AccurET I/O board

User's Manual

Version C

ETEL

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Record of revisions:

Document revisions		
Version	**Date**	**Modification**
Ver A	28.03.12	First version
Ver B	14.10.16	Updated version: - Low voltage directive 2006/95EC replaced by 2014/35/EU and EMC Directive 2004/108EC replaced by 2014/30/EU - Minor changes
Ver C	26.11.19	Updated version: - Analog I/O frequency added (refer to §2.2.3 and §2.2.4)

Documentation concerning the AccurET I/O board:

• **User's Manual**	**AccurET I/O board principle**
• Operation & Software Manual	AccurET setup, use & programming manual

The AccurET I/O board has been successfully tested and evaluated to meet the UL 508C for US market.

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

1. Introduction

This document concerns the AccurET I/O board (also called I/O board in this document) used with ETEL's AccurET Modular position controller.
The purpose of this manual is to give details regarding the specifications, installation, interfacing and hardware items. The I/O board allows the user to add 8 opto-coupled digital inputs, 8 opto-coupled digital outputs, 4 differential analog inputs and 4 differential analog outputs to the AccurET position controller.

Remark: The I/O board can be mounted only in an AccurET having an optional board slot.
The updates between two successive versions are highlighted with a modification stroke in the margin of the manual.

1.1 Safety

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

- Never use the AccurET I/O board in operating conditions and for purposes other than those described in this manual.
- A competent and trained technician must install and operate the AccurET I/O board (and the position controller), in accordance with all specific regulations of the respective country concerning both safety and EMC aspects.
- The customer must provide at all time the appropriate protections against electrical hazard and moving parts of the connected system. Operating the I/O board (and the controller) will make the motor move.
- Before connecting or disconnecting the I/O board or the connector connected to it, turn off all the power supplies and wait 2 minutes to allow the internal DC bus capacitors to discharge.
- Troubleshooting and servicing are permitted only for ETEL's technicians and agreed distributors.
- Operating the AccurET I/O board (and the position controller) will make the motor move. **Keep away from all moving parts to avoid injuries!**
- The safety symbols placed on the I/O board (and the controller) or written in the manuals (page 5) must be respected.
- If the AccurET I/O board, associated with a position controller, is integrated into a machine, the manufacturer of this machine must establish that it fulfills the 2014/30/EU directive on EMC before operating the controller.

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

Remark: The I/O board and controller associated to its motor connector complies with the 2014/30/EU directive on EMC and the 2014/35/EU low voltage directive.

1.2 Transport and storage conditions

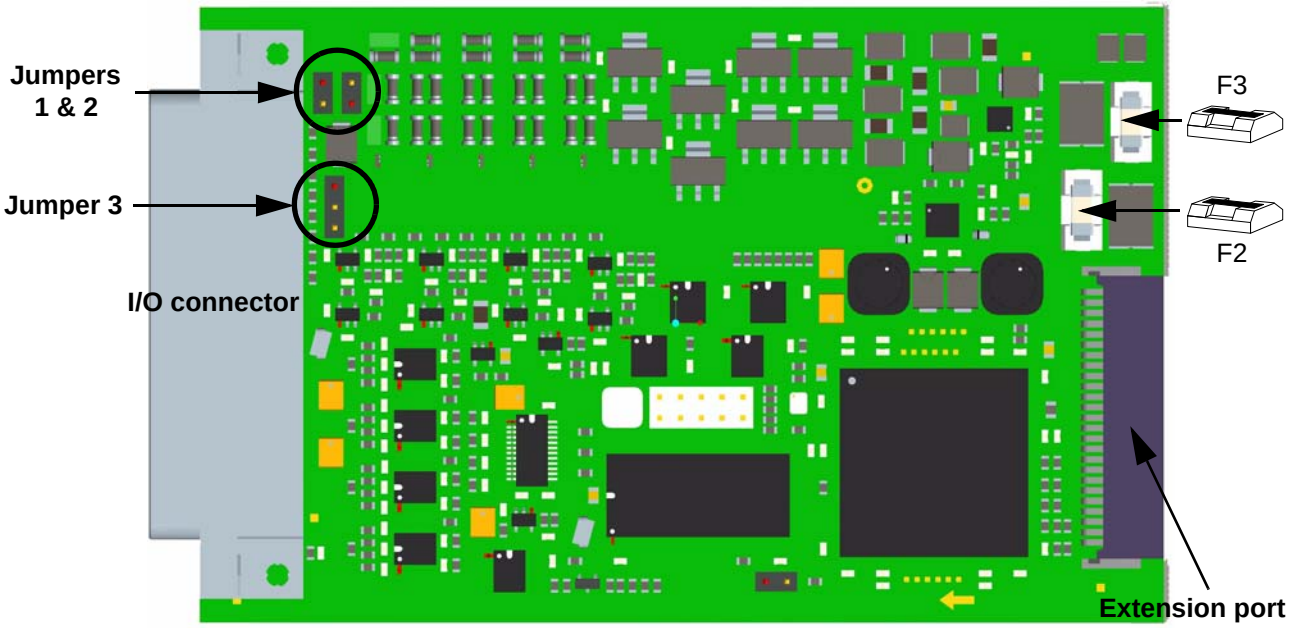
During the transport and the storage, the I/O board must remain inside their original packaging which complies with the ESD standard. The transport conditions must respect the class 2K3 of the IEC 60721-3-2 standard (temperature between -25°C (-13°F) and +70°C (+158+C), and humidity < 95% without condensation)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

