EDPS User Manual

Overview

The Electric Drive Power Stage (EDPS) Board, a Trenz Electronic TEC0053, is to be used together with the Controller Board for the evaluation of Motor Control.

Key Features

- Evaluation of Motor Control with a suitable Controller Board
- Power option up to 48V and 30A main supply current
- MOSFET power stage supporting 3-phase BLDC motors
- Current measurement on 2-phases (3 phase measurement is optional)
- On-board temperature sensor and 1-wire bus connector for additional sensors
- Encoder input capable of receiving both single ended and differential signals

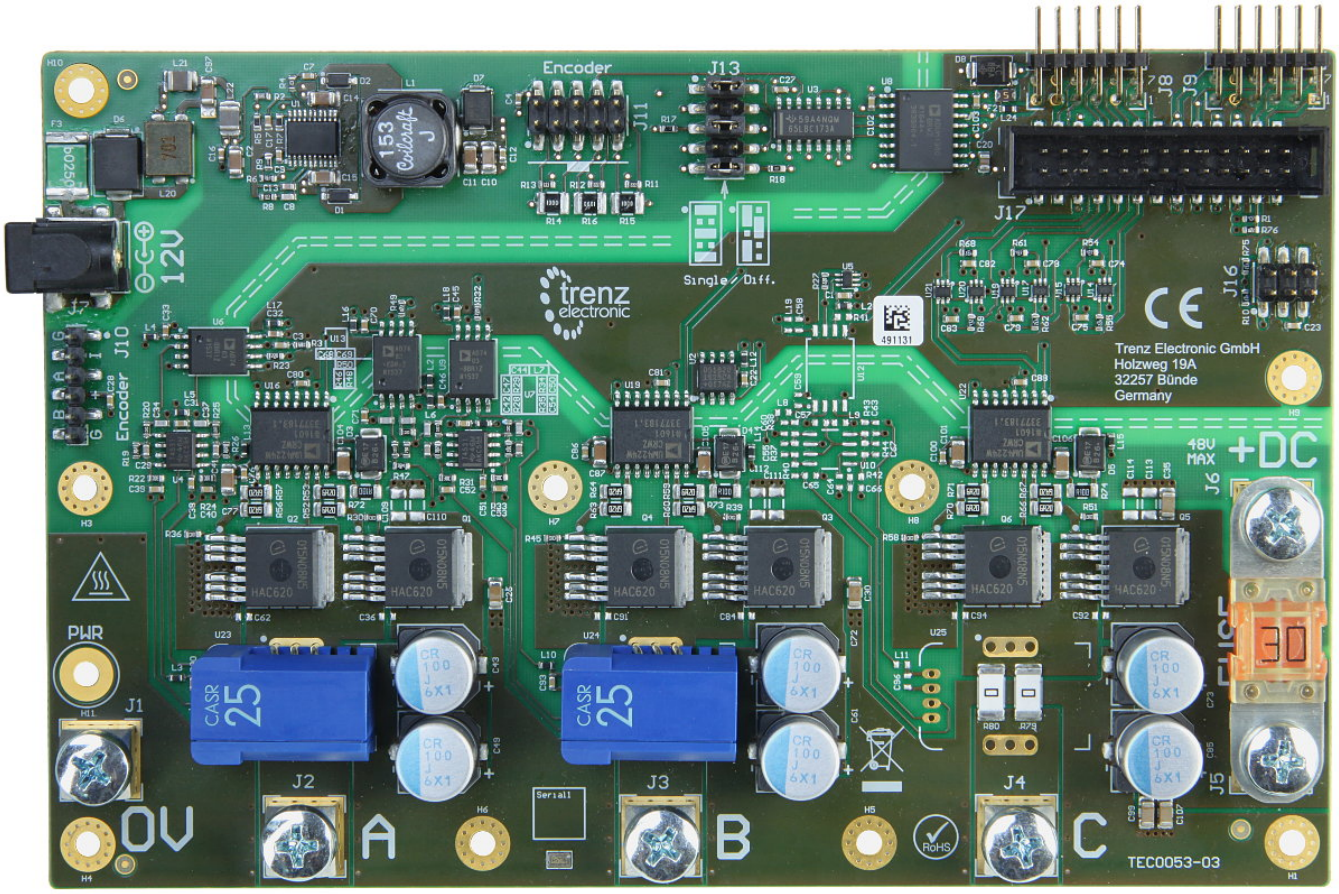


Figure 1: Top view of the EDPS Board PCB.

