

# ETEL



## ACCURET+ 300 Position Controllers

Hardware Manual

Version 1.0

THIS PAGE IS INTENTIONALLY LEFT BLANK

## Table of contents

<b>1</b>	<b>Introduction.....</b>	<b>7</b>
1.1	Working principle.....	7
1.2	Applications.....	8
1.3	Personnel qualification.....	8
1.4	Safety.....	8
1.5	Standards and guidelines.....	9
1.5.1	Specific operating conditions when using the +PS300.....	11
1.5.2	Specific operating conditions when using third-party power supply.....	11
<b>2</b>	<b>Product life cycle.....</b>	<b>12</b>
2.1	Transport conditions.....	12
2.2	Storage conditions.....	12
2.3	Handling.....	12
2.4	Installation and operation.....	13
2.5	Maintenance operations.....	15
<b>3</b>	<b>Models characteristics.....</b>	<b>17</b>
3.1	Outline and dimensions.....	17
3.1.1	Controller without optional board slot.....	17
3.1.2	Controller with optional board slot.....	18
3.2	Weight.....	18
3.3	Block diagram.....	19
3.3.1	Position controller.....	19
3.3.2	Power supply.....	20
3.4	Ratings.....	21
3.4.1	Position controllers.....	21
3.4.2	Power supply.....	23
3.5	Control features.....	24
3.6	Connectors layout.....	26
3.6.1	Top view.....	26
3.6.2	Front view.....	27
3.6.3	Bottom view.....	29
3.7	Ordering information.....	30
3.7.1	Position controller.....	30
3.7.2	Power supply.....	30
3.7.3	Cooling unit.....	31
3.7.4	Mounting bar.....	32
3.7.5	Kits.....	33

<b>4</b>	<b>Mounting.....</b>	<b>34</b>
4.1	Cooling unit dedicated to ACCURET+.....	35
4.2	Cooling unit of the previous AccurET family.....	38
<b>5</b>	<b>Electrical interface.....</b>	<b>42</b>
5.1	Protective earth connection.....	43
5.2	Cables manufacturing.....	43
5.3	Communication connectors.....	44
5.3.1	USB communication (connector X00).....	44
5.3.2	TRANSNET input / Ethernet (connector X01).....	44
5.3.3	TRANSNET output (connector X02).....	45
5.4	Encoders (connectors X10 and X20).....	45
5.4.1	Incremental analog encoder (1 Vpp).....	45
5.4.2	Serial interface EnDat 2.2.....	47
5.4.3	Serial interface EnDat 3.....	48
5.4.4	TTL encoder.....	49
5.4.5	Dual encoder feedback.....	51
5.4.6	Encoder cables manufacturing.....	52
5.5	GPIO (connectors X11 and X21).....	53
5.5.1	Standard digital I/Os.....	53
5.5.2	Fast digital I/Os.....	55
5.5.3	I/O cables manufacturing.....	55
5.5.4	I/O pins assignment.....	56
5.6	Motors (connectors X12 and X22).....	57
5.6.1	Motor cable manufacturing.....	58
5.7	Power connectors.....	59
5.7.1	At the position controller level.....	60
5.7.2	At the power supply level.....	64
5.7.3	ETEL cooling unit (connector X200).....	68
5.8	Safe Torque Off - STO (connector X103).....	69
5.9	Download key (connector X102).....	70
5.10	ID selection (connector X101).....	70
5.11	ETEL dongle slot (connector X105).....	71
5.12	Optional board.....	71
5.13	LEDs.....	72
5.13.1	At the controller level.....	72
5.13.2	At the power supply level.....	73

<b>6 Brake resistor sizing.....</b>	<b>75</b>
6.1 How big is the energy stored in my system?.....	75
6.1.1 Torque motor case, standard configuration (Ep term equal to zero).....	75
6.1.2 Linear motor case with gravitational potential energy.....	75
6.2 Is a brake resistor needed?.....	76
6.3 How to determine the resistance value?.....	76
6.3.1 Torque motor case.....	76
6.3.2 Linear motor case.....	77
6.4 How to determine the resistance dissipated power?.....	77
6.5 ACCURET+ specifications.....	77
<b>7 Service and support.....</b>	<b>78</b>

## Record of revisions

Version	Date	Main modifications
Ver 1.0	23.03.23	First version

## Associated documentation

- Data sheet Product specifications, refer to website
- Interface drawing Product description, refer to website
- Operation & Software Manual Product setup, operation and programming manual
- Functional Safety User's Manual Functional Safety implementation

### Acronyms

<b>BCP</b>	Branch Circuit Protection
<b>DVC-A</b>	Decisive Voltage Class A (limited voltage requiring reinforced insulation from hazardous voltages; refer to IEC 61800-5-1:2007 for further information).
<b>DVC-B</b>	Decisive Voltage Class B (voltage requiring reinforced insulation from hazardous voltages; refer to IEC 61800-5-1:2007 for further information).
<b>EMC</b>	ElectroMagnetic Compatibility.
<b>ESD</b>	Electrostatic Discharge.
<b>EUC</b>	Equipment Under Control.
<b>GPIO</b>	General Purpose Input Output.
<b>PE</b>	Protective Earth.
<b>PELV</b>	Protective Extra Low Voltage.
<b>RCD</b>	Residual Current Device
<b>SELV</b>	Separated Extra Low Voltage.
<b>STO</b>	Safe Torque Off.

## 1 Introduction

This document concerns one of the members of the ACCURET+ range of position controllers: the ACCURET+ 300 (EA+P2M-300-xxxxxA-xxxx-xx). The ACCURET+ 300, referred to as 'controller' or 'position controller' in this manual, is a PWM-based fully digital dual-axis position controller. ETEL recommends to use this controller in combination with the ACCURET+ PS300 power supply (EA+S0M-300-10/40A-xxxx-xx), referred to as '+PS300' in this manual. This ETEL power supply must be used with ETEL's controllers only. Other third-party power supplies may be used providing they fulfill the requirements described in this manual.

The purpose of this manual is to provide information about the specifications, installation requirements and electrical interfacing of the ACCURET+ 300 position controller and +PS300 power supply. Information concerning the setup, operation and programming of this controller can be found in the corresponding "Operation & Software Manual" and the ones concerning the Functional Safety implementation can be found in the "Functional Safety User's Manual".



(En)

- The user must have read and understood this documentation as well as those listed in "[page 5](#)" before carrying out any operation on the controllers and +PS300. ETEL S.A. disclaims all responsibility for accidents and damages if it is not done. Please contact ETEL or authorized distributors in case of missing information or doubt regarding the installation procedures, safety or any other issue.

(Fr)

- L'utilisateur doit avoir lu et compris cette documentation ainsi que celles listées en "[page 5](#)" avant d'effectuer toute intervention sur les contrôleurs et leur +PS300. ETEL S.A. décline toute responsabilité en cas d'accidents et de dommages s'il cela n'est pas fait. Veuillez contacter ETEL ou les distributeurs agréés en cas d'informations manquantes ou de doute concernant les procédures d'installation, la sécurité ou tout autre problème.



(En)

- Only qualified personnel (refer to [§1.3](#)) are allowed to handle, install and operate the controllers and +PS300, respecting all regulations of the respective country concerning both safety and EMC aspects.
- 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.

(Fr)

- Seul un personnel qualifié (se référer à [§1.3](#)) est autorisé à manipuler, installer et faire fonctionner les contrôleurs et leur +PS300, en respectant toutes les réglementations du pays respectif concernant à la fois les aspects de sécurité et de CEM.
- Une utilisation inappropriée peut causer des dommages considérables aux personnes ou aux biens. ETEL n'accepte aucune responsabilité pour les dommages directs ou indirects causés aux personnes ou aux biens suite à une mauvaise utilisation ou un fonctionnement incorrect de la machine.

### 1.1 Working principle

The controllers are designed in a compact and modular form-factor simplifying their integration into a machine requiring high performance multi-axis motion control. These position controllers include a control circuitry, interfaces for the position feedback and the power bridge for controlling two axes independently, as well as, communication interfaces and GPIOs. When used in combination with the +PS300, several position controllers can be powered from a single power supply (the exact

number depends on the power requirements of the end application), thus minimizing the overall space requirements for ETEL electronics.

## 1.2

## Applications

The ACCURET+ 300 can drive two single-phase, two-phase or three-phase motors. This controller can drive brushless motors, DC motors and steppers. They must also be fitted with analog incremental 1 Vpp encoders, EnDat 2.2, EnDat 3 or TTL encoders. It is also possible to drive stepper motors in open loop.



(En)

- Never use this controller and other devices cited in this manual for purposes other than those described in this manual.
- The controllers / +PS300 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.

(Fr)

- N'utilisez jamais ce contrôleur et les autres appareils cités dans ce manuel à des fins autres que celles décrites dans ce manuel.
- Les contrôleurs / +PS300 ne sont pas conçus ni destinés à être utilisés dans le contrôle en ligne du trafic aérien, de la navigation aérienne et des communications ainsi que des composants critiques des systèmes de survie ou dans la conception, la construction, l'atmosphère explosive, l'exploitation et la maintenance d'installation nucléaire.

## 1.3

## Personnel qualification

In this manual, qualified personnel refers to persons who are familiar with the installation, mounting, commissioning, and operation of the ETEL components and with the requirements and specifications of the relevant sector, national and international standards. These trained personnel are also the target group of the manuals listed in "[page 5](#)" and is generally named as 'user' in the document.

Persons who perform work on ETEL components must meet the following requirements:

- Completion of a training for the corresponding ETEL component(s).
- Training or instruction in the standards of safety engineering (state-of-the-art technology).
- Training, education or instruction related to the work to be performed.
- Use of appropriate safety equipment (clothing, measuring systems, etc.).
- Completion of first aid training.

To perform machine integration design, advanced operation or parameterization of ETEL products, qualified personnel must satisfy the following requirements:

- Have the required technical training, knowledge and experience to perform the assigned work.
- Know and understand the applicable legal regulations related to safety.
- Be able to proactively identify and avoid potential risks.

## 1.4

## Safety

- The user must ensure that moving parts cannot be set in motion dangerously due to external forces such as gravity, remaining inertia, shock, vibrations, contact with other moving parts, etc.
- Only qualified personnel (according to [§1.3](#)) must install and operate the controllers and their +PS300, in accordance with all specific regulations of the respective country concerning both safety and EMC aspects.
- During installation, the requirements of test standards and expressed in this manual must be fulfilled.

- The safety symbols placed on the controllers and their +PS300 or written in the manuals (["page 5"](#)) must be respected.
- The controllers / +PS300 are not designed for stand-alone operation and must always be installed in a machine or system. After installation, the additional documentation and safety instructions provided by the machine manufacturer must be read and followed. The machine manufacturer must also establish that it fulfills the 2014/30/EU directive on EMC before operating the controller.
- The user must always comply with the applicable local safety rules and regulations while working.

## 1.5 Standards and guidelines

The controllers / +PS300 have been designed in accordance with the following standards and directives:

---

### Standards

---

IEC / EN 61800-5-1:2007	Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements - Electrical, Thermal and Energy.
IEC / EN 61800-5-2:2017	Adjustable speed electrical power drive systems - Part 5-2: Safety requirements – Functional.
EN 61800-3:2004	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods.
IEC 61010-1 chap. 9.4 / IEC 61010 / SN EN 61010	Compatible with measuring devices requiring limited energy interface.
UL 61800-5-1: 2012-R :2021-02	Standard for Safety: Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements - Electrical, Thermal and Energy.
CSA C22.2 No. 274:2017	Adjustable speed drives.

---

### Directives

---

2006/42/EC	Machinery Directive
2014/30/EU	EMC Directive
2014/35/EC	EC Low Voltage Directive
2015/863/UE	RoHS 3 Directive

The controllers / +PS300 fulfill their share of the requirements as specified in the above directives, thus enabling the user as the manufacturer to produce EUCs in accordance with the Machinery Directive. The user is responsible for checking all indicated standards and directives for their validity. Furthermore, the user must ensure that all standards and directives applicable to his product are available in their currently valid version and are implemented in the product accordingly.

---

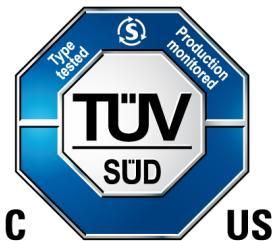
### Certifications

---



The controllers / +PS300 do not fall within the scope of application of the Machinery Directive. However, ETEL controllers are designed and evaluated in full compliance with all relevant standards related to personal safety and use in a machine or system.

## Certifications



The controllers / +PS300 have been successfully tested and evaluated to meet the UL 61800-5-1 for US market and CSA 274 for Canada. 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.



The Safe Torque Off (STO) function of the controllers described in the "Functional Safety User's Manual" has been successfully tested and evaluated according to IEC 61508:2010 and ISO 13849-1:2015.

The requirements fulfillment for the CE and NRTL are as follows:

- During installation, the requirements of test standards and those expressed in this manual must be fulfilled.
- The controllers / +PS300 are an open type device that must be installed in an enclosure providing electrical, mechanical and fire protection and without any flammable surface directly above or below the controller(s).
- The controllers / +PS300 are designed to operate in a controlled environment, such as temperature, humidity and pollution degree 2 (refer to IEC 61800-5-1:2007 for further information) and conforming to the following operating conditions (refer to IEC 60721-3-3:2019 for further information):
  - Climatic conditions: 3K22; this class defines temperature between +5 °C (41 °F) and +40 °C (104 °F) and humidity between 10 % and 85 % as well as other conditions related to operation.
- The controllers / +PS300 are intended for use in the second environment (industrial) according to IEC61800-3 (EMC standard).
- All models must be fan-forced cooled. ETEL strongly recommends the use of the EA+CUM-050-BT-00 cooling unit specifically designed to operate with the new ACCURET+ family of controllers and their +PS300. Alternatively, ETEL's previous generation cooling unit EA-CUM-y-BT-00 (y = fan size: 75, 100 and 125 mm) may also be employed.

In case a third-party cooling system is used, the following considerations must be observed:

- The cooling system must be installed on the bottom side of the electronics like ETEL's standard cooling units.
- The cooling system must provide a bottom to top airflow uniformly blown through the whole ventilation area available on the housing.
- The cooling system must provide a minimum airflow of 76 m<sup>3</sup>/h.
- In case of doubt, please contact ETEL's technical support.
- It is recommended to leave 100 mm above and below the controller to guarantee the airflow.
- Mains supply of external power supplies must comply with the following requirements: system voltage 300V, TN-S net with loadable Neutral, overvoltage category III.
- The power bus overall capacitance must not exceed 3000 µF. When sizing this capacitance, the power supply and the individual controllers internal capacitances must be accounted for (each controller's power input has an internal capacitance of 94 µF and 1044 µF for the +PS300).
- The power supplies (24 V and control signal) must ensure the reinforced insulation between mains and output and provide overvoltage category II (refer to EN 61800-5-1 and UL 61800-5-1 standards for more information).

- The power supply connected to the controller's control input (X100) must fulfill the following requirements: DVC-A and 50 A maximum short circuit current.
- Motors, power and control input wiring must satisfy minimal requirements as stated in §5.6 and §59.
- The controllers, the +PS300 and the corresponding controlled motors must be bonded with the PE in the final installation.
- Permanent connections and terminal blocks are only suitable for factory wiring conditions.
- Motor heating control and evaluation must be ensured by an external measuring and control system.
- Encoder interfaces comply with the following requirements: DVC-A and limited energy (according to IEC 61010-1).
- GPIO output interfaces comply with the following requirements: DVC-A.
- GPIO input interfaces must comply with the following requirements: DVC-A.
- ETEL recommends limiting the vibration level of controller by not mounting them on highly dynamic moving parts.

### 1.5.1 Specific operating conditions when using the +PS300

- The +PS300 is suitable for use on a circuit capable of delivering maximum 5000 Arms Symmetrical.
- An external power supply connected to the ACCURET+ PS300 control input (P00) must fulfill the following requirements: DVC-A and 50 A maximum short-circuit current.
- The +PS300 is designed to operate in a controlled environment, such as temperature, humidity and pollution degree 2 (refer to IEC 61800-5-1:2007 for further information) and conforming to the following operating conditions (refer to IEC 60721-3-3:2019 for further information):
  - Climatic conditions: 3K22; this class defines temperature between +5 °C (41 °F) and +40 °C (104 °F) and humidity between 10 % and 85 % as well as other conditions related to operation.
- The +PS300 must be fan-forced cooled. ETEL strongly recommends the use of the EA+CUM-050-BT-00 cooling unit specifically designed to operate with the controllers and +PS300. Alternatively, ETEL's previous generation cooling unit EA-CUM-y-BT-00 (y = fan size: 75, 100 and 125 mm) may also be employed.  
In case a third-party cooling system is used, the following considerations must be observed:
  - The cooling system must be installed on the bottom side of the electronics like ETEL's standard cooling units.
  - The cooling system must provide a bottom to top airflow uniformly blown through the whole ventilation area available on the housing.
  - The cooling system must provide a minimum airflow of 76 m<sup>3</sup>/h.
  - In case of doubt, please contact ETEL's technical support.
- The +PS300 has an internal capacitance of 1044 µF that must be accounted for when sizing the overall Power bus capacitance ( $\leq 3000 \mu\text{F}$ ).
- The following Listed Branch Circuit Protection shall be installed in the end-use application (in Line and Neutral): Carlo Gavazzi, type GMB632PC13, 240 Vac, 50/60 Hz, 10 kA A.I.C.; rated C13A.

### 1.5.2 Specific operating conditions when using third-party power supply

- The power supply connected to the controller's Power input (X104) must fulfill the following requirements: 3500 A maximum short circuit current protected by a Littelfuse KLKD 20A 600 VAC/VDC fast acting fuse connected to the DC output of the power supply.
- The power supply connected to the controller's Control input (X100) must fulfill the following requirements: DVC-A and 50 A maximum short circuit current.

## 2 Product life cycle

### 2.1 Transport conditions



(En)

- During transport, the controller / +PS300 must remain inside their original packaging which complies with the ESD standard.

(Fr)

- Pendant le transport, le contrôleur / +PS300 doivent rester dans leur emballage d'origine conforme à la norme ESD.



(En)

- Transport conditions must respect the class 2K11 of the IEC 60721-3-2 standard.

(Fr)

- Les conditions de transport doivent respecter la classe 2K11 de la norme IEC 60721-3-2.

### 2.2 Storage conditions



(En)

- During storage, the controller / +PS300 must remain inside their original packaging which complies with the ESD standard.

(Fr)

- Pendant le stockage, le contrôleur / +PS300 doivent rester dans leur emballage d'origine conforme à la norme ESD.



(En)

- Storage conditions must respect the class 1K21 of the IEC 60721-3-1 standard.

(Fr)

- Les conditions de stockage doivent respecter la classe 1K21 de la norme IEC 60721-3-1.

### 2.3 Handling

When removed from their original packaging, the controller / +PS300 shall be manipulated with ESD protective equipment. The housing of the controller / +PS300 protects the inner components, but discharges might occur when touching the connectors, which are in direct contact with the electronic components. If the controller / +PS300 must be transferred or shipped (including returns to ETEL for service and repair), they must be packed in their original package.

Before unpacking the controller / +PS300, the unit shall be placed in the room at working environmental conditions (in accordance with the requirements stated in §2.4) during at least 2 hours. This is to avoid damages due to condensation. If the controller / +PS300 are transferred in the operating room within a complete system, the acclimation time shall be adapted to the thermal inertia of the complete system.

## 2.4 Installation and operation

- Mechanical mounting: refer to [§4](#).
- Electric interface: refer to [§5](#).
- Operating and software: refer to the “Operation & Software Manual”.



