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# AX-V

# MAIN USER MANUAL

Release 5.2

Date: Feb. 25  2002

**Supported models:**

AX-V 06094

AX-V 10144

AX-V 10284

AX-V 23404

AX-V 25554

Phase Motion Control s.r.l.
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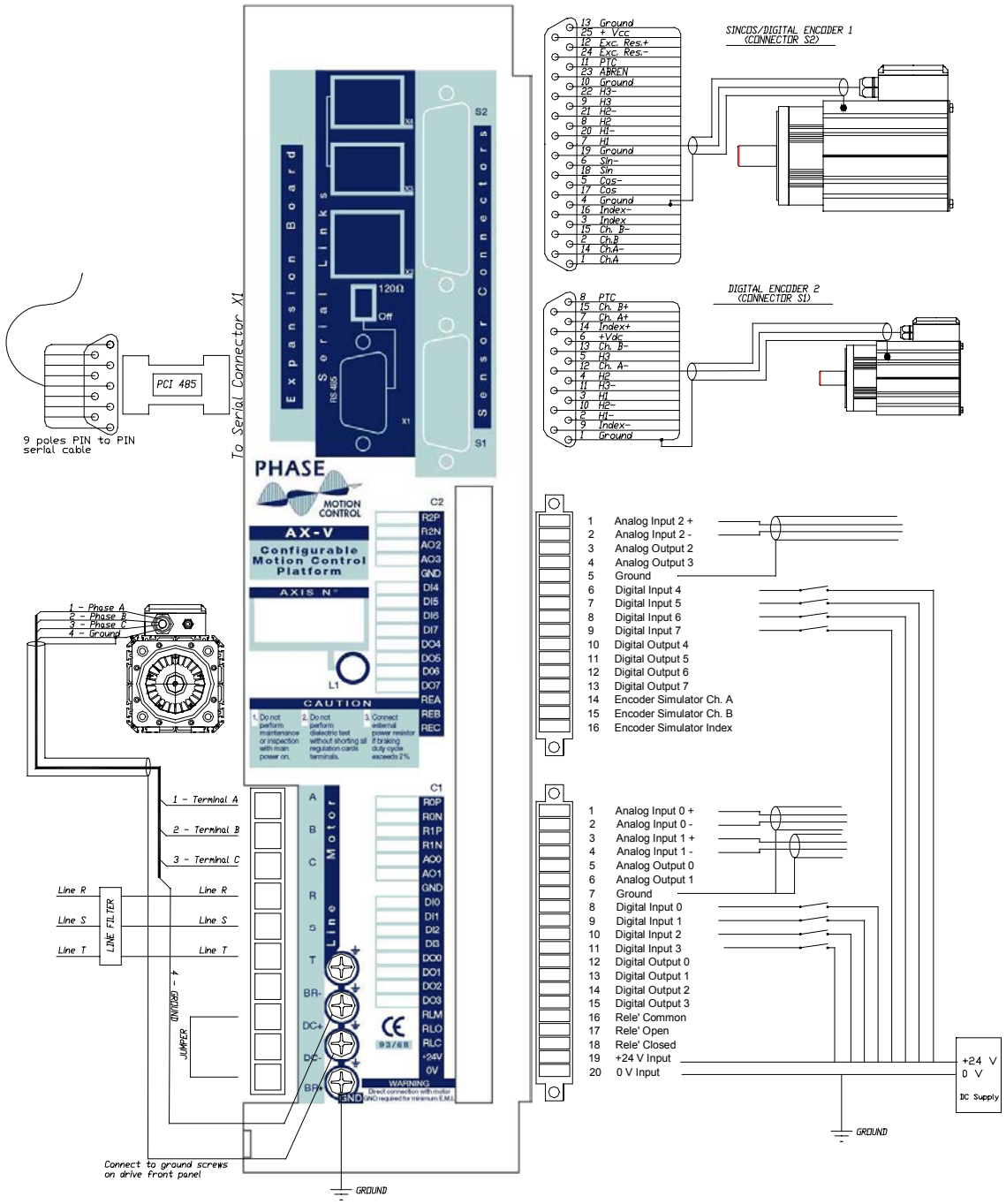
e-mail: support@phase.it

# General connection diagram



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# 1 Quick Overview

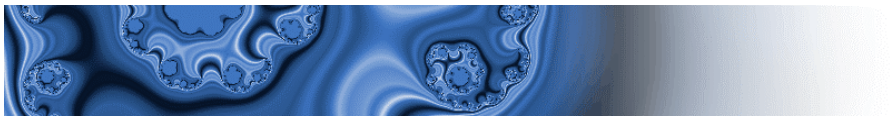
The AXV programmable motion control platform is characterised by an innovative power control hardware which is fully personalised by software and configured via a PC link.
For **hardware installation** information, read on in this **hardware manual**.
For information on the PC resident control and configuration tool **AXV Cockpit**, refer to the **AXV Cockpit Manual**.
For information on specific functions of all applications refer to HTML help pages in configuration tool **AXV Cockpit.**
For information on programming refer to the software manual "**Programming AXV**" in the CD bundled with the platform.

# 2 What is a motion control platform?

**AX-V** is the first realisation of a novel concept in motion control technology. AX-V is a *configurable motion control platform*, based on a very fast DSP dedicated to real time servo control application (VECON™) integrated into a versatile and innovative power control hardware.
The result is a fully configurable IGBT drive, particularly suited for high bandwidth brushless PM motor servo control, which can be configured, just by loading an application from a software library, as a digital drive, an intelligent axis controller, an electric gear, an electronic cam or, more generally, a fast motion control PLC or GPLC.

The AXV drive is fully controlled by software; no hardware adjustments are needed or possible. The control software, which personalises the unit, as well as all the application and tuning parameters, are stored in the unit non volatile memory and are accessed and edited by linking the drive with a PC. Such a start-up connection is usually performed via the RS 485 serial port[1].
The set of application data and tuning parameters, which are application specific, is the application database. To create, inspect, edit and copy this database, the **AXV Cockpit** configuration tool is supplied along with the platform. This tool is installed in the PC, which is used to perform the installation of the AX-V drive. AXV Cockpit works as the control centre of the drive during installation; it accesses all drive functions and parameters, identifies the unit and its operational life, and allows copying to and from

1 The AX-V platform is equipped with a multi drop, industry standard RS 485 serial link. If only a RS 232 connection is available, a RS 232 - RS 485 converter is necessary.



stored data and to duplicate installations. It also works as a powerful diagnostic tool by interfacing with the drive "flight recorder" function.
Cockpit also implements application security by allowing a multilevel password access restriction.
For more information about AXV Cockpit, refer to the **AXV Cockpit Application Manual.**

Software enclosed in AXV platforms consists of Firmware and Application.

*Firmware* manages operating system and basic resources of the platform: current loop, speed and position loop, protections and diagnostics. Parameters to configure these functions are detailed in chapter *System parameters.*
Some firmware characteristics are:

- Fully digital dual direct and quadrature current control loop, updated at 16 kHz, with 4 kHz control bandwidth;
- Digital speed loop with true zero speed, PII$^2$D controller[2] with generalised feedforward, standard servo;
- Interpolation of analogic encoder to increase resolution;
- Autophasing routine for incremental encoders which can be activated from GPLC application;
- Configurable encoder simulation output.

Firmware is developed in Phase Motion Control and cannot be modified by the final user. Periodically new firmware releases are available at http//www.phase.it.
New firmware is always compatible with older applications.

Application contains the motion control program and logic management. To develope applications use the Global PLC, a programming environment which empowers the user with the ability to create his own automation project inside the drive. Within the limits of the available I/Os and of the program memory, all standard automation functions of the IEC 1131-3 PLC language are available, on top of the real time motion control ability of the AXV platforms, including the acquisition of two separate encoders. The PLC software runs three independent tasks, a fast one used for motion control purposes, which runs at 4 kHz, and two slow tasks, for all other uses, running at 125 Hz. The GPLC language is so powerful that very fast functions such as position control, electronic camshaft, trajectory control, electric gear, can be implemented together with dedicated sensor and I/O interface. This way, the AX-V, equipped with application specific, and private, software, can become the very control centre of an automation application.
For detailed information on programming refer to "**AXV Programming Manual**" in the CD bundled with the platform.

A set of basic Applications (with related GPLC source code) is provided with AXV platform. These applications can be loaded into the drive by means of AXV Cockpit (see manual).

[2] PII$^2$D controller: 4 compensation terms are available: proportional (speed), derivative (acceleration), integral (position) integral of position (with this term, zero steady state position error can be obtained).

In every platform at the end of factory tests, the standard application Speed-V is loaded (standard software): designed for classical applications, SpeedV turns the AXV in a versatile digital platform for brushless servo motors.
Main features are:

- Two different control mode: current or speed control;
- Standard analogue interface +/- 10V differential or frequency input;
- Internal ramp generator;
- Capability to maintain in memory 8 different complete sets of tasks, with possibility to switch from one to another, on the fly, by digital inputs;
- Electrical gear capability.

