AccurET Modular VHP 48 Rev.2 Position Controllers

Hardware Manual

Version J

ETEL

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Record of revisions:

Document revisions		
Version	**Date**	**Main modifications**
Ver A	08.08.12	First version
Ver B	16.05.14	Updated version: - Minor changes
Ver C	08.12.14	Updated version: - Dual encoder feedback connection (refer to §3.2.5) - Technical details added
Ver D	07.05.15	Updated version: - Minor technical change (refer to §1.3)
Ver E	06.07.16	Updated version: - EMC Directive 2004/108EC replaced by 2014/30/EU - Minor changes
Ver F	30.11.18	Updated version: - Minor changes
Ver G	17.05.19	Updated version: - Minor modification concerning Hall effect sensor (refer to §3.3.1)
Ver H	25.11.19	Updated version: - Minor changes (refer to the modification strokes in the margin)
Ver I	26.11.19	Updated version: - I/O commutation times updated (refer to §3.3.1, §3.3.2, §3.3.3 & §3.3.4) - Analog I/O frequency added (refer to §3.3.5) - Minor changes (refer to modification stroke in the margin)
Ver J	14.09.21	Updated version: - Minor changes

Documentation concerning the AccurET Modular VHP 48 revision 2:

- **Hardware Manual**
- Operation & Software Manual

Specifications & electrical interfaces
AccurET setup, use & programming

Type tested
Production monitored
TÜV PRODUCT SERVICE
NRTL
UL 508 C

The AccurET Modular VHP 48 revision 2 position controllers have been successfully tested and evaluated to meet the UL 508C for US market.

This standard describes the fulfillment by design of minimum requirements for electrically operated power conversion equipment which is intended to eliminate the risk of fire, electrical shock, or injury to persons being caused by such equipment.

1. introduction

This document concerns a two axes position controller of ETEL's AccurET family: the AccurET Modular VHP 48 Revision 2 with High Speed Encoder Interface (EA-H2M-048-xxxxxA-x**1**xx-**01**) also called 'controller' in this document.
The purpose of this manual is to give details regarding the specifications, installation, interfacing and hardware items. All details for proper connections are provided herein. Detailed information concerning the programming of the controller is provided in the corresponding **'Operation & Software Manual'**.

Remark: The updates between two successive versions are highlighted with a modification stroke in the margin of the manual.

1.1 Safety

	**The user must have read and understood this documentation before carrying out any operation on an AccurET position controller. Please contact ETEL or authorized distributors in case of missing information or doubt regarding the installation procedures, safety or any other issue.**
	**ETEL SA disclaims all responsibility to possible industrial accidents and material damages if the procedures & safety instructions described in this manual are not followed (including the ones given in the manuals listed page 5).**

- Never use the controller in operating conditions and for purposes other than those described in this manual.
- A competent and trained technician must install and operate the controller, in accordance with all specific regulations of the respective country concerning both safety and EMC aspects.
- The customer must provide at all time the appropriate protections against electrical hazard and moving parts of the connected system. Operating the controller will make the motor move.
- The safety symbols placed on the controller or written in the manuals (page 5) must be respected.
- If the controller is integrated into a machine, the manufacturer of this machine must establish that it fulfills the 2014/30/EU directive on EMC before operating the controller.

	**Signals a danger of electrical shock to the operator. Can be fatal for a person.**
	**Signals a danger for the controller. Can be destructive for the material. A danger for the operator can result from this.**
	**Indicates electrostatic discharges (ESD), dangerous for the controller. The components must be handled in an ESD protected environment, only.**

Remark: The controller associated to its motor connector complies with the 2014/30/EU directive on EMC.

1.2 Presentation

1.2.1 Working principle

AccurET position controllers are proposed in a modular format dedicated to multi-axis applications where a single power supply unit (not provided) is able to power many AccurET units to minimize the space required for the Electronics. Their modular cooling unit as well as their versatile design allow several configurations. These controllers include the control circuits, the power bridge and all the necessary interfaces for the communication, the encoders and the inputs/outputs for two motors.

1.2.2 Applications

The AccurET modular VHP 48 can drive two, single-phase, two-phase or/and three-phase motors. This controller can drive brushless motors, DC motors, steppers, etc. They must also be implemented with analog incremental 1 Vpp encoder or absolute encoder (EnDat 2.1 and EnDat 2.2) or TTL encoders (only 1Vpp for the HSEI encoder connector). Digital Hall effect sensor can also be connected to the controller. It is also possible to drive stepper motors in open loop (no need of encoder in this case).

1.2.3 General operating conditions

	**- The AccurET controller is an open type device and must be installed in an enclosure providing electrical, mechanical and fire protection as well as controlled environment such as temperature, humidity, and pollution degree 2,…(refer to UL 508C and EN 61800-5-1 standards for more information).** **- Never switch the unit ON outside of the enclosure.** **- The controllers supply inputs (X100 and X104) must be connected to power supplies that ensure the reinforced insulation between mains and output and provide overvoltage category II (refer to EN 61800-5-1 and UL 508C standards for more information).** **- All control voltages or all connections (except Mains) must fulfill requirements for Limited Voltage Circuits/ Isolated Secondary Circuits.** **- The controllers must have its control input (X100) connected to a power supply with SELV outputs (Isolated secondary output).** **- The control input 0 VDC is internally connected to the Protective Earth (PE).**
	**- The AccurET modular VHP 48 are designed to operate in a non-aggressive and clean environment, within a humidity range of 10 % and 85 %, an altitude < 2000 m (6562 ft), and a temperature range between +10 °C (50 °F) and +40 °C (104 °F).** **- The AccurET modular VHP 48 are intended for use in the second environment(1).** **- The AccurET modular VHP 48 are not designed or intended for use in the on-line control of air traffic, aircraft navigation and communications as well as critical components in life support systems or in the design, construction, explosive atmosphere, operation and maintenance of any nuclear facility.** **- ETEL recommends limiting the vibration level of AccurET controllers by not mounting them on highly dynamic moving parts.**

(1): Definition of Second Environment in product standard EN 61800-3 (2004): Environment that includes all establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes (industrial areas and technical areas of any building fed from a dedicated transformer are examples of second environment locations).

1.2.4 Transport and storage conditions

	**- During the transport and the storage, the controller and the corresponding power supply must remain inside their original packaging which complies with the ESD standard.**
	**- The transport conditions must respect the class 2K3 of the IEC 60721-3-2 standard (temperature between -25 °C (-13 °F) and +70 °C (+158 °F), and humidity < 95 % without condensation).** **- The storage conditions must respect the class 1K2 of the IEC 60721-3-1 standard (temperature between +5 °C (+41 °F) and +45 °C (+113 °F), and humidity between 5 and 85 % without condensation).**

1.2.5 Unpacking, packing and handling

When removed from the original packaging, the controller shall be manipulated with ESD protective equipment. The housing of the controller protects the inner components, but discharges might occur when touching the connectors, which are in direct contact with the electronic components.
If the controller must be transferred or shipped (including returns to ETEL for service and repair), it must be packed in the original package.
Before unpacking the controller, the unit shall be placed in the room at working environmental conditions (in accordance with the requirements stated in §1.2.3) during at least 2 hours. This is to avoid damages due to condensation. If the controller is transferred in the operating room within a complete system, the acclimation time shall be adapted to the thermal inertia of the complete system.

1.2.6 Installation and initial operation

- Mechanical mounting: refer to §2.4.
- Electric Interface: refer to §3.
- Operating and software: refer to “Operation & Software Manual”.

The AccurET modular VHP 48 is intended to move axes, and this can lead to some risks at the machine level:

Warning	
	**Faulty machine performance** Collision with persons, property damage to machine - Inappropriate use may cause considerable damage to persons or property. ETEL does not accept any responsibility for direct or indirect damage caused to persons or property through improper use or incorrect operation of the machine. - Before switch-on, close the electrical cabinet - Commissioning is to be performed only by qualified personnel - Remember that kinetic energy is stored in the movable parts of a machine and that it may continue to move without braking if the servo drives suddenly fail. - During initial switch-on after installation, maintain a safe a distance from the inverters or power stages and drives. If malfunctions occur, switch off the power supply of the system, and contact qualified personnel.

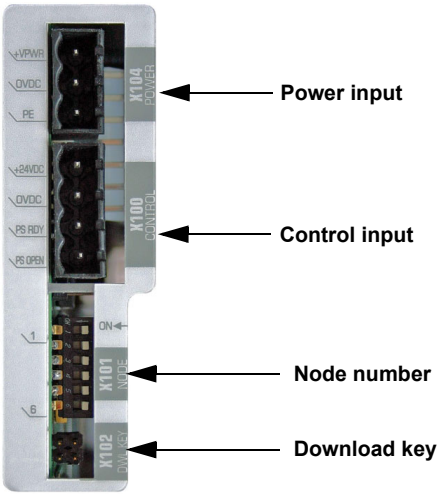
Notice	
	Prior to the following tests, the machine or system must be disconnected from the power supply and tested for zero voltage! - The continuity of the protective conductor circuit is to be inspected (10 A testing current is recommended), EN 60204-1. - Check the protective conductor contact resistance according to EN 60204-1, EN 61800-5-1 or a nationally valid standard. - Conduct a visual inspection on the security of all connections, in particular of the protective conductor connections. - For the correct grounding of protective conductor of the controller, please refer to §3.8. - Ensure that no flammable objects are near the vent openings.

1.2.7 Maintenance operations

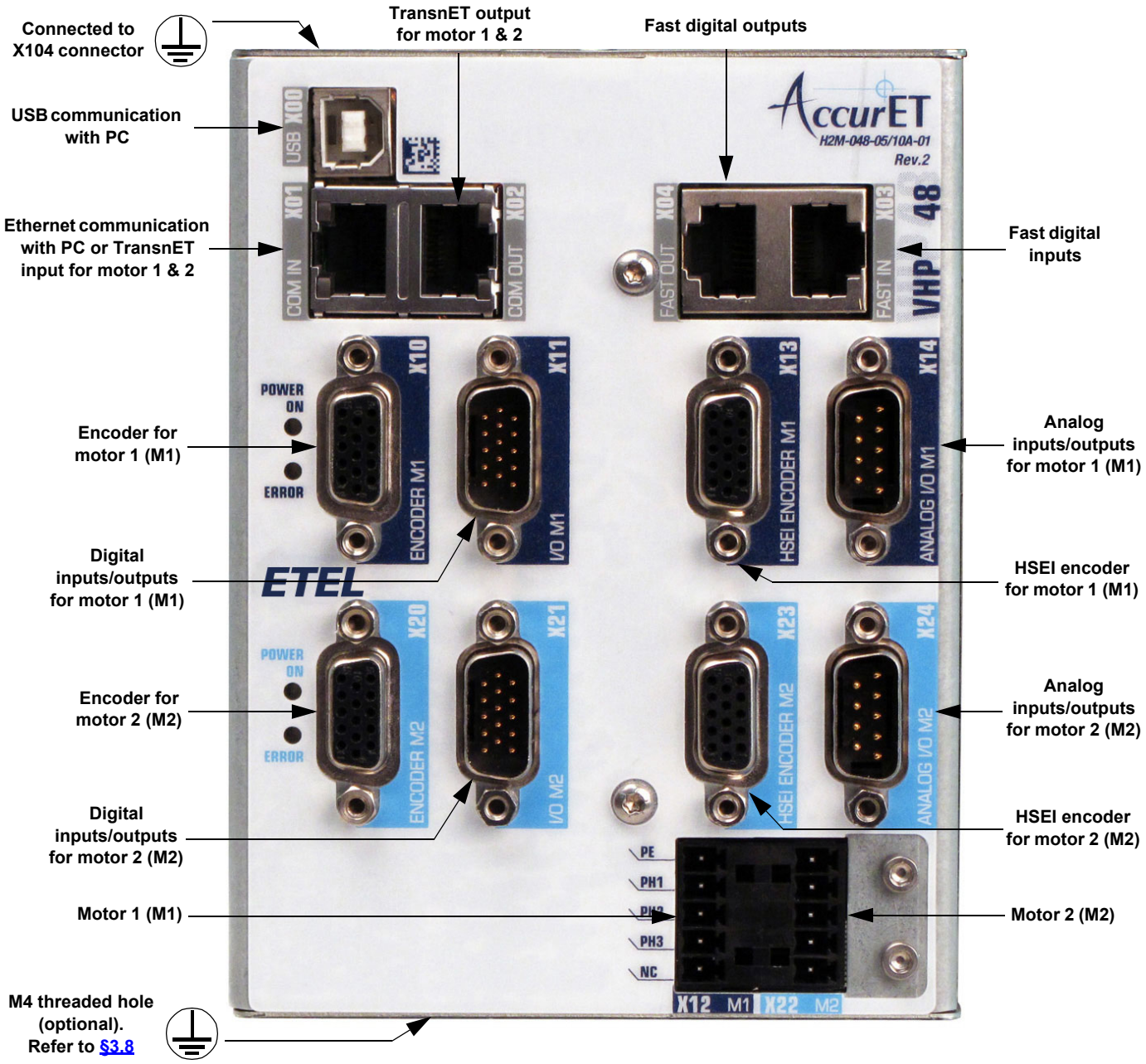
No maintenance operation is required. No replacement of safety-related components is necessary during the lifetime of the product

