

EDPS User Manual

- [Overview](#)
 - [Key Features](#)
 - [EDPS Block Diagram](#)
- [General Safety Instructions](#)
- [Signals, Interfaces and Pins](#)
 - [Control Board Connectors](#)
 - [Motor and Power Connections](#)
 - [On-Board Temperature Sensor](#)
- [Power and Power-On Sequence](#)
 - [DC 12V power supply for the Motor and Driver board](#)
 - [DC 5...48V power supply for the Motor only](#)
 - [Initial Operation](#)
 - [Power-On Sequence](#)
- [Adapter Board TEC0060](#)
 - [Reference Motor](#)
- [Technical Specifications](#)
 - [Absolute Maximum Ratings](#)
 - [Recommended Operating Conditions](#)
 - [Electrical characteristics](#)
 - [Physical Dimensions](#)
 - [Operating Temperature Ranges](#)
- [References](#)
- [Revision History](#)
 - [Hardware Revision History](#)
 - [Document Change History](#)
- [Disclaimer](#)
 - [Document Warranty](#)
 - [Limitation of Liability](#)
 - [Copyright Notice](#)
 - [Technology Licenses](#)
 - [Environmental Protection](#)
 - [REACH, RoHS and WEEE](#)

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

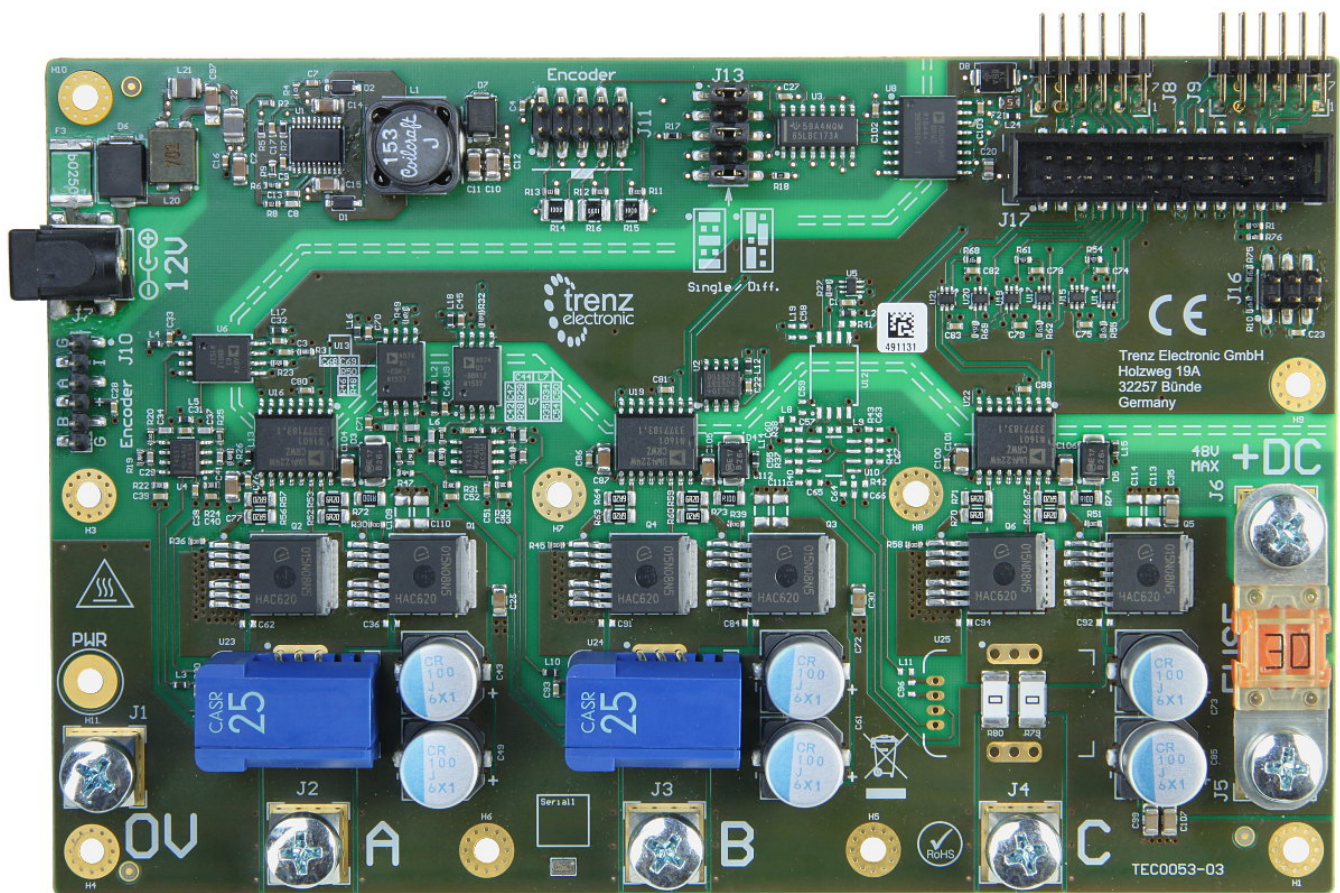


Figure 1: Top view of the EDPS Board PCB.

EDPS Block Diagram

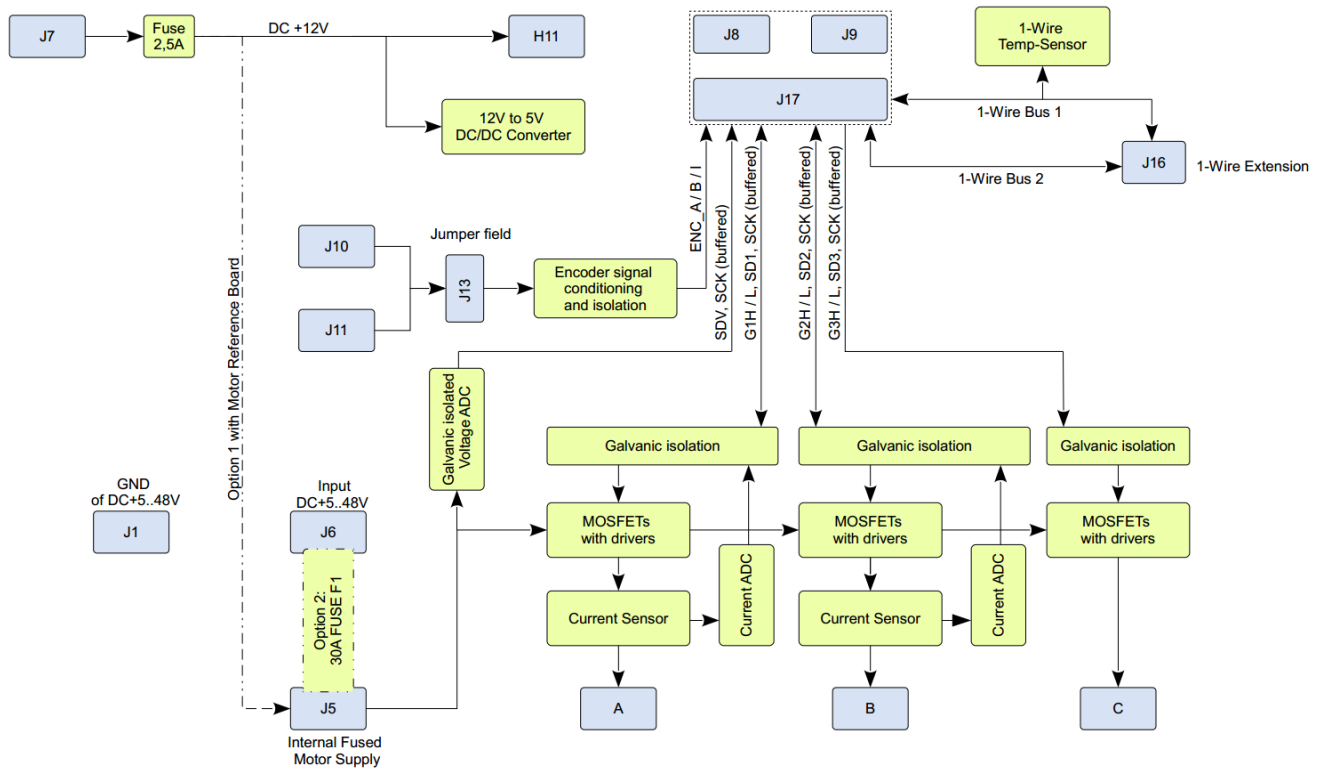


Figure 2: Block diagram of the EDPS Board.