EDPS Block Diagram

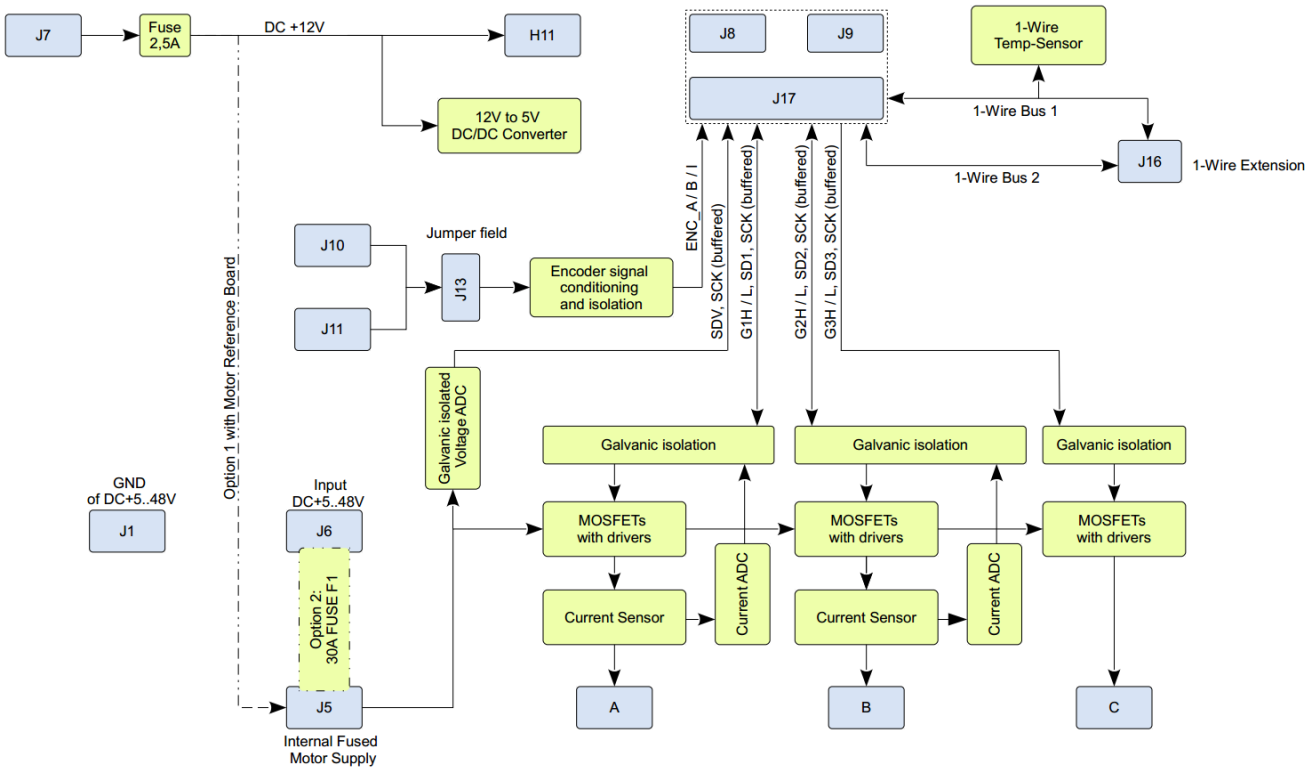


Figure 2: Block diagram of the EDPS Board.

General Safety Instructions

- This product should be operated by qualified electrical specialist only.
- Never leave an operating board unattended.
- There is a risk of burns while operating an EDPS Board because of the high currents in the power stage heating the board surfaces and the board components.
- All externally connected power sources must be SELV protected (Separated or Safety Extra Low Voltage).
- All wiring and installation should be performed only with all external power sources switched OFF or disconnected.
- No wiring or mechanical setup changes should be performed while the board is operating.
- The product is rated for dry indoor environment use only.
- The product is intended to be used only in horizontal position on a non-conducting and non-inflammable surface.
- The mechanical setup must ensure that the board and all of its parts are firmly fixed in place to prevent accidental or unwanted movement(e.g. sliding, falling. etc.).

Signals, Interfaces and Pins

Control Board Connectors

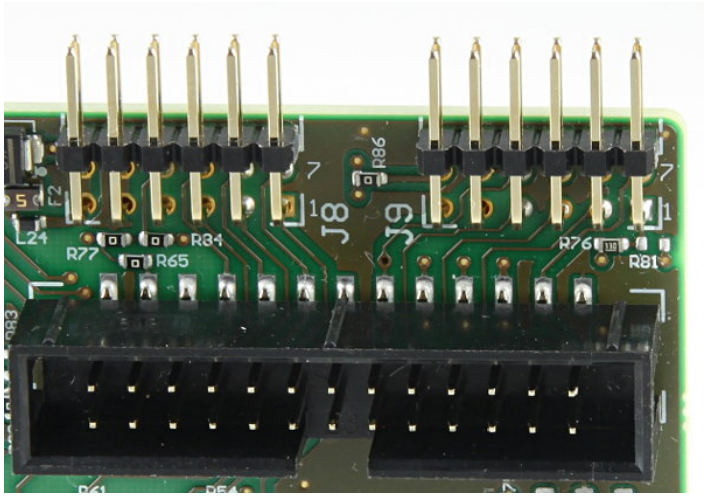


Figure 3: PCB connectors J8 and J9.

