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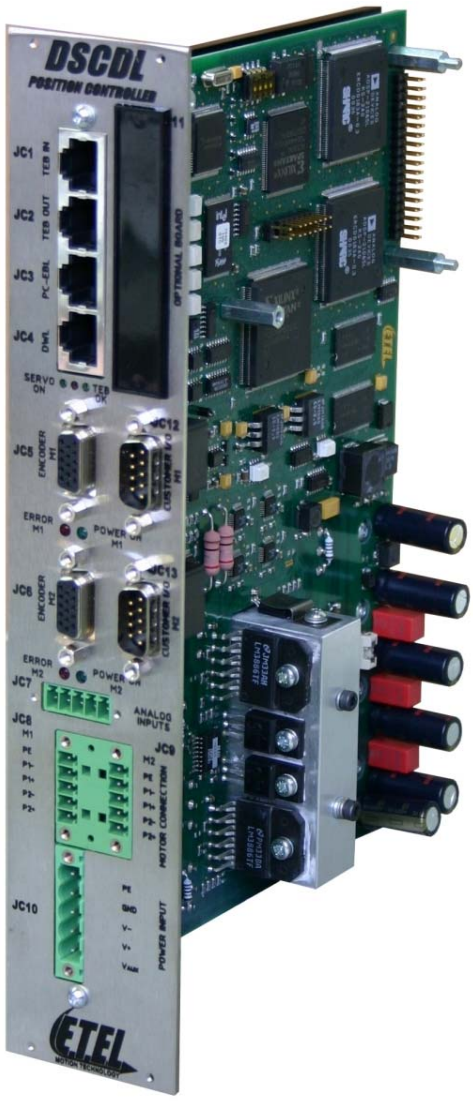
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DSCDL 904 ver. D



ETEL MOTION TECHNOLOGY

Two axes position controller



DSCDL Hardware Manual

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Record of revisions, document # DSCDL 904 x

Document revisions		
Issue (x)	**Date**	**Modified**
Ver A	14.10.02	First version
Ver B	25.11.03	Updated version - New hardware version - Additional safety precautions in accordance with the UL & CE standards
Ver C	16.04.04	Updated version - New hardware version (DSCDL3xx-xxx) - EnDat encoder
Ver D	20.12.05	Updated version - Additional detailed descriptions

Documentation concerning the DSCDL:

- **DSCDL Hardware Manual** **(Specifications & electrical interfaces)** **# DSCDL 904 D**
- Operation & Software Manual (DSCDL's setup, use and programming) # DSC2P 903 x
- DSO-RAC2 Hardware Manual (DSO-RAC2 principle) # DSORAC2 904 x
- EBL2 Communication Manual (EBL2 principle, message mapping) # EBL2 908 x
- DSCDL Service Manual (Maintenance of the fuses) # DSCDL 905 x

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1. Introduction

This document concerns a two axes digital position controller of ETEL's DSCxx family: the **DSCDL** also called 'controller' in this document.
The purpose of this manual is to give details regarding the specifications, installation, interfacing and hardware items. All details for proper connections (power supply, motor, encoder connection, etc...) are provided herein. Detailed information concerning the programming of the controller is provided in the corresponding **'Operation & Software Manual'**.

The information given in this manual is valid for type # D S C D L 3 x x - x x x C and later.

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

1.1 Safety

Please, read all the safety precautions listed in this manual before handling the DSCDL:

- Never use the DSCDL for purposes other than those described in this manual.
- A competent and trained technician must install and operate the DSCDL, in accordance with all specific regulations of the respective country concerning both safety and EMC aspects.
- Troubleshooting and servicing are permitted only by ETEL's technicians and agreed distributors.
- Operating the DSCDL will make the motor move. **Keep away from all moving parts to avoid injuries!**
- The safety symbols placed on the DSCDL or written in the manuals must be respected.
- If the DSCDL is integrated into a machine, the manufacturer of this machine must establish that it fulfils the 89/336/EEC directive on EMC before operating the controller.



Caution: Signals a danger for the DSCDL. Can be destructive for the material.
A **danger** for the operator can result from this.



Caution: Indicates electrostatic discharges (ESD), dangerous for the DSCDL.
The components must be handled in an ESD protected environment only.

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1.2 DSCDL presentation

1.2.1 Working principle

The DSCDL is a digital position controller. It has been designed for direct drive applications. It includes on a single board, the control circuits, the power stage and all the necessary interfaces for the communication, the encoders and the inputs/outputs for **two** motors.

1.2.2 Applications

The DSCDL can drive two single or/and two-phase motors. The DSCDL can drive brushless and DC motors. They must also be implemented with analog (incremental or absolute (EnDat 2.1)) or TTL encoders available on the market. It is also possible to drive stepper motors in open loop (no need of encoder in this case) with firmware from version 1.06A.

1.2.3 General operating conditions

The DSCDL is designed to operate in a non-aggressive and clean environment, with a humidity rate ranging between 10% and 85%, an altitude < 2000m (6562 ft), and a temperature ranging between + 15°C (59°F) and + 30°C (86°F). The DSCDL must be connected to an electrical network of overvoltage category 2 (refer to EN 50178 and UL 804 standards for more information). The electronics must be in an enclosure respecting a pollution degree of 2 (refer to UL 508C and EN 50178 standards for more information). The DSCDL is 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, operation and maintenance of any nuclear facility.

1.2.4 Transport and storage conditions

During the transport and the storage, the controller must remain inside its original packaging. The transport conditions must respect the class 2K3 of the IEC 60721-3-2 standard (temperature between -25°C and +70°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 and +45°C, and humidity between 5 and 85% without condensation).

1.2.5 Interfaces possibilities

Motor and its position encoder
To control the position (in closed loop) of a rotary and/or linear motor, the DSCDL needs a signal coming from an analog (incremental or absolute (EnDat 2.1)) or a TTL encoder linked to this or these motor(s). It is also possible to drive stepper motors in open loop (no need of encoder in this case).

Communication
The user can set the DSCDL with a PC (Win 9x/2000/NT/XP) using the ETEL Tools (ETT) software through the ETEL-Bus-Lite2 (RS232 / RS422) communication port. Refer to the **'EBL2 Communication Manual'** for more information.
The DSCDL also includes ETEL's Turbo-ETEL-Bus (TEB) which is a high speed field bus based on an Ethernet 100 Mbps chip. It includes all features to interpolate complex movements with several synchronized DSCDLs, if ETEL's DSMAX motion controller is installed in a PC and linked to the TEB. If ETEL Tools is installed on the same PC than the DSMAX (or DSTEB) board, all the DSCDLs can be set through the TEB. The user can 'daisy chain' up to 31 nodes on the TEB (15 DSCDLs (30 axes) and one DSMAX (or DSTEB) board).

