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MOTION TECHNOLOGY

Digital position controller





DSC2P Hardware Manual

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Record of revisions concerning the DSC2P manual:

Document revisions		
Issue (x)	**Date**	**Modified**
beta	23.08.00	Specifications, preliminary
Ver A	26.01.01	First version
Ver B	19.09.01	Updated version (update of the motor connection and DIP switch)
Ver C	12.09.03	Updated version - New rack format: DSC2Px41-xxx (refer to §2.1.3) - New housed format (refer to §2.2 and §3.5) - Brake resistor as well as power stage and short-circuit relay on housed format (refer to §3.5.2, §3.5.3 and §3.5.4) - Additional safety precautions in accordance with the UL & CE standards
Ver D	19.02.04	Updated version - Housed format is UL certified
Ver E	31.03.04	Updated version - Housed format dimensions modified
Ver F	02.09.04	Updated version - New rack format: DSC2Px11-xxx (refer to §2.1.3)
Ver G	19.12.05	Updated version - New signals on JC4 connector (§3.3.4) - Additional detailed descriptions
Ver H	06.01.11	**Updated version:** **- New UL certification laboratory (TUV)**

Documentation concerning the DSC2P:

- **DSC2P Hardware Manual** **(Specifications & electrical interfaces)** **# DSC2P 904 H**
- Operation & Software Manual (DSC2P's setup, use & programming) # DSC2P 903 x
- DSO-PWS User's Manual (Power module installation and specifications) # DSOPWS 902 x
- DSO-RAC2 Hardware Manual (DSO-RAC2 principle) # DSORAC2 904 x
- EBL2 Communication Manual (EBL2 principle, messages mapping) # EBL2 908 x

The DSC2P position controllers have been successfully tested and evaluated to meet the UL 508C for US market and CSA-C22.2 N°14-05 for canadian 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.

Remark: By default, the DSC2P is delivered without UL recognition.

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1. Introduction

This document concerns a digital position controller of ETEL's DSCxx family: **the DSC2 position controller** or **DSC2P** 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'**.

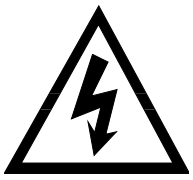
The information given in this manual is valid for type # D S C 2 P x x x – x x x **A** and later.

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 DSC2P:

- Never use the DSC2P for purposes other than those described in this manual.
- A competent and trained technician must install and operate the DSC2P, 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 DSC2P will make the motor move. **Keep away from all moving parts to avoid injuries!**
- The safety symbols placed on the DSC2P or written in the manuals must be respected.
- If the DSC2P 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.



Warning: Signals a danger of electrical shock to the operator.
Can be fatal for a person.



Caution: Signals a danger for the DSC2P. Can be destructive for the material.
A **danger** for the operator can result from this.



Caution: Indicates electrostatic discharges (ESD), dangerous for the DSC2P.
The components must be handled in an ESD protected environment only.

Remark: The DSC2P associated to its motor connector complies with the 89/336/EEC directive on EMC and the 73/23/EEC low voltage directive.

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1.2 DSC2P presentation

1.2.1 Working principle

The DSC2P is a digital position controller. It has been designed for direct drive applications. Its power bridge PWM switching is determined by the motor position encoder. The DSC2P includes on a single board, the control circuits, the power bridge and all the necessary interfaces for the communication, the encoders and the inputs/outputs. The housed format includes also a power supply on the same board, inside the same housing.

1.2.2 Applications

The DSC2P can drive single-phase, two-phase and three-phase motors. You can obtain brushless torque and linear motors from ETEL, as well as moving coils and moving magnets. The DSC2P can drive these motors and also brushless motors, DC motors, steppers. They must also be implemented with analog (incremental or absolute (EnDat 2.1)) or TTL encoders available on the market. Digital Hall effect sensor can also be connected to the controller.

1.2.3 General operating conditions

The DSC2P 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 +40°C (104°F) for the rack format or +30°C (86°F) for the housed format. The DSC2P must be connected to an electrical network of overvoltage category 2 (refer to EN 50178 and UL 840 standards for more information) and is suitable for use on a circuit capable of delivering not more than 5000 Arms, symmetrical amperes, 400 volts maximum. 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 DSC2P 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 of a rotary or linear motor, the DSC2P needs a signal coming from an analog (incremental or absolute (EnDat 2.1)) or a TTL encoder linked to this motor.

Communication
The user can set the DSC2P 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 DSC2P 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 DSC2Ps, 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 DSC2Ps can be set through the TEB. The user can 'daisy chain' up to 32 nodes on the TEB (31 DSC2Ps and one DSMAX (or DSTEB) board or 31 DSC2Ps with one of them in µ-master mode).

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.

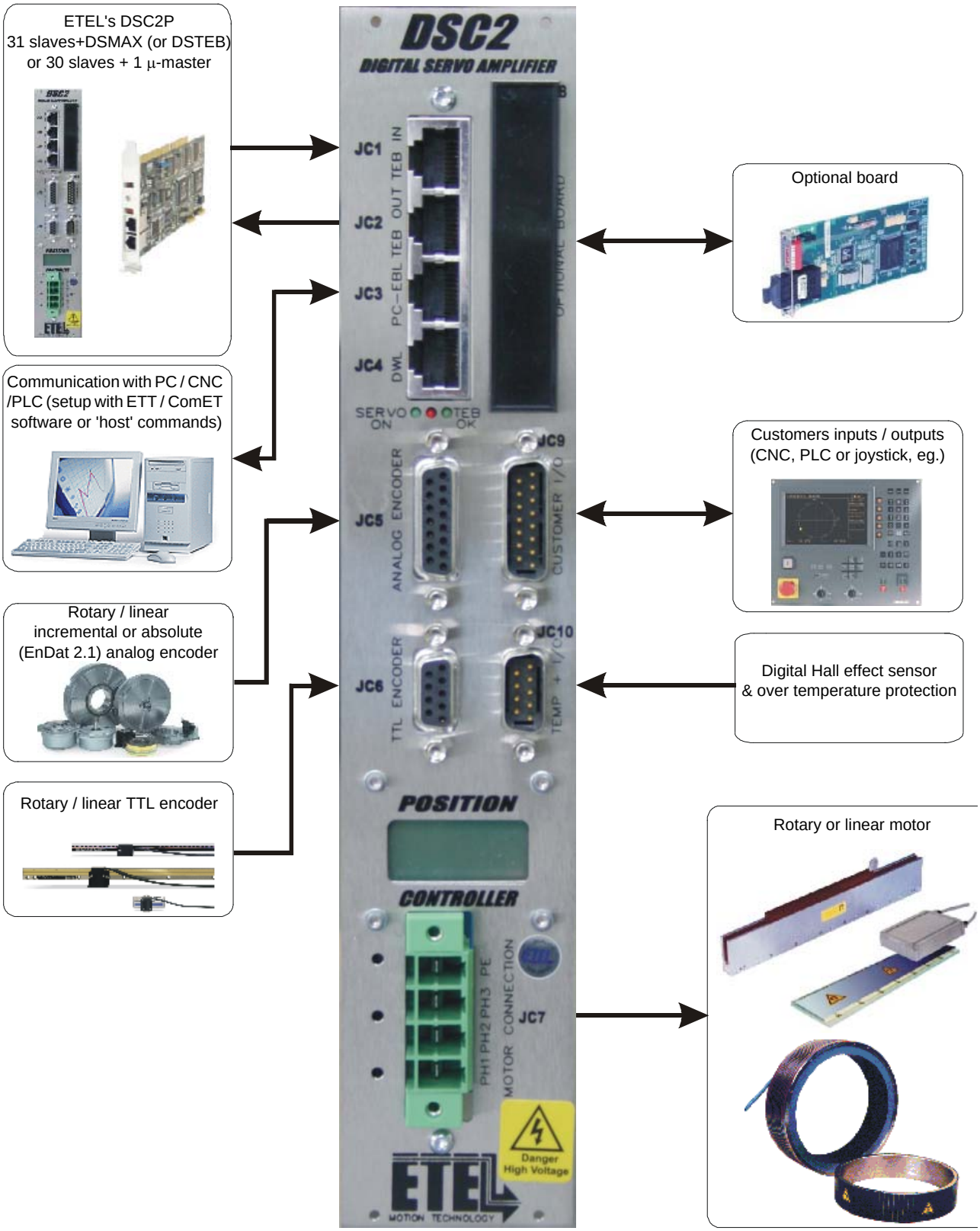
Inputs / outputs
The customer's inputs / outputs are digital and/or analog signals coming from a CNC machine-tool, a PLC or a joystick for example (refer to the connection diagram next page).

The electrical interface details are given in §3.

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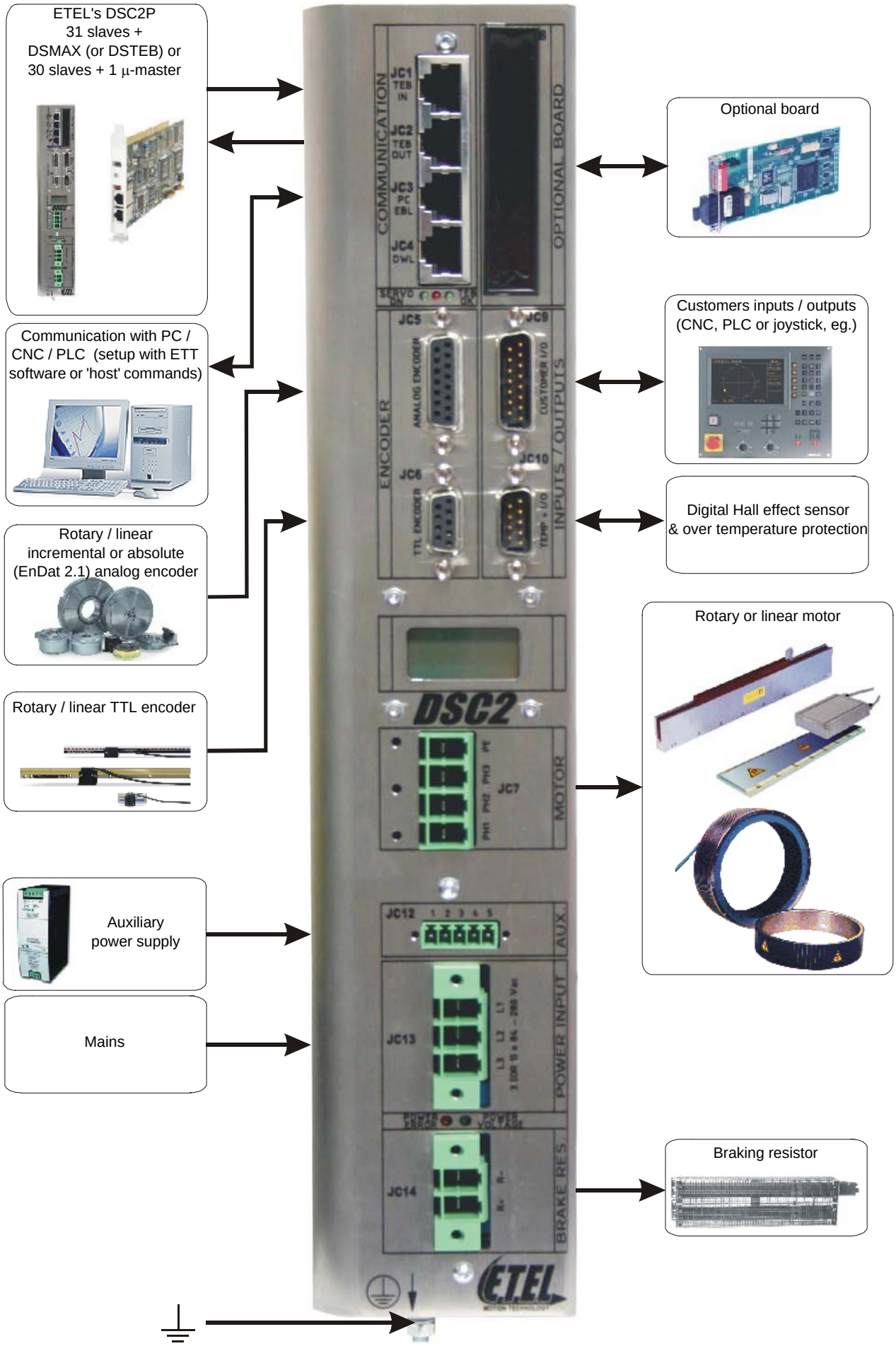
Connection diagram:

Rack format



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Housed format



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2. Models characteristics

Three models of DSC2P are available, according to the needs:

1. **Rack format with plate heat sink** (refer to §2.1)
2. **Rack format with extruded heat sink** (refer to §2.1)

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 (JC15) by an external power supply (the ETEL DSO-PWS power module, e.g.) ideally installed inside the rack case.

