CMZ SISTEMI ELETTRONICI

soga energyteam

Solutions in *motion*

EASY

Installation guide

Intelligence Production Movement

Doc. TR401507

WARNING

This is a general manual describing a series of servo drives having output capability suitable for driving AC brushless sinusoidal servo motors.

Please see also:

- **EASY User Guide** for the operation of the drive (commissioning, configuration, ...)
- **EASY STO** for the Safe Torque Off function
- **Gem Drive Studio software Quick Start** manual for the drive parameterization.

Instructions for storage, use after storage, commissioning as well as all technical details require the MANDATORY reading of the manual before getting the drives operational.

Maintenance procedures should be attempted only by highly skilled technicians having good knowledge of electronics and servo systems with variable speed (EN 60204-1 standard) and using proper test equipment.

The conformity with the standards and the "CE" approval is only valid if the items are installed according to the recommendations of the drive manuals. Connections are the user's responsibility if recommendations and drawings requirements are not met.

Any contact with electrical parts, even after power down, may involve physical damage.
Wait at least 10 minutes after power down before handling the drives (a residual voltage of several hundreds of volts may remain during a few minutes).

Caution: Hot surface, risk of burns (wait for cooling after power down).

ESD INFORMATION (ElectroStatic Discharge)
CMZ Sistemi elettronici S.r.l. drives are designed for being best protected against electrostatic discharges. However, some components are particularly sensitive and may be damaged if the drives are not properly stored and handled.

STORAGE

- The drives must be stored in their original packaging.
- When taken out of their packaging, they must be stored positioned on one of their flat metal surfaces and on a dissipating or electrostatically neutral support.
- Avoid any contact between the drive connectors and material with electrostatic potential (plastic film, polyester, carpet…).

HANDLING

- If no protection equipment is available (dissipating shoes or bracelets), the drives must be handled via their metal housing.
- Never get in contact with the connectors.

WASTE DISPOSAL
In order to comply with the 2002/96/EC directive of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE), all CMZ Sistemi Elettronici S.r.l. devices are labelled with a sticker symbolizing a crossed-out dustbin as shown in Appendix IV of the 2002/96/EC Directive.
This symbol indicates that CMZ Sistemi Elettronici S.r.l. devices shall be eliminated by selective disposal and not with household waste.

CMZ Sistemi Elettronici S.r.l. does not assume any responsibility for any physical or material damage due to improper handling or wrong descriptions of the ordered items.
Any intervention on the items, which is not specified in the manual, will immediately cancel the warranty.

CMZ Sistemi Elettronici S.r.l. reserves the right to change any information contained in this manual without notice.

Content

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Chapter 1 – General

1.1 - INTRODUCTION

EASY all-digital drives with sinusoidal PWM control are servo drives that provide the control of brushless AC motors.

The standard control interface can be:

- CANopen®[1],
- Analog.

Series EASY drives are dedicated to basic applications that do not have a high level of requirements in terms of functionalities and where cost effectiveness is very important.

The EASY can be used in following typical applications:

- Axes controlled by CANopen® fieldbus according to the DS402 protocol,
- Stand-alone operation as a sequencer with control by means of logic I/Os,
- Traditional analog speed drive with +/- 10 V command and A, B, Z encoder output for the position feedback.

The configuration and parameterization software tool Gem Drive Studio allows a quick configuration of the EASY drives according to the target application.

1.2 - DESCRIPTION / COMPLIANCE WITH THE STANDARDS

1.2.1 - General description

The EASY drive can be configured in 4 feedback modes:

- Resolver or Analog hall (Sin Cos Track)
- TTL encoder with or without Hall effect sensors
- Hall effect sensors only
- Sensorless

The appropriate position sensor configuration is software selectable and saved in the drive.

When using a position sensor, this sensor ensures a high dynamic motor torque/force control and full torque/force is available at low speed and standstill.

▪ With a **resolver** sensor feedback, the motor absolute position value over one revolution is available and the servo motor can immediately be enabled after the drive power up.

▪ With an **incremental encoder** only**,** a motor phasing procedure **(Phasing)** must be executed at each drive power up before the motor enabling.

▪ With an **incremental encoder + Hall Effect Sensors (HES)** feedback, the motor phasing procedure is no more necessary and the servo motor can immediately be enabled after the drive power up.

▪ With only a Hall effect Sensor (HES) feedback, the position resolution is low, involving reduced dynamic performances.

▪ In **sensorless** mode, a motor phasing procedure is automatically executed at the drive enabling.

[1] *CANopen® is a registered Community Trademark of CAN in Automation e.V, Germany.*

Series EASY drives have their own DC/DC converter to provide the voltages required for the drive operation with a 24 V_{DC} +/- 15 % supply source which is generally available on machines. The auxiliary supply allows keeping the drive logic supplies after the power supply has been switched off. Thus, the position output can be kept without new initializations of the machine. A 24 V_{DC} battery supply with specific wiring allows keeping the position even after switching off the auxiliary 24 V_{DC} supply. This wiring can be used for getting an "absolute" servo drive operation.
A soft start system limits the inrush current at the mains power on.

All control parameters are programmable via a serial link (e.g. RS-232) and saved in a memory. The auto-tuning and auto-phasing functions allow a quick and easy commissioning of the drive.

Thanks to the **Gem Drive studio** software tool, which is PC compatible with the WINDOWS® operating system, all drive parameters can be displayed and easily modified.

Gem Drive Studio also allows the quick configuration of the EASY drive according to the application type.

The **Digital Oscilloscope** of this software tool ensures an easy and quick commissioning of the drive.

The **Gem Drive Studio** software also allows parameterization and diagnostic in a multi-axis configuration.

1.2.2 - Reference to the standards: CE

Electromagnetic compatibility

According to the Directive 2004/108/EC, the actuators are complying with the Electromagnetic Compatibility standards regarding the power servos, referenced in the EN 61800-3 – Part 3 about "Electrical power servo systems with variable speed":

EMISSION	
EN 61800-3	**C1 category equipment** – table 14
IMMUNITY	
EN 61000.4-2-3-4.5-6	**Expected use**: **Second environment** including other areas than those directly supplied with electricity by a public low-voltage mains network.

NOTE: Industrial areas and technical rooms are examples of second environment.

Security:

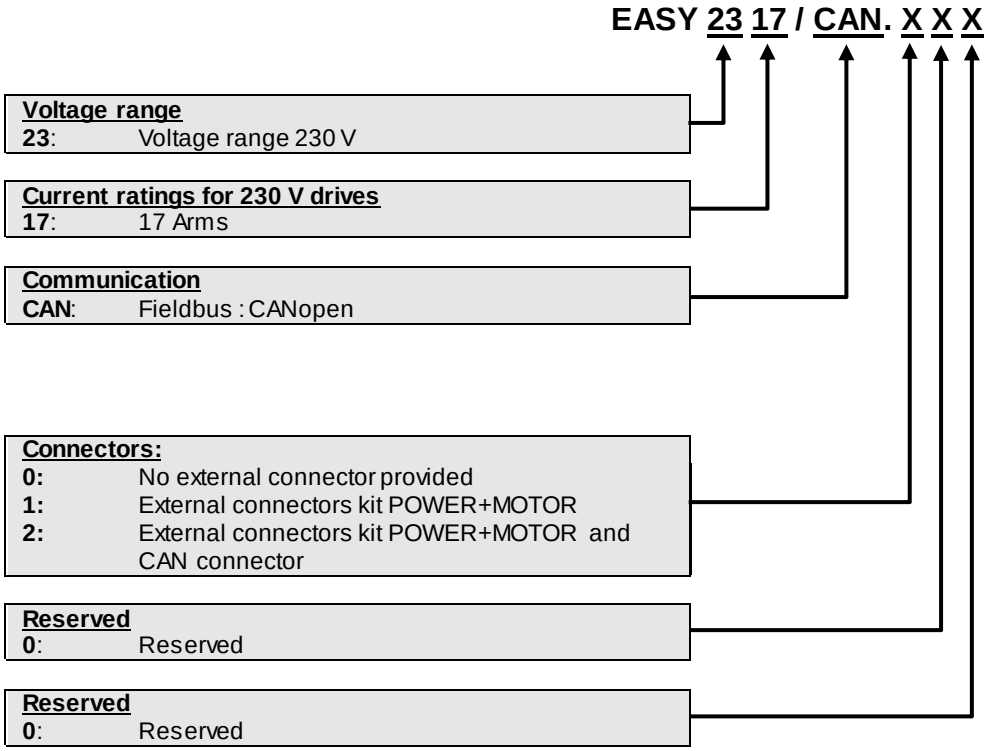
73/23/EEC modified by the directive 93/68/EEC:	Low voltage directive
EN 61800-5-1: (Overvoltage category III, System Voltage = 300 V)	Electrical, Thermal and Energetic security requirements
EN 60204-1:	Safety of machinery: electrical equipment of machines
UL508C:	Power Conversion Equipment
UL840:	Insulation coordination for electrical equipment
EN 61800-5-2:	Adjustable speed electrical power drive systems : Safety requirements - Functional

EC conformity of the EASY drive

1.3 - OTHER DOCUMENTS

- EASY User guide.
- EASY STO manual.
- Gem Drive Studio software Quick Start manual.

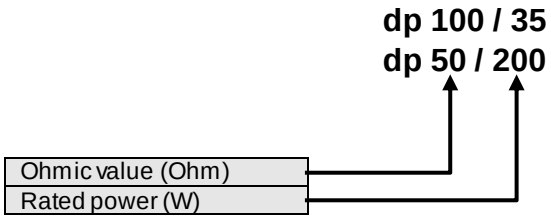
1.4 - ORDERING CODE



1.5 - ACCESSORIES

1.5.1 - Ordering code of the braking resistor for EASY-230/17

The recommended braking resistor types are:



Chapter 2 – Specifications

2.1 - MAIN TECHNICAL DATA

2.1.1 - EASY-230/17

Design	Stand-alone
Available cooling version	Natural convection
Operating power supply voltage (1)	110 to 230V_{AC} +/- 10% single-phase 50 - 60Hz Grounded neutral system with balanced phase to ground voltage
Undervoltage threshold(1)	100V_{DC}
Braking threshold(1)	390V_{DC}
Overvoltage threshold(1)	430V_{DC}
EMC filter on the mains power supply	Fully integrated in the drive
Motor phase-to-phase output voltage	95% of mains voltage
External braking resistor(1)	Minimum external resistor: 50 Ω
Minimum phase-to-phase inductance(1)	1mH
Galvanic isolated auxiliary supply voltage	24V_{DC} +/-15% - 150mA (without output loads)
EMC filter on auxiliary supply	Integrated in the drive

(1) These values correspond to the default configuration of the drive. For lower operating voltage, see section 5.2 "Low operating voltage".