For detailed information on SpeedV functions and I/O refer to related HTML pages available by opening the SpeedV3_4eng.par file with AXV Cockpit.

# 3 To get started

The AX-V platform is a fully digital, fully configurable drive. To interface with the drive and to input the application parameters for the first time, a link with a PC is necessary. After programming, the drive can be either controlled via the terminals, the serial line, or a field bus option.
For the drive initialisation, a PC running Win 9x, Me, 2000 or Window NT 4.0 or higher is required with a RS 485 serial line and at least 15 Mbytes free disk space is required.
If no RS 485 serial line is available on the selected PC, a RS232-485 interface converter is required.

Supplied components:

- AX-V hardware platform
- Pre-loaded VPLC firmware (all drives are supplied, unless otherwise specified, with the SPEED-V application set for Ultract II and SINCOS encoder)
- Application Parameter table (a default parameter set as stated above is supplied with the original control firmware and can be modified as necessary and saved)
- AXV Cockpit configuration tool CD containing:
  - Hardware manual (the present one)
  - AXV Cockpit configuration program manual;
  - AXV Programming manual;
  - AXV Cockpit software to program, interface, install and monitor the application in the AXV;
  - GPLC software to develop dedicated applications
  - copy of latest release of firmware;
  - directory BONUS with samples of GPLC programming;
  - Mechanical drawings of ULTRACT II motors, AXV drive in DXF format and DWF format;
  - Utilities to view and print manuals and drawings

Necessary components for first initialization:

- AXV and selected motor.
- 198-465 Vac three phase power supply (not necessary for programming and uploading but necessary for testing the drive).
- 24-30 Vdc, > 0.6 A control power supply, unregulated (up to 1 Vpk-pk ripple)
- PC running Windows 9x, ME, 2000 or NT 4.0 or higher is required with a RS 485 serial line.
- If no RS 485 serial line is available on the selected PC, a RS232-485 interface converter is required (available on demand).
- The browser Internet Explorer 4.0 or higher must be installed (available on CD).
- 15Mbyte free space on hard disk.

Software installation:

- Insert the supplied CD-Rom into the PC drive.
- If autorun is enabled the main application starts automatically; else, open page *index.htm* in root directory of CD with any browser internet (e.g. Internet Explorer).
- It is possible also run the file setup.exe in the folder d:\setup\axvsetup\disk1.
- Install AXV Cockpit in the PC
- After the end of setup restart the PC;
- To complete installation is needed run the file *Run Me First* in the menù Start->Programs->AXV Cockpit (to do only one time after installation).

Minimum wiring requirements:

For PC connection only:
- Connect 24 V supply between +24 V and 0 V on C1 interface
- Connect RS 485 line to PC
- In this state, the drive can be queried and programmed. No high voltage power is necessary.

Power wiring:

- Wire motor phases to A, B and C terminals of power connector, respecting scheme enclosed with the motor. For this wiring is needed a shielded cable with a section appropriate for the nominal current of the motor. The shield must be connected to ground both on motor side and on AXV panel. In case of doubt, it is possible to check the phase sequence (and the encoder phasing) by means of Test Routine application.
- Wire external power supply to R, S and T terminals of power connector. NOTE: AXV drives are designed to work only with three phase supply at any voltage up to 460V (+10%).
- WARNING: A braking resistor is needed for proper use of AXV. To use internal one, connect an insulated jumper with section appropriate to the drive current between power terminals BR+ and DC+. To use an external braking resistor with higher rated power connect it to DC+ and BR- terminals (without the jumper between BR+ and DC+). Resistance values for external braking resistor must comply with the following table:

| Model | Min | Max |
|---|---|---|
| AX-V 06094 | 60 Ω | 80 Ω |
| AX-V 10144 | 38 Ω | 50 Ω |
| AX-V 10284 | 20 Ω | 25 Ω |
| AX-V 25554 | 10 Ω | 13 Ω |

If an external resistor is used, two system parameters must be configured: SYS_R_BRAKE (R value in ohm) and SYS_PBRAKE_MAX (nominal power in watt). Firmware uses these values to activate thermal protection of braking resistor. Additional details in *System Parameters* paragraph.

# 4 Hardware Description

The drive platform is characterized by :

Power stage:

- Innovative Ac-Ac converter without DC bus electrolytic capacitor, which provides instant availability at power-on and correct input current waveform, in line with the future IEC 555 norm;
- Auto tuning of current limit vs. supply voltage and ambient temperature; single drive for 198-465 Vac supply;
- 16 kHz carrier power IGBT stage, 16 kHz ripple frequency, built-in full power, limited duty cycle brake resistor; full power braking chopper;
- Forced ventilation controlled by the drive temperature (the fan is turned on only above 70 °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.

High speed sensor interface
two independent inputs, configurable:

a (main) 4 channel analogue/digital encoder input (200 kHz BW) which can be programmed to receive the following signals:

1. SINCOS 5 channel encoder (2 absolute analogue tracks, 2 incremental analogue tracks, index) (default encoder).
2. Digital 6 track encoder (3 Hall commutation + 2 incremental + index)
3. Analogue 6 track encoder (3 Hall commutation + 2 analogue incremental + index)
4. Incremental digital encoder without commutation tracks (requires autophasing)
5. Analogue SINCOS 2 tracks encoder or Resolver[1]
6. Hall sensors
7. Incremental 2 track analogue encoder
8. SINCOS 5 track encoder with digital incremental track

A secondary encoder I/O (500 kHz) which can be programmed as follows:

2 Digital 6 track encoder (3 Hall commutation + 2 incremental + index)
4 Incremental digital encoder without commutation tracks (requires autophasing)
6 Hall sensors

[1] Resolver output signals must be connected to sine and cocine inputs of terminal S2

REMARK: to provide for long supply cables, the encoder power supply can be programmed in the 5-15 Vdc range.

Two high speed outputs:

- Encoder emulation, any ratio with the main encoder, including index, on the S1 connector (alternative to secondary encoder input), line driver 5V differential;
- Secondary encoder replica, 24 V single ended open collector, hard wire connection with the S1 encoder input (it is a replica of encoder emulation or of the secondary encoder, depending on option chosen)

General purpose interface:

3 programmable differential analogue inputs
4 programmable analogue outputs
8+8 programmable digital I/Os
Programmable mechanical relay contacts 1A, 250V.

Communication:

Opto isolated, multi-drop RS 485 asynchronous serial interface;
Field bus option;
1 synchronous high speed serial line
INTRADRIVE™ ultra high speed (1 Mbaud) serial loop interface to link up to 4 AX-V drives into a multi axis, multi I/O coordinated environment

Hardware:

IP 20 insulated enclosure with internal RFI shielding, book type
Power and control interfaces with removable terminal/connector
Encoder and serial interfaces via standard D connectors
Built in ground bar (4 x M4) for cable shield termination

Architecture:

Nonvolatile program memory area: 256 kByte
Processors: 40 MIPs

Task timing:

Current and drive monitor loops: 16 kHz
Servo and position loop calculations: 8 kHz
Fast task (user programmable): 4 kHz
Slow task: (user programmable): 125 Hz
Position and position targets registers: 64 bit words ($2^{32}$ turns with $1/2^{32}$ resolution per turn)

Opzioni[1]

- Digital I/O expansion board (12 inpit + 4 output)
- CanOpen expansion board
- Profibus expansion board

[1] Only one option board can be installed on each drive

# 5 Emergency and power fail condition handling

## 5.1 General

The AX-V platform has been purpose designed with two completely separate power supplies. The power circuit is fed from the mains voltage, without preload timing; while the control part needs to be fed from a separate unregulated 24 V supply, which is converted by the internal switching regulator for all internal services and for the supply of motor encoders at the appropriate voltages.
This design solution overcomes all uncertainties of timing and synchronisation between drive and control cabinet, by unifying the same power supply for all services, such as sensors, PLCs, switches and latches. In this way, all data are memorised and reset at the same time, and a simple back-up is possible for all machine information without backing up the main power too.
The power stage without preload (and without storage capacitors) ensures that the main power is available to the drive without delay whenever the mains power switch is operated.

## 5.2 Emergency stop with inertial loads; safety brakes

Many applications involving brushless servo drives move high inertia loads in short, fast cycles (typical example are Cartesian robots or pick and place machines). When the load is moving at top speed, a significant amount of energy is stored in the load, so that a sudden deenergization of the brake could be dangerous. It is therefore essential that, in the event of an emergency, the load is braked as quickly as possible.
To resolve this problem, the use of a servo motor with a safety brake is sometimes considered. The simple use of a safety brake, however, is wrong and dangerous for the following reasons:

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

Consequently, the function “emergency stop” must be realized as follows:
the emergency condition, because of safety regulation, must turn off the mains power to the drive; however, the auxiliary 24 V must be 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.

