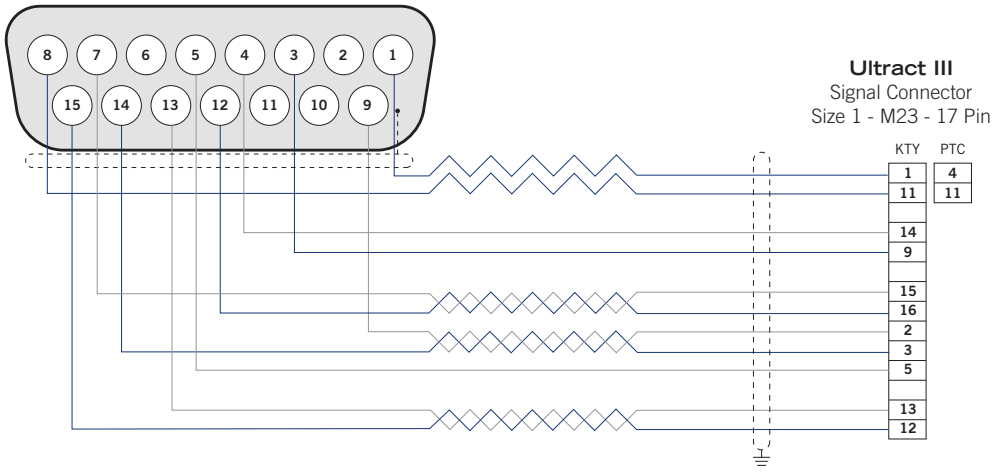
Endat Encoder Connections Table



WARNING
Maximum cable length with ENDAT encoder 40 mt

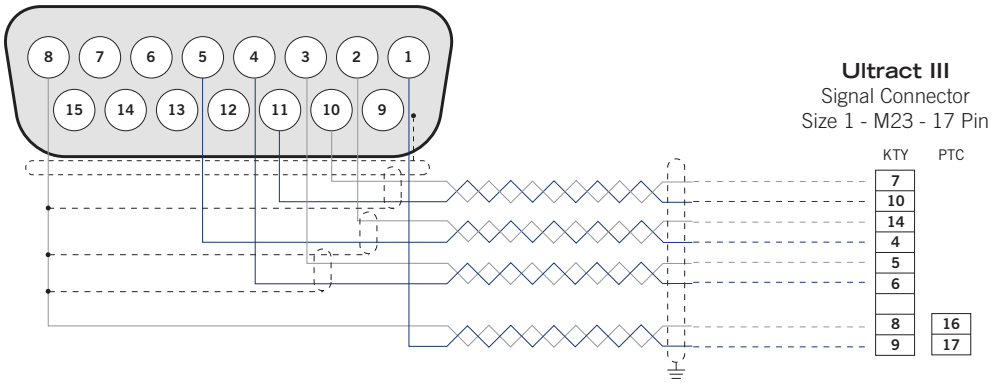
Pin	Name	Type	Function	Signal description
1	**GND / PTC- / KTY-**	Supply 0V	Supply ground and thermal sensor	Encoder ground
2	- - -			
3	**ENDATCLK+**	Multifunction input	ENDAT clock	TTL
4	**ENDATCLK -**	Multifunction input	ENDAT clock	TTL
5	- - -			
6	**+ Vcc**	5V / 7,5V Auxiliary supply	Encoder supply	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- / KTY-**	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- / KTY-**	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				

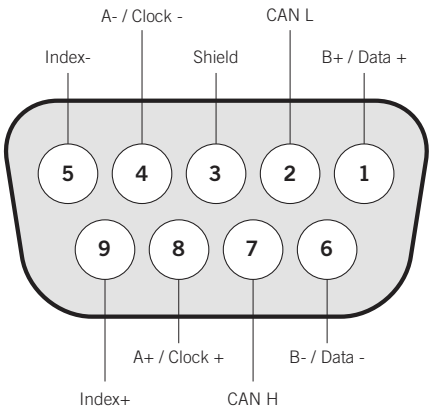
With the **Resolver** sensor, adopt a cable with individually shielded twisted pairs and connect all the internal shields to the pin 1 of the connector; connect the external shield to the connector body.

5.3 CAN CONNECTOR (C1)

Cannon connector sub D 9 pin, Male plug

C1 connector can be used for CAN field bus line plus the auxiliary encoder signals or alternatively the encoder simolation.

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

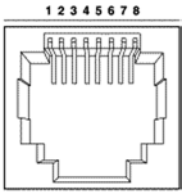


Pin	Name	Type	Function	Signal description
1	**B +**	Digital I/O	Encoder incremental channel	TTL Differential line driver
	DATA+	Endat I/O	ENDAT data	
2	**CAN L**	Digital I/O	CAN interface	CAN positive signal
3	**Shield**	Gnd	CAN cable Shield	Logic Ground
4	**A -**	Digital I/O	Encoder incremental channel	TTL Differential line driver
	CLOCK-	Endat I/O	ENDAT Clock	
5	**I -**	Digital I/O	Encoder index	TL Differential line driver
6	**B -**	Digital I/O	Encoder incremental channel	TL Differential line driver
	DATA-	Endat I/O	ENDAT data	
7	**CAN H**	Digital I/O	CAN interface	CAN negative signal
8	**A +**	Digital I/O	Encoder incremental channel	TL Differential line driver
	CLOCK+	Endat I/O	ENDAT Clock	
9	**I +**	Digital I/O	Encoder index	TL Differential line driver

5.4 ETHERCAT CONNECTORS (IN/OUT)

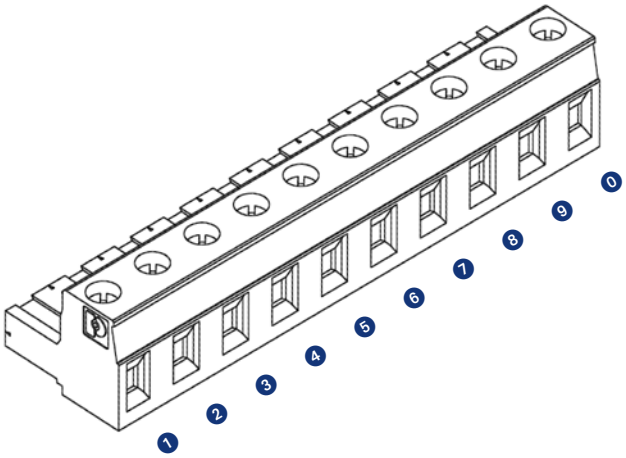
RJ45 100Base-TX female plug:

Pin	Name	Description / Function
1	**TX +**	Transmit Data +
2	**TX -**	Transmit Data -
3	**RX +**	Receive Data +
4	**---**	---
5	**---**	---
6	**RX -**	Receive Data –
7	**---**	---
8	**---**	---



5.5 AxM II **SIZE 1** POWER CONNECTIONS

Power Connector (P1)
Phoenix terminal board 10 poles – cod. GMSTB 2.5/10-ST-7,62

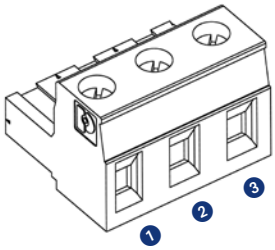


NOTE
To activate the internal Brake resistor short-circuit, with a jumper wire, the pins BR+ and DC+; to use an external Brake resitor connect it be tween pins BR- and DC+.

