



MOTION CONTROL SYSTEMS

HARDWARE INSTRUCTION MANUAL
STEPPING MOTOR DRIVES
HI-MOD ET A – HI-MOD ETS A
HI-MOD ET E – HI-MOD ETS E



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WARNING: It is user **RESPONSIBILITY** to check that this manual refers to product model and version that will be used.

Symbol meaning

 The section marked with this symbol contains warnings regarding safety problems. If the directions indicated in these sections are not fulfilled, it could arise hazardous situations .

 The section marked with this symbol contains information regarding operations which are strictly forbidden.

1. NOTICES AND MANUAL STRUCTURE

1.1 - This manual covers the following items:

- HI-MOD ET and HI-MOD ETS series stepping motor drives in all their standard versions
- Standard characteristics of special versions of HI-MOD ET and HI-MOD ETS series stepping motor drives
- For models and versions identification see also chapter 3.

This manual covers hardware characteristics of models described in Chap. 3.1 and contains informations for mounting and electrical connections of these drives. Software characteristics are described in programmer's manual.

1.2 - Products described in this manual (see identification code in chapter 3) complies with Low Voltage (2014/35/CE) and Electromagnetic Compatibility (2014/30/CE).

Product standards:

- 1) UL508C – Power Conversion Equipment
- 2) CSA C22.2 No.274 – Adjustable Speed Driver

1.3 - Remember that, as stated in all directives, compliance exists only when a product is used in accordance with its destination and following manufacturer prescriptions. Thereby, all relevant indications about use, cautions, installation and limitations here described must be followed by user in order to stay within compliance limits; from this point of view the entire content of this manual has to be carefully read and considered in order to obtain the information necessary for a correct use.

1.4 - Conformity declaration regarding above mentioned products is kept by R.T.A. (as manufacturer residing in EEC country) together with technical construction file at authority disposal.

1.5 - This manual is conceived in a way to offer to the personnel involved in project and safety verification of a machine all information concerning characteristics, working conditions, application limits and cautions about stepping motor drives. The knowledge of this information is essential for a correct project of machines, apparatus and systems in which the drives are used; it is strongly recommended not to start any operation with the drives before you have completely read and understood the content of this manual; if you find some part of this manual not completely understandable or lacking regarding your particular application, do not hesitate to contact directly R.T.A. that can provide, if necessary, further information in order to make the user able to design his machine and the related safety systems in the best way. Take into account that an incorrect use or installation, a wrong dimensioning of external safety elements related with the drive could bring to economical damages and also to hazards for human life.

1.6 - Consider the fact that these are products with a very wide range of possible applications in many different working and environmental conditions. For this reason this manual can only fix limits and general rules but cannot take in consideration every single possible application condition. If you have problems to understand some part of this manual or to meet its indications with your specific application, do not hesitate to contact R.T.A. for further information. Take into account that R.T.A. has twenty years of experience in any kind of applications, which cannot be condensed in a manual but can always be at customer disposal.

1.7 - The terms "user and customer" often used in this manual always indicate a skilled person.

1.8 - This manual is considered valid at the moment of the selling of the product. It cannot be considered inadequate as a consequence of product or manual changes or improvements after the selling. R.T.A. reserves the right of products and manual revisions without notice neither obligation of previous products and manuals revision.

2. LIMITATIONS, HAZARDS AND CAUTIONS

- 2.1 - It is not allowed the use in any condition not complying with one or more specific limitations stated in this manual for electrical, mechanical and environmental quantity or characteristics.
- 2.2 - HI-MOD ET and HI-MOD ETS series drives must be mounted as in Fig. 1. Do not take out or insert connectors when the drive is switched on.
- 2.3 - HI-MOD ET and HI-MOD ETS series drives contain capacitors able to store a certain amount of electrical energy. As a consequence, in some cases, according with application conditions and supply dimensioning, a dangerous voltage could remain on the drive, after switching off, for a time greater than 5 seconds. So it is recommended to wait an adequate time before working on the drive.
- 2.4 - The heatsink can reach high temperatures during normal working conditions. Do not touch this component for some minutes, after switching off, in order to avoid scald hazard.
- 2.5 - The drives are suitable to be installed in environment with pollution degree 3, see Chap. 7.1. The installation in environments in which flammable and/or explosive, and/or chemically aggressive and/or electrically conductive gas, vapor or dust could be present is strictly forbidden. Avoid also to install near easily flammable or sensitive to heat materials and components; we recommend to verify that all the components located in the enclosure are realized using self-extinguishing materials.
- 2.6 - All products considered in this manual are sub-assemblies without a direct function, foreseen to be integrated in a more complex machine. Only a professional assembler, expert in the field of motor drives and in their related problems, can install and put in service this component. It is exclusive responsibility of the designer of the complete machine or installation in which this component is used to take care of the safety and reliability of his project. It is forbidden to use this material in application covered from one or more EEC directives (for instance 2014/30/CE, 2006/42/CE, etc.) before the conformity to those directives has been declared. Regarding 2014/30/CE directive, see chapter 7.
- 2.7 - Use for safety related functions is forbidden (EN 60204-1). Moreover, when the application arrangement is in such way that a drive fault or failure could generate a dangerous condition, external independent safety protection system must be provided in the machine.
- 2.8 - In some case of drive failure, dangerous high voltage could appear at logic low voltage input and output terminals, even if this event is extremely rare. For this reason, from the point of view of evaluation of the machine safety during a single fault condition, the external control system, connected to these inputs, has to be considered potentially subjected to high voltage, unless an external separation is provided.
- 2.9 - EtherCAT commands used to interrupt power to the drive outputs and internal electronic functional protections switch off the drive output power by means of semiconductor devices; they cannot be used to interrupt power in some emergency stop function or in any function involving personnel safety.
- 2.10 - Some versions of Hi-MOD ET have threaded holes that allow the connection of an external source of inert gas so that the pressure inside the drive become positive with respect to the environment. The threaded holes must always be connected to specific fittings or plugs, even when not used.
Any different use of that holes is forbidden. RTA does not take any kind of responsibility for property losses, equipment damages and personnel injuries resulting from use or installation of the product without the appropriate plugs.
- 2.11 - In the case of an Ethercat connector is not in use, it is strongly recommended to protect the drive plug by means of a suitable M12 dust cover.



3. GENERAL CHARACTERISTICS AND IDENTIFICATION

3.1. *Hi-Mod ET and Hi-Mod ETS identification*

The models identification of HI-MOD ETS series drives is as follows:

HI MOD ET **A5DxHn.m**

HI MOD ET **A5FxHn.m**

HI MOD ETS **A4FxHn.m**

HI MOD ETS **E4FxHn.m**

x = Stepping motor model

- 1** → 1 stack 86mm motor (6 Amps)
- 2** → 2 stack 86mm motor (6 Amps)

n = Release software (alphanumeric character)

m = special version with some variations regards to standard models (is not present in standard models and it is alphanumeric character if present).

Each sample is also identified with a serial number.