## 5.3 Power fail with high energy load

Mains power failure with a high kinetic energy load requires special control provisions. In this case, the auxiliary 24 V supply may not be available for a time long enough to stop the load. Two solutions are possible:
To back up the 24 V supply with a small battery system. This is the highest quality solution; all encoders and sensors ride through the power failure and no reinitialization is required when the power supply is again available.
When the back-up solution is not possible, the auxiliary 24 V should be generated with a switching power supply fed from the drive DC Bus. The drive is equipped with a special power fail routine that, irrespective of reference, when the DC bus falls, regenerates energy from the motor to keep the DC bus at just above the undervoltage level. In this way, the auxiliary power is made available to the system as long as there is kinetic energy in the load. A 0 speed reference or a braking ramp can be programmed as needed. Once more, a safety brake can be safely released only at the end of the braking cycle. The 24 V supply of the brake should be thus derived from the same switching power supply feeding the drive. The drive relay can be used to release the brake once all the kinetic energy has been dissipated.

## 5.4 Thermal protection delay

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

# 6 Technical Specifications

## 6.1 Electrical specifications

| Electrical Specifications | AX-V 06094 | AX-V 10144 | AX-V 10284 | AX-V 23404 | AX-V 25554 | Units |
|---|---|---|---|---|---|---|
| Supply voltage | 0-506 | | | | | Vac 3 phase |
| Supply current 1) | 9 | 14 | 28 | 40 | 55 | Arms |
| Supply Frequency | 0-400 | | | | | Hz |
| Nominal power 2) | 2.8 | 5 | 5 | 11 | 11.5 | KW |
| Output current, < 100 rpm speed, S1 3) | 6 (9*) | 10 (14*) | 10 (14*) | 23 (36*) | 25(32*) | Arms |
| Output current, max speed 3) | 5 (6.5*) | 8 (10*) | 8 (10*) | 18 (23*) | 18.4(22*) | Arms |
| Peak current | 9 | 14 | 28 | 40 | 55 | Arms |
| Output voltage | Vin × 0.95 | | | | | Vac |
| PWM Frequency | 16 | | | | | KHz |
| Efficiency at nominal power 4) | 96.5 | 96.5 | 96.5 | 95 | 95 | |
| Form factor | .9 | | | | | |
| Maximum braking current | 100 | | | | | % of peak current |
| Aux. Supply Voltage 5) | 20-30 | | | | | Vdc |

* For 230 Vac input supply

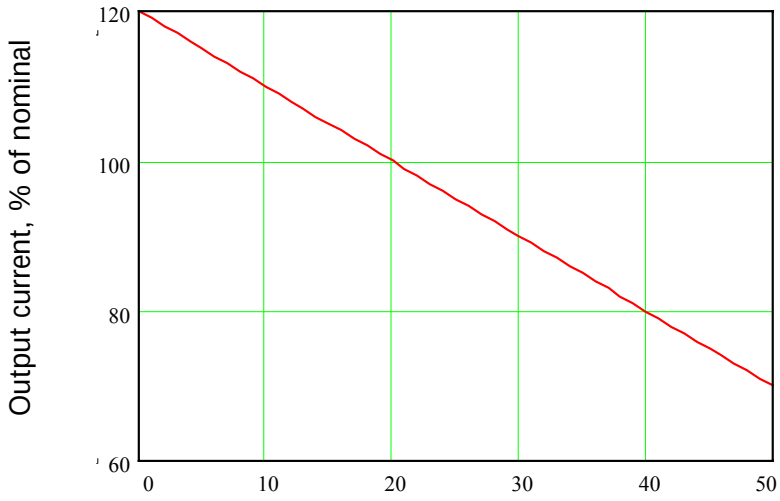
1) Peak Value
2) Input bridge losses included
3) Vin =380Vac, Tamb=40C, Freq. Comm. 16 kHz, Vout=Vin*.95
4) Excluded auxiliary supply losses
5) Not stabilized (max. ripple 1 Vpk-pk), > 0.6 A nom.

## 6.2 Physical Data

| Physical Data | AX-V 06094 | AX-V 10144 | AX-V 10284 | AX-V 23404 | AX-V 25554 | Unità |
|---|---|---|---|---|---|---|
| Average brake power with internal resistor | 100 | | | 200 | | W |
| Power loss at nominal current | 120 | 160 | 180 | 300 | 300 | W |
| Thermal capacity | 1400 | | | 2800 | | J/C |
| Cooling | Forced cooling | | | | | |
| Size (WxDxH) | 85x225x341 | | | 182x225x341 | | Mm |
| Mass | 2.4 | | | 5.3 | | Kg |
| Protection level | IP20 | | | | | |
| Permissible vibrations | 0.5 g in every direction, 0-10 Hz | | | | | |
| Shocks | 0.5 g | | | | | |
| Operating ambient temperature | 0-50 | | | | | °C |
| Storage temperature range | -20-70 | | | | | °C |
| Relative humidity | 0-95%, non condensing | | | | | |
| Altitude | 0-1000 mt; derate current by 3% each 100 m above 1000 m | | | | | |

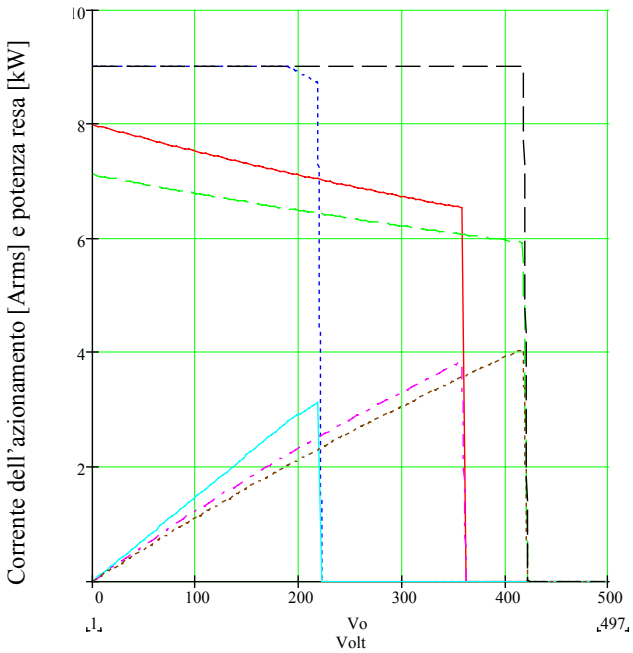
# 7 Electrical Ratings

## 7.1 Derating of output current with temperature increase



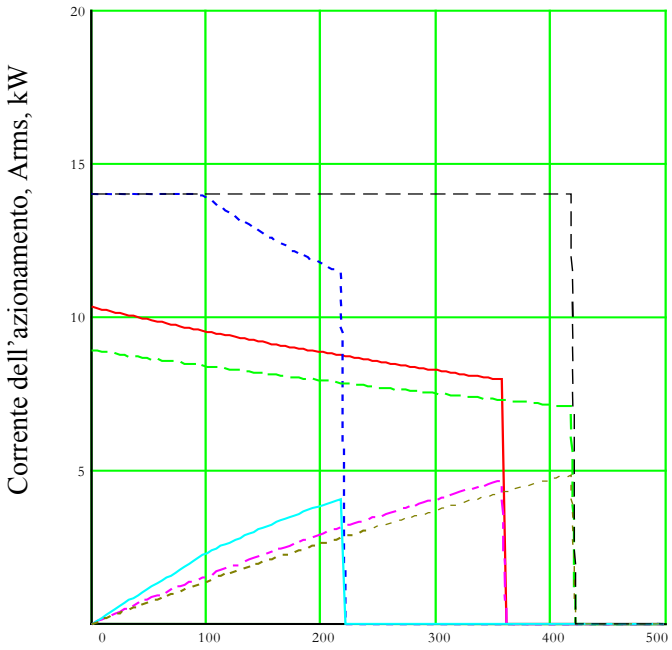

Percentage variation of output current vs. room temperature (°C)