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	**A**	Motor phase A	Motor power supply	Blu / A
5	**B**	Motor phase B	Motor power supply	Red / B
6	**C**	Motor phase C	Motor power supply	Yellow / C
7	**DC-**	DC bus negative	DC-bus parallel connection possible	Rectified power supply
8	**BR-**	Brake terminal -	Brake terminal	Connect to the internal or external braking resistor
9	**BR+**	Brake terminal +	Brake terminal	Connect to the internal or external braking resistor
10	**DC+**	DC bus positive	DC+bus parallel connection possible	Rectified power supply

Power Connections of new AxM II drive differ from AxM 1 version. See ***Appendix***.

Relay Connector (R1)
Phoenix terminal board 3 poles – cod. MC 1.5/3-ST-3,81

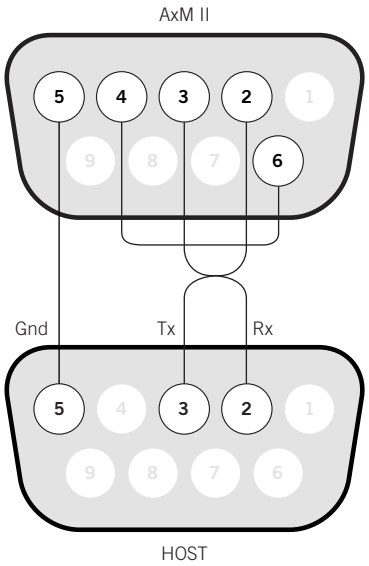


Pin	Name	Type	Function	Signal description
1	N.C.	NC relay	Relay normally closed contact	To be used as Drive Ok signal
2	N.O.	NO relay	Relay normally open contact	
3	Com	Relay Common	Common relay contact	

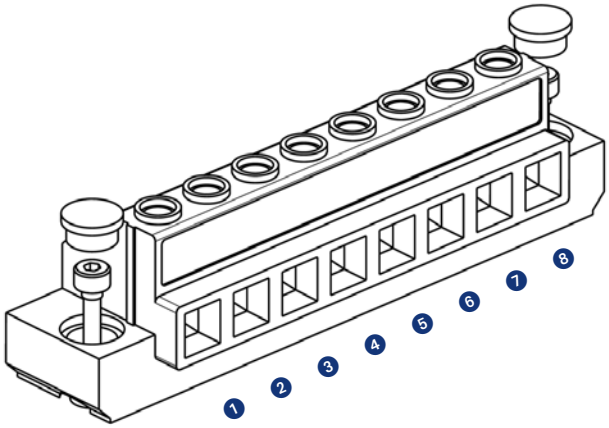
Standard RS 232 DCE (+ Rs 485) + Auxiliary CAN
Cannon connector sub D 9 pin, female plug

Pin	Standard RS 232	S1 connections				Description
		RS 232	RS 422	RS 485	CAN	
1	DCD	---	---	---	CAN H	
2	RxD	RxD	Rx -, A	LN -,A	---	Data Line
3	TxD	TxD	Tx +, Z	LN +,B	---	Data Line
4	DTR	+12V	--	--	---	100mA MAX
5	GND	GND	GND	GND	GND	Ground connection
6	DSR	232 / 485	232 / 485	232 / 485	---	If +/-12V RS232, if open RS485
7	RTS	RTS	Tx -, Y	LN -,A	---	Data Line
8	CTS	CTS	Rx +,B	LN +,B	---	Data Line
9	RI	---	---	---	CAN L	

Minimal RS 232 Connection to Host



5.6 AxM II **SIZE 2** POWER CONNECTION



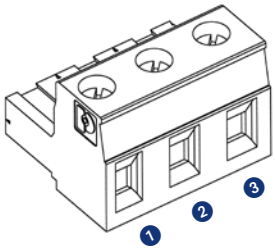
Power Connector (P1) Power supply DC Input
Phoenix terminal board 8 poles

Pin	Name	Type	Function	Description
1	**DC +**	DC bus positive	DC+bus parallel connection possible	Rectified power supply
2	**BRK +**	Brake terminal +	Brake terminal	Connect to the internal or external braking resistor
3	**BRK -**	Brake terminal -	Brake terminal	Connect to the internal or external braking resistor
4	**DC -**	DC bus negative	DC-bus parallel connection possible	Rectified power supply
5	**R**	Mains phase	Triphase power supply	Triphase power supply 0 – 460V
6	**S**	Mains phase	Triphase power supply	
7	**T**	Mains phase	Triphase power supply	
8	⏚			

Power Connector (P1) Motor Output
Phoenix terminal board 8 poles

Pin	Name	Type	Function	Description
1	**A1**	Motor phase A	Motor power supply	Blu / A
2	**A2**			
3				
4	**B1**	Motor phase B	Motor power supply	Red / B
5	**B2**			
6				
7	**C1**	Motor phase C	Motor power supply	Yellow / C
8	**C2**			

Relay Connector (R1)
Phoenix terminal board 3 poles – cod. MC 1.5/3-ST-3,81

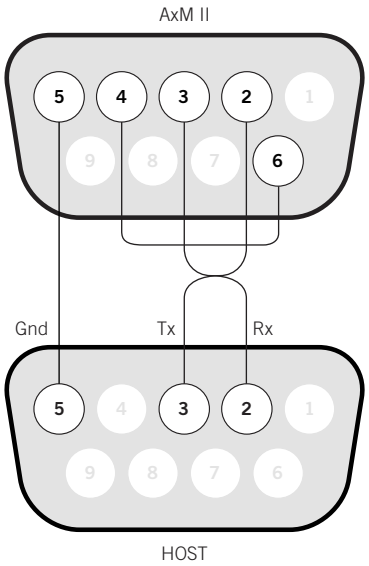


Pin	Name	Type	Function	Signal description
1	N.C.	NC relay	Relay normally closed contact	To be used as Drive Ok signal
2	N.O.	NO relay	Relay normally open contact	
3	Com	Relay Common	Common relay contact	

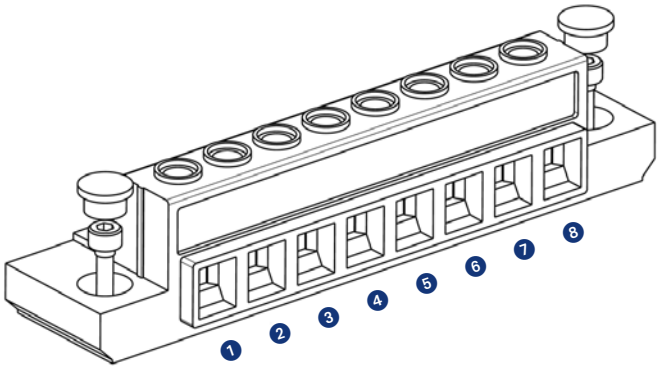
Standard RS 232 DCE (+ Rs 485) + Auxiliary CAN
Cannon connector sub D 9 pin, female plug

Pin	Standard RS 232	S1 connections				Description
		RS 232	RS 422	RS 485	CAN	
1	DCD	---	---	---	CAN H	
2	RxD	RxD	Rx -, A	LN -,A	---	Data Line
3	TxD	TxD	Tx +, Z	LN +,B	---	Data Line
4	DTR	+12V	--	--	---	100mA MAX
5	GND	GND	GND	GND	GND	Ground connection
6	DSR	232 / 485	232 / 485	232 / 485	---	If +/-12V RS232, if open RS485
7	RTS	RTS	Tx -, Y	LN -,A	---	Data Line
8	CTS	CTS	Rx +,B	LN +,B	---	Data Line
9	RI	---	---	---	CAN L	

Minimal RS 232 Connection to Host



5.7 AxM II **SIZE 3** POWER CONNECTION



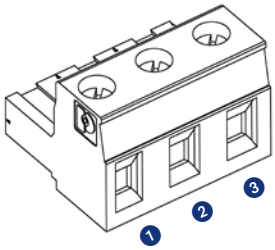
Power Connector (P1) Power supply DC Input
Phoenix terminal board 8 poles