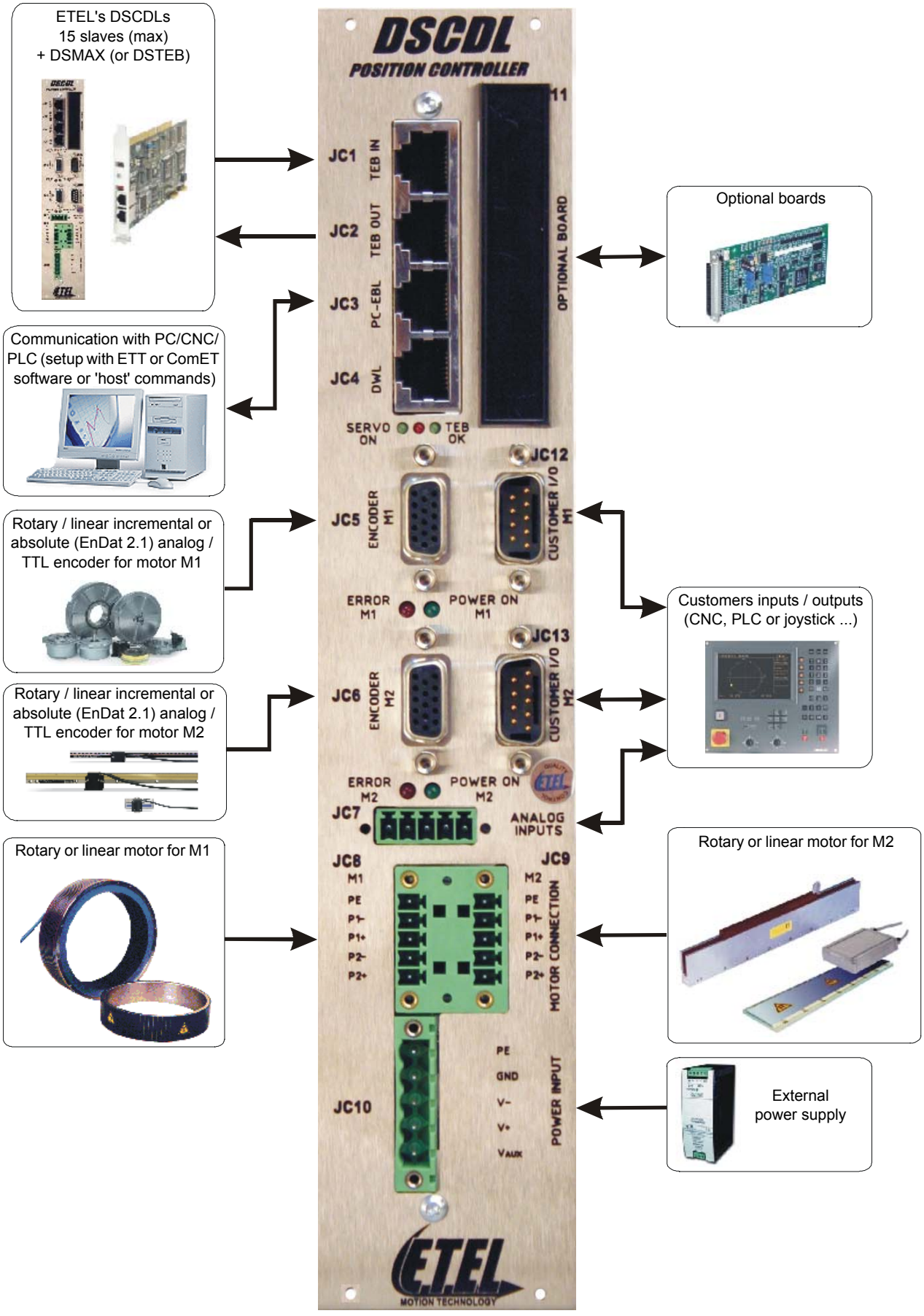
Caution: **The TEB is not compatible with Ethernet** boards available on the market. Therefore, do not connect the TEB on the Ethernet port of your PC.

Inputs / outputs
The customer's inputs / outputs are digital signals coming from a CNC machine-tool, a PLC or a joystick for example (refer to the connection diagram next page).

The electrical interface details are given in §3.

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Connection diagram:



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2. Models characteristics

Two models of DSCDL are available, according to the needs:

1. **Rack format with plate heat sink**
2. **Rack format with extruded heat sink**

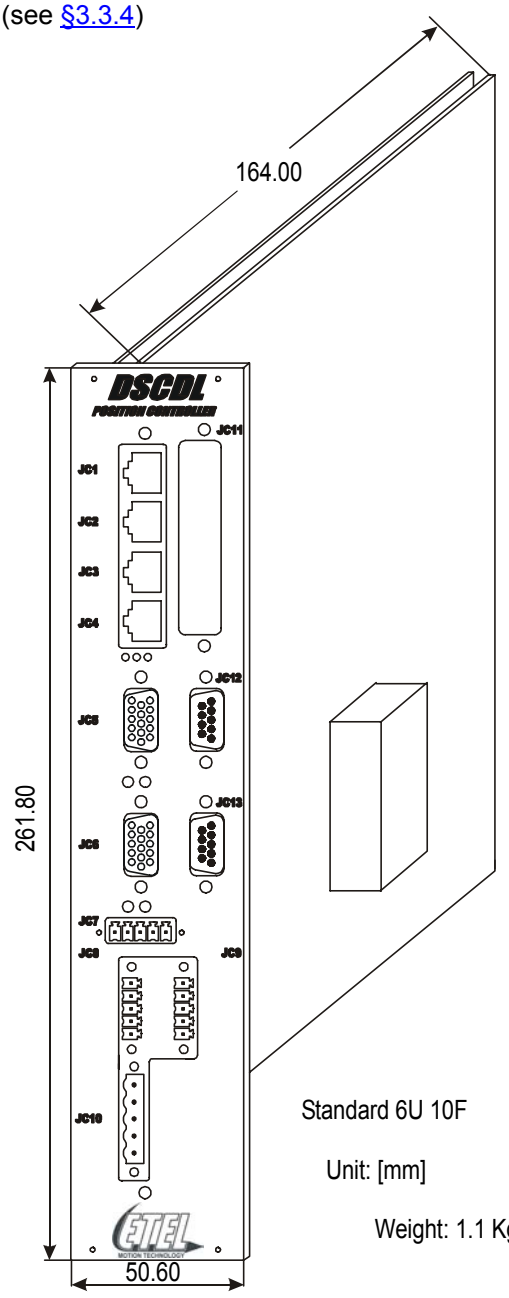
These 2 models are dedicated to be mounted inside a standard 6U rack case. They do not include any power supply board and need to be powered through their DC power connector (JC10) by an external power supply.

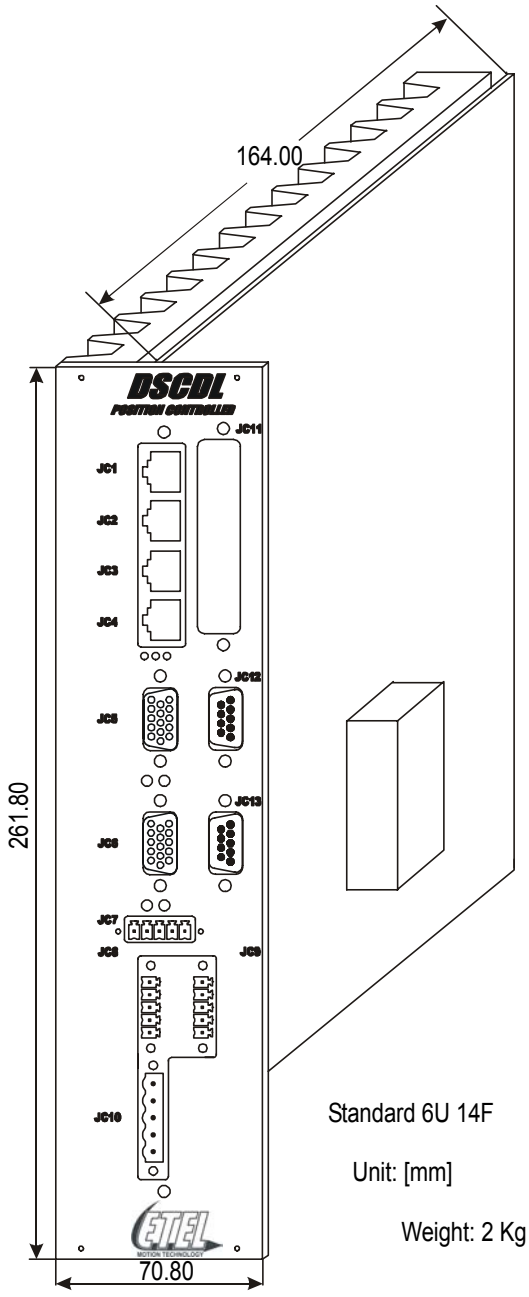
There are two different sizes of DSCDL rack format: the DSCDL3x**1**-xxx (10F wide) and the DSCDL3x**2**-xxx (14F wide).