OUTPUT CURRENT RATINGS

Type	Max. output current for 3 s (Arms) (1)	Rated output current (Arms)	Power losses at rated current (W)	Thermal resistance	Rated input current (Arms)	Maximum protection line circuit fuses	Mains short-circuit power
Easy-230/17	17	5 (2)	34 (2)	1.6°C/W	9 (2)	20 A	5 kA

(1) Internal protection automatically divides the time by 3 at standstill.
(2) As from serial number 11344000.

Maximum surrounding air temperature: 40°C.

2.1.3 - Technical specifications

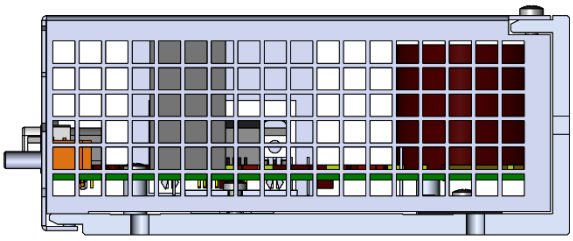
Servo loops: current, speed, position	Digital
Position sensor	Sin Cos tracks (analog Hall) Transmitter resolver TTL Incremental encoder TTL Incremental encoder + Hall Effect sensors Hall Effect Sensors only
Power protections	See section 3.1.1 - LEDs
Switching frequency	8 kHz
Analog input 1	±10 V (resolution: 12 bit)
Speed and position regulators	Sampling period = 0.5ms Anti-wind-up system of the integrator Anti-resonance filter Adjustable digital gains
Speed loop bandwidth	Selectable cut-off frequency for 45° phase shift: 50Hz (low), 75Hz (medium) or 100Hz (high)
Current loop bandwidth	Cut-off frequency for 45° phase shift: 500Hz (low) or 1000Hz (high)
Max. motor speed	Adjustable from 100 to 25'000rpm
Drive reaction time (initialization delay before PWM on)	6.25ms
Encoder position output	Encoder output is only available if TTL encoder is connected.
Resolver input	Software selectable: Transmitter resolver: Excitation frequency: 8 kHz Max. output current = 30 mA Transformation ratio: 0.3 to 0.5 (other values are factory set) Sin Cos tracks : 1Vpp to 4Vpp Sin and Cos signals
Encoder input	Software selectable: Quadrature signals A& B + one Z marker pulse per revolution. Line receiver: RS-422 Max. frequency of encoder pulses: 400kHz Resolution: 500 to 10^6ppr
Hall sensors input	5V to 24V positive logic voltage accepted External HES supply voltage required if different from 5V HES sequence error detection
Logic inputs	4 GND referenced logic inputs: - 3 software configurable logic inputs - Response time: 500µs - 1 input dedicated to the STO/INHIBIT function Response time: < 50ms
Capture input	1 programmable input (IN1, IN2 or IN3) Response time: 62.5µs

Logic outputs	2 software configurable logic outputs type PNP "high side" 24V_{DC}, max. 500mA Response time: 500µs
Error display	Front panel LEDs + diagnostic via serial link or CAN bus
Motor and application parameterization	Serial link RS-232 or bus interface with CANopen® communication protocol
CAN interface	CANopen® Protocol (DS301, DSP402)
Automatic functions	Drive adjustment to the motor (AUTO-PHASING) Adjustment of the servo loops (AUTO-TUNING)
MTBF (Mean Time Between Failures)	> 100'000 hours
Maximum surrounding air temperature	- Operation: -40°C to +50°C: from 40°C, the rated current must be reduced by 3% per additional Celsius degree - Storage: -40°C to +50°C
Altitude	1000 m

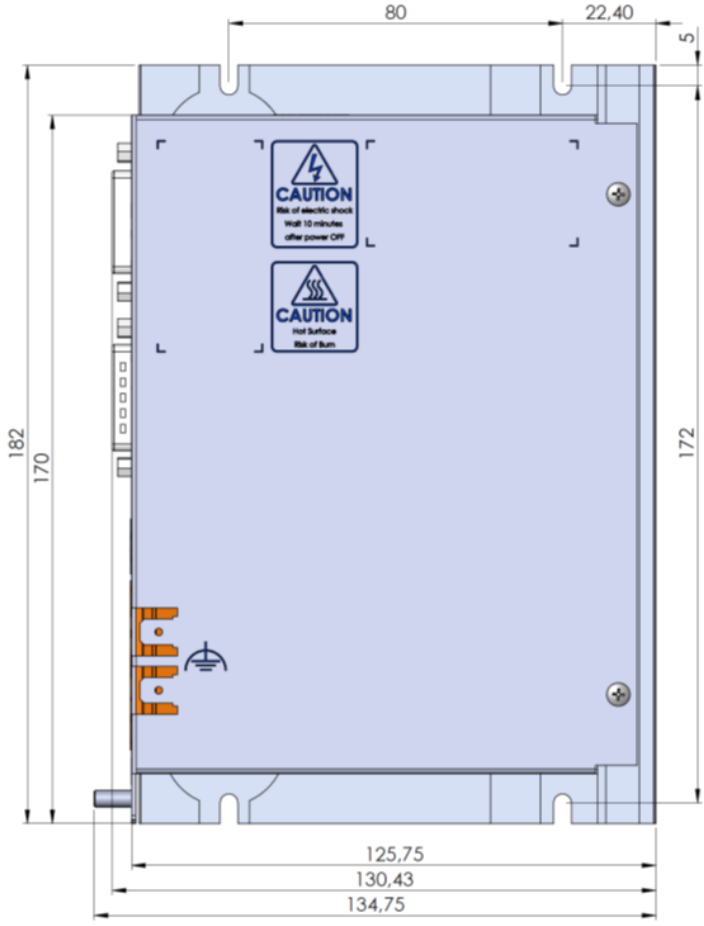
Moisture	< 50% at 40°C and < 90% at 20°C: EN 60204-1 standard **Condensation prohibited (storage and operation)**
Cooling	Natural air convection Check for free air convection and for no obstruction of the upper or lower air admissions.
Environment	Open chassis to be mounted inside a cabinet protecting the drive from conducting dust and condensation (pollution degree 2 environment) and according to the room temperature requirements.
Pollution degree of the drive	IP20
Mounting position	Vertical
Weight	approximately 900g

2.2 - DIMENSIONS AND CONNECTOR LOCATION

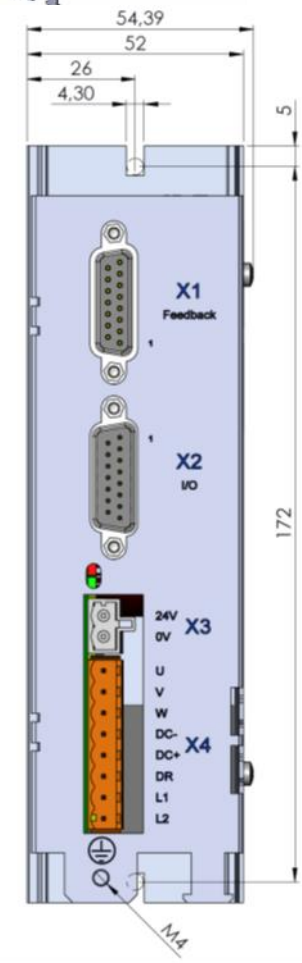
2.2.1 - EASY-230/17 dimensions (mm)