Pin	Name	Type	Function	Description
1	**DC +**	DC bus positive	DC+bus parallel connection possible	Rectified power supply
2	**BRK +**	Brake terminal +	Brake terminal	Connect to the internal or external braking resistor
3	**BRK -**	Brake terminal -	Brake terminal	Connect to the internal or external braking resistor
4	**DC -**	DC bus negative	DC-bus parallel connection possible	Rectified power supply
5	**R**	Mains phase	Triphase power supply	Triphase power supply 0 – 460V
6	**S**	Mains phase	Triphase power supply	
7	**T**	Mains phase	Triphase power supply	
8	⏚			

Power Connector (P1) Motor Output
Phoenix terminal board 8 poles

Pin	Name	Type	Function	Description
1	**C1**	Motor phase C	Motor power supply	Yellow / C
2	**B1**	Motor phase B	Motor power supply	Red / B
3	**A1**	Motor phase A	Motor power supply	Blu / A
4	**DC -**	DC bus negative	DC-bus parallel connection possible	Rectified power supply
5	**DC +**	DC bus positive	DC+bus parallel connection possible	Rectified power supply
6	**A2**	Motor phase A	Motor power supply	Blu / A
7	**B2**	Motor phase B	Motor power supply	Red / B
8	**C2**	Motor phase C	Motor power supply	Yellow / C

Relay Connector (R1)
Phoenix terminal board 3 poles – cod. MC 1.5/3-ST-3,81

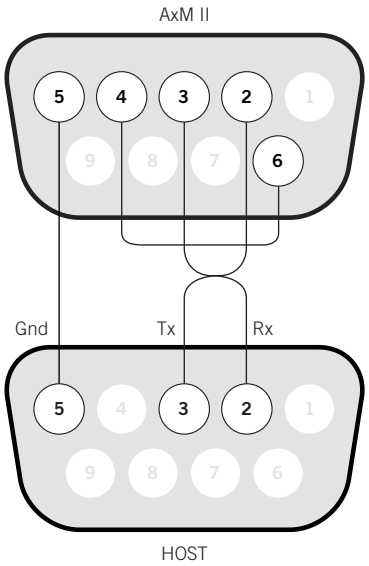


Pin	Name	Type	Function	Signal description
1	N.C.	NC relay	Relay normally closed contact	To be used as Drive Ok signal
2	N.O.	NO relay	Relay normally open contact	
3	Com	Relay Common	Common relay contact	

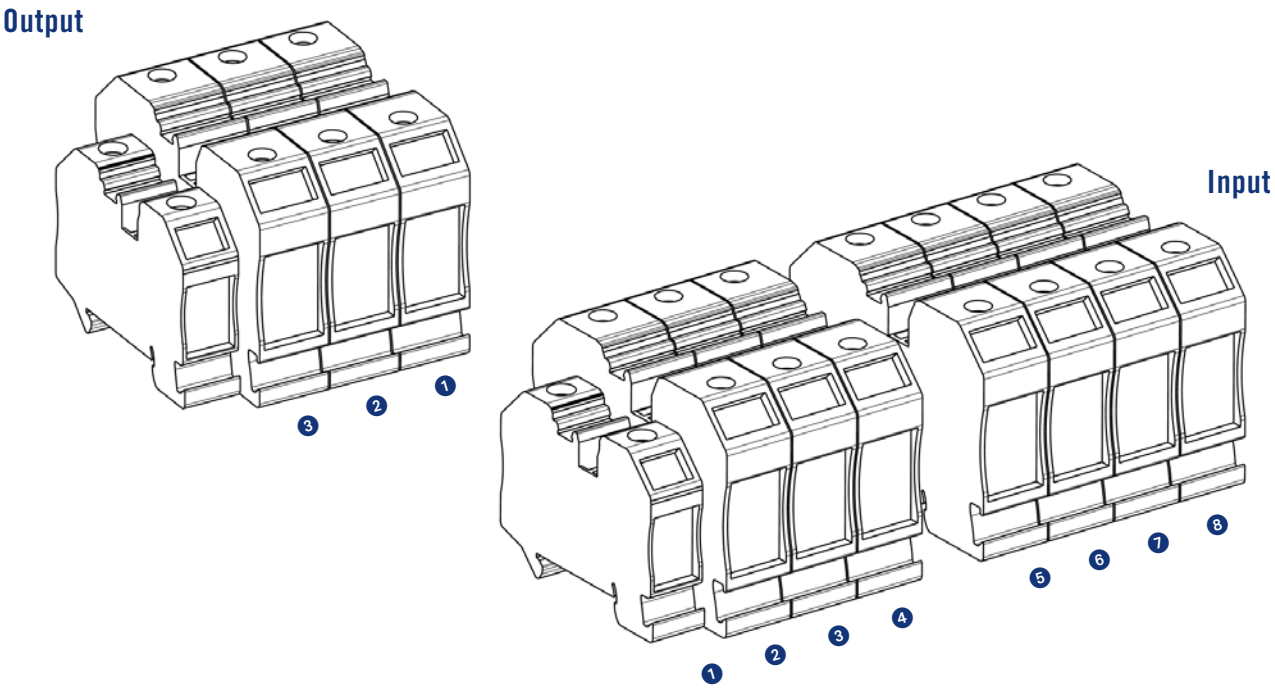
Standard RS 232 DCE (+ Rs 485) + Auxiliary CAN
Cannon connector sub D 9 pin, female plug

Pin	Standard RS 232	S1 connections				Description
		RS 232	RS 422	RS 485	CAN	
1	DCD	---	---	---	CAN H	
2	RxD	RxD	Rx -, A	LN -,A	---	Data Line
3	TxD	TxD	Tx +, Z	LN +,B	---	Data Line
4	DTR	+12V	--	--	---	100mA MAX
5	GND	GND	GND	GND	GND	Ground connection
6	DSR	232 / 485	232 / 485	232 / 485	---	If +/-12V RS232, if open RS485
7	RTS	RTS	Tx -, Y	LN -,A	---	Data Line
8	CTS	CTS	Rx +,B	LN +,B	---	Data Line
9	RI	---	---	---	CAN L	

Minimal RS 232 Connection to Host



5.8 AxM II **SIZE 4** POWER CONNECTION



Power Connector (P1) Power supply DC Input
Phoenix terminal board 8 poles

Pin	Name	Type	Function	Description
1	⏚			
2	**R**	Mains phase	Triphase power supply	Triphase power supply 0 – 460V
3	**S**	Mains phase	Triphase power supply	
4	**T**	Mains phase	Triphase power supply	
5	**DC -**	DC bus negative	DC-bus parallel connection possible	Rectified power supply
6	**BRK -**	Brake terminal -	Brake terminal	Connect to the internal or external braking resistor
7	**BRK +**	Brake terminal +	Brake terminal	Connect to the internal or external braking resistor
8	**DC +**	DC bus positive	DC+bus parallel connection possible	Rectified power supply

Power Connector (P1) Motor Output
Phoenix terminal board 3 poles

Pin	Name	Type	Function	Description
1	**A**	Motor phase A	Motor power supply	Blu / A
2	**B**	Motor phase B	Motor power supply	Red / B
3	**C**	Motor phase C	Motor power supply	Yellow / C

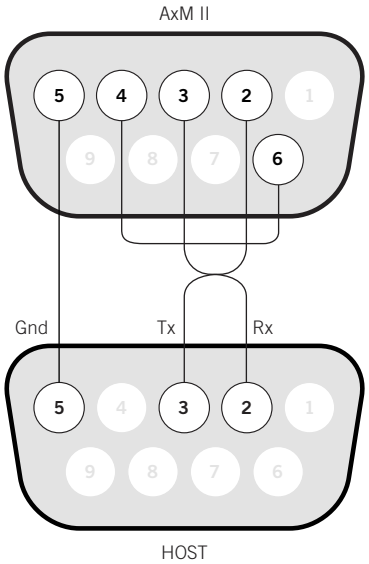
P1 Connector – AUX Power
Phoenix terminal board 4 poles