4. MODELS WITH CONNECTORS: DIMENSIONS AND CONNECTIONS

4.1. Mechanical dimensions

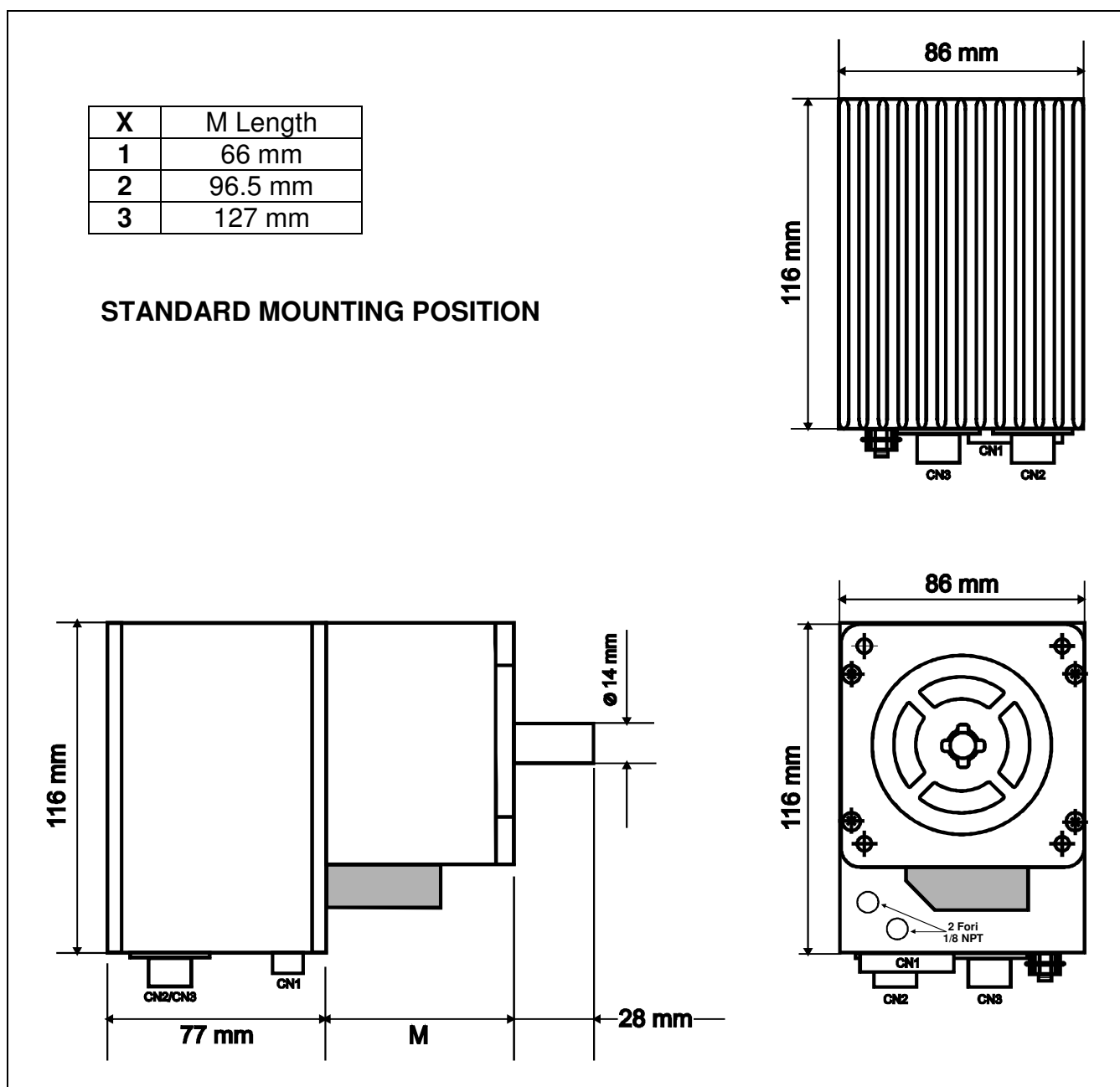


Figure 1 – Dimensions in mm.

4.2. Electrical connections

Electrical connections include:

- Cannon connector 15 terminals for power supply and logic signals (CN1 Figure 2b).
- Two connectors for IN and OUT EtherCAT (CN2, CN3 Figure 3) to allow a daisy-chain connection.

4.3. CN1 connector

- 1 O0 OUTPUT.**
Auxiliary output.
- 2 I1 INPUT.**
Auxiliary input. This input is optically insulated towards internal power circuits. This input is ON (logic level 1) when at its terminals there is a voltage between 8 and 24 Volt. This input is OFF (logic level 0) when there is a voltage < 1.5 Volt.
- 3 I0 INPUT.**
Auxiliary input/proximity input (setting through software); when input is ON, PX is the reference for a zero search procedure This input is optically insulated towards internal power circuits. This input is ON (logic level 1) when at its terminals there is a voltage between 8 and 24 Volt. This input is OFF (logic level 0) when there is a voltage < 1.5 Volt.
- 4 COMMON OF INPUTS and O0 OUTPUT.**
Internally connected to terminal 13.
- 5 +24 VDC.**
Control logic supply positive pole (20-24 Vdc).
- 6,14,15 COMMON OF POWER SUPPLY VOLTAGE.**
- **HVDC:** Power supply negative pole ($-V_{DC\ nom}$), and **-24 VDC** (logic supply negative pole). Supply negative poles must be connected to earth (PE) of power supply side.
- 7, 8 +HVDC.**
Power supply positive pole ($+V_{DC\ nom}$). Use both 7 and 8 terminals.
- 9 O1 OUTPUT (for HI-MOD ETS).**
EDM OUTPUT (Error Detection Monitor) / Driver FAULT OUTPUT (setting through software, see software manual).
If it is set as **EDM (Error Detection Monitor)**, this output is ON if both STO1 and STO2 inputs are OFF. In this case the drive is in Safe Torque Off operation mode and the current flowing in each motor winding is inhibited. The output is OFF if one or both STO1 or STO2 inputs are ON.
If it is set as **Driver FAULT OUTPUT**, output is ON when drive is active; output is OFF when drive is blocked by a protection.
- O1 OUTPUT (for HI-MOD ET).**
If it is set as **Driver FAULT OUTPUT**, output is ON when drive is active; output is OFF when drive is blocked by a protection.
- 10 COMMON OF O1 OUTPUT.**
- 11 STO1 INPUT (for HI-MOD ETS).**
With this signal ON drive is active (with flowing current in each motor winding) on condition that STO2 input is ON. When STO1 is OFF the drive is inhibited, thus motor current (and so holding torque) is turned to zero.
- I2 INPUT (for HI-MOD ET).**
Auxiliary input. It is optically insulated from internal power circuits.
This input is ON (logic level 1) when at its terminals there is a voltage between 8 and 24 Volt. This input is OFF (logic level 0) when there is a voltage < 1.5 Volt.
Maximum signal frequency of I2 input can not be > 50 Hz.
- 12 STO2 INPUT (for HI-MOD ETS).**
With this signal ON drive is active (with flowing current in each motor winding) on condition that STO1 input is ON.
When STO2 is OFF the drive is inhibited, thus motor current (and so holding torque) is turned to zero.
- I3 INPUT (for HI-MOD ET).**
Auxiliary input. It is optically insulated from internal power circuits.
This input is ON (logic level 1) when at its terminals there is a voltage between 8 and 24 Volt. This input is OFF (logic level 0) when there is a voltage < 1.5 Volt.
Maximum signal frequency of I3 input can not be > 50 Hz.
- 13 COMMON OF STO INPUTS (for HI-MOD ETS).**
COMMON OF INPUTS AND OUTPUT O0 (for HI-MOD ET).
Internally connected to terminal 4.