## 7.2 Area Operativa AX-V 06094



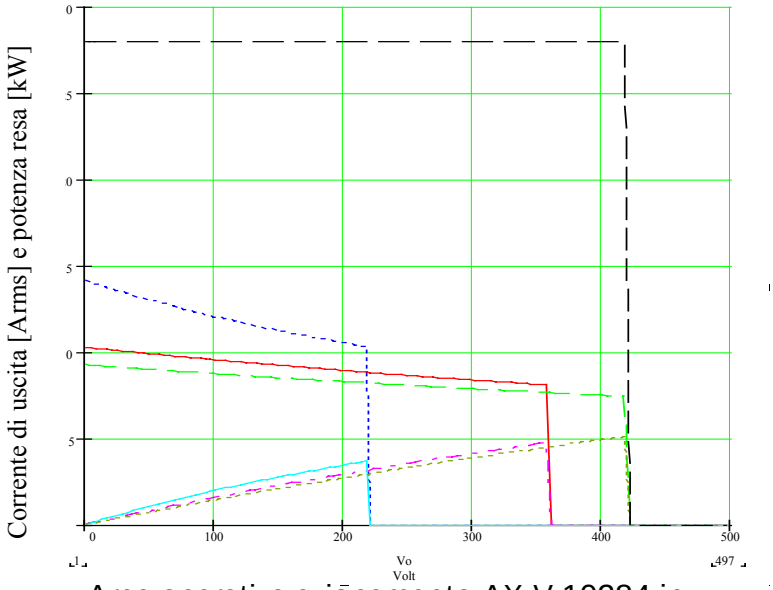

Area operativa azionamento AX-V 06094 in funzione della tensione di uscita per alimentazioni 230, 380 e 460 Vac

## 7.3 Area Operativa AX-V 10144



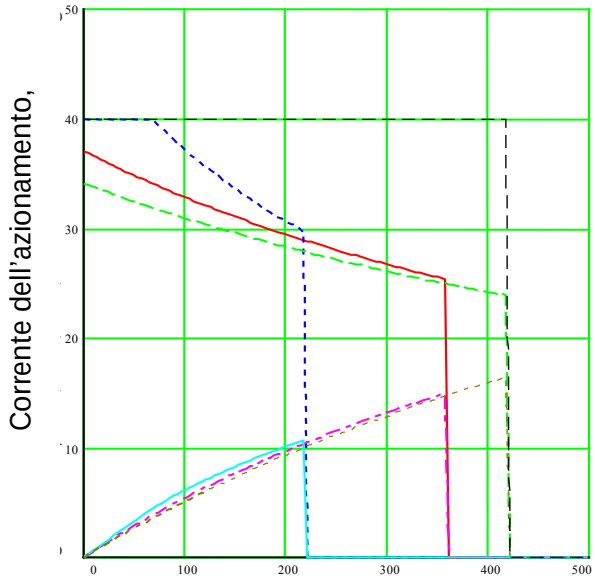

Area operativa azionamento AX-V 10444 in funzione della tensione di uscita per alimentazioni 230, 380 e 460 Vac

## 7.4 Area Operativa AX-V 10284



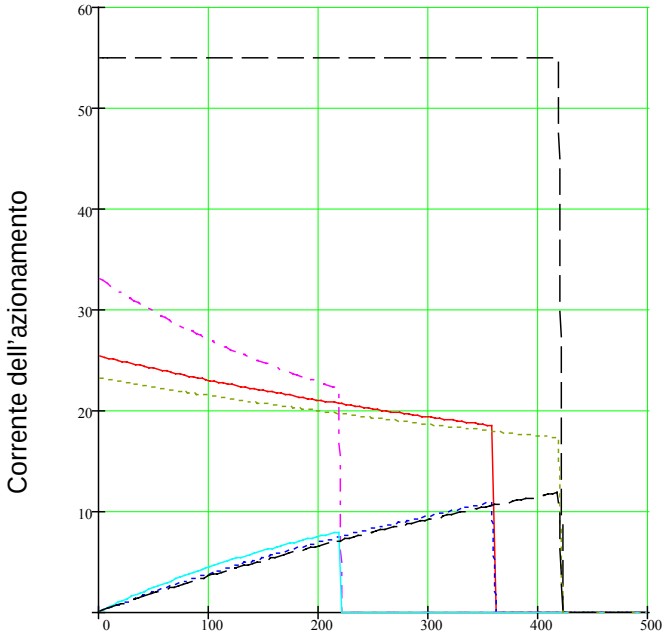

Area operativa azionamento AX-V 10284 in funzione della tensione di uscita per alimentazioni 230, 380,460 Vac

## 7.5 Area Operativa AX-V 23404




Area operativa azionamento AX-V 23404 in funzione della tensione di uscita per alimentazioni 230, 380 e 460 Vac

## 7.6 Area Operativa AX-V 25554




Area operativa azionamento AX-V 23404 in funzione della tensione di uscita per alimentazioni 230, 380 e 460 Vac

# 8 Electrical Connections

| COMMAND TERMINAL C1 – FUNCTION AND SIGNAL DESCRIPTION<br>Connector Terminal Phoenix 20 pin cod. 1847301 | | | | |
|---|---|---|---|---|
| Pin N. | Name | Type | Function | Signal Description |
| 1 | R0P | Analog Input | Positive signal of differential input | +/-10V, Zin = 10Kohm; if not used connect to GND |
| 2 | R0N | Analog Input | Negative signal of differential input | +/-10V, Zin = 10Kohm; if not used connect to GND |
| 3 | R1P | Analog Input | Positive signal of differential input | +/-10V, Zin = 10Kohm; if not used connect to GND |
| 4 | R1N | Analog Input | Negative signal of differential input | +/-10V, Zin = 10Kohm; if not used connect to GND |
| 5 | AO0 | Analog Output | Programmable Output | +/-10V f.s., 5 mA |
| 6 | AO1 | Analog Output | Programmable Output | +/-10V f.s., 5 mA |
| 7 | GND | Analog Ground | | |
| 8 | DI0 | Digital Input | Programmable Input | 6.6 kOhm rel. to ground, 20-30 V |
| 9 | DI1 | Digital Input | Programmable Input | 6.6 kOhm rel. to ground, 20-30 V |
| 10 | DI2 | Digital Input | Programmable Input | 6.6 kOhm rel. to ground, 20-30 V |
| 11 | DI3 | Digital Input | Programmable Input | 6.6 kOhm rel. to ground, 20-30 V |
| 12 | DO0 | Digital Output | Programmable Output | PNP open collector, 24 V, 100mA max |
| 13 | DO1 | Digital Output | Programmable Output | PNP open collector, 24 V, 100mA max |
| 14 | DO2 | Digital Output | Programmable Output | PNP open collector, 24 V, 100mA max |
| 15 | DO3 | Digital Output | Programmable Output | PNP open collector, 24 V, 100mA max |
| 16 | RLM | Relay Contact | Common relay ouput | 1A, 250 Vac resistive |
| 17 | RLO | Relay Contact | N.A. relay contact | 1A, 250 Vac resistive |
| 18 | RLC | Relay Contact | N.C. relay contact | 1A, 250 Vac resistive |
| 19 | 24V | Aux Supply | Regulation circuit Aux Alim. | Voltage: 20-30 V referred to Pin 20<br>Absorbed current: 600mA. |
| 20 | 0V | Aux. Supply | Neg Aux Alim. | |

## COMMAND TERMINAL C2 – FUNCTION AND SIGNAL DESCRIPTION

Connector Terminal Phoenix 16 pin cod. 1847262

| Pin N. | Name | Type | Function | Signal Description |
|---|---|---|---|---|
| 1 | R2P | Analog Input | Positive signal of differential input | +/-10V, Zin = 10Kohm; if not used connect to GND |
| 2 | R2N | Analog Input | Negative signal of differential input | +/-10V, Zin = 10Kohm; if not used connect to GND |
| 3 | AO2 | Analog Output | Programmable Output | +/-10V f.s., 5 mA |
| 4 | AO3 | Analog Output | Programmable Output | +/-10V f.s., 5 mA |
| 5 | GND | Analog Ground | | |
| 6 | DI4 | Digital Input | Programmable Input | 6.6 kOhm rel. to ground, 20-30 V |
| 7 | DI5 | Digital Input | Programmable Input | 6.6 kOhm rel. to ground, 20-30 V |
| 8 | DI6 | Digital Input | Programmable Input | 6.6 kOhm rel. to ground, 20-30 V |
| 9 | DI7 | Digital Input | Programmable Input | 6.6 kOhm rel. to ground, 20-30 V |
| 10 | DO4 | Digital Output | Programmable Output | PNP open collector, 24 V, 100mA max |
| 11 | DO5 | Digital Output | Programmable Output | PNP open collector, 24 V, 100mA max |
| 12 | DO6 | Digital Output | Programmable Output | PNP open collector, 24 V, 100mA max |
| 13 | DO7 | Digital Output | Programmable Output | PNP open collector, 24 V, 100mA max |
| 14 | REA | Digital Output | Digital encoder repetition: Ch. A | NPN open collector 30 V, 100 mA |
| 15 | REB | Digital Output | Digital encoder repetition: Ch. B | NPN open collector 30 V, 100 mA |
| 16 | REC | Digital Output | Digital encoder repetition: Ch. C | NPN open collector 30 V, 100 mA |