3. **Housed format with power supply** (refer to §2.2)

This controller is a 'stand alone' controller. It includes a complete controller with its power supply inside the same housing. The main difference between the rack formats and the housed format concerns the power supply connectors.

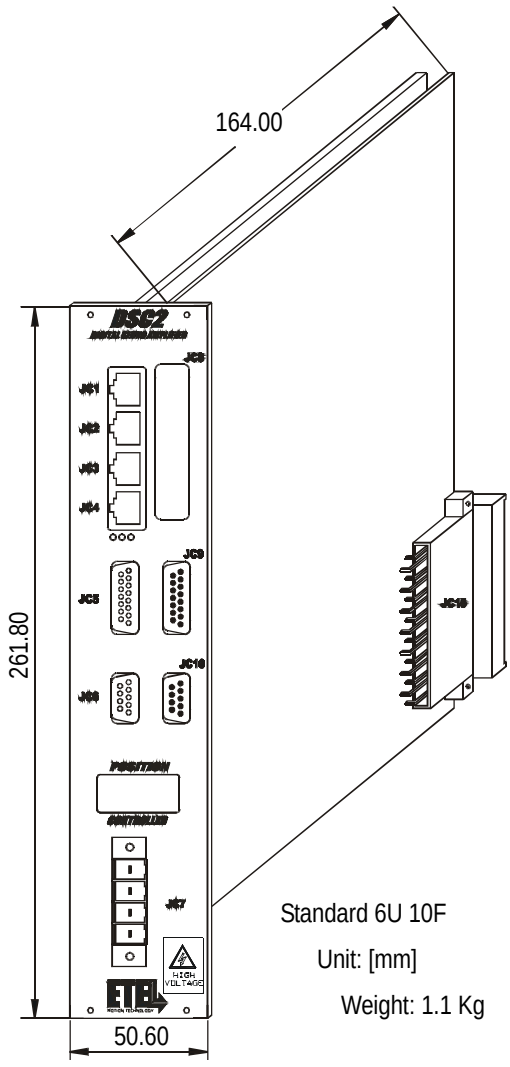
2.1 Rack format

There are two different sizes of DSC2P rack format: the DSC2Pxx**1**-xxx (10F wide) and the DSC2Pxx**2**-xxx (14F wide).

2.1.1 Outline and dimensions

Refer to the following chapters for more details about the connectors:

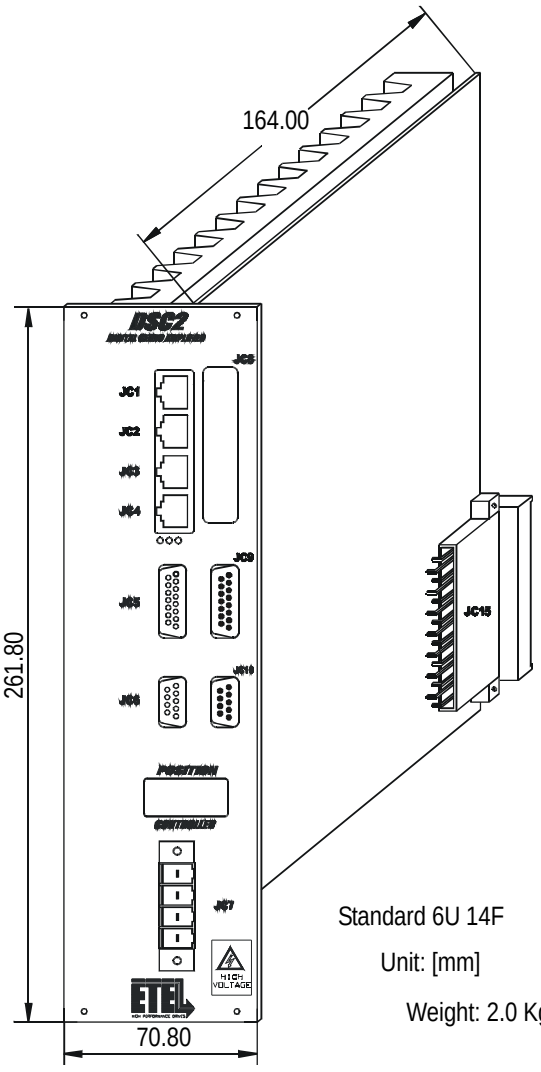
JC1 (see §3.3.1)
JC2 (see §3.3.2)
JC3 (see §3.3.3)
JC4 (see §3.3.4)
JC5 (see §3.1.1)
JC6 (see §3.1.2)
JC7 (see §3.4.2)
JC8 (see §3.6.1)
JC9 (see §3.2.1)
JC10 (see §3.1.3)
JC15 (see §3.5.1)



Standard 6U 10F

Unit: [mm]

Weight: 1.1 Kg



Standard 6U 14F

Unit: [mm]

Weight: 2.0 Kg

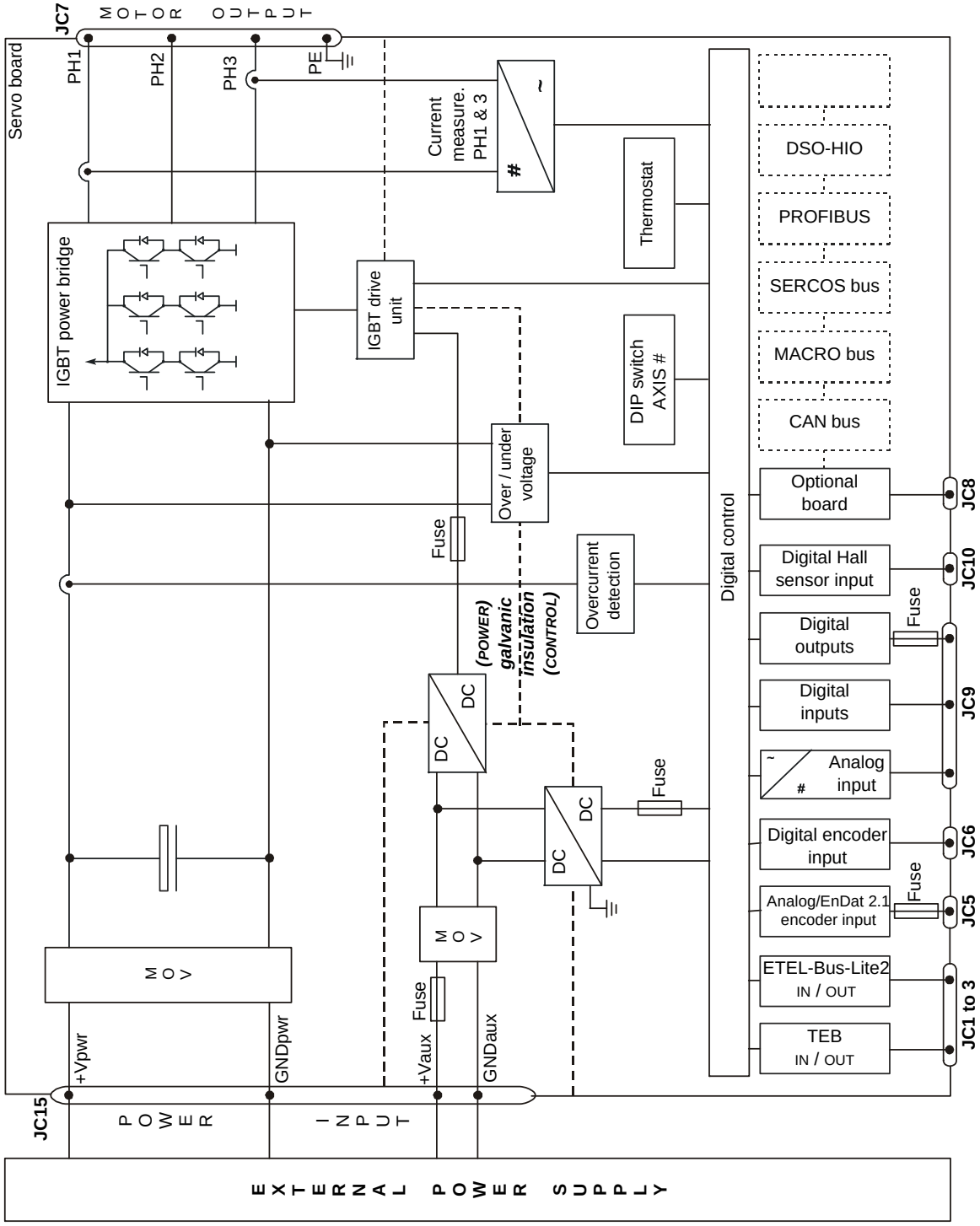
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2.1.2 Block schematics

In the DSC2P rack formats, all parts are on a single board: the servo board.

They need to be powered by an external power supply. The power supply developed by ETEL (refer to the **'DSO-PWS User's Manual'** for more information) is designed to fit most applications. If you use another power supply, it must meet all the specifications written on the next page.

On the servo board, the power part and the control part are galvanically separated. The inputs and outputs are insulated from the control part by opto-couplers.



Caution: The GND is internally connected to the DSC2P front panel which is connected to the ground (PE).
The power GND is not connected to the ground (PE).

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2.1.3 Ratings

To meet the specifications listed below, it is recommended to use an ETEL power supply (DSO-PWS). There are four different types of 10F wide rack formats (the DSC2Px**11**-xxx, the DSC2Px**21**-xxx, the DSC2Px**31**-xxx and the DSC2Px**41**-xxx) and three different types of 14F wide rack formats (the DSC2Px**32**-xxx, the DSC2Px**42**-xxx and the DSC2Px**52**-xxx).

All the specifications are given for an ambient temperature ranging from +15°C (59°F) to +40°C (104°F) and with an air flow of 2 m/s (400 LFM) inside the rack case:

DSC2P POWER FEATURES for RACK FORMAT									
Characteristics			-Px11-	-Px21-	-Px31-	-Px41-	-Px32-	-Px42-	-Px52-
Output to the motor		Voltage (up to)	400 VDC						
		Current range on product label	3.75 Arms (no time limit)	3.75 Arms/ 7.5 Arms (1s)	5 Arms/ 15 Arms (1s)	10 Arms/ 30 Arms (1s)	7.5 Arms/ 15 Arms (1s)	15 Arms/(*) 30 Arms (1s)	15 Arms/(*) 40 Arms (0.5s)
	PWM at 24 kHz	**Three-phase** motor Max. full load current	5.3(1) A (3.75 Arms)	8.8(1) A (6.2 Arms)	15(1) A (10.6 Arms)	15(1) A (10.6 Arms)	21(1) A (14.8 Arms)	21(1) A (14.8 Arms)	21(1) A (14.8 Arms)
		Three-phase motor Max. overload current during 2 s	5.3(1) A / no time limit (3.75 Arms)	11 A (7.7 Arms)	24.2 A (17.1 Arms)	42 A / 1.5s (29.6 Arms / 1.5s)	24.2 A (17.1 Arms)	42 A / 1.5s (29.6 Arms / 1.5s)	42 A / 1.5s (29.6 Arms / 1.5s)
	PWM at 12 kHz	**Three-phase** motor Max. full load current	5.3(1) A (3.75 Arms)	8.8(1) A (6.2 Arms)	15(1) A (10.6 Arms)	18(1) A (12.7 Arms)	21(1) A (14.8 Arms)	28(1) A (19.8 Arms)	28(1) A (19.8 Arms)
		Three-phase motor Max. overload current during 2 s	5.3(1) A / no time limit (3.75 Arms)	11 A (7.7 Arms)	24.2 A (17.1 Arms)	48.8 Arms (34.5 Arms)	24.2 A (17.1 Arms)	48.4 Arms (34.2 Arms)	56 A (39.5 Arms)
	PWM at 24 kHz	**Two-phase** motor Max. full load current	5.3(1) A (3.75 Arms)	10(1) A (7 Arms)	10.6(1) A (7.5 Arms)	14(1) A (9.8 Arms)	14(1) A (9.8 Arms)	14(1) A (9.8 Arms)	14(1) A (9.8 Arms)
		Two-phase motor Max. overload current during 2 s	5.3(1) A / no time limit (3.75 Arms)	12 A / 10 s (8.4 Arms)	21.2 A (15 Arms)	28 A (19.8 Arms)	21.2 A (15 Arms)	28 A (19.8 Arms)	28 A (19.8 Arms)
	PWM at 12 kHz	**Two-phase** motor Max. full load current	5.3(1) A (3.75 Arms)	12(1) A (8.4 Arms)	12.4(1) A (8.7 Arms)	17(1) A (12 Arms)	14(1) A (9.8 Arms)	14(1) A (9.8 Arms)	14(1) A (9.8 Arms)
		Two-phase motor Max. overload current during 2 s	5.3(1) A / no time limit (3.75 Arms)	12 A / no time limit (8.4 Arms)	24.2 A / 4 s (17.1 Arms)	28 A / 4 s (19.8 Arms)	24.2 A / 4 s (17.1 Arms)	28 A / 4 s (19.8 Arms)	28 A / 4 s (19.8 Arms)
	PWM at 24 kHz	**One-phase** motor Max. full load current	5.3(1) A (3.75 Arms)	12(1) A (8.4 Arms)	15(1) A (10.6 Arms)	14(1) A (9.9 Arms)	20(1) A (14.1 Arms)	20(1) A (14.1 Arms)	20(1) A (14.1 Arms)
		One-phase motor Max. overload current during 2 s	5.3(1) A / no time limit (3.75 Arms)	12 A / no time limit (8.4 Arms)	24.2 A (17.1 Arms)	40 A (28.2 Arms)	24.2 A (17.1 Arms)	40 A (28.2 Arms)	40 A (28.2 Arms)
	PWM at 12 kHz	**One-phase** motor Max. full load current	5.3(1) A (3.75 Arms)	12(1) A (8.4 Arms)	17.5(1) A (12.3 Arms)	17(1) A (12 Arms)	20(1) A (14.1 Arms)	20(1) A (14.1 Arms)	20(1) A (14.1 Arms)
		One-phase motor Max. overload current during 2 s	5.3(1) A / no time limit (3.75 Arms)	12 A / no time limit (8.4 Arms)	24.2 A / 4 s (17.1 Arms)	40 A / 4 s (28.2 Arms)	24.2 A / 4 s (17.1 Arms)	40 A / 4 s (28.2 Arms)	40 A / 4 s (28.2 Arms)
Power supply input		DC voltage	24 - 400 VDC						
Auxiliary supply input for DSC2Pxxx-x1x		DC voltage	120 - 340 VDC						
		Max. current at 120 VDC	200 mA(2)						
		Max. current at 340 VDC	70 mA(2)						
Auxiliary supply input for DSC2Pxxx-x2x		DC voltage	24 - 55 VDC						
		Max. current at 24 VDC	850 mA(2)						
		Max. current at 55 VDC	350 mA(2)						
Max. current measurable by the controller			6.25 A	12.5 A	25 A	50 A	25 A	50 A	66.67 A