1.3 Connection diagram

1.3.1 Top view



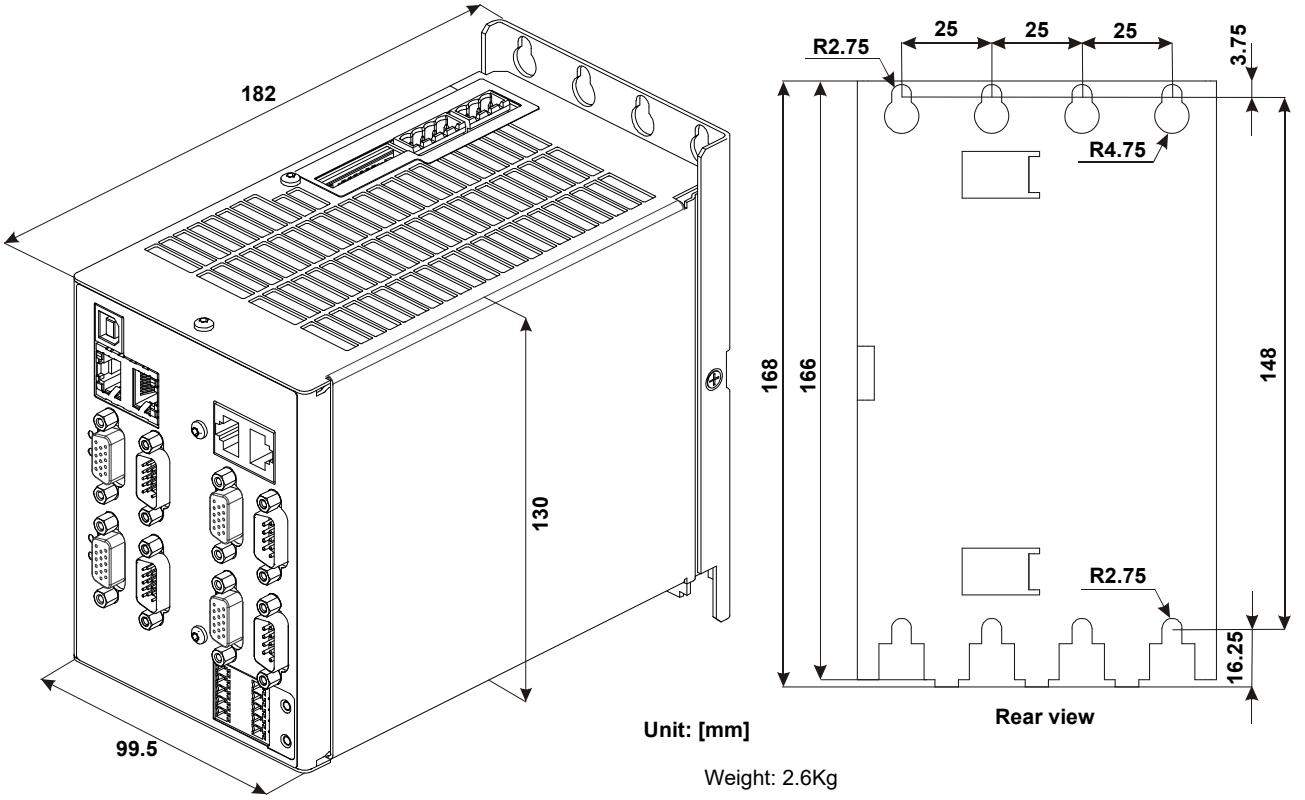
1.3.2 Front view



Remark: Refer to §3. for more information.

2. Models characteristics

2.1 Outline and dimensions



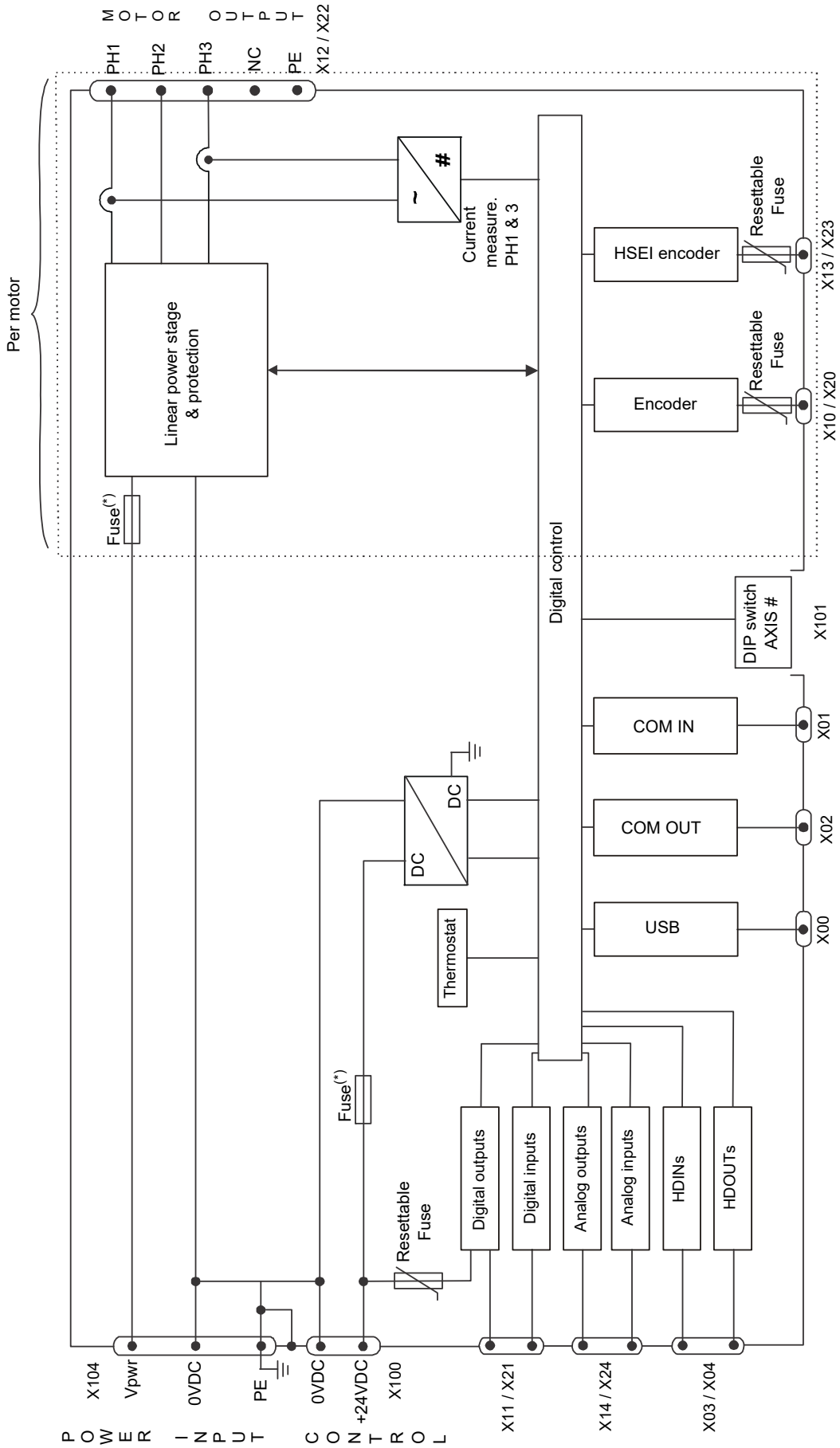
Weight: 2.6Kg

Remark: If the user needs the ETEL's cooling system, the center-to-center distance between the screws at the top of the controller and the bottom screws used to fix the mounting bar is 169 mm (refer to §2.4).

It is recommended to leave 100 mm above and under the controller to guarantee an air flow (the fan power depends on the user application).
Caution: some magnetic components like the fans (not those present in ETEL's cooling unit) may perturb the current measurement of the controller if they are too close. If this problem occurs, use another type of fan or increase the distance between **the fan and the controller while ensuring the following minimum air flow: 130.8m^3/h.**

The ventilation must be activated on as soon as the control and/or power input is switched on.

2.2 Block schematics



(*): The customer is not allowed to change the fuses himself

2.3 Ratings

2.3.1 Position controllers

All the specifications are given for an ambient temperature ranging from +10 °C (50 °F) to +40 °C (104 °F) and with the ETEL bottom to top air flow cooling system (with a top to bottom air flow, the performances are 25 % lower). If this cooling system is not used, a minimum air flow of 130.8 m^3/h is required. Contact your ETEL's representative if the ambient temperature is not included in the above-mentioned range.

EA-H2M-048 POWER FEATURES			
Characteristics		**EA-H2M-048-1.5/3A**	**EA-H2M-048-05/10A**
Output to the motor (per axis)	Bus voltage	Max. 48 VDC (1)	
	Current range on product label	1.5 / 3 Arms	05 / 10 Arms
	Measurable current - full range	5.21 A	17.36 A
	Three-phase motor Max. full load current	2.1 A (1.5 Arms)	7 A (5 Arms)
	Three-phase motor Max. overload current	4.2 A (3 Arms) (2 s)	14 A (10 Arms) (2 s)
	Two-phase motor Max. full load current	2.1 A (1.5 Arms)	7 A (5 Arms)
	Two-phase motor Max. overload current	3.1 A (2.2 Arms) (2 s)	12.2 A (8.6 Arms) (2 s)
	One-phase motor Max. full load current	2.1 A (1.5 Arms)	7 A (5 Arms)
	One-phase motor Max. overload current	4.2 A (3 Arms) (2 s)	14 A (10 Arms) (2 s)
Power input (X104 conector)	DC voltage	15 - 48 VDC	
	Max. continuous input current	10 Arms	
	Max. peak input current	18 A (40 ms)	
	DC bus capacitor	660 µF	
Control input (X100 conector)	DC voltage	24 VDC (±10%)	
	Max. current at 24 VDC	Typ. 1.3 A(2) / Max. 2.5 A	
	DC bus capacitor	2200 µF	

(1): The maximum real voltage applied between terminals of motors is limited to the bus voltage - 7 VDC. For instance, in case of 48 VDC bus voltage, the user must consider a voltage range of -41 VDC to + 41 VDC between terminals of motor.

(2): The current can change depending on the type(s) of encoder(s) as well as the number of inputs/outputs used. A current equal to about twice the above-mentioned typical value can be necessary to switch on the controller (because of the inrush pulse).