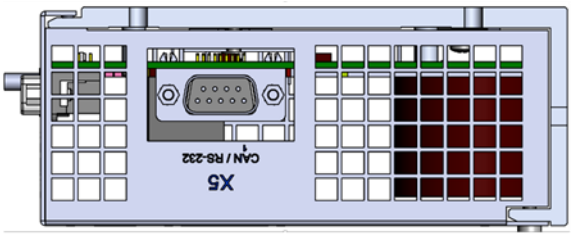
BOTTOM VIEW



SIDE VIEW



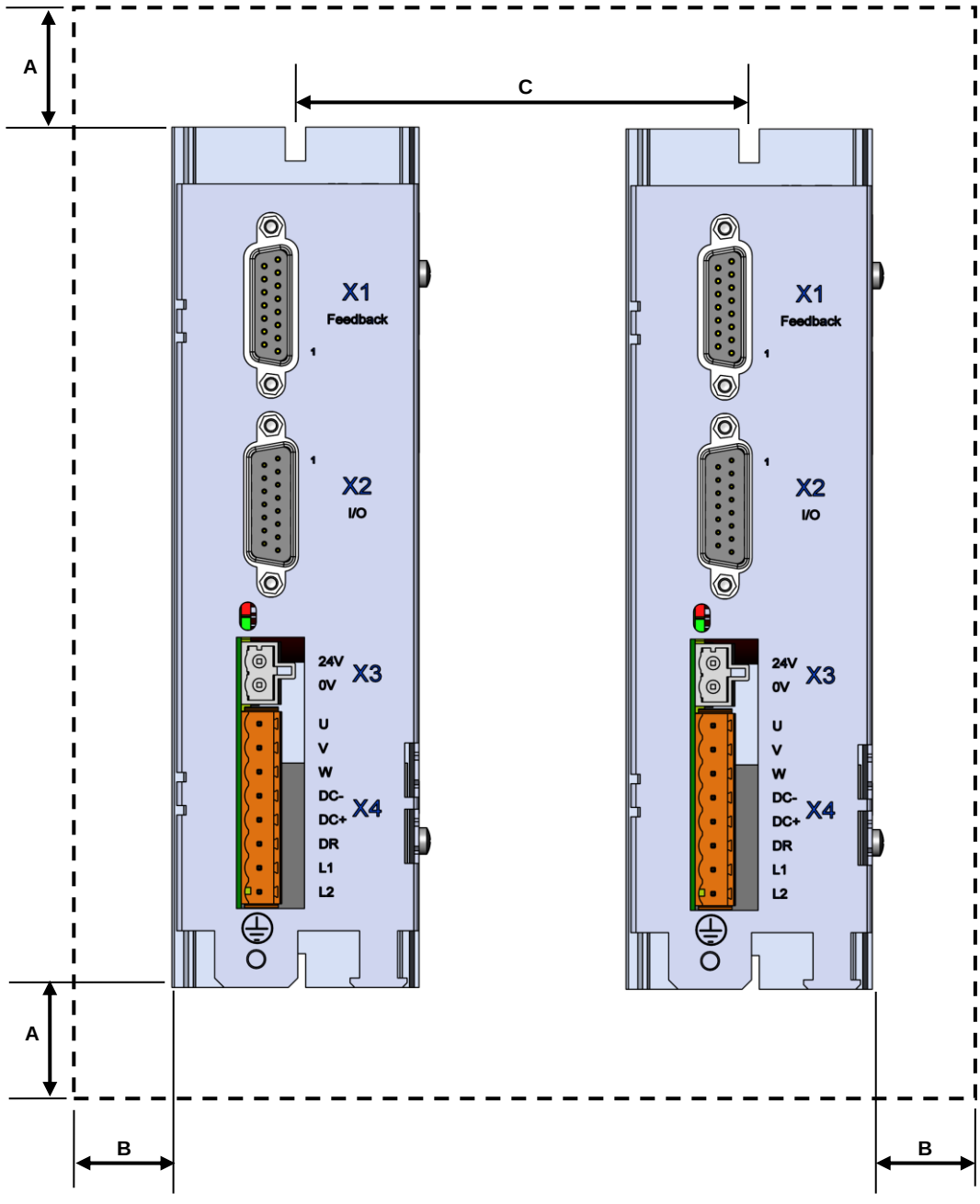
FRONT VIEW



UPPER VIEW

2.2.4 - EASY-230/17: Panel layout dimensions (mm)

VERTICAL MOUNTING IS MANDATORY



Description	Symbol	Easy-230/17
Minimum top and bottom clearance	A	50
Minimum side clearance	B	30
Recommended pitch	C	80

Chapter 3 – Inputs - Outputs of the EASY range

3.1 - DISPLAY

3.1.1 - Leds

RUN (green) 

ERROR (red) 

RUN: status of the CANopen® communication bus connection.

ERROR: faults grouped on the 'ERROR' LED: these errors are coded and can be displayed by means of the parameter setting software.

ERROR LED unlit if no fault.
ERROR LED flashing: 'UNDERVOLTAGE' error: no power supply voltage.
ERROR LED continuously lit: fault.

The **ERROR** LED groups the following faults:

- Power supply overvoltage.
- $24V_{DC}$ logic supply < $17.5V_{DC}$.
- Motor phase / GND short-circuit.
- Braking system short-circuited or overheated, or braking resistor in open circuit.
- Motor phase / motor phase short-circuit, power stage overtemperature, defective IGBT module.
- Triggering of the I^2t protection.
- Counting error.
- Position following error
- EEPROM error.
- Procedure execution error (busy).
- Current offset error.
- Drive rating overcurrent.
- Motor temperature error.
- Resolver or encoder cable interruption.
- Hall sensors or absolute encoder error.

Notes

Any of these errors (except for the "Undervolt." error) involves:

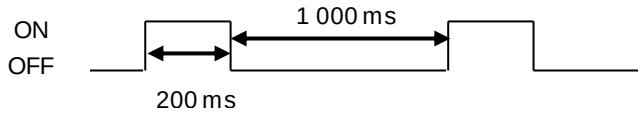
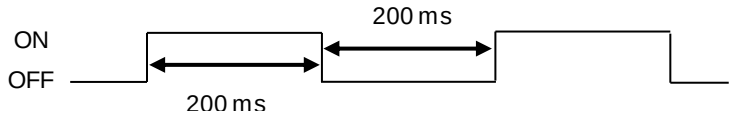
- The continuous lighting of the red **ERROR** LED,
- The drive disabling,
- The motor brake control,
- The disabling of the **AOK** output. This output must be wired as described in the connection diagram of section 4.1, in order to switch-off the power supply.

The 'UNDERVOLTAGE' error (flashing **ERROR** LED) involves:

- The drive disabling,
- The motor brake control.

3.1.2 - CANopen® communication bus

RUN: The CANopen® RUN LED indicates the status of the NMT state machine (see DS-301 – 9.52 NMT state machine):

CAN RUN LED	STATUS	
FLASHING	STOP	
BLINKING	PRE-OPERATIONAL	
ON	OPERATIONAL	

See "DR-303-3 Indicator specification" for more information.

Note:
Each drive of the network must be configured with one single address.
The factory set addressing is address 1 and the default communication speed is 1 Mbits.

3.2 - FEEDBACK CONNECTOR: X1

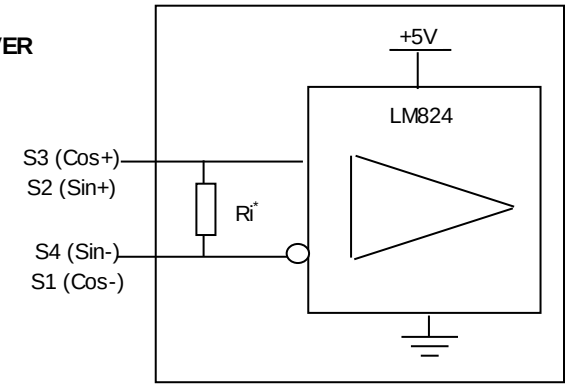
The feedback connector is a Sub D 15 pin female.

3.2.1 - X1 connector for transmitter resolver input

The wiring of the EASY drive resolver is compatible with the LBD and CD1-K series.
The "Transmitter resolver" configuration is software selectable and saved in the drive EEPROM.

PIN	FUNCTION	I/O	DESCRIPTION
12	TC-	I	Motor thermal sensor inputs. The valid measurement range is between 100Ω and 44kΩ.
13	TC+	I	
2	S3 (cosine +)	I	Resolver signal
10	S1 (cosine -)	I	Resolver signal
11	S2 (sine +)	I	Resolver signal
3	S4 (sine -)	I	Resolver signal
5	R1 (reference +)	O	Resolver signal
4	R2 (reference -)	O	Resolver signal
Others	Reserved		

SPECIFICATION OF THE RESOLVER INPUT LINES



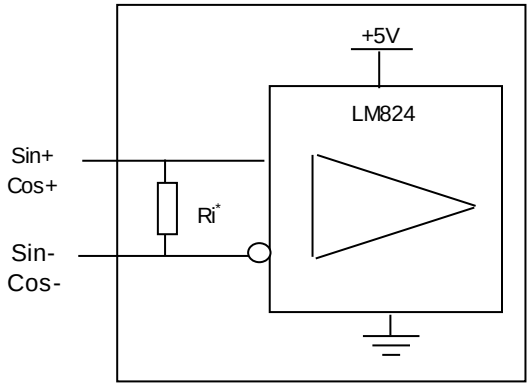
(*) Ri > 4.9K

3.2.2 - X1 connector for Sin Cos tracks input

PIN	FUNCTION	I/O	DESCRIPTION
12	TC-	I	Motor thermal sensor inputs. The valid measurement range is between 100Ω and 44kΩ.
13	TC+	I	
2	cosine +	I	SinCos track signal
10	cosine -	I	SinCos track signal
11	sine +	I	SinCos track signal
3	sine -	I	SinCos track signal
7	+5V	O	Sensor supply voltage
8	GND	O	Sensor supply GND
Others	Reserved		

SPECIFICATION OF THE SIN COS TRACKS INPUT LINES

(*) Ri > 4.9K

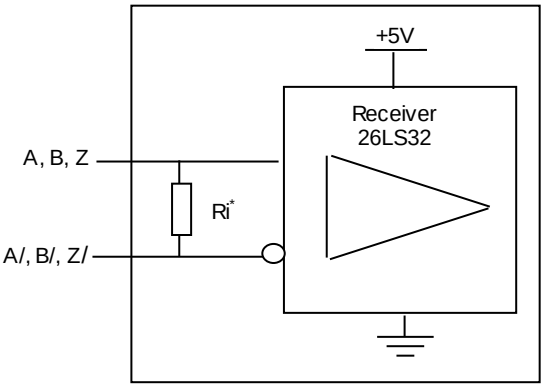


3.2.3 - X1 connector for incremental TTL & HES encoder input

The “Incremental TTL & HES encoder” configuration is software selectable and saved in the drive EEPROM.

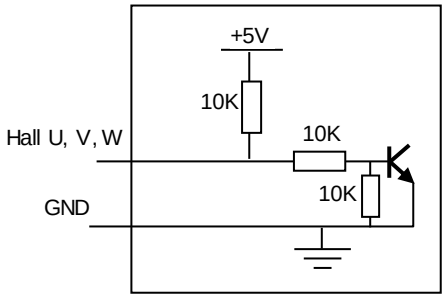
PIN	FUNCTION	I/O	DESCRIPTION
9	Z/ marker pulse	I	Differential input of the encoder marker pulse Z/
1	Z marker pulse	I	Differential input of the encoder marker pulse Z
2	A/ channel	I	Differential input of the encoder channel A/
10	A channel	I	Differential input of the encoder channel A
11	B/ channel	I	Differential input of the encoder channel B/
3	B channel	I	Differential input of the encoder channel B
7	+5V	O	Encoder supply voltage (max. current = 300mA)
8	GND	O	Encoder supply GND
6	HALL U	I	Hall sensor input signal phase U
14	HALL V	I	Hall sensor input signal phase V
15	HALL W	I	Hall sensor input signal phase W
12	TC-	I	Motor thermal sensor input. The valid measurement range is between 100Ω and 44kΩ.
13	TC+	I	
Others	Reserved		

SPECIFICATION OF THE INCREMENTAL TTL ENCODER INPUT LINES



(*) Ri > 4.9K

SPECIFICATION OF THE HALL SENSOR INPUT LINES



	Min.	Max.
High input voltage	3.3V	24V + 15%
Low input voltage	0V	0.6V

Hall inputs are compatible with open collector outputs, without any external component.