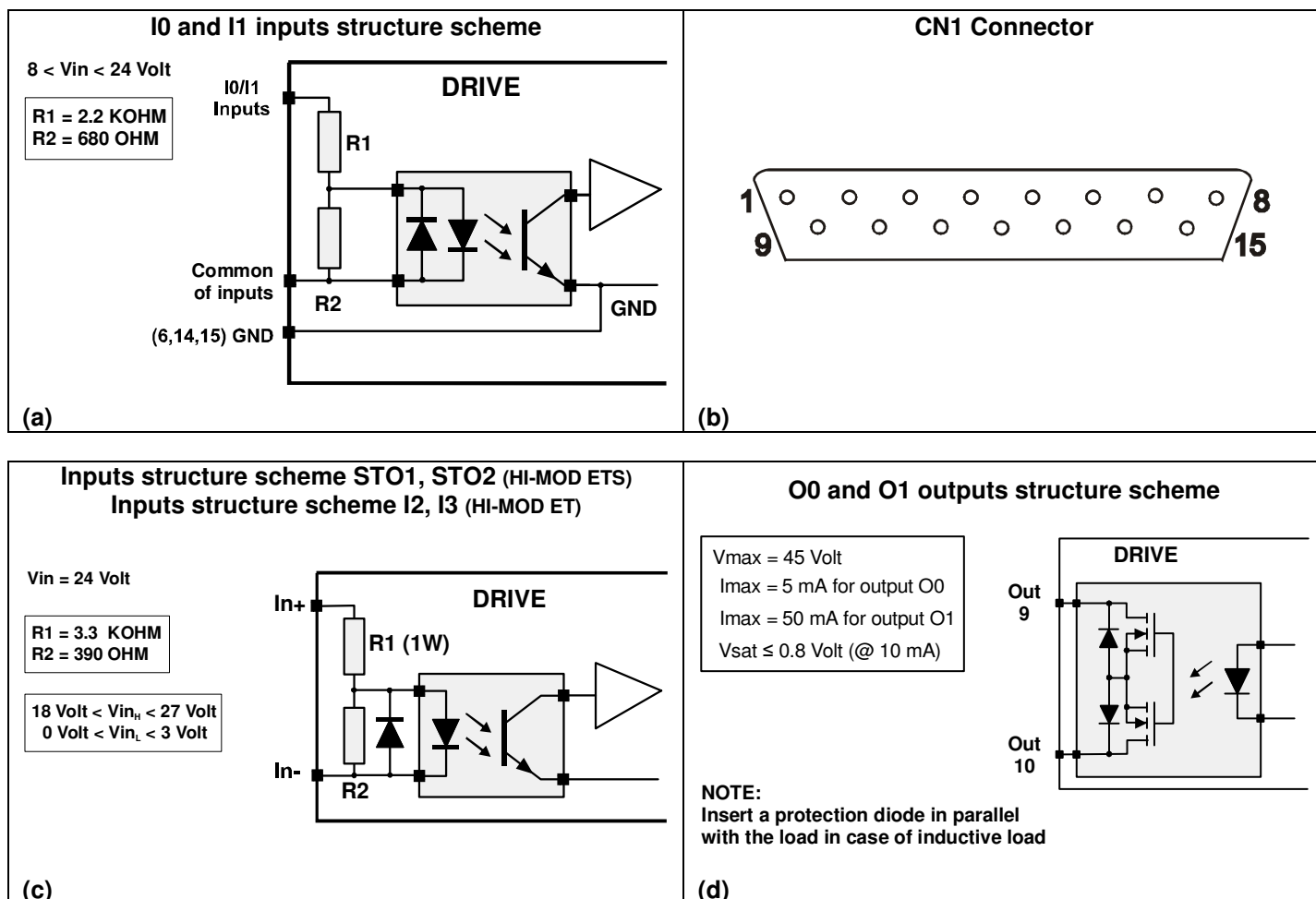


Figure 2– Inputs and outputs scheme.

4.4. CN2 CN3 EtherCAT connectors

Two standard Ethernet M12 modular connectors (IN, OUT) are provided for the EtherCAT communication. The same pin disposition (same signal) is assigned for both connectors. Figure 3 shows connector M12 connectors used for connection between the drive and the control system.

- 1 **Trasmit Data+**: trasmit data positive pole;
- 2 **Receive Data+**: receive data positive pole;
- 3 **Trasmit Data-**: trasmit data negative pole;
- 4 **Receive Data-**: receive data positive pole.

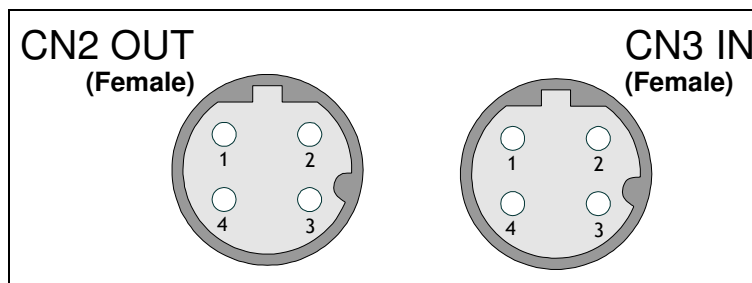


Figure 3 –CN2 and CN3 connectors (front side)

Connect IN to the higher-level device and OUT to the next slave.
 Use twisted-pair cables that satisfy at least “Category 5e” to connect the cable.
 When you make cables using exclusive tools, use STP (Shielded twisted pair cable) and M12 modular plug with shield.