2.1 Outline and dimensions

Refer to the following chapters for details about the connectors:

JC1 (see §3.3.1)
JC2 (see §3.3.2)
JC3 (see §3.3.3)
JC4 (see §3.3.4)
JC5 (see §3.1.1)
JC6 (see §3.1.1)
JC7 (see §3.2.2)
JC8 (see §3.4.1)
JC9 (see §3.4.1)
JC10 (see §3.5.1)
JC11 (see §3.6.1)
JC12 (see §3.2.1)
JC13 (see §3.2.1)



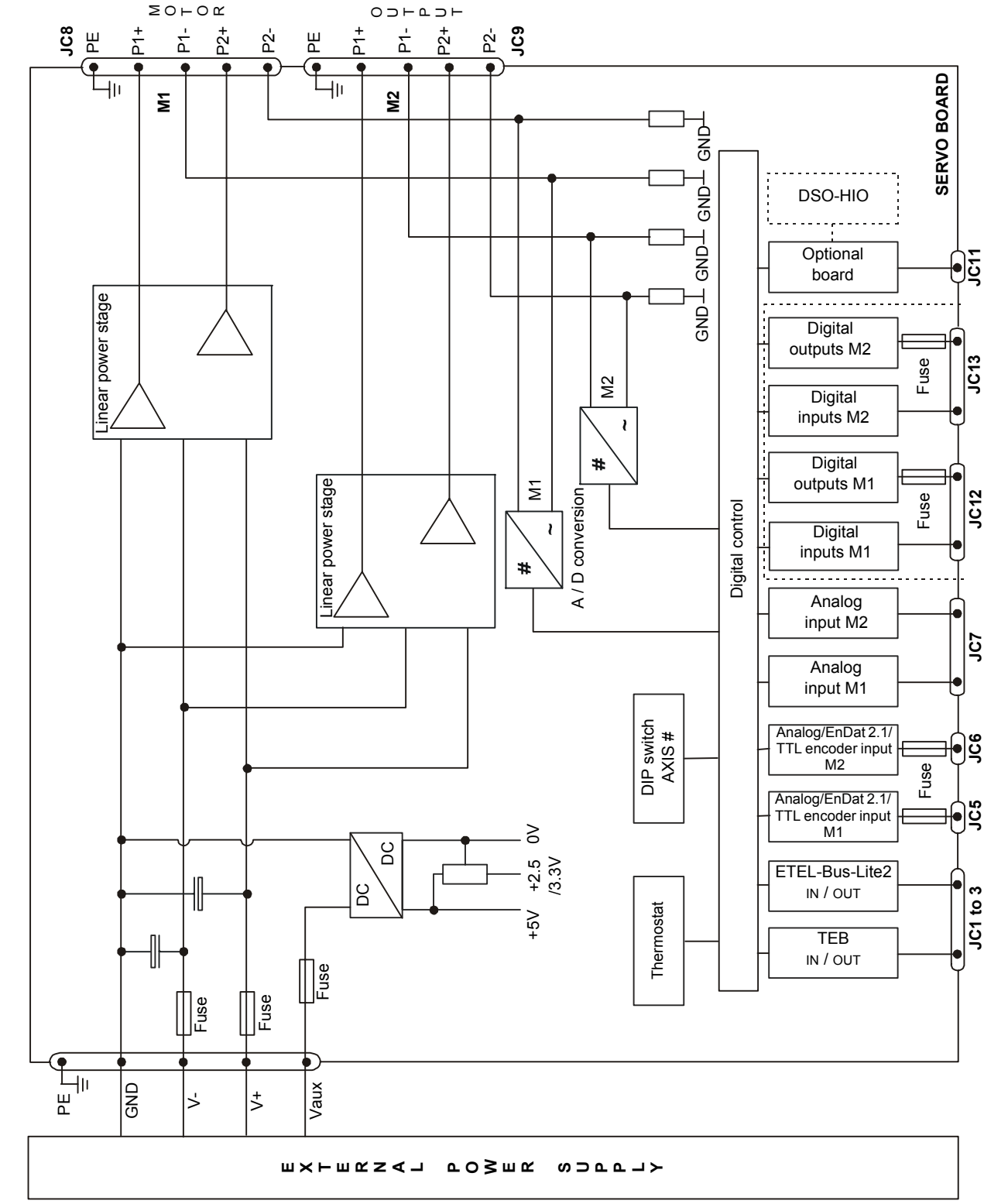


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2.2 Block schematics

In the DSCDL rack format, all parts are on a single board: the servo board. They need to be powered by an external power supply. This power supply must meet all the specifications written in §2.3.

On the servo board, the power part and the control part are not galvanically separated. The inputs and outputs are insulated from the control part by opto-couplers.



Remark: M1 and M2 represent the motor 1 and the motor 2 respectively.

Caution: The GND (marked 0V) is internally connected to the DSCDL front panel which is connected to the ground (PE).

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2.3 Ratings

There is one type of 10F wide rack format (the DSCDL3**31**-xxx) and one type of 14F wide rack format (the DSCDL3**32**-xxx).

All the specifications are given for an ambient temperature ranging from +15°C (59°F) to +30°C (86°F) and with an air flow of 2 m/s (400 LFM) inside the rack case:

Remark: The values given in the following table are valid for each motor.

DSCDL POWER FEATURES			
Characteristics		**DSCDL331-13x**	**DSCDL332-13x**
Output to the motor (per motor)	Voltage	±36VDC	
	Current range on product label	1.2 Arms / 2.8 Arms (1s)	2.4 Arms / 3.6 Arms (1s)
	One-phase motor Max. full load current	1.5(1) A (1.06 Arms)	2.3(1) A (1.62 Arms)
	One-phase motor Max overload current during 2 seconds	4(1) A (2.82 Arms)	5(1) A (3.53 Arms)
	Two-phase motor Max. full load current	1.7(1) A (1.2 Arms)	3.5(1) A (2.47 Arms)
	Two-phase motor Max overload current during 2 seconds	4(1) A (2.82 Arms)	5(1) A (3.53 Arms)
Power supply input	DC voltage	±36VDC	
	Max. DC current (at ±36VDC)	5 A(2)	10 A(2)
Auxiliary supply input	DC voltage	+15VDC to +36VDC	
	Max. current at 15VDC	1.5 A(2)	
	Max. current at 36VDC	750 mA(2)	
Maximum current measurable by the controller		6.25 A	6.25 A

(1): Continuous current can be reached only with forced air cooling (external fan necessary: refer to §2.4)
(2): With optional board mounted on the DSCDL, no external device connected to the I/O. The current can change depending on the type(s) of encoder(s) used.

Remark: The values given in the above-mentioned table are given for a sinusoidal output current with a frequency higher than 0.5 Hz. The losses induced by a AC current are shared between the transistors. A DC current heat up only some of the power elements and can induce their breakdown after 10 minutes if the current is near the maximum full load.

DSCDL CONTROL FEATURES		
General	Motion profile and command management sampling time	500 µs
	Current loop sampling time	13.89 µs (72 KHz)
	Position loop sampling time	55.55 µs (18 KHz)
	Motion profiles	Trapezoidal / S-curve / Sine / look-up table / interpolated (DSMAX)
	32 bits floating point DSP	Dual SHARC Digital Signal Processor
Standard interfaces	ETEL-BUS-LITE 2 host (PC) communication	RS232 or RS422 / 115'200 bps
	Turbo-ETEL-Bus multi-axis communication	100 Mbps (based on Ethernet components)
Position encoders interfaces	EnDat 2.1 compatible	RS485
	Analog 1 Vptp	Max. 400KHz in. / up to 32768 (x4) interpolation factor
	TTL encoder possible	Max 400KHz (period frequency)
	Encoder limit switch (EHO + ELS)	TTL signal