2. Characteristics

2.1 Hardware characteristics

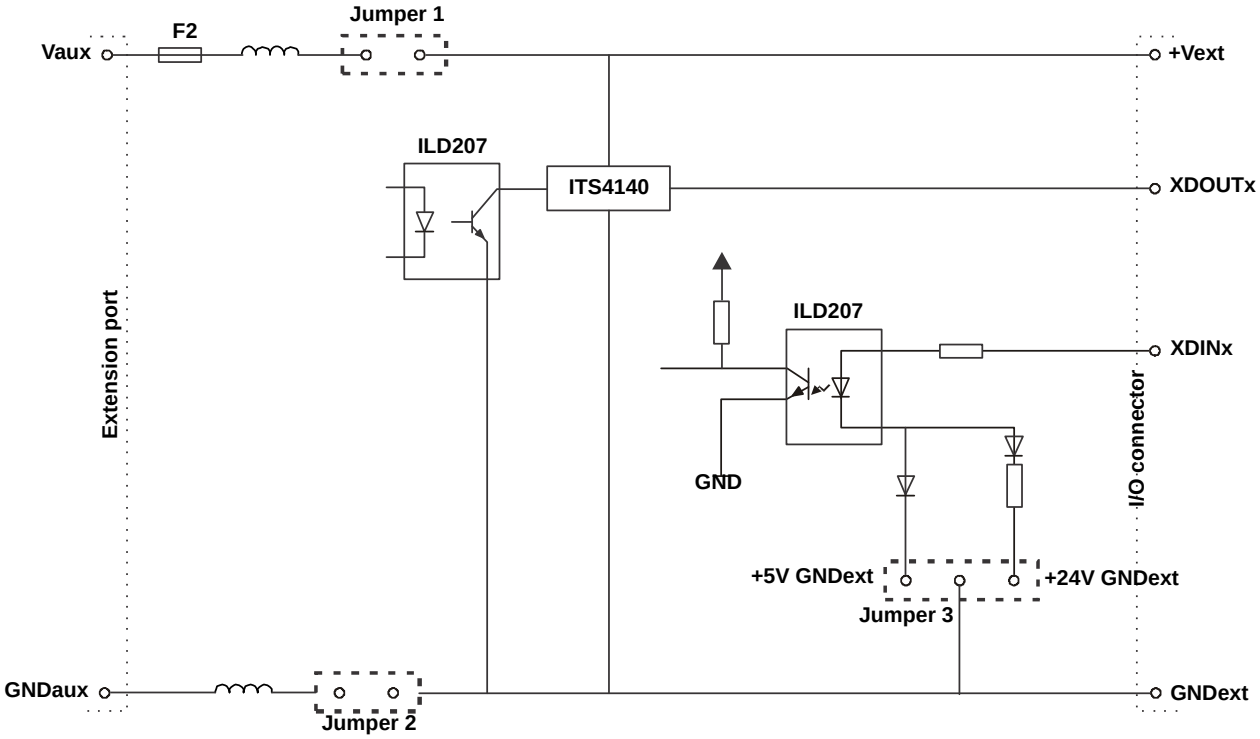
	**The board must be handled in an ESD protected environment only.**

The **I/O connector** (D-Sub, 37 poles, female connector) allows the user to connect additional inputs/outputs to the position controller front panel (refer to §2.2.5 for more information about the pin assignment). The **extension port** connects the board to the position controller (it is not described in this manual because this connection is ETEL's property).