| I/O EXPANSION BOARD (Option)<br>Connector Terminal Phoenix 20 pin cod. 1847301 | | | | |
|---|---|---|---|---|
| N. Pin | Name | Type | Function | Description |
| 1 | +V_DO | Supply Voltage | Insulated reference for Digital Outputs | Supply Voltage: 10-30 V to Pin 15 ( 0V ) |
| 2 | DO8 | Digital Output | Programmable output | PNP open collector 100mA max |
| 3 | DO9 | Digital Output | Programmable output | PNP open collector 100mA max |
| 4 | DO10 | Digital Output | Programmable output | PNP open collector 100mA max |
| 5 | DO11 | Digital Output | Programmable output | PNP open collector 100mA max |
| 6 | GND_DO | Digital outputs Insulated gnd | | |
| 7 | DI8 | Digital Input | Programmable input | 6.6 kOhm to gnd (Pin 1), 20-30 V |
| 8 | DI9 | Digital Input | Programmable input | 6.6 kOhm to gnd (Pin 1), 20-30 V |
| 9 | DI10 | Digital Input | Programmable input | 6.6 kOhm to gnd (Pin 1), 20-30 V |
| 10 | DI11 | Digital Input | Programmable input | 6.6 kOhm to gnd (Pin 1), 20-30 V |
| 11 | DI12 | Digital Input | Programmable input | 6.6 kOhm to gnd (Pin 1), 20-30 V |
| 12 | DI13 | Digital Input | Programmable input | 6.6 kOhm to gnd (Pin 1), 20-30 V |
| 13 | DI14 | Digital Input | Programmable input | 6.6 kOhm to gnd (Pin 1), 20-30 V |
| 14 | DI15 | Digital Input | Programmable input | 6.6 kOhm to gnd (Pin 1), 20-30 V |
| 15 | DI16 | Digital Input | Programmable input | 6.6 kOhm to gnd (Pin 1), 20-30 V |
| 16 | D17 | Digital Input | Programmable input | 6.6 kOhm to gnd (Pin 1), 20-30 V |
| 17 | DI18 | Digital Input | Programmable input | 6.6 kOhm to gnd (Pin 1), 20-30 V |
| 18 | DI19 | Digital Input | Programmable input | 6.6 kOhm to gnd (Pin 1), 20-30 V |
| 19 | GND_IN | Insulated Gnd digital inputs | | |
| 20 | GND_IN | Insulated Gnd digital inputs | | |

| CAN-BUS CONNECTOR J1 (Option C)<br>Board connector type Cannon Sub-D 9 pin, male plug | | | |
|---|---|---|---|
| Pin N. | Name | Type | Signal Description |
| 1 | n.c | | |
| 2 | CAN-L | Digital 5V | Signal CAN LOW |
| 3 | SHIELD | Ground | |
| 4 | n.c | | |
| 5 | n.c. | | |
| 6 | GND | Ground | |
| 7 | CAN-H | Digital 5V | Signal CAN HIGH |
| 8 | n.c. | | |
| 9 | n.c. | | |

| PROFIBUS CONNECTOR (Option P)<br>Phoenix Terminal 9 pins | | | |
|---|---|---|---|
| Pin N. | Name | Type | Signal Description |
| 1 | Shield | Ground | Cable shield connection |
| 2 | n.c. | | |
| 3 | RX/TX – B | Digitale 5 V | Positive Receive/transmit Channel |
| 4 | n.c. | | |
| 5 | 0 V | Ground | Ground reference for data signals |
| 6 | + 5 V | Alimentazione | Supply voltage for terminating resistance |
| 7 | n.c. | | |
| 8 | RX/TX - A | | Negative Receive/transmit Channel |
| 9 | n.c. | | |

| ENDAT ENCODER CONNECTOR J2 (Option C)<br>Board connector type Cannon Sub-D 15 pin, male plug | | | |
|---|---|---|---|
| Pin N. | Name | Type | Signal Description |
| 1 | 0 V / PTC- | Ground | Connect 0 V, PTC- and shield |
| 2 | n.c. | | |
| 3 | CLK+ | Digital 5 V | Positive Clock Signal |
| 4 | CLK- | Digital 5 V | Negative Clock Signal |
| 5 | n.c. | | |
| 6 | +Vcc | Power supply | Encoder Supply Voltage |
| 7 | n.c. | | |
| 8 | PTC+ | Digital 5 V | Motor PTC thermal sensor input |
| 9 | DATA - | Digital 5 V | Negative Data Signal |
| 10 | n.c. | | |
| 11 | n.c. | | |
| 12 | n.c. | | |
| 13 | n.c. | | |
| 14 | DATA+ | Digital 5 V | Positive Data Signal |
| 15 | n.c. | | |

## ASYNCHRONOUS SERIAL PORT X1

CARD CONNECTOR - CANNON – D 9 PIN, MALE PLUG

RS 485 multidrop, half duplex, insulated 2500 Vdc, standard speed 18.2 kB, max. hardware 1 MB

Terminate line with 120 Ohm by means of panel switch

| Pin | Name | Type | Function | Description |
|---|---|---|---|---|
| 1 | Reserved | | | |
| 2 | Reserved | | | |
| 3 | LINE A (RS485) | I/O | RS485 line Channel A | |
| 4 | SHIELD | 0V + 100 Ohm | Cable Shield | |
| 5 | GND | Signal Gnd | | |
| 6 | + 5V OUT | Output Voltage | Supply voltage for RS485 - RS232 converter | Max. 20 mA |
| 7 | LINE B (RS485) | I/O | RS485 line Channel B | |
| 8 | GND | Signal Gnd | | |
| 9 | ENABLE485 | Digital input | Enable RS485 Mode (Active High) * | Input NPN 5 V |

* Jumper with pin 6 to connect to RS 485 Devices

| SENSOR CONNECTOR S1: FUNCTIONS AND SIGNAL DESCRIPTION[1]<br>CARD CONNECTOR - CANNON – D 15 PIN, MALE | | | | |
|---|---|---|---|---|
| Card Pin Conn. | Name | Type | Function | Signal Description |
| 1 | GND+PTC | 0V | | |
| 2 | H1N | Digital input | Negative Hall Sensor phase 1 | Square wave 0-5V |
| 3 | H1 | Digital Input | Hall Sensor phase 1 | Square wave 0-5V |
| 4 | HALL 2 | Digital Input | Hall Sensor phase 2 | Square wave 0-5V |
| 5 | HALL 3 | Digital Input | Hall Sensor phase 3 | Square wave 0-5V |
| 6 | AUX +5V | Aux Alim. | | |
| 7 | ENC A+ | Digital Input | Encoder Ch. A | Square wave 0-5V |
| 8 | PTC | Digital Input | Motor thermal protection | |
| 9 | ENC I- | Digital Input | Negative Encoder Index | Square wave 0-5V |
| 10 | H2N | Digital Input | Negative Hall Sensor phase 1 | Square wave 0-5V |
| 11 | H3N | Digital Input | Negative Hall Sensor phase 1 | Square wave 0-5V |
| 12 | ENC A- | Digital Input | Negative Encoder Ch. A | Square wave 0-5V |
| 13 | ENC B- | Digital Input | Negative Encoder Ch. B | Square wave 0-5V |
| 14 | ENC I | Digital Input | Encoder Index | Square wave 0-5V |
| 15 | ENC B | Digital Input | Encoder Ch. B | Square wave 0-5V |

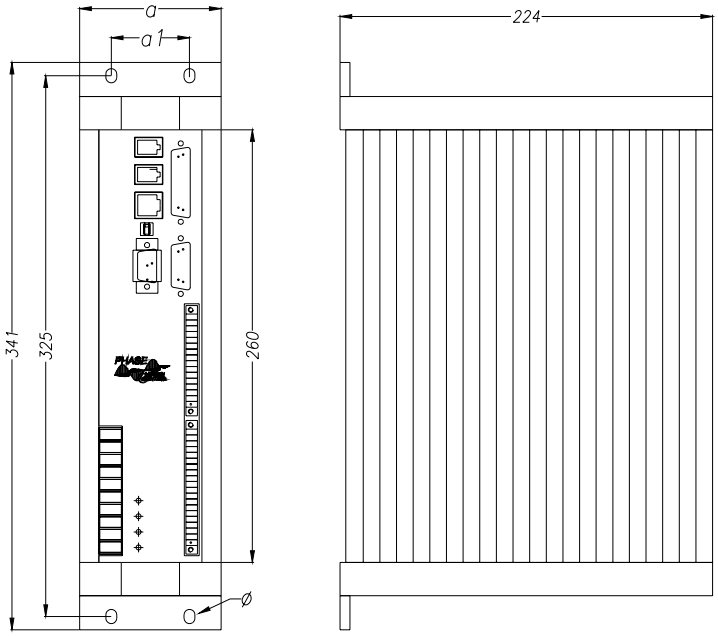
[1] In case of connection to Ultract motors, for encoder codes refer to Appendix A in this manual