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(*): For the DSC2Px42-xx**2** and the DSC2Px52-xx**2** (UL version), the current range on the product label is 14.5 Arms/30 Arms(0.5s) and 14.5 Arms/40 Arms(0.5s) respectively.
(1): Continuous current can be reached only with forced air cooling (external fan necessary: refer to §2.1.4).
(2): With optional board mounted on the DSC2P, no external device connected to the I/O. The current can change depending on the type(s) of encoder(s) used.

Remark: With PWM at 24 kHz, the current ripple in the motor is at 48 kHz (24 kHz with PWM at 12 kHz).

With two-phase motor, the current in 'motor phase 1- / 2-' (pin 3 of JC7 connector) is equal to (√2 x motor phase 1+) or (√2 x motor phase 2+). Be careful to use the suitable cable diameter.

DSC2P CONTROL FEATURES for RACK FORMAT		
General	Motion profile and command management sampling time	166 µs
	Current loop sampling time	41.6 µs
	Position loop sampling time	41.6 µs
	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 / 9600 to 115'200 bps
	Turbo-ETEL-Bus multi-axis communication	100 Mbps (based on Ethernet components)
	CAN interface option	with DSO-CAN board
	PROFIBUS interface option	with DSO-PRO board
	MACRO interface option	with DSO-MAC board
	SERCOS interface option	with DSO-SER2 board
Position encoders interfaces	Analog 1Vptp	Max. 400kHz in. / Up to 2'048 (x4) interpolation factor
	Digital (TTL, RS422)	Max. 10 MHz input frequency
	EnDat 2.1 compatible input (EDT + ECL)	RS485
	Encoder limit switch (EHO + ELS)	TTL signal (rack format from version DSC2Pxxx-xxx**C)**
User's inputs / outputs	Digital input, insulated	6 + 3(1) (+ 8 with DSO-HIO optional board)
	Digital output, insulated	4 (+ 8 with DSO-HIO optional board)
	Analog input	1 (+ 4 depending on the DSO-HIO optional board version)
	Analog output	0 (+ 4 depending on the DSO-HIO optional board version)
Software / Programmability	ETEL Tools software for setting / monitoring	Windows 9x / 2000 / NT / XP
	DLL files (C / C++ / VB / LV)	Windows 9x / 2000 / NT / XP / QNX4 / QNX6
	User's programmable sequence	8191 lines
	Liquid Crystal Display	16 characters
	Firmware update	RS232, Turbo-ETEL-Bus

(1): These 3 inputs can be used if no digital Hall effect sensor is present on connector JC10.

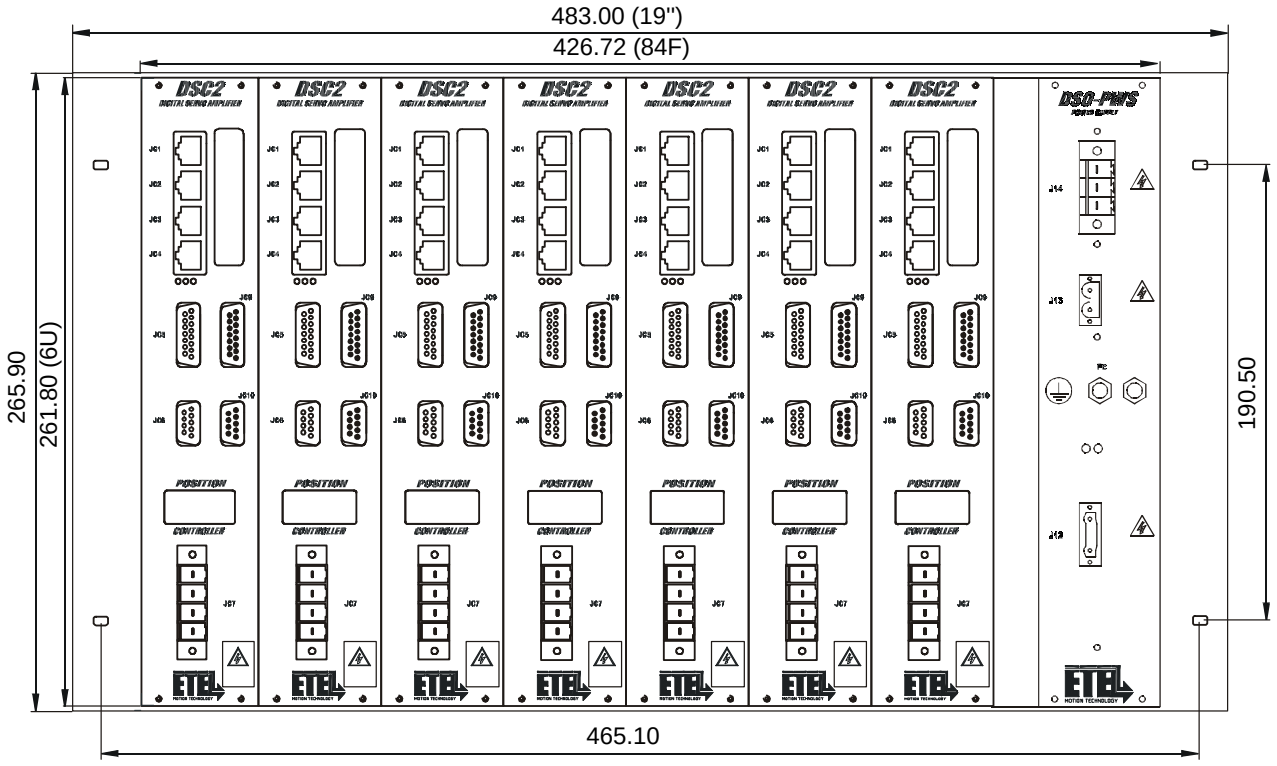
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2.1.4 Mounting systems – Installation requirements

The DSC2P rack formats are dedicated to be mounted inside a rack case system.

Warning: The rack case with the controllers and the power supply 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]

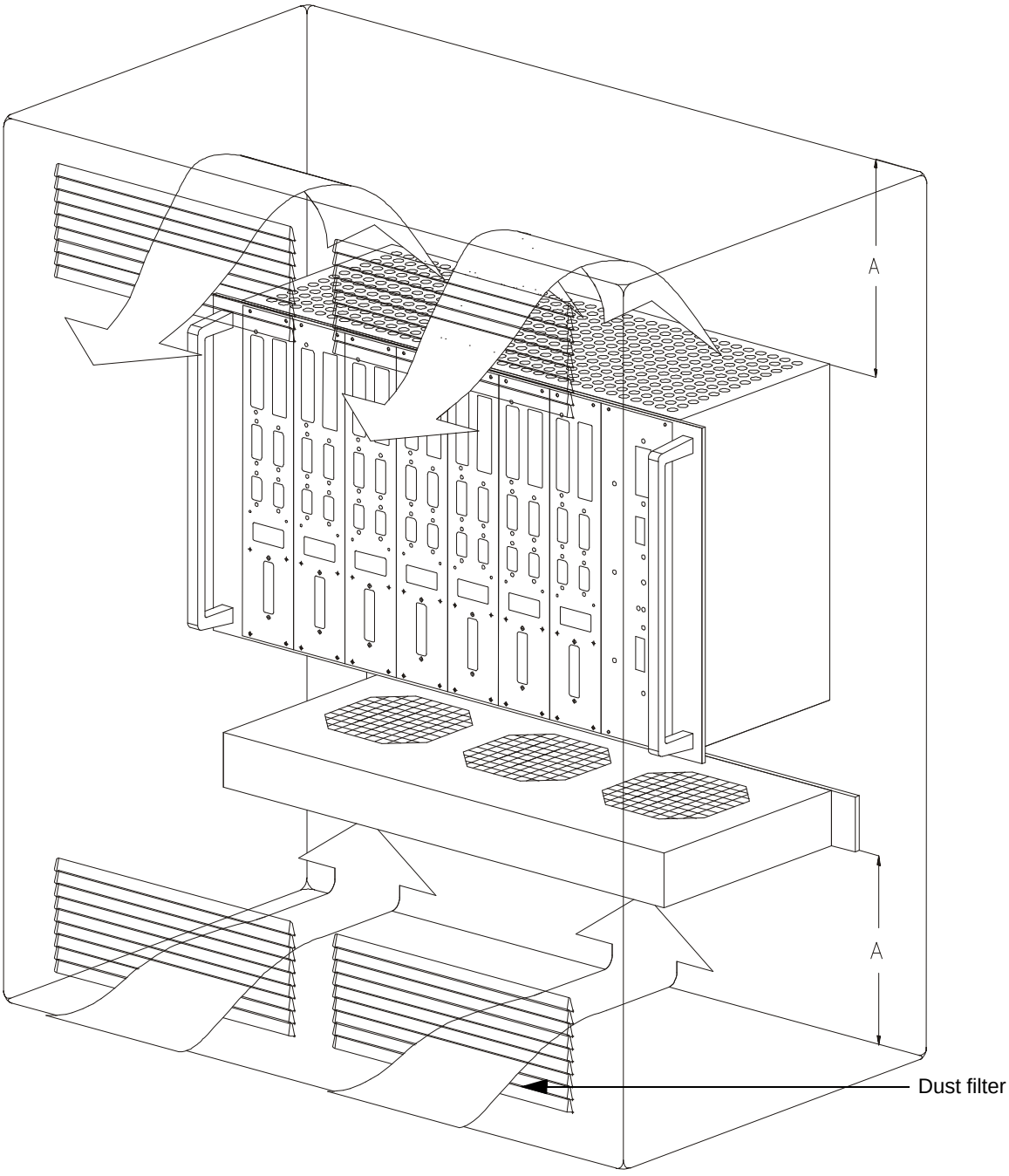
In the solution outlined above, seven DSC2Pxx1-xxx are powered by a DSO-PWS (ETEL's power supply).

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.

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.