Pin	Name	Type	Function	Signal description
1	**24 V_AUX**	Auxiliary supply	Auxiliary supply of power board circuits	Voltage: 24 Vdc
2	**24 Vdc**	Auxiliary supply	Auxiliary supply of power board circuits	Voltage: 24 Vdc
3	**24 Vdc**	Auxiliary supply	Auxiliary supply of power board circuits	Voltage: 24 Vdc
4	**GND_AUX**	Auxiliary supply	Reference ground	Digital signal reference

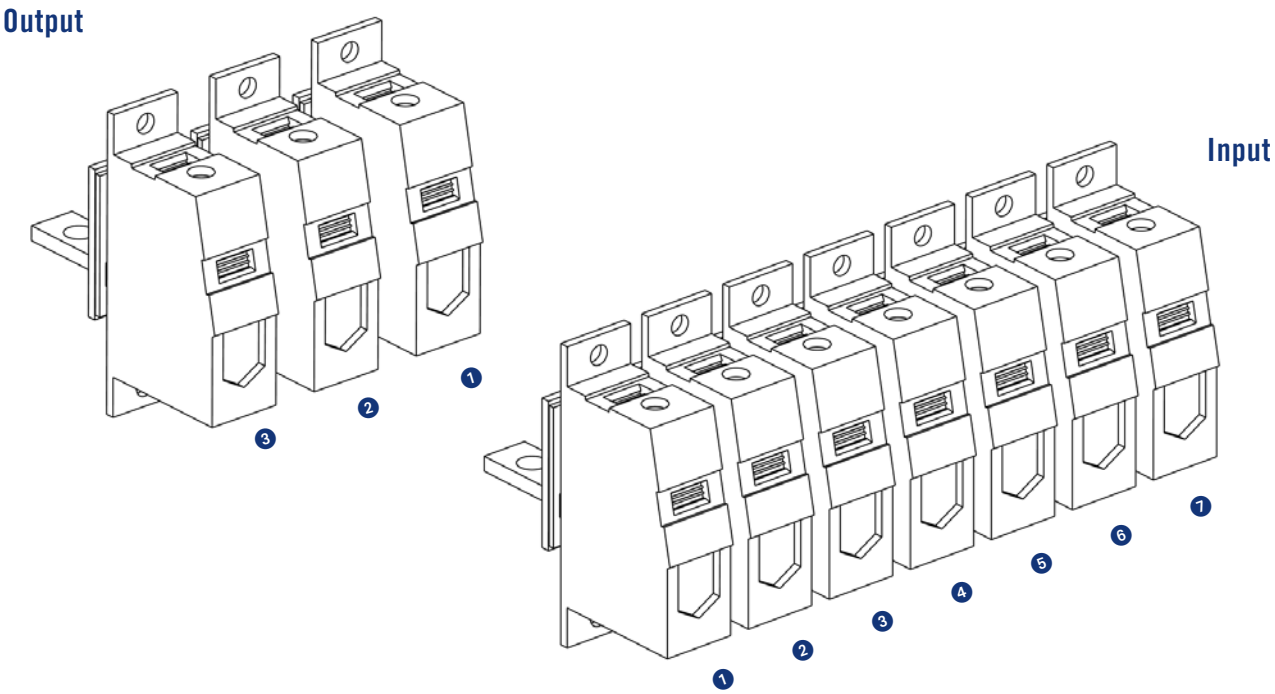
Standard RS 232 DCE (+ Rs 485) + Auxiliary CAN
Cannon connector sub D 9 pin, female plug

Pin	Standard RS 232	S1 connections				Description
		RS 232	RS 422	RS 485	CAN	
1	DCD	---	---	---	CAN H	
2	RxD	RxD	Rx -, A	LN -,A	---	Data Line
3	TxD	TxD	Tx +, Z	LN +,B	---	Data Line
4	DTR	+12V	--	--	---	100mA MAX
5	GND	GND	GND	GND	GND	Ground connection
6	DSR	232 / 485	232 / 485	232 / 485	---	If +/-12V RS232, if open RS485
7	RTS	RTS	Tx -, Y	LN -,A	---	Data Line
8	CTS	CTS	Rx +,B	LN +,B	---	Data Line
9	RI	---	---	---	CAN L	

Minimal RS 232 Connection to Host



5.9 AxM II **SIZE 5** POWER CONNECTION



Power Connector (P1) Power supply DC Input
Phoenix terminal board 7 poles

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	**BRK -**	Brake terminal -	Brake terminal	Connect to the internal or external braking resistor
6	**BRK +**	Brake terminal +	Brake terminal	Connect to the internal or external braking resistor
7	**DC +**	DC bus positive	DC+bus parallel connection possible	Rectified power supply

Power Connector (P1) Motor Output
Phoenix terminal board 3 poles

Pin	Name	Type	Function	Description
1	**A**	Motor phase A	Motor power supply	Blu / A
2	**B**	Motor phase B	Motor power supply	Red / B
3	**C**	Motor phase C	Motor power supply	Yellow / C

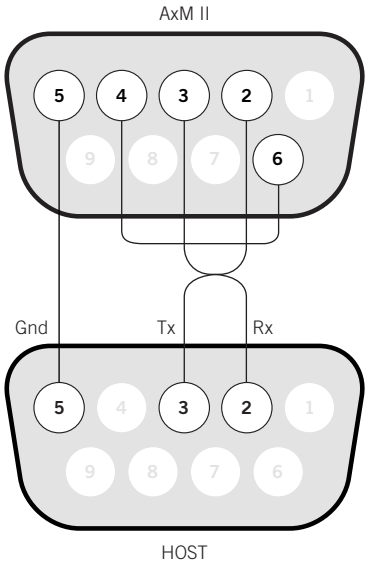
P1 Connector – AUX Power
Phoenix terminal board 4 poles

Pin	Name	Type	Function	Signal description
1	**24 V_AUX**	Auxiliary supply	Auxiliary supply of power board circuits	Voltage: 24 Vdc
2	**24 Vdc**	Auxiliary supply	Auxiliary supply of power board circuits	Voltage: 24 Vdc
3	**24 Vdc**	Auxiliary supply	Auxiliary supply of power board circuits	Voltage: 24 Vdc
4	**GND_AUX**	Auxiliary supply	Reference ground	Digital signal reference