(En)

- The user must ensure that the PE is correctly connected. The PE is used to provide protection from electric shock and to allow sufficient current to flow so that the protective devices can trip. Interruptions in the PE conductor may cause damage to persons or property. It is the responsibility of the user to ensure that the connection is effective at any time.
- Inadvertent movements of the EUC parts or dangerous touch voltages may be caused by:
  - Faulty wiring.
  - Faulty assembly.
  - Defective and/or damaged components.
  - External forces such as gravity.
- In certain cases of failure, the power stages are switched off without the axes being decelerated. In these cases, axes without mechanical brakes or end stops can continue moving. The user must take this into account in the risk analysis of the EUC.
- The user must ensure that the main switch of the control or EUC is switched off when engaging or disengaging connecting elements or connection clamps, and/or performing other work on electrical components.
- The controllers / +PS300 are designed to operate in a controlled environment, such as temperature, humidity and pollution degree 2 (refer to IEC 61800-5-1:2007 for further information) and conforming to the following operating conditions (refer to IEC 60721-3-3:2019 for further information):
  - Climatic conditions: 3K22; this class defines temperature between +5 °C (41 °F) and +40 °C (104 °F) and humidity between 10 % and 85 % as well as other conditions related to operation.
  - Special climatic conditions: 3Z2 and 3Z12 (i.e. 84 kPa corresponding to approx. 1500 m above sea level).
  - Mechanical conditions: 3M11.
  - Mechanically active substances: 3S5.
- Commissioning is to be performed only by qualified personnel.
- Refer to the system's control circuit diagrams and grounding diagrams for the various supply voltages in the control system.
- Before being switched on, the electrical cabinet must be closed.
- During initial switch-on after installation, maintain a safe distance from the controller(s) and/or power supply.
- Ensure that no flammable objects are near the vent openings.
- The following points must be observed during mounting and electrical connection:
  - National regulations for low-voltage installations at the operating site of the machine or components.
  - National regulations regarding interference and noise immunity at the operating site of the EUC or components.
  - National regulations regarding electrical safety and operating conditions at the operating site of the EUC or components.



- If a defect is found on the EUC, in which ETEL components and/or ETEL devices are installed, or if an ETEL component and/or ETEL device is defective, then the machine must be turned off and secured against restarting. The defect must be removed and the possible consequences addressed before restarting the EUC.

(Fr)

- L'utilisateur doit s'assurer que le PE est correctement connecté. Le PE est utilisé pour fournir une protection contre les chocs électriques et pour permettre à un courant suffisant de circuler afin que les dispositifs de protection puissent se déclencher. Les interruptions du conducteur PE peuvent causer des dommages aux personnes ou aux biens. Il appartient à l'utilisateur de s'assurer que la connexion est effective à tout moment.
- Des mouvements involontaires des pièces de l'EUC ou des tensions de contact dangereuses peuvent être causés par :
  - Câblage défectueux.
  - Assemblage défectueux.
  - Composants défectueux et/ou endommagés.
  - Forces externes telles que la gravité.
- Dans certains cas de panne, les étages de puissance sont éteints sans que les axes ne soient ralenti. Dans ces cas, les axes sans freins mécaniques ni butées de fin de course peuvent continuer à se déplacer. L'utilisateur doit en tenir compte dans l'analyse des risques de l'EUC.
- L'utilisateur doit s'assurer que l'interrupteur principal de la commande ou de l'EUC est éteint lors de l'engagement ou du désengagement des éléments de connexion ou des pinces de connexion, et/ou d'effectuer d'autres travaux sur les composants électriques.
- Ces contrôleurs / +PS300 sont conçus pour fonctionner dans un environnement contrôlé, tel que la température, l'humidité et le degré de pollution 2 (reportez-vous à la norme CEI 61800-5-1:2007 pour plus d'informations) et conformément aux conditions de fonctionnement suivantes (reportez-vous à la norme CEI 60721-3- 3:2019 pour plus d'informations):
  - Conditions climatiques : 3K22 ; cette classe définit une température entre +5 °C (41 °F) et +40 °C (104 °F) et une humidité entre 10 % et 85 % ainsi que d'autres conditions liées au fonctionnement.
  - Conditions climatiques particulières : 3Z2 et 3Z12 (soit 84 kPa correspondant à environ 1500 m d'altitude).
  - Conditions mécaniques : 3M11.
  - Substances mécaniquement actives : 3S5.
- La mise en service doit être effectuée uniquement par du personnel qualifié.
- Reportez-vous aux schémas du circuit de commande du système et aux schémas de mise à la terre pour les différentes tensions d'alimentation du système de commande.
- Avant la mise sous tension, l'armoire électrique doit être fermée.
- Lors de la mise sous tension initiale après l'installation, maintenez une distance de sécurité par rapport au(x) contrôleur(s) et/ou à l'alimentation électrique.
- Assurez-vous qu'aucun objet inflammable ne se trouve à proximité des ouvertures de ventilation.

- Les points suivants doivent être respectés lors du montage et du raccordement électrique :
  - Réglementations nationales pour les installations à basse tension sur le site d'exploitation de la machine ou des composants.
  - Réglementations nationales concernant l'immunité aux interférences et au bruit sur le site d'exploitation de l'EUC ou des composants.
  - Réglementations nationales concernant l'immunité aux interférences et au bruit sur le site d'exploitation de l'EUC ou des composants.
- Si un défaut est détecté sur l'EUC, dans lequel des composants ETEL et/ou des dispositifs ETEL sont installés, ou si un composant ETEL et/ou un dispositif ETEL est défectueux, la machine doit être éteinte et sécurisée contre tout redémarrage. Le défaut doit être supprimé et les conséquences possibles traitées avant de redémarrer l'EUC.

---

The ventilation must be activated as soon as the power input is switched on.

An additional warning sticker (identical to the one placed on the side of the controller) is delivered separately with each controller and the installer must ensure that at least one warning sticker is visible to the end user once the controllers are integrated into the machine. Prior to starting the controller, the machine or system must be disconnected from the power supply and tested for zero voltage. The following tests are also recommended:

- Visual inspection of all connections, in particular of the PE connections. For the correct PE grounding of the controller, refer to [§5.1](#)
- The continuity of the PE conductor circuit must be inspected (10 A testing current is recommended), EN 60204-1.
- The PE conductor contact resistance must be checked according to EN 60204-1, EN 61800-5-1 or a nationally valid standard.

## 2.5 Maintenance operations



(En)

- For safety reasons, it is forbidden to open the controller / +PS300 housing. Opening the devices invalidates the warranty.
- Repair and servicing a controller / +PS300 are permitted only by ETEL's technicians and agreed distributors.
- Only qualified personnel are allowed to troubleshoot an ETEL controller and/or its +PS300.

(Fr)

- Pour des raisons de sécurité, il est interdit d'ouvrir le boîtier du contrôleur / +PS300. L'ouverture des appareils annule la garantie.
- La réparation et l'entretien d'un contrôleur / +PS300 sont autorisés uniquement par les techniciens d'ETEL et les distributeurs agréés.
- Seul le personnel qualifié est autorisé à dépanner un contrôleur ETEL et/ou sa +PS300.

**NOTICE**

- No field maintenance operation is required.
- The "Operation & Software Manual" provides the information about what can be used to identify the source of a warning or error message.
- If any connector needs to be unplugged or modified, refer to the guidelines provided in [§2.4](#).
- Refer to [§7](#) if support for troubleshooting or service from ETEL is required.

### 3 Models characteristics

#### 3.1 Outline and dimensions

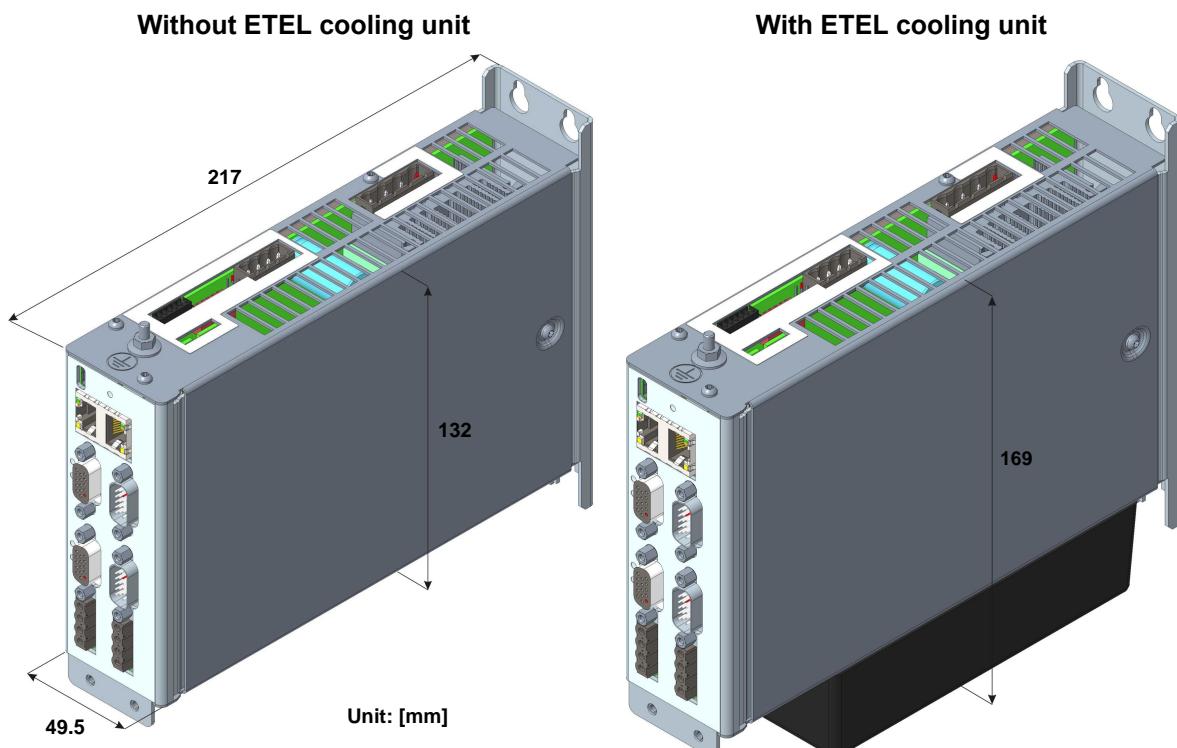
Depending on the possibility to have or not an optional board (and a cooling unit), there are different dimensions for the controller. The ACCURET+ PS300 power supply has the same dimensions as the 50 mm width controller.

Model	Width	Height	Length
Controller without optional board	49.5 mm	132 mm or 169 mm (without or with ETEL cooling unit)	182 mm
Controller with optional board	74.5 mm		

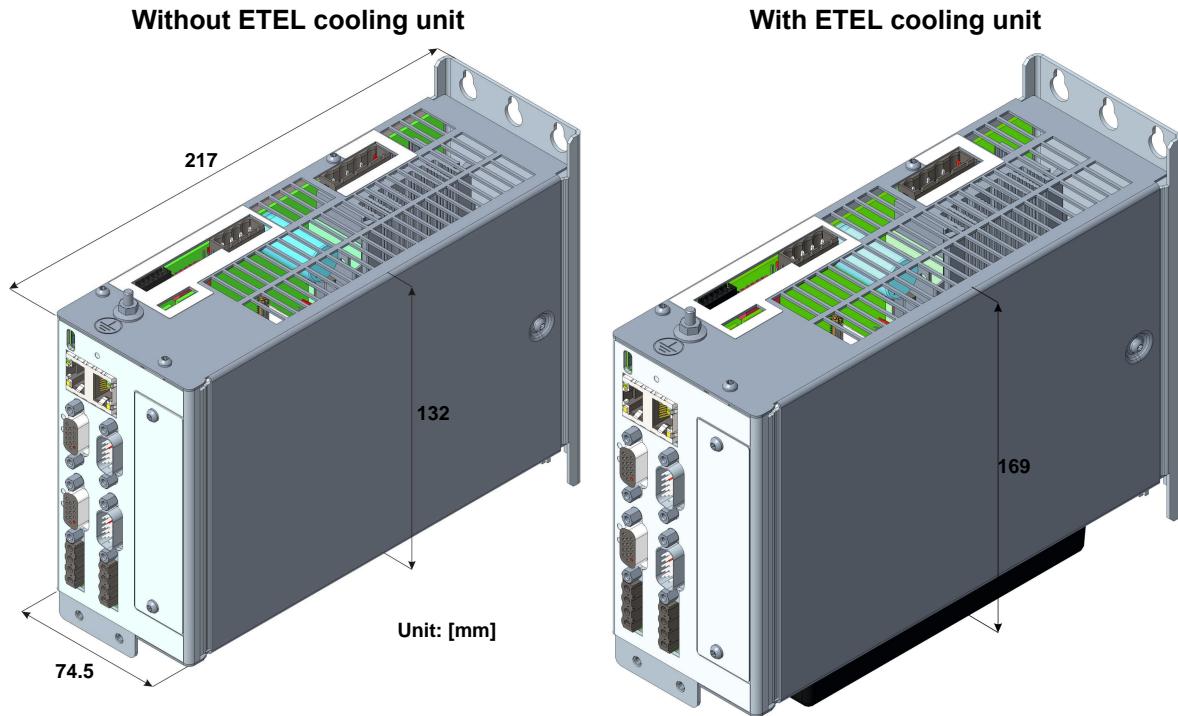
#### NOTICE

- Refer to the "Interface drawing" available on [www.etel.ch](http://www.etel.ch) for more information.
- If the user needs the ETEL cooling unit, refer to §4 for more information.
- It is recommended to leave 100 mm above and under the controller / +PS300 to guarantee the airflow.

##### 3.1.1 Controller without optional board slot



### 3.1.2 Controller with optional board slot



## 3.2 Weight

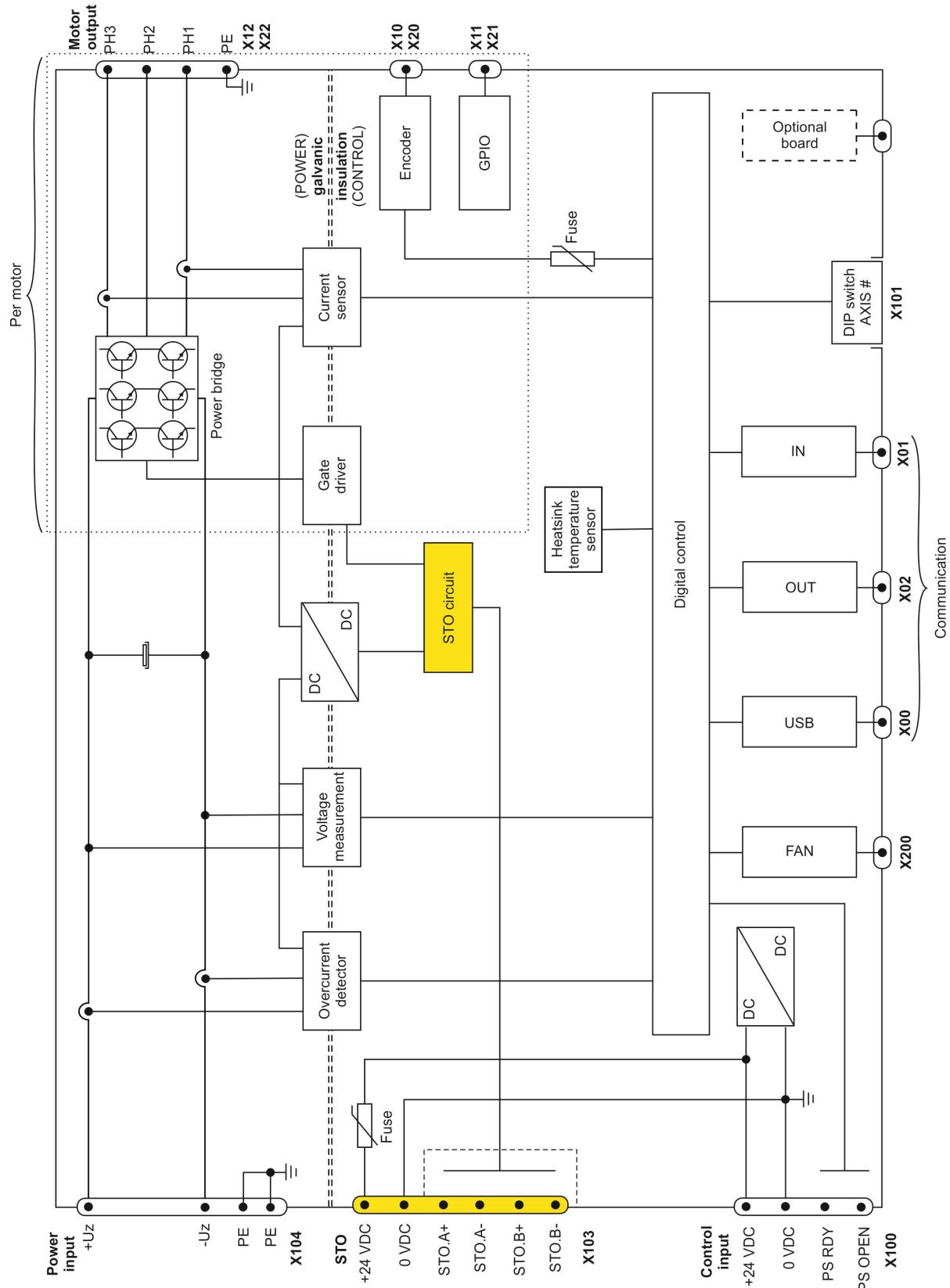
The weight of the controllers, +PS300 and cooling unit are listed in the following table:

	<b>ACCURET+ 300</b>	<b>+PS300</b>	<b>Cooling unit</b>
<b>Characteristics</b>	Without optional board slot	With optional board slot	-
<b>Weight</b>	$1.4 \pm 0.1$ kg	$1.60 \pm 0.1$ kg	$1.4 \pm 0.1$ kg

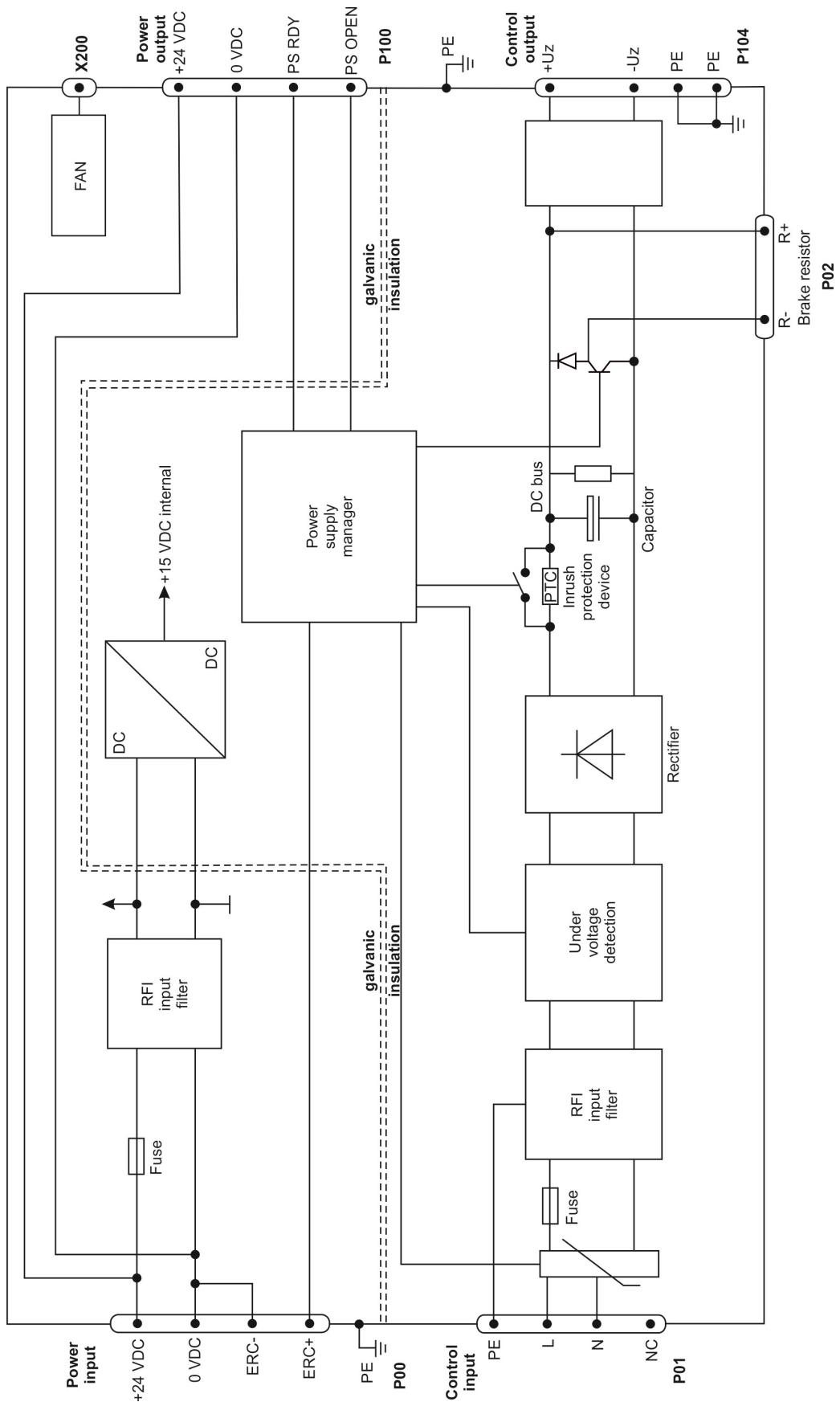
### 3.3 Block diagram

#### 3.3.1 Position controller

The power part and the control part of the controller are galvanically isolated.