Signal names	Connector J8	Connector J9	Connector J17
Digital Supply to EDPS	Pin 6, 12: +3.3V Pin 5, 11: GND	Pin 6, 12: +3.3V Pin 5, 11: GND	Pin 5, 6, 21, 22: +3.3V Pin 1, 2, 25, 26: GND
Motor Driver PWM Signals to EDPS **High and Low Side control signals are hardware protected against simultaneously ON switching of the MOSFETs**	Pin 1: G1H - Ch.A HighSide Pin 7: G1L - Ch.A LowSide Pin 2: G2H - Ch.B HighSide Pin 8: G2L - Ch.B LowSide Pin 3: G3H - Ch.C HighSide Pin 9: G3L - Ch.C LowSide		Pin 11: G1H - Ch.A HighSide Pin 12: G1L - Ch.A LowSide Pin 9: G2H - Ch.B HighSide Pin 10: G2L - Ch.B LowSide Pin 7: G3H - Ch.C HighSide Pin 8: G3L - Ch.C LowSide
ADC Clock Signal to EDPS		Pin 1: SCLK	Pin 23: SCLK
Encoder Digital Signals from EDPS		Pin 8: ENC_A Pin 9: ENC_B Pin 10: ENC_I	Pin 20: ENC_A Pin 18: ENC_B Pin 16: ENC_I
Motor Current ADC "raw" Signals from EDPS (usable with FPGA IP)		Pin 2: SDI1 - Current Ch.A Pin 3: SDI2 - Current Ch.B Pin 4: SDI3 - Current Ch.C	Pin 19: SDI1 - Current Ch.A Pin 17: SDI2 - Current Ch.B Pin 15: SDI3 - Current Ch.C
Supply Voltage ADC "raw" Signal from EDPS (usable with FPGA IP)		Pin 7: SDIV - from DC_LINK (Fused Motor Supply Voltage)	Pin 24: SDIV - from DC_LINK (Fused Motor Supply Voltage)
1-Wire bus for temperature measurement	Pin 10: EXT1 - 1-Wire Bus 1 Pin 4: EXT2 - 1-Wire Bus 2		Pin 4: EXT1 - 1-Wire Bus 1 Pin 3: EXT2 - 1-Wire Bus 2
Pins not connected	None	None	Pin 13, 14

Table 1: Description of the PCB connectors J8 and J9.

Motor and Power Connections

There are two options available for the motor and power concept:

Detail	Option 1: Reference Motor Board with DC +12V Supply	Option 2: Customer Motor at individual DC +5..48V	Comments

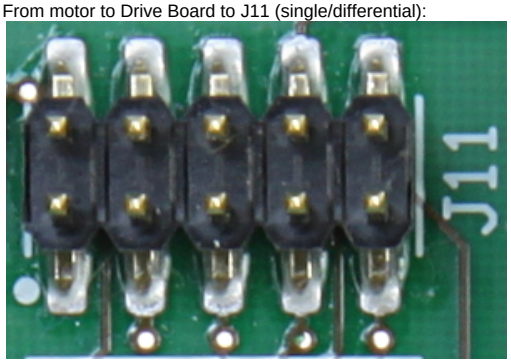
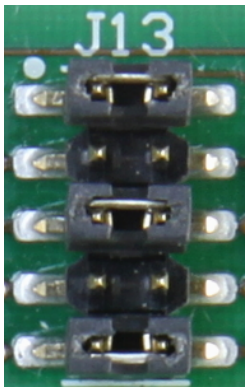
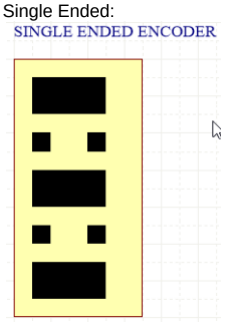
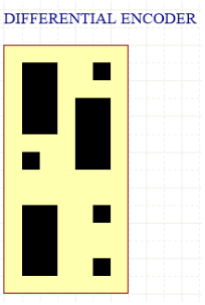
Motor Supply	From DC +12V Input J7 via fuse F3 via Motor Reference Board to J5 of Drive board	From customer DC power supply to J6 via F1 on Drive Boad	
Motor Connection	Motor wires connected to cage clamps on Motor Reference Board J5 (A), J4 (B), J3 (C)	Motor wires connected to bolt screw terminals on Drive Board J2 (A), J3 (B), J4 (C)	
Encoder Connection Single Ended	From encoder pins via 6-pin Pmod to Drive Board  J10: **J10 single ended:** Pin 1: GND Pin 2: ENC I input Pin 3: ENC A input Pin 4: +5V Supply Pin 5: ENC B input Pin 6: GND	From motor to Drive Board to J11 (single/differential):  **J11 single ended:** Pin 2: +5V Supply Pin 3: GND Pin 6: ENC A input Pin 8: ENC B input Pin 10: ENC I input	Jumper Settings for encoder signals.  Single Ended: 
Encoder Connection Differential		**J11 differential with 100R terminated:** Pin 2: +5V Supply Pin 3: GND Pin 5: ENC A negativ Pin 6: ENC A positiv Pin 7: ENC B negativ Pin 8: ENC B positiv Pin 9: ENC I negativ Pin 10: ENC I positiv	