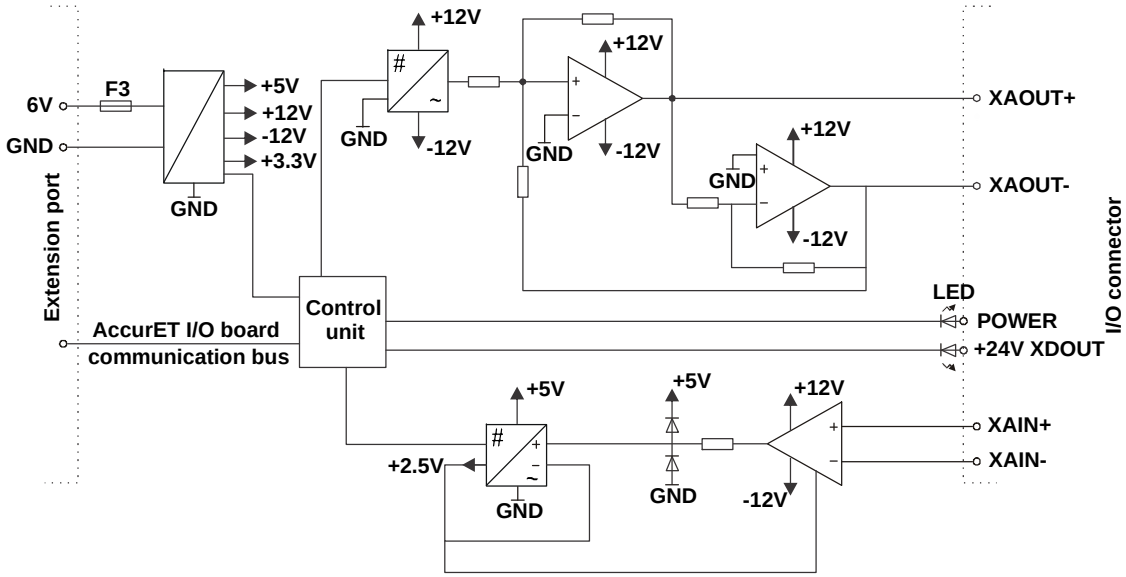


2.1.1 Block diagram

- **For XDIN and XDOUT**



- **For XAIN and XAOUT**

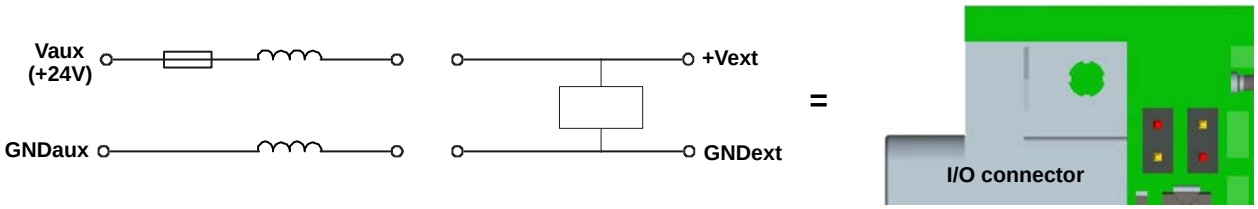


2.1.2 Jumpers description

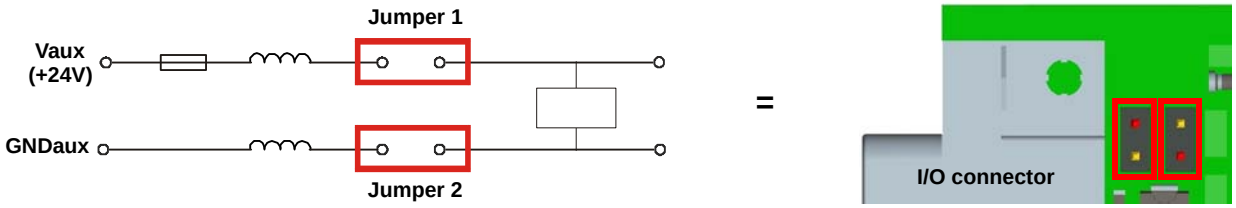
2.1.2.1 Jumpers 1 & 2

The jumpers 1 and 2 (refer to §2.1) allow the user to select where the digital input/output voltage comes from:

- When the jumpers are not present **(configuration by default)**, the input voltage comes from an external source (+Vext):