4.5. External connections

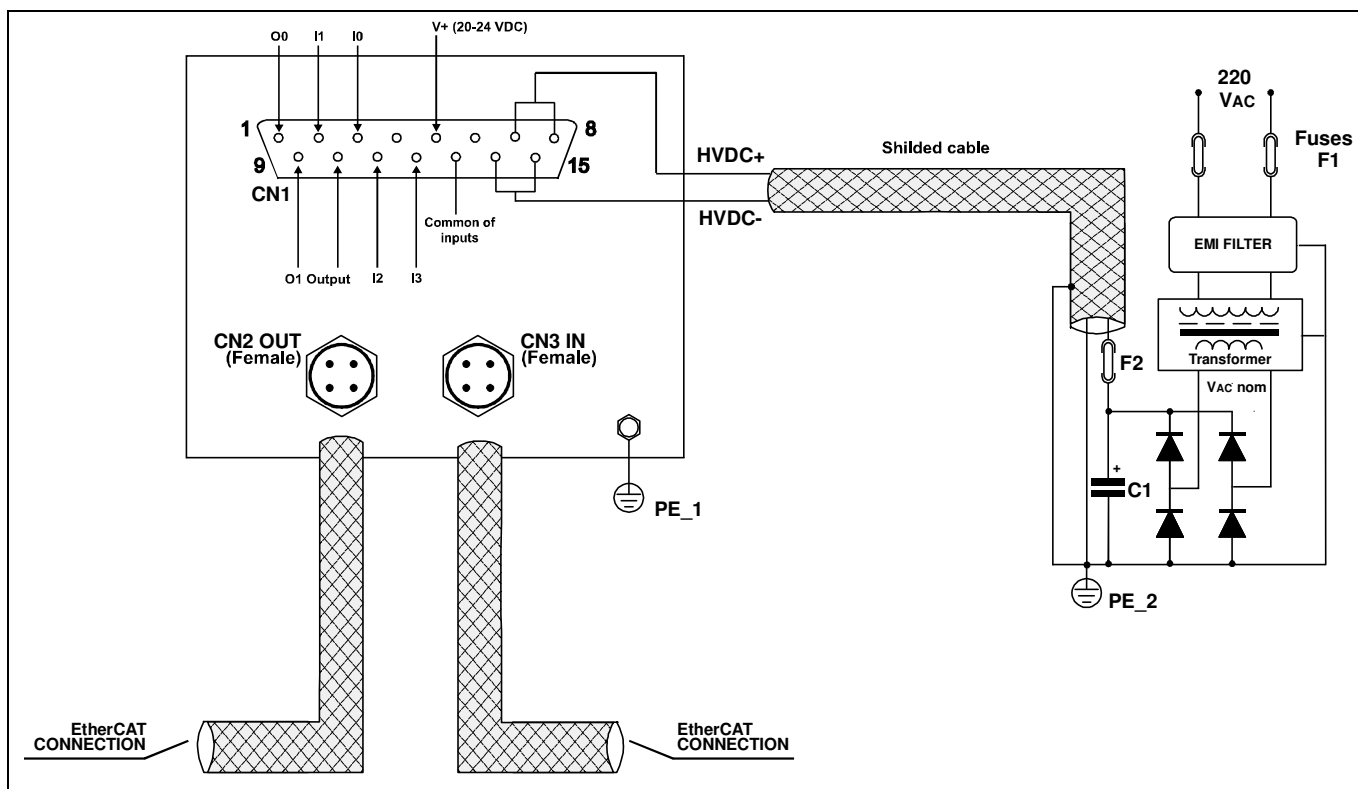


Figura 4a – HI-MOD ET connections scheme

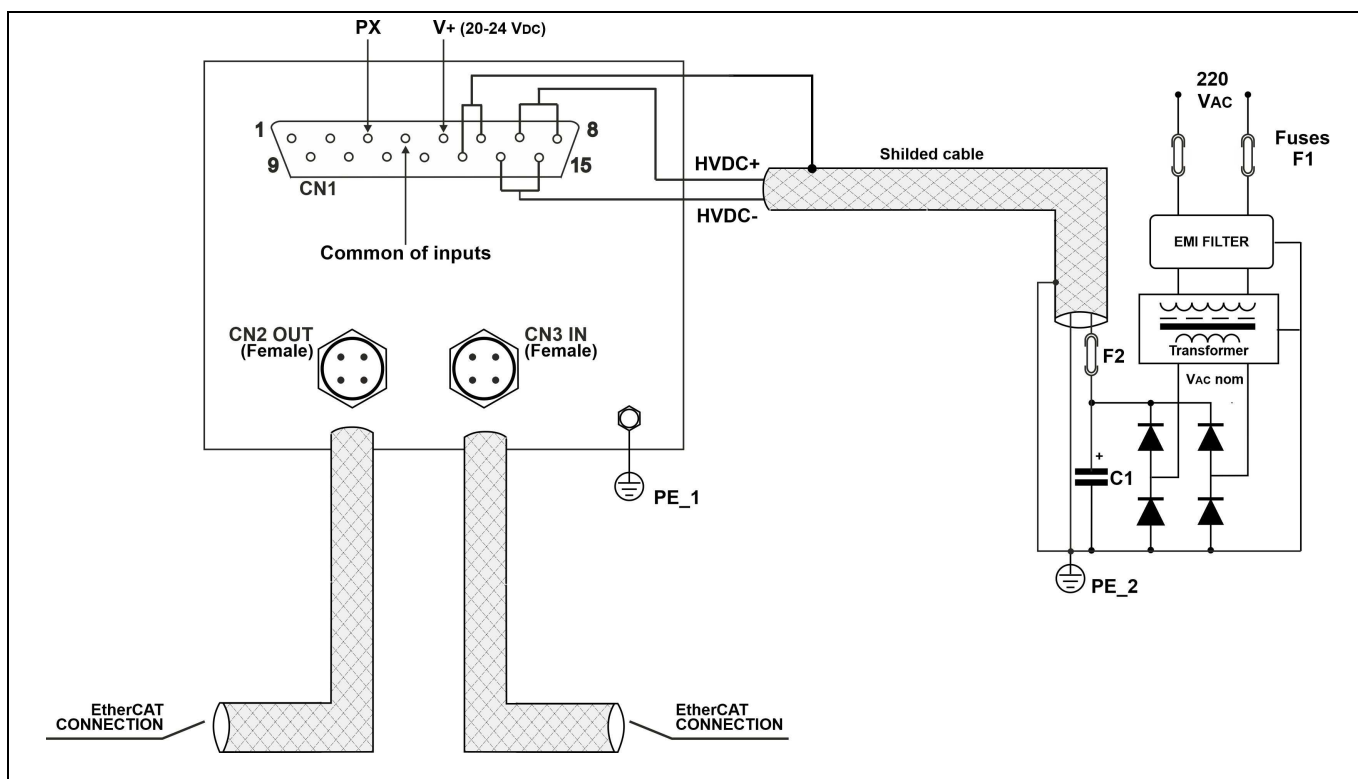


Figura 4b – HI-MOD ETS connections scheme

Note 1: See Chap. 7 and software manual, cap 3.7 for power supply and fuses dimensioning and features.

Note 2: See Chap. 8 for connections of STO1 and STO2 inputs and EDM output.

Note 3: See software manual, cap. 3.7 for informations about reverse energy

5. DRIVE CHARACTERISTICS

5.1. Nominal values of electrical and environmental characteristics

Table 1		
V _{DC} nom	(V)	80
V _{DC} nom tolerance	(%)	+/-20
P _{nom}	(W)	310
I nom	(A)	4.0
I _{ph} nom	(A)	4.3
I _{ph} % (H motors)	(%)	0÷120%
Operating temperature	(%)	from + 5°C to + 40°C
Environment installation pollution degree		3
Overvoltage category		II
Insulation Class		F

Definition of terms used in Table 1:

V_{DC} nom: Nominal value of DC voltage supply at the drive input.

Tolerance: Maximum percentage variation allowed regard to VDC nom values.

I nom: Nominal current at the drive power supply input.

P_{nom}: Nominal power absorbed by the drive.

I_{ph} nom RMS value of motor nominal phase current.

I_{ph} %: Percentage values regard to phase current nominal values, setting by means of software commands (see software manual).

5.2. Operation mode and allowed duty cycle

Hi-Mod series drives are suitable for intermittent operation mode. Table 2 shows allowed duty cycle limits:

Table 2	Motors 1H, 2H and 3H		Motors 2M and 3M	
	≤ 300	> 300	≤ 300	>300
Speed (RPM)				
Max duty cycle (%)	30	25	50	40
Maximum cycle (Sec)	240			

6. ELECTRICAL DIMENSIONING OF EXTERNAL COMPONENTS

6.1. Power supply

Power supply shown in Figure 4 can be realized with single-phase bridge rectifier (as indicated in figure) or with three-phase bridge rectifier. C1 filter capacitor can never have a capacitance below $4700 \times n \mu\text{F}$ (n = number of drives connected to the same power supply). The use of three-phase solution has to be preferred when the number of drives connected to the same power supply is more than three.