| SENSOR CONNECTOR S2: FUNCTION AND SIGNAL DESCRIPTION [1]<br>CARD CONNECTOR – CANNON – D 25 PIN, MALE | | | | |
|---|---|---|---|---|
| Card Pin | Name | Type | Function | Signal Description |
| 1 | AANA | Ana/digi | Direct Input ch A | Sine 1V pk/pk / digital |
| 2 | BANA | Ana/digi | Direct Input ch B | Sine 1V pk/pk / digital |
| 3 | IANA | Ana/digi | Direct Input Index | Sine 1V pk/pk / digital |
| 4 | GND+PTC | 0V | | |
| 5 | COSN | Ana/digi | Negative Cos Input (ch. D+) | Sine 1v PK/PK absolute |
| 6 | SINN | Ana/digi | Negative Sin Input (ch. C-) | Sine 1v PK/PK absolute |
| 7 | H1 | Digital Input | Hall Ch. 1 | Square wave 0-5V |
| 8 | H2 | Digital Input | Hall Ch. 2 | Square wave 0-5V |
| 9 | H3 | Digital Input | Hall Ch. 3 | Square wave 0-5V |
| 10 | GND+PTC | 0V | | |
| 11 | PTC+ | | Motor sensor terminal | |
| 12 | RESEXN | Analog Output | Positive resolver excitation | Sinusoidal, 2 V pk-pk, 8 kHz |
| 13 | GND+PTC | 0V | | |
| 14 | ANNA | Ana/digi | Negative Input ch A | Sine 1V pk/pk / digital |
| 15 | BNANA | Ana/digi | Negative Input ch B | Sine 1V pk/pk / digital |
| 16 | INANA | Ana/digi | Negative Input Index | Sine 1V pk/pk / digital |
| 17 | COS | Ana/digi | Direct Cos Input (ch. D-) | Sine 1V pk/pk absolute |
| 18 | SIN | Ana/digi | Direct Sin Input (ch. C+) | Sine 1V pk/pk absolute |
| 19 | GND+PTC | 0V | | |
| 20 | H1N | Digital Input | Negative Hall Ch. 1 | Square wave 0-5V |
| 21 | H2N | Digital Input | Negative Hall Ch. 2 | Square wave 0-5V |
| 22 | H3N | Digital Input | Negative Hall Ch. 3 | Square wave 0-5V |
| 23 | ABREN | Digital Input | Enable encoder simulation | Converts encoder input S1 in encoder simulation output, low active |
| 24 | RESEXP | Analog Output | Negative resolver excitation | Sinusoidal, 2 V pk-pk, 8 kHz |
| 25 | AUX + | Analog Output | Encoder Alim. | Programmable 4.5-15V, 250 mA |

[1] In case of connection to Ultract motors, for encoder codes refer to Appendix A in this manual

| POWER CONNECTOR<br>CARD TERMINAL - PHOENIX PC4/10-ST 7.62 10 WAYS - FEMALE | | | |
|---|---|---|---|
| Terminal | Description | ULTRACT Pin connector | ULTRACT motor wire colour |
| A | Motor phase A | A | Blue |
| B | Motor phase B | B | Red |
| C | Motor phase C | C | Yellow |
| R | Mains Supply R | --- | --- |
| S | Mains Supply S | --- | --- |
| T | Mains Supply T | --- | --- |
| BR- | External braking resistance connection (connect this terminal to DC+) | --- | --- |
| DC+ | Positive DC bus | --- | --- |
| DC- | Negative DC bus | --- | --- |
| BR+ | Connect to DC+ to enable internal braking system | --- | --- |

# 9 Mechanical Installation




AX-V Dimensions

| Cod. | a | a1 |
|---|---|---|
| AX-V 06094 | 85 | 50 |
| AX-V 10144 | 85 | 50 |
| AX-V 10284 | 85 | 50 |
| AX-V 25544 | 182 | 100 |

ϕ= 5 mm

- Install inside control cabinet; do not obstruct air flow (from low side to upper side)
- Avoid proximity (<40 mm) of walls and other devices on upper and lower side
- Check distance between drive and motor; if wiring exceeds 15m, insert appropriate snubber inductors
- Check cabinet inside temperature and cooling conditions

# 10 AX-V Fault codes

**Remark**: fault conditions are identified either with the Flight Recorder function in AX-V Cockpit, or, when the PC is not connected, by a digital code on the signal LED. The code meaning is as follows:

- Continuous green: normal operation
- Continuous yellow: data transfer
- flashing: fault: green=0, red=1

Example: green, green, red, red, red: 00111, motor Overtemperature
All fault conditions are latched and are reset either by Control Panel or by cycling the 24 V off and on.
Note – If Control Panel is enabled, the error code cannot be read because of the fast communication speed with the drive; close Control Panel to allow the correct view of red and green blinks.

| CODE | Error n. | Description | Possible Reason |
|---|---|---|---|
| 00001 | Error 1 | Bridge Short Circuit | A short circuit occurred on the motor windings or the power bridge |
| 00010 | Error 2 | Overcurrent | Over current protection. It may occur if current loop parameters are not properly tuned for the motor. |
| 00011 | Error 3 | Dc-Link Overvoltage | Brake resistance is not properly connected or is broken. |
| 00100 | Error 4 | Heat Sink Overtemperature | Too heavy work cycle |
| 00101 | Error 5 | Module Junction Overtemperature | Too heavy work cycle |
| 00110 | Error 6 | Brake Short Circuit | A short circuit occurred on brake resistance |
| 00111 | Error 7 | Motor Overtemperature | Motor windings overtemperature or PTC sensor not connected to the drive |
| 01000 | Error 8 | Aux Power Undervoltage | Supply voltage (24 V) too low |
| 01001 | Error 9 | DSP Program Error | Firmware error |
| 01010 | Error 10 | 16 KHz Interrupt Overtime | Firmware error |
| 01011 | Error 11 | Invalid Flash Parameters | Parameters values are not recognized. Try to click the SAVE button in AXV-Cockpit and than reset the drive. |
| 01100 | Error 12 | Bad Flash Device | Firmware error |
| 01101 | Error 13 | Brake Overpower | Brake resistance too hot due to excessive regenerative energy. If repeated, switch to an appropriate external braking resistor. |
| 01110 | Error 14 | Heatsink NTC Disconnected | The Heatsink thermal sensor could be broken or disconnected |
| 01111 | Error 15 | R Brake always on | Power supply voltage is too high or clamp voltage is too low. Check parameter SYS_OV_CLM_LIM |
| 10000 | Error 16 | Lock Drive | Drive stopped by software |
| 10001 | Error 17 | Digital Encoder Count Error | Wrong number of encoder pulses between two indexes . Check parameter Tn_CY_REV and verify all ground and shields connections. |
| 10010 | Error 18 | SinCos Encoder Count Error | Wrong number of encoder pulses between two indexes. Check parameter Tn_CY_REV and verify all ground and shields connections. |
| 10011 | Error 19 | Encoder Simulation | Maximum output bandwidth of encoder simulation exceeded. Check parameter Tn_SE_MAX_BW |

| CODE | Error n. | Description | Possible Reason |
|---|---|---|---|
| 10100 | Error 20 | Level fault in AD Encoder | The check of the level in analogic/digital encoder has reported an error |
| 10101 | Error 21 | Level fault in AN Encoder | The check of the level in analogic encoder has reported an error |
| 10110 | Error 22 | Incremental to absolute sensor error | Sensor check error |
| 10111 | Error 23 | Hardware not compatible with Software | The firmware is not compatible with the loaded application |
| 11000 | Error 24 | Cooling fan locked | The cooling fan didn't start at system command. This alarm only commutate the relay but don't stop the drive automatically. |
| 11001 | Error 25 | Invalid system parameters | System parameters values are not valid. Rewrite into the drive parameters of table System_eng.par. |
| 11010 | Error 26 | Expansion board Error | An error was found on selected expansion board. If no expansion board is installed, verify parameter SYS_EXP_BOARD in table System_eng.par |
| 11011 | Error 27 | Intradrive not synchronised | Only for Slave axes of Intradrive link. Indicate that the axis is not receiving the synchronisation signals from Master axis. If you have no Intradrive link, verify parameter SYS_ID_ADDRESS in table System_eng.par |
| 11100 | Error 28 | Slow Task overtime | Slow task didn't return within 8 ms. Reduce execution time of slowtsk. Verify that there are no infinite loops in the code. |
| 11110 | Error 30 | Relay Off | Drive Relay commutated |
| 11111 | Error 31 | User Alarm | This alarm can be forced by the user in a GPLC program. |

**Auxiliary 24 V supply** with excessive ripple voltage or high impedance: In this case, the internal processor cycles between UV lockout and reset, generating an apparent error code (no communication is possible): **RED-AMBER-GREEN**. In this case, increase the filtering or stiffen the auxiliary power supply.