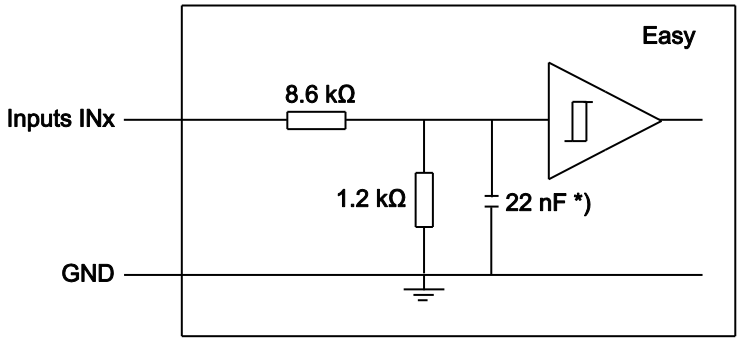
3.3 - INPUTS-OUTPUTS CONNECTOR: X2

SUB D 15 PIN MALE CONNECTOR

PIN	FUNCTION	I/O	DESCRIPTION
1	IN1 (configurable)	I	All logic inputs are referenced to GND Vin voltage = 18V < Vin < 27V Input impedance Zin = 10kOhms IN4 input is dedicated to STO
2	IN2 (configurable)	I	
3	IN3 (configurable)	I	
4	IN4 (STO/INHIBIT)	I	
15	Differential encoder output channel A	O	Differential encoder outputs Signals directly provided by the TTL encoder.
8	Differential encoder output channel A/	O	
14	Differential encoder output channel B	O	
7	Differential encoder output channel B/	O	
13	Differential encoder Marker pulse Z	O	
6	Differential encoder Marker pulse Z/	O	
9	OUT1	O	"High side" logic outputs 24V / 500mA
10	OUT2	O	
11	GND	O	
12	ANA1+	I	Analog input nr. 1 Differential input +/-10V *
5	ANA1-	I	

(*) For a non-differential input signal, ANA1- must be connected to GND on the drive side.

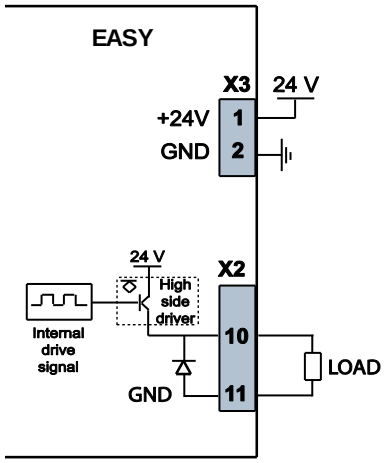
3.3.1 - Specification of the logic inputs



*) From serial number 11420004, the capacitor value is 10µF for the IN4 input only, in order to support safety relays with test pulse output (for short-circuit detection).

	Minimum	Recommended	Maximum
High input voltage	18V	24V	27V
Low input voltage	0V	0V	5V

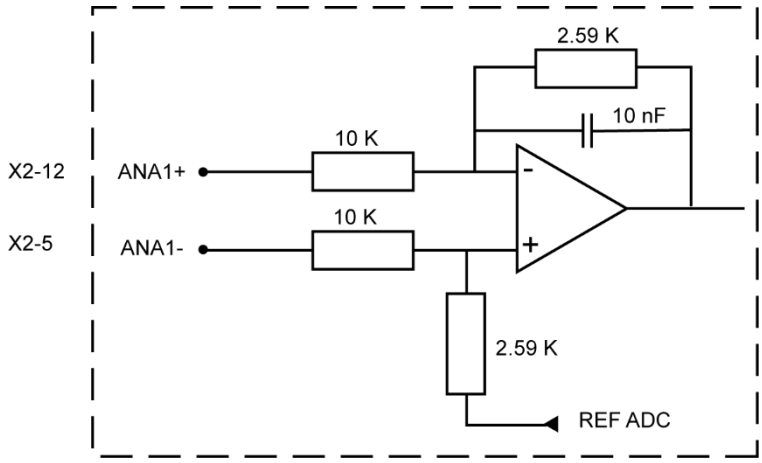
3.3.2 - Specification of the logic outputs OUT1 and OUT2



Digital outputs can be paralleled in order to increase the maximum output current.
Be careful to connect all paralleled outputs to the same drive signal.

Paralleled outputs	Output voltage	Maximum output current
1	24V	500mA
2	24V	900mA

3.3.3 - Specification of the analog inputs ANA1+/-



3.4 - COMMUNICATION CONNECTOR: X5

SUB D 9 pin male connector

PIN	FUNCTION	REMARKS
1	Termination resistor	Connect X5.1 to X5.7 to enable the termination resistor
2	CAN-L	Line CAN-L (dominant low)
3	GND	GND signal for CAN communication
4	TXD	Transmit data RS-232
5	GND	GND (shield connection if no 360° connection on the connector). 360° shield connection is highly recommended.
6		Reserved
7	CAN-H	Line CAN-H (dominant high)
8	RXD	Receive data RS-232
9		Reserved

Default parameters for the CANopen® bus are:
- Transmission speed of 1 Mb/s,
- Address set at 1,

Please see **Gem Drive Studio Software Quick Start manual** for detailed information on changing this configuration.

3.5 - 24V_{DC} AUXILIARY POWER SUPPLY CONNECTOR: X3

Manufacturer: Wago
Type: Midi connector
Reference: 721-102/026-000

PIN	SIGNAL	I/O	FUNCTION	DESCRIPTION
1	24V	I	Mains isolated 24V_{DC} auxiliary power supply 0V input referenced to the GND potential on the drive housing	24V_{DC} supply: +/- 15% Consumption: 300mA without digital output loads
2	0V = GND	I		

3.6 - POWER CONNECTORS: X4

3.6.1 - EASY-230/17: X4

Manufacturer: Weidmüller
Type: BLZ 5.08 / 8
Reference: 152706
Tightening torque: 0.4 to 0.5Nm

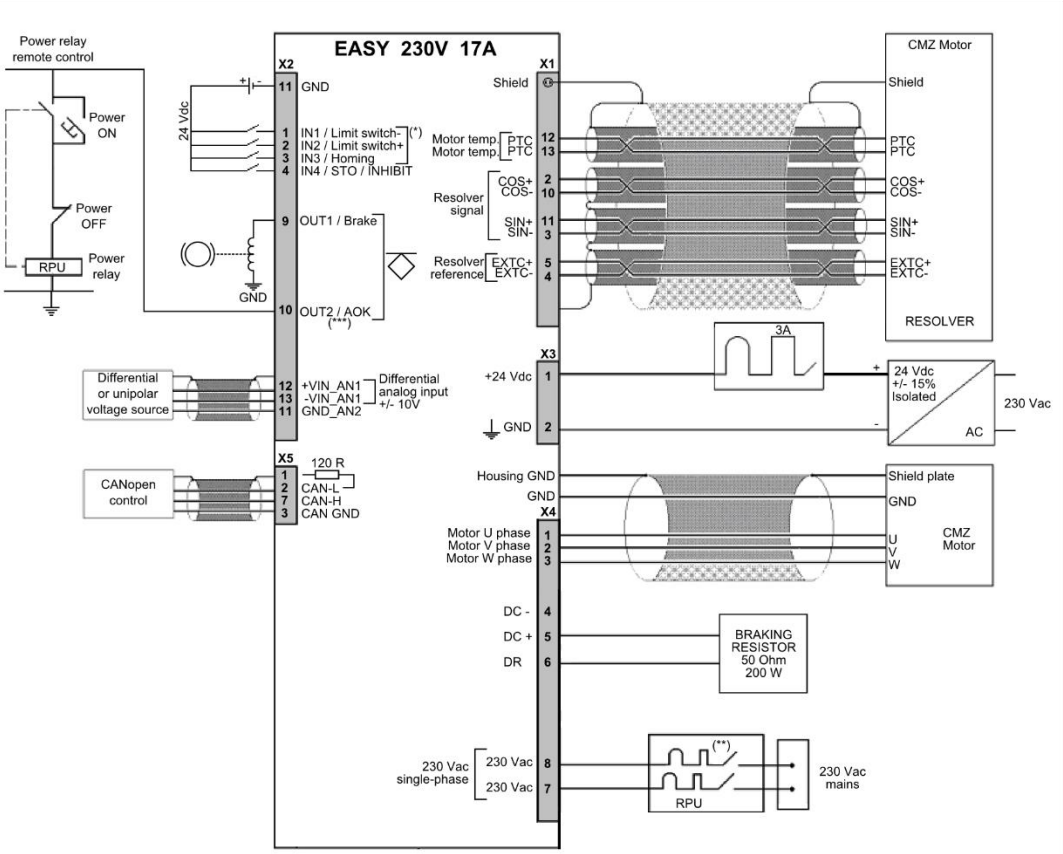
PIN	SIGNAL	I/O	FUNCTION	DESCRIPTION
1	U	O	Motor phase U	Shielded motor cable: - PE connection on the bottom plate, - 360° shield connection.
2	V	O	Motor phase V	
3	W	O	Motor phase W	
4	DC-	I/O	DC bus negative voltage output	For the DC bus paralleling in multi-axis applications
5	DC+	I/O	DC bus positive voltage output	
6	DR	O	Braking transistor output	Minimum braking resistor value = 50Ω Connect the braking resistor between pins 5 and 6.
7	L1	I	230V_{AC} single-phase mains input supply	230V_{AC} single-phase +10% / -15% Fully integrated EMC mains filter.
8	L2	I		

IMPORTANT
Motor and brake cables must be shielded.
The 360° shield connection must be ensured by metallic collars and connected to the ground reference potential.
The GND wire of the motor cable MUST be connected to the housing of the drive by means of a Faston terminal or ring terminal available at the bottom of the front panel.
See section 4.6 for grounding and shielding precautions.