Remark: The values of current in the table above are given for a two or three-phase sinusoidal current. If a DC current is requested (motor at standstill, or very low speed), these values can be divided by a factor up to √2.

EA-H2M-048 CONTROL FEATURES		
General	Motion profile and command management sampling time	400 µs
	Digital current loop sampling time	12.5 µs
	Position loop sampling time	50 µs
	Motion profiles	Trapezoidal / S-curve / sine / look-up table /.../ interpolated (UltimET)
	Processor	SHARC Digital Signal Processor, 40 bits floating point

EA-H2M-048 CONTROL FEATURES		
Standard interfaces	USB 2.0 (for setting only)	Full speed (12 Mbps)
	TransnET Ethernet	1 Gbps 10 / 100MHz
Position encoders interfaces	Analog 1Vpp	Max. 500kHz / Up to 8192 interpolation factor per signal period on X10 & X20 Max. 6MHz / Up to 65536 interpolation factor per signal period on X13 & X23
	EnDat 2.1 and 2.2 (absolute encoder)	RS485
	Encoder limit switch (EHO/L1 & ELS/L2 signals)	TTL signal
	Digital (TTL high speed)(*)	Max. 10MHz input frequency
User's inputs / outputs	Digital input	4 per motor
	Fast digital input	6 FDINs (common to both motors) 4 HDINs (common to both motors) FOR FUTURE USE
	Digital output	2 per motor
	Fast digital output	4 FDOUTs (common to both motors) 4 HDOUTs (common to both motors) FOR FUTURE USE
	Analog input	±10V, 16 bits, 4 (common to both motors)
	Analog output	±20V, 16 bits, 4 (common to both motors)
Software / programmability	ComET commissioning software	For software compatibility, refer to the ComET manual
	EDI (DLL files for C and C++)	For software compatibility, refer to the EDI manual
	Firmware update	USB and TransnET

(*): the period frequency (2.5MHz) is one fourth of the counter frequency (10MHz).

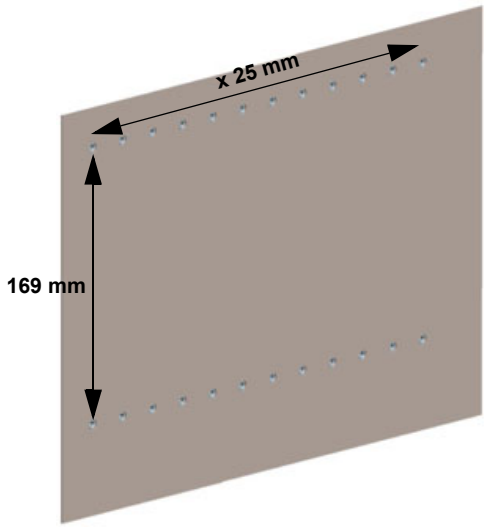
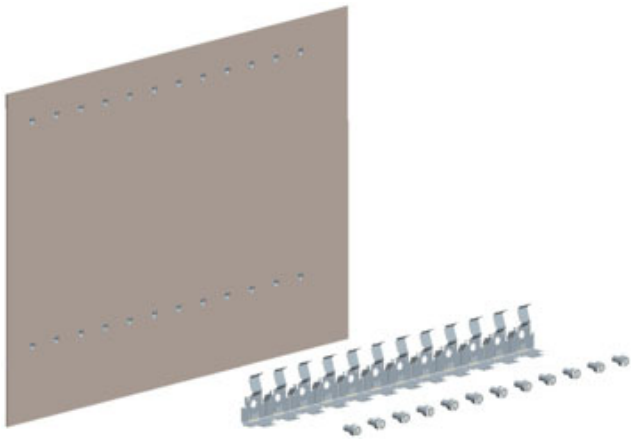
2.4 Mounting

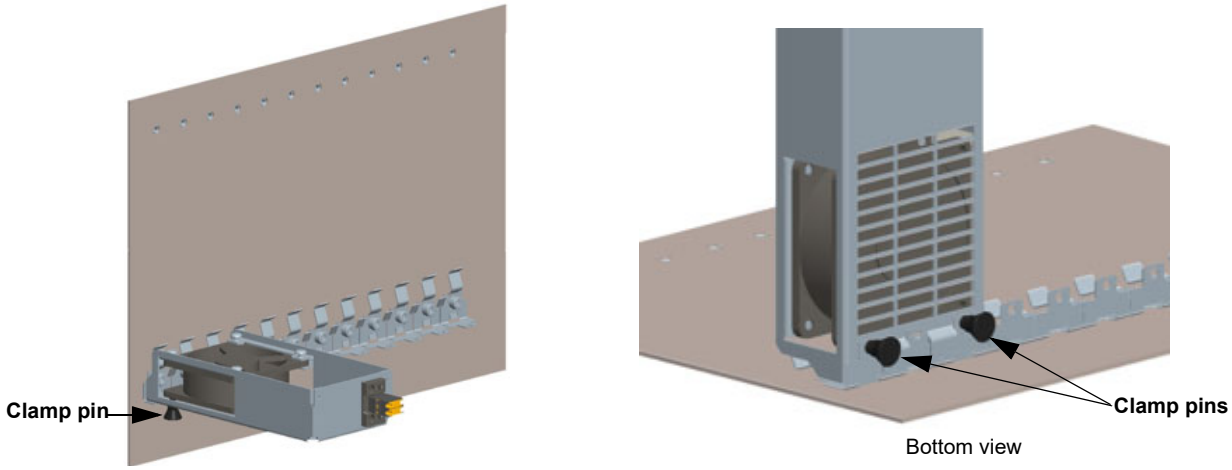
The controller has the following electrical safety degree: IP 20 (according to EN 60529 standard). The AccurET controller must be installed in an enclosure providing electrical, mechanical and fire protection as well as adapted environment such as temperature, humidity, pollution degree 2,…(refer to UL 508C and EN 61800-5-1 standards for more information).

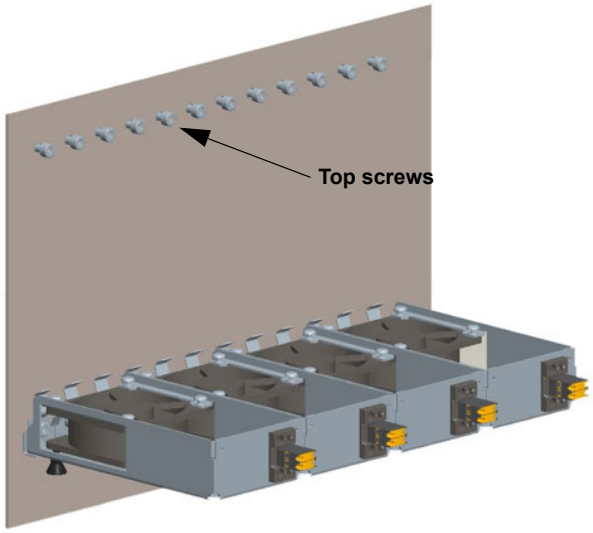
2.4.1 Hardware mounting

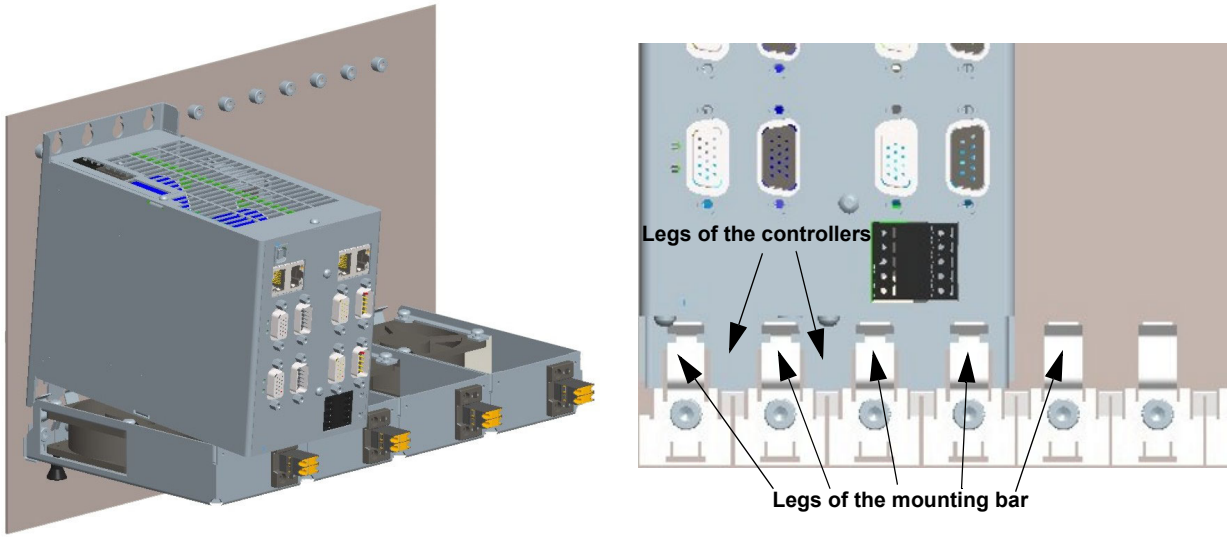
The controller should be protected against any splashes of liquid and any contacts with smoke and dust. It must be installed inside a closed cabinet and mounted as mentioned below. The ground must be connected prior to any other connections (refer to §3.8 for more information). Fresh air is necessary to cool the controller inside the cabinet. It is recommended to leave 100 mm above and under the controller to guarantee an air flow (the fan power depends on the user application).
Caution: some magnetic components like the fans (not those present in ETEL's cooling unit) **may perturb the current measurement of the controller if they are too close**. If this problem occurs, use another type of fan or increase the distance between the fan and the controller while ensuring the following minimum air flow: 130.8m^3/h.

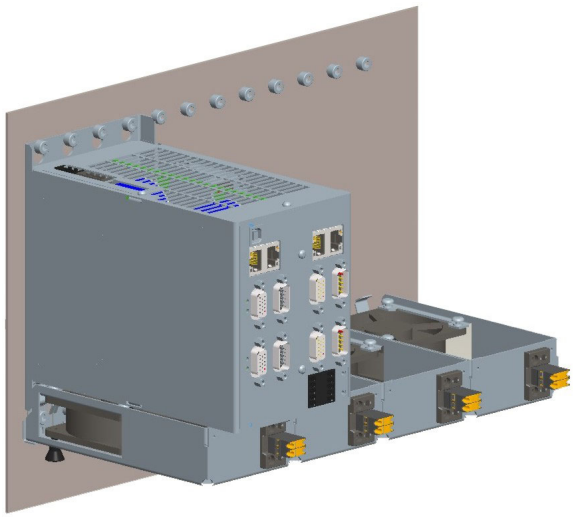
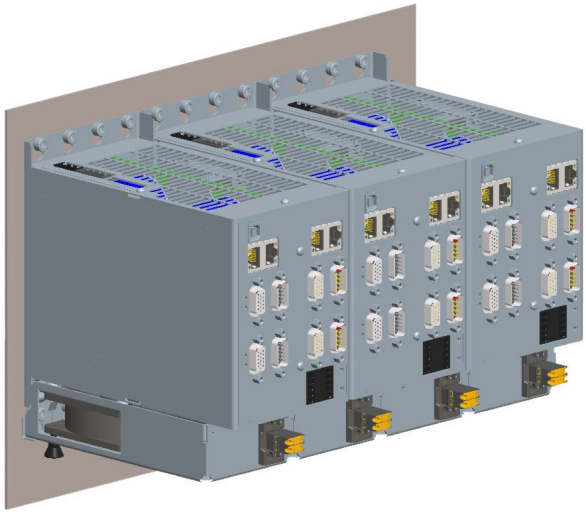
There are three different ways to fasten the controller:
- The ETEL's cooling system is required. In that case, the procedure described hereafter must be followed.
- The user does not need the ETEL's cooling system as well as the mounting bar. In that case, only 4 screws are needed to fasten it. Refer to §2.1 to have the dimensions.
- The user does not need the ETEL's cooling system but wants to use the mounting bar. In that case, the step 1 and 2 of the procedure mentioned below must be followed (refer also to §2.1 to have the dimensions).