Power supply must fulfill the following requirements:

- Separation from the main: the separation from the main must be granted in order to ensure that the over-voltage category of the DC side is II.
- Nominal power of power supply has to be the sum of every single connected drive power.
- Short-circuit current must be lower than 1000 Amp

6.2. Fuses

- F1 fuses (or equivalent protection systems) must be dimensioned in accordance with total power of power supply.
- F2 fuse: a Branch circuit protection fuse 8 Amp must be for each drive. The fuse that fulfils requirements of UL directive is the following:
Class CC - Current Limiting Time-Delay - Rated: 150 Vdc – 600 Vac 8 A
Fuse: Listed – Cartridge Fuses (JDDZ)
Manufacturer: Cooper Bussmann LLC - Model No.: LP-CC – 8 A

6.3. Earth connections

The points PE_1 (drive case) and PE_2 (power supply negative pole) must be connected to earth line of the machine (PE). The length, section, and topology of the connections that connect PE_1 and PE_2 have to be realized in a way to present the less possible inductance.

6.4. Length and section of power supply cables

For power supply can be used AWG16 cables for a length of 25 mt.

6.5. EtherCAT connections

For this connection can be used whatever EtherCAT bus cable in accordance with valid directive and with drive connectors.

7. APPLICATION NOTES

- 7.1 Electromagnetic interferences and immunity (directive 2014/30/CE)
HI-MOD ET and HI-MOD ETS series drives are BDM (Basic Drive Module) conceived for restricted distribution (EN 61800-3). This means that R.T.A. has the responsibility to verify the products compatibility in some typical way of use in order to give correct installation information. In any cases, it is responsibility of the professional assembler, who installs this product, to verify the compatibility of the complete machine or system.
- 7.2 The set consisting of drive, motor and all related cablings are source of electromagnetic interferences. The assembler of installation must consider these problems during the project of the plant where the drive (or drives) will be installed in order to shield and/or reduce these interferences. Tests performed by R.T.A. show that the most effective measures able to reduce these interferences are the following:
- Use only shielded cable for power supply.
 - Interpose an EMI filter (CORCOM mod. 6VVK1) on the transformer power that is used to supply the drives in order to reduce conducted electromagnetic interferences.
 - Connection made to Protective Earth terminal (PE), shown in Fig. 4, must be short and have the lowest possible inductance.
 - All connections made to Protective Earth (PE) must be realized to have the lowest possible inductance.
- 7.3 Considering drive logic input signals immunity from external noise present in the environment in which they are most often used, take in account following normal procedures, suggested from the classical techniques about relatively fast signals treatment:
- Use shielded cables.
 - Keep shielded signal cables separate from shielded power cables.
 - Verify carefully logic level compatibility when interfacing drive with control system.
- 7.4 A correct accomplishment of these procedures constitutes an essential starting point in order to realize an installation which complies with the requirements of 2014/30/CE directive. The effective compliance with specific standards covering the particular application in which this drive is used will have in any



case to be proved in the complete installation, because the effectiveness of suggested actions depends also on machine topology and on their correct fulfillment. Tests performed by R.T.A. simulating typical installations and following above mentioned indications show that it is possible to stay within the limit of EN61800-3 standard.

7.5 In some cases, due to the characteristics of particular installations, conflicts between ground connections necessary for shielding purposes and ground connections necessary for safety reasons could arise. Remember that, in such cases, prescriptions regarding safety take priority, but remember also that, in the great majority of cases it is possible to find a solution meeting both prescriptions; R.T.A. is at disposal for further information about these problems.

7.6 **REVERSE ENERGY MANAGEMENT.**

During deceleration of load with high inertia, some amount of energy can flow from motor to drive. In case of excessive reverse energy, an overvoltage protection could inhibit the drive operation making impossible the application. During the test of a new application in which there are decelerations starting from relatively high speed, with high inertial load, always check carefully the operation conditions during the decelerations.

If speed problems occur, it is necessary to check speed and acceleration parameters of the application and make sure about the value of the capacity in the power supply.

8. STO FUNCTION (for HI-MOD ETS)

8.1- SYSTEM CONFIGURATION DESCRIPTION

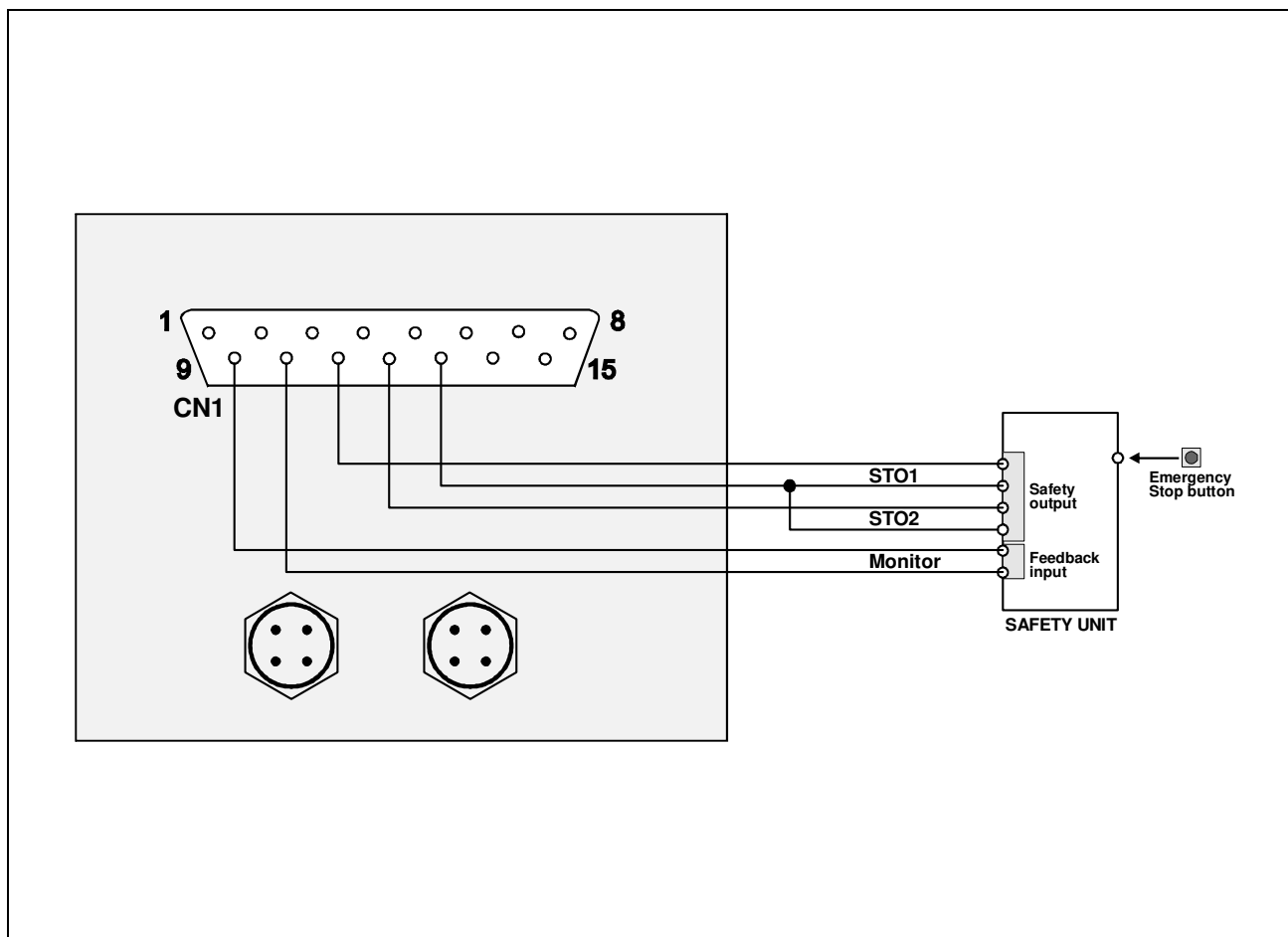


Figure 5 – Connection scheme.