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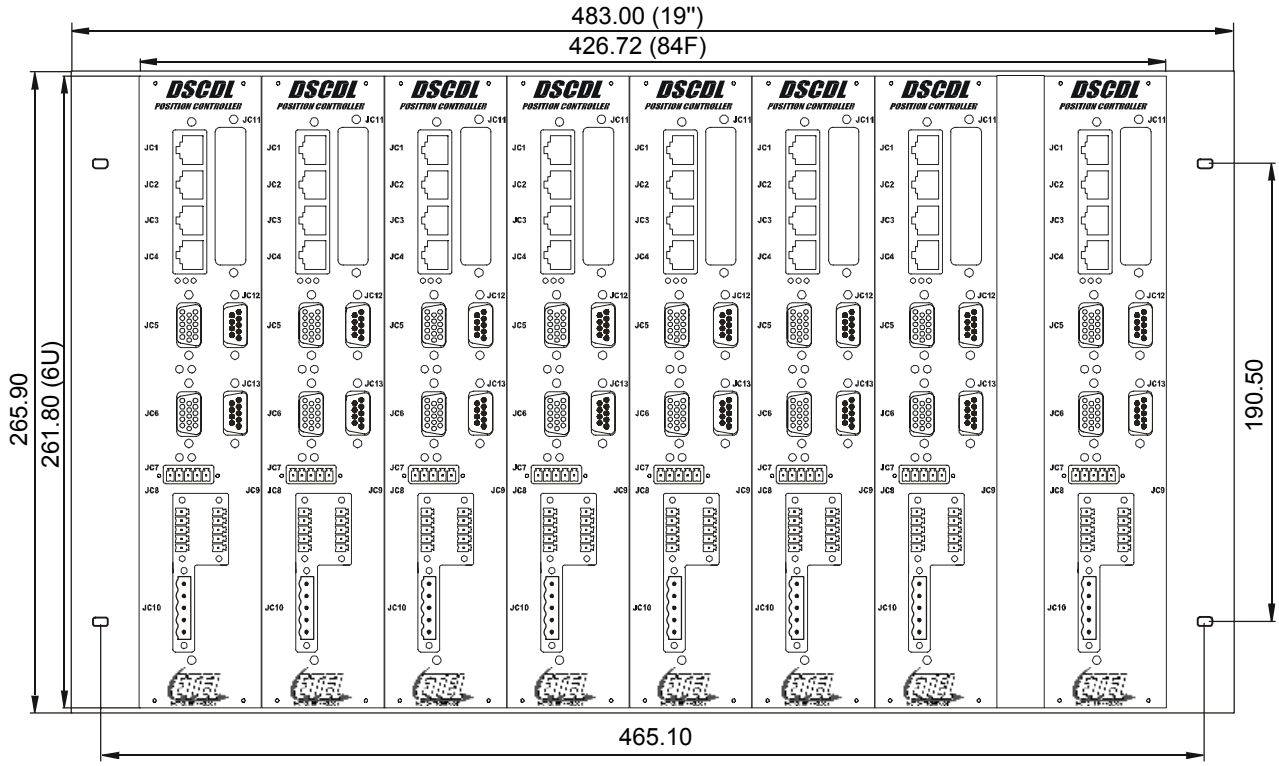
DSCDL CONTROL FEATURES		
User's inputs / outputs	Digital input, insulated	4 per motor (+8 with DSO-HIO optional board but shared between both motors)
	Digital output. insulated	2 per motor (+8 with DSO-HIO optional board but shared between both motors)
	Analog input	1 per motor (+4 depending on the DSO-HIO optional board version but shared between both motors)
	Analog output	0 (+4 depending on the DSO-HIO optional board version but shared between both motors)
Software / programmability	ETEL Tools software for setting / monitoring	Windows 9x / XP / 2000 / NT
	DLL files (C / C++ / VB / LV)	Windows 9x / XP / 2000 / NT / QNX4 / QNX6
	User's programmable sequence	4096 lines per axis
	Firmware update	RS232 / Turbo-ETEL-Bus

2.4 Mounting systems – Installation requirements

The DSCDL rack formats are dedicated to be mounted inside a rack case system.

Warning: The rack case with the controllers has the following electrical safety degree: IP 20 (according to EN 60529 standard). To respect this degree, each empty slot (if a controller is not present in the rack case) must be closed by a front panel.
The rack case must be in an enclosure respecting a pollution degree of 2 (refer to UL 508C and EN 50178 standards for more information).

The rack formats are mounted vertically inside a rack case. Here is an example:



Rack case depth: 240 (without the depth of the handle)

Unit: [mm]

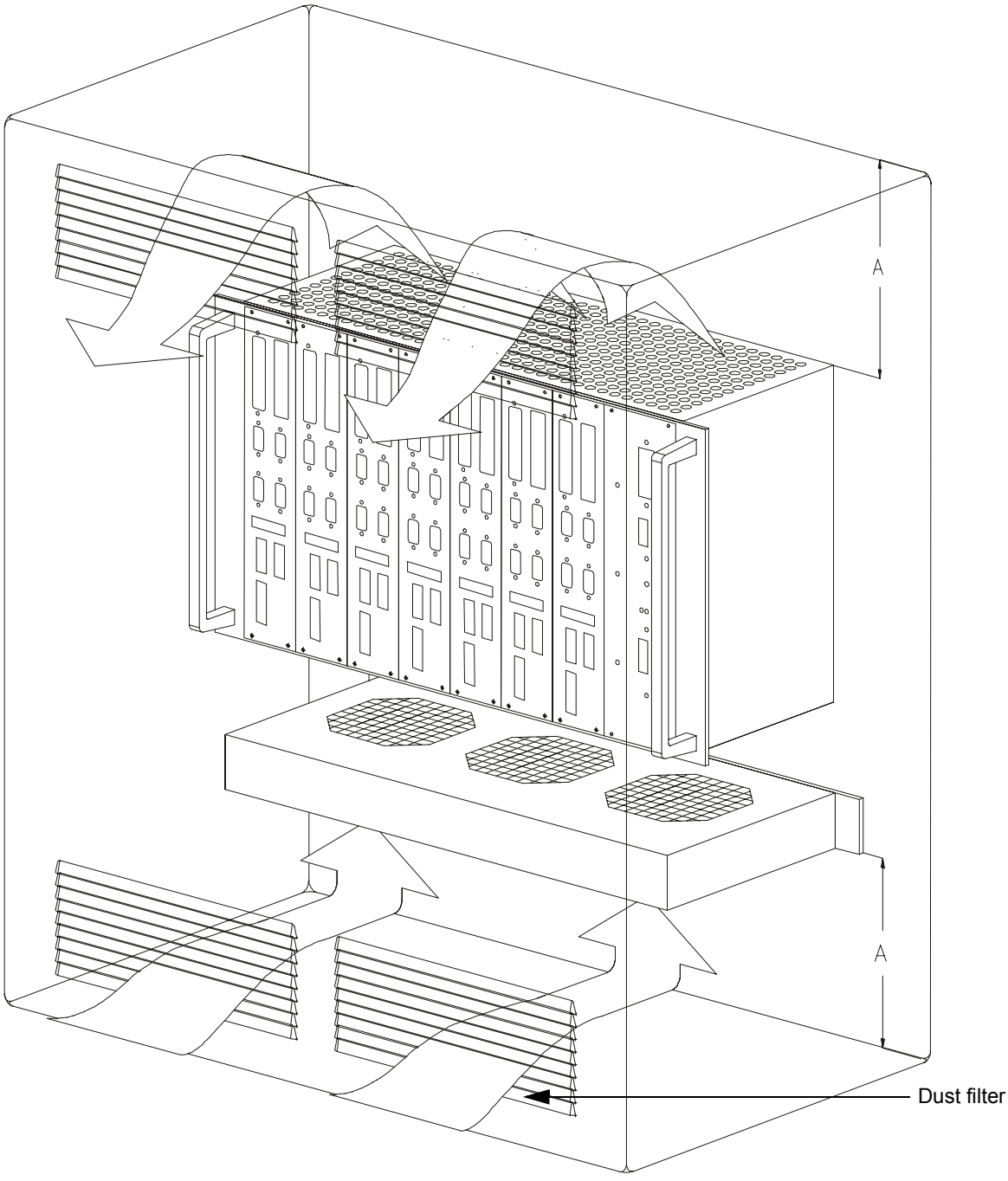
In the solution outlined above, height DSCDL3x1-xxx are present in a rack case (powered by an external power supply not included in the above-mentioned drawing).

The rack case systems should be protected against any splashes of liquid and any contacts with smoke and dust. It must be installed inside a closed cabinet and screwed on a metallic plate, connected to the ground, where no vibration will occur.

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Fresh air is necessary to cool the controllers inside the rack case (the flow depends on the user application). It is recommended to install fans in the cabinet to guarantee an air flow (the fan power depends on the user application). **Caution: some fans may perturb the current measurement of the controller if they are too close to the rack case. If this problem occurs, use another type of fan or increase the distance between the fan and the rack case while ensuring the air flow mentioned hereafter.** The air flow inside ETEL's rack cases with fans is equal to minimum 2 m/s (400 LFM) (the fans, used with the rack case, have an air flow of 94.2 CFM). Refer to the **'DSO-RAC2 Hardware Manual'** for more information about the rack case.

This drawing shows a rack case with rack formats, inside a cabinet:



The following distances are recommended: A = 100 [mm] (drawing out of scale).