Step 1	Step 2
	
The drilling must be realized. The center-to-center distance between the screws at the top of the controller and the bottom screws used to fix the mounting bar is 169 mm. The pitch between each screw belonging to the same row is 25 mm.	Fasten the mounting bar with M5 screws

Step 3

Put the fans in position and fix them with the black clamp pins (2 per fan)

Step 4

Screw, half way, the top screws

Step 5

Put the controller as mentioned above. The legs at the bottom of the controller must be inserted between each leg of the mounting bar.

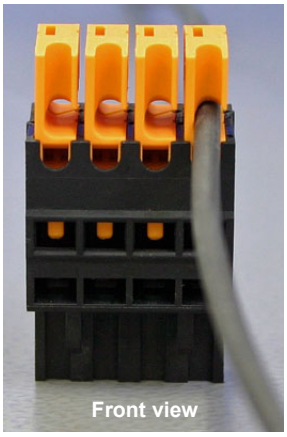
Step 6	Step 7
	
Push the controller against the back panel, then against the fan and finish to screw the top screws.	Proceed as mentioned in step 5 and 6 to put the controllers.

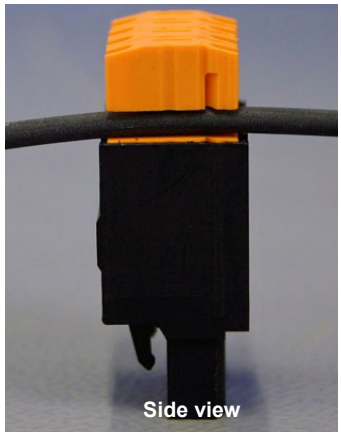
Remark: **The mounting bar and ETEL's fans are identical whatever the AccurET modular product.**

2.4.2 Fan power, control input and power input wiring

All connectors corresponding to the power input voltage of the fans as well as the control and power input voltage of the controller (going to the top of each connected controllers) are connected all together with the type of connector delivered by ETEL. These connectors are self-strip connectors and are delivered only if the connectors kit is ordered. The user must correctly size his power supply according to the number of controller (with or without optional board) connected together.

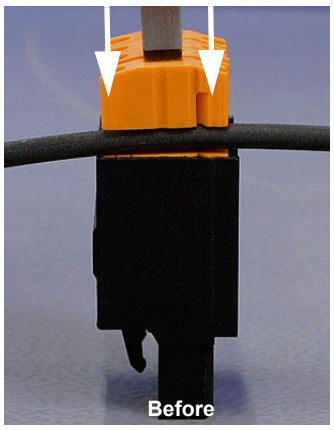
Here is the procedure to manufacture the wiring:

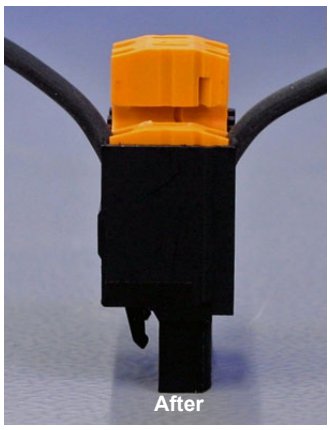




1) Insert the cable in the slot.

Caution: Use only wire with a section from 0.5 mm^2 (AWG 20) to 1 mm^2 (AWG 18).

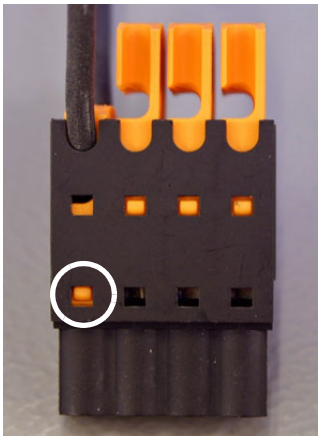




2) Push down the upper part (orange) with a screwdriver for example.

Caution: It is forbidden to realize this operation with the connector plug on the controller. It must be done before plugging it into the controller.

Be careful, not to get your finger caught when pushing down.

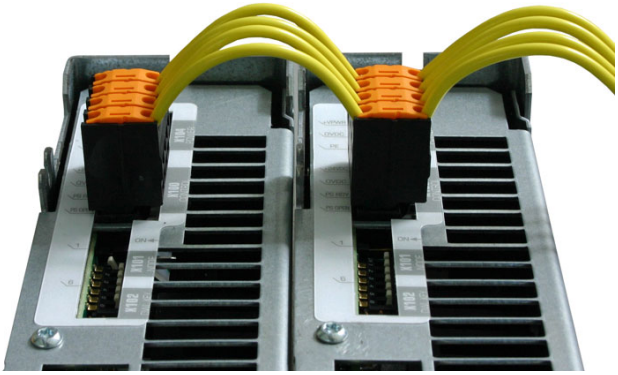


3) To check if the upper part has been pushed enough, the orange pin must be visible in the black cut-out.

4) Repeat the steps 1 to 3 for the other wires. 4 wires are needed per control input connector, 3 per power input connector and 2 for the fan power connector.

5) Repeat the steps 1 to 4 for the other connectors. There are as many control and power input connectors as controllers. The number of fan power connectors depends on the width of the fan (refer to §2.5.2).

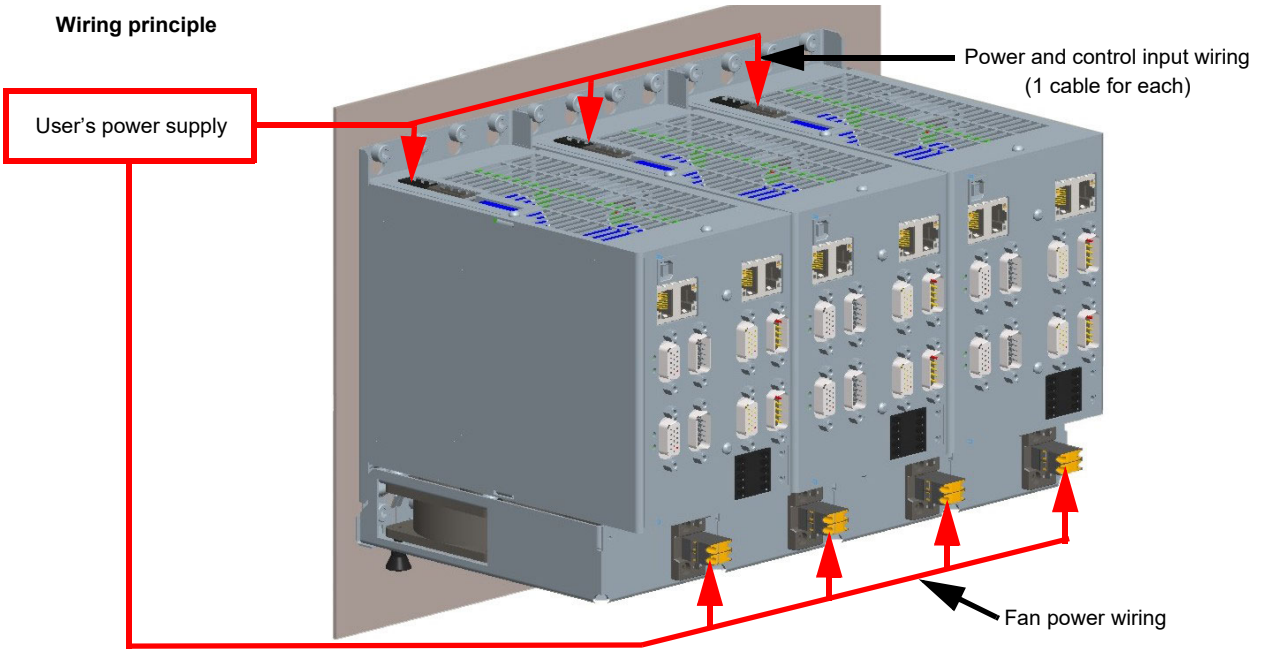
6) The wires after the last connectors must be cut short.

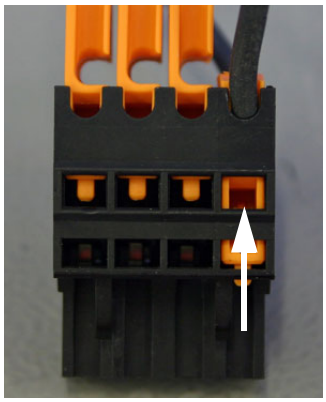


Here is an example with two controllers.

Caution: the length of the wires between 2 connectors must take into account the length lost inside the connector and the fact that the distance may change depending on the controller's width.

Wiring principle





If the wire must be released, push up the orange part with a small screwdriver for example. However, it is not recommended to do it to avoid failure and security problem.

2.5 Ordering information

Here is the ordering information describing the meaning of each digit present on each product:

2.5.1 Position controller

EA	-	H	2	M	-	048	-	1.5/3A	-	0	1	0	0	-	0	1

Family code:
EA = Electronics AccurET

Product type / technology:
H = High performance - Linear technology

Axis number:
2 = Dual axis

Format:
M = Modular

Maximum operating DC voltage:
048 = 48 VDC

Continuous / peak current:
1.5/3A = 1.5 / 3 Arms
05/10A = 05 / 10 Arms

Reserved

Fast encoder input option:
1 = HSEI (High Speed Encoder Interface) version

Standard:
0 = UL 508C compliant(*)
9 = Not UL 508C compliant(**)

Reserved

Customer's specification:
01 = Standard product: hardware revision 2

(*): By default, all products are compliant.
(**): May exceptionally occur during product life time. Should this happen, customer would be officially notified in case it may be unacceptable.

2.5.2 Cooling unit

EA	-	CU	M	-	125	-	BT	-	0	0

Family code:
EA = Electronics AccurET

Product type / technology:
CU = Cooling Unit

Format:
M = modular

Size:
75 = 75 mm
100 = 100 mm
125 = 125 mm

Type:
BT = Bottom to Top air flow (by default)
TB = Top to Bottom air flow (performances 25% lower compared to BT)

Reserved

Reserved

Remark: ETEL's fans are identical whatever the AccurET modular product.

2.5.3 Mounting bar

EA	-	MB	M	-	300	-	0	0

Family code:
EA = Electronics AccurET

Product type / technology:
MB = Mounting Bar

Format:
M = modular

Size:
300 = 300 mm

Reserved

Reserved

Remark: The mounting bar is identical whatever the AccurET modular product.

2.5.4 AccurET kits

EA	-	BCK	-	P2M	-	48	-	00

Family code:
EA = Electronics AccurET

Product type / technology:
BCK = Black Connectors Kit
STK = Starting Kit
SHK = Shielding kit

Product type:
P2M = Modular position controller 2 axes

Voltage:
48 = 48VDC

Reserved

3. Electrical interface

This chapter describes the pin assignment for every connector. More detailed explanations for proper connections are given in each case.

Here is the list of the groups of connectors, according to their function:

Communication connectors (refer to §3.1).

Encoders connectors (refer to §3.2).

Inputs / outputs connectors (refer to §3.3).

Motor connectors (refer to §3.4).

Power connectors (refer to §3.5).

Download key connector (refer to §3.6).

Node number switch (refer to §3.7).

Remark: **Avoid misalignment of male and female connector as well as insertion of other connector than the one intended to receive it.**

In the next paragraphs, connectors with male pins are indicated with the • symbol (full), and female pins are represented with the o symbol (empty).