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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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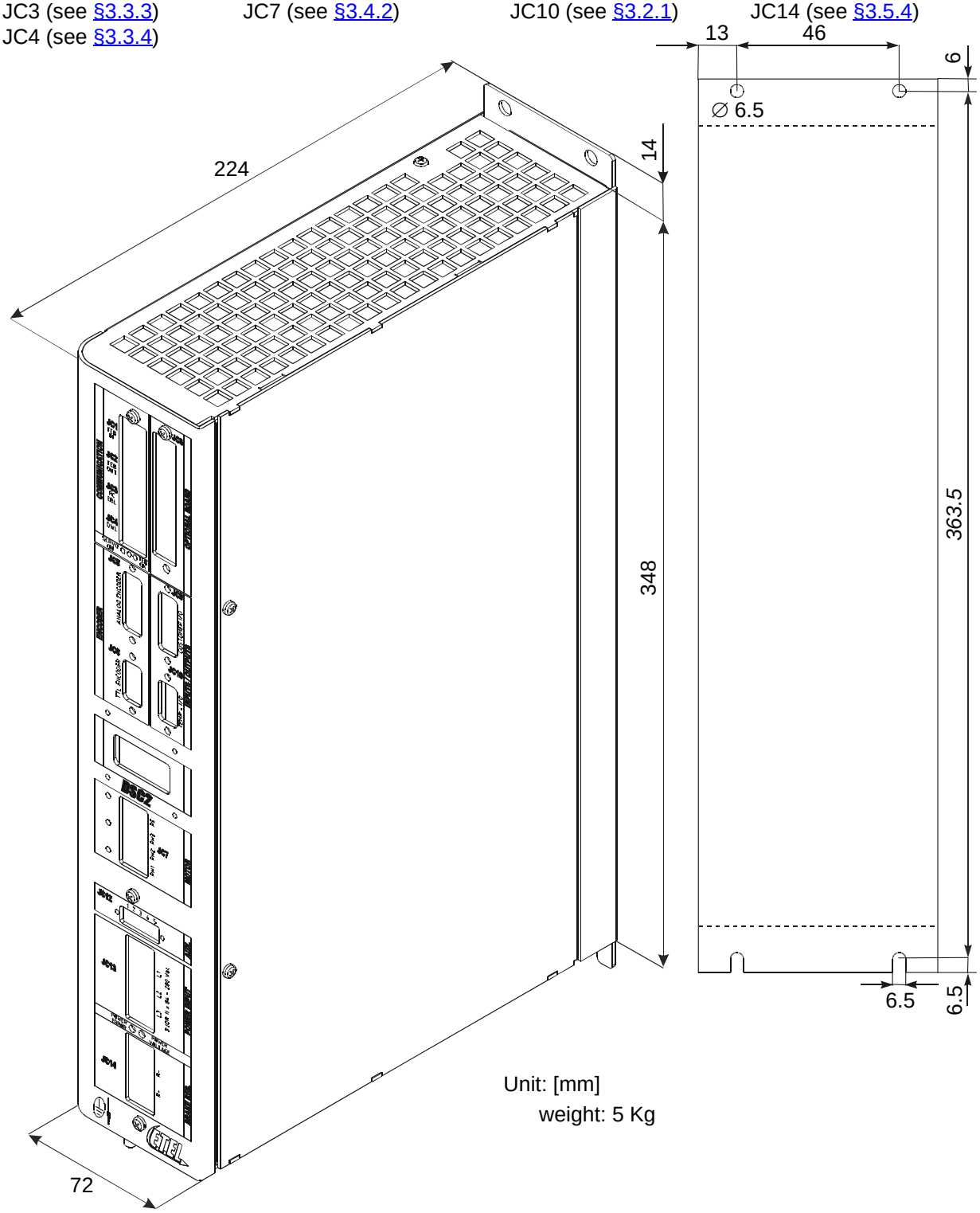
2.2 Housed format with power supply

There is one size of DSC2P housed format: the DSC2Pxx**4**-xxx (72 x 224 x 376 mm).

2.2.1 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 §3.1.2)
JC6 (see §3.1.2)
JC7 (see §3.4.2)
JC8 (see §3.6.1)
JC9 (see §3.2.1)
JC10 (see §3.2.1)
JC12 (see §3.5.3)
JC13 (see §3.5.2)
JC14 (see §3.5.4)



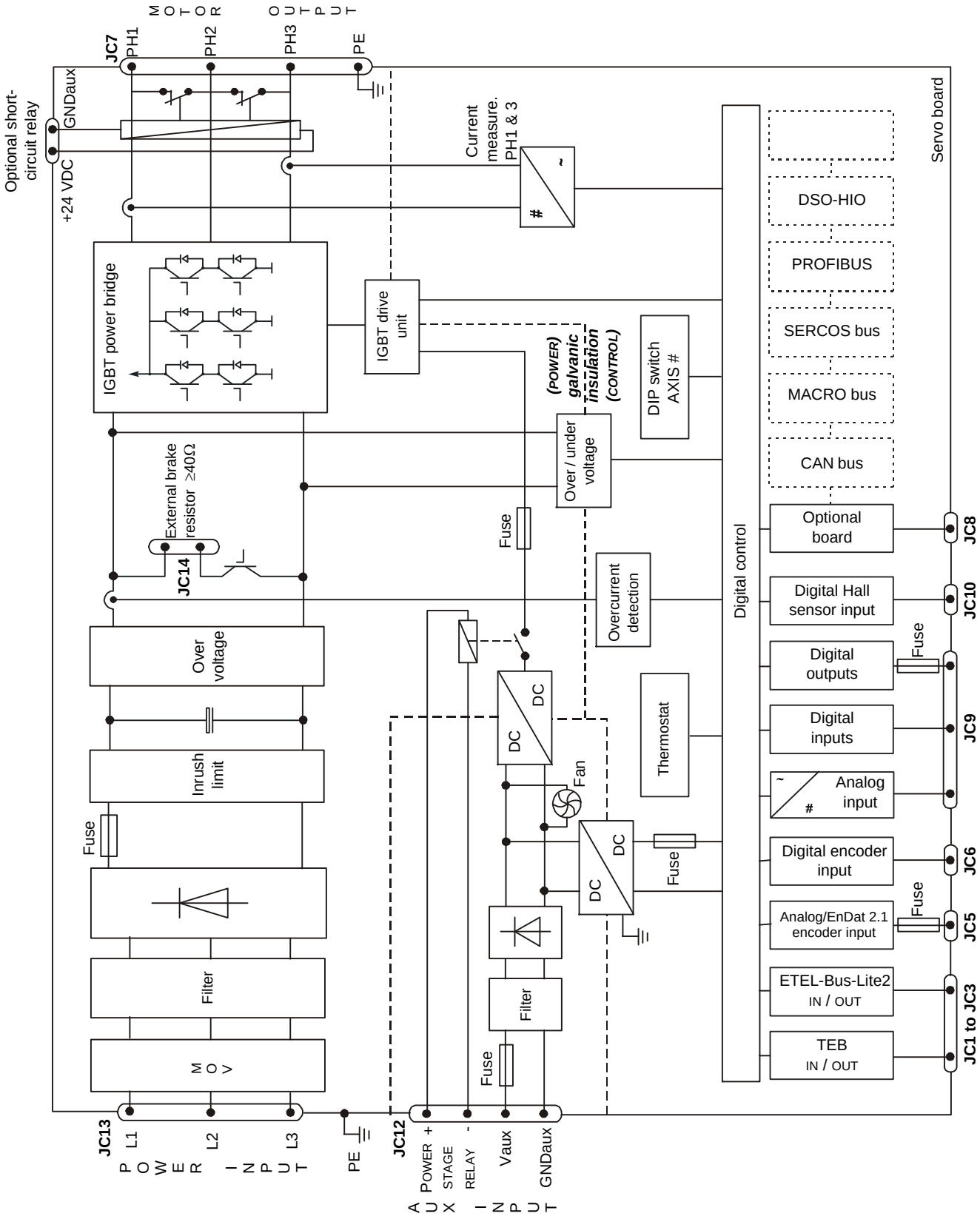
Unit: [mm]
weight: 5 Kg

Remark: 2 mm must be added to the above-mentioned width of the controller to take the screw heads into account.

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2.2.2 Block schematics

The housed format contains two boards: the servo board and the power supply board. On the servo board, the power part and the control part are galvanically separated. The inputs and outputs are insulated from the control part by opto-couplers.



Caution: The GND is internally connected to the DSC2P front panel which is connected to the ground (PE).
The power GND is not connected to the ground (PE).

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2.2.3 Ratings

There are four different types of DSC2P housed formats: the DSC2Px**24**-xxx, the DSC2Px**34**-xxx, the DSC2Px**44**-xxx and the DSC2Px**54**-xxx.

All the specifications are given for an ambient temperature ranging from +15°C (59°F) to +30°C (86°F):

DSC2P POWER FEATURES for HOUSED FORMAT						
Characteristics			**-Px24-**	**-Px34-**	**-Px44-**	**-Px54-**
Output to the motor		Voltage (up to)	400 VDC			
		Current range on product label	3.75 Arms / 7.5 Arms (1s)	7.5 Arms / 15 Arms (1s)	15 Arms / 30 Arms (1s)	15 Arms / 40 Arms (0.5s)
	PWM at 24 kHz	**Three-phase** motor Max. full load current	8.8 A (6.2 Arms)	21 A (14.8 Arms)	21 A (14.8 Arms)	21 A (14.8 Arms)
		Three-phase motor Max. overload current during 2 s	11 A (7.7 Arms)	24.2 A (17.1 Arms)	42 A / 1.5s (29.6 Arms / 1.5s)	42 A / 1.5s (29.6 Arms / 1.5s)
	PWM at 12 kHz	**Three-phase** motor Max. full load current	8.8 A (6.2 Arms)	21 A (14.8 Arms)	28 A (19.8 Arms)	28 A (19.8 Arms)
		Three-phase motor Max. overload current during 2 s	11 A (7.7 Arms)	24.2 A (17.1 Arms)	48.4 Arms (34.2 Arms)	56 A (39.5 Arms)
	PWM at 24 kHz	**Two-phase** motor Max. full load current	10 A (7 Arms)	14 A (9.8 Arms)	14 A (9.8 Arms)	14 A (9.8 Arms)
		Two-phase motor Max. overload current during 2 s	12 A / 10 s (8.4 Arms)	21.2 A (15 Arms)	28 A (19.8 Arms)	28 A (19.8 Arms)
	PWM at 12 kHz	**Two-phase** motor Max. full load current	12 A (8.4 Arms)	14 A (9.8 Arms)	14 A (9.8 Arms)	14 A (9.8 Arms)
		Two-phase motor Max. overload current during 2 s	12 A / no time limit (8.4 Arms)	24.2 A / 4 s (17.1 Arms)	28 A / 4 s (19.8 Arms)	28 A / 4 s (19.8 Arms)
	PWM at 24 kHz	**One-phase** motor Max. full load current	12 A (8.4 Arms)	20 A (14.1 Arms)	20 A (14.1 Arms)	20 A (14.1 Arms)
		One-phase motor Max. overload current during 2 s	12 A / no time limit (8.4 Arms)	24.2 A (17.1 Arms)	40 A (28.2 Arms)	40 A (28.2 Arms)
	PWM at 12 kHz	**One-phase** motor Max. full load current	12 A (8.4 Arms)	20 A (14.1 Arms)	20 A (14.1 Arms)	20 A (14.1 Arms)
		One-phase motor Max. overload current during 2 s	12 A / no time limit (8.4 Arms)	24.2 A / 4 s (17.1 Arms)	40 A / 4 s (28.2 Arms)	40 A / 4 s (28.2 Arms)
Power supply input		AC voltage (single or three-phase)	84 - 280 VAC			
		Max. AC current at 1x or 3x 84 - 280 VAC	1x or 3x 6 A			
		Max. inrush current per phase at 280 VAC	15 Apeak			
Auxiliary supply input		DC voltage	24 VDC			
		Max. current at 24 VDC	850 mA(1)			
Maximum current measurable by the controller			12.5 A	25 A	50 A	66.67 A

(1): With optional board mounted on the DSC2P, no external device connected to the I/O. The current can change depending on the type(s) of encoder(s) used. A current equal to about twice the above-mentioned value can be necessary to switch on the controller (because of the trigger pulse).

Remark: With PWM at 24 kHz, the current ripple in the motor is at 48 kHz (24 kHz with PWM at 12 kHz).

With two-phase motor, the current in 'motor phase 1- / 2-' (pin 3 of JC7 connector) is equal to (√2 x motor phase 1+) or (√2 x motor phase 2+). Be careful to use the suitable cable diameter.

For an ambient temperature exceeding +30°C, a derating of 0.5 A per degree must be applied on the above-mentioned current values.

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 IGBTs and can induce their breakdown after 10 minutes if the current is near the maximum full load.