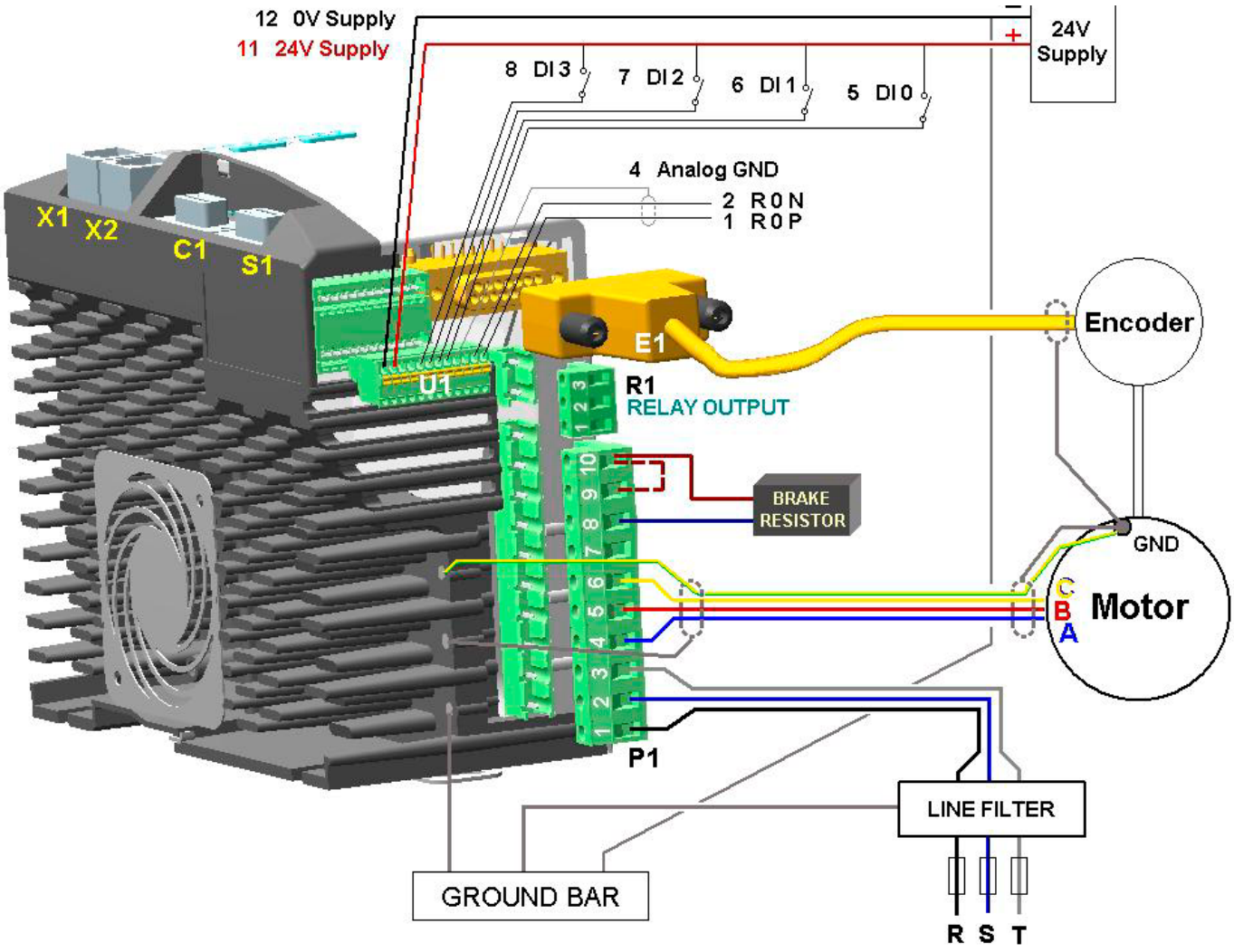
Standard RS 232 DCE (+ Rs 485) + Auxiliary CAN
Cannon connector sub D 9 pin, female plug

Pin	Standard RS 232	S1 connections				Description
		RS 232	RS 422	RS 485	CAN	
1	DCD	---	---	---	CAN H	
2	RxD	RxD	Rx -, A	LN -,A	---	Data Line
3	TxD	TxD	Tx +, Z	LN +,B	---	Data Line
4	DTR	+12V	--	--	---	100mA MAX
5	GND	GND	GND	GND	GND	Ground connection
6	DSR	232 / 485	232 / 485	232 / 485	---	If +/-12V RS232, if open RS485
7	RTS	RTS	Tx -, Y	LN -,A	---	Data Line
8	CTS	CTS	Rx +,B	LN +,B	---	Data Line
9	RI	---	---	---	CAN L	

Minimal RS 232 Connection to Host



5.10 CONNECTION **EXAMPLE**



Make the jumper with 1,5 mm² wire between **BR+** and **DC+** to use the internal braking resistor. If an external resistor is connected to pins **BR-** and **DC+** the jumper must not be done.

6

FIRST **INSTALLATION** AND TESTS

Phase Motion Control
AxM II / AxP Configurable Motion Control Platform

6.1 **NEEDED** FOR FIRST TEST

» AxM II / AxP drive and Phase brushless motor.
» Power Supply 198-465 Vac tri-phase for AxM-II or 110-230Vac single or tri-phase for AxP. Not needed for parameters configuration and application download.
» 22-30 Vdc > 0,6 A auxiliary supply;
» PC with Windows 2000, XP, Vista (32bit) and Windows 7 (32bit) with a RS 232 serial line or USB to RS 232 serial converter.
» RS232 / 485 serial cable female-female, null modem
» Minimum 20 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 setup tool will start automatically.

6.2 **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 consulted 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.**

AxP drives are designed to work with 2 or 3 phase supply, the voltage value must be less than 230V (+10%).

AxM II drives are designed to work with 3 phase supply only, the voltage value must be less than 460V (+10%).

WARNING
Correct performance of the drive requires a braking resistor connection. The internal braking resistor can dissipate 10W only. To use it a connection between BR+ and DC+ must be done on the power terminal box P1. When a higher dissipation is required, an external suitable resistor must be connected on the BR- and DC+ terminals of P1 terminal box. Minimum and maximum ohmic values for the external resistor are shown in the par. 4.1. (see par. 8.4 for power connection outline).

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.**

6.3 COKPIT TOOL START UP AND PARAMETERS CONFIGURATION

Start the "Cockpit" configuration tools in order to configure the necessary parameters (for example: motor poles, encoder type and specifications, inputs and outputs configuration, current, speed and acceleration limits).
Open the System parameters table (`SysApp-X-x_eng.par`), from the Application area in the left part of the Cockpit main page; selecting `New application/AxMIIDrive/SysApp-X-x`.

Only if the motor is a PMC Ultract II or III type with ENDAT encoder you can control the motor without any configuration of the drive.

Parameters Configuration

To configure the principal parameters in order to obtain any motor operation  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 configuaration from drive or ***write*** the modiified parameters to activate the new settings, in both case the parameters will displaied on black.

After the modification you made and download through the Write or Write all buttons, to confirm the modifications and to maintain new parameters use the "save" button.

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.

Parameters setting

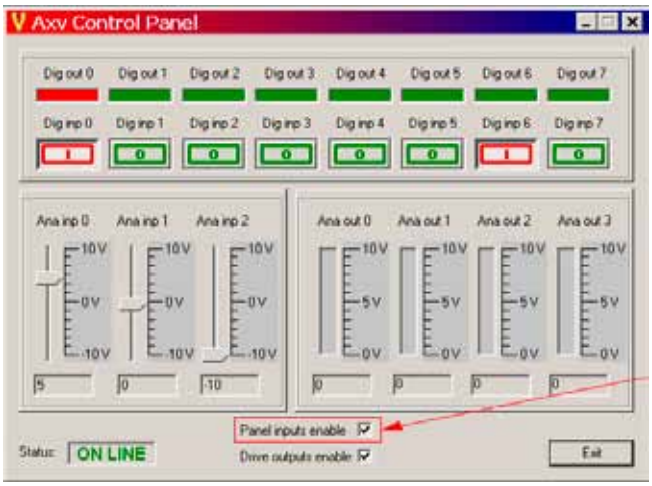
The Motor, Encoder and PID parameters (in the system table) need usually to be configurated depending from the selected motor; then Acceleration, Speed and Current limit must be set on the application table.

6.4 "BASIC" MODE DEFINITIONS

Phase Motion Control supplies the AxM II / AxP drive with Basic application downloaded. 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	DI0	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
Digital 2	DI2	Polarity Inversion	The reference settings are reversed If this input is high.
Digital 6	DI6	Control Selector -OPTIONAL-	If this input is high the speed control is selected; if not the current control is selected. Selectable from parameter
Analog 0	AI0	Speed Reference	When the speed control is selected this analog input changes the speed reference.
Analog 1	AI1	Current Ref.	When the current control is selected this analog input changes the current reference.