	**Before connecting or disconnecting a cable on one of these connectors or touching the controller, turn off all the power supplies and wait 2 minutes to allow the internal DC bus capacitors to discharge.** **Always connect the ground prior to any other connection.**
	**Low voltage and data signals are not insulated from Protective Earth (PE).** **The motor connectors must always be correctly screwed onto the controller.**
	**All the connectors must be handled in an ESD protected environment, only.**
	**This is a product of the restricted distribution class according to IEC61800-3. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures.**

3.1 Communication connectors

	**Signals are not insulated from Protective Earth (PE).**
	**The communication connectors must be handled in an ESD protected environment, only.**

The communication between a host (PC) and a controller is obtained via a USB protocol (connector X00). The communication between the controllers and the master (UltimET) is obtained via a TransnET (ETEL's property) protocol, To do so, the connectors X01 and X02 are used to make a daisy chain with standard RJ-45 cables.

3.1.1 USB communication (connector X00)

The USB 2.0 (full speed) communication is used for the setting and the monitoring of the controller. The USB connector is a «Type B» connector.

3.1.2 TransnET / Ethernet input (connector X01)

This input, mentioned «COM IN» (COMmunication INput) on the front panel of the controller, is used to connect the input cable of the ETEL TransnET or the Ethernet communication. **Both communications are not possible at the same time**. The Ethernet connection is used to directly connect the PC to a single controller.

Remark: The RJ-45 cable must meet the following characteristics: 1:1 shielded cable, category 5E SFTP with 8 wires. The cumulated length of all TransnET cables must not exceed 100m.

3.1.3 TransnET output (connector X02)

The TransnET output, mentioned «COM OUT» (COMmunication OUTput) on the front panel of the controller is used to connect the output cable of ETEL's TransnET communication. For the last controller, this connector is not used as the incoming and outgoing data run through the same cable.

Remark: The RJ-45 cable must meet the following characteristics: 1:1 shielded cable, category 5E SFTP with 8 wires. The cumulated length of all TransnET cables must not exceed 100m.

3.2 Encoder connectors (connectors X10, X13, X20 and X23)

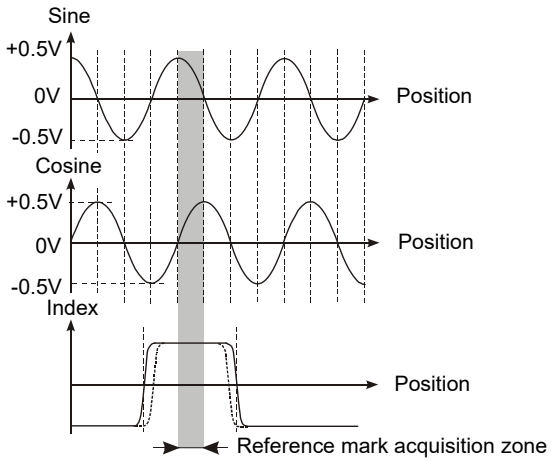
	**Signals are not insulated from Protective Earth (PE).** **Avoid proximity with noisy power cable.**
	**The encoder connectors must be handled in an ESD protected environment, only.**

Remark: The encoder cable(s) connected to the controller must be shielded (refer to §3.9.1).
The connector X10 and X13 are used to connect the encoder of motor 1, and X20 and X23 for the one of motor 2.

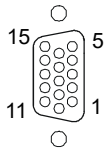
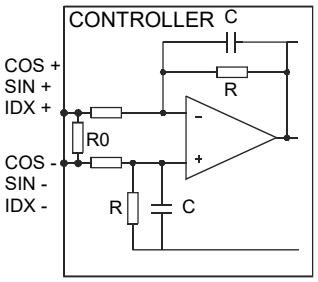
On connectors X10 and X20, three different types of encoder can be connected: either an incremental analog 1 Vpp encoder or an absolute encoder (EnDat 2.1 and 2.2) or a true TTL encoder.
On connectors X13 and X23, only an incremental analog 1 Vpp encoder can be connected. This interface is dedicated to high speed encoder input (up to 6 MHz).

3.2.1 Incremental analog encoder (1 Vpp)

The incremental analog encoder has 1Vpp signals with a load resistor R_0=120Ω. It determines the motor position thanks to two sinusoidal signals with a 90° phase-shift (sine and cosine). A third signal, the index (also called reference mark) gives the absolute motor position:



D-SUB, 15 pins, high density, female

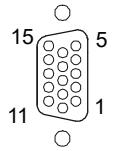
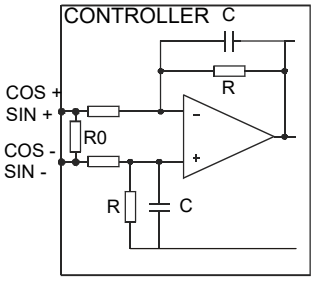
Encoder	Pin #	Signal	Function	Interface
X10, X13 X20 & X23 	1	Reserved	**Do not connect**	
	2	Reserved	**Do not connect**	
	3	Reserved	**Do not connect**	
	4	+5VDC	Encoder supply output (protected by a resettable fuse of 1.5A)	
	5	GND	Encoder supply output (0V)	
	6	COS -	Cosine - signal input	
	7	SIN -	Sine - signal input	
	8	IDX -	Index - signal input(*)	
	9	Reserved	**Do not connect**	
	10	EHO/L1	Encoder home switch input EHO or encoder limit switch L1 (TTL signal)	
	11	ELS/L2	Encoder limit switch input ELS or encoder limit switch L2 (TTL signal)	
	12	GND	Encoder supply output (0V)	
	13	COS +	Cosine + signal input	
	14	SIN +	Sine + signal input	
	15	IDX +	Index + signal input(*)	

Remark: **The incremental analog 1 Vpp encoder can be connected to the connectors X10, X13, X20 and X23!**
The +5VDC encoder supply output is protected by a resettable fuse (1.5 A) on X10 and X20 as well as on X13 and X23.
Refer to the corresponding **'Operation & Software Manual'** for more information about the use of the EHO/L1 and ELS/L2 signals.
The connector X10 and X13 are used to connect the encoder of motor 1, and X20 and X23 for the one of motor 2.
(*): To be able to use the index on the HSEI encoder, the homing speed must not exceed 500kHz frequency on the analog signal.

3.2.2 Absolute encoder (EnDat 2.1)

The EnDat 2.1 is an **absolute encoder**. It has 1Vpp signals with a load resistor R_0=120Ω. Its signals are similar to the incremental encoders (without the index), but it additionally includes a RS485 serial link (EIA standard, EnDat 2.1 interface) for the absolute position measure: EDT (serial data) and ECL (clock). The ECL (clock) signal is received from the controller. From its first falling edge (latch signal), the **absolute position will be defined within one incremental signal period** (depends on the encoder type)

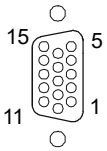
D-SUB, 15 pins, high density, female

Encoder	Pin #	Signal	Function	Interface
X10 & X20  	1	EDT +	EnDat serial data I/O + / RS485	
	2	ECL +	EnDat clock output + / RS485	
	3	ECL -	EnDat clock output - / RS485	
	4	+5VDC	Encoder supply output (protected by a resettable fuse of 1.5 A)	
	5	GND	Encoder supply output (0V)	
	6	COS -	Cosine - signal input	
	7	SIN -	Sine - signal input	
	8	Reserved	**Do not connect**	
	9	EDT -	EnDat serial data I/O - / RS485	
	10	Reserved	**Do not connect**	
	11	Reserved	**Do not connect**	
	12	GND	Encoder supply output (0V)	
	13	COS +	Cosine + signal input	
	14	SIN +	Sine + signal input	
	15	Reserved	**Do not connect**	

Remark: **The absolute encoder (EnDat 2.1) can be connected to the connectors X10 and X20 only!**
The +5VDC encoder supply output is protected by a resettable fuse (1.5 A) on X10 and X20.
The cable used with an absolute encoder (EnDat 2.1) must have power wires with a minimum section to guarantee a sufficient voltage at the terminals of the encoder (refer to the data sheet of the encoder for more information).
The connector X10 is used to connect the encoder of motor 1 and X20 for the one of motor 2.

3.2.3 Absolute encoder (EnDat 2.2)

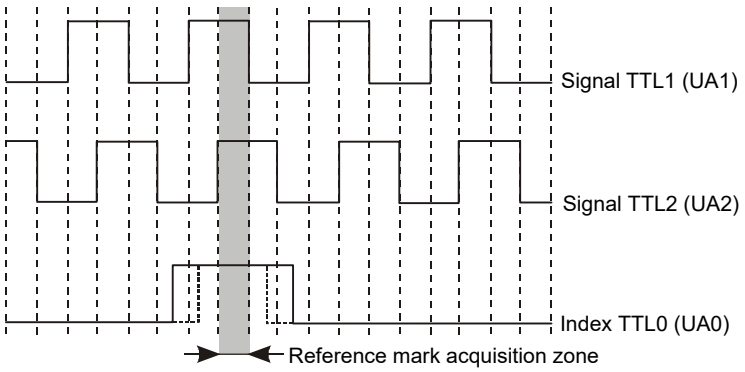
The EnDat 2.2 is an **absolute encoder**. It includes a RS485 serial link (EIA standard, EnDat 2.2 interface) for the absolute position measure: EDT (serial data) and ECL (clock). The ECL (clock) signal is received from the controller. Refer to the Heidenhain documentation for more information about the EnDat 2.2.

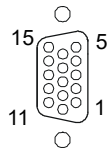
D-SUB, 15 pins, high density, female			
Encoder	**Pin #**	**Signal**	**Function**
X10 & X20 	1	EDT +	EnDat serial data I/O + / RS485
	2	ECL +	EnDat clock output + / RS485
	3	ECL -	EnDat clock output - / RS485
	4	+5VDC	Encoder supply output (protected by fuse F5 of 1.5 A)
	5	GND	Encoder supply output (0V)
	6	Reserved	**Do not connect**
	7	Reserved	**Do not connect**
	8	Reserved	**Do not connect**
	9	EDT -	EnDat serial data I/O - / RS485
	10	Reserved	**Do not connect**
	11	Reserved	**Do not connect**
	12	GND	Encoder supply output (0 V)
	13	Reserved	**Do not connect**
	14	Reserved	**Do not connect**
	15	Reserved	**Do not connect**

Remark: **The absolute encoder (EnDat 2.2) can be connected to the connectors X10 and X20 only!**
The +5VDC encoder supply output is protected by a resettable fuse (1.5 A) on X10 and X20.
The cable used with an absolute encoder (EnDat 2.2) must have power wires with a minimum section to guarantee a sufficient voltage at the terminals of the encoder (refer to the data sheet of the encoder for more information) and a length of maximum 40m.
The connector X10 is used to connect the encoder of motor 1 and X20 for the one of motor 2.

3.2.4 TTL encoder

TTL encoders measure the motor position with 2 phase-shifted TTL signals. Each change of state of one of the signals corresponds to an increment of the motor position. A third signal (index) gives the motor reference position. The encoder TTL signals have to be compatible with the EIA standard RS422. These signals have the following form:

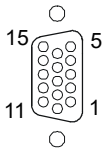


D-SUB, 15 pins, high density, female			
Encoder	**Pin #**	**Signal**	**Function**
X10 & X20 	1	UA1 +	TTL1 + signal input
	2	UA2 +	TTL2 + signal input
	3	UA2 -	TTL2 - signal input
	4	+5VDC	Encoder supply output (protected a resettable fuse of 1.5 A)
	5	GND	Encoder supply output (0V)
	6	Reserved	**Do not connect**
	7	Reserved	**Do not connect**
	8	Reserved	**Do not connect**
	9	UA1 -	TTL1 - signal input
	10	UA0 -	TTL0 - signal input
	11	UA0 +	TTL0 + signal input
	12	GND	Encoder supply output (0V)
	13	Reserved	**Do not connect**
	14	Reserved	**Do not connect**
	15	Reserved	**Do not connect**

Remark: **The TTL encoder can be connected to the connectors X10 and X20 only!**
The +5VDC encoder supply output is protected by a resettable fuse (1.5 A).
The connector X10 is used to connect the encoder of motor 1 and X20 for the one of motor 2.
The period frequency (2.5MHz) is one fourth of the counter frequency (10MHz).