### 3.3.2 Power supply



## 3.4 Ratings

All the specifications are given for an ambient temperature ranging from +5 °C (41 °F) to +40 °C (104 °F) and with the use of the EA+CUM-050-BT-00 cooling unit specifically designed to operate with the new ACCURET+ family of controllers and power supply. Alternatively, ETEL's previous generation cooling unit EA-CUM-y- BT-00 (y = fan size: 75, 100 and 125 mm) may also be used.

### NOTICE

- In case a third-party cooling system is used, the following considerations must be observed:
  - The cooling system must be installed on the bottom side of the electronics like ETEL's standard cooling units.
  - The cooling system must provide a bottom to top airflow uniformly blown through the whole ventilation area available on the housing.
  - The cooling system must provide a minimum airflow of 76 m<sup>3</sup>/h.
  - In case of doubt, please contact ETEL's technical support.

### 3.4.1 Position controllers

EA+P2M-300 POWER FEATURES			
Characteristics	EA+P2M-300-4/7.5A	EA+P2M-300-07/15A	EA+P2M-300-10/20A
Output to the motor (per axis)	Bus voltage	96 -340 VDC	
	Current range on product label (refer to §3.7)	4/7.5 A	07/15 A
	Measurable current - full range	12.86 A	25.73 A
	<b>Three-phase</b> motor Max. full load current	5.65 A (4 Arms)	9.9 A (7 Arms)
	<b>Three-phase</b> motor Max. overload current during 1 s	10.6 A (7.5 Arms)	21.21 A (15 Arms)
	<b>Two-phase</b> motor Max. full load current	5.65 A (4 Arms)	9.9 A (7 Arms)
	<b>Two-phase</b> motor Max. overload current during 0.5 s	10.6 A (7.5 Arms)	21.21 A (15 Arms)
	<b>One-phase</b> motor Max. full load current	5.65 A (4 Arms)	9.9 A (7 Arms)
	<b>One-phase</b> motor Max. overload current during 1 s	10.6 A (7.5 Arms)	21.21 A (15 Arms)
Power input (X104 connector)	DC voltage	96 - 340 VDC	
	Max. continuous input current	8 Arms	
	Max. peak input current	Not limited at controller level. Refer to power supply.	
Control input (X100 connector)	DC bus capacitors	94 µF	
	DC voltage	24 VDC ± 10 %	
	Max. current at 24 VDC	Typ. 1.3 A <sup>(1)</sup> / Max. 2.5 A	
	DC bus capacitors	2200 µF	

(1) The current can change depending on the type(s) of encoder(s), the type of optional board, and the number of GPIOs used. An inrush current of 3.8 A for 20 ms is required to switch on the controller. Size the power supply accordingly.

With two-phase motor, the current in 'motor phase 1- / 2-' is equal to ( $\sqrt{2} \times$  motor phase 1+) or ( $\sqrt{2} \times$  motor phase 2+). Be careful to use the suitable cable diameter.

### NOTICE

- Be careful to select an external 24 VDC power supply which delivers a voltage ramp up during switch on without rebound or oscillation.

When the current ripple in the motor becomes too important, it could limit the performance of the control loops or even overheat the motor. To avoid this, the inductance of the motor must comply with the following formula:

$$\frac{L \cdot I_p \cdot \sqrt{2}}{\alpha} \geq \frac{U_{dc}}{f_{PWM}}$$

Where

- |                    |   |
|--------------------|---|
| L:                 | inductance of the motor [mH] (terminal to terminal)   |
| I <sub>p</sub> :   | peak current of the motor [Arms]  |
| U <sub>dc</sub> :  | DC power input voltage of the position controller [V]   |
| f <sub>PWM</sub> : | controller PWM frequency [kHz]  |
| α:                 | constant, depending on use cases: <ul style="list-style-type: none"> <li>■ α = 2 when fe ≤ 100 Hz</li> <li>■ α = 4 when fe &gt; 100 Hz</li> </ul> |
| f <sub>e</sub> :   |   |

For a rotary motor, it is defined as:

$$f_e = \frac{n}{60} \cdot p$$

n: speed of the rotary motor [rpm]

p: number of pair of poles (2p is the number of poles)

For a linear motor, it is defined as:

$$f_e = \frac{v}{2T_p}$$

v: speed of the motor [mm/s]

2T<sub>p</sub>: magnetic period [mm]

### NOTICE

- In case the operating conditions do not comply with the above formula, the users could add an external inductance on each phase of the motor.

Example using an ETEL ironless linear motor (ILF+03-030):

$$2T_p = 32 \text{ mm}$$

$$L = 12.3 \text{ mH}$$

$$R = 22.8 \Omega$$

$$I_p = 3.52 \text{ Arms}$$

$$v = 1000 \text{ mm/s}$$

$$f_{PWM} = 20 \text{ kHz}$$

$$U_{dc} = 100 \text{ V}$$

Electrical frequency:

$$f_e = \frac{1000}{32} = 3125 \text{ Hz}$$

Constant  $\alpha = 2$  (as  $f_e \leq 100 \text{ Hz}$ )

Verification that the inductance of the motor is big enough:

$$\frac{123 \cdot 3.52 \cdot \sqrt{2}}{2} \geq \frac{100}{20} \quad \Rightarrow \quad 30.6 \geq 5 \quad \Rightarrow \quad \text{there is no risk}$$

### 3.4.2 Power supply

EA+S0M-300 POWER FEATURES		
	Characteristics	EA+S0M-300-10/40A
<b>Power input (P01 connector)</b>	AC operating voltage range (single phase)	100 - 240 VAC (50 / 60 Hz)
	Inrush threshold voltage	71 VAC
	Max. AC current	13 Arms
	Max. inrush current	15 Apeak at 240 VAC
	Max. continuous power	2.4 kW (at 240 V input) or 1 kW (at 100 V input)
<b>Control input (P00 connector)</b>	Power factor correction	No
	DC voltage	24 VDC ± 10 %
	Max. current	10 A (0.5 A internal consumption)
<b>External braking resistor (P02 connector)</b>	Internal value (voltage limitation device)	No
	External resistor (depends on user's application)	>39 Ω
	Max. continuous current <sup>(1)</sup>	10 A
<b>Power output (P104 connector)</b>	DC voltage	140 - 340 VDC
	Max. continuous current	10 Arms
	Max. pulse current	40 A <sup>(2)</sup>
<b>Control output (P100 connector)</b>	Efficiency	> 95 %
	DC voltage	24 VDC ± 10 %
	Max. continuous current (coming from external 24VDC power supply)	9.5 A <sup>(3)</sup>

<sup>(1)</sup> the current is fixed by the value of the external resistor (>39 Ω).

<sup>(2)</sup> tested conditions: repeated pulses of 1 s every 5 minutes.

<sup>(3)</sup> depending on the type of encoder, the type of optional board as well as the number of GPIOs used, one controller can consume differently from another. It is possible to connect several ACCURET+300 controller on the same DC bus. The maximum number of controller that can share the same DC bus is limited by the more stringent of the following requirements: maximum current supply output on P100, maximum power output on P104 or the DC bus capacitance (<3 mF).

DESIGN & FEATURES		
Characteristics	Power input	Control input
<b>Separated supply</b>	No specific power up sequence is required, however, ETEL recommends not to supply "power input" (P01 connector) if the "control input" (P00 connector) is not supplied.	
<b>Input filters</b>	Yes	Yes
<b>Fuse</b>	Yes	Yes
<b>Inrush current limiters</b>	Measurement, relay and limitation PTC resistor, with feedback to the controller. Input AC voltage threshold for Inrush relay closed: 71VAC. Input AC voltage threshold for Inrush relay opened 50VAC. Inrush current < 15 A <sup>(1)</sup>	-
<b>DC bus capacitors</b>	1044 µF ± 20 %	2200 µF ± 20 %
<b>Undervoltage detection</b>	If Vin<50 VAC (red LED power error is ON)	In the controller
<b>Voltage limitation / braking</b>	If Vpwr > 370 VDC, refer to § (no feedback to the controller)	Not applicable
<b>Output overvoltage detection</b>	Error if > 400 VDC	36 V (protection by zener)
<b>Input overvoltage protection</b>	Surge protection thanks to MOV with monitoring of the status	MOV

(1): Repeated Input AC voltage drop might lead to unusual PTC heating and thus slow down subsequent DC Bus voltage rise (i.e. capacitors charging).

### 3.5 Control features

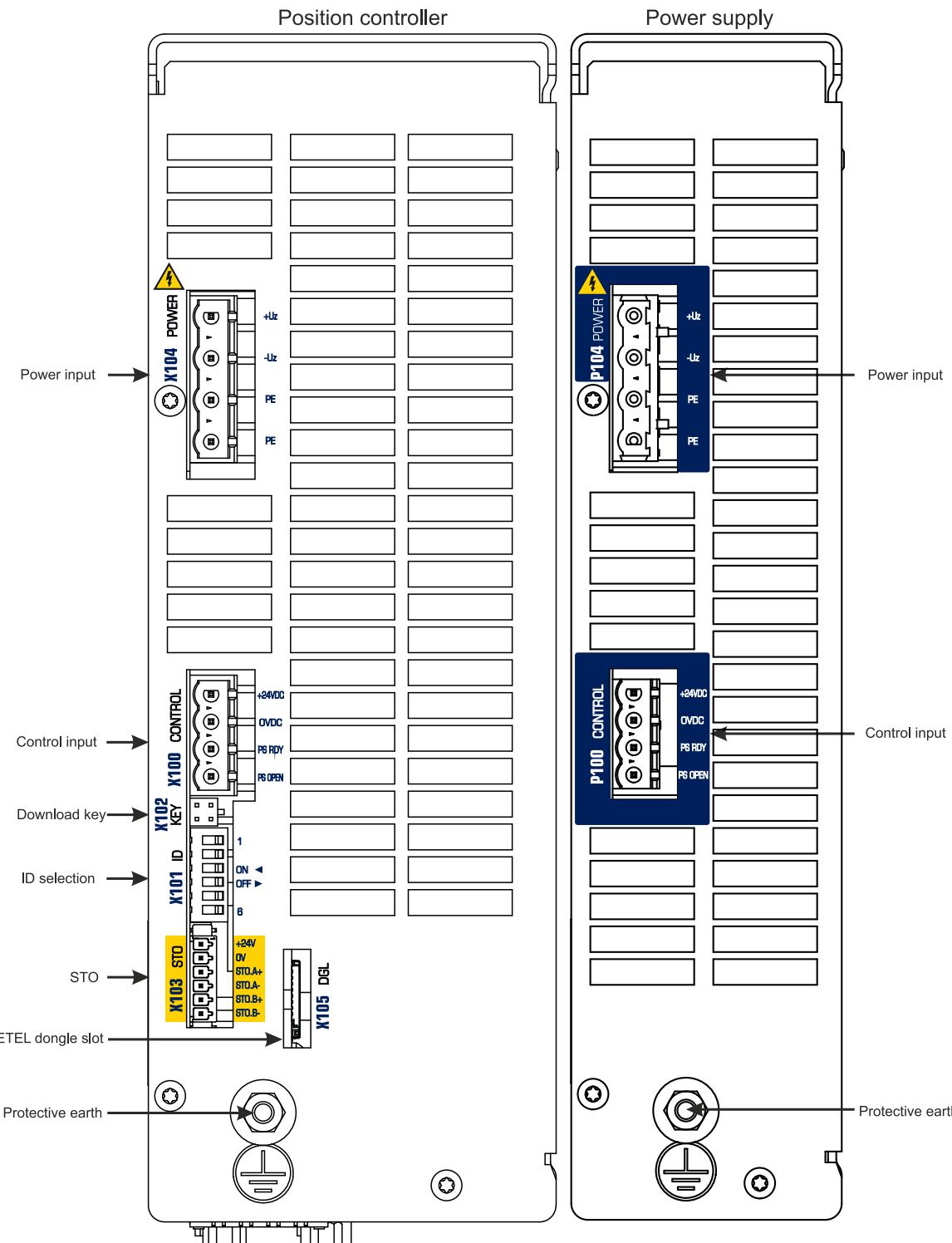
EA+P2M-300 CONTROL FEATURES		
<b>General</b>	Motion profile and command management sampling time	400 µs
	Digital current loop sampling time	50 µs
	Position loop sampling time	50 µs
	Functional safety	STO: SIL3, Cat. 3, PLd
<b>Standard interfaces</b>	USB 2.0 (for setting only)	Full speed (12 Mbps), Type-C (refer to §5.3.1)
	TRANSNET	1000 Mbps (refer to §5.3.2)
	Ethernet	100 / 1000 Mbps (refer to §5.3.2)
<b>Position encoders interfaces</b>	Analog 1Vpp	Max. 2 MHz input / 16384 interpolation factor (refer to §5.4.1)
	EnDat 2.2	Max. 6.25 Mbps (refer to §5.4.2)
	EnDat 3	Max. 25 Mbps, 4-wire only (bus operation not supported) (refer to §5.4.3)
	Encoder limit switch (EHS / L1 & ELS / L2 signals)	TTL signal (refer to §5.4.1)
	Digital (TTL high speed) <sup>(1)</sup>	Max. 40 MHz input frequency (refer to §5.4.4)

EA+P2M-300 CONTROL FEATURES		
<b>GPIOs</b>	Standard digital input	8 (common to both axes) (refer to <a href="#">§5.5.1</a> )
	Standard digital output	4 (common to both axes) (refer to <a href="#">§5.5.1</a> )
	Fast digital input	6 (common to both axes) (refer to <a href="#">§5.5.2</a> )
	Fast digital output	4 (common to both axes) (refer to <a href="#">§5.5.2</a> )
<b>Software / programmability</b>	COMET commissioning software	For software compatibility, refer to the "COMET User's Manual"
	EDI (ETEL Device Interface)	For software compatibility, refer to the "EDI User's Manual"
	Firmware update	USB, Ethernet and TRANSNET (refer to <a href="#">§5.3.1</a> )

<sup>(1)</sup> The signal frequency (10 MHz) is one fourth of the counter frequency (40 MHz).

## 3.6 Connectors layout

### 3.6.1 Top view

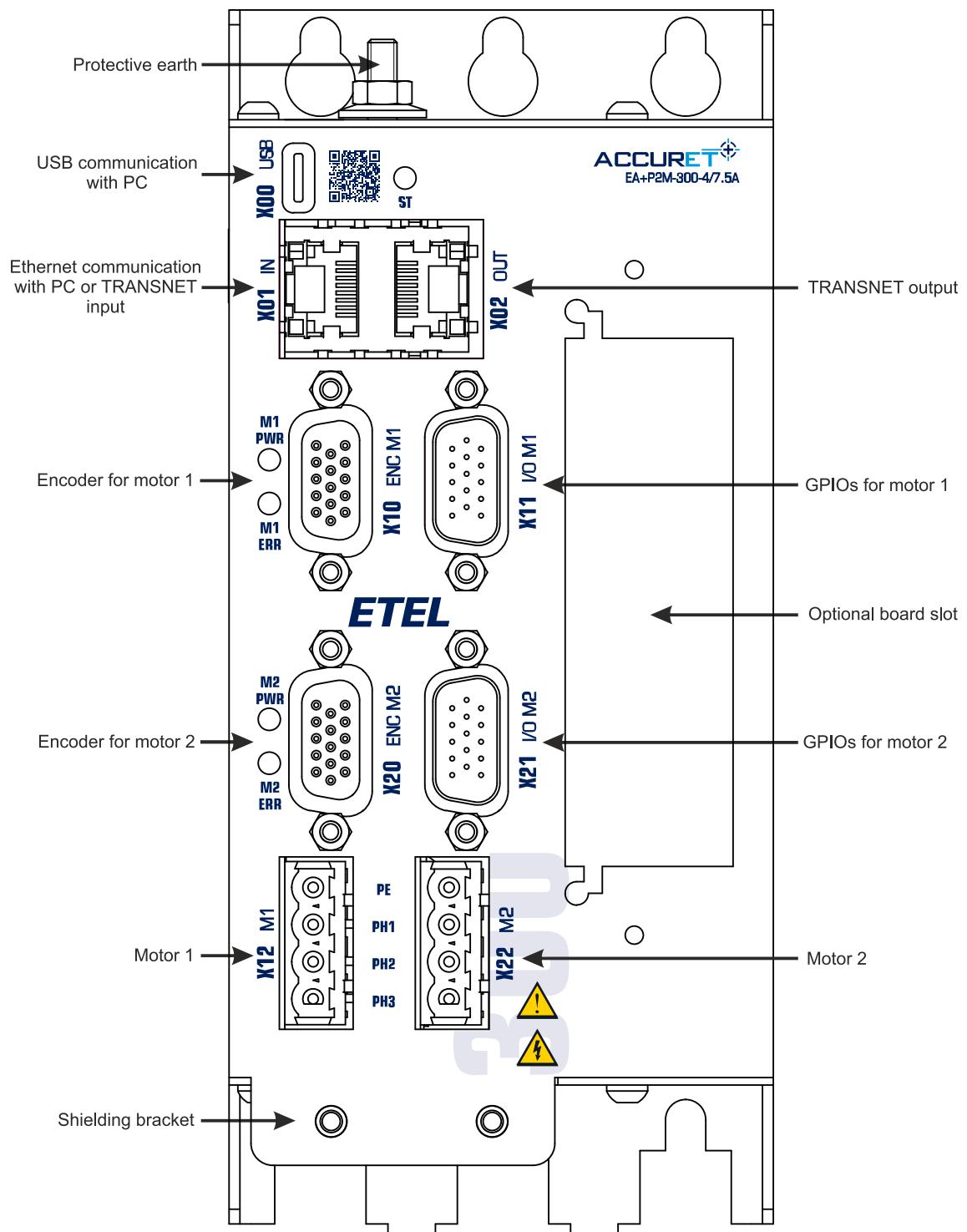


#### NOTICE

- Refer to §5 for more information about the connectors. A narrower version for the controller also exists without optional board slot.