Chapter 4 – Connections

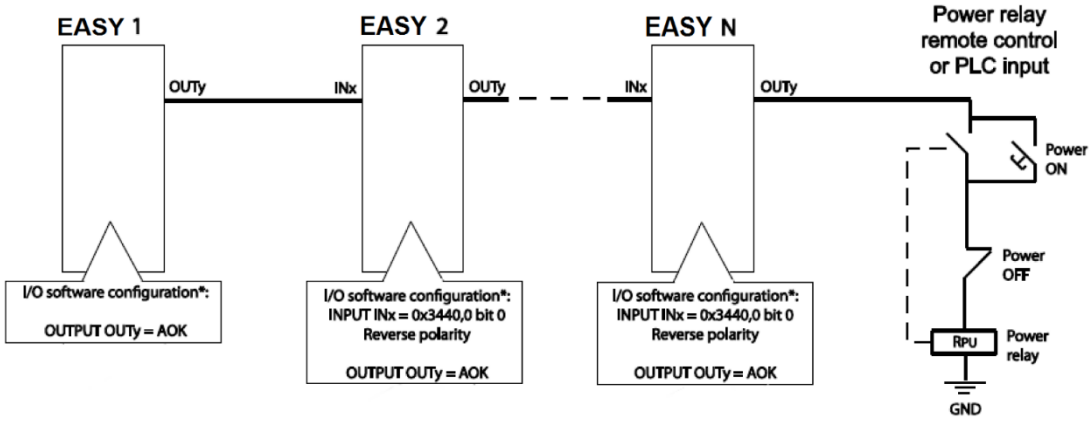
4.1 - EXAMPLES OF CONNECTION DIAGRAMS

4.1.1 - EASY-230/17 default configuration



Note: The 24V and power supply protection on source side must be ensured by the user.

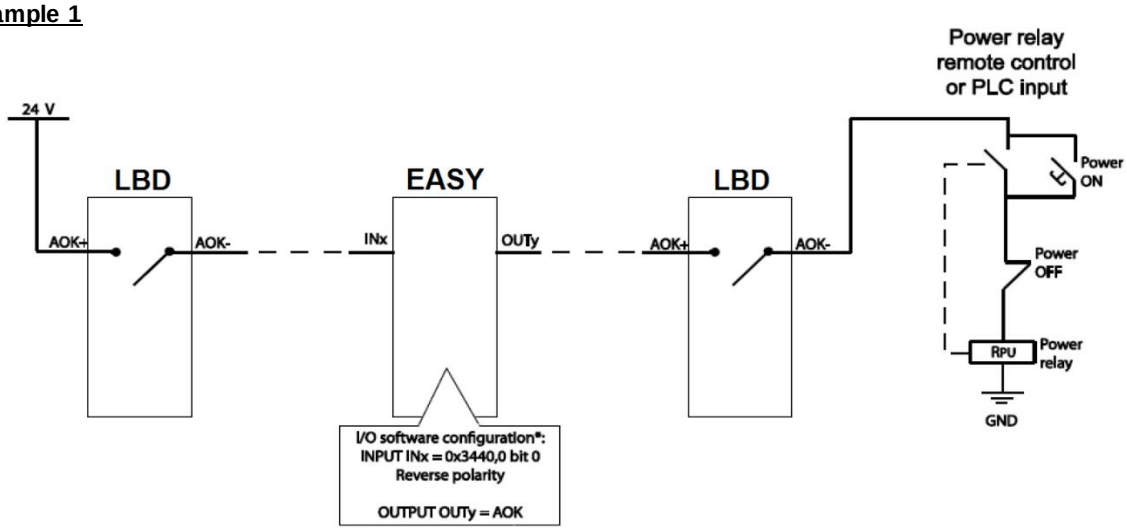
4.1.3 - AOK chaining with EASY drives only



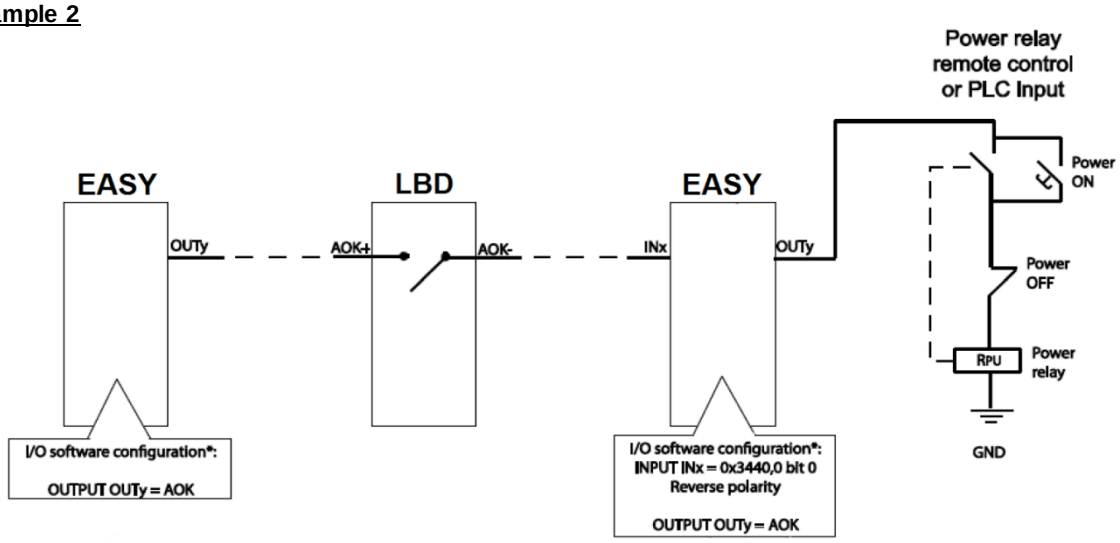
Note: Maximum delay for the power relay deactivation: number of EASY drives x 1ms.

4.1.4 - AOK chaining with EASY and LBD drives together

Example 1



Example 2



(*) INx = IN1 or IN2 or IN3 and OUTy = OUT1 or OUT2.
EASY drive inputs and outputs must be configured according to the wiring diagram.

Note: Maximum delay for the power relay deactivation: number of EASY drives x 1ms.

4.1.5 - Protections

4.1.5.1 - Auxiliary power supply

The final user has to provide an isolated auxiliary 24 V_{DC} +/-15% supply (e.g. with isolation transformer) for the auxiliary supply input, protected by a 3A fuse or circuit breaker.

4.1.5.2 - Power supply

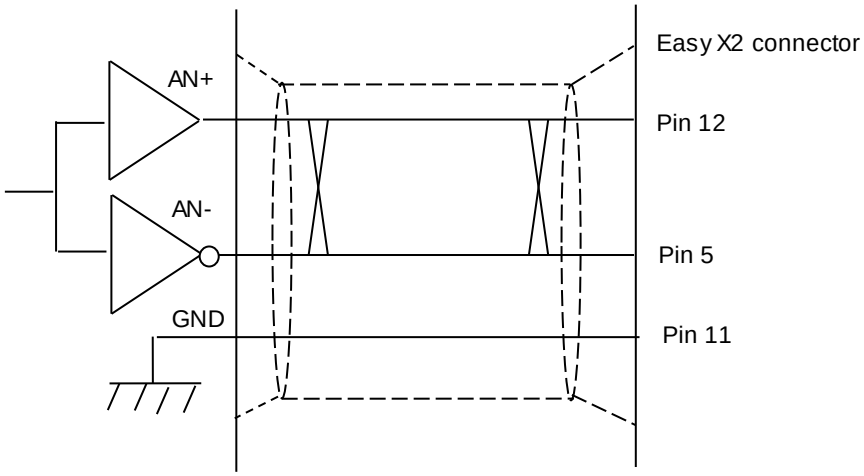
The recommended protection is a D-type: current for 1s = 10 x rated current.
The maximum mains short-circuit power must not exceed 5000 Arms.

On **EASY** drives, the recommended fuse or circuit breaker ratings are the following:

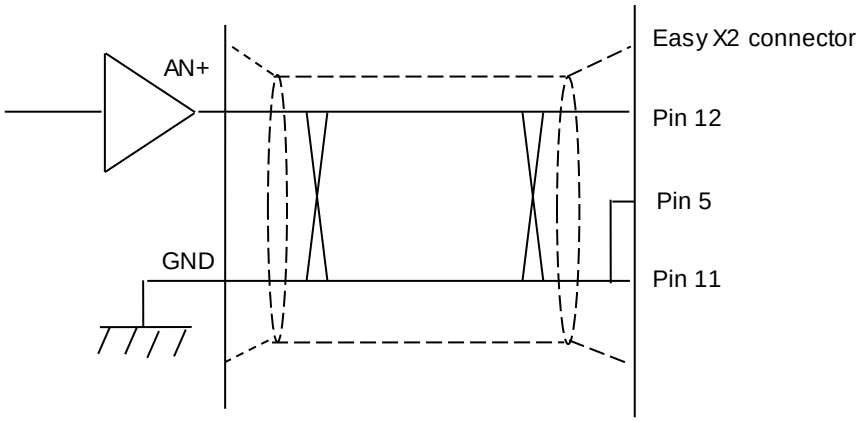
	Recommended D-type protection rating
Easy 230 V / 17 A	10A