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DSC2P CONTROL FEATURES for HOUSED FORMAT		
General	Motion profile and command management sampling time	166 µs
	Current loop sampling time	41.6 µs
	Position loop sampling time	41.6 µs
	Motion profiles	Trapezoidal / S-curve / Sine / look-up table / interpolated (DSMAX)
	32 bits floating point DSP	Dual SHARC, Digital Signal Processor
	Power stage relay	Relay cutting the + 15 VDC voltage of the power part
	Brake resistor	External > 40Ω with thermal switch protection
Standard interfaces	ETEL-BUS-LITE 2 host (PC) communication	RS232 or RS422 / 9600 to 115'200 bps
	Turbo-ETEL-Bus multi-axis communication	100 Mbps (based on Ethernet components)
	CAN interface option	with DSO-CAN board
	PROFIBUS interface option	with DSO-PRO board
	MACRO interface option	with DSO-MAC board
	SERCOS interface option	with DSO-SER2 board
Position encoders interfaces	Analog 1Vptp	Max. 400kHz in. / Up to 2'048 (x4) interpolation factor
	Digital (TTL, RS422)	Max. 10 MHz input frequency
	EnDat 2.1 compatible input (EDT + ECL)	RS485
	Encoder limit switch (EHO + ELS)	TTL signal
User's inputs / outputs	Digital input, insulated	6 + 3(1) (+ 8 with DSO-HIO optional board)
	Digital output, insulated	4 (+ 8 with DSO-HIO optional board)
	Analog input	1 (+ 4 depending on the DSO-HIO optional board version)
	Analog output	0 (+ 4 depending on the DSO-HIO optional board version)
Software / Programmability	ETEL Tools software for setting / monitoring	Windows 9x / 2000 / NT / XP
	DLL files (C / C++ / VB / LV)	Windows 9x / 2000 / NT / XP / QNX4 / QNX6
	User's programmable sequence	8191 lines
	Liquid Crystal Display	16 characters
	Firmware update	RS232, Turbo-ETEL-Bus
Option	Motor's short-circuit relay	Relay short-circuiting the motor's phases

(1): These 3 inputs can be used if no digital Hall effect sensor is present on connector JC10.

2.2.4 Mounting systems – Installation requirements

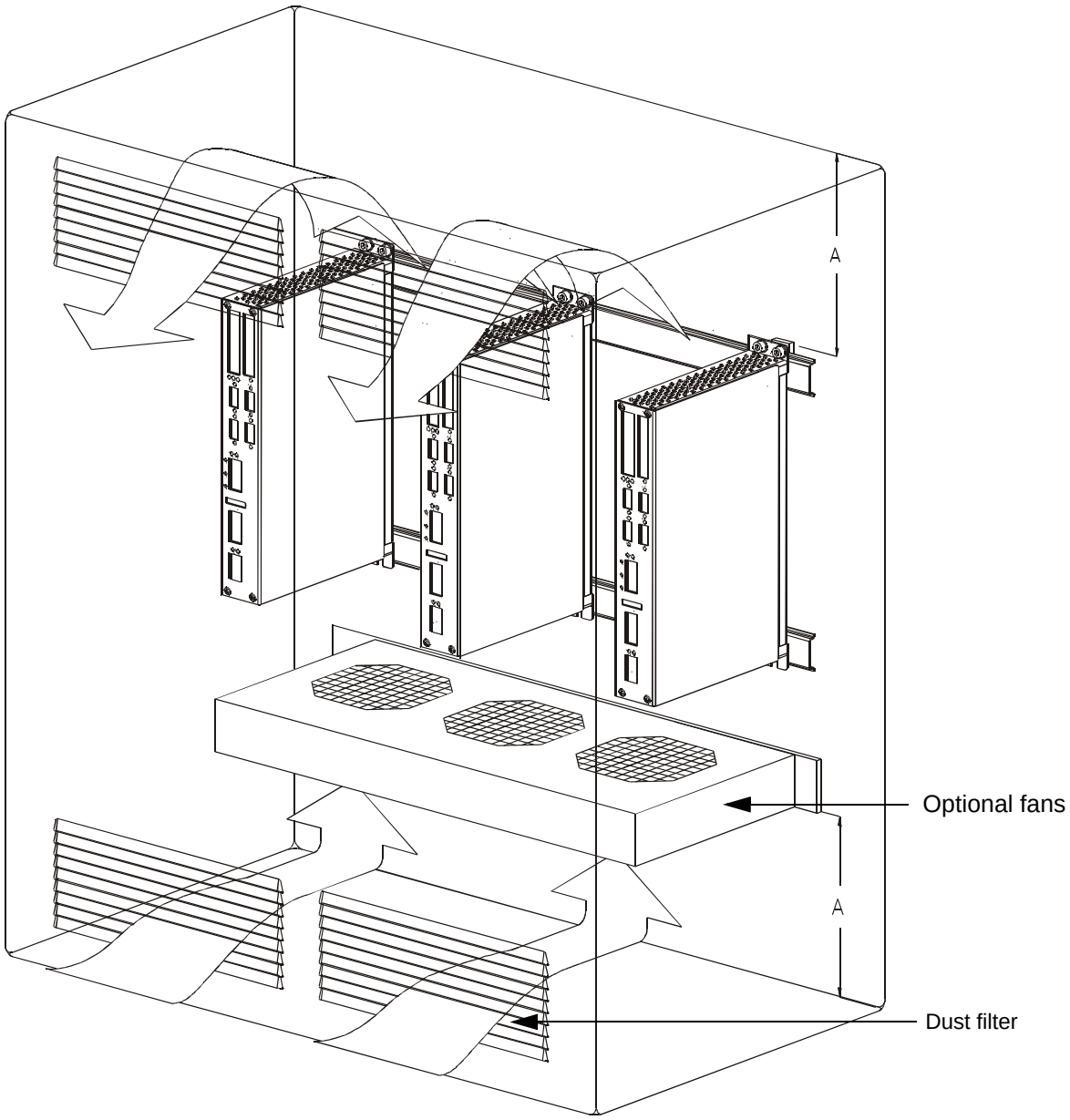


Warning: The housed format has the following electrical safety degree: IP 20 (according to EN 60529 standard).
The housed format must be installed in an enclosure respecting a pollution degree of 2 (refer to UL 508C and EN 50178 standards for more information).

The controllers should be protected against any splashes of liquid and any contacts with smoke and dust. They must be installed inside a closed cabinet and screwed on a metallic plate, where no vibration will occur. The ground of the controller(s) must be connected prior to any other connections.

A fan is already present in the housing of the housed format. Nevertheless, it is recommended to install fans in the cabinet to guarantee an air flow (the fan power depends on the user application).

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

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2.3 Ordering information

Here is the ordering information describing the meaning of each digit present on the label of the DSC2P:

D	S	C	2	P	1	2	1	-	1	1	1	X	-	0	0	0

Family product:
DSC2P: 400VDC position controller

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

Power output:
1 = 3.75 Arms (no time limit)
2 = 3.75 Arms / 7.5 Arms (1s)
3 = 5 Arms (for 10F rack) or 7.5 Arms (for 14F rack) / 15 Arms (1s)
4 = 10 Arms (for 10F rack) or 15 Arms (for 14F rack) / 30 Arms (1s)
5 = 15 Arms / 40 Arms (0.5s)

Assembly:
1 = Rack format with plate heat sink and frontplate of 10F (available with power output 1, 2, 3 and 4, with relay option 1)
2 = Rack format with extruded heat sink and frontplate of 14F (available with power output 3, 4 and 5, with relay option 1)
4 = Housed format (available with power output 2, 3, 4 and 5, with relay option 3 or 4, and auxiliary supply input 2)

Relay option:
1 = Without relay (only for rack format assembly 1 and 2)
3 = With power stage relay (only for housed format assembly 4)
4 = With motor's short-circuit relay AND power stage relay (only for housed format assembly 4)

Auxiliary supply input:
1 = 120 - 340VDC
2 = 24 - 55VDC (only +24VDC for housed format assembly 4)

Standard option:
1 = Not UL recognized
2 = UL recognized
By default, the DSC2P 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 connector (see §3.4).

Power connector (see §3.5).

Optional boards connector (see §3.6).



Warning: 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 controller, **turn off all the power supplies and wait 10 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 connector must always be correctly screwed onto the DSC2P.



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 Encoders connectors

3.1.1 Connector JC5: Analog position encoder (1Vptp, EnDat 2.1)

Caution: The encoder cable 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).

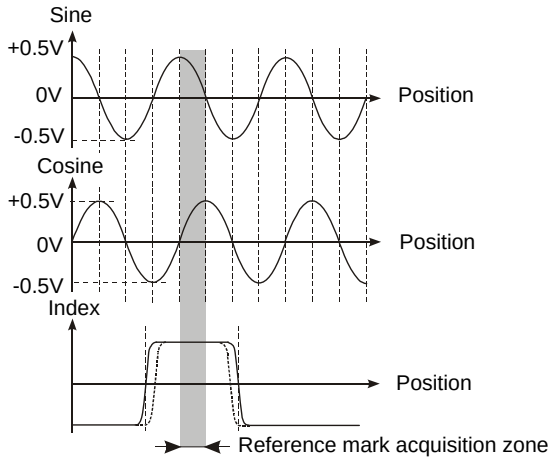
Caution: The encoder connector must be handled in an ESD protected environment, only.

Remark: The encoder cable(s) connected to the DSC2P must be shielded (see §3.7.1).

Two different types of encoder can be connected to the analog encoder connector: either an incremental analog encoder 1 Vptp or an analog absolute encoder (EnDat 2.1).

3.1.1.1 Incremental analog encoder (1 Vptp)

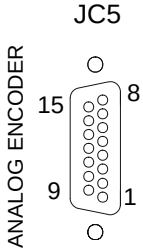
The incremental analog encoder has 1 Vptp signals with a load resistor R_0=120Ω. It determines the motor position thanks to two sinusoidal signals with a 90° phase-shift (sine and cosine). A third signal, the index (also called reference mark), gives the absolute motor position:

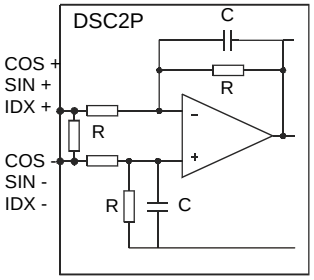


The +5VDC encoder supply output is protected by the fuse F3 (1A) on JC5, JC6 and JC10.

D-SUB, 15 pins, female

ANALOG ENCODER	Pin #	Signal	Function	Interface
JC5	1	Reserved	**Do not connect**	
	2	Reserved	**Do not connect**	
	3	Reserved	**Do not connect**	
	4	+5VDC	Encoder supply output (protected by fuse F3 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	





Remark: Refer to the corresponding **'Operation & Software Manual'** for more information about the use of EHO and ELS signals. The EHO signal is only present from the DSC2Pxxx-xxx**C**.

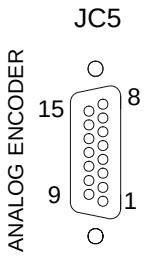
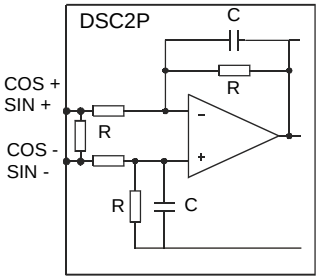
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3.1.1.2 *Absolute analog encoder (EnDat 2.1)*

The EnDat 2.1 is an absolute encoder. It has 1 Vptp 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 DSC2P. From its first falling edge (latch signal), the **absolute position will be defined within one incremental signal period** (depends on the encoder type).

The +5VDC encoder supply output is protected by the fuse F3 (1A) on JC5, JC6 and JC10.

D-SUB, 15 pins, female

ABSOLUTE ENCODER	Pin #	Signal	Function	Interface
	1	EDT +	EnDat serial data I/O + / RS485	
	2	ECL +	EnDat clock output + / RS485	
	3	ECL -	EnDat clock output - / RS485	
	4	+5VDC	Encoder supply output (protected by fuse F3 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 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).

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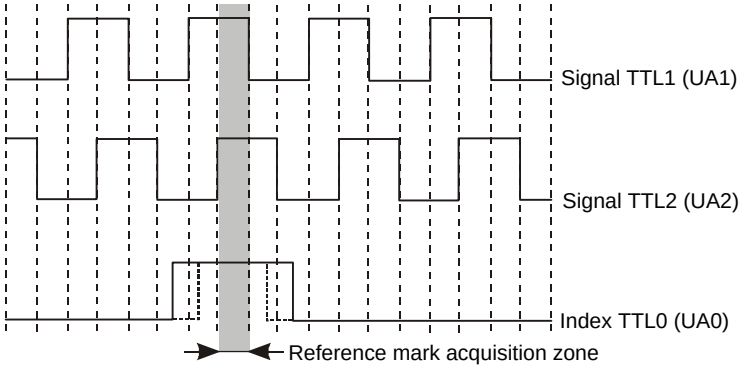
3.1.2 Connector JC6: TTL position encoder

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

Remark: The encoder cable(s) connected to the DSC2P must be shielded (see §3.7.1).

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:



Furthermore, **the motor over temperature protection** (TSD: Temperature Sensor Digital) can also be connected to this connector (JC6). This signal is also present on JC10 (Temperature + I/O) connector. Both TSD inputs are hard-wired and then only one TSD input must be connected: JC6 **or** JC10! (refer to §3.1.3 for more information about the TSD input).

The +5VDC encoder supply output is protected by the fuse F3 (1A) on JC5, JC6 and JC10.