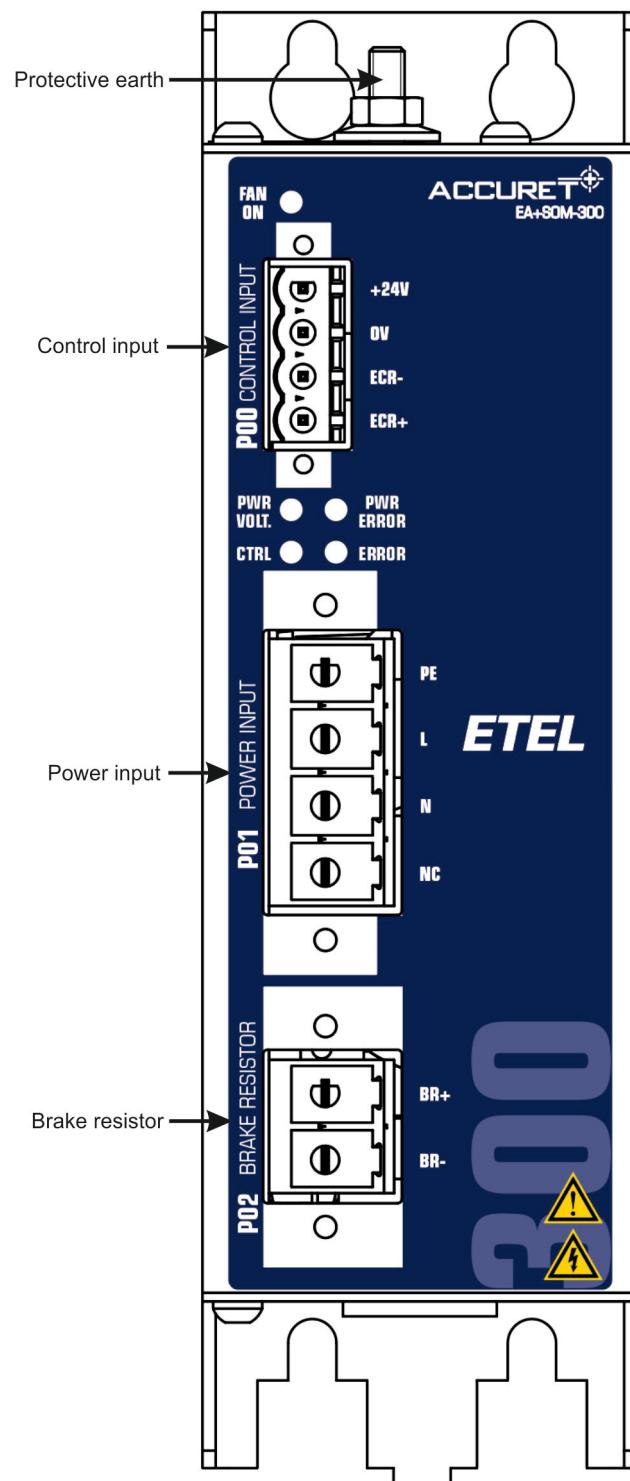
## 3.6.2 Front view

### ■ Position controller

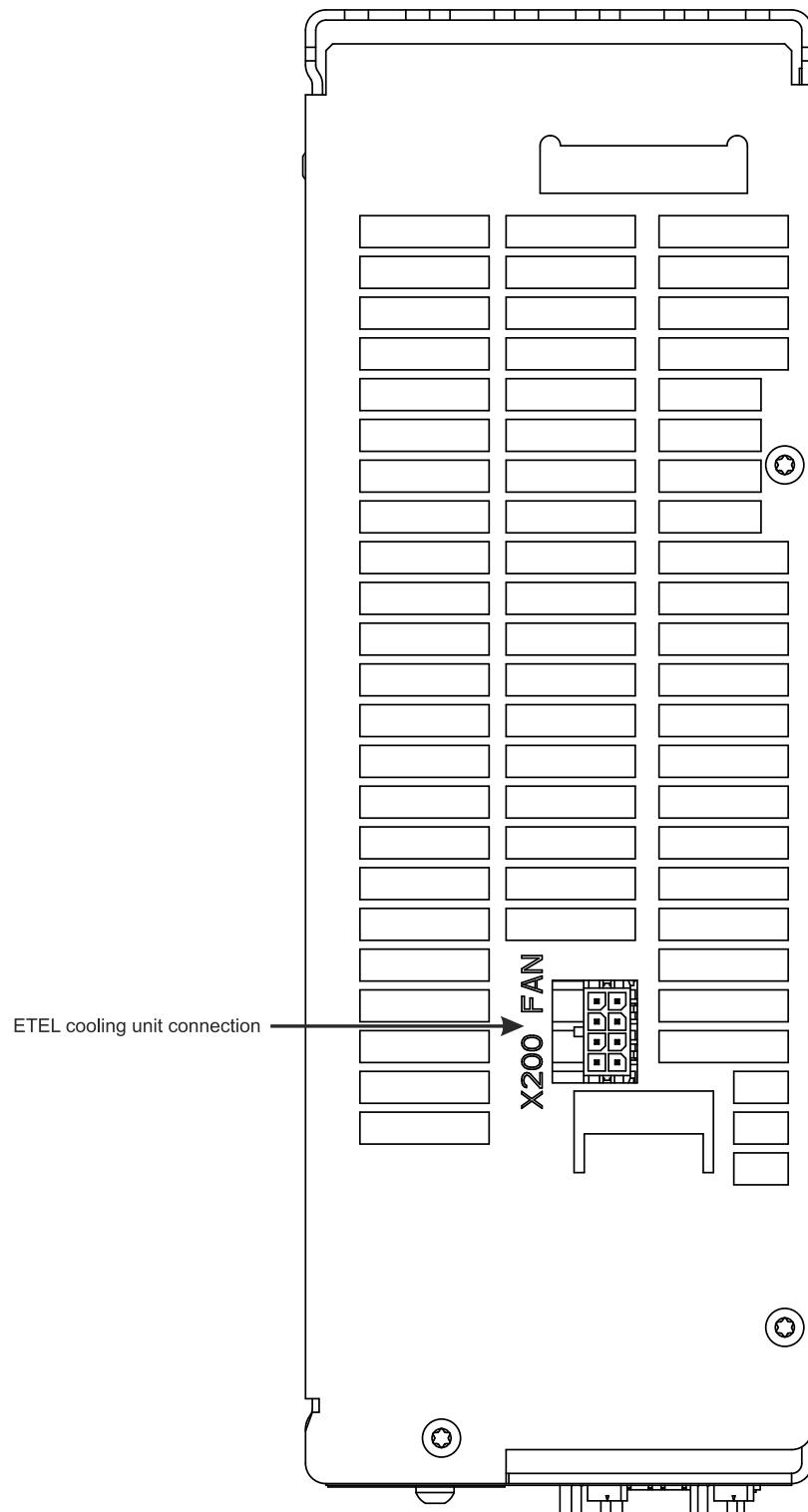


### NOTICE

- Refer to [§5](#) for more information about the connectors. A narrower version also exists without optional board slot.

**■ Power supply**

### 3.6.3 Bottom view

**NOTICE**

- Refer to [§5](#) for more information about the connectors. The connector is identical under the +PS300. A narrower version for the controller also exists without optional board slot.

### 3.7 Ordering information

The following paragraphs describe the meaning of each digit composing the commercial codification of the controller, the power supply and all related additional kits. The codification shall be used for ordering purposes.

#### 3.7.1 Position controller

**EA+P2M-300-07/15A-0000-00**

<b>EA</b>	<b>Family code:</b> EA = Electronics ACCURET
<b>+</b>	<b>“+” = ACCURET+ range</b>
<b>P</b>	<b>Product type / technology:</b> P = PWM
<b>2</b>	<b>Number of axes:</b> 2 = Dual-axis
<b>M</b>	<b>Format:</b> M = Modular
-	
<b>300</b>	<b>Maximum operating DC voltage:</b> 300 = 300 VDC
-	
<b>07/15A</b>	<b>Continuous / peak current:</b> 4/7.5A = 4 / 7.5 Arms 07/15A = 07 / 15 Arms 10/20A = 10 / 20 Arms
-	
<b>0</b>	<b>Reserved</b>
<b>0</b>	<b>Optional board slot:</b> 0 = No 1 = Yes
<b>0</b>	<b>Standard compliance:</b> 0 = UL, CSA and Functional safety certified
<b>0</b>	<b>Software options:</b> Reserved
-	
<b>00</b>	<b>Hardware revision:</b> 00 = Standard product (1st hardware revision)

#### 3.7.2 Power supply

**EA+S0M-300-10/40A-0000-00**

<b>EA</b>	<b>Family code:</b> EA = Electronics ACCURET
<b>+</b>	<b>“+” = ACCURET+ range</b>

<b>S</b>	<b>Product type / technology:</b> S = power Supply
<b>0</b>	<b>Reserved</b>
<b>M</b>	<b>Format:</b> M = Modular
-	
<b>300</b>	<b>Maximum operating DC voltage:</b> 300 = 300 VDC
-	
<b>10/40A</b>	<b>Continuous / peak current:</b> 10/40A = 10 Arms cont. / 40 Arms peak
-	
<b>0</b>	<b>Reserved</b>
<b>0</b>	<b>Reserved</b>
<b>0</b>	<b>Standard compliance:</b> 0 = UL and CSA
<b>0</b>	<b>Software options:</b> Reserved
-	
<b>00</b>	<b>Hardware revision:</b> 00 = Standard product (1st hardware revision)

### 3.7.3 Cooling unit

**EA+CUM-50-BT-00**

<b>EA</b>	<b>Family code:</b> EA = Electronics ACCURET
<b>+</b>	<b>“+” = ACCURET+ range</b>
<b>CU</b>	<b>Product type / technology:</b> CU = Cooling Unit
<b>M</b>	<b>Format:</b> M = Modular
-	
<b>50</b>	<b>Size:</b> 50 = 50 mm
-	
<b>BT</b>	<b>Type:</b> BT = Bottom to top airflow
-	
<b>0</b>	<b>Reserved</b>
<b>0</b>	<b>Reserved</b>

**NOTICE**

- The ETEL cooling unit can be used with any ACCURET+ product.

### 3.7.4 Mounting bar

**EA+MBM-300-00**

<b>EA</b>	<b>Family code:</b> EA = Electronics ACCURET
<b>+</b>	<b>“+” = ACCURET+ range</b>
<b>MB</b>	<b>Product type / technology:</b> MB = Mounting Bar
<b>M</b>	<b>Format:</b> M = Modular
-	-
<b>300</b>	<b>Size:</b> 300 = 300 mm
-	-
<b>0</b>	<b>Reserved</b>
<b>0</b>	<b>Reserved</b>

**NOTICE**

- The mounting bar is identical whatever the ACCURET+ product.

### 3.7.5 Kits

- Shieding kit

**EA+SHK-P2M-100/300-00**

<b>EA</b>	<b>Family code:</b> EA = Electronics ACCURET
<b>+</b>	“+” = ACCURET+ range
<b>SHK</b>	<b>Product type / technology:</b> SHK = SHielding Kit
-	
<b>P2M</b>	<b>Product type:</b> P2M = Position Controller 2 axes
-	
<b>100/300</b>	<b>Voltage:</b> 100/300 = Suitable for ACCURET+ 100 and 300
-	
<b>00</b>	<b>Reserved</b>

- Connectors kit

**EA+BCK-P2M-300-00**

<b>EA</b>	<b>Family code:</b> EA = Electronics ACCURET
<b>+</b>	“+” = ACCURET+ range
<b>BCK</b>	<b>Product type / technology:</b> BCK = Connectors Kit
-	
<b>P2M</b>	<b>Product type:</b> P2M = Position controller 2 axes S0M = Power supply +PS300
-	
<b>300</b>	<b>Voltage:</b> 300 = Suitable for ACCURET+ 300
-	
<b>00</b>	<b>Reserved</b>

## 4 Mounting



(En)

- The controllers / +PS300 are an open type device that must be installed in an enclosure providing electrical, mechanical and fire protection and without any flammable surface directly above or below the controller(s) / +PS300, as defined in UL 61800-5-1:2015 and IEC 61800-5-1:2007 and according to fire prevention regulations at the place of installation. The user is responsible for fire protection.
- The controllers / +PS300 must be forced-air cooled (refer to §3.4 and §4.1 for more information).
- It is recommended to leave 100 mm above and below the controllers / +PS300 to guarantee the airflow.
- The controllers, the +PS300 and corresponding controlled motors must be bonded with the PE in the final installation.
- Motor heating control and evaluation must be ensured by an external measuring and control system.
- ETEL recommends limiting the vibration level of controllers / +PS300 by not mounting it on highly dynamic moving parts.
- The controllers / +PS300 should be protected against any splashes of liquid and any contacts with smoke and dust. The user must ensure that no small parts enter inside the devices through any housing openings. ETEL components or ETEL devices must not come into contact with chemicals, acids or bases. Detergents for cleaning ETEL components or devices must not be used. The use of lubricants and contact grease is not permitted for screw and clamp connections on ETEL controllers / +PS300.
- Cables and terminals for the power connection and DC link must be arranged to be safe to touch in the electrical cabinet.

(Fr)

- Les contrôleurs / +PS300 sont des appareils de type ouvert qui doit être installé dans un boîtier offrant une protection électrique, mécanique et anti-incendie et sans aucune surface inflammable directement au-dessus ou en dessous du ou des contrôleurs / +PS300, comme défini dans UL 61800-5-1:2015 et IEC 61800 -5-1:2007 et conformément aux réglementations de prévention des incendies sur le lieu d'installation. L'utilisateur est responsable de la protection incendie.
- Les contrôleurs / +PS300 doivent être refroidis par air forcé (se référer à §3.4 et §4.1 pour plus d'informations).
- Il est recommandé de laisser 100 mm au-dessus et au-dessous des contrôleurs / +PS300 pour garantir le débit d'air.
- Les contrôleurs, la +PS300 et les moteurs commandés correspondants doivent être reliés au PE dans l'installation finale.
- Le contrôle et l'évaluation de l'échauffement du moteur doivent être assurés par un système de mesure et de contrôle externe.
- ETEL recommande de limiter le niveau de vibration des contrôleurs / +PS300 en ne le montant pas sur des pièces mobiles hautement dynamiques.
- Les contrôleurs / +PS300 doivent être protégés contre toute projection de liquide et tout contact avec la fumée et la poussière. L'utilisateur doit s'assurer qu'aucune petite pièce ne pénètre à l'intérieur des appareils par les ouvertures du boîtier. Les composants ETEL ou les appareils ETEL ne doivent pas entrer en contact avec des produits chimiques, des acides ou des bases. Les détergents pour le nettoyage des composants ou appareils ETEL ne doivent pas être utilisés. L'utilisation de lubrifiants

et de graisse de contact n'est pas autorisée pour les raccords vissés et par serrage sur les contrôleurs ETEL / +PS300.

- Les câbles et les bornes pour le raccordement électrique et le circuit intermédiaire doivent être disposés de manière à pouvoir être touchés en toute sécurité dans l'armoire électrique.

### NOTICE

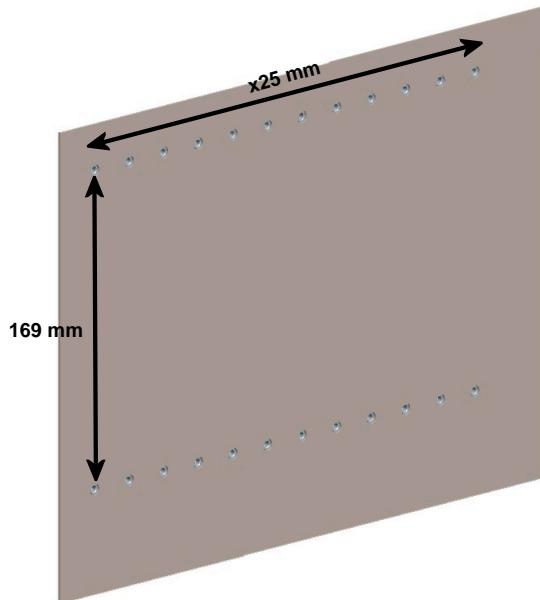
- The controllers / +PS300 have the following degree of protection: IP 20 (according to EN 60529 standard).

The mounting surface for the devices must be chosen such that it does not deform under the weight of all devices and sustains the vibrations related to the application. The selection of mounting devices (e.g. screws) and of the related tightening torque must be done accordingly.

There are three different ways to fasten the controller:

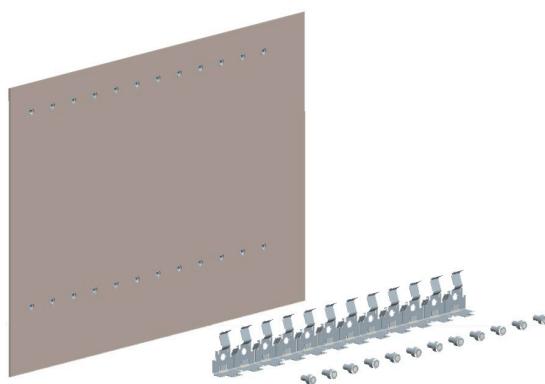
- With an ETEL cooling unit. In that case, the procedures described hereafter must be followed.
- Without an ETEL cooling unit nor mounting bar. In that case, only 4 screws are needed to fasten it. Refer to the "Interface drawing" available on [www.etel.ch](http://www.etel.ch) for the required dimensions.
- Without an ETEL cooling unit but with the mounting bar. In that case, the steps 1 and 2 of the procedure mentioned below must be followed (refer to the "Interface drawing" available on [www.etel.ch](http://www.etel.ch) for the required dimensions).

## 4.1 Cooling unit dedicated to ACCURET+



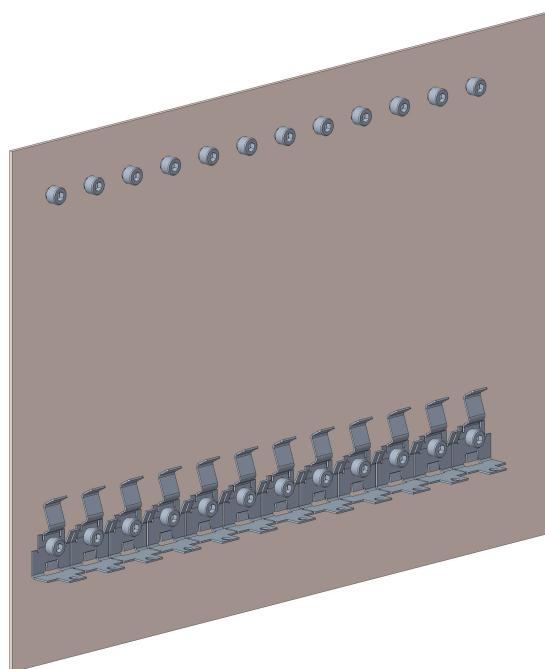
#### ► Step 1

The drilling must be realized. The vertical pitch (distance between the screws at the top of the controller and the bottom screws used to fix the mounting bar) is 169 mm. The horizontal pitch between each screw belonging to the same row is 25 mm (refer to the "Interface drawing" available on [www.etel.ch](http://www.etel.ch) for more information).



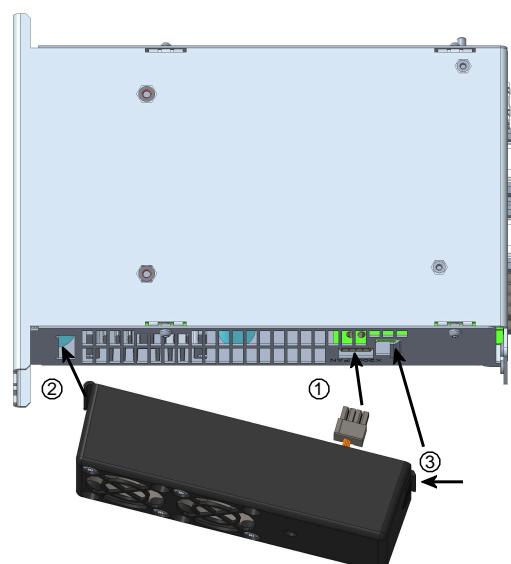
► **Step 2:**

Fasten the mounting bar with M5 screws.



► **Step 3:**

Screw half way, all the needed top screws.



► **Step 4:**

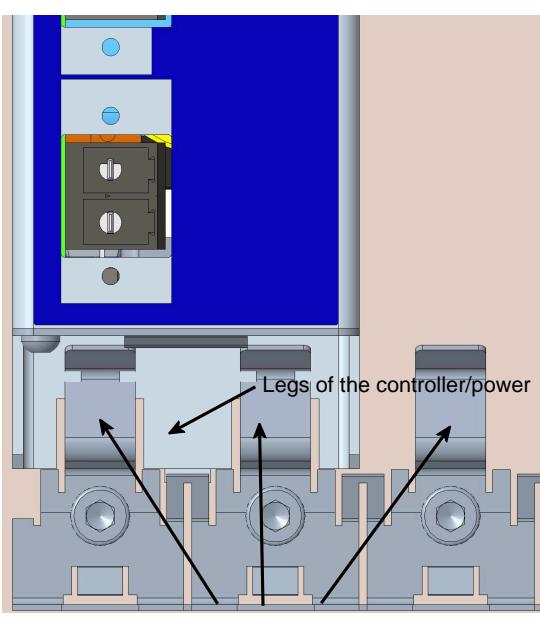
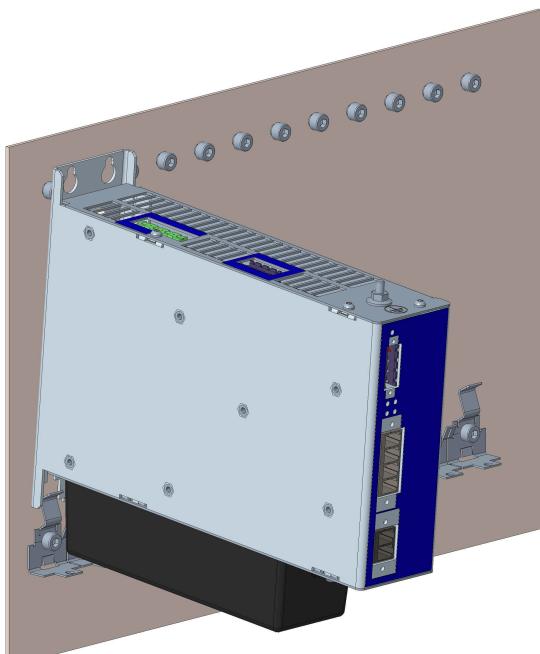
Install the cooling unit under the controller / +PS300 as follows:

① Insert the connector of the cooling unit to the connector X200 under the controller / +PS300.