8.2- STO FUNCTION

Safe-torque-off function reduces injury risks and ensures the safety for those who work near moving parts of equipment. This function employs 2-channel input signal that independently block the motor current.

8.3- STO FUNCTION SCHEME DESCRIPTION

STO function disables the current flowing into motor windings.

Each of two STO1 and STO2 channels act independently to shut down motor current. A failure of one single channel does not compromise the activation of the safety function.

8.4- STANDARD CONFORMITY

STO function meets the following safety standards:

- IEC 61800-5-2, safe torque off (STO)
- IEC 61508, SIL3

Probability of a dangerous failure per hour, with use of Error Detection Monitor (EDM) to grant Diagnostic Coverage (DC), is described in the following table:

PHFd	Test Timing	Mission Timing	SIL
3.54×10^{-10}	1 month	10 years	3
4.11×10^{-10}	10 years	10 years	3

8.5- **RISK ASSESSMENT**

The drive meets the requirements safety standards above described.

However, before activating safety function, make sure to assess the risks associated with the overall equipment to ensure complete safety.

8.6- **RESIDUAL RISK**

Even if STO function is active, the following risks remain. Please ensure the installation safety is maintained, even in case the below-indicated situations occur, through a correct risk assessment.

1. When STO function is activated while the motor is running, the current into the motor is shut down. The motor continues to run due to inertia. Please make sure to ensure safety conditions of the system to avoid any danger until the motor stops completely.
2. When the motor is used in vertical axes, it is possible that without holding torque, the axes rotate due to gravity. In this case, it is necessary to provide external device (i.e. electromagnetic brake) to stop the motor within requested range.
3. In case of short circuit or failure of power device transistor, the motor could make an uncontrolled movement within a range up to 180 degrees in electrical angle (180 degrees in electrical angle=1/50 of a turn) and then remain a stable position. It is necessary to verify that this limited movement does not correspond to some risky conditions.
4. Be sure that SAFE TORQUE OFF function properly works before machine use, at first machine start-up and at every drive replacement. If input / output signals are not used correctly, the STO function doesn't work properly and dangerous situation can occur.
5. When STO function is active, the drive power supply is not shut down. In case of maintenance or check of the drive, please be sure to shut down power supply to avoid electric shock.

8.7- **CONNECTIONS**

All input and output logic signals are optically insulated among them and from internal power circuits. Positive and negative terminals are separately accessible. For all logic signals in the following we indicate the corresponding numbers of connector C2. An input signal is considered ON when a voltage is applied (Fig. 2a).

9 and 10 EDM OUTPUT (ERROR DETECTION MONITOR): this output is ON if both STO1 and STO2 inputs are OFF. In this case, the drive is in Safe Torque Off operation mode and the current flowing in each motor winding is inhibited. The output is OFF if one or both STO1 or STO2 inputs are ON.

12(+) and 13(-) STO2 INPUT: with this signal ON drive is active (with flowing current in each motor winding) on condition that STO1 input is ON. When STO2 is OFF the drive is inhibited, thus motor current (and so holding torque) is turned to zero.

11(+) and 13(-) STO1 INPUT: with this signal ON drive is active (with flowing current in each motor winding) on condition that STO2 input is ON. When STO1 is OFF the drive is inhibited, thus motor current (and so holding torque) is turned to zero.

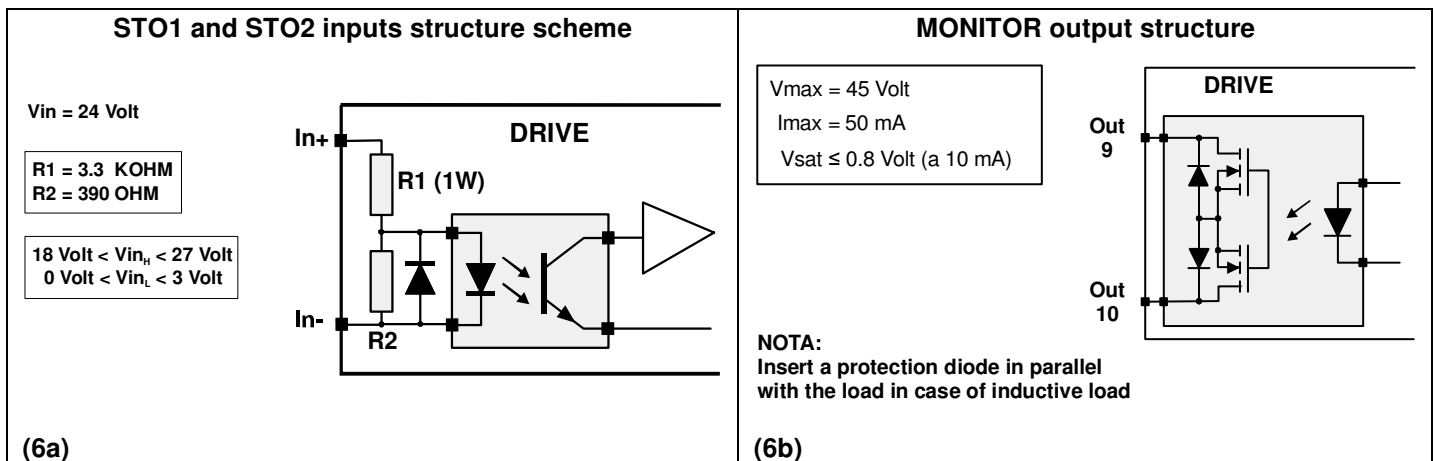


Figure 6 – STO1 and STO2 inputs and EDM output scheme.