Table 2: Description of the Motor and Power connector.

On-Board Temperature Sensor

There is a on-board 1-Wire temperature sensor DS18S20Z+ from Maxim located in the middle of the PCB for optimal readings.
Addional 1-wire sensor(s) can be connected to the connector J16:

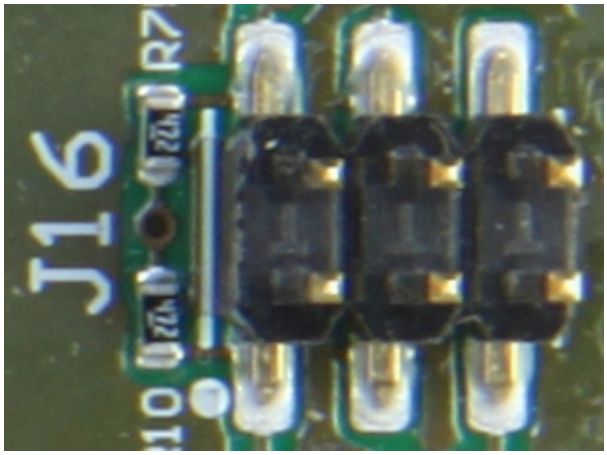


Figure 4: 1-wire sensors connector J16.

- Pin 1(DQ), 3 (GND),5 (+3.3V) at the same 1-wire bus as the onboard one
- Pin 2(DQ), 4 (GND),6 (+3.3V) at a separate 1-wire bus

Power and Power-On Sequence

DC 12V power supply for the Motor and Driver board

The power source must be SELV (Separated or safety extra-low voltage) protected.

The motor drivers and the reference motor on the pre-mounted motor board TEC0060 are supplied by this voltage.

The internal +5V digital supply is generated from this +12V supply.

DC 5...48V power supply for the Motor only

SAFETY INSTRUCTIONS:

External power supply for the motor must be SELV (Separated or safety extra-low voltage) protected.

- only allowed to be used for electrical specialist for the used electrical voltage and power conditions
- only allowed to be used under electrical laboratory conditions
- only allowed to be used in horizontal position on a non-conducting and non-inflammable surface
- only allowed to be used with a wiring, which fulfills the current rating for the maximum possible currents.
- only allowed to be used with a suitable current limiting circuit such that the maximum continuous current does not exceed 30A as follows:
    - The delivered fuse "Littelfuse Type 142.5631.5302" must be used as current limiter between connectors J5 and J6.
    - To limit the current for smaller motor loads an ADDITIONALL appropriate current limiter can be used e.g. a current limited power source or a fuse integrated in the wiring.
- only allowed to be used with appropriate connectors at the M5 screw connectors, which means M5 cable lugs must be used and fastened according to technical standards.
- only allowed to be used, if the high current parts conducting up to 30A nominal, are covered by isolating, mechanically stable, non-inflammable (UL V-1 or better) material. The high current parts are shown on the following picture:

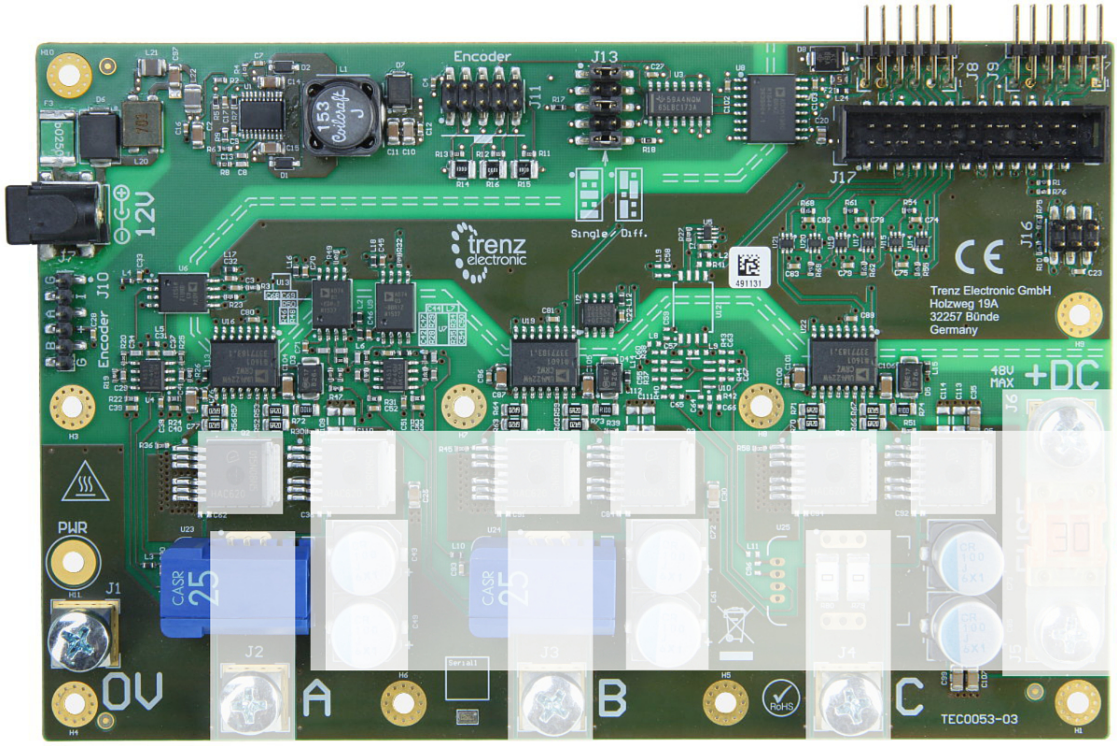


Figure 5: The high current parts on the EDPS Board, the motor outputs A, B, C, fuse F1 Connectors J5, J6 and further internal connections, are marked white.

It is mandatory to use the delivered isolating cover of the PCB made of plexiglass as a minimum protection. Use holes H1, H9, H3 and H4 with the delivered 10mm spacers when mounting.

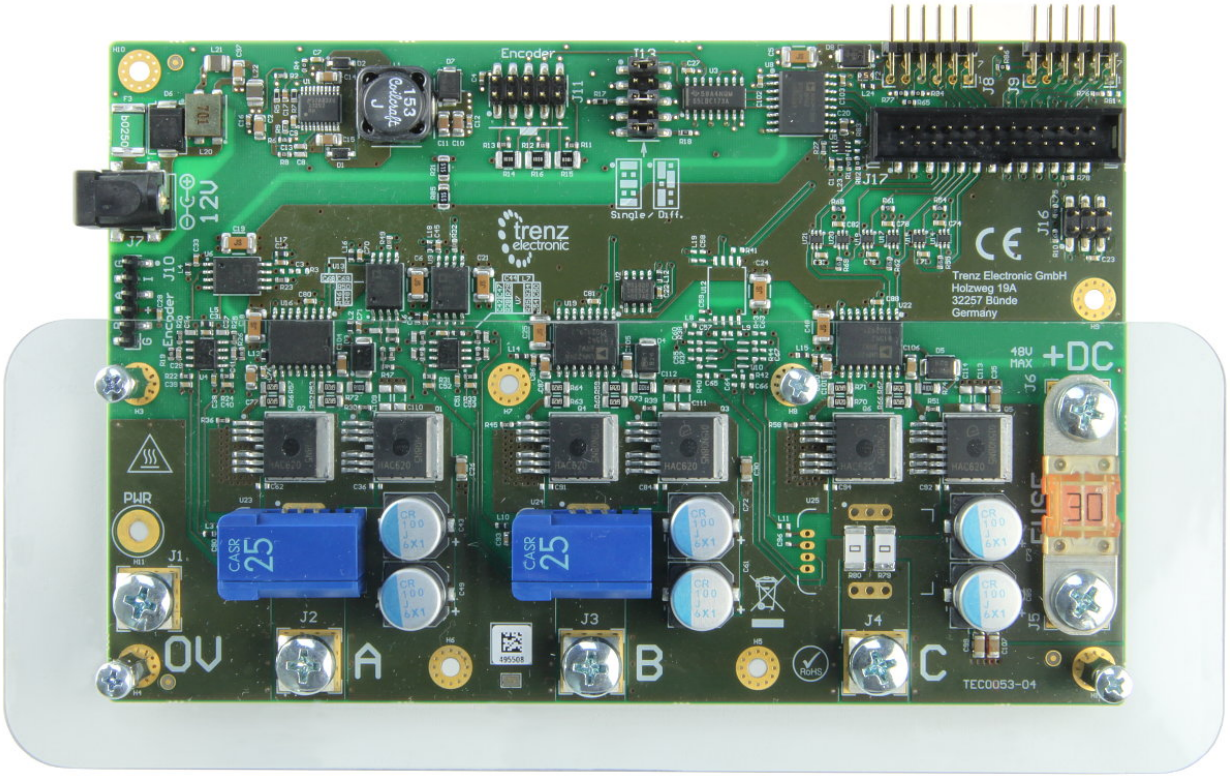


Figure 6: Top view of the EDPS Board with isolating transparent plexiglass cover attached.