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

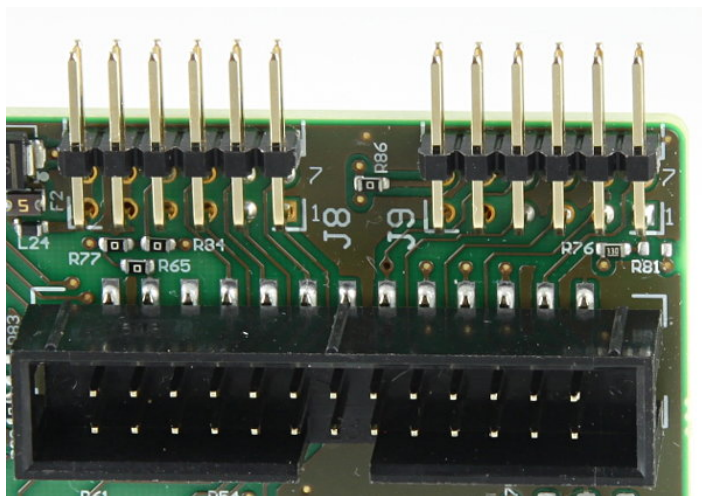


Figure 3: PCB connectors J8 and J9.

| 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 |
|--------|---|---|----------|
| | | | |


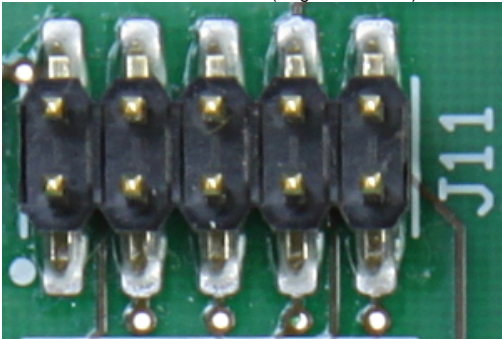
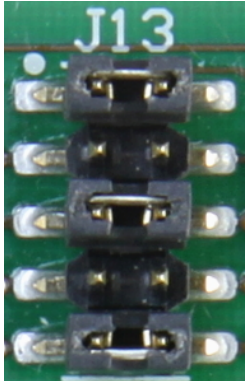
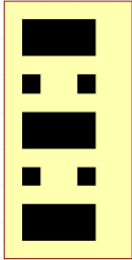
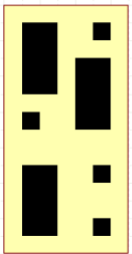
| | | | |
|--|--|---|---|
| Motor Supply | From DC +12V Input J7 via fuse F3 via Motor Reference Board to J5 of Drive board | From customer DC power supply to J6 via F1 on Drive Board | |
| Motor Connection | Motor wires connected to cage clamps on Motor Reference Board J5 (A), J4 (B), J3 (C) | Motor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

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. Additional 1-wire sensor(s) can be connected to the connector J16:

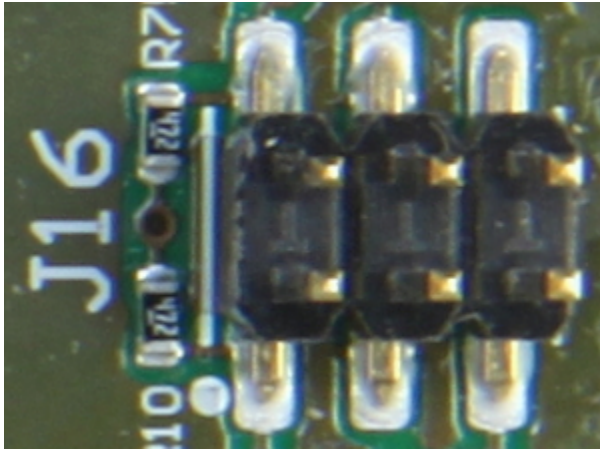


Figure 4: 1-wire sensors connector J16.