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.

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

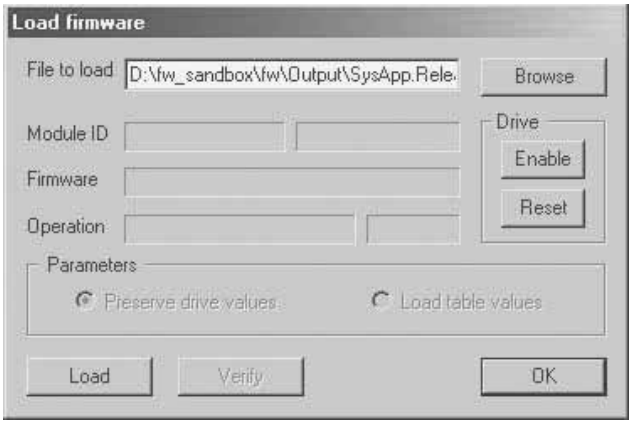
Input	Mark	Function	Description
Digital 0	DI0	Drive Ok	This output is enabled when the drive is on and no alarms is present.
Digital 1	DI1	Run	This output is enabled when the drive activates the set references.

6.5 PLC APPLICATION USE

In addition to the basic application, it could be useful to develop additional features. Phase Motion Control supplies some standard applications (SpeedV and Positioneer) that generally satisfying the most common control requests.
The use of dedicated applications implies their downloading into the drive only through the tool LogcLAB.

6.6 FIRMWARE DOWNLOADING

Firmware upgrades are periodically available on the web site 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 download this, open a system table and select “Load firmware” from “Service” menù; the follow window will appear:



With ***Browse*** button select the firmware file to download

Ex. "SysApp-1-4-291-xxxx-xx.sre"

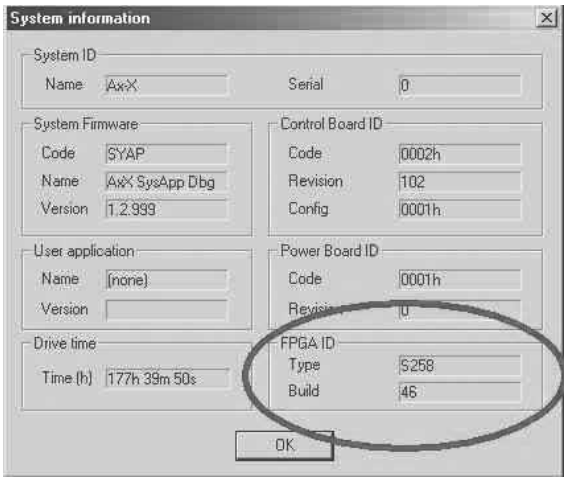
Press ***Enable*** button to enable drive receiving new firmware, then press ***Load*** to effectively start code download. When finish ***Reset*** the drive.

We supply different kind of drive with different hardware settings so a files list are available. It is important select the right file.SRE to download.

SysApp-1-4-291-xxxx-xx.sre
SysApp-1-4-291-xxxx-xx.sre
SysApp-1-4-291-xxxx-xx.sre

The drive will be unusable if any troubles occurs during the Firmware download operation (Ex. Lost of 24V supply, PC connection problem, ...). Repeat the firmware download setting serial interface parameters to Bit Rate 38400 – N,8,1 – address 0.

You can see the wich Hardware you have by selecting ***Service/Target Information*** menù:



Select .SRE file with corresponding FPGA ID Type (FPGA ID Build has to be ignored).

7

EMERGENCY AND POWER **FAIL CONDITION** HANDLING

Phase Motion Control
AxM II / AxP Configurable Motion Control Platform

7.1 **GENERAL** INFORMATIONS

The AxM II / AxP 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 in AxM range) ensures that the main power is available to the drive without delay whenever the mains power switch is operated.

7.2 **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 solve 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 mantained, 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.

8

ERROR CODES

Phase Motion Control

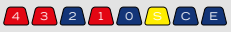
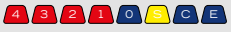
AxM II / AxP Configurable Motion Control Platform

8.1 AxM II / AxP DRIVE'S ALARM LIST

If more alarms are simultaneously activated the drive displays only the more important one; e.g. if the alarms activated are Nr 9 "Overcurrent" and Nr 17 "Endat error" only the first one is displayed. To have a full list of active alarms, use the "Alarms window" function of the "Cockpit" configurator.

The last column of the following table is the alarm code as shown on the panel's leds.

Code	Alarm Type	Description	Suggested Action	Panel's leds
0	Software Error	An internal error occurred in the regulation and control firmware.	Call the Phase Motion Control service.	
1	PLC Overtime	One of the PLC task time is longer of its activation time.	If a user application is active, try to optimize the PLC task performance time.	
2	Boot Fail	An internal error due to invalid factory configuration or wrong FPGA ID Type firmware downloaded	Call the Phase Motion Control service.	
3	Boot Invalid Par	An internal error due to invalid value in one or more system parameters	Check values of each parameter in the system parameter table and correct them, then store and reset drive should solve	
4	Power Fail	Fault on the IGBT control or power circuit	Reset the drive and check if error returns	
5	Flash Error	Flash device error	Try to reload software and parameters table on the drive. Then contact PMC service	
6				
7				
8	Overcurrent	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.	
9	Overvoltage	Too high voltage level detected on the DC bus.	Check presence and connection of braking resistor.	
10	Undervoltage	The DC bus voltege become lower than the user set parameter	Check the parameters configuration and the input line voltage	
11				
12				
13				
14				
15	Encoder Manager Fail	The difference between absolute position value and incremental position value is too high	Check parameters configuration and encoders connection	
16	Endat Error	ENDAT encoder fail	Check parameters configuration and Endat encoder connections.	

Code	Alarm Type	Description	Suggested Action	Panel's leds
17	Absolute encoder fail	Absolute encoder fail	Check parameters configuration and encoder connections.	
18	Incremental encoder fail	Incremental encoder fail	Check parameters configuration and encoder connections.	
19				
20	Temperature Fail	Too high temperature on power drive circuit	Too heavy work cycle or problem in the cooling circuit	
21				
22	Back EMF fail	Sensorless procedure fail	Check parameters configuration, motor phases connections and drive AC line input	
23	Brake Error	Brake circuit error	Check parameters configuration, Brake resistor connection and power size	
24	CAN fail	CAN fieldbus physical layer error	Check CAN configuration, hardware connections, CANOpen master configuration, messages overrun	
25	EtherCAT fail	EtherCAT fieldbus physical layer error	Check ethernet cables connections, check EtherCAT master running status	
26				
27	Motor Overtemp	The PTC sensor has detected a too high tempertaure of the motor.	Check the motor PTC connection to drive terminals and the real temperature of the motor.	
28	USER defined fail	Error generated from the customer PLC application	Depend on PLC application	
29				
30				
31				

Drive condition	Led on	Lighting mode	Description
Drive Enabled	E	2 fast flashing every 500ms	Drive's normal run.
Command Serial Line	C	Variable frequency flashing	The drive is connected to a field bus line. Flashing every data received.
On		Fixed	0, 1, 2, 3, 4 Display the binary code of the active alarm. E.g.: means 0x1Bh error code.
Off		OFF	No fault
Blinking		1 Hz flashing	The drive is in alarm or in error condition

9

CE CONFORMITY

Phase Motion Control
AxM II / AxP Configurable Motion Control Platform

9.1 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 AxM digital platforms and the ULTRACT III brushless motors.