② Hook the cooling unit to the slot present at the back of the controller / +PS300.

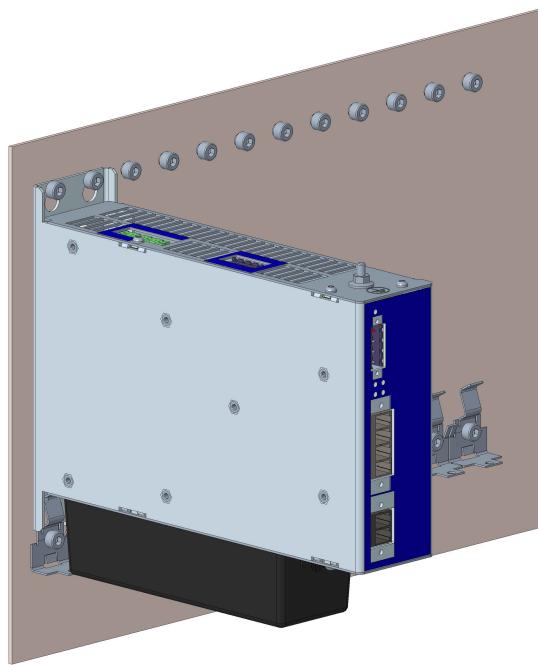
③ Clip the cooling unit front to the slot present below the controller / +PS300.

**Be careful not to jam the power cable of the cooling unit.**



► **Step 5:**

Slightly incline the controller / +PS300 as showed on the picture opposite.  
The legs at the bottom of the controller / +PS300 must be inserted between each leg of the mounting bar.



► **Step 6:**

Push the controller / +PS300 against the back panel and then towards the bottom.  
Screw the top screws to fasten the controller / +PS300.



► **Step 7:**

Proceed as mentioned in steps 4 to 6 to mount the other controller(s).

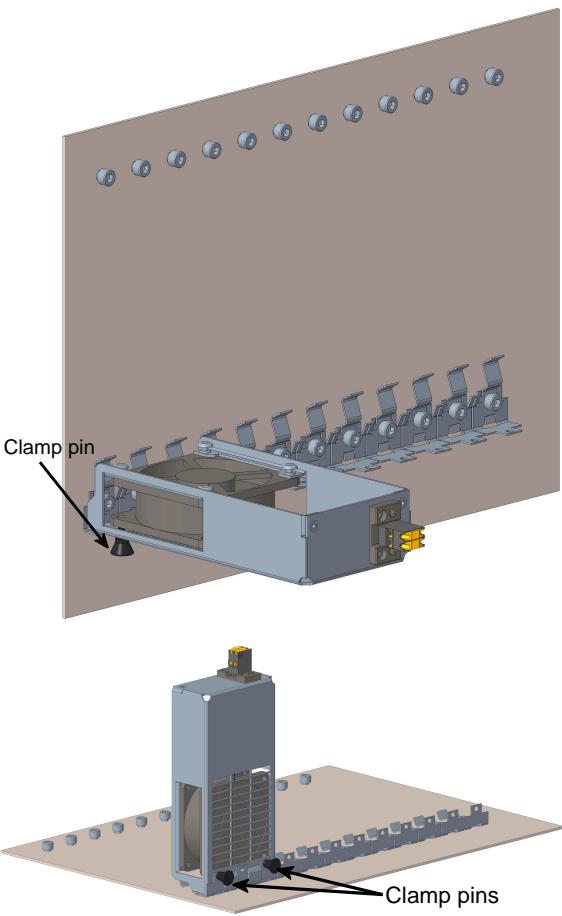
**NOTICE**

- ETEL's mounting bar and cooling unit are identical whatever the ACCURET+ product used.

## 4.2

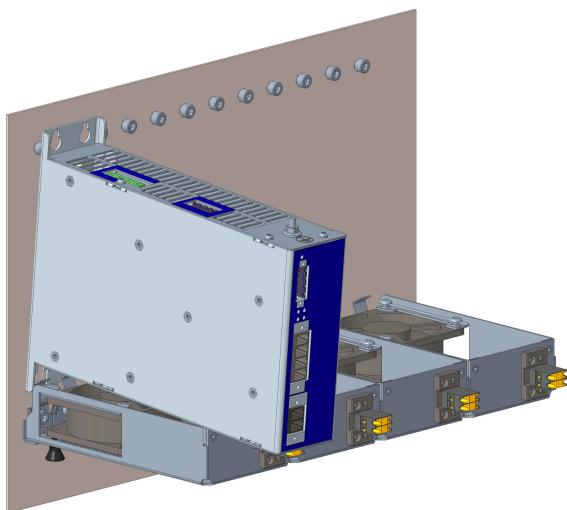
### Cooling unit of the previous AccurET family

The ACCURET+ controllers / +PS300 are backward compatible with the cooling unit developed for the previous controllers family (AccurET).



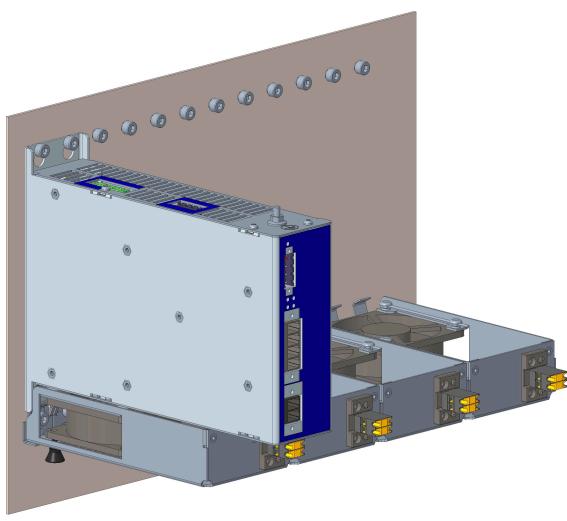
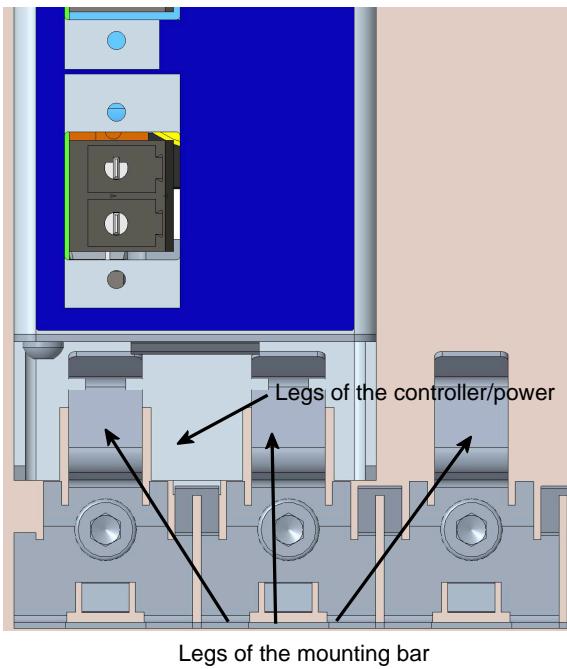
► **Step 1**

Follow first the steps 1 to 3 described in the procedure above.  
Put the fans in position and fix them with the black clamp pins (2 per fan).



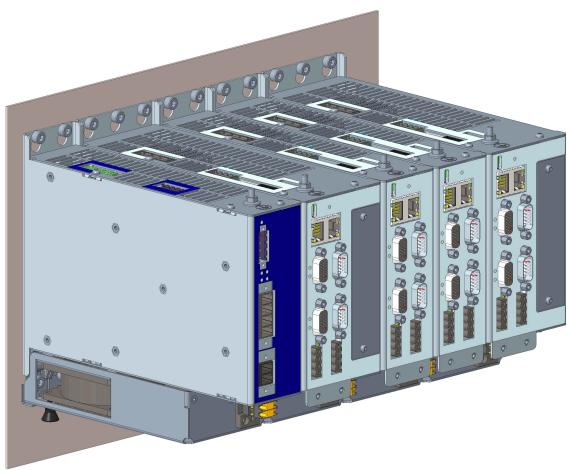
► **Step 2:**

Slightly incline the controller / +PS300 as showed on the picture opposite.  
The legs at the bottom of the controller / +PS300 must be inserted between each leg of the mounting bar.



► **Step 3:**

Push the controller / +PS300 against the back panel and then towards the bottom.  
Screw the top screws to fasten the controller / +PS300.



► **Step 4:**

Proceed as mentioned in steps 2 and 3 to mount the other controller(s).

## 5 Electrical interface



(En)

- High voltage may be present on the power and motor connectors.
- Before connecting or disconnecting a cable on one of these connectors or touching the controllers / +PS300, turn off all the power supplies and wait 10 minutes to allow the internal DC bus capacitors to discharge.
- Always connect the PE prior to any other connections.
- Low voltage and data signals are not insulated from PE.

(Fr)

- Avant de connecter ou de déconnecter un câble sur l'un de ces connecteurs ou de toucher les contrôleurs / +PS300, coupez toutes les alimentations et attendez 10 minutes pour permettre aux condensateurs internes du bus de puissance de se décharger.
- Toujours connecter la terre avant toute autre connexion.
- Les signaux de basse tension et de données ne sont pas isolés de la terre.



(En)

- 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.
- The use of cables longer than 30 m requires EMC qualification.

(Fr)

- Il s'agit d'un produit de la classe de distribution restreinte conformément à la norme IEC61800-3. Dans un environnement domestique, ce produit peut provoquer des interférences radio, auquel cas l'utilisateur peut être amené à prendre des mesures adéquates.
- L'utilisation de câbles de plus de 30 m nécessite une qualification CEM.



(En)

- All the connectors must be handled in an ESD protected environment.

(Fr)

- Tous les connecteurs doivent être manipulés dans un environnement protégé contre les décharges électrostatiques.

This chapter describes the pin assignment for every connector. More detailed explanations for proper connections are provided in the corresponding paragraph.

The selection, the preparation (e.g. wiring) and the mounting (including the selection of the tightening torque) of the connectors used for the electrical interfaces must consider the operating conditions (e.g. cables' weight and level of vibrations) related to the application. The user is responsible for the compliance of the connectors with the applicable electrical safety regulations.

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

- Protective earth (refer to [§5.1](#)).
- Communication (refer to [§5.3](#)).
- Encoders (refer to [§5.4](#)).
- GPIOs (refer to [§5.5](#)).
- Motors (refer to [§5.6](#)).
- Power (refer to [§5.7](#)).
- STO (refer to [§5.8](#)).

- Download key (refer to [§5.9](#)).
- ID number (refer to [§5.10](#)).
- ETEL dongle (refer to [§5.11](#)).
- Optional board (refer to [§5.12](#)).

## NOTICE

- To prevent damage, ensure correct alignment of male and female connectors as well as insertion of correctly mated connectors.
- In the following paragraphs, male connectors are indicated with the '•' symbol (full), and female connectors are represented with the 'o' symbol (empty).

## 5.1 Protective earth connection



(En)

- Always connect the PE prior to any other connection.

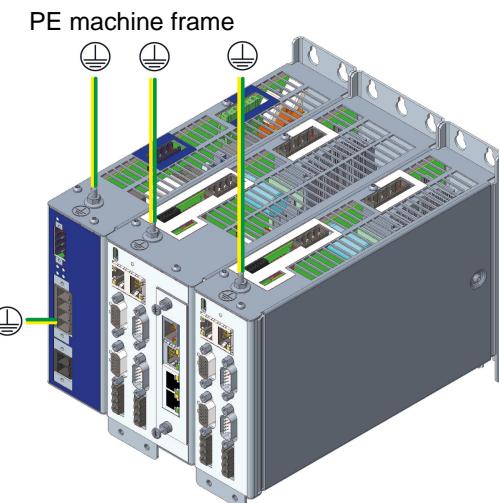
(Fr)

- Toujours connecter la terre avant toute autre connexion.

The user must ensure that the PE is correctly connected. It is used to provide protection from electric shock and to allow sufficient current to flow so that the protective devices can trip. Interruptions in the PE conductor may cause damage to persons or property. It is the responsibility of the user to ensure that the connection is effective at any time.

ETEL recommends to connect the PE cables as follows:

- Each controller / power supply must be individually connected to the M4 threaded rod present at the top of each of them.
- Each PE wire (green and yellow cable) must have a section at least equal to the wires +Uz and -Uz present on the 'power input' connector (X104) and must be connected to the machine frame (PE machine) according to the relevant standards.
- On top of this PE cable, the one present on the 'power input' connector (P01) of the +PS300 MUST also be connected with the same section as mentioned above.



## 5.2 Cables manufacturing

When using cables not provided by ETEL, follow carefully these recommendations to ensure proper shielding:

- The encoder cables: X10 and X20 (refer to [§5.4](#)).
- The GPIO cables: X11 and X21 (refer to [§5.5](#)).
- The motor cables: X12 and X22 (refer to [§5.6.1](#)).
- The STO cable: X103 (refer to [§5.8](#)).

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

### NOTICE

- All the cables connected to the controller must have copper conductors only and an insulation withstanding at least 75 °C.
- Shield with only aluminum foil (metallized plastic film is forbidden!).
- A bad shielding connection can generate EMC problems.

## 5.3 Communication connectors



(En)

- Signals are not insulated from PE. Avoid proximity with noisy power cable.

(Fr)

- Les signaux ne sont pas isolés de la terre de protection. Évitez la proximité avec un câble de puissance perturbant.



(En)

- The communication connectors must be handled in an ESD protected environment, only.

(Fr)

- Les connecteurs de communication doivent être manipulés uniquement dans un environnement protégé contre les décharges électrostatiques.

The communication between a host (PC) and a controller is made via a USB interface (connector X00) or Ethernet when TRANSNET is not used (connector X01). The communication between the position controllers (ACCURET+) and the motion controller (ULTIMET) is established via the TRANSNET communication bus (ETEL's proprietary fieldbus in a daisy chain topology). To do so, the connectors X01 and X02 are used to make a daisy chain with RJ-45 cables.

### NOTICE

- 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 100 m, however, the use of a cable longer than 30 m requires EMC qualification.

### 5.3.1 USB communication (connector X00)

The USB 2.0 (full speed) interface is used for the setting and monitoring of the controller. The USB connector is a Type-C.

### 5.3.2 TRANSNET input / Ethernet (connector X01)

This input, labeled "IN" (Input) on the front panel of the controller, is used to connect the input daisy-chained cable of the TRANSNET communication bus (1000 Mbps). Alternatively, the controller can be configured to use this connector to establish a standard Ethernet communication to a host (PC) in a point-to-point topology.

### 5.3.3 TRANSNET output (connector X02)

This output, labeled "OUT" (OUTput) on the front panel of the controller, is used to connect the output daisy-chained cable of the TRANSNET communication bus (1000 Mbps). For the last controller in the chain, this connector must be left unconnected.

## 5.4 Encoders (connectors X10 and X20)



(En)

- Signals are not insulated from PE. Avoid proximity with noisy power cables.
- All interfaces comply with the following requirements: DVC-A and limited energy (according to IEC 61010-1).

(Fr)

- Les signaux ne sont pas isolés de la terre de protection. Évitez la proximité avec des câbles de puissance perturbants.
- Toutes les interfaces sont conformes aux exigences suivantes : DVC-A et énergie limitée (conformément à la norme IEC 61010-1).



(En)

- The encoder connectors must be handled in an ESD protected environment, only.

(Fr)

- Les connecteurs des codeurs doivent être manipulés uniquement dans un environnement protégé contre les décharges électrostatiques.

### NOTICE

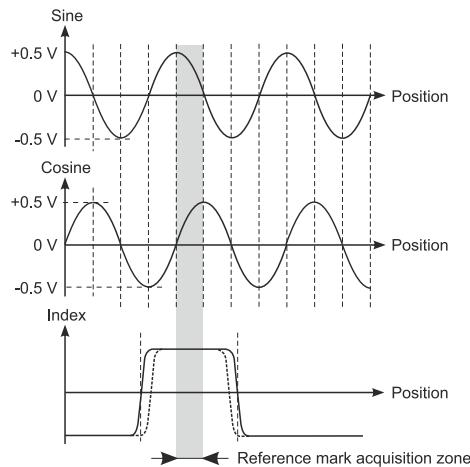
- The encoder cable(s) connected to the controller must be shielded (refer to §5.4.6).
- The connector X10 is used to connect the encoder of motor 1 and X20 for the one of motor 2.
- The use of a cable longer than 30 m requires EMC qualification.

Three different types of encoder can be connected to the encoder connectors:

- Incremental analog 1 Vpp encoder.
- Serial interface EnDat 2.2 or EnDat 3 encoder.
- TTL encoder.

### 5.4.1 Incremental analog encoder (1 Vpp)

The incremental analog encoder has 1Vpp signals with a load resistor  $R_0=120\ \Omega$ .



### D-SUB, 15 pins, high density, female

Encoder	Pin #	Signal	Function	Interface
X10 & X20  ○ 15 11 ○	1	Reserved	Do not connect	
	2	Reserved	Do not connect	
	3	Reserved	Do not connect	
	4	+5.2 VDC	Encoder supply output	
	5	GND	Encoder supply output (0 V)	
	6	COS -	Cosine - signal input	
	7	SIN -	Sine - signal input	
	8	IDX -	Index - signal input	
	9	Reserved	Do not connect	
	10	EHS / L1	Encoder home switch (EHS) input or encoder limit switch L1 (TTL signal)	
	11	ELS / L2	Encoder limit switch (ELS) input or encoder limit switch L2 (TTL signal)	
	12	GND	Encoder supply output (0 V)	
	13	COS +	Cosine + signal input	
	14	SIN +	Sine + signal input	
	15	IDX +	Index + signal input	

### NOTICE

- The +5.2 VDC encoder supply output is shared between both connectors X10 and X20, with a 1.2 A maximum combined output current and protected by a 1.5 A resettable fuse.
- Refer to the corresponding "Operation & Software Manual" for more information about the use of the EHS / L1 and ELS / L2 signals.

Pin number	Specifications	Minimum	Typical	Maximum
All	Autorized Input voltage [V]	0	-	5.4
4	Encoder supply [V]	4.9(1)	5.2	-

Pin number	Specifications	Minimum	Typical	Maximum
6, 7, 13, 14	Common mode input [V] [(sin+) + (sin -)/2], [(cos+) + (cos -)/2]	1	-	2.9
	Signal amplitude [V] [(sin+) - (sin -)], [(cos+) - (cos -)]	0.7	-	1.3
8, 15	Common mode [V] [(IDX+) + (IDX -)/2]	1	-	2.9
	Signal amplitude [V] [(IDX+) - (IDX -)]	-	-	5
10, 11	Positive going input threshold voltage [V]	2.1	-	3.5
	Negative going input threshold voltage [V]	1.3	-	2.3
	Hysteresis [V]	0.7	-	1.4

(1): with 1.2 A max. current.

#### 5.4.2 Serial interface EnDat 2.2

The EnDat 2.2 is an serial interface encoder. It includes a RS485 serial link (EIA standard, EnDat 2.2 interface) for the position measure: EDT (serial data) and ECL (clock). The ECL (clock) signal is received from the controller. Refer to the HEIDENHAIN's 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 +
	2	ECL +	EnDat clock output +
	3	ECL -	EnDat clock output -
	4	+5.2 VDC	Encoder supply output
	5	GND	Encoder supply output (0 V)
	6	Reserved	Do not connect
	7	Reserved	Do not connect
	8	Reserved	Do not connect
	9	EDT -	EnDat serial data I/O -
	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

**NOTICE**

- The +5.2 VDC encoder supply output is shared between both connectors X10 and X20, with a 1.2 A maximum combined output current and protected by a 1.5 A resettable fuse.
- The cable used with an EnDat 2.2 encoder 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).