3.2.5 Dual encoder feedback

The dual encoder feedback is only possible with 1Vpp, TTL, HSEI and absolute EnDat 2.1 and 2.2 encoders. There are 9 possible configurations. Here is only described the first three as they need to be connected to the same encoder connector. The other configurations (from K76=4 to K76=9) use separated encoder connectors described above.

D-SUB, 15 pins, high density, female			
		1 Vpp / TTL (K76=1)	**1 Vpp / EnDat 2.2 (K76=2) & EnDat 2.2 / 1 Vpp (K76=3)**
Encoder	**Pin #**	**Signal**	**Signal**
X10 & X20 	1	UA1 +	EDT +
	2	UA2 +	ECL +
	3	UA2 -	ECL -
	4	+5VDC	+5VDC
	5	GND	GND
	6	COS -	COS -
	7	SIN -	SIN -
	8	IDX -	IDX -
	9	UA1 -	EDT -
	10	EHO/L1 or UA0 -	EHO/L1
	11	ELS/L2 or UA0 +	ELS/L2
	12	GND	GND
	13	COS +	COS +
	14	SIN +	SIN +
	15	IDX +	IDX +

Remark: Refer to the corresponding encoder table to know the function of each signal.

3.3 Inputs / outputs connectors

	**Signals are not insulated from Protective Earth (PE).**
	**The inputs/outputs connectors must be handled in an ESD protected environment, only.**

Remark: The inputs/outputs cable(s) connected to the controller must be shielded (refer to §3.9.1).

The controller has:

- 4 standard digital inputs (DIN1, DIN2, DIN9 and DIN10) per motor and 6 **fast** digital inputs (FDIN1 to FDIN6) for both motors on connectors X11 and X21.
- 4 fast digital inputs (HDIN1 to HDIN4) for both motor on connector X03 (future use).
- 2 standard digital outputs (DOUT1 and DOUT2) per motor and 4 **fast** digital outputs (FDOUT1 to FDOUT4) for both motors on connectors X11 and X21.
- 4 fast digital outputs (HDOUT1 to HDOUT4) for both motor on connector X04 (future use).
- 4 analog inputs (AIN) and 4 analog output (AOUT) for both motors on connectors X14 and X24.

Only inputs and outputs **interface** is considered here. Refer to the corresponding **'Operation & Software Manual'** for more information about the use of these inputs and outputs.

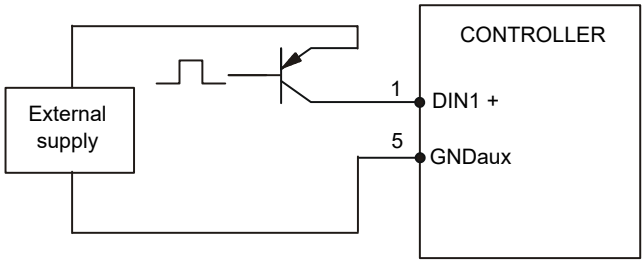
3.3.1 Digital inputs (connectors X11 and X21)

- **Standard digital inputs**

The digital inputs switch to ’1’ when a voltage ranging between +14VDC and +28VDC is applied between pins DIN+ of the corresponding input and GND.
The digital inputs switch to ‘0’ when a voltage ranging between 0VDC and +3VDC to is applied between pins DIN+ of the corresponding input and GND. Any voltage between +3VDC and +14VDC will give an uncertain input value.

Remark: When using an external ‘positive limit switch’, connect it to DIN10.
When using an external ‘negative limit switch’, connect it to DIN9.
When using an external ‘home switch’, connect it to DIN2.

The auxiliary supply can be external to the controller, as shown below:



The commutation times of the above-mentioned inputs are as follows:

	Status	Maximum	Unit
DINs	0 => 1	30	ns
	1 => 0	30	ns

Remark: The above-mentioned times takes only the hardware into account and are measured with a driver with low output impedance. With a non-null impedance, the internal input capacitance (1nF) slow down the commutation time.

- **Fast digital inputs**

There are 6 fast digital inputs present on the connectors X11 and X21 for both motors and 4 on the connector X03 also for both motors. They can be used by the customer for synchronization, position capture, etc. The digital inputs switch to '1' when a voltage ranging between +2VDC and +5VDC is applied between pins DIN+ of the corresponding input and GND.
The digital inputs switch to '0' when a voltage ranging between 0VDC and +0.8VDC is applied between pins DIN+ of the corresponding input and GND. Any voltage between +0.8VDC and +2VDC will give an uncertain input value.

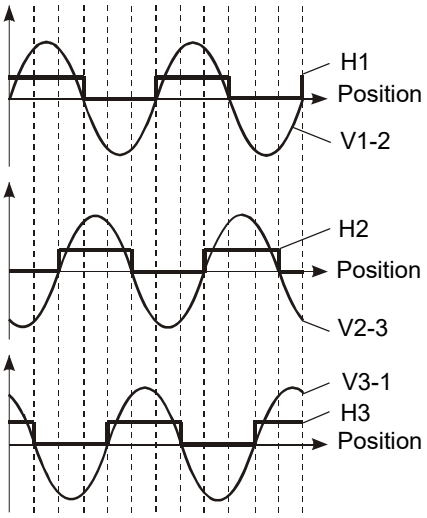
The commutation times of the above-mentioned inputs are as follows:

	Status	Maximum	Unit
FDINs	0 => 1	30	ns
	1 => 0	30	ns

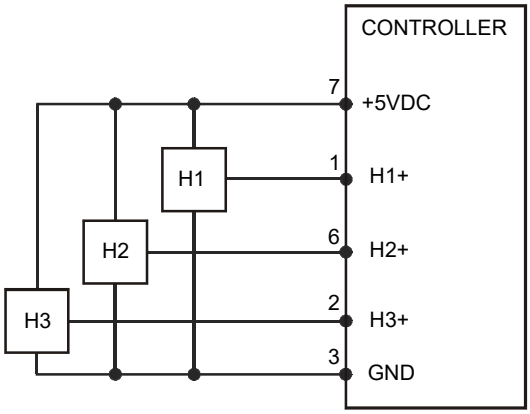
Remark: The above-mentioned times takes only the hardware into account and are measured with a driver with low output impedance. With a non-null impedance, the internal input capacitance (1nF) slow down the commutation time.

- **Digital Hall effect sensor**

3 digital inputs (H1+, H2+ and H3+) which correspond to the 3 fast digital inputs, are used to connect a digital Hall effect sensor. This sensor is used for the motor commutation thanks to three digital signals (one for each Hall effect sensor). On the following graph, the Hall signals and the sine voltages between the motor phases are displayed:



The digital Hall effect sensors (H1, H2 and H3) must be connected as shown below:



External pull up resistors are not required. As described in §3.3.2, H1+, H2+, H3+ are connected internally to +5V through a 3KΩ pull up.

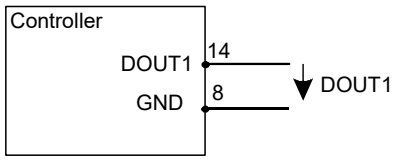
Remark: The connector X11 is used to connect the digital inputs/outputs of motor 1 and X21 for the ones of motor 2.

Refer to §3.3.2 for the pin assignment of the connector.

3.3.2 Digital outputs (connectors X11 and X21)

- **Standard digital outputs**

The +Vaux voltage used to supply the digital output is the same as the one present on the control input connector (X100). **Do not supply Vaux voltage on connector X11 or X21 but only on connector X100.** The maximum total current provided per digital output is limited to 500 mA but 800 mA all together.



Remark: This diagram shows the use of DOUT1, but it is the same with DOUT2.

The commutation times of the above-mentioned outputs are as follows:

	Status	Maximum	Unit
DOUTs	0 => 1	500	µs
	1 => 0	500	µs

Remark: The above-mentioned times takes only the hardware into account.

- **Fast digital outputs**

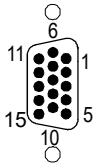
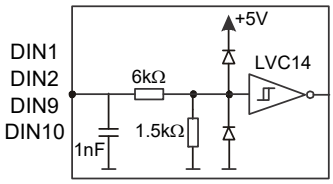
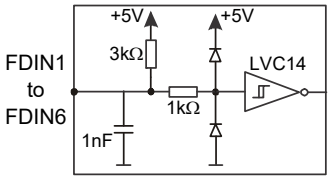
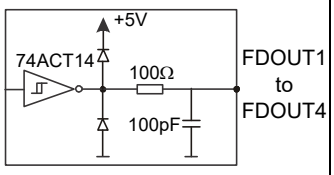
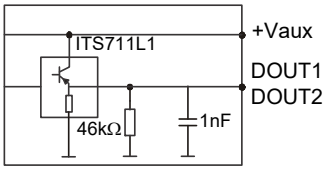
The fast digital outputs are common to both motors and can be used by the customer for triggers, encoder signals outputs, etc.

The commutation times of the above-mentioned outputs are as follows:

	Status	Maximum	Unit
FDOUTs	0 => 1	30	ns
	1 => 0	30	ns

Remark: The above-mentioned times takes only the hardware into account and not the output cable capacitance.
The connector X11 is used to connect the digital inputs/outputs of motor 1 and X21 for the ones of motor 2.

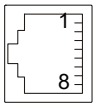
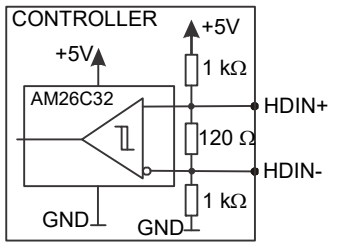
D-SUB, 15 pins, male

I / O	Pin #	Signal	Function	Interface
X11 & X21 	1	FDIN1 (X11) / FDIN4 (X21)	Fast digital input 1 + (H1+)	
	2	FDIN3 (X11) / FDIN6 (X21)	Fast digital input 3 + (H3+)	
	3	GND	External supply input (0V) for FDIN and FDOUT (linked to the 0VDC of the connector X100)	
	4	DIN2 +	Digital input 2 +	
	5	DIN10 +	Digital input 10 +	
	6	FDIN2 (X11) / FDIN5 (X21)	Fast digital input 2 + (H2+)	
	7	+5VDC	Power supply output for Hall sensor (max 100 mA)	
	8	GND	External supply input (0V) for DIN and DOUT (linked to the 0VDC of the connector X100)	
	9	DIN1 +	Digital input 1 +	
	10	DIN9 +	Digital input 9 +	
	11	FDOUT1 (X11) / FDOUT3 (X21)	Fast digital output 1 + (±24 mA)	
	12	FDOUT2 (X11) / FDOUT4 (X21)	Fast digital output 2 + (±24 mA)	
	13	+Vaux	Power supply output provided by +24 VDC on connector X100 (fuse of 3.5 A - limits user's input current)	
	14	DOUT1	Digital output 1 +	
	15	DOUT2	Digital output 2 +	

3.3.3 Fast inputs (connector X03) FOR FUTURE USE

The fast digital inputs are common to both motors and can be used by the customer for synchronization, position capture, etc. They are RS422 signals.