# 11 System Parameters

Many of firmware functions may be configurated via "*System Parameters*".
To enter these parameters run AXV Cockpit and open the file SysXX_en.par (XX refers to numeric release of firmware referred by parameter table).

## 11.1 Current loop

Control current loop is PID type. It is possible set three gains indipendent (Proportional, Integral and Derivative). To obtain a good loop calibration (bandwidth 1 kHz, overshoot <10%) many parameters may be setted as in the following table. Special motors may require a particular calibration to closed loop step response.

| Parameter | Value | Default |
|---|---|---|
| SYS_IC_P_FAK | 255 * L(*) | 2000 |
| SYS_IC_I_FAK | SYS_IC_P_FAK / 2 | 2000 |
| SYS_IC_D_FAK | SYS_IC_P_FAK / 4 | 1000 |
| SYS_HIGH_RES_PHASE | Enables the commutation of magnetic field orientation on high resolution encoder after the first reference mark latch.<br>These function requires that the encoder is phased according to Phase Motion Control standard.<br>If a third party motor or non standard motor is used, verify encoder phasing before enabling the function. | On |
| SYS_ABS_START | If On, uses absolute encoder (if installed) to determine magnetic field guidance. If Off uses absolute encoder only at reset. | Off |

(*) Where L is the inductance measured between two phases in mH

## 11.2 Braking resistor

Following parameters allow to calibrate braking resistor related functions:

| Parameter | Value | Default |
|---|---|---|
| SYS_OV_CLM_LIM | DC-Link voltage to activate braking resistor in Volt | 850 |
| SYS_P_BRAKE_MAX | Nominal power of braking resistor in Watt | AXV06094 = 100<br>AXV10144 = 100<br>AXV10284 = 100<br>AXV25554 = 200 |
| SYS_R_BRAKE | Value of braking resistor in Ohm | AXV06094 = 80<br>AXV10144 = 40<br>AXV10284 = 25<br>AXV25554 = 12 |

## 11.3 Encoder counters

Following parameters allow to configure the behaviour of encoder counters:

DI encoder: Auxiliary encoder (connector S1 - Ch. A, Ch. B and Index)

| Parameter | Value | Default |
|---|---|---|
| SYS_DI_ENC_FILT | Digital filter for noise suppression<br>(see table 1 below) | 3 |
| SYS_DI_ENC_MODE | Select the count mode:<br>[0] = Multiply x 4 (standard encoder);<br>[1] = Ch. A count up, Ch. B direction;<br>[2] = Ch. A count up, Ch. B count down. | 0 |
| SYS_INDEX_ALARM | Set a function to verify index position. If count error is greater than number in parameter SYS_IND_DI_TOL alarm 17 is set. | On |
| SYS_IND_DI_TOL | See SYS_INDEX_ALARM | 2 |

AD Encoder: Fast encoder (connector S2 - Ch. A, Ch. B and Index)

The fast AD encoder input can handle both analogue and digital encoders. Some parameters act on both encoders types, others are referred to a specific one.

| Parameter | Value | Default |
|---|---|---|
| SYS_AD_ENC_FILT | Digital filter for noise suppression see table 1 below | 4 |
| SYS_AD_RIPPLE | Acceptable range of analogue levels. The drive can execute a control of analogue levels ($\sin^2 + \cos^2$) to verify encoder or cable failures. If limit is exceeded **alarm 20** is set. Lower the value, lower the permitted fluctuation. Value 128 disables the control. | 100 |
| SYS_AD_GAIN2 | Set the max input range of **analog input** of AD encoder. Expressed in differenzial $V_{pk-pk}$ . | 1 |
| SYS_COMP_ENC_AD | Enables an automatic routine to compensate offset and gain of AD **analog input**. | Off |
| SYS_INDEX_ALARM | Set a function to verify index position. If count error is greater than number in parameter SYS_INDEX_ALARM **alarm 18** is set. | On |
| SYS_IND_AD_TOL | See SYS_INDEX_ALARM | 2 |
| SYS_GATED_ENC | Set to **On** this parameter if using **digital encoder** with masked index with high channels A and B. Set to **Off** if using **analog encoder.** | Off |

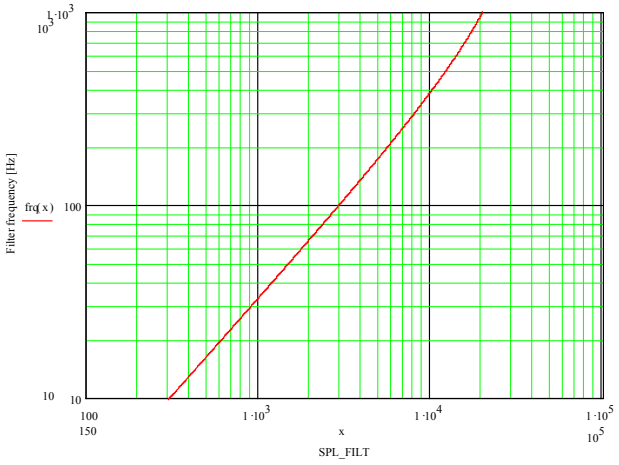
Table 1: Digital filter on AD and DI encoder input

| SYS_DI_ENC_FILT<br>SYS_AD_ENC_FILT | Suppress fronts closer than |
|---|---|
| 0 | 0 ns |
| 1 | 50 ns |
| 2 | 100 ns |
| 3 | 200 ns |
| 4 | 400 ns |
| 5 | 800 ns |
| 6 | 1.6 µs |
| 7 | 3.2 µs |

AN Encoder: Slow analogue encoder input (connector S2 - Ch. Sin and Ch. Cos).

| Parameter | Value | Default |
|---|---|---|
| SYS_AN_FILT | Digital filter for noise suppression see graph 1 | 4096 |
| SYS_AN_RIPPLE | Acceptable range of analogue levels. The drive can execute a control of analogue levels ($\sin^2 + \cos^2$) to verify encoder or cable failures. If limit is exceeded **alarm 20** is set. Lower the value, lower the permitted fluctuation. Value 128 disables the control. | 100 |
| SYS_AD_GAIN1 | Set the max input range of **analogue input** of AN encoder. Expressed in differential $V_{pk-pk}$ . | 1 |
| SYS_COMP_ENC_AN | Set an automatic routine to compensate offset and gain of AN **analogue input**. | Off |

Graph1: Cutoff frequency for digital filter



## 11.4 Intradrive

These parameters allow the serial synchronous connection INTRADRIVE, a fast bidirectional data exchange through AX-V drives (16 word, 4 kHz). This link uses RJ11connectors X3 and X4. For more information refer to manual "*Intradrive*"

| Parameter | Value | Default |
|---|---|---|
| SYS_ID_ADDR | [0] Disable Intradrive connection<br>[1] Configure AXV drive as Master Intradrive<br>[2..15] Configure AXV drive as Slave Intradrive | 0 |
| SYS_ID_ELEMENTS | [0..15] Select the total number of AXV drive connected to Intradrive bus. This value is necessary for the master, optional for slaves. | 0 |

## 11.5 Analogue outputs

These parameters allow balance offset of user's analogue outputs.

| Parameter | Value | Default |
|---|---|---|
| SYS_DAC0_OFFSET | Offset, analog output 0 (Connector C1/5) | 0 |
| SYS_DAC0_OFFSET | Offset, analog output 1 (Connector C1/6) | 0 |
| SYS_DAC0_OFFSET | Offset, analog output 2 (Connector C2/3) | 0 |
| SYS_DAC0_OFFSET | Offset, analog output 3 (Connector C2/4) | 0 |

## 11.6 Serial link RS485

These parameters set-up the communication over RS485 (Connector X1). Remember AXV drive can operate only as Slave, that is answers only to a Master request.

| Parameter | Value | Default |
|---|---|---|
| SYS_BAUD_RATE | Set serial port RS485 baud rate. | 38400 |
| SYS_SER_DELAY | Set min delay in ms before AXV drive answer. | 0 |

## 11.7 Motor thermal protection

A peculiarity of brushless motor is overload. In transient, for example during an acceleration phase, it is possible to supply 3 or 4 times the nominal current. However strong overloads, if not monitored, may be dangerous for motor, especially if it is of small size (ULII size 2 and 4). This may happen because local overheating of winding may be so fast to damage it before thermal sensor works.
AXV drive holds a motor thermal model that allows to temporary feed the the max current to the motor, but limits it to avoid damaging the motor itself.
Parameter SYS_MOTOR_TC allows this protection to take into account the motor thermal time constant. The value of motor nominal current, used for limitation, must be written in GPLC application into Inom variable.

| Parameter | Value | Default |
|---|---|---|
| SYS_MOTOR_TC | Motor thermal constant.<br>Note: This variable is expressed in local units: the value may be calculated as 5000 / Ta where Ta is motor thermal constant period in seconds. | 15 |