9.2 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.

9.3 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.

9.4 APPLICATION AS DIRECTED SCOPE OF APPLICATION

1. AxM II / AxP 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

9.5 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.

9.6 EC DECLARATION OF CONFORMITY AND DIRECTIVE EMCD

Ref. to EC Low Voltage Directive 72/23/EWG
ULTRACT III series motors and AxM II / AxP 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.p.A., Via Adamoli 461, 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 op-

eration 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.

9.7 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.

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

9.8 EC DECLARATION OF CONFORMITY

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

ULTRACT III series motors and AxM II / AxP 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 III 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 AxM II / AxP drives comply with the IEC 1000-4-2 (IEC 801-2) and IEC 1000-4-4 (IEC 801-4), without any accessory or protection.

10

SAFETY INSTRUCTIONS

Phase Motion Control

AxM II / AxP Configurable Motion Control Platform

10.1 IMPORTANT DIRECTIONS FOR USE

Appropriate Use

Introduction

PMC products represent state-of-the-art developments and manufacturing. They are tested prior to delivery to ensure operating safety and reliability.
The products may only be used in the manner that is defined as appropriate. If they are used in an inappropriate manner, then situations can develop that may lead to property damage or injury to personnel.

Note: PMC as manufacturer is not liable for any damages resulting from inappropriate use. In such cases, the guarantee and the right to payment of damages resulting from inappropriate use are forfeited. The user alone carries all responsibility of the risks.

Before using PMC products, make sure that all the pre-requisites for an appropriate use of the products are satisfied:

» Personnel that in any way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with appropriate use.
» If the products take the form of hardware, then they must remain in their original state, in other words, no structural changes are permitted. It is not permitted to decompile software products or alter source codes.
» Do not mount damaged or faulty products or use them in operation.
» Make sure that the products have been installed in the manner described in the relevant documentation.

Areas of Use and Application

Drive controllers made by PMC are designed to control electrical motors and monitor their operation. Control and monitoring of the motors may require additional sensors and actors.

Note: The drive controllers may only be used with the accessories and parts specified in this document. If a component has not been specifically named, then it may not be either mounted or connected. The same applies to cables and lines. Operation is only permitted in the specified configurations and combinations of components using the software and firmware as specified.

Every drive controller has to be programmed before commissioning, making it possible for the motor to execute the specific functions of an application. The drive controllers have been developed for use in single- and multiaxis drive and control tasks.
To ensure an application-specific use, the drive controllers are available with different drive power and different interfaces.

Typical applications of the drive controllers include:

» handling and mounting systems,
» packaging and food machines,
» printing and paper processing machines and
» machine tools.

The drive controllers may only be operated under the assembly and installation conditions described in this documentation, in the specified position of normal use and under the ambient conditions as described (temperature, degree of protection, humidity, EMC, etc.).

Inappropriate Use

Using the drive controllers outside of the operating conditions described in this documentation and outside of the indicated technical data and specifications is defined as “inappropriate use”.
Drive controllers must not be used, if

» … they are subject to operating conditions that do not meet the specified ambient conditions. This includes, for example, operation under water, under extreme temperature fluctuations or extremely high maximum temperatures.
» Furthermore, the drive controllers must not be used in applications which have not been expressly authorized by PMC.
» Please carefully follow the specifications outlined in the general Safety Instructions!

10.2 SAFETY INSTRUCTIONS FOR ELECTRIC DRIVES AND CONTROLS

General Information

Using the Safety Instructions and Passing them on to Others
Do not attempt to install or commission this device without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation prior to working with the device. If you do not have the user documentation for the device, contact your responsible PMC sales representative. Ask for these documents to be sent immediately to the person or persons responsible for the safe operation of the device.
If the device is resold, rented and/or passed on to others in any other form, then these safety instructions must be delivered with the device.

Improper use of these devices, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, may result in material damage, bodily harm, electric shock or even death!

Instructions for Use
Read these instructions before the initial startup of the equipment in order to eliminate the risk of bodily harm or material damage. Follow these safety instructions at all times.

» PMC is not liable for damages resulting from failure to observe the warnings provided in this documentation.
» Read the operating, maintenance and safety instructions in your language before starting up the machine. If you find that you cannot completely understand the documentation for your product, please ask your supplier to clarify.
» Proper and correct transport, storage, assembly and installation as well as care in opera-

tion and maintenance are prerequisites for optimal and safe operation of this device.

» Only assign trained and qualified persons to work with electrical installations:
  Only persons who are trained and qualified for the use and operation of the device may work on this device or within its proximity. The persons are qualified if they have sufficient knowledge of the assembly, installation and operation of the equipment as well as an understanding of all warnings and precautionary measures noted in these instructions.
  Furthermore, they must be trained, instructed and qualified to switch electrical circuits and devices on and off in accordance with technical safety regulations, to ground them and to mark them according to the requirements of safe work practices. They must have adequate safety equipment and be trained in first aid.
» Only use spare parts and accessories approved by the manufacturer.
» Follow all safety regulations and requirements for the specific application as practiced in the country of use.

» The devices have been designed for installation in industrial machinery.
» The ambient conditions given in the product documentation must be observed.
» Only use safety-relevant applications that are clearly and explicitly approved in the Project Planning Manual. If this is not the case, they are excluded. Safety-relevant are all such applications which can cause danger to persons and material damage.
» The information given in the documentation of the product with regard to the use of the delivered components contains only examples of applications and suggestions.
  The machine and installation manufacturer must make sure that the delivered components are suited for his individual application and check the information given in this documentation with regard to the use of the components, make sure that his application complies with the applicable safety regulations and standards and carry out the required measures, modifications and complements.
» Startup of the delivered components is only permitted once it is sure that the machine or installation in which they are installed complies with the national regulations, safety specifications and standards of the application.
» Operation is only permitted if the national EMC regulations for the application are met.
» The instructions for installation in accordance with EMC requirements can be found in the documentation “EMC in Drive and Control Systems”.
» The machine or installation manufacturer is responsible for compliance with the limiting values as prescribed in the national regulations.
» Technical data, connections and operational conditions are specified in the product documentation and must be followed at all times.

Explanation of Warning Symbols and Degrees of Hazard Seriousness

The safety instructions describe the following degrees of hazard seriousness. The degree of hazard seriousness informs about the consequences resulting from non-compliance with the safety instructions:

Warning symbol with signal word	Degree of hazard seriousness according to ANSI Z 535
 DANGER	Death or severe bodily harm will occur.
 WARNING	Death or severe bodily harm may occur.
 CAUTION	Bodily harm or material damage may occur.

Hazards by Improper Use

 DANGER	**High electric voltage and high working current! Risk of death or severe bodily injury by electric shock!**
 DANGER	**Dangerous movements! Danger to life, severe bodily harm or material damage by unintentional motor movements!**
 WARNING	**High electric voltage because of incorrect connection! Risk of death or bodily injury by electric shock!**
 WARNING	**Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!**
 CAUTION	**Hot surfaces on device housing! Danger of injury! Danger of burns!**
 DANGER	**Electrical hazard due to water leakage on electrical component. Risk of injury by improper handling! Risk of bodily injury by bruising, shearing, cutting, hitting, or improper handling of pressurized lines!**

10.3 INSTRUCTIONS WITH REGARD TO SPECIFIC DANGERS

Protection Against Contact with Electrical Parts

Note: This section only concerns devices and drive components with voltages of more than 50 Volt.

Contact with parts conducting voltages above 50 Volts can cause personal danger and electric shock. When operating electrical equipment, it is unavoidable that some parts of the devices conduct dangerous voltage.

High electrical voltage! Danger to life, electric shock and severe bodily injury!