D-SUB, 9 pins, female

TTL ENCODER	Pin #	Signal	Function	Interface
JC6 (TTL ENCODER)	1	+5VDC	Encoder supply output (protected by fuse F3 of 1A)	UA0- UA1- UA2- UA0+ UA1+ UA2+ DSC2P R
	2	UA2 -	TTL 2 - signal	
	3	UA2 +	TTL 2 + signal	
	4	UA1 -	TTL 1 - signal	
	5	UA1 +	TTL 1 + signal	
	6	UA0 -	TTL 0 - signal	
	7	UA0 +	TTL 0 + signal	
	8	TSD	Digital temperature sensor input (SNM or thermostat) **Caution:** Input also on JC10 - **connect only one!**	
	9	GND	Encoder supply output (0V)	

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3.1.3 Connector JC10: Temperature sensor and digital inputs/Hall effect sensor

Caution: This cable must be insulated (no contact) from the power and the mains.
The inputs (except TSD) of this connector are galvanically insulated by opto-couplers. The inputs and outputs must be connected to an Extra Low Voltage circuit only (SELV).

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

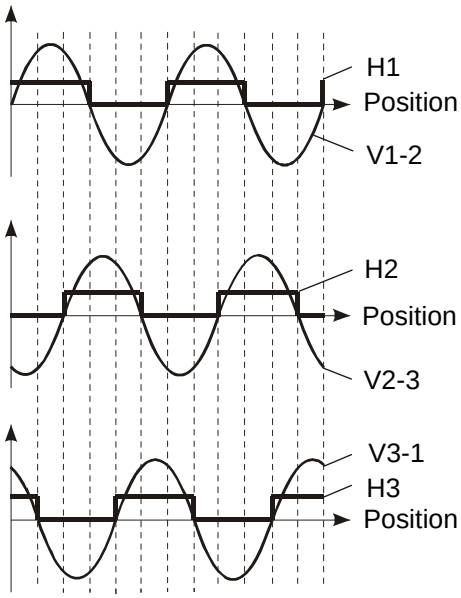
Remark: The temperature sensor cable connected to the DSC2P must be shielded (see §3.7.1).

3.1.3.1 Digital inputs

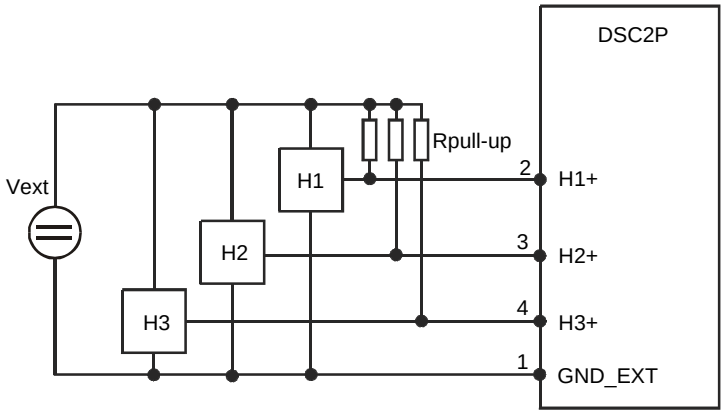
The 3 digital inputs (DIN5 to DIN7) can be used additionally to the 6 digital inputs already present on connector JC9 or can be connected to a digital Hall effect sensor.

Digital Hall effect sensor

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



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



An external pull-up (resistor) must be added per sensor. A resistor of 1.5 kΩ (1/4 W) must be used if Vext is equal to +15VDC. If the user needs to supply the Hall effect sensor with another voltage, please contact ETEL to define the value of the resistor.

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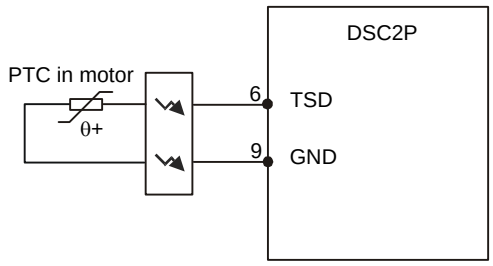
3.1.3.2 Motor temperature

A temperature input (TSD: Temperature Sensor Digital) is present on the DSC2P to protect the motor against overheating.

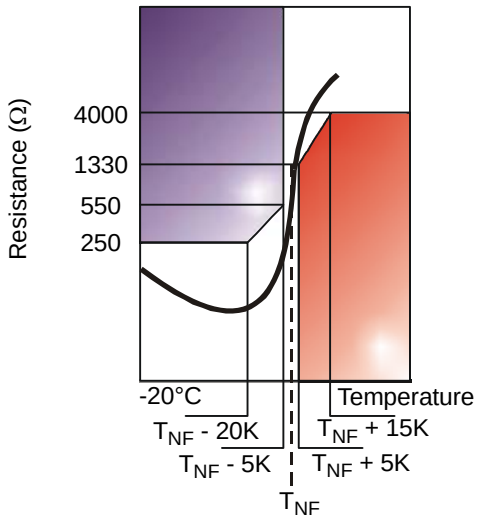
Warning: If the insulation (SELV) of the temperature sensor (TSD) does not comply with the EN 50178 standard, an extra insulation protection must be added between the controller and the PTC.

Motor over temperature protection (TSD)

If a motor must be protected against overheating, ETEL includes an optional PTC resistor (Positive Temperature Coefficient) inside its windings. If the user has asked for this option, the temperature protection must be connected as shown below:



Remark: The diagram above shows the connection of a Positive Temperature Coefficient sensor (PTC). A 'normally closed' thermostat can also be connected to the TSD input. Here is the PTC sensor characteristics used by ETEL.



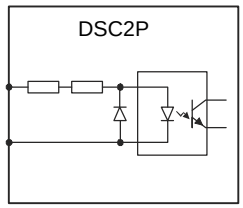
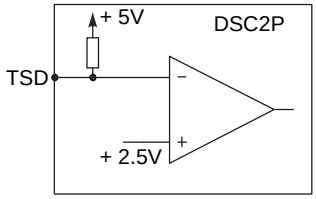
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The +5VDC encoder supply output is protected by the fuse F3 (1A) on JC5, JC6 and JC10.

The table below shows the pin assignment of the connector JC10 for two different uses:

- Use of additional digital inputs (DIN) if the others (6) on connector JC9 are already used.
- Use of a digital Hall effect sensor.

D-SUB, 9 pins, male

TEMPERATURE + I/O	Pin #	Signal	Function	Interface
TEMPERATURE + I/O JC10 6 1 9 5	1	GNDext	External supply input (0V) for DIN **(same GNDext also on JC9)**	DIN5+ DIN6+ DIN7+ or H1+ H2+ H3+ GNDext 
	2	DIN5 +	Digital input 5 + (H1+)	
	3	DIN6 +	Digital input 6 + (H2+)	
	4	DIN7 +	Digital input 7 + (H3+)	
	5	GND	Encoder supply output (0V) - **not used with DIN!**	
	6	TSD	Digital temperature sensor input (SNM or thermostat) **Caution:** input also on JC6 **- connect only one!**	
	7	+5VDC	Encoder supply output - **not used with DIN!** (protected by fuse F3 of 1A)	
	8	Reserved	**Do not connect**	
	9	GND	Encoder supply output (0V) - **not used with DIN!**	

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

	Status	Typical	Maximum
DINs 5, 6 & 7	0 => 1	4 µs	5 µs
	1 => 0	35 µs	40 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.

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3.2 Inputs / outputs connector

3.2.1 Connector JC9: Customer inputs / outputs

Caution: The inputs/outputs cable 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)
The digital inputs and outputs of this connector are galvanically insulated by opto-couplers.
The analog input is not galvanically insulated from the GND.

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

Remark: The inputs/outputs cable connected to the DSC2P must be shielded (see §3.7.1).

The DSC2P has 6 digital inputs (DIN1 to DIN4, DIN9 and DIN10) and 4 digital outputs (DOUT1 to DOUT4). Every digital input and output is opto-coupled. DIN3, DIN4, DIN9 and DIN10 are opto-coupled through a **high speed** opto-couplers (100 ns). The DSC2P has also one analog input (AIN1). The A/D converter has a 12 bits resolution and can convert analog signals ranging between +10VDC and -10VDC.

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 Analog input

To use the analog input (AIN1), a voltage ranging from +10VDC to -10VDC must be applied between pins 2 (AIN1+) and 9 (AIN1-).

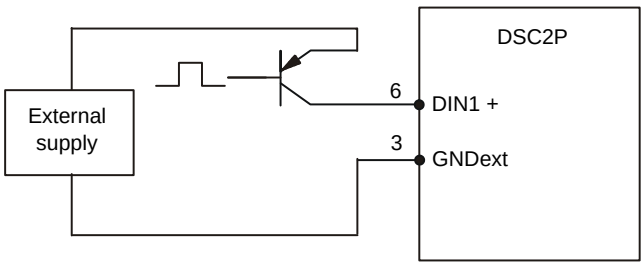
Remark: If AIN1 = +10VDC ⇒ monitoring M51 = -2048, and if AIN1 = -10VDC ⇒ monitoring M51 = +2047

3.2.1.2 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.

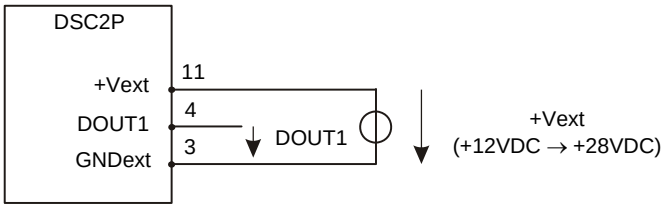
The auxiliary supply can be external to the controller, as shown below:



3.2.1.3 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 F2).
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 GNDext).

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Remark: **This diagram shows the use of DOUT1, but it is the same with DOUT2, DOUT3 and DOUT4.**

D-SUB, 15 pins, male

CUSTOMER I / O	Pin #	Signal	Function	Interface
JC9 CUSTOMER I/O (9, 1, 15, 8)	1	GND	Auxiliary supply output (0V)	DIN1+ to DIN4+ DIN9+ DIN10+ / GNDext — DSC2P
	2	AIN1 +	Analog input 1 +	
	3	GNDext	External supply input (0V) for the digital inputs and outputs	
	4	DOUT1	Digital output 1 +	DSC2P — +Vext, F2, BSP450, DOUT1 to DOUT4, 33 kΩ, GNDext
	5	DOUT3	Digital output 3 +	
	6	DIN1 +	Digital input 1 +	
	7	DIN3 +	Digital input 3 + (high speed 100ns)	
	8	DIN9 +	Digital input 9 + (high speed 100ns)	
	9	AIN1 -	Analog input 1 -	DSC2P — AIN1+, +/- 10V, AIN1-, R, C
	10	DOUT4	Digital output 4 +	
	11	+Vext	External supply input for digital outputs (protected by fuse F2 of 500mA - limits user's input current)	
	12	DOUT2	Digital output 2 +	
	13	DIN2 +	Digital input 2 +	
	14	DIN4 +	Digital input 4 + (high speed 100ns)	
	15	DIN10 +	Digital input 10 + (high speed 100ns)	

Remark: The converter used for the analog input is a 12 bits converter.

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

	Status	Typical	Maximum	Unit
DOUTs	0 => 1	50	55	µs
	1 => 0	300	330	µs
DINs 3, 4, 9 and 10 (high speed)	0 => 1	100	110	ns
	1 => 0	600	660	ns
DINs 1 and 2	0 => 1	4	5	µs
	1 => 0	40	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.

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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 DSC2P must be shielded (see §3.7.1).

The communication between a host (PC) and a DSC2P is obtained via the ETEL-Bus-Lite2 (EBL2) protocol (refer to the **'EBL2 Communication Manual'** for more information). The communication between the DSC2Ps is obtained via the Turbo-ETEL-Bus (TEB) protocol which needs a TEB master (DSMAX or DSTEB or DSC2P in μ-master mode).

The ETEL-Bus-Lite2 protocol is open to the user. It is configured as follows:

Transmission rate	9600 to 115'200 bps
Data length	8 bits
Start bit	1
Stop bit	1
Parity	No
Handshaking	No

The EBL2 transmission rate can be selected with the parameter K195 (refer to the corresponding **'Operation & Software Manual'** for more information).

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

ETEL-Bus-Lite2 (communication between a PC and a DSC2P)		**Turbo-ETEL-Bus (communication between DSC2Ps)**
RS 232	**RS 422**	
Normal connection between a PC and a DSC2P 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.

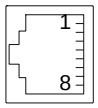
The communication connectors are JC1, JC2, JC3 and JC4 (see the following tables).

The JC1 connector is used for the TEB data input and JC2 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 as well as the slow time interrupt (STI).

Remark: The download key of the DSC2P is not compatible with the DSB2P key.