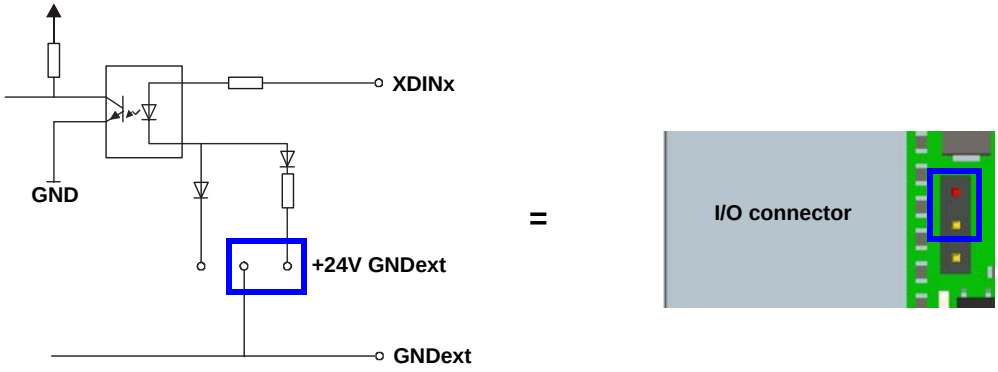
- When the jumpers are in position, the input voltage comes from the +24V of the AccurET controller:



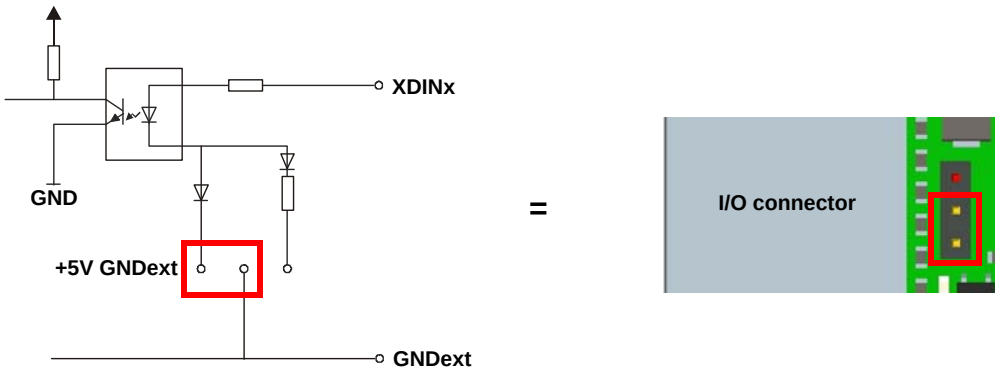
2.1.2.2 Jumper 3

There are two ground references, +5V GNDext or +24V GNDext, depending on the voltage applied on the digital input (XDIN). The jumper 3 (refer to §2.1) allows the user to select one of the two:

- When the jumper is as mentioned below **(configuration by default)**, the +24V GNDext is selected allowing the use of +24V level on XDIN:



- When the jumper is as mentioned below, the +5V GNDext is selected allowing the use of +5V level on XDIN:



2.2 Electrical interface

This chapter describes the pin assignment of the connectors.

	**The inputs/outputs cable must be insulated (no contact) from the power and mains lines.** **The inputs and outputs of these connectors are not galvanically insulated from the GND.** **The inputs and outputs must be connected to an Extra Low Voltage circuit only (SELV).**
	**The board must be handled in an ESD protected environment only.**

Remark: The inputs/outputs cable connected to the AccurET I/O board must be shielded (refer to §2.4).

2.2.1 Digital inputs

There are 8 opto-coupled digital inputs on the I/O board. The monitoring M55 of the corresponding position controller allows the user to monitor the state of the 8 digital inputs (refer to the **'Operation and Software Manual'** for more information about the monitorings).

Depending on the position of jumper 3 (refer to §2.1.2.2), the +5V GNDext or the +24V GNDext is selected.

When used with +5V GNDext:

- The digital inputs switch to '1' (ON state) when a voltage ranging between +3.5VDC and +8VDC is applied between the pin of the corresponding input (XDIN) and +5V GNDext.
- The digital inputs switch to '0' (OFF state) when a zero voltage (or a voltage ranging between -5VDC and +1VDC) is applied between the pin of the corresponding input (XDIN) and +5V GNDext

When used with +24V GNDext:

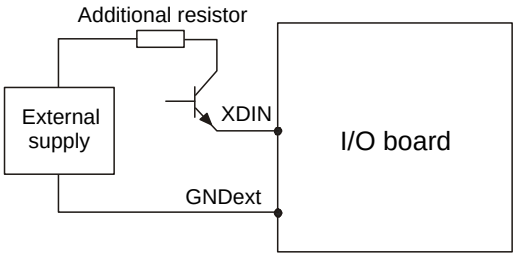
- The digital inputs switch to '1' (ON state) when a voltage ranging between +12VDC and +28VDC is applied between the pin of the corresponding input (XDIN) and +24V GNDext.
- The digital inputs switch to '0' (OFF state) when a zero voltage (or a voltage ranging between -5VDC and +2.5VDC) is applied between the pin of the corresponding input (XDIN) and +24V GNDext.