4.2 - ANALOG INPUTS CONNECTION

4.2.1 - ANA1 input connection with a differential analog signal source

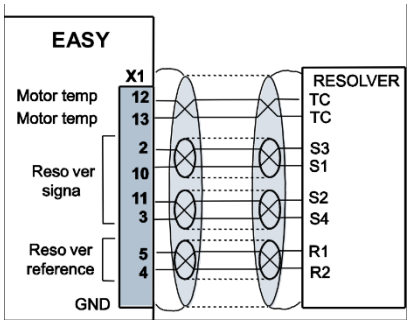


4.2.2 - ANA1 input connection with a non-differential analog signal source

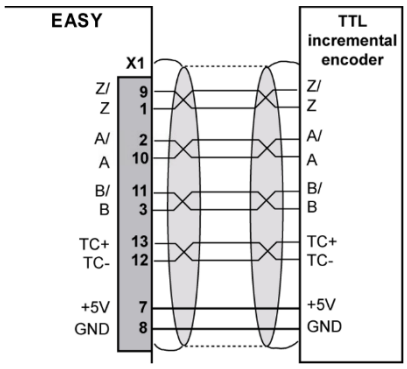


4.3 - CONNECTION TO VARIOUS SENSOR TYPES

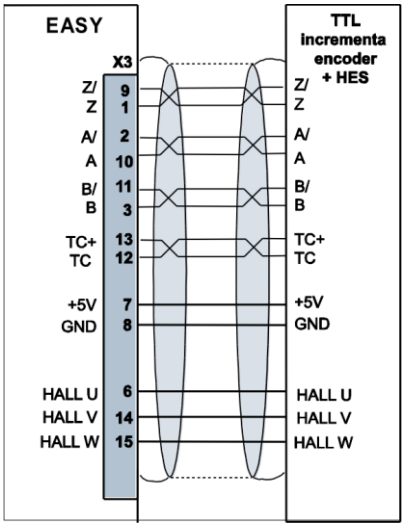
4.3.1 - Connection to a resolver: X1 - Sub D 15 pin female connector



4.3.2 - Connection to an incremental TTL encoder: X1 - Sub-D 15 pin female connector



4.3.3 - Connection to an incremental TTL encoder with Hall sensor: X1 Sub-D 15 pin female connector



4.4 - ACCESSORIES AND CONNECTIONS

4.4.1 - Connection of the external braking resistor

All EASY stand-alone drives are fitted with the power feedback system. When the motor is decelerating with high inertia and high speed, the mechanical braking energy is reflected to the drive. This energy is dissipated inside a resistor called "braking resistor".

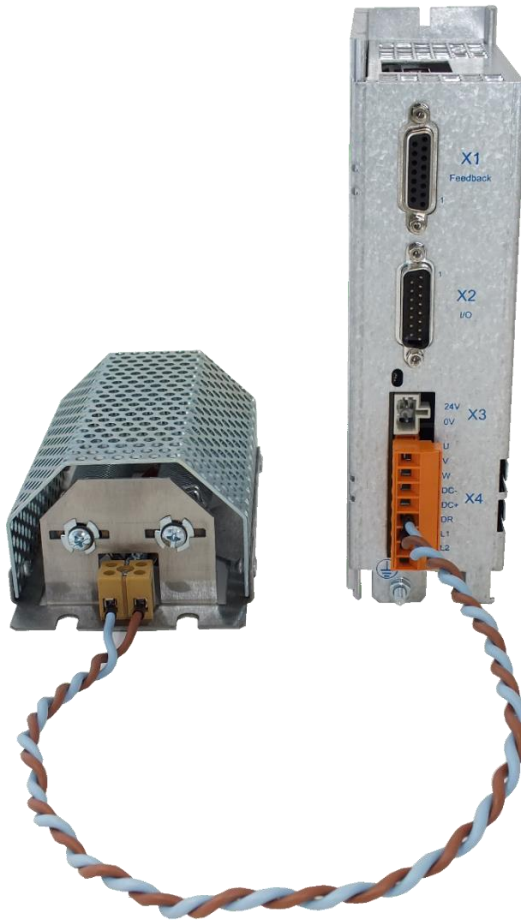
An electronic control of the dissipated power avoids the overload of the braking resistor. So, if the energy reflected to the drives is too high, the DC bus voltage will rise up to the release of the "**Overvoltage**" fault.

The braking resistor MUST be mounted out of range of heat sensitive and inflammable parts (plastic, cable sleeves, etc.).

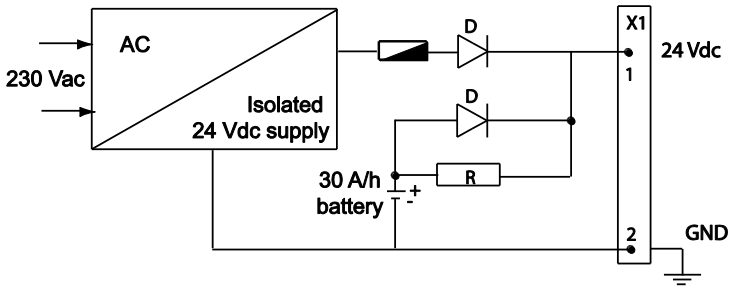
In order to avoid any EMC or electrical problem, some rules must be observed:

- heat must be evacuated,
- shielded cables or at least twisted wires must be used,
- wires must bear high voltage and high temperature (recommended type: UL1015, AWG 14)
- wires must be as short as possible (max. 1m).

Example of correctly twisted wires
The external braking resistor shall be connected between pins 5 and 6 of X4.



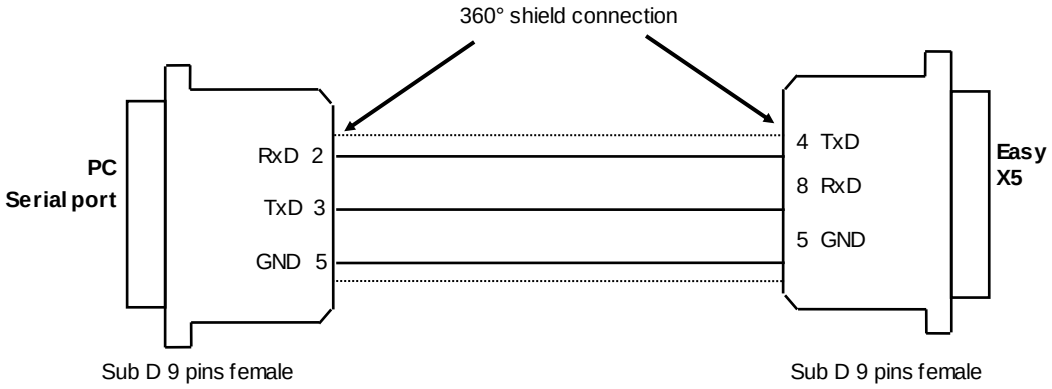
4.4.2 - Connection of a backup battery



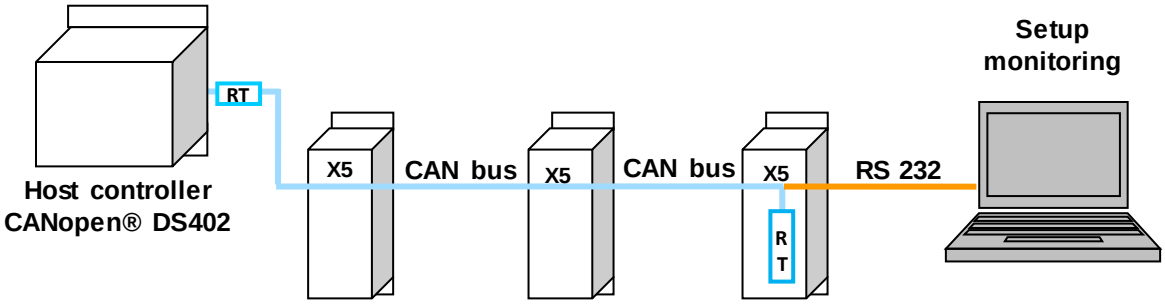
The EASY drive consumption is less than 300 mA with 24V_{DC}. So, a 24V / 30A/h battery can keep the drive powered during e.g. a long 3-day week-end. This backup method is interesting for saving the machine initialization as well as the axis position even when moving with the mains switched off.

4.5 - CONNECTION TO THE "GEM DRIVE STUDIO" SOFTWARE TOOL

4.5.1 - Connection of the serial link to the X5 connector



4.5.2 - Multi-axis connection of the serial link



RT = 120Ohm terminal resistor connected between CAN-L and CAN-H lines

The parameterization of all axes is made by one single connection to the first axis via the serial link RS232. The other axis are parameterized via the CAN bus.
Internal terminal resistor can be enabled by connecting X5.1 to X5.7.

4.6 - WIRING INSTRUCTIONS

According to the EN61000.4-2-3-4-5 and EN55011 standards.

4.6.1 - Ground connection

LEAKAGE CURRENT TO THE GROUND

The "Electronic Power Unit" equipment which includes the control, the drive, the motor and the sensors, generates a leakage current to the ground higher than 10 mA continuous: the protection conductor section must be **at least** 10mm² (Cu) or 16mm² (Al).

This product may generate a leakage current with a DC component. If a Residual Current Device is used, it should be:

- of type A in single-phase applications,
- of type B in three-phase applications.

The use of a 300mA trip current is recommended.

The PE wire of the mains cable MUST be connected to the housing by means of a Faston terminal or ring terminal.

The reference potential must be the ground: 10mm² section or ground braid to the reference potential.

If there is a potential reference, e.g. a chassis or cabinet with low impedance between its various parts, it should be used for connections to this potential which shall be itself grounded.

Reference potential loops (especially with the ground) are allowed **only** if these loops have a very low impedance (< 0.1Ω). Any shield that is not used as a conductor can be connected at both ends under the condition to be connected over 360° at both ends by means of metal links in order to ensure the shield continuity.

4.6.2 - Shield connection

CAUTION!
Each potential conducting element must be **shielded**. Several potential conductors **in one single sleeve** must be **twisted and shielded**.

A shield has no effect if it is not connected:

- to a reference potential,
- via a 360° shield connection at both ends. This means that the whole shield sleeve circumference must be directly in contact with the reference signal without any conductor insertion.

Cables with low potential should **never** run in the proximity of high power lines.

The connectors used for the compliance with the EN61000.4 standard must be made of metal or metalized and must allow the 360° shield connections.

The shield of the motor and brake cable must be connected over 360°.
The 360° shield connection must be ensured by metallic collars and connected to the ground reference potential.

The shield should never be interrupted or corrupted over the whole cable length.

4.6.3 - Example of ground and shield connections

4.6.4 - Motor, resolver and encoder cables

Motors, resolvers and encoders are grounded via their housing.
Cable inputs must be made by means of metal connectors with collars allowing the 360° shield connection.