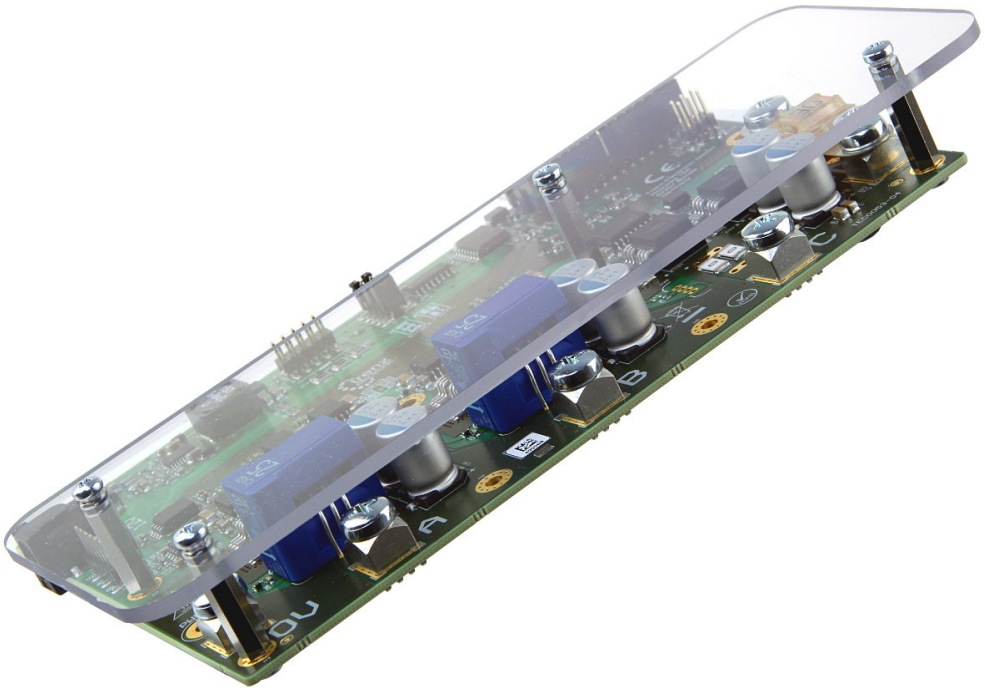


Figure 7: Side view of the EDPS Board with isolating plexiglass cover.

The cable lugs used should be isolated in the outer border area of the EDPS Board.

Make sure that the Isolating PCB Cover is overlapping the conducting material by a minimum of 20 mm.

Initial Operation

Prepare the EDPS board as follows:

1. In the case of low-powered motors and/or low-powered power supply it is recommended to use additional current limiter circuit or additional fuse.
2. Mount the delivered 30A fuse to the connectors J5 and J6 with the delivered M5 screws.
3. Use at most 3m long cable with lugs to connect the positive terminal of the motor power supply to J6 (DC +5..48V) and the negative terminal to J1 (0V).
4. Use at most 3m long cable to connect the three motor phases to J2 (A), J3 (B) and J4 (C).
5. Connect 12V power supply to J7 (12V). In the case motor power supply voltage is 12V as well, one power supply can be used.
6. Optional: Connect the encoder to J10 or J11 and set jumper field J13 according to the signal specification either to differential or to single ended configuration.

Power-On Sequence

Any power sequence of the three supply sources is allowed:

- +3V3 Supply from the Control Board, generated by Control Board supply
- +12V and
- Optional +5..48V Motor Supply

Adapter Board TEC0060

For easy connection of the Reference Motor and Encoder to the EDPS Board a special Adapter Board TEC0060 is included in the EDDP Kit.