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2.5 Ordering information

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

D	S	C	D	L	3	3	1	-	1	1	1	X	-	0	0	0

Family product:
DSCDL: Linear position controller

Encoder type:
3 = Analog (1Vptp) or absolute (EnDat 2.1) or TTL

Power output:
3 = 1.2 Arms / 2.8 Arms (1s) for 10F rack
2.4 Arms / 3.6 Arms (1s) for 14F rack

Assembly:
1 = Rack format with plate heat sink and frontplate of 10F
2 = Rack format with extruded heat sink and frontplate of 14F

Reserved for future use

Power supply input:
3 = ±36VDC

Standard option:
1 = Not UL recognized
2 = UL recognized
By default, the DSCDL3 is delivered without UL recognition

Hardware version

Customer modification
000 means 'standard product'

Remark: Not all the combinations are possible.

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3. Electrical interface

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

There are six groups of connectors, according to their function:

Encoders connectors (see §3.1).

Inputs / outputs connectors (see §3.2).

Communication connectors (see §3.3).

Motor connectors (see §3.4).

Power connector (see §3.5).

Optional boards connector (see §3.6).



Caution: Before connecting or disconnecting a cable on one of these connectors or touching the controller, **turn off all the power supplies and wait 2 minutes** to allow the internal DC bus capacitors to discharge.



Caution: All the inputs/outputs cables must be insulated (no contact) from the power and the mains.
The inputs and outputs must be connected to an Extra Low Voltage circuit only (SELV).
Most inputs and outputs are not galvanically insulated from the GND.
The motor connectors must always be correctly screwed onto the DSCDL.



Caution: All the connectors must be handled in an ESD protected environment, only.

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

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3.1 Encoder connectors

3.1.1 Connectors JC5 and JC6: Position encoders

Caution: The encoder cable(s) must be insulated (no contact) from the power and the mains. The inputs and outputs of this connector are not galvanically insulated from the GND. The inputs and outputs must be connected to an Extra Low Voltage circuit only (SELV).

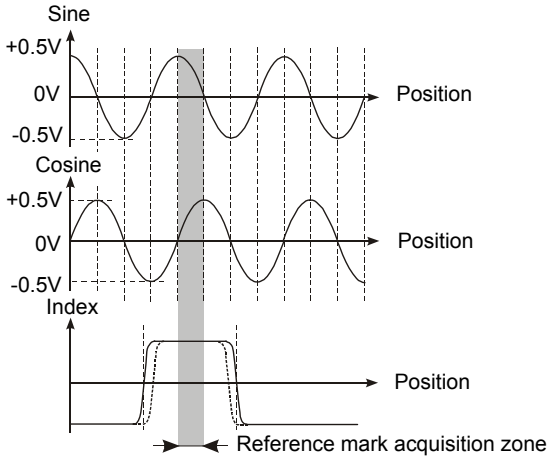
Caution: The encoder connectors must be handled in an ESD protected environment, only.

Remark: The encoder cable(s) connected to the DSCDL must be shielded (see §3.7.1).

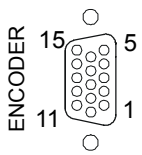
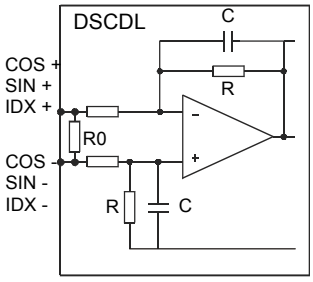
3 different types of encoder can be connected to each encoder connector of a DSCDL: either an incremental analog encoder 1 Vptp, or an analog absolute encoder (EnDat 2.1) or a TTL encoder.

3.1.1.1 Incremental analog encoder (1 Vptp)

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



D-SUB, 15 pins, high density, female

ENCODER	Pin #	Signal	Function	Interface
JC5 & JC6 	1	Reserved	**Do not connect**	
	2	Reserved	**Do not connect**	
	3	Reserved	**Do not connect**	
	4	+5VDC	Encoder supply output (protected by fuse F2 of 1A)	
	5	GND	Encoder supply output (0V)	
	6	COS -	Cosine - signal input	
	7	SIN -	Sine - signal input	
	8	IDX -	Index - signal input	
	9	Reserved	**Do not connect**	
	10	EHO	Encoder home switch input (TTL signal)	
	11	ELS	Encoder limit switch input (TTL signal)	
	12	GND	Encoder supply output (0V)	
	13	COS +	Cosine + signal input	
	14	SIN +	Sine + signal input	
	15	IDX +	Index + signal input	

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Remark: The +5VDC encoder supply output is protected by the fuse F2 (1A) on JC5 and JC6.

JC5 is used to connect the encoder of motor 1 and JC6 for the one of motor 2.

Refer to the corresponding **'Operation & Software Manual'** for more information about the use of the EHO and ELS signals.

3.1.1.2 Absolute analog encoder (EnDat 2.1)

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

D-SUB, 15 pins, high density, female

ENCODER	Pin #	Signal	Function	Interface
JC5 & JC6 ENCODER 15 5 11 1	1	EDT +	EnDat serial data I/O + / RS485	DSCDL C R COS + SIN + R0 COS - SIN - R C
	2	ECL +	EnDat clock output + / RS485	
	3	ECL -	EnDat clock output - / RS485	
	4	+5VDC	Encoder supply output (protected by fuse F2 of 1A)	
	5	GND	Encoder supply output (0V)	
	6	COS -	Cosine - signal input	
	7	SIN -	Sine - signal input	
	8	Reserved	**Do not connect**	
	9	EDT -	EnDat serial data I/O - / RS485	
	10	Reserved	**Do not connect**	
	11	Reserved	**Do not connect**	
	12	GND	Encoder supply output (0V)	
	13	COS +	Cosine + signal input	
	14	SIN +	Sine + signal input	
	15	Reserved	**Do not connect**	

Remark: The +5VDC encoder supply output is protected by the fuse F2 (1A) on JC5 and JC6.

The cable used with an absolute analog encoder (EnDat 2.1) must have power wires with a minimum diameter to guarantee a sufficient voltage at the terminals of the encoder (refer to the data sheet of the encoder for more information).

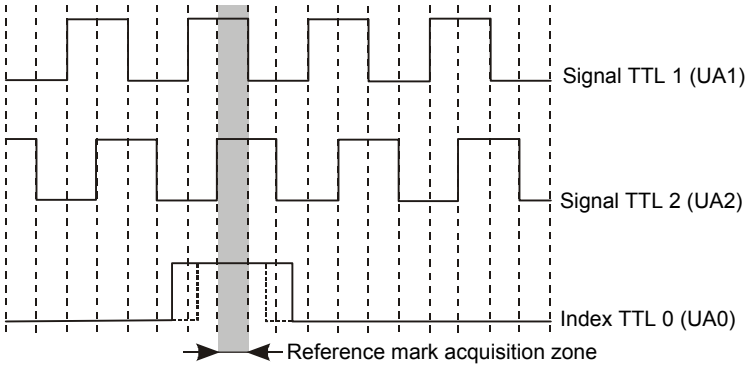
JC5 is used to connect the encoder of motor 1 and JC6 for the one of motor 2.

3.1.1.3 TTL encoder

Caution: It is possible to connect a TTL encoder on this connector but the input frequency is limited to 400KHz because the interface is an analog one.

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

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The +5V encoder supply output is protected by fuse F2 (1A) on JC5 and JC6.

D-SUB, 15 pins, high density, female

ENCODER	Pin #	Signal	Function	Interface
JC5 & JC6 ENCODER 15 5 11 1	1	Reserved	**Do not connect**	DSCDL C R COS + SIN + IDX + R=120Ω COS - SIN - IDX - R C
	2	Reserved	**Do not connect**	
	3	Reserved	**Do not connect**	
	4	+5V	Encoder supply output (protected by fuse F2 of 1A)	
	5	GND	Encoder supply output (0V)	
	6	UA2 -	TTL2 - signal input	
	7	UA1 -	TTL1 - signal input	
	8	UA0 -	TTL0 - signal input	
	9	Reserved	**Do not connect**	
	10	EHO	Encoder home switch input (TTL signal)	
	11	ELS	Encoder limit switch input (TTL signal)	
	12	GND	Encoder supply output (0V)	
	13	UA2 +	TTL2 + signal input	
	14	UA1 +	TTL1 + signal input	
	15	UA0 +	TTL0 + signal input	

Remark: JC5 is used to connect the encoder of motor 1 and JC6 for the one of motor 2.