Characteristics	Min. value	Max. value
V_{XDIN} - $V_{+24V\ GNDext}$ for 'ON' state	+12VDC	+28VDC
V_{XDIN} - $V_{+5V\ GNDext}$ for 'ON' state	+3.5VDC	+8VDC
I_{XDIN} for 'ON' state	4mA(1)	8mA(2)
V_{XDIN} - $V_{+24V\ GNDext}$ for 'OFF' state	-5VDC	+2.5VDC
V_{XDIN} - $V_{+5V\ GNDext}$ for 'OFF' state	-5VDC	+1VDC

Characteristics	Min. value	Max. value
I_{XDIN} for 'OFF' state	0mA	0.2mA(3)
Commutation time	10µs	60µs

(1): Minimum current needed to drive a digital input
(2): Maximum current allowed by a digital input
(3): Maximum current certifying that the input is OFF

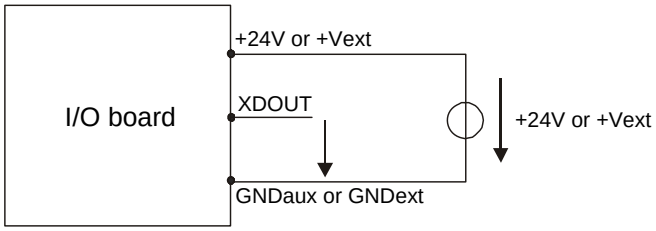
Remark: The above-mentioned commutation time takes only the hardware into account.



Caution: The DC voltage difference between GNDext and GND must not exceed 50VDC.

2.2.2 Digital outputs

There are 8 opto-coupled digital outputs on the I/O board. All the digital outputs together can deliver maximum 560mA. The common parameter C6 allows the user to activate or deactivate the digital outputs of the I/O board (refer to the corresponding **'Operation and Software Manual'** for more information about the parameters).
To use a digital output, a voltage should previously be supplied to the external auxiliary supply (+24V or +Vext). If +Vext is selected (depending on jumper 1 & 2), this voltage should range between +5VDC and +28VDC.



Characteristics	Min. value	Max. value
V_{ext}	+5VDC	+28VDC
I_{max} per XDOUT	-	70mA
Commutation time	10µs	200µs

2.2.3 Analog inputs

There are 4 differential analog inputs (16bits) on the I/O board. To use the analog input, a voltage ranging from +10VDC to -10VDC must be applied between the corresponding XAIN+ and XAIN-. The offset and amplitude errors of the input signal can be removed with the common parameters C17 and CF18. The monitoring M56 allow the user to read the status of the analog inputs of the optional board. (refer to the corresponding **'Operation and Software Manual'** for more information about the monitorings).

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

The analog inputs are sampled once every PLTI, without oversampling. It means that the sampling frequency is 20kHz.

2.2.4 Analog outputs

Do not connect XAOUT+ or XAOUT- to the GND!

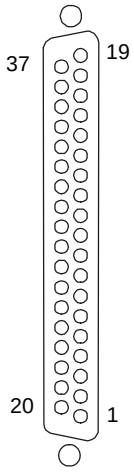
There are 4 differential analog outputs on the I/O board. The common parameter C7 allows the user to allocate a defined value (defined voltage) to the analog outputs (XAOUT1 to XAOUT4) of the optional board. The digital analog converter (DAC) may induce a small offset and amplitude error. These errors can be removed with the common parameters C27 and CF28. The monitorings M173 allows the user to read the value of the 4 analog outputs by taking the common parameters C27 and CF28 into account (refer to the corresponding **'Operation and Software Manual'** for more information).
As the common parameter is referenced to the GND, +10VDC corresponds to 32767 increments and -10VDC to -32768 increments. Each analog output can sink or source maximum 5mA.