RJ-45, 8 pins, female

Fast input	Pin #	Signal	Function	Interface
X03 	1	HDIN1+	Fast digital input 1+ (data reception RS422 +)	
	2	HDIN1-	Fast digital input 1- (data reception RS422 -)	
	3	HDIN3+	Fast digital input 3+ (data reception RS422 +)	
	4	HDIN2+	Fast digital input 2+ (data reception RS422 +)	
	5	HDIN2-	Fast digital input 2- (data reception RS422 -)	
	6	HDIN3-	Fast digital input 3- (data reception RS422 -)	
	7	HDIN4+	Fast digital input 4+ (data reception RS422 +)	
	8	HDIN4-	Fast digital input 4- (data reception RS422 -)	

Remark: The RJ-45 cable must be shielded.

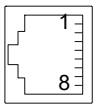
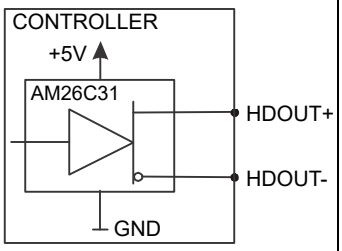
The commutation times of the above-mentioned inputs are as follows:

	Status	Maximum	Unit
HDINs	0 => 1	30	ns
	1 => 0	30	ns

Remark: The above-mentioned times takes only the hardware into account.

3.3.4 Fast outputs (connector X04) FOR FUTURE USE

The fast digital outputs are common to both motors and can be used by the customer for triggers, encoder signals outputs, etc. They are RS422 signals.

RJ-45, 8 pins, female				
Fast output	**Pin #**	**Signal**	**Function**	**Interface**
X04 	1	HDOUT1+	Fast digital output 1+ (data transmission RS422 +)	
	2	HDOUT1-	Fast digital output 1- (data transmission RS422 -)	
	3	HDOUT3+	Fast digital output 3+ (data transmission RS422 +)	
	4	HDOUT2+	Fast digital output 2+ (data transmission RS422 +)	
	5	HDOUT2-	Fast digital output 2- (data transmission RS422 -)	
	6	HDOUT3-	Fast digital output 3- (data transmission RS422 -)	
	7	HDOUT4+	Fast digital output 4+ (data transmission RS422 +)	
	8	HDOUT4-	Fast digital output 4- (data transmission RS422 -)	

Remark: The RJ-45 cable must be shielded.

The commutation times of the above-mentioned outputs are as follows:

	Status	**Maximum**	**Unit**
HDOUTs	0 => 1	30	ns
	1 => 0	30	ns

Remark: The above-mentioned times takes only the hardware into account.

3.3.5 Analog inputs / output (connectors X14 and X24)

- **Analog inputs**

There are 4 differential analog inputs (16bits) (common to both motors). To use the analog input, a voltage ranging from +10 VDC to -10 VDC must be applied between the corresponding AIN+ and AIN.

+10 VDC ⇔ 32767 increments
–10 VDC ⇔ -32768 increments

The analog inputs are sampled once every PLTI. It means that the sampling frequency is 20 kHz.

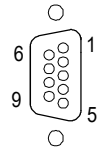
- **Analog outputs**

There are 4 differential analog outputs (16bits) (common to both motors). +10 VDC corresponds to 32767 increments and -10 VDC to -32768 increments. Each analog output can sink or source maximum 5 mA.

+32767 ⇔ +20 VDC between AOUT+ and AOUT-
-32768 ⇔ -20 VDC between AOUT+ and AOUT-
+32767 ⇔ +10 VDC between AOUT+ and GND
-32768 ⇔ -10 VDC between AOUT+ and GND
+32767 ⇔ +10 VDC between AOUT- and GND
-32768 ⇔ -10 VDC between AOUT- and GND

The analog outputs are refreshed once every PLTI. It means that the refresh frequency is 20kHz.

Remark: Please preferably use the connection between AOUT+ and AOUT-. The signal between the GND and AOUT+ or AOUT- might be disrupted and consequently have a lower resolution.

D-SUB, 9 pins, male			
I / O	**Pin #**	**Signal**	**Function**
X14 & X24 	1	GND	External supply input (0V) (linked to the 0VDC of the connector X100)
	2	AOUT1-	Analog output 1 -
	3	AOUT2-	Analog output 2 -
	4	AIN1+	Analog input 1 +
	5	AIN2+	Analog input 2 +
	6	AOUT1+	Analog output 1 +
	7	AOUT2+	Analog output 2 +
	8	AIN1-	Analog input 1 -
	9	AIN2-	Analog input 2 -

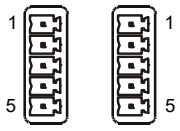
Remark: The connector X14 is used to connect the analog inputs/outputs of motor 1 and X24 for the ones of motor 2.

3.4 Motor connectors (connectors X12 and X22)

	**Before connecting or disconnecting the motor cable or touching the controller, turn off all the power supplies and wait 2 minutes to allow the internal DC bus capacitors to discharge. When the power input voltage is higher than 26.4V, and since the motor output is non DC voltage, this is considered as an hazardous voltage according to IEC61800-5-1. Therefore there is a risk of electrical shock and adequate precautions have to be taken to avoid direct contact with motor output connections. Always connect the ground prior to any other connection.**
	**The motor connectors must be insulated (no contact) from the power and the mains.The motor connectors must always be correctly screwed onto the controller to respect the EMC standard.**
	**The motors connectors must be handled in an ESD protected environment, only.**

Remark: The motor cables connected to the controller must be shielded (refer to §3.9.1).

The controller can drive single-phase, two-phase and three-phase motors. Connectors X12 and X22 enable the supply of the motor phase(s).

Phoenix Contact MC 1.5/5-G-3.81 BK (plastic connector)					
MOTOR CONNECTION	**Pin #**	**Signal**	**Function**		
			Single-phase motor	**Two-phase motor**	**three-phase motor**
X12 X22  M1 M2	1	PE	Protective earth	Protective earth	Protective earth
	2	PH1	Motor phase1 +	Motor phase1 +	Motor phase1
	3	PH2	Motor phase1 -	Motor phase1 - / 2 - (*)	Motor phase2
	4	PH3	**Do not connect**	Motor phase2 +	Motor phase3
	5	NC	**Do not connect**	**Do not connect**	**Do not connect**

(*): With two-phase motor, the current in 'motor phase 1- / 2-' is equal to (√2 x motor phase 1+) or (√2 x motor phase 2+). Be careful to use the suitable cable diameter.

Remark: The connector X12 is used to connect the motor 1 and X22 for the motor 2.
It is compulsory to use the metallic bracket described in §3.9.2.
The associated connector can be ordered through the connector kit (refer to §2.5.4). If not, be sure to use a connector compatible with the above-mentioned one.

3.5 Power connectors

	**Before connecting or disconnecting the power cables or touching the controller, turn off all the power supplies and wait 2 minutes to allow the internal DC bus capacitors to discharge. Always connect the ground prior to any other connection.**
	**The power connectors must be handled in an ESD protected environment, only.**

Remark: The power cables connected to the controller must be shielded (refer to §3.9.1).

3.5.1 At the position controller level

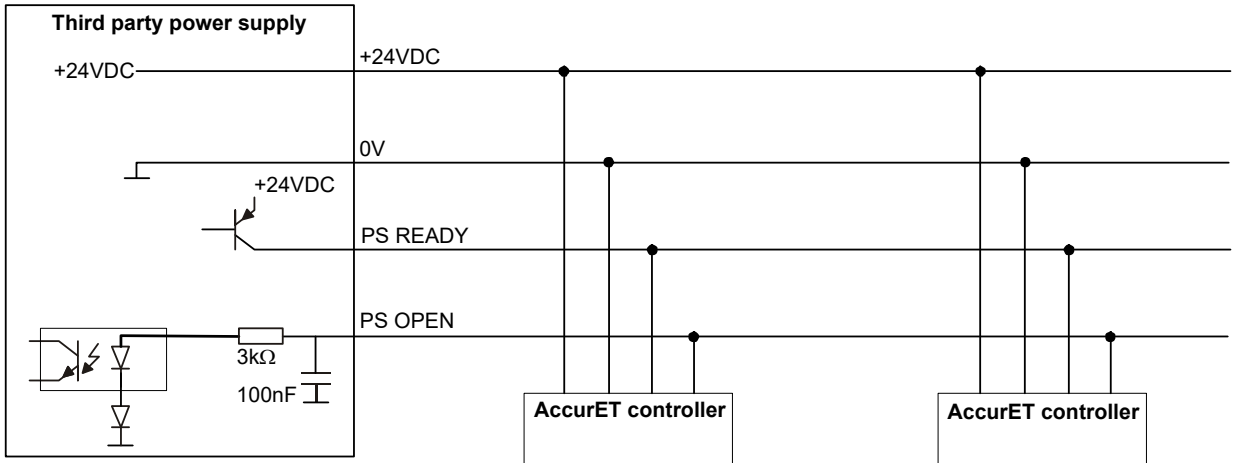
3.5.1.1 Control input (connector X100)

Phoenix Contact MSTBA 2.5/4-G BK (plastic connector)			
Control	**Pin #**	**Signal**	**Function**
X100 1 2 3 4	1	+24VDC	Control input (24VDC (±10%))
	2	0VDC	Control input (0VDC)
	3	PS RDY	Power supply ready input
	4	PS OPEN	Power supply opened output

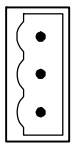
For safety reasons, always connect first the ground!

Remark: To ensure proper operation of the controller, it is recommended to wait for 1 second between two successive ON or OFF cycles (1 s minimum for the OFF state when ON/OFF/ON cycle and 1 s minimum for the ON state when OFF/ON/OFF).
The control input shall be supplied by an isolated power supply with SELV outputs (Isolated secondary output), rated 24VDC (±10%). The power supply must ensure the reinforced insulation between mains and output and provide overvoltage category II (refer to EN 61800-5-1 and UL 508C standards for more information).
To avoid any mis-connection (damage or hazard), coding parts on both the X100 connector and the mating connector of X104 can be used (Phoenix Contacts ref: CR-MSTB for X100 and CPMSTB for X104).
The control input connector is located on the top of the controller.
The associated connector can be ordered through the connector kit (refer to §2.5.4). If not, be sure to use a connector compatible with the above-mentioned one.

To guarantee perturbation immunity coming from the external environment, a 4.7uH inductance MUST be added and connected in series to pin 1 (control input) and as close as possible from the control input connector (X100).
This inductance can be done with a ferrite clip (for example: Sibalco ref: 6000323 with 2 loops or NEC/TOKIN ref: ESD-SR-150 with 2 loops) or a ferrite core (for example: Fair-Rite Products Corp. ref: 2643665802 with 2 loops or Würth Electronik GmbH, Axial ferrite bead, ref: 7427727, (ETEL's ref: # 805009-01) with only one loop).
The 'PS RDY' (Power Supply ReaDY) signal comes from the power supply and indicates that the voltage present on the DC bus can be used (with +24VDC) or not (with 0V). This signal must be connected to +24VDC. It is then possible to link pin 3 with pin1.
The 'PS OPEN' (Power Supply OPENed) signal comes from each controller asking for a power interrupt (with +24VDC). The normal state is when the signal is at 0V.



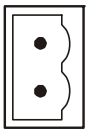
3.5.1.2 *Power input (connector X104)*

Phoenix Contact MSTBA 2.5/3-G BK (plastic connector)			
Control	**Pin #**	**Signal**	**Function**
X104 	1	+Vpwr	Power input (15VDC to 48VDC (±5%))
	2	0VDC	Power input (0VDC)
	3	PE	Protective earth

For safety reasons, always connect first the ground!

Remark: The power input shall be supplied by an isolated power supply with SELV outputs (Isolated secondary output), rated 48VDC (maximum). The power supply must ensure the reinforced insulation between mains and output and provide overvoltage category II (refer to EN 61800-5-1 and UL 508C standards for more information).
To avoid any mis-connection (damage or hazard), coding parts on both the X100 connector and the mating connector of X104 can be used (Phoenix Contacts ref: CR-MSTB for X100 and CPMSTB for X104).
The power input connector is located on the top of the controller.
The associated connector can be ordered through the connector kit (refer to §2.5.4). If not, be sure to use a connector compatible with the above-mentioned one.