Refer to the corresponding **'Operation & Software Manual'** for more information about the use of the EHO and ELS signals.

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3.2 Inputs / outputs connectors

3.2.1 Connectors JC12 and JC13: Digital inputs / outputs

Caution: The digital inputs/outputs cable must be insulated (no contact) from the power and the mains.
The digital inputs and outputs must be connected to an Extra Low Voltage circuit only (SELV).
The digital inputs and outputs are galvanically insulated from the GND by opto-couplers.

Caution: These connectors must be handled in an ESD protected environment, only.

Remark: The digital inputs/outputs cable(s) connected to the DSCDL must be shielded (see §3.7.1).

The DSCDL has 4 digital inputs (DIN1, DIN2, DIN9 and DIN10) and 2 digital outputs (DOUT1 and DOUT2) per motor. Every digital input and output is opto-coupled. DIN2 is opto-coupled through a **high speed** opto-couplers (100 ns).

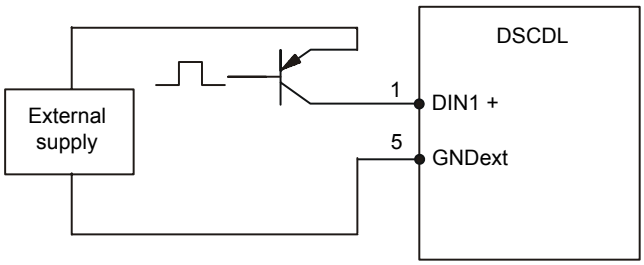
Only inputs and outputs **interface** is considered here. Refer to the corresponding **'Operation & Software Manual'** for more information about the use of these inputs and outputs.

3.2.1.1 Digital inputs

The digital inputs switch to '1' when a voltage ranging between +12VDC and +28VDC is applied between pins DIN+ of the corresponding input and GNDext.
The digital inputs switch to '0' when a zero voltage is applied between pins DIN+ of the corresponding input and GNDext.

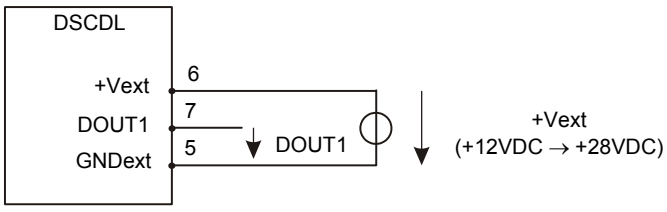
Remark: When using an external 'positive limit switch', connect it to DIN10.
When using an external 'negative limit switch', connect it to DIN9.
When using an external 'home switch', connect it to DIN2.

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



3.2.1.2 Digital outputs

To use a digital output, a voltage should previously be supplied to the external auxiliary supply (+Vext). This voltage should range between +12VDC and +28VDC. The maximum total current provided by the digital outputs is limited to 500 mA (limited by fuse F1).
It is recommended to use an external auxiliary supply (+Vext) as shown below (in this case, the logical value '1' will correspond to +Vext and '0' to GND ext).



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

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D-SUB, 9 pins, male				
CUSTOMER I/O	Pin #	Signal	Function	Interface
JC12 & JC13 CUSTOMER I/O 6 1 9 5	1	DIN1 +	Digital input 1 +	DSCDL DIN1+ DIN9+ DIN10+ GNDext
	2	DIN2 +	Digital input 2 + (High speed: 100 ns)	
	3	DIN9 +	Digital input 9 +	
	4	DIN10 +	Digital input 10 +	
	5	GNDext	External supply input (0V) for DIN and DOUT	
	6	+Vext	External supply input for digital outputs (fuse F1, 500mA - limits user's input current)	DSCDL +Vext F1 BSP450 DOUT1 DOUT2 33 kΩ GNDext
	7	DOUT1	Digital output 1 +	
	8	DOUT2	Digital output 2 +	
	9	Reserved	**Do not connect**	

Remark: JC12 is used to connect the inputs/outputs of motor 1 and JC13 for the ones of motor 2.

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

	Status	Typical	Maximum	Unit
DOUTs	0 => 1	25	30	µs
	1 => 0	300	330	µs
DIN 2 (high speed)	0 => 1	100	110	ns
	1 => 0	400	440	ns
DINs 1, 9 and 10	0 => 1	4	5	µs
	1 => 0	45	50	µs

Remark: The above-mentioned times takes only the hardware into account. To have the entire time, a delay (max. 1 STI) must be added to these times, to take the treatment of the command by the software into account.

3.2.2 Connector JC7: Analog inputs



Caution: The analog inputs cable must be insulated (no contact) from the power and the mains. The analog inputs must be connected to an Extra Low Voltage circuit only (SELV).



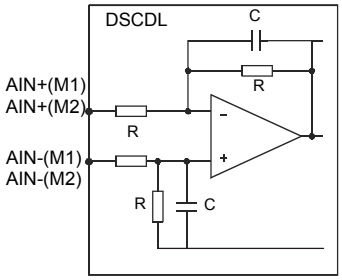
Caution: This connector must be handled in an ESD protected environment, only.

Remark: The analog inputs cable connected to the DSCDL must be shielded (see §3.7.1).

The DSCDL has also two analog inputs (one for each motor). To use the analog input (AIN), a voltage ranging from -10 VDC to +10 VDC must be applied between pins 2 and 3 for motor 1 and between pins 4 and 5 for motor 2.

Remark: If AIN = + 10 VDC ⇒ monitoring M51 = -32767, and if AIN = - 10 VDC ⇒ monitoring M51 = +32768

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Phoenix Contact MC 1.5/5-STF-3.81				
ANALOG INPUTS	Pin #	Signal	Function	Interface
ANALOG INPUTS JC7 1 5	1	GND	Ground (0V)	
	2	AIN+ (M1)	Analog input + for motor M1	
	3	AIN- (M1)	Analog input - for motor M1	
	4	AIN+ (M2)	Analog input + for motor M2	
	5	AIN- (M2)	Analog input - for motor M2	

Remark: The converter used for the analog input is a 16 bits converter.

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3.3 Communication connectors



Caution: The communication connectors must be insulated (no contact) from the power and the mains.
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).



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

Remark: The communication cables connected to the DSCDL must be shielded (see §3.7.1).

The communication between a host (PC) and a DSCDL is obtained via the ETEL-Bus-Lite2 (EBL2) protocol (refer to the **'EBL2 Communication Manual'** for more information). The communication between the DSCDLs is obtained via the Turbo-ETEL-Bus (TEB) protocol which needs a TEB master (DSMAX or DSTEB).
The ETEL-Bus-Lite2 protocol is open to the user. It is configured as follows:

Transmission rate	115'200 bps
Data length	8 bits
Start bit	1
Stop bit	1
Parity	No
Handshaking	No

The Turbo-ETEL-Bus protocol is closed to the user who cannot have direct access to it.

ETEL-Bus-Lite2 (communication between PC and DSCDL)		**Turbo-ETEL-Bus (communication between DSCDLs)**
RS 232	**RS 422**	
Normal connection between a PC and a DSCDL for communication purposes (with **ETEL Tools** software, e.g.).	For example, for the use of an 'on-line' control system with a communication system other than RS232, or if the PC comes with a RS422 board and its RS 232 port is already used.	The Turbo-ETEL-Bus works at 100 Mbps and is based on Ethernet components.

The user can select the RS232 type of ETEL-Bus-Lite2 communication by connecting the **EBL2_select_232/422** pin to the GND (0V). If this connection is not made, RS422 type is automatically selected (default status).

Remark: If the cables provided by ETEL are used, the communication type by default is RS232.

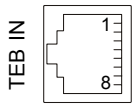
The communication connectors are JC1, JC2, JC3 and JC4 (see the following tables).

The JC1 connector is used for the TEB data input and JC2 is for the TEB data output. They are used to make a daisy chain between controllers, simply with standard RJ-45 cables. The JC3 connector allows both types of ETEL-Bus-Lite2 communication (RS232 or RS422), and the selection between them. The JC4 connector is used, for the download key, to set the controller to the 'wait for program' mode; it also includes TTL signals to indicate the states of the encoder's sine and cosine.

Remark: The download key of the DSCDL is compatible with the DSC2P and DSCDP key.