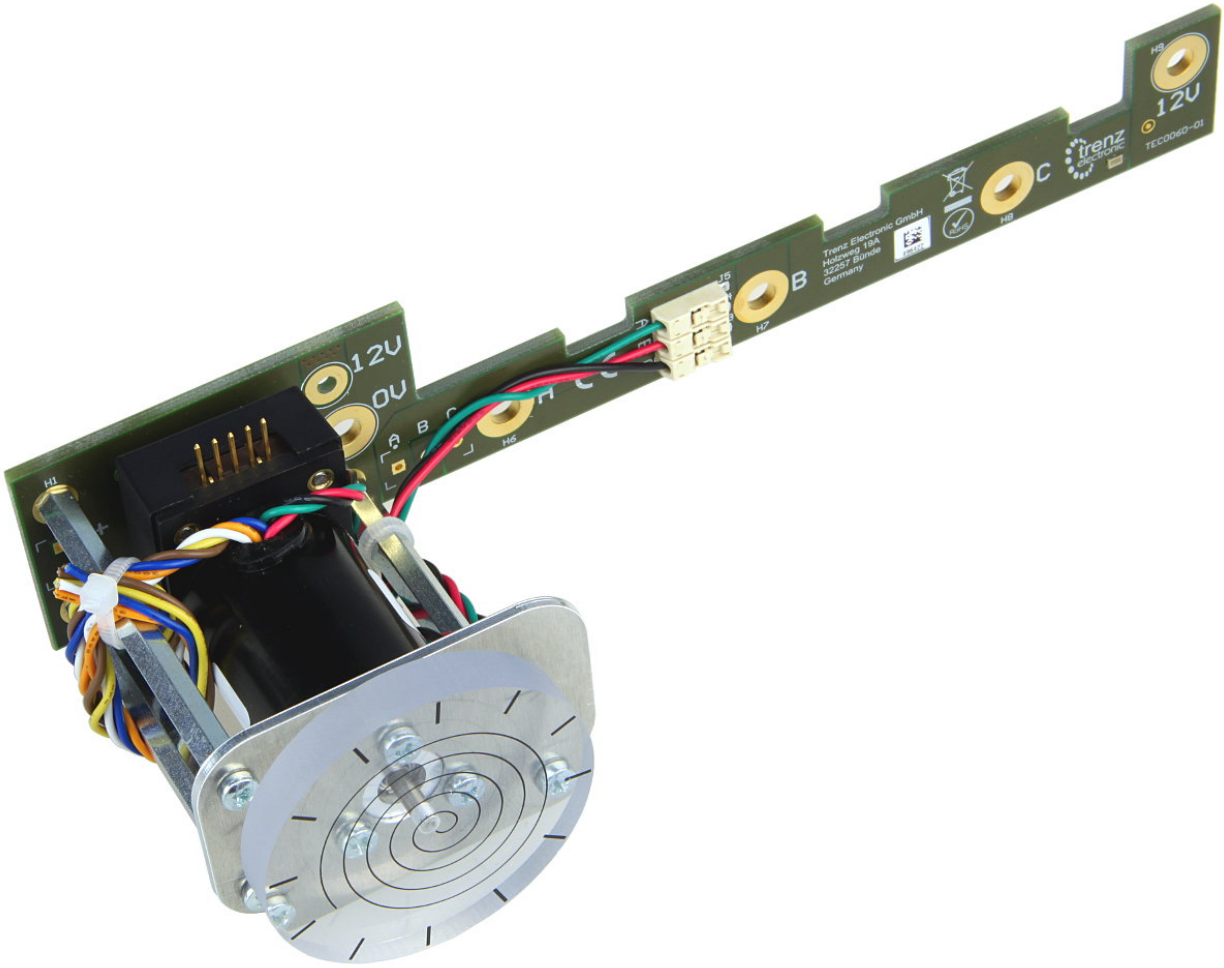


Figure 8: Adapter Board TEC0060 with the Reference Motor and Plastic DEMO load attached.

Reference Motor

The Reference Motor and Encoder are manufactured by Anaheim Automation. The order code for the motor with the encoder already mounted is BLWR111D-24V-10000-1000SI. Please note that the encoder is not available separately. The nominal motor voltage is DC 24V, however, only 12V is supplied by the Reference Motor Board, which results in reduced performance.

Refer to the BLWR11 - Brushless DC Motors and Single-Ended Encoder with Index Channel for more information.

Technical Specifications

Absolute Maximum Ratings

Parameter	Min	Max	Units	Notes

DC +12V supply	0	15	V	
DC +5..48V supply	0	50V	V	
DC +3V3 supply	-0.5	6	V	
PWM Input	-0.5	6	V	
ADC Digital Input	-0.5	3.8	V	Assuming digital power supply voltage is at 3.3V
Encoder Input	-10	15	V	

Table 3: Absolute maximum ratings.

Recommended Operating Conditions

Parameter	Min	Max	Units
DC +12V supply	11.5	12.5	V
DC +5..48V supply	5	48	V
DC +3V3 supply	3.0	3.6	V
PWM Input	0	DC +3V3 supply	V
ADC Digital Input	0	DC +3V3 supply	V
Encoder Input	-7	12	V

Table 4: Recommended oprating conditions.