Pin number	Specifications	Minimum	Typical	Maximum
4	Encoder supply [V]	4.9	5.2	-
	Data input range [V]	-15	-	15
	Common mode input voltage [V]	-15	-	15
1, 9	Positive-going input threshold voltage [mV]	-	-	-20
	Negative-going input threshold voltage [mV]	-200	-	-
	Input hysteresis [mV]	30	-	-
	Common mode output voltage [V]	1	-	3
1, 9, 2, 3	Output voltage differential magnitude [V]	2	-	4

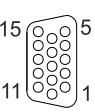
**5.4.3 Serial interface EnDat 3**

The EnDat 3 is a serial interface encoder. The ACCURET+ is compatible **with the 4-wire design only**. The controller supplies power to the encoder over one pair of wires and uses the second wire pair for communication with the encoder. Refer to the HEIDENHAIN's documentation for more information about the EnDat 3.

**NOTICE**

- EnDat 3 daisychain and two wires modes are not supported.

**D-SUB, 15 pins, high density, female**

Encoder	Pin #	Signal	Function
	1	Reserved	Do not connect
	2	SD +	Signal data +
	3	SD -	Signal data -
	4	+5.2 VDC	Encoder supply output
	5	GND	Encoder supply output (0 V)
X10 & X20	6	Reserved	Do not connect
○	7	Reserved	Do not connect
15 	8	Reserved	Do not connect
11	9	Reserved	Do not connect
○	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

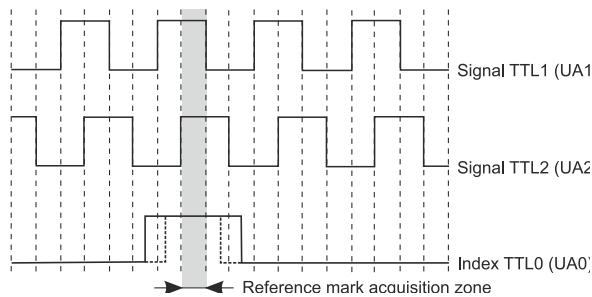
**NOTICE**

- The +5.2 VDC encoder supply output is shared between both connectors X10 and X20, with a 1.2 A maximum combined output current and protected by a 1.5 A resettable fuse.
- The cable used with an EnDat 3 encoder 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).

Pin number	Specifications	Minimum	Typical	Maximum
4	Encoder supply [V]	4.9	5.2	-
	Data input range [V]	-15	-	15
	Common mode input voltage [V]	-15	-	15
	Positive-going input threshold voltage [mV]	-	-	-20
2, 3	Negative-going input threshold voltage [mV]	-200	-	-
	Input hysteresis [mV]	30	-	-
	Common mode output voltage [V]	1	-	3
	Output voltage differential magnitude [V]	2	-	4

#### 5.4.4 TTL encoder

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**

<b>Encoder</b>	<b>Pin #</b>	<b>Signal</b>	<b>Function</b>
	1	UA1 +	TTL1 + signal input
	2	UA2 +	TTL2 + signal input
	3	UA2 -	TTL2 - signal input
	4	+5.2 VDC	Encoder supply output
	5	GND	Encoder supply output (0 V)
X10 & X20	6	Reserved	Do not connect
○	7	Reserved	Do not connect
15 ○ 11 ○	8	Reserved	Do not connect
5	9	UA1 -	TTL1 - signal input
1	10	UA0 -	TTL0 - signal input
	11	UA0 +	TTL0 + signal input
	12	GND	Encoder supply output (0 V)
	13	Reserved	Do not connect
	14	Reserved	Do not connect
	15	Reserved	Do not connect

**NOTICE**

- The +5.2 VDC encoder supply output is shared between both connectors X10 and X20, with a 1.2 A maximum combined output current and protected by a 1.5 A resettable fuse.
- The connectors X10 and X20 are used to connect the encoders corresponding respectively to motors 1 and 2.
- The signal frequency (10 MHz) is one fourth of the counter frequency (40 MHz).

<b>Pin number</b>	<b>Specifications</b>	<b>Minimum</b>	<b>Typical</b>	<b>Maximum</b>
All	Autorized input voltage [V]	0	-	5.4
4	Encoder supply [V]	4.9	5.2	-

Pin number	Specifications	Minimum	Typical	Maximum
1, 2, 3, 9	Differential input voltage [V]	-5.4	-	5.4
	Common mode input voltage [V]	2.4	-	2.7
	Positive-going input threshold voltage [mV]	-	-	-20
	Negative-going input threshold voltage [mV]	-200	-	-
	Input hysteresis [mV]	30	-	-
	Differential input voltage [V]	-5.4	-	5.4
10, 11	Common mode input voltage [V]	2.4	-	2.7
	Positive-going input threshold voltage [mV]	-	-	200
	Negative-going input threshold voltage [mV]	-200	-	-
	Input hysteresis [mV]	50	-	-

#### 5.4.5 Dual encoder feedback

Here are the possible configurations of dual encoder feedback:

##### D-SUB, 15 pins, high density, female

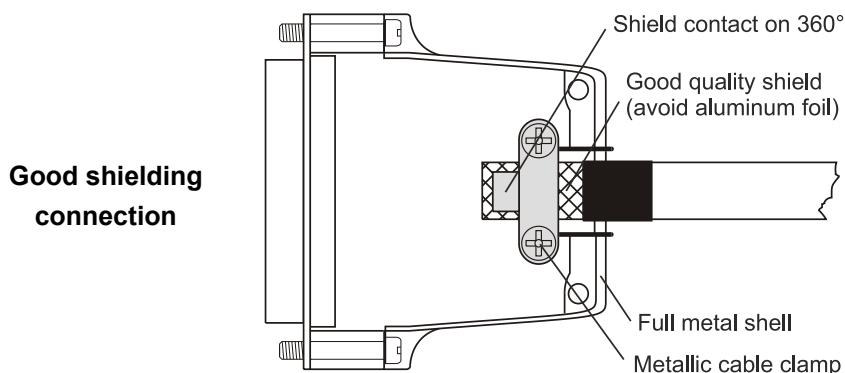
Encoder	Pin #	1 Vpp / TTL	1 Vpp / EnDat 2.2 and EnDat 2.2 / 1 Vpp	1 Vpp / EnDat 3 and EnDat 3 / 1 Vpp
		Signal	Signal	Signal
X10 & X20	1	UA1 +	EDT +	Not connected
	2	UA2 +	ECL +	SD +
	3	UA2 -	ECL -	SD -
	4	+5.2 VDC	+5.2 VDC	+5.2 VDC
	5	GND	GND	GND
	6	COS -	COS -	COS -
	7	SIN -	SIN -	SIN -
	8	IDX -	IDX -	IDX -
	9	UA1 -	EDT -	Not connected
	10	EHS / L1 or UAO -	EHS / L1	EHS / L1
	11	ELS / L2 or UAO +	ELS / L2	ELS / L2
	12	GND	GND	GND
	13	COS +	COS +	COS +
	14	SIN +	SIN +	SIN +
	15	IDX +	IDX +	IDX +

**NOTICE**

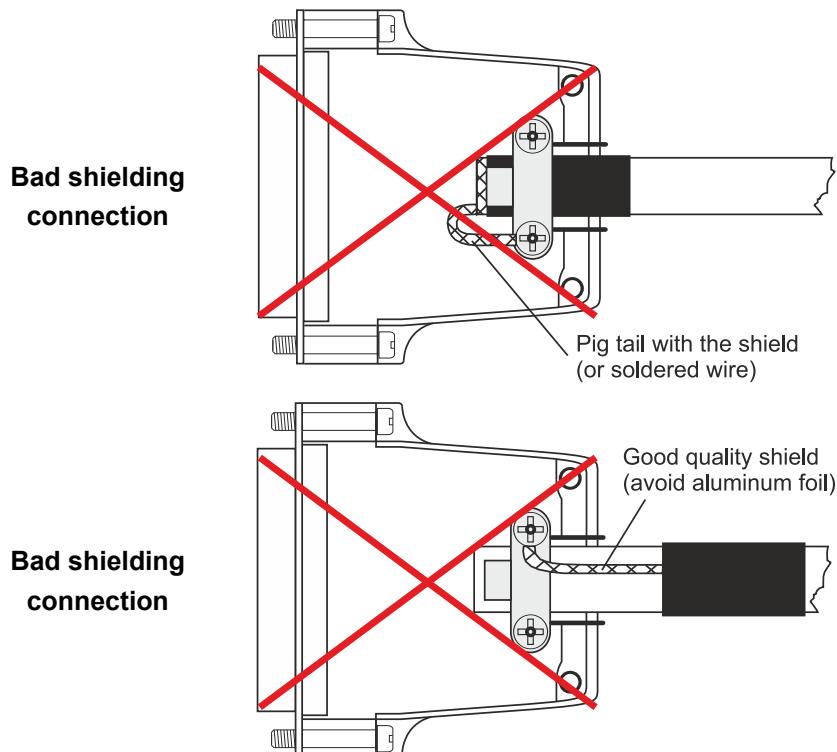
- Refer to the corresponding encoder table to know the function and the rating of each signal.

**5.4.6 Encoder cables manufacturing**

Here is an example of good shielding connection:



Here are examples of bad shielding connection:

**NOTICE**

- Refer also to §5.2 for more information about general guidelines on cables manufacturing.

## 5.5 GPIO (connectors X11 and X21)



(En)

- Signals are not insulated from PE.
- All output interfaces comply with the following requirements: DVC-A.
- All input interfaces must comply with the following requirements: DVC-A.

(Fr)

- Les signaux ne sont pas isolés de la terre de protection.
- Toutes les interfaces de sortie sont conformes aux exigences suivantes : DVC-A.
- Toutes les interfaces d'entrée doivent être conformes aux exigences suivantes : DVC-A.



(En)

- The GPIO connectors must be handled in an ESD protected environment.

(Fr)

- Les connecteurs d'entrées/sorties doivent être manipulés dans un environnement protégé contre les décharges électrostatiques.

Only the input and output interfaces are considered here. Refer to the corresponding "Operation & Software Manual" for more information about the use of these I/Os.

### NOTICE

- The use of a cable longer than 30 m requires EMC qualification.

### 5.5.1 Standard digital I/Os

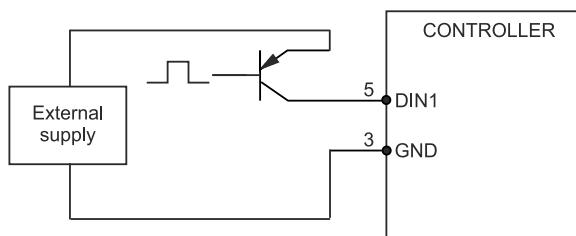
#### ► Standard digital inputs

The standard digital inputs are common to both axes.

The external limit and home switch must be connected as follows:

- 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:



Specifications	Minimum	Maximum
$V_{I_1}$ : input voltage [V]	-2	30
$V_{T+}$ : positive-going input threshold voltage [V]	8	13

Specifications	Minimum	Maximum
$V_{T-}$ : negative-going input threshold voltage [V]	3	7
$\Delta V_T$ : hysteresis ( $V_{T+} - V_{T-}$ ) [V]	2	6
$t_r$ : rise time [ns]	-	30
$t_f$ : fall time [ns]	-	30

**NOTICE**

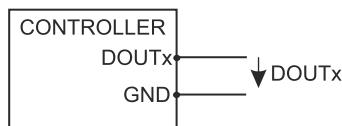
- The above-mentioned timing values are considered from the input pin of the connector to the controller's digital control. Beware that the input capacitance (1 nF) of the input may increase the time.

► **Standard digital outputs**

The +Vaux voltage used to supply the standard digital output is the same as the one present on the control input connector (X100). There is 1 A shared out between all the digital outputs present on both X11 and X21 connectors. The maximum current allowed per digital output is 500 mA.

**⚠ WARNING**

- Do not supply Vaux voltage on connector X11 or X21, but only on connector X100.



Specifications	Minimum	Maximum
$V_{OH}$ : high-level output voltage [V]	21	-
$V_{OL}$ : low-level output voltage [V]	-	12
$I_{OH, DOUT}$ : high-level output current per DOUT [A]	-	0.5
$I_{OH, GLOBAL}$ : high-level output current for the four combined DOUTs [A]	-	1
$t_r$ : rise time [μs]	-	100 + MLTI time
$t_f$ : fall time [μs]	-	100 + MLTI time

**NOTICE**

- The above-mentioned timing values include the firmware process time and the time from the controller's digital control to the output pin of the connector. Refer to the "Operation & Software Manual" for more information about the MLTI time.

## 5.5.2 Fast digital I/Os

### ► Fast digital inputs

The fast digital inputs are common to both axes and can be used for synchronization, position capture, etc.

Specifications	Minimum	Maximum
$V_i$ : input voltage [V]	0	5.5
$V_{T+}$ : positive-going input threshold voltage [V]	1.4	2.4
$V_{T-}$ : negative-going input threshold voltage [V]	0.7	1.3
$\Delta VT$ : hysteresis ( $V_{T+}-V_{T-}$ ) [V]	0.4	1.2
$t_r$ : rise time [ns]	-	30
$t_f$ : fall time [ns]	-	30

### NOTICE

- The above-mentioned timing values are considered from the input pin of the connector to the digital control of ACCURET+. The user must also pay attention that the input capacitance (100 pF) of the input may increase the time.

### ► Fast digital outputs

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

Specifications	Minimum	Maximum
$V_{OH}$ : high-level output voltage [V]	3.8	-
$V_{OL}$ : low-level output voltage [V]	-	0.6
$I_o$ : output current [mA]	-	32
$t_r$ : rise time [ns]	-	30
$t_f$ : fall time [ns]	-	30

### NOTICE

- The above-mentioned timing values takes only into account the time from the digital control of ACCURET+ to the output pin of the connector. The user must pay attention that time could be longer, depending on the load driven by the output.

## 5.5.3 I/O cables manufacturing

Refer to [§5.5.3](#) for more information about the cables manufacturing.

## 5.5.4 I/O pins assignment

D-SUB, 15 pins, high density, male

I/O	Pin #	Signal (with firmware 3.5x)	Function	Signal (for future use)	Interface
	1	FDIN1	Fast Digital Input	FIO0	
	2	FDIN3	Fast Digital Input	FIO1 / AINO	
	3	GND	GND	GND	
	4	DIN2	Digital Input	DIN0	
	5	DIN10	Digital Input	DIN1	
	6	FDIN2	Fast Digital Input	FIO2	
X11 ○	7	+5 VDC	Power supply output (max. 100 mA protected by resettable fuse)	+5.2 VDC	
11 ○	8	GND	GND	GND	
15 ○	9	DIN1	Digital Input	DIN2	
	10	DIN9	Digital Input	DIN3	
	11	FDOUT1	Fast Digital Output	FIO3	
	12	FDOUT2	Fast Digital Output	FIO4	
	13	+Vaux	Auxiliary voltage supply (+24 VDC from X100)	+Vaux	
	14	DOUT1	Digital Output	DOUT0	
	15	DOUT2	Digital Output	DOUT1	

### NOTICE

- The total current driven by all DOUT (+24 VDC) and +Vaux pins on X11 and X21 connectors must not exceed 1A.

**D-SUB, 15 pins, high density, male**

I/O	Pin #	Signal (with firmware 3.5x)	Function	Signal (for future use)	Interface
	1	FDIN4	Fast Digital Input	FIO5	
	2	FDIN6	Fast Digital Input	FIO6 / AIN1	
	3	GND	GND	GND	
	4	DIN2	Digital Input	DIN4	
	5	DIN10	Digital Input	DIN5	
	6	FDIN5	Fast Digital Input	FIO7	
X21	7	+5 VDC	Power supply output (max. 100 mA protected by resettable fuse)	+5.2 VDC	
	8	GND	GND	GND	
	9	DIN1	Digital Input	DIN6	
	10	DIN9	Digital Input	DIN7	
	11	FDOUT3	Fast Digital Output	FIO8	
	12	FDOUT4	Fast Digital Output	FIO9	
	13	+Vaux	Auxiliary voltage supply (+24 VDC from X100)	+Vaux	
	14	DOUT1	Digital Output	DOUT2	
	15	DOUT2	Digital Output	DOUT3	

## 5.6 Motors (connectors X12 and X22)



(En)

- High voltage may be present on the motor connectors.
- Before connecting or disconnecting the motor cable or touching the controller, turn off all the power supplies and wait 10 minutes to allow the internal DC bus capacitors to discharge.
- Always connect the PE prior to any other connection.

(Fr)

- Une haute tension peut être présente sur les connecteurs du moteur.
- Avant de connecter ou de déconnecter le câble du moteur ou de toucher le contrôleur, coupez toutes les alimentations et attendez 10 minutes pour permettre aux condensateurs internes du bus de puissance de se décharger.
- Toujours connecter la terre avant toute autre connexion.



(En)

- The motor connectors must be insulated (no contact) from the power and the mains and must always be correctly connected to the shielding bracket for EMC compliance (refer to §5.6.1).

(Fr)

- Les connecteurs des moteurs doivent être isolés (sans contact) de l'alimentation et du réseau, et doivent toujours être correctement connectés au support de reprise de blindage pour la conformité CEM (se référer à §5.6.1).



(En)

- The motors connectors must be handled in an ESD protected environment.

(Fr)

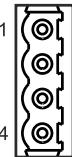
- Les connecteurs des moteurs doivent être manipulés dans un environnement protégé contre les décharges électrostatiques.

### NOTICE

- The motor cables connected to the controller must be shielded (refer to [§5.4.6](#)).
- The use of a cable longer than 30 m requires EMC qualification.

The ACCURET+ 300 can drive two single-phase, two-phase or three-phase motors. Connectors X12 and X22 enable the supply of the motor phase(s).

#### Phoenix Contact IC 2.5/4-G-5,08 BK (plastic connector)

Motor	Pin #	Signal	1-phase motor	2-phase motor	3-phase motor
X12 & X22	1	PE	Protective earth	Protective earth	Protective earth
	2	PH1	Motor phase 1 +	Motor phase 1 +	Motor phase 1
	3	PH2	Motor phase 1 -	Motor phase 1 - / 2 - (*)	Motor phase 2
	4	PH3	<b>Do not connect</b>	Motor phase 2 +	Motor phase 3

(\*): 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.

To be UL and CSA compliant, the minimum section of the motors wires must be as follow:

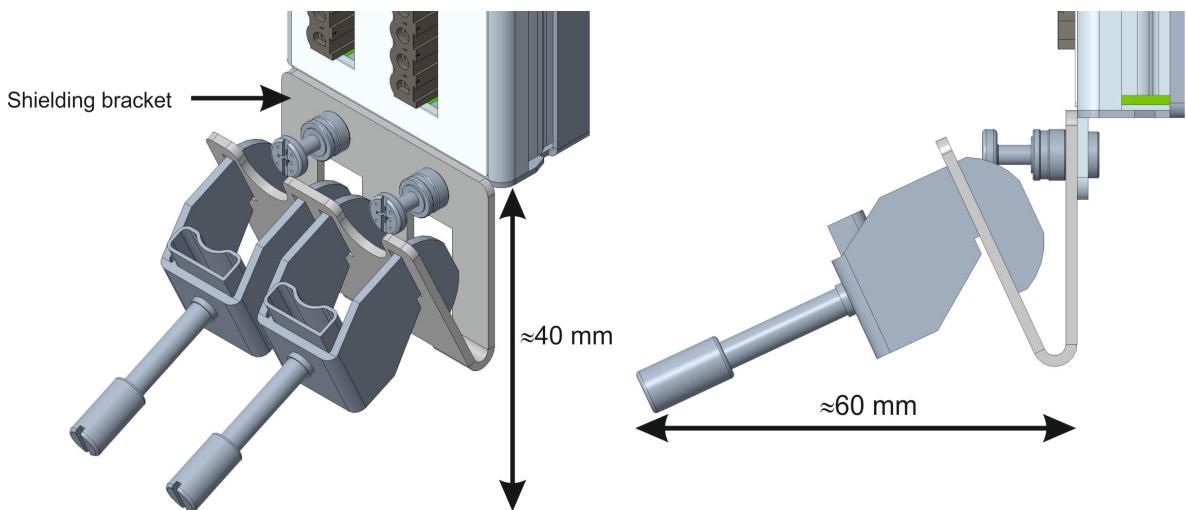
Controller	EA+P2M-300-4/7.5A	EA+P2M-300-07/15A	EA+P2M-300-10/20A
wiring	Single conductor wiring, copper type, temperature rating min. 75 °C.		
	18 AWG / 0,75 mm <sup>2</sup>	16 AWG / 1.5 mm <sup>2</sup>	14 AWG / 2,5 mm <sup>2</sup>

### NOTICE

- The connector X12 is used to connect the motor 1 and X22 for the motor 2.
- The associated connector can be ordered as part of the connector kit (refer to [§3.7.5](#)).