## 11.8 Position/Speed Loop.

| Parameter | Value | Default |
|---|---|---|
| SYS_POS_ERR_MAX | Set max. position recovery. Measured as interpolated encoder counts , that is encoder counts * ^14 | 8388610<br>(512. Enc. pulse) |
| SYS_SPL_ZERO | Set cutoff frequency for digital low-pass filter inserted at speed loop output. Useful to cancel high frequency vibrations (> 300Hz). See graph 1 at page 31 | 4096 |
| SYS_ACC_FFW | If On uses acceleration gain only in feed-forward, that is requires a current proportional to reference acceleration. Useful to minimise the dynamic error when using internal positioner of AXV drive.<br>If Off the acceleration gain needs a current proportional to acceleration error (derivative standard contribution). | Off |
| SYS_HIGH_GAINS | Multiplies by 4 the scale of position and speed gain | Off |

## 11.9 Expansion board

| Parameter | Value | Default |
|---|---|---|
| SYS_EXP_BOARD | Select if an optional expansion board is installed (EXP. I/O, EXP. CanOpen ecc.) | Null |

## 11.10 Emergency braking

| Parameter | Value | Default |
|---|---|---|
| SYS_UV_V_MIN | Voltage at which emergency braking is started | 0 |
| SYS_UV_P_FAK | Voltage regulation loop gain | 10 |

# 12 CE conformity of AXV platforms, Ultract, Minact, Wave motors

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

EC1.8.1.96

## 12.1 Wiring recommendations and CE-typical system for conformity to EMCD and LVD

## 12.2 EC Declaration of Conformity for the purposes of EMCD e LVD

## 12.3 Introduction: EC directives

The EC Directives are manufacturing prescriptions intended to guarantee a standard level of quality, reliability and safety for all industrial goods produced and marketed across the European Union. The EC Directives are general documents that establish base specifications for the certifications, which are subsequently converted into national laws by all member states. A certification issued by a member state is valid automatically in all other member states.
Technical details are not included in the directives. They are determined by the relevant European harmonized standards (EN).
After verification, affixing a CE mark certifies the conformity to the CE directives. Within the EU there are no commercial barriers for a product with the CE mark. A conformity certificate, however, is generally not required for most directives. Consequently, it is not always evident which of the (so far) 21 EC directives is considered in the CE mark of a product and which standards are considered in the conformity verification.

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

## 12.4 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.

## 12.5 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.

## 12.6 Application as directed – Scope of application

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

## 12.7 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.

## 12.8 EC Declaration of Conformity

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

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

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

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

The EMCD directive relating to electromagnetic compatibility is effective for "equipment" which may either cause electromagnetic disturbances or be affected by such disturbances.
The aim is the limitation of the generation of electromagnetic disturbances so that the operation of radio and telecommunication systems and other equipment is possible and that a suitable immunity of the equipment against electromagnetic disturbances is ensured so that the operation can be achieved.
Controllers cannot be driven in stand-alone operation and therefore the controllers themselves cannot correspond to the EMC directive. The controllers must be integrated into a drive system to check the compliance with the EC directive relating to EMC of the "Regulation about the electromagnetic compatibility of devices".
Phase Motion Control has verified the conformity of controllers integrated into a "typical" drive system (see below). The user can use this example as a reference to design a system in according to EMCD.

## 12.10 Installation as specified

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

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

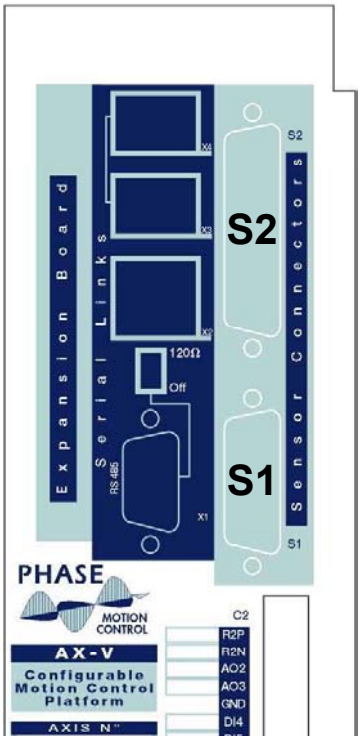
NOTE: As specified in the EMC IEC-22G-21/CDV norm, AXV drives are not domestic appliances and can cause interference to radio and tv reception.

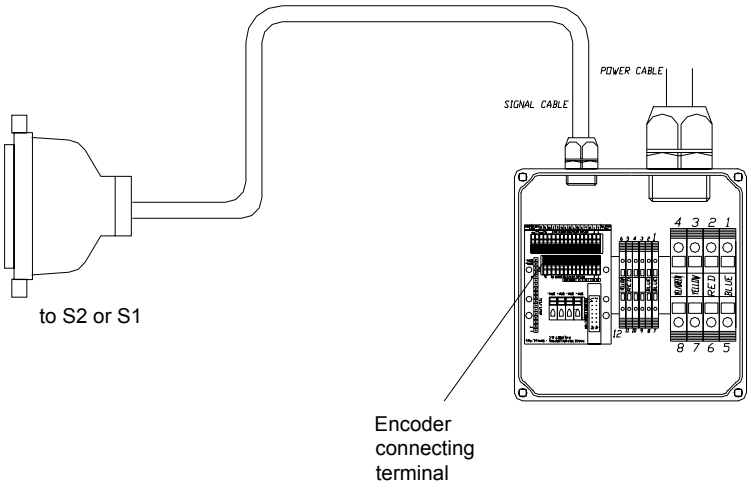
## 12.11 EC Declaration of conformity

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

NOTE: ULTRACT and MINACT series motors and AXV brushless drives series are not stand-alone systems, and are specified to application fields 2 and 3 in accordance with IEC-22G-21/CDV. The conformity with EMC directive cannot be verified on such components.
To assist its own customers, Phase Motion Control declares that AXV drives running Ultract or Minact motors assembled in accordance with the instructions above and completed with the filter SHAFFNER FN251/16/07 or something equivalent, with up to 100 meters of shielded-conductor cable between the drive and the motor, following the cabling normative explained in the user manual, allows the active system (PDS) to satisfy the requirements of the IEC-EN 55011 norm Class A and EN 50022 Class B.
As Components the AXV drives comply with the IEC 1000-4-2 (IEC 801-2) and IEC 1000-4-4 (IEC 801-4), without any accessory or protection.

# 13 Appendix A: ULTRACT MOTORS to DRIVE AXV Connections




| | SINCOS ENCODER 5 TRACKS (Type S, P, SJ)* | | DIGITAL ENCODER (Type E, F, G, GJ)* | | RESOLVER (Type R)* | |
|---|---|---|---|---|---|---|
| Pin motor terminal board (motor side) | Pin AX-V 25 poles connector (S2) | | Pin AX-V 25 poles connector (S2) | | Pin AX-V 25 poles connector (S2) | |
| 1 | 3 | Pair 1 | 25 | Pair 1 | 12 | Pair 1 |
| 2 | 16 | Pair 1 | 10 | Pair 1 | 24 | Pair 1 |
| 3 | 1 | Pair 2 | 21 | Pair 2 | 18 | Pair 2 |
| 4 | 14 | Pair 2 | 8 | Pair 2 | 6 | Pair 2 |
| 5 | 2 | Pair 3 | 7 | Pair 3 | 17 | Pair 3 |
| 6 | 15 | Pair 3 | 20 | Pair 3 | 5 | Pair 3 |
| 7 | 10 | Pair 4 | 1 | Pair 4 | n.c. | n.c. |
| 8 | 25 | Pair 4 | 14 | Pair 4 | n.c. | n.c. |
| 9 | 17 | Pair 5 | 16 | Pair 5 | n.c. | n.c. |
| 10 | 5 | Pair 5 | 3 | Pair 5 | n.c. | n.c. |
| 11 | 18 | Pair 6 | 9 | Pair 6 | n.c. | n.c. |
| 12 | 6 | Pair 6 | 22 | Pair 6 | n.c. | n.c. |
| 13 | n.c. | n.c. | 15 | Pair 7 | n.c. | n.c. |
| 14 | n.c. | n.c. | 2 | Pair 7 | n.c. | n.c. |
| 15 | 11 | Pair 7 | 11 | Pair 8 | 11 | Pair 4 |
| 16 | 19 | Pair 7 | 19 | Pair 8 | 19 | Pair 4 |
| 17 | Reserved (PTC+)** | | Reserved (PTC+)** | | Reserved (PTC+)** | |
| 18 | Reserved (PTC-)** | | Reserved (PTC-)** | | Reserved (PTC-)** | |
| NOTE: Always use shielded cables with twisted pairs. Connect the shield to ground on motor side and to pin 4 of connector S2 on AX-V side. In case of use of cables with double shield, the inner shield should be connected only on AX-V side together with outer shield. | | | | | | |

* Encoder type is impressed on motor label (Feedback Device)

** Internally connected at factory