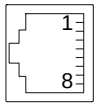
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3.3.1 Connector JC1: Turbo-ETEL-Bus input

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 +	DSC2P synchronization input +
	4	RSI +	DSC2P TEB reset input +
	5	RSI -	DSC2P TEB reset input -
	6	SNI -	DSC2P synchronization input -
	7	AUXO +	Output reserved for a future TEB application
	8	AUXO -	Output reserved for a future TEB application

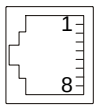
Remark: The TEB cable must meet the following characteristics: 1:1 shielded cable, category 5 with 8 wires.

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 +	DSC2P synchronization output +
	4	RSO +	DSC2P TEB reset output +
	5	RSO -	DSC2P TEB reset output -
	6	SNO -	DSC2P 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.

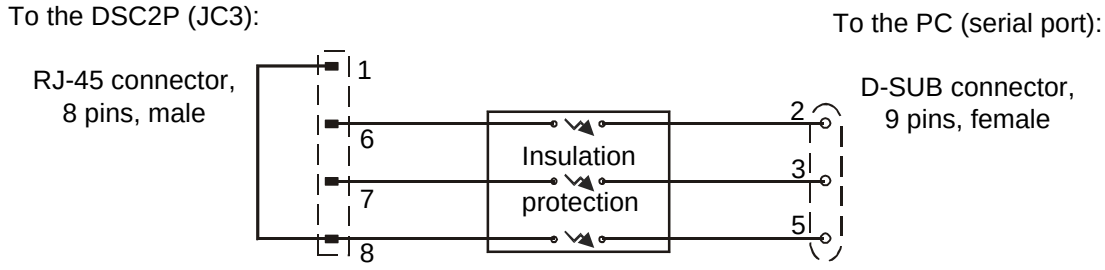
3.3.3 Connector JC3: ETEL-Bus-Lite2 serial communication

RJ-45, 8 pins, female			
PC-EBL	**Pin #**	**Signal**	**Function**
JC3 PC-EBL 	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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Caution: To respect the 'Standard safety of information technology equipment' standard (EN 60950, UL 60950), the serial cable used between the controller and the computer must have an insulation protection (except if the auxiliary and power input are lower than 50VDC).

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



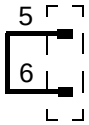
3.3.4 Connector JC4: Download key

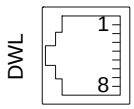
This connector is used for the download key. If the DSC2P does not switch to 'wait for program', there is an hardware override possibility to force this mode. To do so, plug the download key into the JC4 connector, switch off and on the controller, and the DSC2P will switch to 'wait for program' in order to download a new firmware in the DSC2P.

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+ (*) STI+ (*)	Indicates when the analog encoder's sine + signal goes through 0 (TTL signal) Slow time interrupt + signal (6 kHz) active on a low state (TTL signal)
	2	SIN- (*) STI- (*)	Indicates when the analog encoder's sine - signal goes through 0 (TTL signal) Slow time interrupt - signal (6 kHz) active on a low state (TTL signal)
	3	COS+ (*) STI- (*)	Indicates when the analog encoder's cosine + signal goes through 0 (TTL signal) Slow time interrupt - signal (6 kHz) active on a low state (TTL signal)
	4	COS- (*) STI+ (*)	Indicates when the analog encoder's cosine - signal goes through 0 (TTL signal) Slow time interrupt + signal (6 kHz) active on a low state (TTL signal)
	5	DWL +	Sets the DSC2P to 'wait for program' (download) if connected to 0V
	6	GND	Auxiliary supply output (0V)
	7	Reserved	**Do not connect**
	8	Reserved	**Do not connect**

Remark: (*): these signals are only available from the firmware version 1.14B and activated with bit 0 of K100 parameter.
If bit 0 of K100 is cleared, the sine and cosine signals are available
If bit 0 of K100 is set, the STI signals are available

The download key of the DSC2P is compatible with the DSC2V, DSCDP and DSCDL key.

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

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3.4 Motor connector



Warning: High voltage may be present on the motor connector.
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.



Caution: The motor connector must be insulated (no contact) from the power and the mains.
The motor connector must always be correctly screwed onto the DSC2P to respect the EMC standard.



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

Remark: The motor cable connected to the DSC2P must be shielded (see §3.7.1).

3.4.1 ETEL motor cable numbering system

ETEL standard motors cables are numbered according to the following system:

Three-phase motors	
Designation	**Function**
1 or U1	Motor phase 1
2 or VV2	Motor phase 2
3 or WWW3	Motor phase 3
Green / Yellow	Protective earth

3.4.2 Connector JC7: Motor connection

The DSC2P can drive single-phase, two-phase and three-phase motors. Connector JC7 enables the supply of the motor phase(s).

Phoenix Contact PC 4/4-G-7,62 (plastic connector)					
MOTOR CONNECTION	Pin #	Signal	Function		
			1-phase motor	2-phase motor	3-phase motor
JC7 MOTOR CONNECTION 1 4	1	PE	Protective earth	Protective earth	Protective earth
	2	PH3	**Do not connect**	Motor phase 2 +	Motor phase 3
	3	PH2	Motor phase -	Motor phase 1 - / 2 - (*)	Motor phase 2
	4	PH1	Motor phase +	Motor phase 1 +	Motor phase 1

(*): 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.

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3.5 Power connector

Warning: High voltage may be present on the power connectors.
Before plugging or unplugging a controller (in/from the rack case), connecting or disconnecting the power cables (for the housed format) 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 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 DSC2P must be shielded (see §3.7.1).

3.5.1 Connector JC15: Rack format, power supply input

You have the possibility to power the DSC2Ps:

3.5.1.1 With an ETEL power supply

The most practical way is to use an ETEL power supply (with an ETEL back panel) because all the necessary connections are already realized according to the table below. Just plug the power module and the controller at the right place (refer to the **'DSO-RAC2 Hardware Manual'** for more information).

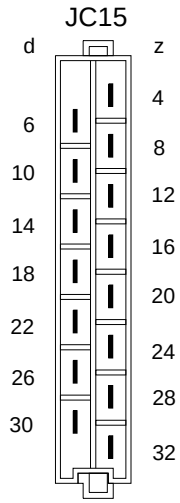
3.5.1.2 With a power supply from the market

If you are using a power supply from the market, it must include: an UL recognized filter for the EMC (refer to the 89/336/EEC directive), UL recognized MOVs (Epcos, SIOV-S14K320G5S5 (Vclamp=840V) for the power input and a SIOV-S14K275G5S5 (Vclamp=710V) for the auxiliary input, or equivalent (CCN XUHT2)), an inrush limiter (according to the size of the capacitor bank) and UL listed fuses (Little fuse, KLKD, F20AH 600VDC or equivalent on the power input and a F2AL, 250V on the auxiliary input).

The signal sent to the DSC2P pin d14 (INRUSH) has to be:

- +15VDC (loading or error): the power supply delivers the current to load the DSC2P DC bus capacitors (+15VDC between d14 (inrush) and z16 (GNDpwr)).
- 0V (ready): the power supply has finished to load the DSC2P DC bus capacitors (shorted to z16 (GNDpwr)).

DIN 41612-H15, 15 pins, male

POWER SUPPLY INPUT	Pin #	Signal	Function
	z4	Reserved	**Do not connect!**
	d6	+15VDC	**Do not connect!**
	z8	Reserved	**Do not connect!**
	d10	Reserved	**Do not connect!**
	z12	+Vaux	Auxiliary supply input, 24 to 55VDC or 120 to 340VDC, depending on controller model
	d14	INRUSH	Inrush input (0V = OK / +15VDC = loading) **Connected to ETEL power supply**
	z16	GNDpwr	Power supply input (0V)
	d18	GNDpwr	Power supply input (0V)
	z20	+Vpwr	Power supply input, 24 to 340VDC - **Always connect z20 and d22**
	d22	+Vpwr	Power supply input, 24 to 340VDC - **Always connect z20 and d22**
	z24	GNDaux	Auxiliary supply input (0V)
	d26	GNDpwr	Power supply input (0V)
	z28	PE	Protective earth - **Must always be connected for safety!**
	d30	PE	Protective earth - **Must always be connected for safety!**
	z32	PE	Protective earth - **Must always be connected for safety!**

For safety reasons, always connect first the protective earth (PE) to the dedicated pins!

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3.5.2 Connector JC13: Housed format, power supply input

This connector is only present on the DSC2Pxx**4**-xxx format.

Caution: **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.**

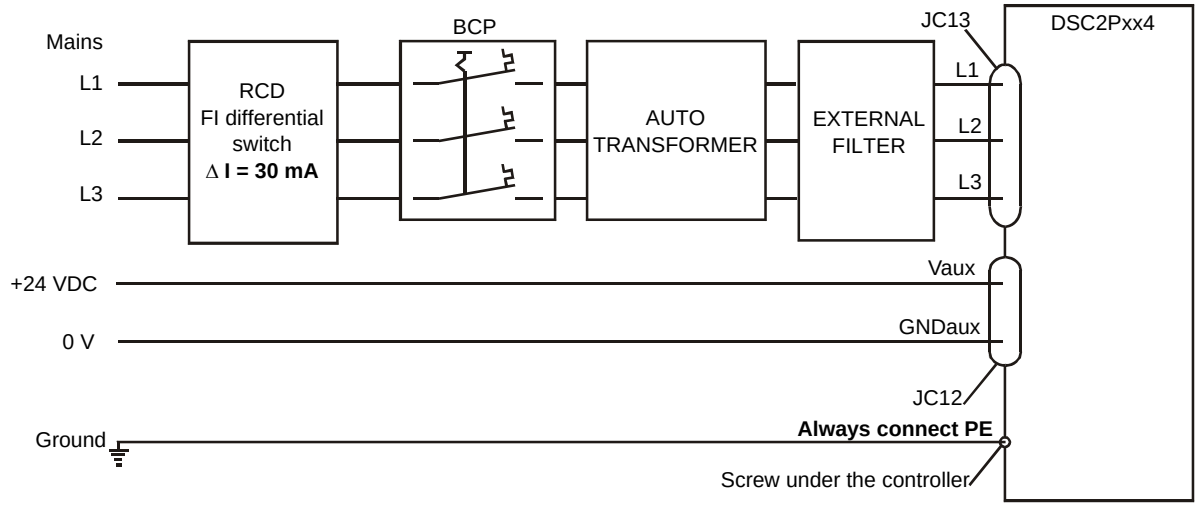
It is recommended to supply the power with an external transformer, whose characteristics depend on the user's application and on the mains supply characteristics. The transformer must meet the standard in force in the corresponding country.

Examples of transformers:

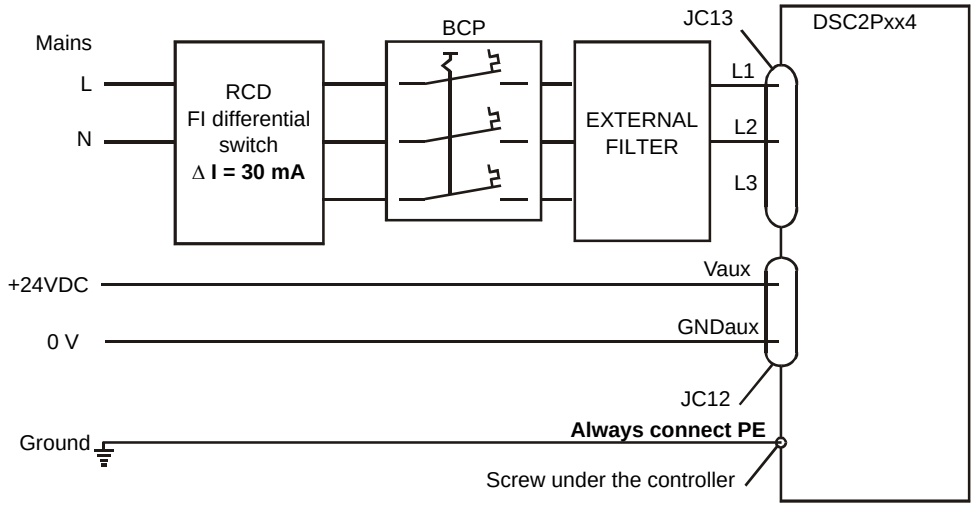
- With European mains: Primary 3 x 380 V ∇ - Secondary 3 x 220 V Y; the transformer adapts the mains voltage to the controller and prevents possible disturbances from invading the mains (meet CE standard).
- With US mains: Primary 3 x 220 V ∇ - Secondary 3 x 220 V Y; the insulation transformer prevents possible disturbances from invading the mains (meet UL standard).

For example, a Branch Circuit Protection (BCP) or a circuit breaker on the power line (JC13) allows the user to switch off the motor (in case of emergency) without loosing the position reading data. So, a new homing process will not be necessary after an emergency stop.

Three-phase connection



Single-phase connection

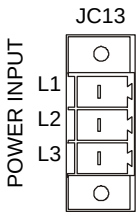


Remark: RCD = Residual Current Device and BCP = Branch Circuit Protection
If the DSC2P is used in an UL compatible system, the manufacturer of this system must use a BCP (ABB, S283UX, 13A, UL 489 listed or equivalent) otherwise a 16A circuit breaker is suitable for non-UL system.