The resolver cable must be pair twisted and shielded (sin, cos, ref.). Motor cables MUST also be shielded and connected over 360° at both ends, as shown on the shield connection picture of section 4.6.3.

Encoder inputs A, B, C, D, Z and R require pair twisted and shielded cables. The shield must have a 360° connection via metallic collars at both ends.

Check that the voltage drop in the power supply lines of the encoder cable is complying with the technical specifications of the encoder. The voltage drop value for a given cable is calculated as follows:

$$\Delta U[V] = 40.10^{-6}.\frac{L_C[m].I[mA]}{S[mm^2]}$$

with
- ΔU: voltage drop in volts
- Lc: cable length in meters
- I: encoder current in milliamps (see technical specifications)
- S: section in square millimetres

Due to this voltage drop:

- an encoder with a wide power supply voltage range should be selected,
- if the encoder has power supply SENSE feedback lines, they can be connected to the power supply lines in order to reduce the voltage drop by the half (the SENSE feedback signal is not used in this drive).

Brake equipped motors must also have their brake cables shielded in order to be EMC compliant.

Maximum cable length: 100m.

For cable length > 25m, we advise:

- the use of the maximum cable section allowed by the connectors,

- the mounting of a reactance with an inductive value between 1% and 3% of the motor inductive value for the motor cable. The reactance inductive value must be taken into account in the calculation of the current loops. The current rating of the reactance must be higher than or equal to the drive rating.

The reactance must be mounted at the drive output.
Due to the use of a reactance, a shielded cable is not mandatory anymore.
A more complex sinus filter type B84143V x R127 by company Epcos may also be mounted instead of the reactance.

UNDESIRABLE EFFECTS OF MOTOR CABLES LONGER THAN 25M:

- Heating of the power module, the motor and the cable.
- High overvoltage on the motor windings, involving a shortening of their lifetime.

The reactance reduces the undesirable effects on motor and drive but it may be quite heated. This requires an appropriate fan.

4.6.5 - Serial link and CAN communication cables

Serial link and CAN communication cables must also be shielded according to the shield connection recommendations above.

CAUTION!
Control cables (resolver, serial link, CAN) and power cables must be connected and disconnected with the drive **turned OFF**.
Reminder:
The power voltage may remain several minutes at the power capacitor terminals.
A contact with high voltage may involve severe physical damage.

4.7 - First Powering of the drive

4.7.1 - Very important

Check the connections, especially of the 24 V_{DC} and power supplies. Check that the housing serigraphy actually corresponds to the power connections.
The 400 V_{AC} connection of a 230 V_{AC} drive will destroy it!

Check that the STO/INHIBIT input is powered.
Check for the braking resistor specifications.
Check for the correct groundings as well as the 360° shield connections.

WARNING !
During the machine adjustments, drive connection or parameterization errors may involve dangerous axis movements. It is the user's responsibility to take all necessary steps in order to reduce the risk of uncontrolled axis movements during the operator's presence in the pertaining area.

4.7.2 - Connection of the 24 V_{DC} supply

The red **Err** LED on the front panel must be flashing ("Undervolt." error).
The **AOK** signal is high. The power voltage relay (Rpu) can then be controlled according to the recommendations of Chapter 4, section 1 (connection diagram). The connection must be made in compliance with the X3 connector serigraphy.

4.7.3 - Connection of the mains power supply

The red **Err** front panel LED must be unlit.

Note: If a fault occurs, the red **Err** LED remains continuously lit.

4.7.4 - Starting procedure

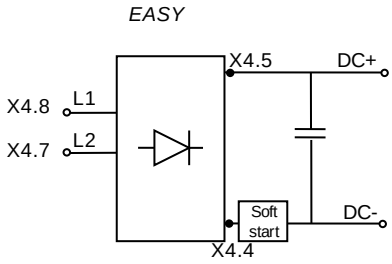
See **EASY – User Guide**.

Chapter 5 – Appendix

5.1 - SOFT START SYSTEM OF EASY-230/17

5.1.1 - Introduction

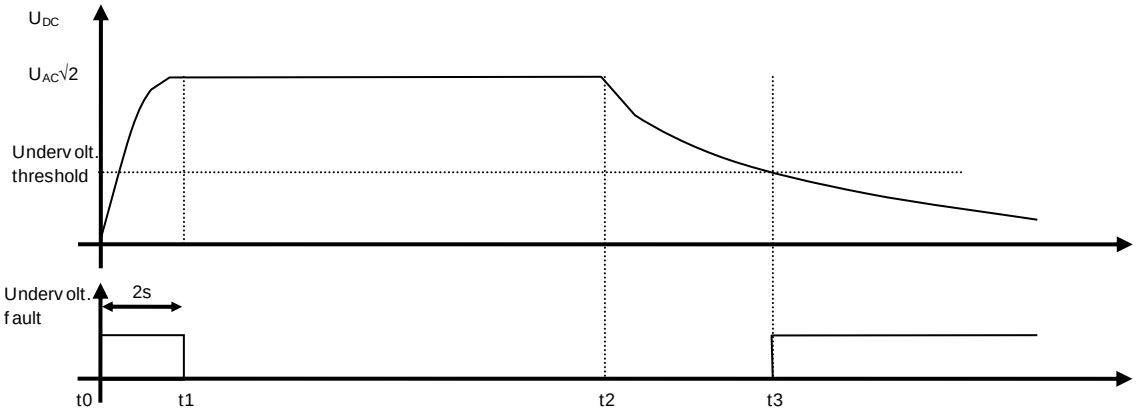
Due to the structure of diode rectifier followed by capacitors of the EASY drive, it is necessary to limit the inrush current at power up.
The EASY drive integrates a soft start system as described below:



Note: The soft start system remains operational when the drive is powered by the DC- and DC+ inputs.

5.1.2 - Integration recommendations

In order to maximize the lifetime of internal components of the EASY drive and external electromechanical components, it is necessary to switch on only when the soft start system is enabled ("Undervoltage" fault displayed).



Details:

- At t0, the power supply of the drive is switched on. DC bus capacitors are charged via the soft start system.
- After a delay of 2 s at t1, the soft start system is disabled, and the "Undervoltage" fault goes off. The drive is ready to switch on.
- Between t1 and t2, normal operations are performed by the drive.
- At t2, the drive power supply is switched off. The drive remains operational while the DC bus voltage is higher than the undervoltage threshold.
- The delay between t2 and t3 is much depending on the application (drive on/off, positive/negative motor power).
- At t3, the DC bus voltage becomes lower than the undervoltage threshold. The "Undervoltage" fault is displayed, the drive is disabled and the soft start system is enabled.

5.2 - LOW OPERATING VOLTAGE

EASY drives offer the possibility to change the operating voltage.
Thanks to this feature, EASY drives are able to work within a wide voltage range, from $24V_{DC}$ / $17V_{AC}$ up to $325V_{DC}$ / $230V_{AC}$.

Please note that the drive specifications are depending on the operating voltage, as shown in the table below:

		Operating voltage				
		$17V_{AC}$ $24V_{DC}$	**$34V_{AC}$ $48V_{DC}$**	**$42V_{AC}$ $60V_{DC}$**	**$48V_{AC}$ $68V_{DC}$**	**$230V_{AC}$ $325V_{DC}$**
Minimum inductance	8kHz	0.08mH*	0.15mH	0.2mH	0.24mH	1mH
	16kHz	0.04mH*	0.08mH*	0.1mH	0.12mH	0.5mH
Minimum braking resistor		*Standard minimum braking resistor x* $\frac{\textit{actual operating voltage}}{\textit{standard operating voltage}}$				
Undervoltage threshold		$17V_{DC}$	$20V_{DC}$	$25V_{DC}$	$30V_{DC}$	$100V_{DC}$
Braking threshold		$30V_{DC}$	$60V_{DC}$	$75V_{DC}$	$85V_{DC}$	$390V_{DC}$
Overvoltage threshold		$35V_{DC}$	$70V_{DC}$	$85V_{DC}$	$100V_{DC}$	$430V_{DC}$

(*) For motor inductance lower than 0.1mH, the current loop gains must be manually calculated using the following procedure :
a) Perform the automatic gain calculation for an inductance of 0.1mH
b) Apply to all the gains found (Id gains and Iq gains) the ratio between your actual inductance and 0.1mH.

Example: Gains found with 0.1mH are Id_proportional=27 Id_integral=51 Iq_proportional=27 Iq_integral=51
Your inductance is 0.05mH, so the correction factor is 0.05mH/0.1mH=0.5
Set the gains to Id_proportional=27*0.5=13 and Iq_proportional=27*0.5=13
Id_integral=51*0.5=25 and Iq_integral=51*0.5=25

IMPORTANT

The use of EASY drives at very low operating voltage suffers from several limitations:

- Voltage below $+15V_{DC}$ cannot be accurately measured on the DC link.

- The capacitors bank is optimized for operation at rated voltage. The energy stored in the capacitors is proportional to the square of the voltage. At very low voltage, the storage ability of regenerative energy is limited. Extra storage (capacitors, battery, …) can be required to assume proper operations during high dynamic deceleration phases.

- The detection of a braking transistor error is not active:
    - below $40V_{DC}$ for EASY $230V_{AC}$ drives.

5.3 - SIZING OF THE BRAKING SYSTEM

5.3.1 - Introduction

The braking I^2t function defines the maximum allowable duty cycle of the braking transistor.
It protects the braking resistor against overload and overheating.