#### 5.6.1 Motor cable manufacturing

In order to fully comply with EMC (best result), the following shielding bracket must be used with the motor connectors.



## NOTICE

- Refer also to [§5.2](#) for more information about general guidelines on cables manufacturing.
- The cable's bend radius must be taken into account when adjusting the distance between the front plate of the controller and the cabinet.
- The shielding bracket can be ordered as part of the connector kit (refer to [§3.7.5](#)).

## 5.7 Power connectors



(En)

- High voltage may be present on the power connectors.
- Before connecting or disconnecting the power cables or touching the controller, turn off all the power supplies and wait 10 minutes to allow the internal DC bus capacitors to discharge.
- Always connect the PE prior to any other connection.

(Fr)

- Une haute tension peut être présente sur les connecteurs d'alimentation.
- Avant de connecter ou de déconnecter les câbles d'alimentation ou de toucher le contrôleur, coupez toutes les alimentations et attendez 10 minutes pour permettre aux condensateurs internes du bus de puissance de se décharger.
- Toujours connecter la terre avant toute autre connexion.



(En)

- The power connectors must be handled in an ESD protected environment.

(Fr)

- Les connecteurs d'alimentation doivent être manipulés dans un environnement protégé contre les décharges électrostatiques.

**NOTICE**

- The power cables connected to the controller must be shielded (refer to §5.4.6).
- The use of a cable longer than 30 m requires EMC qualification.

**5.7.1 At the position controller level****Control input (connector X100)****Phoenix Contact MSTBA 2.5/4-G BK (plastic connector)**

Control input	Pin #	Signal	Function
	1	+24 VDC	Control input (24 VDC ± 10 %)
	2	0 VDC	Control input (0 VDC). It is internally connected to PE
	3	PS RDY	Power supply ready input (for the controller)
	4	PS OPEN	Power supply opened output (for the controller)

The 'PS RDY' (Power Supply ReaDY) signal indicates the status of the voltage present on the DC bus (0 VDC = DC power not ready and 24 VDC = power supply ready). If this signal is not provided to the controller, an error will occur when the power bridge is enabled.

The 'PS OPEN' (Power Supply OPEN) signal comes from each controller requesting for a power interrupt (internal relay opened) (0 VDC = normal condition and 24 VDC = PS OPEN requested). The PS OPEN of each controller can be put in parallel. This allow a daisy chained connection between the controllers and the +PS300 (P100).

Pin number	Specifications	Minimum	Typical	Maximum
1	Control input [V]	21.6	24	26.4
	Positive-going input threshold voltage [V]	11.2	-	19.2
3	Negative-going input threshold voltage [V]	5.6	-	11.5
	Input hysteresis [V]	3.5	-	9.1
	$V_{OH}$ high level output voltage [V] (@ Typ 24 V control input)	23.2	-	-
4	$V_{OL}$ low level output voltage [V]	-	-	10
	$I_{OH}$ high level output current [mA]	-	-	100
	$I_{OL}$ low level output current [mA]	-10	-	-

**For safety reasons, always connect first the PE as mentioned in §5.1!**

To be UL and CSA compliant, the minimum section of the control input wires must be as follow:

Controller	EA+P2M-300-4/7.5A	EA+P2M-300-07/15A	EA+P2M-300-10/20A
Wiring	Single conductor wiring, copper type, temperature rating min. 75 °C.		
	18 AWG / 0,75 mm <sup>2</sup> up to 6 A or 16 AWG / 1,5 mm <sup>2</sup> up to 10 A		

**NOTICE**

- Be careful to select an external 24 VDC power supply which delivers a correct voltage ramp up during switch on without rebound or oscillation.
- To ensure proper operation of the controller, it is recommended to wait for at least 1 second before changing from ON to OFF and vice-versa.
- The control input must be supplied by an isolated power supply with SELV or PELV outputs (Isolated secondary output), rated 24 VDC  $\pm 10\%$ . A SELV power supply connected to an ETEL controller will become de facto a PELV power supply, as the controller is internally connected to the ground.
- The external power supply must ensure the reinforced insulation between mains and output and provide overvoltage category II (refer to EN 61800-5-1 and UL 61800-5-1 standards for more information).
- EN 61800-5-1 must be observed for the +24 VDC voltage cables and cable routing. Therefore, cables for safely separated electric circuits must have double or reinforced insulation between the wire and the surface if they are routed without spatial separation from other cables. The insulation must then be chosen correspondingly to the maximum possible voltage that can be generated.
- The associated connector can be ordered as part of the connector kit (refer to §3.7.5).
- The use of a cable longer than 30 m requires EMC qualification.

**Control input wiring**

(En)

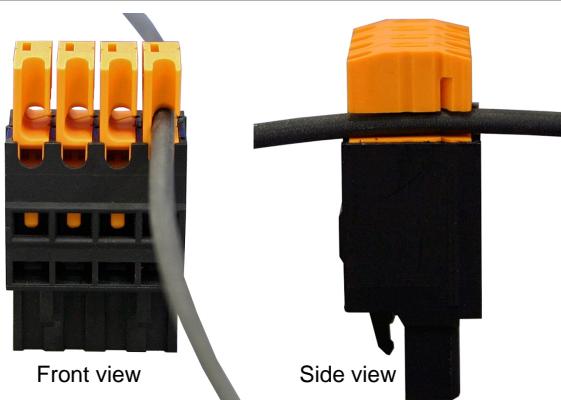
- Permanent connections and terminal blocks are only suitable for factory wiring conditions.

(Fr)

- Les connexions permanentes et les borniers ne conviennent que pour les conditions de câblage d'usine.

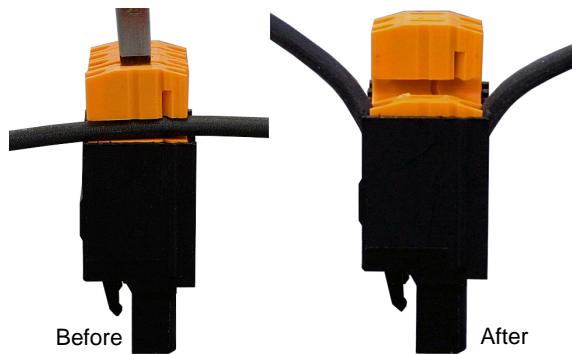
The control input voltage of the controllers can be connected together, in a bus connection, with the connector delivered by ETEL. These connectors are self-strip connectors and are delivered only if the connector kit is ordered. The user must correctly size the power supply according to the number of controllers (with or without optional board) to be connected together.

Here is the procedure to manufacture the wiring:

► **Step 1**

Insert the cable in the slot.

**Caution: Use only wire with a section from 0.75 mm<sup>2</sup> (AWG 18) to 1 mm<sup>2</sup>.**

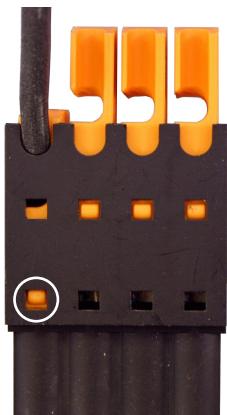


► **Step 2**

Push down the upper clip (orange) with a screw-driver for example.

**It is forbidden to carry out 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 fingers caught when pushing down the clip.**



► **Step 3**

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

Repeat steps 1 to 3 for the other wires. 4 wires are needed per control input connector.

Repeat steps 1 to 4 for the other connectors. There are as many control input connectors as controllers.

There must be no unused length of wire before the first connector of the chain or after the last one. The wires must be cut as short as possible.



► **Step 4**

Here is an example with two controllers.

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.

## Power input (connector X104)



- (En)
- Mains supply of external power supplies must comply with the following requirements: system voltage 300 V, TN-S net with loadable neutral, overvoltage category III.
  - The external power supply must ensure the reinforced insulation between mains and output and provide overvoltage category II (refer to EN 61800-5-1 and UL 61800-5-1 standards for more information).
  - The Power bus overall capacitance must not exceed 3000  $\mu$ F. When sizing this capacitance, the power supply and the individual controllers internal capacitances must be accounted for (each controller's power input has an internal capacitance of 94  $\mu$ F).
  - The power supply connected to the controller's power input (X104) must fulfill the following requirements: DVC-C, 3500 A maximum short circuit current and short circuit protected.
  - The ACCURET+ 300 position controllers are intended for use in the second environment (industrial) according to IEC61800-3 (EMC standard).

(Fr)

- L'alimentation secteur des alimentations externes doit respecter les exigences suivantes : tension système 300 V, réseau TN-S avec conducteur de neutre et conducteur de protection séparés, catégorie de surtension III.
- L'alimentation externe doit assurer l'isolation renforcée entre le secteur et la sortie et assurer la catégorie de surtension II (se référer aux normes EN 61800-5-1 et UL 61800-5-1 pour plus d'informations).
- La capacité globale du bus de puissance ne doit pas dépasser 3000  $\mu$ F. Lors du dimensionnement de cette capacité, l'alimentation et les capacités internes des contrôleurs individuels doivent être prises en compte (l'entrée d'alimentation de chaque contrôleur a une capacité interne de 94  $\mu$ F).
- L'alimentation électrique connectée à l'entrée d'alimentation du contrôleur (X104) doit répondre aux exigences suivantes : DVC-C, courant de court-circuit maximal de 3500 A et protection contre les courts-circuits.
- Les contrôleurs de position ACCURET+ 300 sont destinés à une utilisation dans le second environnement (industriel) selon IEC61800-3 (norme CEM).

### Phoenix Contact GMSTBA 2,5 HC/ 4-G-7,62 BK (plastic connector)

Power input	Pin #	Signal	Function
X104	1	+Uz	Power input +
	2	-Uz	Power input -
	3	PE	Protective earth
	4	PE	Protective earth

To be UL and CSA compliant, the minimum section of the power input wires must be as follow:

Controller	EA+P2M-300-4/7.5A	EA+P2M-300-07/15A	EA+P2M-300-10/20A
Wiring	Single conductor wiring, copper type, temperature rating min. 75 °C.		
	18 AWG / 0,75 mm <sup>2</sup>	16 AWG / 1,5 mm <sup>2</sup>	14 AWG / 2,5 mm <sup>2</sup>

**NOTICE**

- The associated connector can be ordered as part of the connector kit (refer to [§3.7.5](#)).
- The use of a cable longer than 30 m requires EMC qualification.

**5.7.2 At the power supply level****Control input (connector P00)****Phoenix Contact MSTB 2.5/4-G BK (plastic connector)**

<b>Control input</b>	<b>Pin #</b>	<b>Signal</b>	<b>Function</b>
P00	1	+24 VDC	Control input (24 VDC ± 10 %)
1	2	0 VDC	Control input (0 VDC). It is internally connected to PE
	3	ERC -	External Relay Command output (0 VDC)
4	4	ERC +	External Relay Command output (+24 VDC)

**For safety reasons, always connect first the PE as mentioned in [§5.1](#)!**

<b>Pin number</b>	<b>Specifications</b>	<b>Minimum</b>	<b>Typical</b>	<b>Maximum</b>
1	Control input [V]	21.6	24	26.4
4	$V_{OH}$ high level output voltage [V] (@ Typ 24 V control input)	23.8	-	-
	$V_{OL}$ low level output voltage [V]	-	High Z	-
	$I_{OH}$ high level output current [mA]	-	-	200

To be UL and CSA compliant, the minimum section of the control input wires must be as follow:

<b>Power</b>	<b>ACCURET+ PS300</b>
wiring	Single conductor wiring, copper type, temperature rating min. 75 °C. 18 AWG / 0,75 mm <sup>2</sup> up to 6 A or 16 AWG / 1,5 mm <sup>2</sup> up to 10 A

## NOTICE

- To ensure proper operation of the power supply, it is recommended to wait for at least 1 second before changing from ON to OFF and vice-versa.
- The control input must be supplied by an isolated power supply with SELV or PELV outputs (Isolated secondary output), rated 24 VDC ± 10 %.
- The external power supply must ensure the reinforced insulation between mains and output and provide overvoltage category II (refer to EN 61800-5-1 and UL 61800-5-1 standards for more information).
- EN 61800-5-1 must be observed for the +24 VDC voltage cables and cable routing. Therefore, cables for safely separated electric circuits must have double or reinforced insulation between the wire and the surface if they are routed without spatial separation from other cables. The insulation must then be chosen correspondingly to the maximum possible voltage that can be generated.
- The +24 VDC input of this connector is internally connected to the +24 VDC of the control output. The ERC outputs signals command the external input relay connected on the AC power line. In case of problem detected on the controllers or on the power supply side, a zero volt is applied between these two contacts to open this relay.
- The associated connector can be ordered as part of the connector kit (refer to [§3.7.5](#)).
- The use of a cable longer than 30 m requires EMC qualification.

### Power input (connector P01)

**Phoenix Contact PC 4/4-G-7,62 BK (plastic connector)**

Power input	Pin #	Signal	Function
P01	1	PE	Protective earth
	2	L	Mains line supply input for power
	3	N	Neutral
	4	NC	Not connected

**For safety reasons, always connect first the PE as mentioned in [§5.1](#)!**

To be UL and CSA compliant, the minimum section of the power input wires must be as follow:

Power	ACCURET+ PS 300
Wiring	Single conductor wiring, copper type, temperature rating min. 75 °C. 14 AWG / 2,5 mm <sup>2</sup>

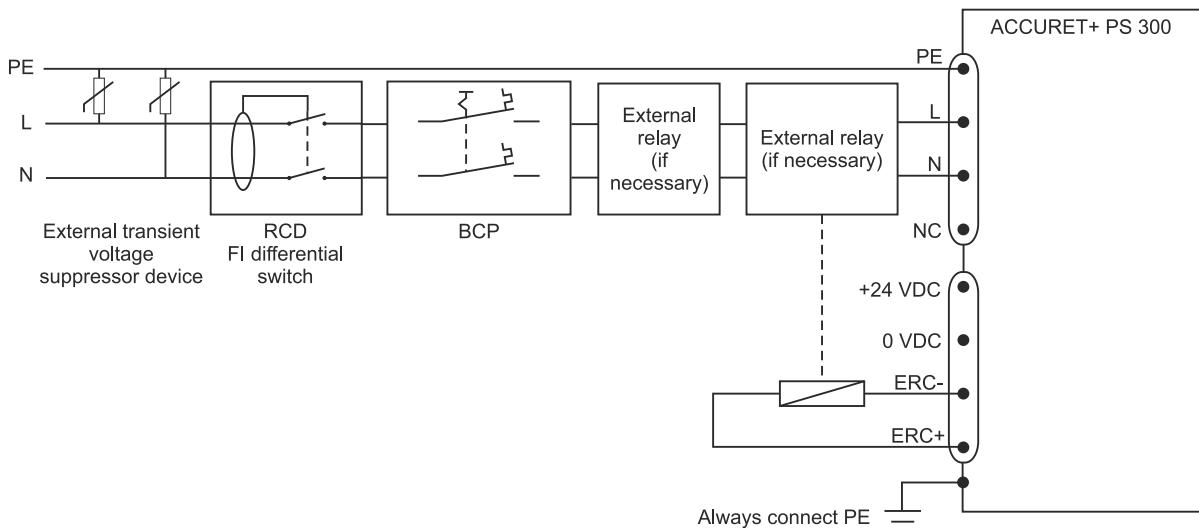
## NOTICE

- Limit to one switch on/off per minute!
- It is strongly recommended to connect the Control input before the power input.
- The associated connector can be ordered as part of the connector kit (refer to [§3.7.5](#)).
- Machinery including a power supply and controller(s) should be equipped with additional emergency stop, brake and protection devices to protect the personnel against any contact with high temperatures, moving parts and high voltage. These devices are not included in the power supply, they must be provided by the machinery manufacturer.
- The use of a cable longer than 30 m requires EMC qualification.

The characteristics of the input filter of ACCURET+ PS300 allows the use of a high sensitivity differential switch (the use of RCD with long motor cable or highly capacitive motor has to be tested).

### **CAUTION**

- This is a product of the restricted distribution class according to IEC61800-3. In a domestic (or first) environment, this product may cause radio interference in which case the user may be required to take adequate measures. Only TN-S power system is allowed. Any other grounding systems such as: corner ground, starpoint to earth with high impedance and isolated,... are forbidden.



If an RCD is used, a type B must be used. The RCD as well as the corresponding Delta I must be selected according to the machine as the leakage current depends on the motor type and the cable lengths. All standards require the use of BCP Carlo Gavazzi, type GMB632PC13, 240 VAC, 50/60 Hz, 10 kA A.I.C, rated C13 A or equivalent.

An external transient voltage suppressor devices is required to reduce overvoltage spikes and suppress their influence on the controller behavior. For example, connect one varistor (ex: S14K420 or Citel module, type DS42S-230) between AC line (L) and PE, and another one between neutral (N) and PE. The ACCURET+ already includes an in-built filter. An additional filter can be added (for example Schaffner FN2080-16-06) to reduce further electromagnetic disturbances.

### **Brake resistor (connector P02)**



(En)

- Use only resistor with thermal shutdown protection. The resistor minimal value is 39 Ω. The use of an undersized power and energy withstand capability resistor could cause an explosion.

(Fr)

- N'utilisez que des résistances avec une protection contre l'arrêt thermique. La valeur minimale de la résistance est de 39 Ω. L'utilisation d'une résistance de puissance et de capacité de résistance énergétique sous-dimensionnée peut provoquer une explosion.

## Phoenix Contact PC 4/2-G-7,62 BK (plastic connector)

Brake resistor	Pin #	Signal	Function
	1	BR+	Brake resistor + (if needed)
	2	BR-	Brake resistor - (if needed)

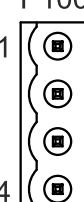
If you determine that a brake resistor is needed, select it to fit your application (refer to [§6](#)). for more information about the sizing). This resistor must include a thermal circuit breaker. Example of resistor recommended by ETEL: Frizlen GmbH (Germany), cemented, double pipe resistor, type FZZG 400x65, 39 Ω , 1200 W at 300 °C. Metallic case protection (shielding), shielded connector.

### NOTICE

- The associated connector can be ordered as part of the connector kit (refer to [§3.7.5](#)).

## Control output (connector P100)

### Phoenix Contact MSTB 2.5/4-G BK (plastic connector)

Control output	Pin #	Signal	Function
	1	+24 VDC	Control output (+24 VDC ± 10 %). It is internally connected to +24 VDC of control input (P00).
	2	0 VDC	Control output (0 VDC). It is internally connected to 0 VDC of control input (P00).
	3	PS READY	Power supply ready (output for the power supply). A high level (24 VDC) on this output indicates everything is OK. A low level indicates an error or an inrush mode not completed. This low level disables the controllers. The inrush relay is closed for PS READY = 1 and opened for 0.
	4	PS OPEN	Power supply open (input for the power supply). A high level (24VDC) on this input disables the power supply. The inrush relay is opened as well as the external input relay.

For safety reasons, always connect first the PE as mentioned in [§5.1](#)!

Pin number	Specifications	Minimum	Typical	Maximum
1	Control output [V] (internally shorted to Pin 1 of P00)	21.6	24	26.4
3	$V_{OH}$ high level output voltage [V] (@ Typ 24 V control input)	23.8	-	-
	$V_{OL}$ low level output voltage [V]	-	High Z	-
	$I_{OH}$ high level output current [mA]	-	-	500
4	Positive-going input threshold voltage [V]	15.6	-	17.8
	Negative-going input threshold voltage [V]	13.8	-	15.6

To be UL and CSA compliant, the minimum section of the control input wires must be as follow:

Controller	EA+P2M-300-4/7.5A	EA+P2M-300-07/15A	EA+P2M-300-10/20A
Wiring	Single conductor wiring, copper type, temperature rating min. 75 °C. 18 AWG / 0,75 mm <sup>2</sup> up to 6 A or 16 AWG / 1,5 mm <sup>2</sup> up to 10 A		

**NOTICE**

- The associated connector can be ordered as part of the connector kit (refer to [§3.7.5](#)).

The +24 VDC output of this connector is internally connected to the +24 VDC coming from the control input. This control output connector is connected with a 1:1 cable to all the control input connectors (connector X100) of the controllers.