- 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:

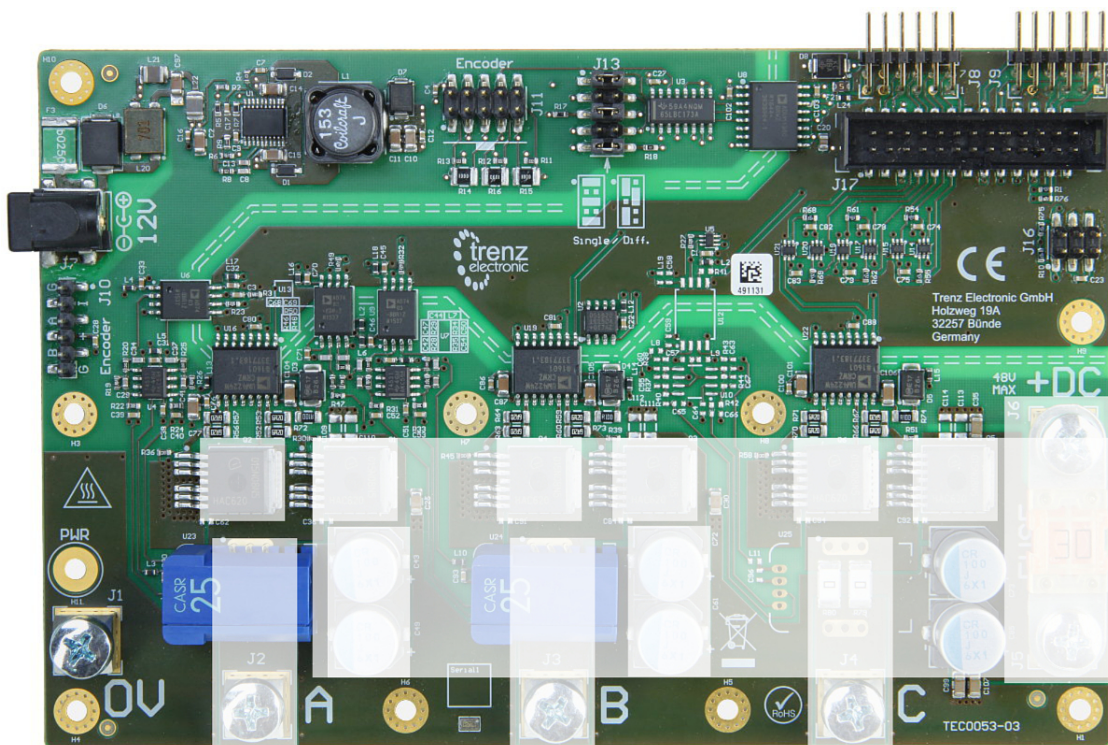


Figure 5: The high current parts on the EDPS Board, the motor outputs A, B, C, fuse F1 Connectors J5, J6 and further internal connections, are marked white.



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.

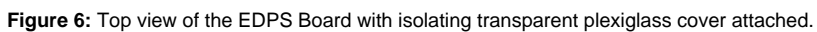


Figure 6: Top view of the EDPS Board with isolating transparent plexiglass cover attached.

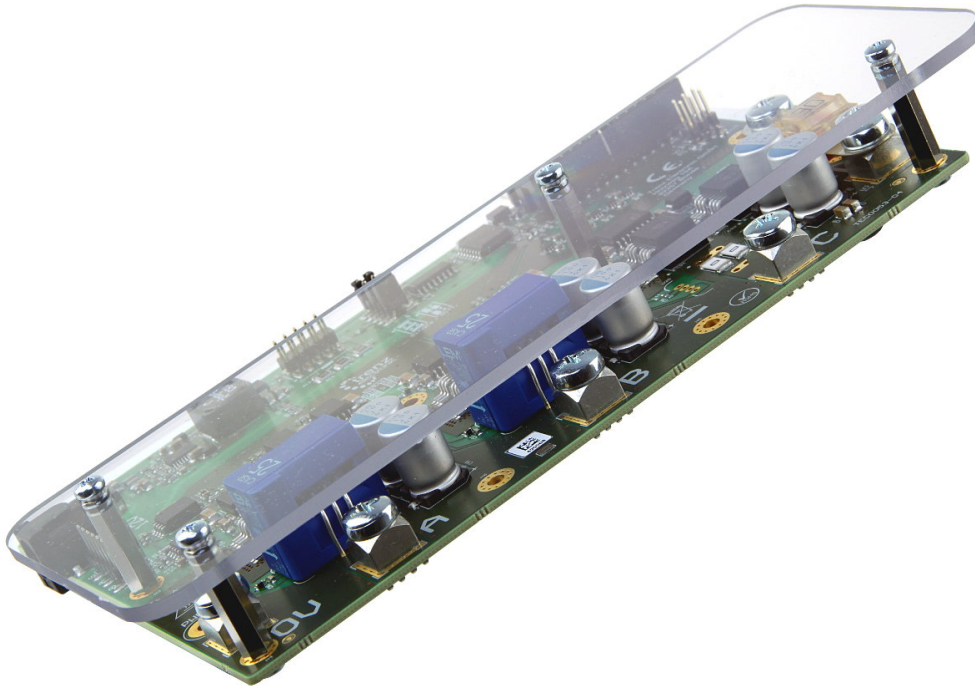


Figure 7: Side view of the EDPS Board with isolating plexiglass cover.