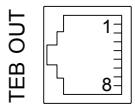
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3.3.1 Connector JC1: Turbo-ETEL-Bus input

RJ-45, 8 pins, female			
TEB IN	**Pin #**	**Signal**	**Function**
JC1  TEB IN	1	RX +	TEB data reception + (Ethernet 100 Mbps)
	2	RX -	TEB data reception - (Ethernet 100 Mbps)
	3	SNI +	DSCDL synchronization input +
	4	RSI +	DSCDL TEB reset input +
	5	RSI -	DSCDL TEB reset input -
	6	SNI -	DSCDL synchronization input -
	7	AUXO +	Output reserved for a future TEB application
	8	AUXO -	Output reserved for a future TEB application

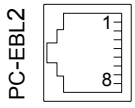
Remark: The TEB cable must meet the following characteristics: 1:1 shielded cable, category 5 with 8 wires.

3.3.2 Connector JC2: Turbo-ETEL-Bus output

RJ-45, 8 pins, female			
TEB OUT	**Pin #**	**Signal**	**Function**
JC2  TEB OUT	1	TX +	TEB data transmission + (Ethernet 100 Mbps)
	2	TX -	TEB data transmission - (Ethernet 100 Mbps)
	3	SNO +	DSCDL synchronization output +
	4	RSO +	DSCDL TEB reset output +
	5	RSO -	DSCDL TEB reset output -
	6	SNO -	DSCDL synchronization output
	7	AUXI +	Input reserved for a future TEB application
	8	AUXI -	Input reserved for a future TEB application

Remark: The TEB cable must meet the following characteristics: 1:1 shielded cable, category 5 with 8 wires.

3.3.3 Connector JC3: ETEL-Bus-Lite2 serial communication

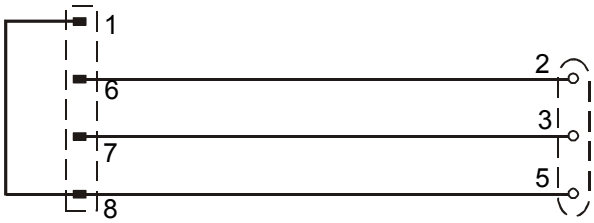
RJ-45, 8 pins, female			
PC-EBL	**Pin #**	**Signal**	**Function**
JC3  PC-EBL2	1	EBL2_select422/232	Select EBL2 transmission type (open ⇒ RS422 / connected to GND ⇒ RS232)
	2	EBL2_RXD422 +	EBL2 Data reception RS422 + from the PC (host)
	3	EBL2_RXD422 -	EBL2 Data reception RS422 - from the PC (host)
	4	EBL2_TXD422 +	EBL2 Data transmission RS422 + to the PC (host)
	5	EBL2_TXD422 -	EBL2 Data transmission RS422 - to the PC (host)
	6	EBL2_TXD232	EBL2 Data transmission RS232 to the PC (host)
	7	EBL2_RXD232	EBL2 Data reception RS232 from the PC (host)
	8	GND	Auxiliary supply output (0V)

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If you want to manufacture your own RS232 communication cable, you should wire it as shown below:

To the DSCDL (JC3):

RJ-45 connector,
8 pins, male



To the PC (serial port):

D-SUB connector,
9 pins, female

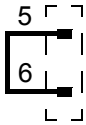
3.3.4 Connector JC4: Download key

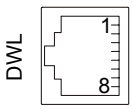
This connector is used for the download key. If the DSCDL does not switch to 'wait for program', there is an hardware override possibility to force this mode. To do so, plug the download key into the JC4 connector, switch off and on the controller, and the DSCDL will switch to 'wait for program' in order to download a new firmware in the DSCDL.

A download key is a 8 pins RJ-45 male connector, with a bridge between pins 5-6:

Download key (JC4) :

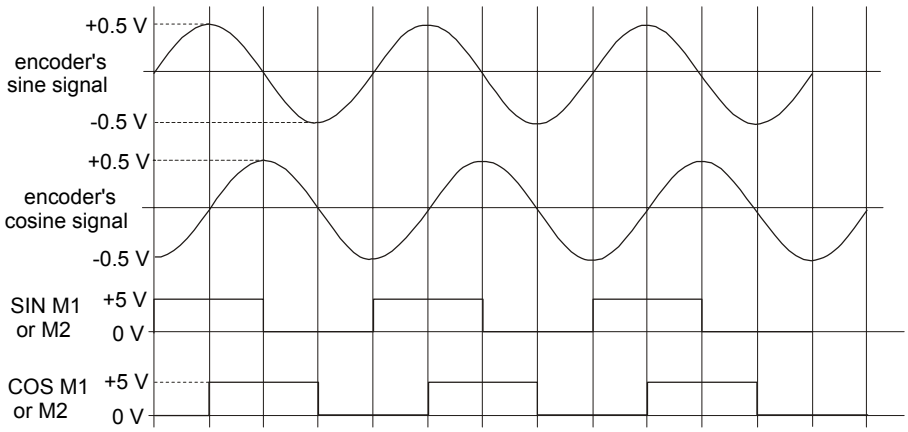
RJ-45 connector, 8 pins, male



RJ-45, 8 pins, female			
DOWNLOAD KEY	**Pin #**	**Signal**	**Function**
JC4  DWL	1	SIN M1	Indicates when the analog encoder's sine signal of motor M1 goes through 0 (TTL signal)
	2	COS M1	Indicates when the analog encoder's cosine signal of motor M1 goes through 0 (TTL signal)
	3	SIN M2	Indicates when the analog encoder's sine signal of motor M2 goes through 0 (TTL signal)
	4	COS M2	Indicates when the analog encoder's cosine signal of motor M2 goes through 0 (TTL signal)
	5	DWL +	Sets the DSCDP to 'wait for program' (download) if connected to 0V
	6	GND	Auxiliary supply output (0V)
	7	SLOW INT.	STI (Slow Time Interrupt) signal (2 kHz) active on a low state (TTL signal)
	8	FAST INT.	FTI (Fast Time Interrupt) signal (18 kHz) active on a low state (TTL signal)

Remark: The download key of the DSCDL is compatible with the DSC2P and DSCDP key.

Refer to the corresponding **'Operation & Software Manual'** for more information about the STI and FTI.



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3.4 Motor connectors



Warning: Before connecting or disconnecting the motor cable or touching the controller, **turn off all the power supplies and wait 2 minutes** to allow the internal DC bus capacitors to discharge.



Caution: The motor connectors must be insulated (no contact) from the power and the mains. The motor connectors must always be correctly screwed onto the DSCDL to respect the EMC standard.



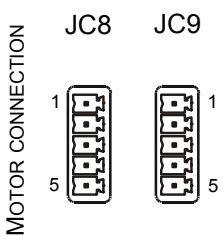
Caution: The motor connectors must be handled in an ESD protected environment, only.

Remark: The motor cables connected to the DSCDL must be shielded (see §3.7.1).

3.4.1 Connectors JC8 and JC9: Motor connection

The DSCDL can drive two single-phase or two two-phase motors. Connectors JC8 and JC9 enable the supply of the motor phase(s).

Phoenix Contact MC 1.5/5-STF-3.81

MOTOR CONNECTION	Pin #	Signal	Function	
			Single-phase motor	Two-phase motor
	1	PE (M1)	Protective earth	Protective earth
	2	P1- (M1)	Motor 1 phase1 -	Motor 1 phase1 -
	3	P1+ (M1)	Motor 1 phase1 +	Motor 1 phase1 +
	4	P2- (M1)	**Do not connect**	Motor 1 phase2 -
	5	P2+ (M1)	**Do not connect**	Motor 1 phase2 +
	1	PE (M2)	Protective earth	Protective earth
	2	P1- (M2)	Motor 2 phase1 -	Motor 2 phase1 -
	3	P1+ (M2)	Motor 2 phase1 +	Motor 2 phase1 +
	4	P2- (M2)	**Do not connect**	Motor 2 phase2 -
	5	P2+ (M2)	**Do not connect**	Motor 2 phase2 +

Remark: JC8 is used to connect the motor 1 and JC9 for the motor 2.

The tightening torque for the screws of the motor connectors is 0.25 Nm max.