5.3.2 - Method for the design of the braking system

Two different quantities are necessary to completely define an application:

- The peak power:
    - It defines the deceleration energy,
    - It is limited by the braking transistor current.
- The average power:
    - It defines the heat dissipation

1. Estimation of the regenerative power

The regenerative power must be calculated for each deceleration phase of each motor.

$$P_{LOAD} = \frac{J_{TOTAL}.(n_1^{\,2} - n_2^{\,2})}{180.t_{DEC}} - \frac{T_{LOAD}.(n_1 + n_2)}{19}$$

$$P_{MOTOR} = P_{LOAD}.\eta_{COUPLING}$$

$$P_{JOULE} = \frac{3}{2} R_{MOTOR}.I_{MOTOR}^{\,2}$$

$$P_{ELEC} = P_{MOTOR} - P_{JOULE}$$

with:
- P_{LOAD}: Power regenerated by the load during the deceleration phase in W
- J_{TOTAL}: Motor + load inertia of the axis reflected to the motor shaft in kg.m²
- n_1: Rotation speed at the beginning of the deceleration phase in RPM
- n_2: Rotation speed at the end of the deceleration phase in RPM
- t_{DEC}: Deceleration time in s
- T_{LOAD}: Torque applied by the load on the motor shaft at the beginning of the deceleration phase in Nm
- P_{MOTOR}: Power regenerated on the motor shaft in W
- $\eta_{COUPLING}$: Efficiency of the mechanical coupling (gearbox). If no gearbox is used, $\eta_{COUPLING} \approx 1$
- P_{JOULE}: Losses in the motor windings in W
- R_{MOTOR}: Winding resistance measured between two phases of the motor in Ω
- I_{MOTOR}: Average current in one phase of the motor during the deceleration phase in A
- P_{ELEC}: Average power managed by the drive during the deceleration phase in W.

2. Choice of the ohmic value

$$R_{MIN} \leq R_{BRAKING} < \frac{U_{BRAKING}^{\,2}}{2.\hat{P}_{ELEC}}$$

with:
- R_{MIN}: Minimum braking resistor value in Ohm according to section "Main technical data".
- $U_{BRAKING}$: Triggering threshold of the braking system in V.
- $R_{BRAKING}$: Braking resistor in Ω.
- $\hat{P}_{ELEC}$: Maximum of all P_{ELEC} calculated for all motors and for all deceleration phases in W.

3. Average power

The required average power must be calculated to correctly choose the size of the braking resistor and to take into account the heat dissipation effect in the near environment.

$$P_{AVERAGE} = \frac{\sum_{1,1}^{N,P} P_{ELEC}(n,p) \times T_{DEC}(n,p)}{T_{CYCLE}}$$

with:
- P_{ELEC}: Power managed by the drive axis n during the deceleration phase p in W

4. Braking I²t setup

$$P_{I^2t} = \frac{t_{ON}}{1000}.\frac{U_{BRAKING}^{\,2}}{R_{BRAKING}}$$

with:
- P_{I^2t}: Maximum average power allowed by the braking I²t function in W
- t_{ON}: Conduction time allowed by the braking I²t function in ms
- $U_{BRAKING}$: Triggering threshold of the braking system in V
- $R_{BRAKING}$: Braking resistor in Ω

5. Connection of the braking resistor

The braking resistor MUST be mounted out of range of heat sensitive and inflammable parts (plastic, cable sleeves, etc.).

In order to avoid any EMC or electrical problem, some rules must be observed:

- heat must be evacuated,
- shielded cable or at least twisted wires must be used,
- wires must bear high voltage and high temperature (recommended type: UL1015, AWG 14),
- wires must be as short as possible (max. 1m).

5.4 - MAINTENANCE

5.4.1 - Periodical checking

Maintenance procedures should be attempted only by highly skilled technicians having good knowledge of electronics and servo systems with variable speed (EN 60204-1 standard) and using proper test equipment.

Risk of electric shock
Any contact with electrical parts, even after power down, may involve physical damage. Wait for at least 10 minutes after power down before handling the drives (a residual voltage of several hundreds of volts may remain during a few minutes).

Hot surfaces
- Ensure that any contact with hot surfaces is avoided.
- Do not allow flammable or heat-sensitive parts in the immediate vicinity of hot surfaces
- Verify that the product has sufficiently cooled down before handling it.

Damage	Action	Periodicity
Shock on the housing	- Check the drive housing	Every year
Cooling	- Check the fan operation - Check the room temperature of the drive	Every year
Dust	- Check connectors, fan, and cabinet cooling system	Every year
Corrosion	- Check housing and electrical connection	Every year
Mechanical mounting	- Check the correct drive fastening - Check the tightening of the electrical connection	Every year

5.4.2 - Procedure after a long-time storage

After a long-time storage, the leakage current of electrolytic capacitors increases dramatically.
In order to avoid any risk of damage or explosion, DC bus capacitors must be reformatted.
When the drive has been stored for 2 years or more, proceed as described below:

1. With a variable AC power supply, apply 25 % of the rated voltage on the mains input during 30 min,
2. With a variable AC power supply, apply 50 % of the rated voltage on the mains input during 30 min,
3. With a variable AC power supply, apply 75 % of the rated voltage on the mains input during 30 min,
4. With a variable AC power supply, apply 100 % of the rated voltage on the mains input during 30 min,

In order to avoid this procedure, the drive can also be powered at rated voltage every year during 1 hour.

5.4.3 - Warranty

Opening the housing will cancel the warranty.

5.5 - OPERATING ENVIRONMENT CONDITIONS

A - CLIMATIC CONDITIONS

1	-	Cooling fluid temperature	Air : -40°C to +40°C
2	-	Air temperature	-40°C to +40°C
3	-	Relative moisture	5% to 85% **without condensation**
4	-	Dust and particles	Clean air (pollution degree 2) Drive must be protected against conducting dust
5	-	Storage periods	< 1 year: no restrictions > 1 year: re-format the power capacitors according to section 5.4.1.

B - MECHANICAL INSTALLATION CONDITIONS

The drive must be mounted on a stiff surface, in rooms or additional housings without hindering the heatsink.
The reliability may be increased by installing a cooling system (take care of condensation).
Other installation conditions must be specially analysed and subjected to a technical specification in agreement with CMZ Sistemi elettronici S.r.l..

Vibration level

Vibrations must remain within the limit values of the IEC 60721-3-3, class 3M1 standard for fixed equipment.

Frequency (Hz)	Amplitude (mm)	Acceleration (m/s²)
2 ≤ f < 9	0,3	not applicable
9 ≤ f < 200	not applicable	1

Vibrations which exceed these limits or the use on mobile equipment are considered as unusual operating conditions.

C - UNUSUAL OPERATING ENVIRONMENT CONDITIONS

The use of the power converter, of its pertaining control system and of the servo in conditions which are diverging from the usual ones defined by the IEC 60146-1-1 standard must be considered as abnormal. These abnormal operating conditions must be specified by the purchaser.

Abnormal operating conditions as those listed below may require a special construction or special protections. The conditions below must be notified if they are known or specified:

1. Exposure to corrosive gas.
2. Exposure to excessive moisture (relative moisture exceeding 85 %).
3. Exposure to excessive dust.
4. Exposure to abrasive dust.
5. Exposure to water steam or condensation.
6. Exposure to oil steam.
7. Exposure to explosive dust or gas mixtures.
8. Exposure to salt air.
9. Exposure to abnormal vibrations, shocks, jerking.
10. Exposure to inclemency or water dripping.
11. Exposure to unusual storing or freight conditions.
12. Exposure to sudden or rough temperature variations.
13. Abnormal exiguity of the available room.
14. Abnormal high nuclear radiations.
15. Altitude higher than 1000 m.
16. Long storage periods.
17. Outdoor equipment.

D - INSTALLATION, COMMISSIONING AND OPERATION

Normal and abnormal operating conditions apply the same way to installation, commissioning and use.

E - EQUIPMENT STORAGE

At receipt, the equipment must be immediately stored under adequate shelter. The transport packaging is not suited to outdoor or non-protected storing.

Climatic conditions

Equipments must be stored in the environment conditions specified by the IEC 60721-3-1 standard. This includes:

1 -	Room temperature: class 1K4 with extended low temperature range	-40°C to +55°C
2 -	Relative moisture: class 1K3	5% to 95%

Modules and panels must be protected against condensation. Rough temperature and moisture variations should be avoided, as far as possible. If the temperature of the storing room is varying such as to subject the equipment to condensation or to frost, the equipment must then be protected by a reliable heating system which will keep it at a temperature slightly higher than the surrounding air temperature.
If the equipment has been subjected to a low temperature during a long time, it should not be unpacked before having reached the surrounding air temperature, in order to avoid condensation. Such moisture in some parts of the equipment may involve a faulty electric insulation.

F - PARTICULAR STORING RISKS

The following risks must be carefully considered:

1. Water: The equipment must be protected against rain, snow, rime, etc…

2. Altitude: The equipment should not be stored at an altitude higher than 3000 m.

3. Corrosive agents: The equipment must be protected against salty sea spray, emanations of dangerous gasses or corrosive liquids, etc…

4. Duration: the specifications of the above mentioned items are only valid for a total transport and storage period of up to six months. Longer periods may require a special treatment (smaller surrounding air temperature range such as in class 1K3).

G - TRANSPORT

1 - Climatic conditions

The equipment can be transported in its standard packaging in the environment conditions specified by class 2K3 of the IEC 60721-3-2 with extended low temperature range. This includes:

a - Surrounding air temperature: -40°C to +70°C
NOTE: The surrounding air temperature is the temperature which is the nearest to the equipment, i.e. the inside of the container.

b - Relative moisture: 95% at +40°C
NOTE: Some temperature and moisture combinations may cause condensation.

2 - Mechanical conditions

The equipment may be transported in its standard packaging in the conditions specified by class 2M1 of the IEC 60721-3-2 standard.
This includes vibrations and shocks (see tables below).

TABLE 4 – Vibration limits during the transport

Frequencies (Hz)	Amplitude (mm)	Acceleration (m/s^2)
$2 \leq f < 9$	3.5	-
$9 \leq f < 200$	-	10
$200 \leq f < 500$	-	15

TABLE 5 – Shock limits during the transport

Mass (kg)	Free fall height (m)
$M < 20$	0.25
$20 \leq M < 100$	0.25
$100 \leq M$	0.10

NOTE: If the equipment may be subjected to shocks or vibrations beyond these limits, it will require special packaging or transport conditions.

FACTORY AND
HEADQUARTERS

CMZ SISTEMI ELETTRONICI S.r.l.
Via dell'Artigianato, 21
31050 Vascon (TV) - Italy
Phone 39 (0)422 447411
Fax +39 (0)422 447444

e-mail: sales@cmz.it
web site: www.cmz.it

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