DANGER

» Only those trained and qualified to work with or on electrical equipment are permitted to operate, maintain and repair this equipment.
» Follow general construction and safety regulations when working on electrical power installations.
» Before switching on the device, the equipment grounding conductor must have been nondetachably connected to all electrical equipment in accordance with the connection diagram.
» Do not operate electrical equipment at any time, even for brief measurements or tests, if the equipment grounding conductor is not permanently connected to the mounting points of the components provided for this purpose.
» Before working with electrical parts with voltage potentials higher than 50 V, the device must be disconnected from the mains voltage or power supply unit. Provide a safeguard

to prevent reconnection.

» With electrical drive and filter components, observe the following:
  Wait 30 minutes after switching off power to allow capacitors to discharge before beginning to work. Measure the voltage on the capacitors before beginning to work to make sure that the equipment is safe to touch.
» Never touch the electrical connection points of a component while power is turned on.
» Install the covers and guards provided with the equipment properly before switching the device on. Before switching the equipment on, cover and safeguard live parts safely to prevent contact with those parts.
» A residual-current-operated circuit-breaker or r.c.d. cannot be used for electric drives! Indirect contact must be prevented by other means, for example, by an overcurrent protective device according to the relevant standards.
» Secure built-in devices from direct touching of electrical parts by providing an external housing, for example a control cabinet.

With electrical drive and filter components, observe the following:

High housing voltage and large leakage current! Risk of death or bodily injury by electric shock!

» Before switching on, the housings of all electrical equipment and motors must be connected or grounded with the equipment grounding conductor to the grounding points. This is also applicable before short tests.
» The equipment grounding conductor of the electrical equipment and the units must be non-detachably and permanently connected to the power supply unit at all times. The leakage current is greater than 3.5 mA.
» Over the total length, use copper wire of a cross section of a minimum of 10 mm2 for this equipment grounding connection!
» Before start-up, also in trial runs, always attach the equipment grounding conductor or connect with the ground wire. Otherwise, high voltages may occur at the housing causing electric shock

Protection Against Electric Shock by Protective Low Voltage (PELV)

All connections and terminals with voltages between 5 and 50 Volt at PMC products are protective extra-low voltage systems which are provided with touch guard according to the product standards.

High electric voltage by incorrect connection! Risk of death or bodily injury by electric shock!

» To all connections and terminals with voltages between 0 and 50 Volt, only devices, electrical components, and conductors may be connected which are equipped with a PELV (Protective Extra-Low Voltage) system.
» Connect only voltages and circuits which are safely isolated from dangerous voltages. Safe isolation is achieved for example by isolating transformers, safe optocouplers or battery operation without mains connection.

Protection Against Dangerous Movements

Dangerous movements can be caused by faulty control of connected motors. Some common examples are:

» improper or wrong wiring of cable connections
» incorrect operation of the equipment components
» wrong input of parameters before operation
» malfunction of sensors, encoders and monitoring devices
» defective components
» software or firmware errors

Dangerous movements can occur immediately after equipment is switched on or even after an unspecified time of trouble-free operation. The monitoring in the drive components will normally be sufficient to avoid faulty operation in the connected drives. Regarding personal safety, especially the danger of bodily harm and material damage, this alone cannot be relied upon to ensure complete safety. Until the integrated monitoring functions become effective, it must be assumed in any case that faulty drive movements will occur. The extent of faulty drive movements depends upon the type of control and the state of operation.

Dangerous movements! Danger to life, risk of injury, severe bodily harm or material damage!

» For the above reasons, ensure personal safety by means of qualified and tested higher-level monitoring devices or measures integrated in the installation. They have to be provided for by the user according to the specific conditions within the installation and a hazard and fault analysis. The safety regulations applicable for the installation have to be taken into consideration. Unintended machine motion or other malfunction is possible if safety devices are disabled, bypassed or not activated.

To avoid accidents, bodily harm and/or material damage:

» Keep free and clear of the machine's range of motion and moving parts. Possible measures to prevent people from accidentally entering the machine's range of motion:
  use safety fences
  use safety guards
  use protective coverings
  install light curtains or light barriers
» Fences and coverings must be strong enough to resist maximum possible momentum.
» Mount the emergency stop switch in the immediate reach of the operator. Verify that the emergency stop works before startup. Don't operate the device if the emergency stop is not working.
» Isolate the drive power connection by means of an emergency stop circuit or use a safety related starting lockout to prevent unintentional start.
» Make sure that the drives are brought to a safe standstill before accessing or entering the danger zone.
» Additionally secure vertical axes against falling or dropping after switching off the motor power by, for example:
  mechanically securing the vertical axes,
  adding an external braking/ arrester/ clamping mechanism or
  ensuring sufficient equilibration of the vertical axes.
  The standard equipment motor brake or an external brake controlled directly by the drive controller are not sufficient to guarantee personal safety!
» Disconnect electrical power to the equipment using a master switch and secure the switch against reconnection for:
  maintenance and repair work
  cleaning of equipment
  long periods of discontinued equipment use
» Prevent the operation of high-frequency, remote control and radio equipment near electronics circuits and supply leads. If the use of such devices cannot be avoided, verify the

system and the installation for possible malfunctions in all possible positions of normal use before initial startup. If necessary, perform a special electromagnetic compatibility (EMC) test on the installation.

Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated by current-carrying conductors and permanent magnets in motors represent a serious personal danger to those with heart pacemakers, metal implants and hearing aids.

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

» Persons with heart pacemakers and metal implants are not permitted to enter following areas:
  Areas in which electrical equipment and parts are mounted, being operated or commissioned.
  Areas in which parts of motors with permanent magnets are being stored, repaired or mounted.
» If it is necessary for somebody with a pacemaker to enter such an area, a doctor must be consulted prior to doing so. The interference immunity of present or future implanted heart pacemakers differs greatly, so that no general rules can be given.
» Those with metal implants or metal pieces, as well as with hearing aids must consult a doctor before they enter the areas described above. Otherwise health hazards may occur.

Protection Against Contact with Hot Parts

Hot surfaces at motor housings, on drive controllers or chokes! Danger of injury! Danger of burns!

» Do not touch surfaces of device housings and chokes in the proximity of heat sources! Danger of burns!
» Do not touch housing surfaces of motors! Danger of burns!
» According to operating conditions, temperatures can be higher than 60 °C, 140 °F during or after operation.
» Before accessing motors after having switched them off, let them cool down for a sufficiently long time. Cooling down can require up to 140 minutes! Roughly estimated, the time required for cooling down is five times the thermal time constant specified in the Technical Data.
» After switching drive controllers or chokes off, wait 15 minutes to allow them to cool down before touching them.
» Wear safety gloves or do not work at hot surfaces.
» For certain applications, the manufacturer of the end product, machine or installation, according to the respective safety regulations, has to take measures to avoid injuries caused by burns in the end application. These measures can be, for example: warnings, guards (shielding or barrier), technical documentation.

Protection During Handling and Mounting

In unfavorable conditions, handling and assembling certain parts and components in an improper way can cause injuries.

Risk of injury by improper handling! Bodily injury by bruising, shearing, cutting, hitting!

» Observe the general construction and safety regulations on handling and assembly.
» Use suitable devices for assembly and transport.
» Avoid jamming and bruising by appropriate measures.
» Always use suitable tools. Use special tools if specified.
» Use lifting equipment and tools in the correct manner.
» If necessary, use suitable protective equipment (for example safety goggles, safety shoes, safety gloves).
» Do not stand under hanging loads.
» Immediately clean up any spilled liquids because of the danger of skidding.

APPENDIX

Phase Motion Control

AxM II / AxP Configurable Motion Control Platform

AxM I SIZE 1 POWER CONNECTION

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

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