3.5.2 At the fan input

Phoenix Contact DFK-MSTB 2.5/2-G BK (plastic connector)			
Power input	**Pin #**	**Signal**	**Function**
2  1	2	0 VDC	Supply input (0 VDC)
	1	+24 VDC	Supply input (24 VDC (±10 %))

Remark: The current requirement according to the fan's width is as follows:
0.2 A for the 75 mm, 0.3 A for the 100 mm and 0.5 A for the 125 mm.

3.6 Download key (connector X102)

If the controller does not switch to 'wait for program' when the user wants to download a new firmware, there is an hardware override possibility to force this mode. To do so, plug the jumper (in any horizontal or vertical position) on the X102 connector, switch off and on the power, and the controller will switch to 'wait for program' to download a new firmware.

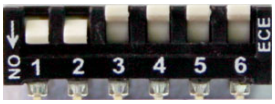
Remark: The download key jumper is located on the top of the controller.

3.7 Axis number selection (connector X101)

On top of the software possibility, it is possible to assign or to change the axis number of the controller with a DIP switch. After each starting, the controller takes the axis number given by the DIP switch except when all the switches are in the down position which means set to 1 (like in the picture below). In this case the axis number is set by the AXI command or the value previously saved in the controller or by the default value always equal to 1 (this default value is used when no AXI command has been executed or no save has been done).

The value given on the DIP switch represents a binary value (64 possibilities). The axes are numbered from 0 to 62 because the node 63 is reserved. If the DIP switch is not used, all the bit must be set to 1 (low position).

Example:



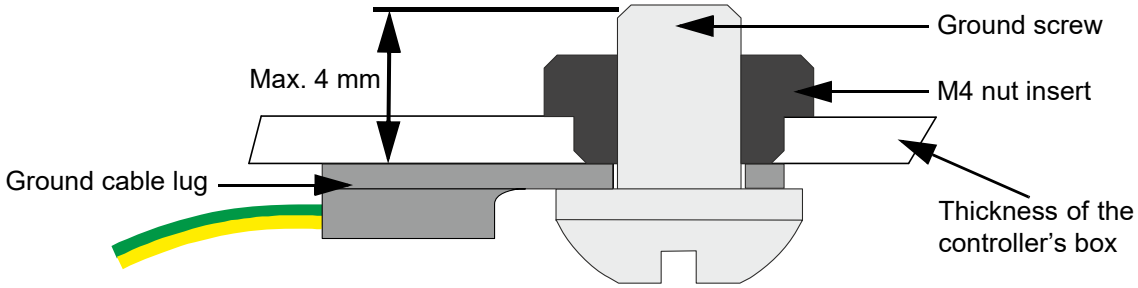
The axis number given by this DIP switch is equal to: $2^0 + 2^1 = 3$. Then, the second axis of the controller will have the number 4.

Remark: **Each axis number must be different from all the others connected to the same TransnET communication bus. It is forbidden to have twice the same axis number on the same TransnET communication bus.**
The DIP switch is located on the top of the controller.

3.8 Ground connection

The ground connection of the controllers is realized with the power input (PE signal of X104 connector).

Remark: If the ETEL cooling unit (refer to §2.5.2) is not used, it is possible to connect the ground cable to the M4 threaded hole present under the controller instead of the wire present on the X104 connector. In this case, the length of the screw (not provided) must not exceed 4 mm from the external surface of the controller box.



3.9 Cables manufacturing

If you do not use the cables delivered by ETEL, follow the shield recommendations below for those cables:

- The encoder cables: X10, X13, X20 and X23
- The inputs/outputs cables: X11, X14, X21 and X24
- The motor cables: X12 and X22

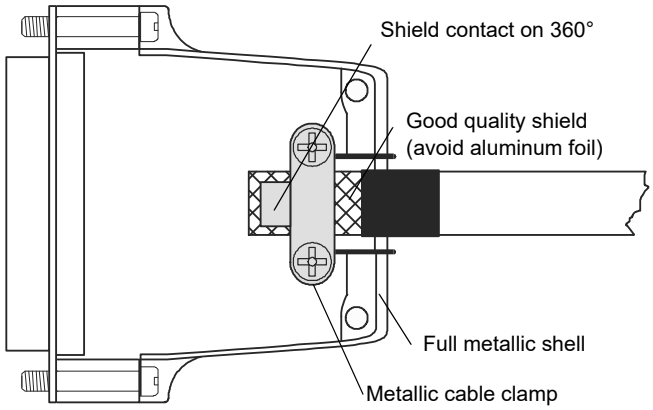
Simple shielded cable must be linked to the connector shells on both cable ends. Only full metallic conductive shells connector must be used. Shield with only aluminum foil (metallized plastic film) is forbidden!. Use only copper braid (85% covering shield). The shield must entirely cover all wires. 'Pig tails' connections are forbidden! The shield contact on 360° and a metallic cable clamp is necessary.

Remark: All the cables connected to the controller must have copper conductors only and an insulation standing at least 75 °C.
A bad shielding connection can perturb the encoder signal, phasing, etc.

3.9.1 Encoder and input/output cables

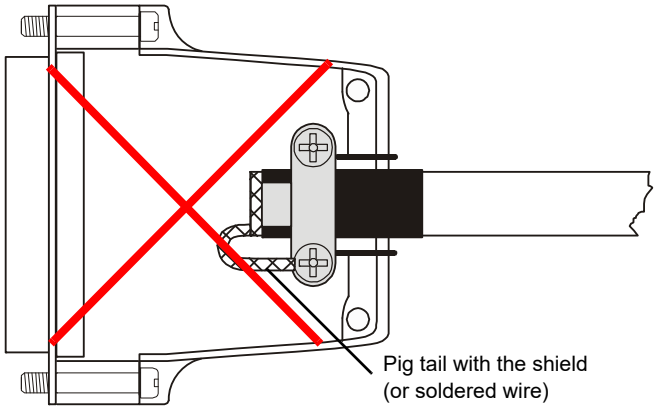
Here is an example of good shielding connection:

Good shielding connection

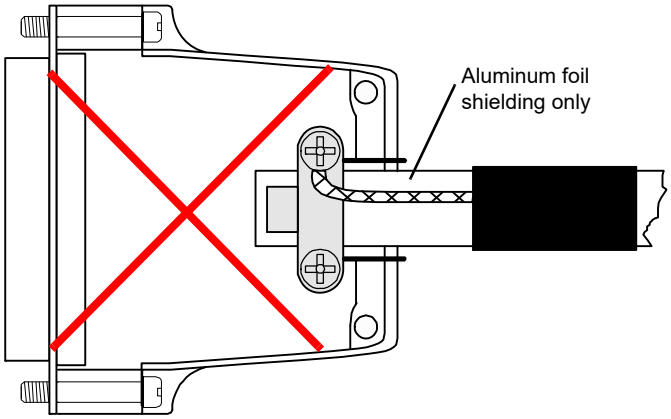


Here are two examples of bad shielding connections:

Bad shielding connection

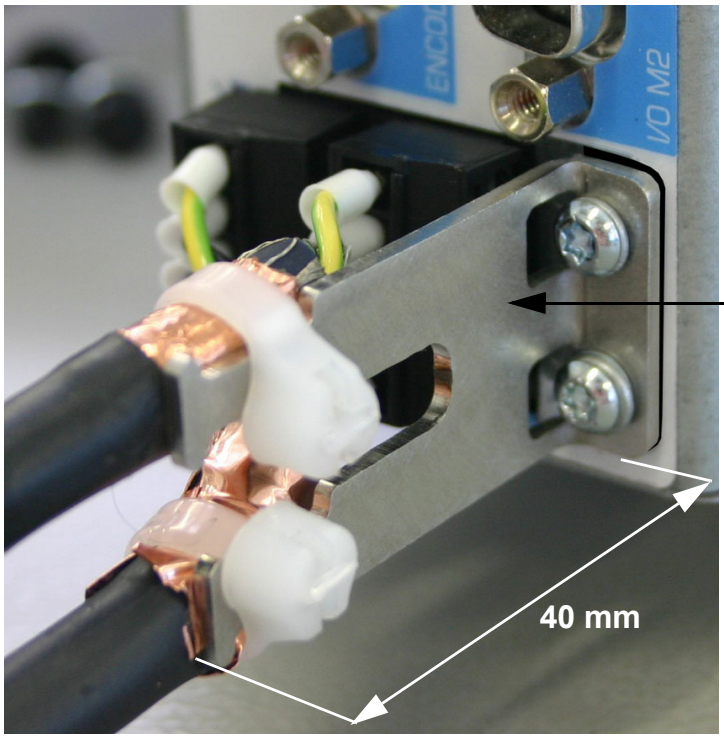


Bad shielding connection



3.9.2 Motor cable

To respect the EMC standard, the following shielding bracket must be used with the motor connector**. It is compulsory to completely screw the two screws to the front panel of the controller.**



To remove the shielding bracket, slightly unscrew both screws (it is not necessary to remove them completely) fastening it to the controller and slide the bracket to the right.

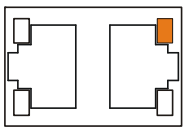
Remark: The cable's radius of curvature must be taken into account to adjust the distance between the front plate of the controller and the cabinet.
The shielding bracket can be ordered through the connector kit (refer to §2.5.4).

3.10 LEDs meaning

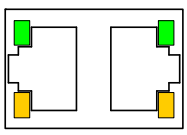
The different LEDs present on the controller have the following meaning:

3.10.1 Communication

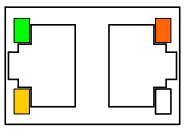
- **The position controller is switched on without connection to a communication bus**

LED regarding the communication	Meaning
COM IN X02  COM OUT X02	Orange LED is ON => The controller is switched on.

- **The position controller is switched on and connected to a TransnET communication bus**

LED regarding the communication	Meaning
COM IN X02  COM OUT X02	Green LEDs is ON => The connection (link) is detected on each connector. Yellow LEDs is ON => The TransnET data are running on each connector. The 'COM OUT' connector of the last controller on the TransnET bus is not connected, however, the green and yellow LEDs are also on to indicate that the TransnET bus loops correctly on itself.

- **The position controller is switched on and connected to an Ethernet communication bus**

LED regarding the communication	Meaning
COM IN X02  **COM OUT X02**	Orange LED is ON => The controller is switched on. Green LED is ON => The connection (link) is detected. Green LED is blinking => The controller is waiting for an IP address from a DHCP server. Yellow LED is flashing => An activity is running on the Ethernet.

3.10.2 Motor

LED regarding motor 1 / 2	Status	Meaning
Red LED 'ERROR'	ON	Error on motor 1 / 2 => check monitoring M64
	OFF	No error on motor 1 / 2
Green LED 'POWER ON'	ON	Motor 1 / 2 is in 'power ON'
	OFF	Motor 1 / 2 is in 'power OFF' (*)

Remark: If the red LED 'ERROR' and the green LED 'POWER ON' are ON at the same time (not blinking), then the controller is waiting for the end of a firmware download (’Wait for program’ mode). Refer to the corresponding ’Operation & Software’ for more information.

The red LED 'ERROR' and the green LED 'POWER ON' can be OFF together when the motor 1 / 2 is without error and in power OFF

(*): If the dynamic braking is activated due to an error (refer to the Operation & Software manual), the power bridge transistors are still switching (shortcut at the motor phases output) while the ’POWER ON’ green LED is OFF.

4. Service and support

For any inquiry regarding technical, commercial and service information relating to ETEL S.A. products, please contact your ETEL S.A. representative:

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Please refer to your corresponding ETEL S.A. representative for more information about the technical documentation. ETEL S.A. organizes training courses for customers on request, including theoretical presentations of our products and practical demonstrations at our facilities.