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For the motor wiring, refer to the EN 60204/1 or NEC (UL) standard in order to use the adequate cable section.
The DSC2P housed format already includes an in-built filter. An additional filter can be added (for example (Schaffner FN2070-16-06) or a 'common mode choke' of 3mH (Schaffner RD6127-16-3m0)) to reduce further electromagnetic disturbances.

Phoenix Contact PC 4/3-G-7.62 (plastic connector)

Power Input	Signal	Function	3-phase mains	1-phase mains
	L1	Mains input for power supply (84 to 280 VAC MAX, between L1-L2)	Mains L1	Mains L1
	L2	Mains input for power supply (84 to 280 VAC MAX, between L2-L3)	Mains L2	Mains L2
	L3	Mains input for power supply (84 to 280 VAC MAX, between L3-L1)	Mains L3	**Do not connect**

For safety reasons, always connect first the protective earth (PE) to the screw under the DSC2P!

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

3.5.3 Connector JC12: Housed format, auxiliary supply input

This connector is only present on the DSC2Pxx**4**-xxx controller.

Phoenix Contact MC 1.5/5-STF-3.81 (plastic connector)

Auxiliary Input	Pin #	Signal	Function
	1	Optional short-circuit relay	Motor's short-circuit relay supply input (24 VDC (referred towards GNDaux))
	2	GNDaux	Auxiliary supply input (0 V)
	3	Vaux	Auxiliary supply input (24 VDC)
	4	Power stage relay -	Relay supply input (0 V)
	5	Power stage relay +	Relay supply input (24 VDC)

For safety reasons, always connect first the protective earth (PE) to the screw under the DSC2P!

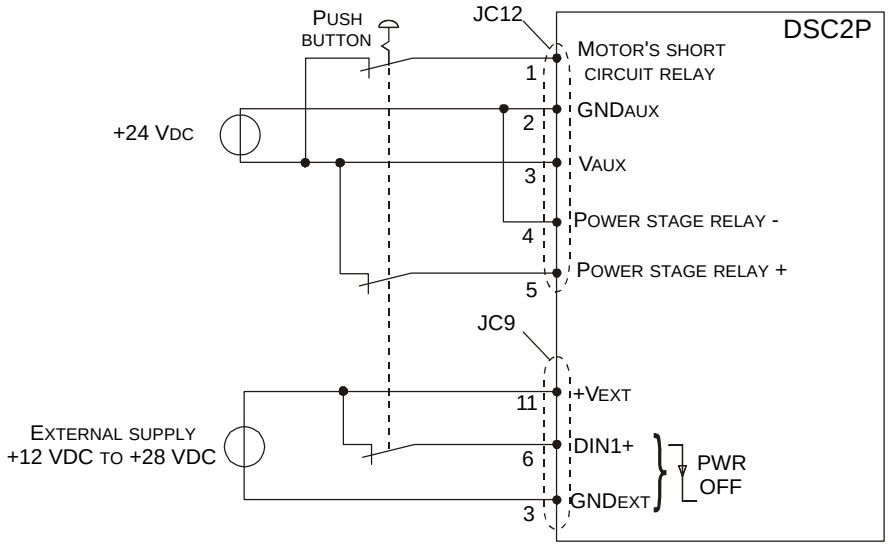
Remark: The tightening torque for the screws of the auxiliary input connector is 0.25 Nm max.

- The **power stage relay** (24 VDC / 2880 Ω) allows the user to cut the +15 VDC voltage supplying the IGBT gate driver, when the +24 VDC supply input of this relay is stopped.
  If the power stage relay is not powered, the IGBT gate driver is deactivated (IGBT opened) and no power is present on the motor's output. The power stage relay **must** then be powered (pin 4 to 0 V and pin 5 to +24 VDC) to have power on the motor's output (otherwise an 'Inrush error' will appear).

- The **motor's short-circuit relay** (+ 24 VDC / 490 Ω), which is **optional**, allows the user to short-circuit the motor's phases.
  If this relay is not powered, the motor's phases are shorted. The motor's short-circuit relay **must** then be powered (pin 1 to +24 VDC) to have power on the motor's output.

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Example of a power stage relay and short-circuit relay used with an emergency stop push button:



Remark: If the motor's short-circuit relay is not powered (motor's phases shorted) and if the user performs a 'PWR ON' on the controller, the 'hardware overcurr' error will occur (which must be avoid). If this relay is not powered while the controller is in 'PWR ON', the same error will occur. To avoid this problem, the DIN1+ can be used as described in the above-mentioned diagram. Refer to the corresponding **'Operation & Software Manual'** for more information about the use of DIN1+ (K33 parameter).

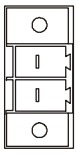
3.5.4 Connector JC14: Housed format, brake resistor

This connector is only present on the DSC2Pxx**4**-xxx format.

Warning: High power may be present on this connector, depending on the application.

Caution: Use only resistor with thermal shutdown protection. The resistor minimal value is 40Ω. The use of an undersized power and energy withstand capability resistor could generate an explosion.

If you determine that a regeneration resistor is necessary, select it to fit your application (refer to the **'Braking resistor' technical note** to calculate the value of this resistor). This resistor **must** include a thermal switch. Example of resistor used by ETEL: Frizlen GmbH (Germany), cemented, double pipe resistor, type FZZCQU-400x65, 39 Ω, 1200 W at 300°C. Metallic case protection (shielding), shielded connector.

Phoenix Contact PC 4/2-G-7.62 (plastic connector)		
BRAKE RESISTOR	**Signal**	**Function**
JC14 BRAKE RES. R+ R- 	R -	External brake resistor
	R +	External brake resistor

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

3.6 Optional boards connector

3.6.1 Connector JC8: Depends on the type of board

OPTIONAL BOARD	
JC8 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 motor cable: JC7.
- The inputs/outputs cables: JC9 and / or JC10.

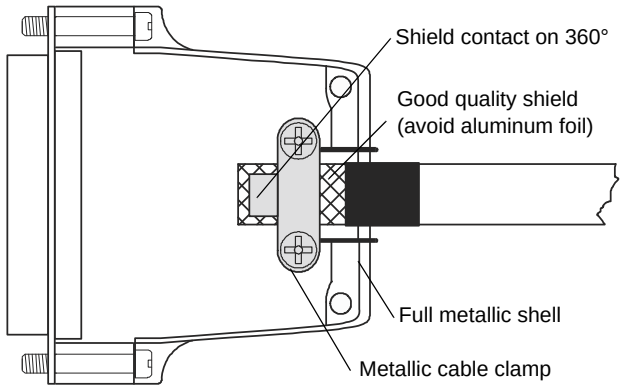
Simple shielded cable must be linked to the connector shells on both cable ends. Only full metallic conductive shells connector must be used. Shield with only aluminum foil (metallized plastic film) is forbidden!. Use only copper braid (85% covering shield). The shield must entirely cover all wires.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

3.7.1.1 The encoder and inputs/outputs cables

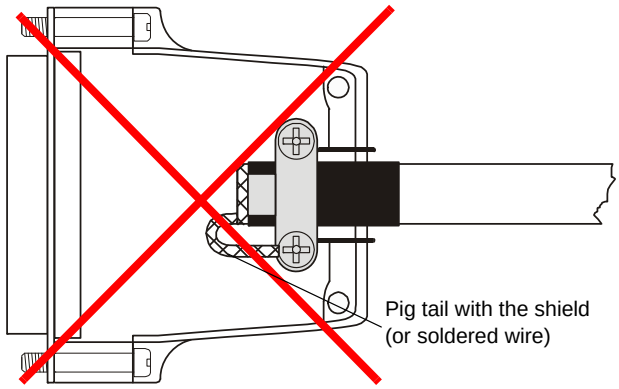
Here is an example of good shielding connection:

Good shielding connection

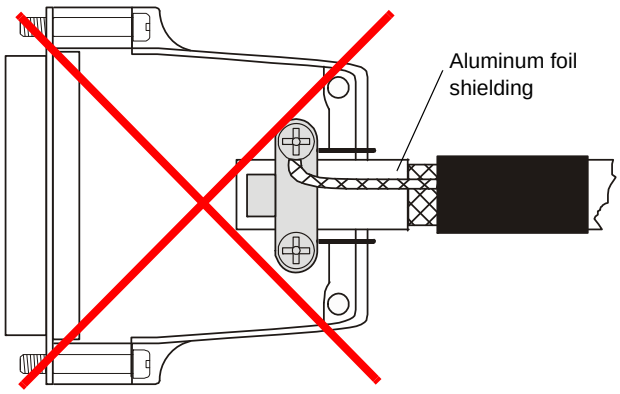


Here are two examples of bad shielding connections:

Bad shielding connection



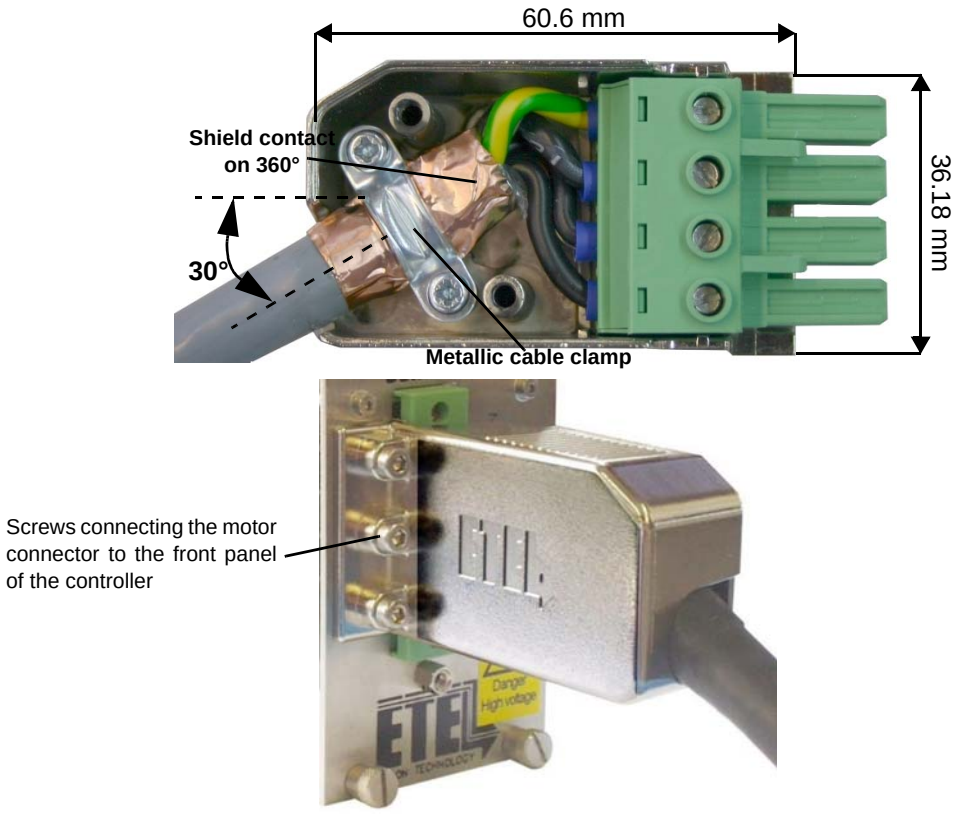
Bad shielding connection



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3.7.1.2 The motor cable

Caution: In order to respect the EMC standard, the following motor connector must be used.



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.
If a motor cable with a small diameter is used, turn the metallic clamp over to maintain the shield continuity

3.8 Axis number selection

It is possible to assign or to change the axis number of the controller with a DIP switch. After each starting, the controller takes the axis number given by the DIP switch except when all the 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. As the switch number 6 is not used, there are 32 possibilities. The axes are numbered from 0 to 30 because the axis 31 is reserved for the DSMAX.

Example:



The axis number given by this DIP switch is equal to: $2^0 + 2^1 = 3$.

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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 the power supply	Status	Meaning
Green LED 'POWER VOLTAGE'	ON	If the red LED is off, both power and auxiliary supply are switched on If the red LED is on, only the power supply input is switched on
	OFF	If the red LED is off, only the auxiliary supply input is switched on
Red LED 'POWER ERROR'	ON	If the green LED is on, only the power supply input is switched on
	OFF	If the green LED is on, both power and auxiliary supply are switched on If the green LED is off, only the auxiliary supply input is switched on

Remark: The power supply's LEDs are present on the DSC2P housed format and on the DSO-PWS supplying the DSC2P rack format.

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4. 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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All marketing and technical documentation as well as firmware and software can be downloaded from ETEL's web site: www.etel.ch. ETEL organizes training courses for customers on request, including theoretical presentations of our products and practical demonstrations at our facilities.

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