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

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

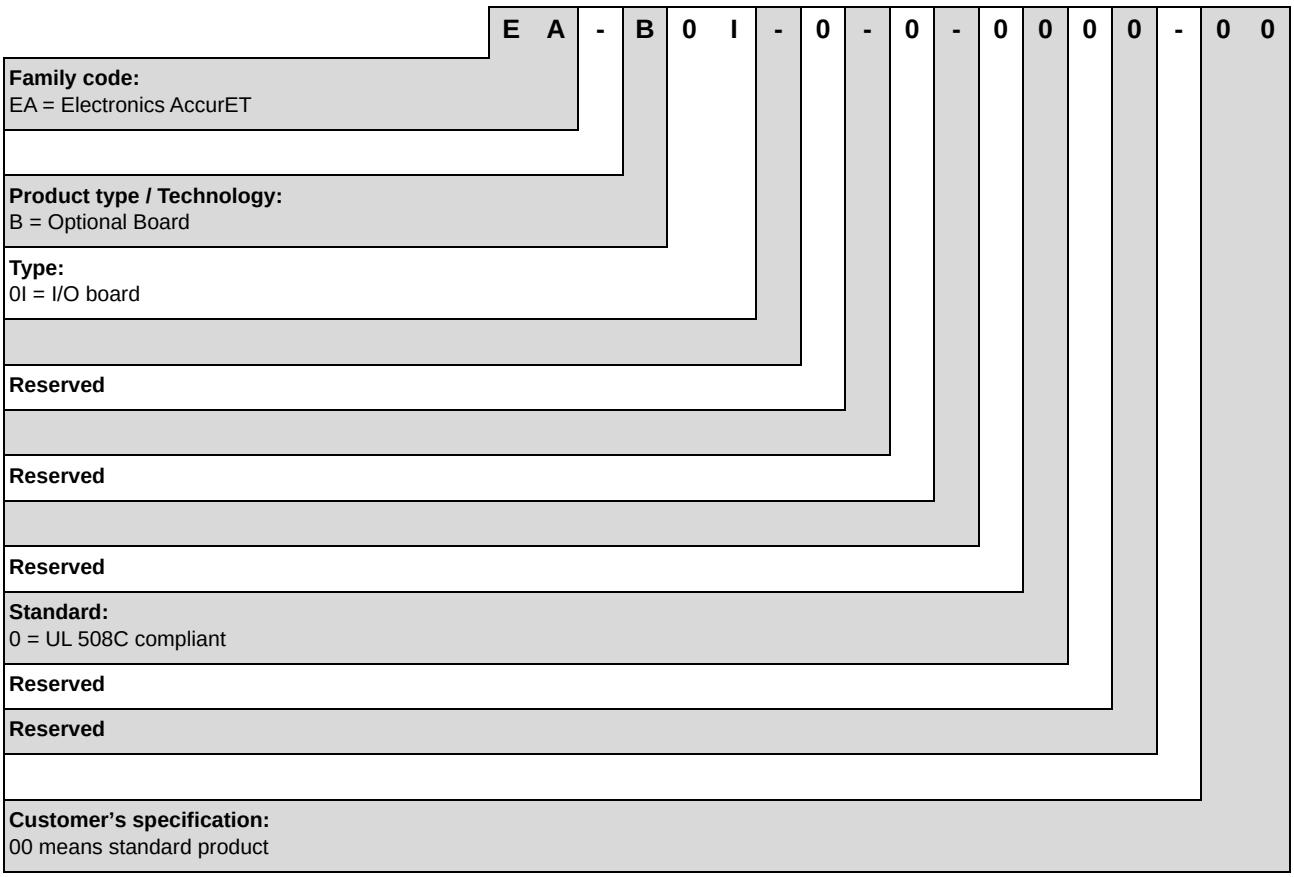
Remark: Please preferably use the connection between XAOUT+ and XAOUT-. The signal between the GND and XAOUT+ or XAOUT- might be disrupted and consequently have a lower resolution.

2.2.5 Pin assignment

D-Sub, 37 pins, female			
I/O CONNECTOR	Pin #	Signal	Function
	1	GNDext or GNDaux	External supply input (0V) for the digital outputs depending on jumper 1 & 2. Refer to §2.1.2.1
	2	GND	Position controller internal supply output (0V)
	3	XAIN1-	Differential analog input 1 -
	4	XAIN2-	Differential analog input 2 -
	5	XAIN3-	Differential analog input 3 -
	6	XAIN4-	Differential analog input 4 -
	7	XAOUT1-	Differential analog output 1 -. Do not connect XAOUT1- to the GND!
	8	XAOUT2-	Differential analog output 2 -. Do not connect XAOUT2- to the GND!
	9	XAOUT3-	Differential analog output 3 -. Do not connect XAOUT3- to the GND!
	10	XAOUT4-	Differential analog output 4 -. Do not connect XAOUT4- to the GND!
	11	XDOUT1	Digital output 1
	12	XDOUT2	Digital output 2
	13	XDOUT3	Digital output 3
	14	XDOUT4	Digital output 4
	15	XDOUT5	Digital output 5
	16	XDOUT6	Digital output 6
	17	XDOUT7	Digital output 7
	18	XDOUT8	Digital output 8
	19	+Vext or +24V	External supply input for digital outputs depending on jumper 1 & 2. Refer to §2.1.2.1
	20	GNDext or GNDaux	External supply input (0V) for the digital outputs depending on jumper 1 & 2. Refer to §2.1.2.1
	21	XAIN1+	Differential analog input 1 +
	22	XAIN2+	Differential analog input 2 +
	23	XAIN3+	Differential analog input 3 +
	24	XAIN4+	Differential analog input 4 +
	25	XAOUT1+	Differential analog output 1 +. Do not connect XAOUT1+ to the GND!
	26	XAOUT2+	Differential analog output 2 +. Do not connect XAOUT2+ to the GND!
	27	XAOUT3+	Differential analog output 3 +. Do not connect XAOUT3+ to the GND!
	28	XAOUT4+	Differential analog output 4 +. Do not connect XAOUT4+ to the GND!
	29	XDIN1	Digital input 1
	30	XDIN2	Digital input 2
	31	XDIN3	Digital input 3
	32	XDIN4	Digital input 4
	33	XDIN5	Digital input 5
	34	XDIN6	Digital input 6
	35	XDIN7	Digital input 7
	36	XDIN8	Digital input 8
	37	+Vext or +24V	External supply input for digital outputs depending on jumper 1 & 2. Refer to §2.1.2.1