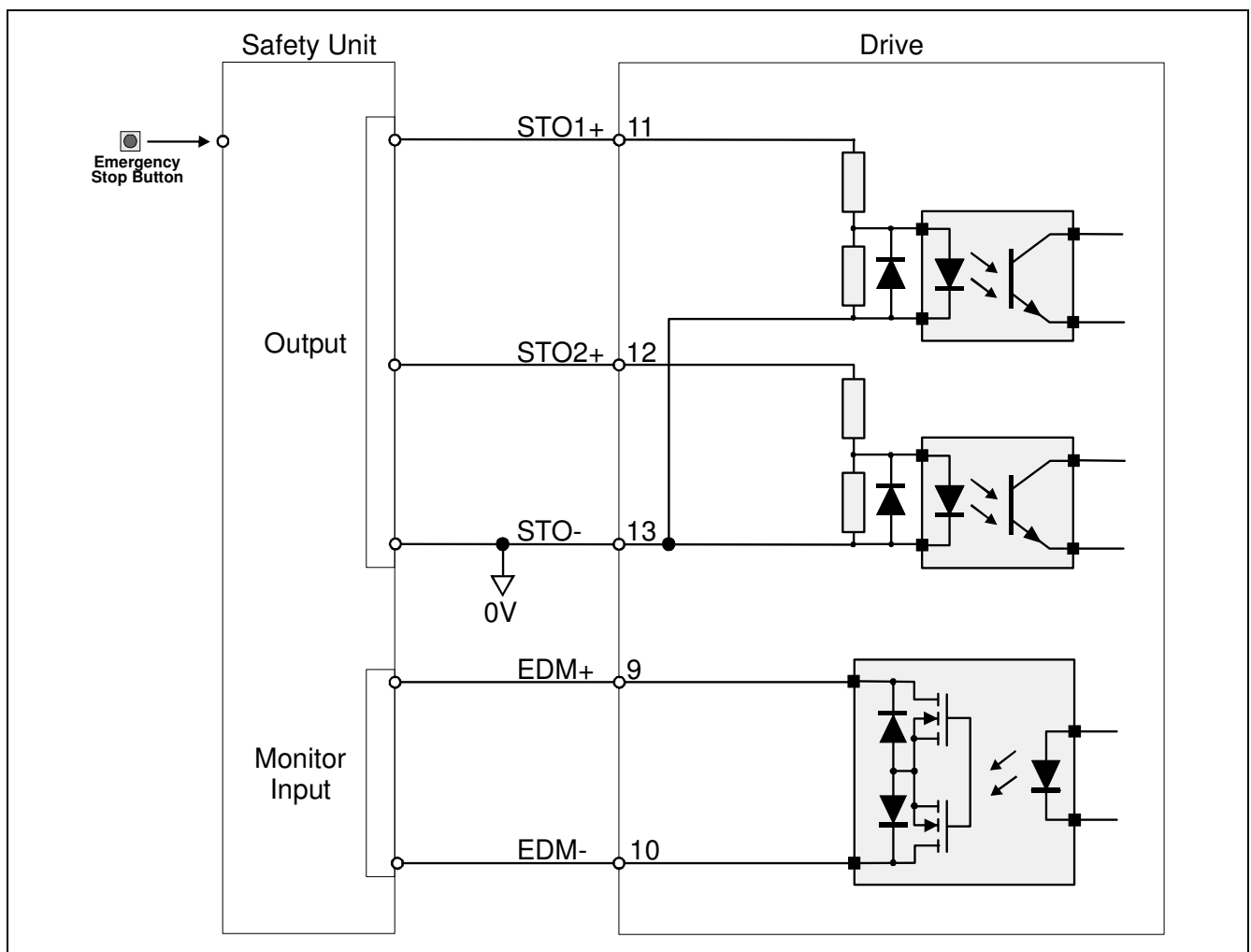


Figure 7 – Wiring to SAFETY UNIT example.

8.8- ENABLE / DISABLE STO: TIMING INDICATIONS

The correct and stable enabling of STO function is effective after a maximum time of 20 ms after STO1 and STO2 switching off.

Monitor Output indicates that STO function is active with a maximum delay of 20 ms from STO1 and STO2 input signals switch off (Figure 8).

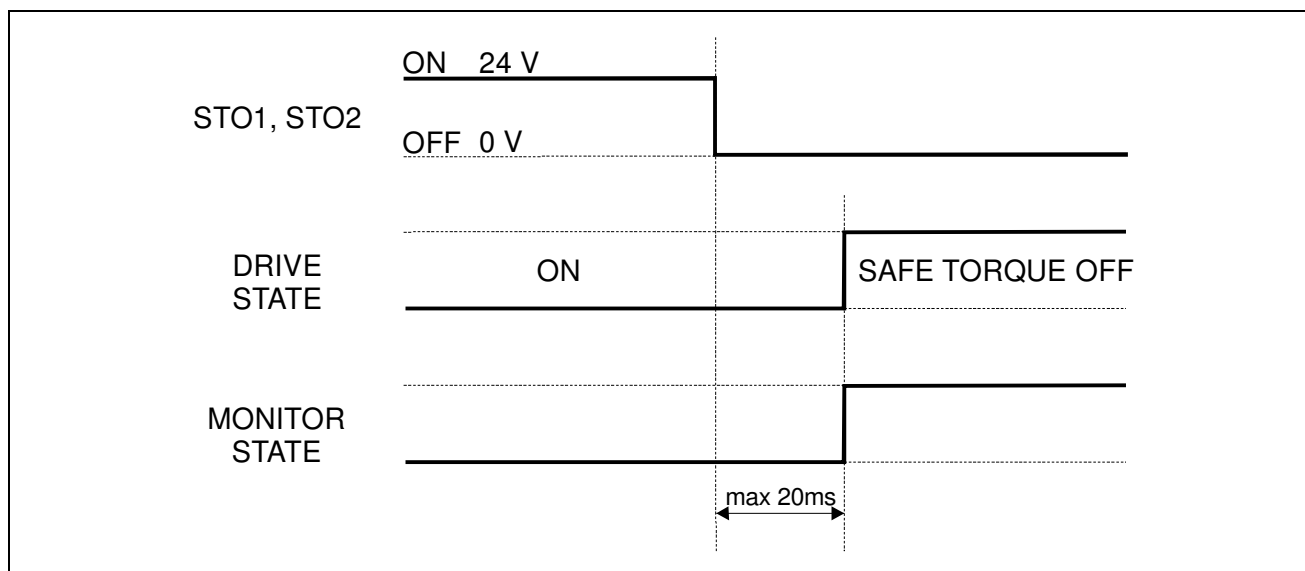


Figure 8 – STO Timing.

8.9- TIMING OF INPUT-OFF SHOT PULSE FOR SAFETY DEVICE SELF-DIAGNOSIS

In case of the safety device perform self-diagnosis through input-off shot pulses, the input-off shot pulse must have a maximum duration of 1 ms.

STO function is not activated when the period of STO inputs signal STO1 / STO2 - OFF is 1 ms or less. In order to surely grant the activation of the Safe Torque Off function, it is necessary that STO1 and STO2 input signals are turned off for 20 ms or more.

NOTE: When STO1 and STO2 input signals switch ON and OFF in a range of 1-20 ms, motor loss of synchronism and/or wrong signaling can occur.

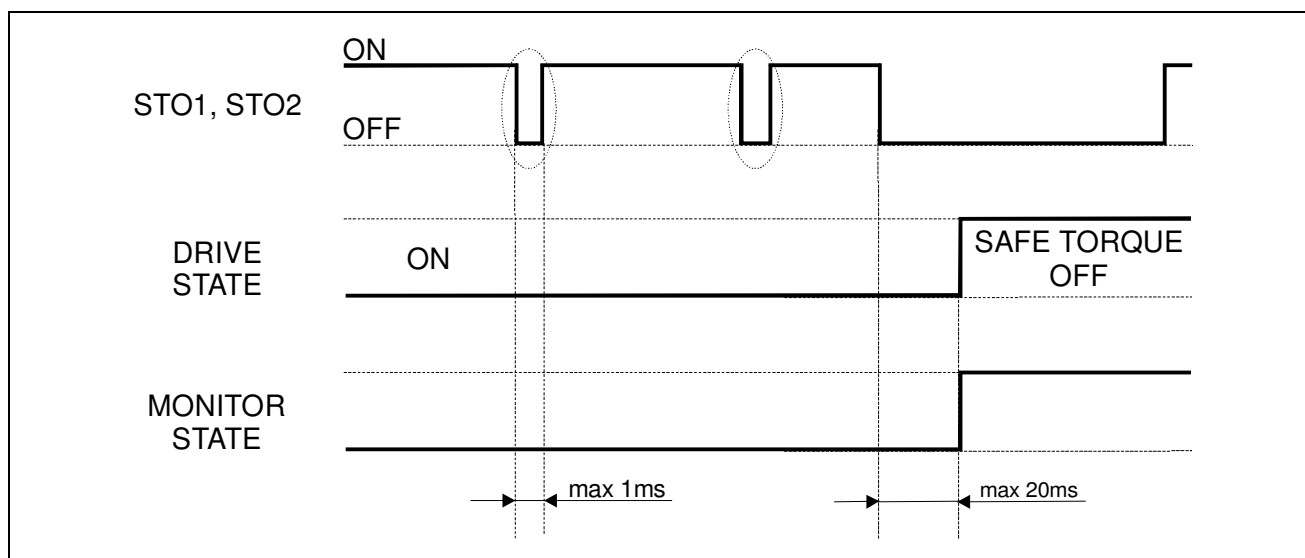


Figure 9 –STO Self-Diagnosis Timing.