The 'PS READY' (Power Supply READY) signal comes from the ETEL power supply and indicates the status of the voltage present on the DC bus (0 VDC = DC power not ready and 24 VDC = power supply ready). The 'PS OPEN' (Power Supply OPEN) signal comes from each controller asking for a power interrupt (internal relay opened) (0 VDC = normal condition and 24 VDC = PS OPEN requested).

### Power output (connector P104)

#### Phoenix Contact GIC 2.5 HC/4-G-7.62 BK (plastic connector)

Power output	Pin #	Signal	Function
P104	1	+Uz	Power output +
	2	-Uz	Power output -
	3	PE	Protective earth
	4	PE	Protective earth

For safety reasons, always connect first the PE as mentioned in [§5.1](#)!

To be UL and CSA compliant, the minimum section of the control input wires must be as follow:

Controller	EA+P2M-300-4/7.5A	EA+P2M-300-07/15A	EA+P2M-300-10/20A
Wiring	Single conductor wiring, copper type, temperature rating min. 75 °C. 18 AWG / 0,75 mm <sup>2</sup>	16 AWG / 1,5 mm <sup>2</sup>	14 AWG / 2,5 mm <sup>2</sup>

**NOTICE**

- For safety and ESD reasons, it is forbidden to touch this connector and its cable as long as the power supply is powered.
- The associated connector can be ordered as part of the connector kit (refer to [§3.7.5](#)).

### 5.7.3 ETEL cooling unit (connector X200)

This connector is reserved for the ETEL cooling unit.

## 5.8 Safe Torque Off - STO (connector X103)



(En)

- The user must have read and understood the "Functional Safety User's Manual" in case of usage of the Functional Safety of the controller.

(Fr)

- L'utilisateur doit avoir lu et compris le "Manuel d'utilisation de la sécurité fonctionnelle" en cas d'utilisation de la sécurité fonctionnelle du contrôleur.



(En)

- Signals connected to the inputs of X103 must comply with the following requirement: DVC-A.

(Fr)

- Les signaux connectés aux entrées de X103 doivent respecter l'exigence suivante : DVC-A.

The STO connector allows to control the behavior of the STO safety function. The purpose of the STO function is to safely shut the power to the motors. This is to prevent the motors to generate a torque or a force. When the STO function is activated, the controller is unable to control the motion of the motors and unable to hold moving parts.

The STO function of the ACCURET+ 300 controller is implemented according to the IEC 61508 and ISO 13849-1 standards. All information related to the characteristics and the implementation of the STO function is provided in the dedicated "Functional Safety User's Manual".

The STO function is implemented as a two-channel architecture. The two channels can independently control two separate auxiliary internal powers of the motor inverters. By default, the system is put into safe mode, which means that the STO function is activated. The procedure to be applied to control the STO function is documented in the "Functional Safety User's Manual". If for any reason, the user does not want to use the STO function, it is possible to bypass it. The STO connector provides everything that is required to bypass the STO with a specific plug. By connecting STO.A+ and STO.B+ to +24 VDC and STO.A- and STO.B- to 0 VDC, the STO function is disabled.



(En)

**Bypass of the safety function:**

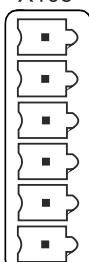
- ETEL cannot be held responsible for any consequences of bypassing the STO safety function by the user.
- The user must ensure that the effects of bypassing the STO safety function are fully understood.

(Fr)

**By-pass de la fonction de sécurité :**

- ETEL ne peut être tenu responsable des conséquences d'un by-pass de la fonction de sécurité STO par l'utilisateur.
- L'utilisateur doit s'assurer que les effets du by-pass de la fonction de sécurité STO sont parfaitement compris.

**Phoenix Contact MC 0,5/ 6-G-2.54 SMD R44 (plastic connector)**

STO	Pin #	Signal	Function
X103 	1	+24 VDC	Control supply output (+24 VDC). The current is limited by a resettable fuse of 160 mA.
	2	0 VDC	Control supply output (0 VDC)
	3	STO.A+	STO channel A + input
	4	STO.A-	STO channel A - input
	5	STO.B+	STO channel B + input
	6	STO.B-	STO channel B - input

**NOTICE**

- The STO connector is located on the top of the controller.
- The +24 VDC (pin 1) is internally connected to +24 VDC (pin 1 of X100) and 0 V connected to pin 2 of X100.
- The associated connector can be ordered as part of the connector kit (refer to [§3.7.5](#)).
- The use of a cable longer than 3 m requires the use of a shielded cable earthed at the controller level.
- The use of a cable longer than 30 m requires EMC qualification.
- STO inputs are protected against reverse polarity connection.

STO inputs specifications	Minimum	Typical	Maximum
VT+: positive-going input threshold voltage [V]	20	-	-
VT-: negative-going input threshold voltage [V]	-	-	5
Recommended operating voltage (STO input = H) [V]	-	24 ± 10 %	-
Absolute maximum voltage on STO input [V]	-	-	30
Input current [mA]	-	5.5 ± 20 %	-
Floating isolated inputs from PE [V]	-	-	50

## 5.9 Download key (connector X102)

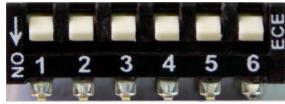
If the controller does not switch to 'wait for program' when the user wants to download a new firmware, there is a hardware override possibility to force this mode. To do so, plug the jumper (in any horizontal or vertical position) on the X102 connector, switch off and on the control input, and the controller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

## 5.10 ID selection (connector X101)

It is possible to assign or to change the axis number (ID selection) of the controller with a DIP switch. After each start-up, 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 the value saved previously in the controller (refer to the AXI command in the "Operation & Software Manual").

**NOTICE**

- Refer to the "Operation & Software Manual" for more informations the commands.



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

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.

**NOTICE**

- 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.

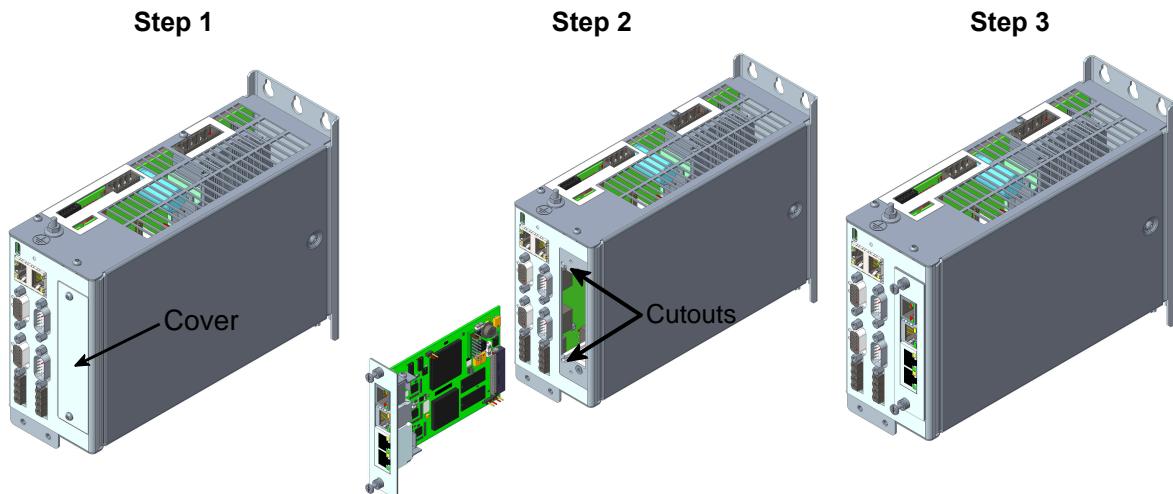
## 5.11 ETEL dongle slot (connector X105)

Reserved for future use.

## 5.12 Optional board

To install an optional board (like the ULTIMET TCP/IP motion controller for example) inside the position controller, the user must use the following procedure:

- 1 Work in an ESD protected environment with operator ground connected.
- 2 Turn off all the power supplies (main and control) and wait 10 minutes to allow the internal DC bus capacitors to discharge.
- 3 Unplug all the cables connected to the position controller.
- 4 Unscrew the two screws fastening the cover of the optional board area on the front panel of the controller (step 1).
- 5 Carefully slide the optional board inside the controller by putting the PCB in the two cutouts (step 2).
- 6 Push the board in until the connection is made with the internal back panel connector.
- 7 Screw the two screws present on the front panel of the optional board (step 3).



### NOTICE

- Only ETEL optional board can be inserted in the optional slot. Please refer to the manual corresponding to the optional board for more informations.
- Refer to the ordering information ([§3.7](#)) to know which controller can accept an optional board.
- The former I/O board (EA-B01) used with the AccurET family is not compatible with the ACCURET + 300.

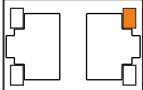
## 5.13 LEDs

Refer to [§3.6.2](#) for the location of the different LEDs and to the "Operation & Software Manual" for the error messages. The LEDs present on the controller have the following meaning:

### 5.13.1 At the controller level

#### Communication

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

LEDs regarding the communication	Meaning
IN (X01)  OUT (X02)	<ul style="list-style-type: none"> <li>■ Orange LED is ON =&gt; The controller is switched on.</li> </ul>

- The position controller is switched on and connected to a TRANSNET communication bus.

LEDs regarding the communication	Meaning
	<ul style="list-style-type: none"> <li>Green LEDs are ON =&gt; The connection (link) is detected on each connector.</li> <li>Yellow LEDs are ON =&gt; The TRANSNET data are running on each connector.</li> <li>The '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.</li> </ul>

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

LEDs regarding the communication	Meaning
	<ul style="list-style-type: none"> <li>Orange LED is ON =&gt; The controller is switched on.</li> <li>Green LED is ON =&gt; The connection (link) is detected.</li> <li>Green LED is blinking =&gt; The controller is waiting for an IP address from a DHCP server.</li> <li>Yellow LED is flashing =&gt; An activity is present on the Ethernet</li> </ul>

## Motor

LED regarding motor 1 / 2	Status	Meaning
Red LED 'M1 ERR' or 'M2 ERR'	ON	Error on the corresponding motor(s) => check monitoring M64 (refer to the "Operation & Software Manual").
	OFF	No error on the corresponding motor(s).
Green LED 'M1 PWR' or 'M2 PWR'	ON	The corresponding motor(s) is (are) in 'power ON'.
	OFF	The corresponding motor(s) is (are) in 'power OFF'.(1)

(1) If the dynamic braking is activated due to an error (refer to the "Operation & Software manual"), the power bridge is still enabled (shortcut at the motor phases output) while the 'M1 PWR' or 'M2 PWR' green LED is OFF.

### NOTICE

- If the red LED 'M1 ERR' or 'M2 ERR' and the green LED 'M1 PWR' or 'M2 PWR' 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 "Operation & Software Manual" for more information.
- The red LED 'M1 ERR' or 'M2 ERR' and the green LED 'M1 PWR' or 'M2 PWR' can be OFF together when the motor 1 / 2 is without error and in power OFF.

## ST LED

The "ST" LED is reserved for a future use.

### 5.13.2 At the power supply level

- The 'PWR VOLT.' LED (green) and the 'PWR ERROR' LED (red) present on the power supply have the following meanings when the power supply (and the controller) are switched on:

LEDs status		Meaning
'PWR ERROR' (red)	'PWR VOLT.' (green)	
OFF	OFF	Low DC voltage on Power output (connector P104). 'PS RDY' on connector P100 is low and it is impossible to enable the power bridge of the controller.
ON	ON	During about 2 seconds after switching ON, the DC bus capacitors is charging. Or The AC supply (connector P01) has been interrupted while there is still a remaining DC voltage on output (connector P104). 'PS RDY' on connector P100 is low and it is impossible to enable the power bridge of the controller.
OFF	ON	AC supply (connector P01) and DC voltage (connector P104) are present. 'PS RDY' on connector P100 is high and it is possible to enable the power bridge of the controller.

- The '**ERROR**' LED (red) and '**CTRL**' (meaning 'Control') LED (green) present on the power supply have the following meanings:

LEDs	Status	Meaning
'CTRL' (green)	ON	The AC voltage is present
	OFF	The MOV (transient voltage suppressor device) is broken
'ERROR' (red)	ON	There is a default on the brake resistor output
	OFF	Standard functioning (no problem detected)

### NOTICE

- After having removed the cause of the error, it is necessary to switch off and on the power supply to reset it.

- The '**FAN ON**' LED (green) present on the power supply has the following meanings:

LEDs	Status	Meaning
'FAN ON' (green)	ON	The ETEL cooling unit (dedicated to the ACCURET+ family) is working properly.
	OFF	The fans of the ETEL cooling unit are not turning at all or at a speed lower => check if the power connector of the cooling unit is properly connected to the X200 connector under the controller. If it is the case, the ETEL cooling unit must be replaced.

## 6 Brake resistor sizing

A motor coupled with a load has a certain amount of energy. This energy is mainly kinetic when the load is moving or rotating. When the system brakes, the energy must be either stored or dissipated. It may be gravitational potential energy in addition to kinetic energy if the load movement is not horizontal (in case of a linear motor), or could be stored in a spring or in any outer system. In this case, the energy must be either stored or dissipated when the system is braking, and sometimes also when the system is at constant speed in descent direction. The ACCURET+ / +PS300 contain capacitors that are capable of storing a certain amount of energy. If the energy is too big, then a brake resistor is needed.

### 6.1 How big is the energy stored in my system?

In a standard direct drive application, the energy balance can be written as follows:

$$E_M = \frac{(E_K + E_P)}{\text{System energy}} - \frac{(E_{Co} + E_F)}{\text{System losses}}$$

With

$E_M$  = Total energy of motor/load minus the system losses [J]

$E_K$  = Kinetic energy of motor/load [J]

$E_P$  = Gravitational potential energy of motor/load [J]

$E_{Co}$  = Energy lost in the motor copper (Ohm losses) [J]

$E_F$  = Energy lost by friction [J]

#### 6.1.1 Torque motor case, standard configuration (Ep term equal to zero)

$$E_M = \frac{1}{2} \cdot \underbrace{(J_M + J_L)}_{\text{Kinetic energy}} \cdot \omega_M^2 - \underbrace{3 \cdot I_M^2 \cdot \left(\frac{R_M}{2}\right)}_{\text{Copper losses}} \cdot t_d - \underbrace{\frac{t_d \cdot \omega_M}{2} \cdot T_F}_{\text{Friction losses}}$$

With

$J_M$  = Rotor inertia [ $\text{kgm}^2$ ]

$J_L$  = Load inertia [ $\text{kgm}^2$ ]

$\omega_M$  = Motor speed before deceleration [rad/s]

$I_M$  = Motor current during deceleration [ $\text{A}_{\text{rms}}/\text{phase}$ ]

$R_M$  = Motor resistance [ $\Omega$ ] terminal to terminal

$t_d$  = Time to decelerate [s]

$T_F$  = Friction torque [Nm]

#### NOTICE

- A rotary axis may have in addition: gravitational potential energy (in case of non-direct drive, if the load is non horizontal), spring stored energy, etc.

#### 6.1.2 Linear motor case with gravitational potential energy

$$E_M = \frac{1}{2} \cdot \underbrace{(m_M + m_L)}_{\text{Kinetic energy}} \cdot v_M^2 + \underbrace{(m_M + m_L) \cdot g \cdot (h_{\text{initial}} - h_{\text{final}})}_{\text{Gravitational potential energy}} - \underbrace{3 \cdot I_M^2 \cdot \left(\frac{R_M}{2}\right)}_{\text{Copper losses}} \cdot t_d - \underbrace{\frac{t_d \cdot v_M}{2} \cdot F_F}_{\text{Friction losses}}$$

With

$m_M$  = Motor mass [kg] moving part of motor only

$m_L$  = Load mass [kg]

$v_M$  = Motor speed before deceleration [m/s]

$g$  = Gravitational acceleration [m/s<sup>2</sup>]  
 $h_{\text{initial}}$  = Initial load altitude [m]  
 $h_{\text{final}}$  = Final load altitude [m]  
 $I_M$  = Motor current during deceleration [A<sub>rms</sub>/phase]  
 $R_M$  = Motor resistance [ $\Omega$ ] terminal to terminal  
 $t_d$  = Time to decelerate [s]  
 $F_F$  = Friction force [N]

### NOTICE

- For a constant speed system (like a long stroke conveyor for example), all the terms of the above-mentioned equation have the same meaning except for:  
 $v_M$  = Motor speed (constant) during the travel [m/s]  
 $I_M$  = Motor current during travel at constant speed [A<sub>rms</sub>/phase]  
 $t_d$  = Time to travel [s]

## 6.2 Is a brake resistor needed?

If the following condition is true, then a brake resistance is needed. For a n axes system plugged on the same power supply (all negative  $E_M$  terms are set to zero in order to have the worst case).

$$\sum_{j=1}^n E_{Mj} > \frac{1}{2} \cdot C \cdot (U_{MAX}^2 - U_{Nom}^2)$$

*Maximal energy storable in the capacitors*

With       $E_M$  = Total energy of motor/load minus the system losses [J]  
 $C$  = Total capacitance seen from the bus [F] (refer to §6.5)  
 $U_{MAX}$  = Maximal allowed bus voltage [V] (refer to §6.5)  
 $U_{Nom}$  = Nominal bus voltage [V] (refer to §6.5)

## 6.3 How to determine the resistance value?

For an n axes system plugged on the same power supply:

$$R_{MAX} = \frac{U_{MAX}^2}{\sum_{j=1}^n U_B j \cdot I_M j \cdot \sqrt{3}}$$

With       $R_{MAX}$  = Brake resistance maximal value [ $\Omega$ ]  
 $U_{MAX}$  = Maximal allowed bus voltage [V]  
 $U_B$  = Motor back EMF less motor losses [V] (refer to §6.3.1 and §6.3.2)  
 $I_M$  = Deceleration current in motor [A<sub>rms</sub>/phase]

### 6.3.1 Torque motor case

$$U_B = \underbrace{K_u \cdot \omega_M}_{\text{Back EMF}} - \underbrace{I_M \cdot \left( \frac{R_M}{2} \right)}_{\text{Phase voltage}} \cdot \sqrt{3}$$

With  $K_u$  = Back EMF constant [V/(rad/s)] terminal to terminal

### 6.3.2 Linear motor case

$$U_B = \frac{K_u \cdot v_M}{\text{Back EMF}} - I_M \cdot \frac{R_M}{2} \cdot \sqrt{3}$$

*Phase voltage*

With  $K_u$  = Back EMF constant [V/(rad/s)] terminal to terminal

## 6.4 How to determine the resistance dissipated power?

For an n axes system plugged on the same power supply (all negative  $E_M$  are set to zero):

With  $P_{AV}$  = Average power to be dissipated by the brake resistance [W]

$U_{HYS}$  = Hysteresis point of power supply [V] (refer to [§6.5](#))

$t_{cycle}$  = Longest (time between two consecutive decelerations) of the n axis system [s]

$$P_{AV} = \frac{\sum_{j=1}^n E_{Mj} - \left( \frac{1}{2} \cdot C \cdot \left( U_{MAX}^2 - U_{HYS}^2 \right) \right)}{t_{cycle}}$$

When the time between two consecutive decelerations becomes very large, the average power is not a meaningful number. In this case, the peak power is the main concerned:

$$P_{PK} = \frac{V_{MAX}^2}{R_{REGEN}}$$

With  $P_{PK}$  = Peak power dissipated by the regenerative resistance [W]

$R_{REGEN}$  = Brake resistance value [ $\Omega$ ]

## 6.5 ACCURET+ specifications

	C	$U_{MAX}^{(1)}$	$R_{internal}$	$U_{Nom\ max}$	$U_{HYS}$
ACCURET+ 300	94 $\mu F$	390 V	-	340 V	370 V
ACCURET+ PS300	1044 $\mu F$	390 V	110 k $\Omega$	340 V	370 V

(1): UMAX = Absolute rating of Uz.

### NOTICE

- In the case of one power supply and n ACCURET+ controller, C is calculated as follows:

$$C [\mu F] = 1044 + n \cdot 94$$

## 7 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 listed on [www.etel.ch](http://www.etel.ch).

The technical hotline, based in ETEL S.A.'s headquarters, can be reached by:

- Phone: +41 (0)32 862 01 12.
- Fax: +41 (0)32 862 01 01.
- E-mail: [support@etel.ch](mailto:support@etel.ch).

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.