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3.5 Power connector

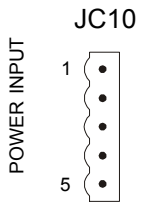
3.5.1 Connector JC10: Power supply input

Warning: Before connecting or disconnecting the motor cable or touching the controller, **turn off all the power supplies and wait 2 minutes** to allow the internal DC bus capacitors to discharge. **Always connect the ground prior to any other connection**.

Caution: This connector must be handled in an ESD protected environment, only.

Remark: The power cables connected to the DSCDL must be shielded (see §3.7.1).

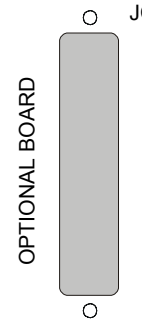
The DSCDL must be powered with an external power supply.

Phoenix Contact MC 1.5/5-STF-3.81			
POWER INPUT	**Pin #**	**Signal**	**Function**
	1	PE	Protective earth - **Must always be connected for safety**
	2	GND	Ground input (0V)
	3	V-	Power supply input -36 VDC (fuse F5 = 8A; limits the input current)
	4	V+	Power supply input +36 VDC (fuse F4 = 8A; limits the input current)
	5	VAUX	Auxiliary supply input +15 to +36 VDC (fuse F3 = 1A; limits the input current)

Remark: The tightening torque for the screws of the power connector is 0.6 Nm max.

3.6 Optional boards connector

3.6.1 Connector JC11: Depends on the type of board

OPTIONAL BOARD	
	Refer to the specific documentation if you have an optional board.

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3.7 Cables

3.7.1 Manufacturing

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

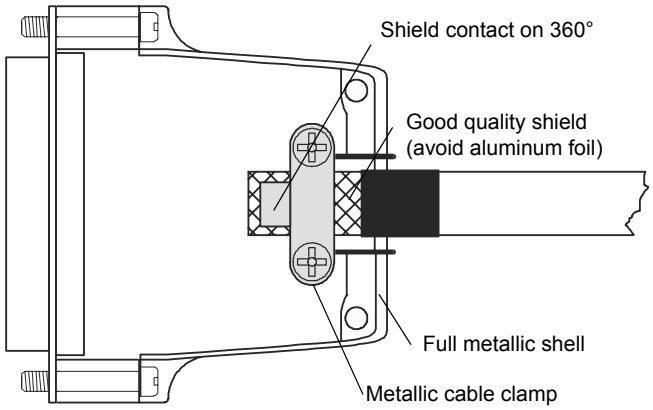
- The encoder cables: JC5 and / or JC6.
- The inputs/outputs cables: JC12 and / or JC13.

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

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

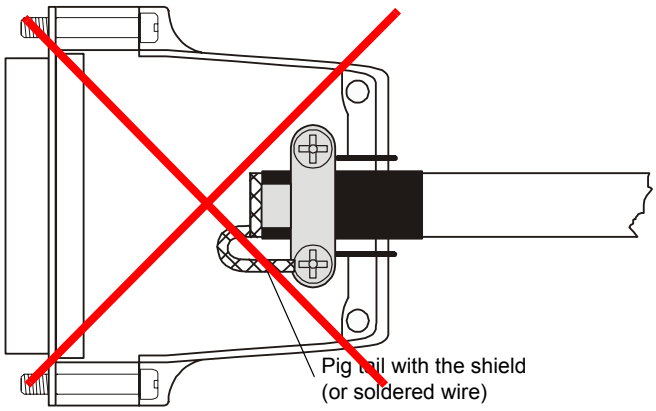
Here is an example of good shielding connection:

Good shielding connection

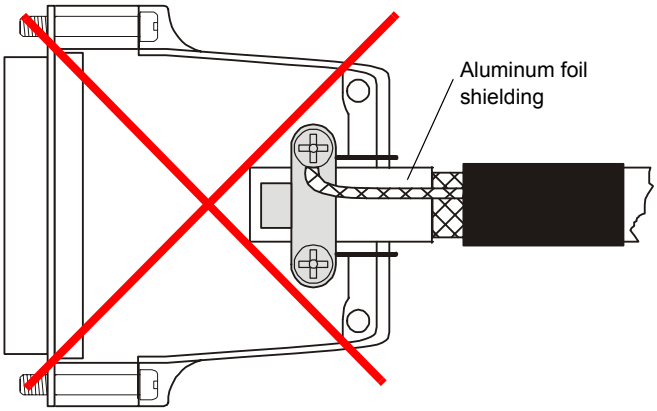


Here are two examples of bad shielding connections:

Bad shielding connection

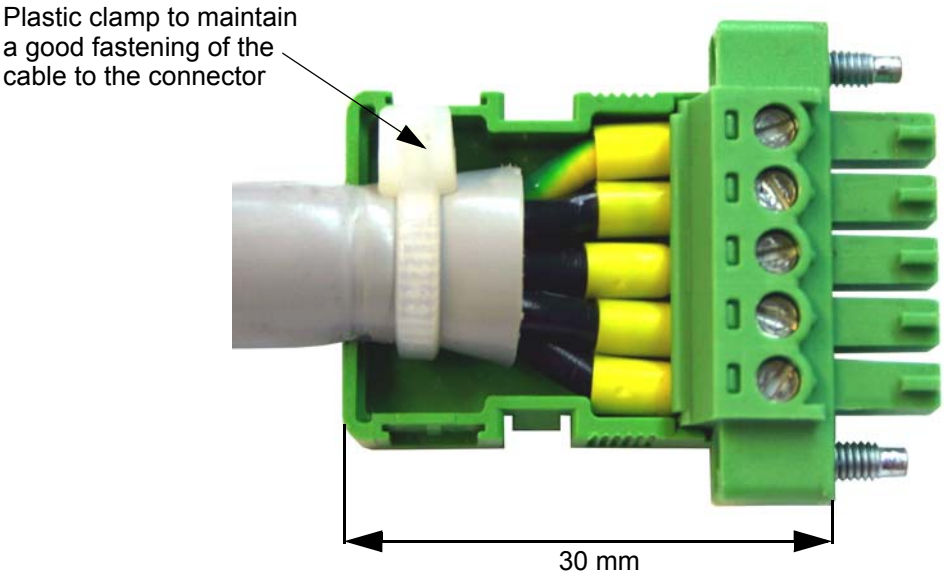


Bad shielding connection



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The motor cable



Remark: The cable's radius of curvature must be taken into account to adjust the distance between the front plate of the controller and the cabinet.

3.8 Axis number selection

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



The value given on the DIP switch represents a binary value (16 possibilities).

As there are 16 possible values on the DIP switch for 30 axes maximum (0 to 29), the number of the first axis of a controller will be equal to the value given by the DIP switch multiplied by 2. The second axis' number of the same controller will be automatically incremented by one.

Example:



The axis number given by this DIP switch is equal to: $2^0 + 2^1 = 3$. Then, the first axis of this controller will have the number 6 and the second one the number 7.

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3.9 LEDs meaning

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

LED	Status	Meaning
Green LED 'TEB OK'	ON	The communication through the TEB is running
	OFF	The communication through the TEB is not running => check the wiring or/and the master
Green LED 'SERVO ON'	ON	Controller without error
	OFF	Controller in error or not ON
Red LED	ON	Controller in error => check monitoring M64
	OFF	Controller without error

Remark: The green LED 'SERVO ON' and the red LED cannot be ON together.

LED regarding motor 1	Status	Meaning
Red LED 'ERROR M1'	ON	Error on motor 1 => check monitoring M64
	OFF	No error on motor 1
Green LED 'POWER ON M1'	ON	Motor 1 is in 'power ON'
	OFF	Motor 1 is in 'power OFF'

Remark: The red LED 'ERROR M1' and the green one 'POWER ON M1' cannot be ON together (except during the starting phase of the controller).
The red LED 'ERROR M1' and the green one 'POWER ON M1' can be OFF together when the motor 1 is without error and in power OFF.

LED regarding motor 2	Status	Meaning
Red LED 'ERROR M2'	ON	Error on motor 2 => check monitoring M64
	OFF	No error on motor 2
Green LED 'POWER ON M2'	ON	Motor 2 is in 'power ON'
	OFF	Motor 2 is in 'power OFF'

Remark: The red LED 'ERROR M2' and the green one 'POWER ON M2' cannot be ON together (except during the starting phase of the controller).
The red LED 'ERROR M2' and the green one 'POWER ON M2' can be OFF together when the motor 2 is without error and in power OFF.

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