8.10- EDM (ERROR DETECTION MONITOR)

Error Detection Monitor output is a signal to monitor problems in safe-torque-off circuit or between SAFETY UNIT and STO1 and STO2 inputs. The following Table 10 shows correspondences between STO1 and STO2 inputs and Monitor Output states.

STO1	STO2	MONITOR OUT
ON	ON	OFF
ON	OFF	OFF
OFF	ON	OFF
OFF	OFF	ON

Table 10

8.11- EDM – CONNECTION EXAMPLE

In Figure 7 is described a connection example that allows to enable Safe Torque Off function by means of emergency stop button through SAFETY UNIT (Figure 7).

Under normal conditions, pressing emergency stop button, STO1 and STO2 become OFF and EDM becomes ON (with maximum delay of 10 ms). When emergency stop button is released, if feedback circuit of SAFETY UNIT is reset and two safety inputs are set ON, EDM becomes OFF. This allows to restart the machine working.

8.12- ERROR DETECTION METHOD

Errors between input logic states and monitor output must be detected by means of SAFETY UNIT.

For correct connections, please refer to the SAFETY UNIT manual.

EDM (Error Detection Monitor) is not a safety output. Do not use EDM for any purpose other than failure monitoring.

8.13- VERIFICATION TEST

Please verify that SAFE TORQUE OFF function properly works at every first machine start-up and at every drive replacement.

Before check the correct working of SAFE TORQUE OFF function, please verify that every drive connections properly operate.

Verification Test needs the following procedures:

1. Switch on the drive power supply.
2. Set ON both STO1 and STO2 inputs.
3. Verify that motor is in CURRENT ON state.
4. Verify corresponding EDM output state.
5. Set OFF both STO1 and STO2 inputs.
6. Verify that motor runs without holding torque and it is in CURRENT OFF state.
7. Verify corresponding EDM output state.
8. Repeat the points from 5 to 7 setting OFF STO1 and STO2 inputs separately.

8.14- SAFETY CAUTIONS

Please thoroughly observe the following safety cautions to use safe-torque-off function.

Not correct use of safe-torque-off function can result to personal injury or death.

1. Safety system with safe-torque-off function must be designed by person with expertise of related safety standards and through understanding the descriptions specified in this manual.
2. The security system development that involves the use of STO function must be the result of an appropriate risk assessment.
3. When safe-torque-off function is active during the motor run, current motor is turned to zero and the motor continues to run due to inertia. Please design safety system so that no risks occur until the system stopped.
4. When the motor is used in vertical axes, the motor can rotate due to gravity. Please provide external device (i.e. brake) to stop the motor within requested range.
5. In case of short circuit or failure of power device transistor, the motor could make an uncontrolled movement within a range up to 180 degrees in electrical angle (180 degrees in electrical angle=1/50 of a turn) and then remain a stable position. It is necessary to verify that this limited movement does not correspond to some risky conditions.



Be sure that SAFE TORQUE OFF function properly works at first machine start-up and at every drive replacement. If input / output signals are not used correctly (for example due to miswiring), the STO function doesn't work properly and dangerous situation can occur.

9- UL SPECIFICATIONS AND REQUIREMENTS

When the drives are installed in machines which have to be compliant with UL standards, the following specifications and requirements must be taken into account.

Electrical ratings

Table 3 Motor Series Hi-Mod	Vdc	A (Max)	Rpm	Max allowed value Intermittent Duty	
				Time	%
A4.x.1Hx.y, E4.x.1Hx.y, B4.x.1Hx.y A5.x.1Hx.y, E5.x.1Hx.y, B5.x.1Hx.y	80	1.5	< 300	72" ON / 168" OFF	30
		3.6	300 - 2500	60" ON / 180" OFF	25
A4.x.2Hx.y, E4.x.2Hx.y, B4.x.2Hx.y A5.x.2Hx.y, E5.x.2Hx.y, B5.x.2Hx.y		2.2	< 300	72" ON / 168" OFF	30
		2.8	300 - 2000	60" ON / 180" OFF	25
A4.x.3Hx.y, E4.x.3Hx.y, B4.x.3Hx.y A5.x.3Hx.y, E5.x.3Hx.y, B5.x.3Hx.y		2.5	< 300	72" ON / 168" OFF	30
		4.0	300 - 2000	60" ON / 180" OFF	25
A4.x.2Mx.y, E4.x.2Mx.y, B4.x.2Mx.y A4.x.3Mx.y, E4.x.3Mx.y, B4.x.3Mx.y A5.x.2Mx.y, E5.x.2Mx.y, B5.x.2Mx.y A5.x.3Mx.y, E5.x.3Mx.y, B5.x.3Mx.y		2.4	<300	120" ON / 120" OFF	50
		3.6	300 - 1500	96" ON / 144" OFF	40

Duty cycle

The allowed limits of duty cycle, defined in Table 3, meet the following requirements:

- They are in accordance with the tests made by UL during the approval process and therefore they can be directly used without further investigation.
- Within these limits, the system can run indefinitely without any intervention of the thermal protection in the full range of allowed operating temperature.

From the technical point of view, if the internal phase current setting is less than the maximum or some kind of forced cooling is provided, it is possible to use a wider range of duty cycle. In this case it's important to take in account the following points:

- There is no more accordance with the tests made by UL during the approval process and therefore the approval thermal testing have to be done again.
- In this case, the thermal tests must be done on the machine in the specific installation situation and working conditions.

Environmental Condition

- "Maximum Operating Ambient Temperature 40°C".
- "Suitable for Industrial Pollution Degree-3 Environment".
-


Installation instructions

- "Suitable for use on a circuit capable of delivering not more than 1000 Amperes, 80 Vdc +15% maximum".
- "When protected by UL-Listed Cartridge Fuses, Nonrenewable (JDDZ), Class CC, Current Limiting, Time Delay, rated 150 Vdc / 600 Vac, 8 A, 20 kAdc AIC / 200 kArms AIC".
- The final end-use connections of these Drives with the "Input Power- Supply", with "Auxiliary Control Supply" and with "Auxiliary Signal I/O's Ports (Encoder & Can Bus)" are provided R/C Connectors (ECBT2/8), suitable for Factory-Wiring only.



However the Drives shall be provided with the Wiring diagrams (Fig. 4) and the instructions to indicate the wiring connections for the end-use equipment installation (Fig. 2b e Fig. 3).

- Over-Voltage Control - "D.C. Enclosed Motor Drive" Mod. No. "HI-MOD (A-B-E) Series" the levels of "Overvoltage Protection" will be secured by a "Power Supply or System" of "Over-Voltage Category-II" (LOAD LEVEL – Secondary Circuit of a "protected utility Transformer" / "protected Power Supply") suitable to control over-voltages at the maximum rated "Impulse withstand Voltage-peak" of 0.8 kV, for rated "Phase-Ground (rms/dc)" of 85 V, and with a maximum "Short-circuit Current" available of 1 kA.

Grounding Identification - A wire connector intended for connection of a installed equipment grounding conductor shall be plainly identified, with the symbol  (see Fig. 4 for details).