Electrical characteristics

DC +3V3 supply = 3.3V

Parameter	Min	Max	Units	Notes
PWM Input Logic High Level	2.2		V	
PWM Input Logic Low Level		0.8	V	
ADC Digital Input Logic High Level	2.7		V	
ADC Digital Input Logic Low Level		0.6	V	
ADC Digital Output Logic High Level	3.2	3.3	V	I_O=-200A
ADC Digital Output Logic Low Level	0	0.4	V	I_O=+200A
Encoder Input Logic High Level (Differential)		-0.2	V	
Encoder Input Logic Low Level (Differential)	-0.01		V	
Encoder Input Logic High Level (Single ended)	2		V	
Encoder Input Logic Low Level (Single ended)		0.6	V	

Table 5: Electrical characteristics.

Physical Dimensions

- Board size: 100 mm × 166 mm. Please download the assembly diagram for the exact numbers.
- PCB thickness: 1.75 mm +/-10%
- Highest part on PCB: approximately 17 mm. Please download the step model for the exact numbers.

All dimensions are shown in millimeters.

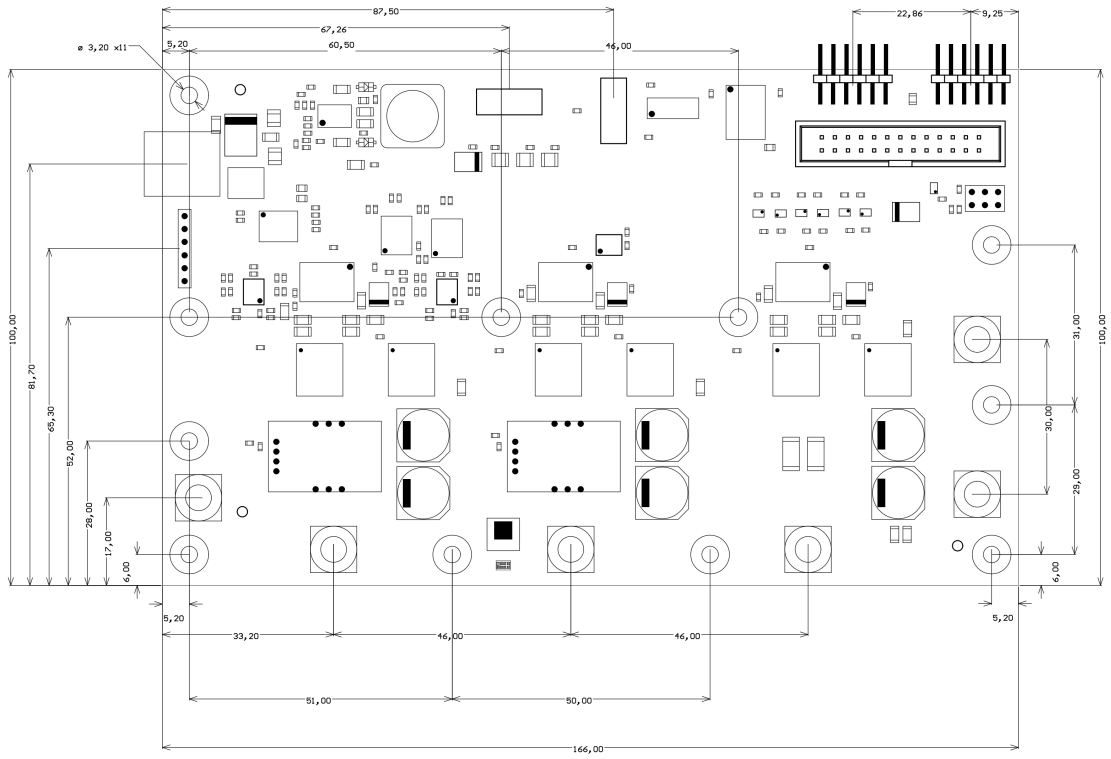


Figure 9: Physical Dimensions of the EDPS Board.

Operating Temperature Ranges

0°C - 70°C, cooling might be required depending on environment and airflow.

References

All resource links for other relevant documents and websites are available from Trenz EDDP Web Hub:

http://trenz.org/EDDP

Revision History

Hardware Revision History

Date	Revision	Notes	PCN Link	Documentation Link
2017-08-14	04	Initial public revision		

Table 6: Hardware revision history.

Hardware revision number is printed on the PCB board in the bottom right corner.

Document Change History

Date	Revision	Authors	Description
Error rendering macro 'page-info' Ambiguous method overloading for method jdk.proxy279.$Proxy4022#hasContentLevelPermission. Cannot resolve which method to invoke for [null, class java.lang.String, class com.atlassian.confluence.pages.Page] due to overlapping prototypes between: [interface com.atlassian.confluence.user.ConfluenceUser, class java.lang.String, class com.atlassian.confluence.core.ContentEntityObject] [interface com.atlassian.user.User, class java.lang.String, class com.atlassian.confluence.core.ContentEntityObject]	Unknown macro: 'metadata'	Jan Kumann	General formatting changes and small corrections.
2017-08-14	v.10	Antti Lukats, Andrei Errapart	Initial version.

Table 7: Document change history.

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