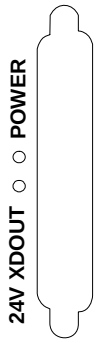
2.2.6 Ordering information

Here is the ordering information describing the meaning of each digit present on the label of the I/O board:



2.3 LEDs meaning

The LEDs present on the I/O board front panel have the following meanings:

LED	Power	24V XDOUT	Meaning
	Off	X(1)	The I/O board is not supplied by the AccurET (AccurET switched off or fuse broken)
	Red	X(1)	The I/O board is faulty (or during boot up (about 1sec))
	Green	X(1)	The I/O board is operating normally
	X(1)	Off	The +24V for the digital outputs is not present
	X(1)	Green	The +24V for the digital outputs is present

X(1): X means any state

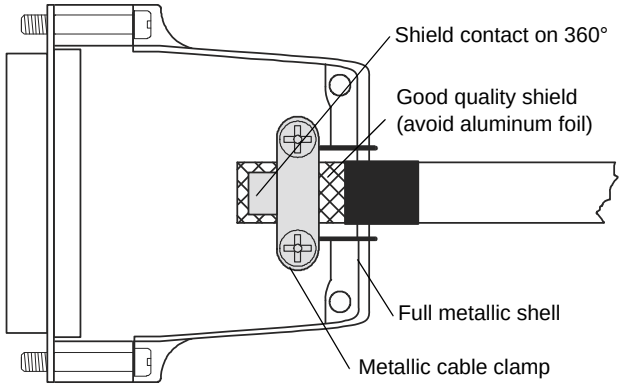
2.4 Cable shielding

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

Remark: All the cables connected to the position controller must have copper conductors only and an insulation standing at least 75°C.

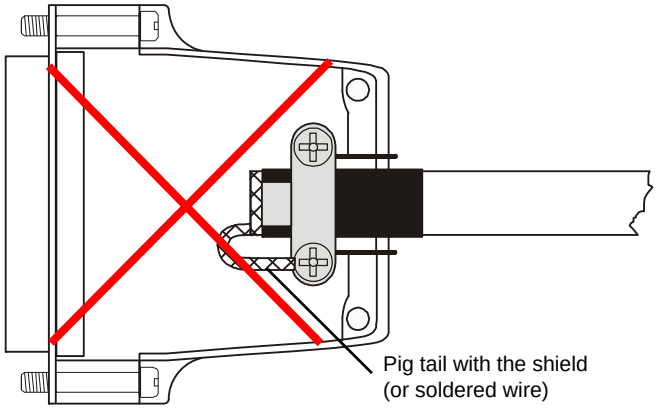
Here is an example of good shielding connection:

Good shielding connection

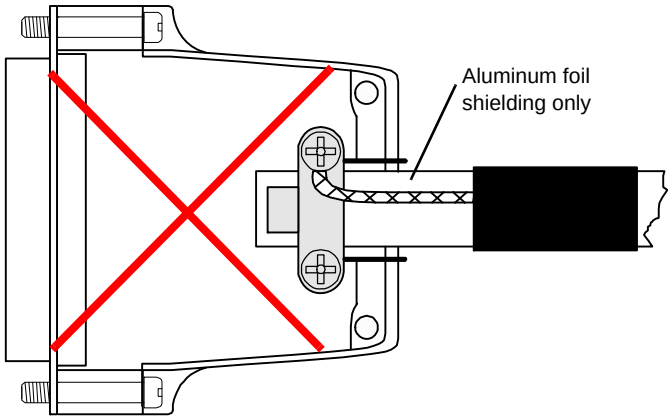


Here are two examples of bad shielding connections:

Bad shielding connection



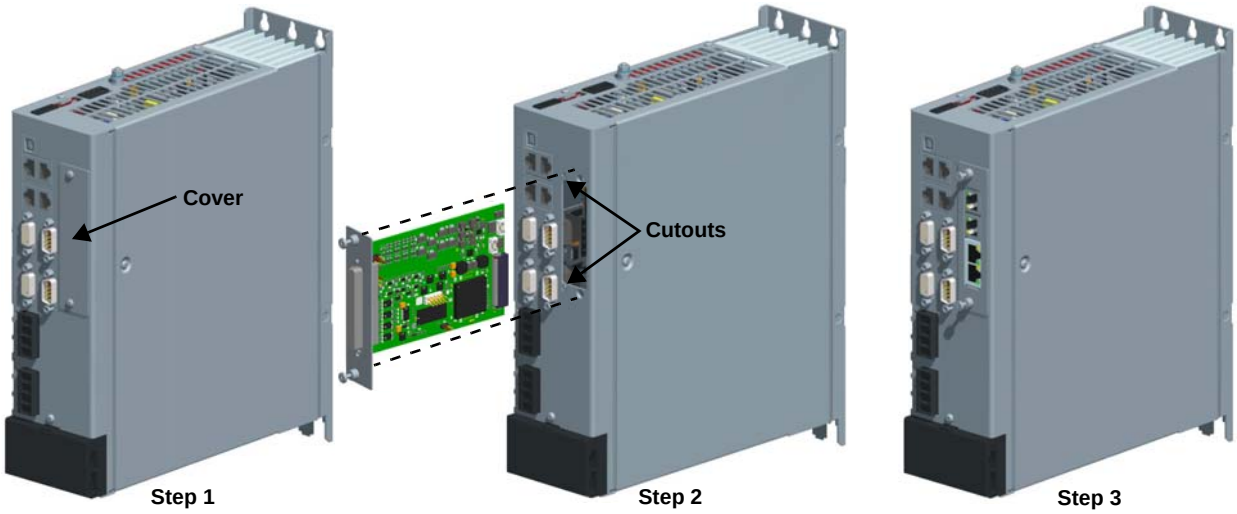
Bad shielding connection



3. General instruction for installation

To install an I/O board inside the position controller, the user must use the following procedure:

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



Remark: Follow in the reverse order the opposite actions of the above-mentioned steps to remove the I/O board from the controller.
Refer to the ordering information corresponding to your controller to know which one can accept an I/O board.

4. Fuses replacement procedure

It is necessary to find the reason of a failed fuse and to solve the problem before replacing it. **The failed fuses have to be replaced by the same type of fuse, as listed in §4.2.** The fuse location is mentioned in §2.1.

4.1 Detection of a failed fuse

Fuse	May be failed if the symptoms are...
F2	**If the jumpers 1 and 2 are present, there is no voltage present on the XDOUT and the +24V XDOUT LED is off. If there is no jumper (1 and 2), nothing is visible**
F3	**Both LEDs are switched off (M76 = 0 after switch on)**

4.2 Fuses descriptions

The following tables give the function of each fuse in order to help the user to resolve the problem of a failed fuse.

Fuse	Functions and troubleshooting	Value	Manufacturer & type
F2	Protects the power input voltage (Vaux).	125VDC 1A	Littlefuse, NANO2 fast-acting
F3	Protects the DC/DC. If this fuse is broken, the user must contact its ETEL's representative.	125VDC 1A	Littlefuse, NANO2 fast-acting

Remark: **It is strictly forbidden to use another fuse than those mentioned above. These fuses can be ordered through a fuse kit. Contact your ETEL's representative to order it.**

5. Service and support

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

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ETEL S.A. **Zone industrielle** **CH-2112 Môtiers** **Phone: +41 (0)32 862 01 00** **E-mail: etel@etel.ch** **http://www.etel.ch**	**HEIDENHAIN nv/sa** Pamelse Klei 47 1760 Roosdaal Phone: +32 54 34 31 58 E-mail: sales@heidenhain.be	**DR. JOHANNES HEIDENHAIN (CHINA) Co., Ltd** No. 6, Tian Wei San Jie, Area A, Beijing Tianzhu Airport, Industrial Zone Shunyi District, Beijing 101312 Phone: +86 400 619 6060 E-mail: sales@heidenhain.com.cn
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The technical hotline, based in ETEL's headquarters, can be reached:

- by phone: +41 (0)32 862 01 12.
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