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.

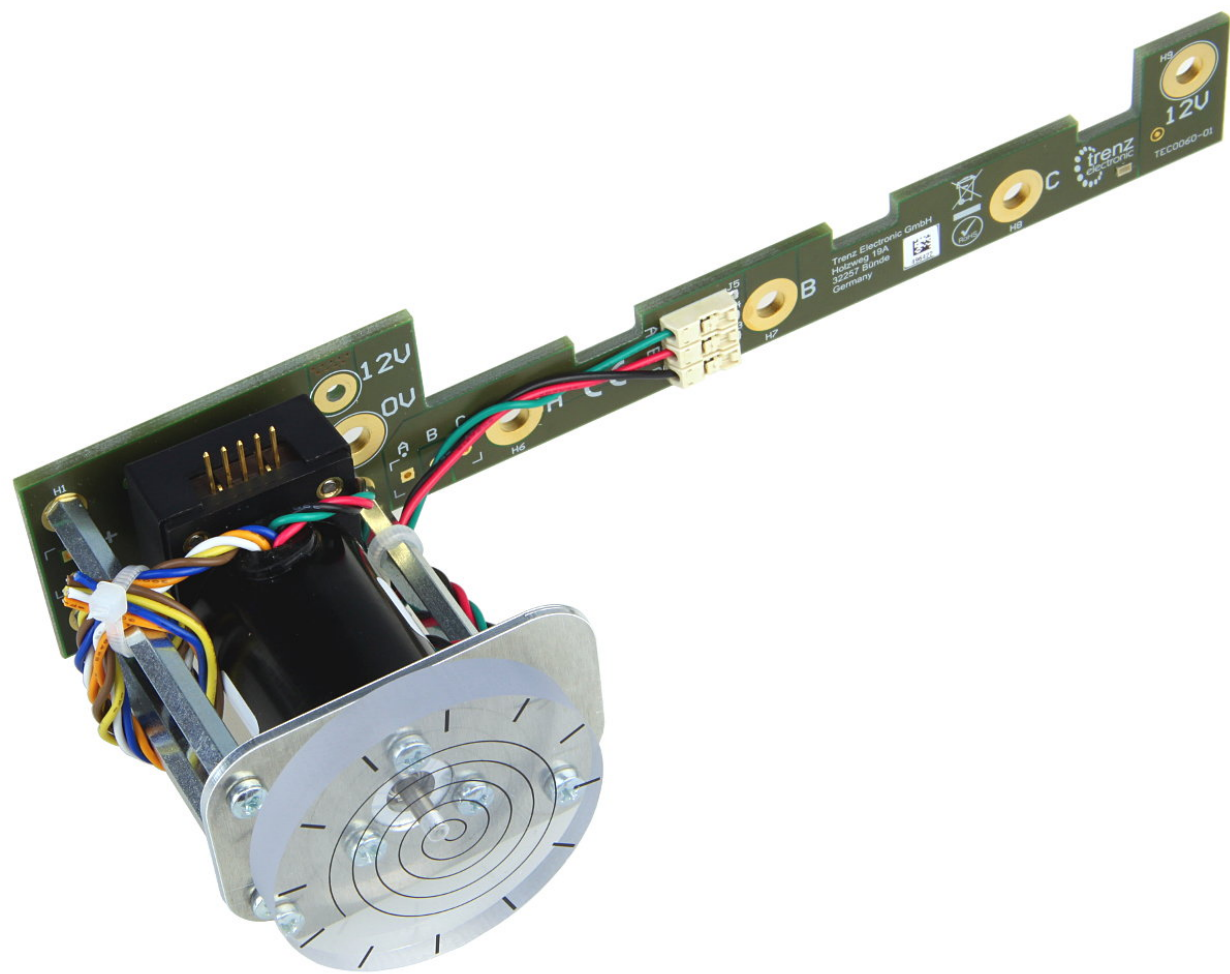


Figure 8: Adapter Board TEC0060 with the Reference Motor and Plastic DEMO load attached.

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 operating 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.

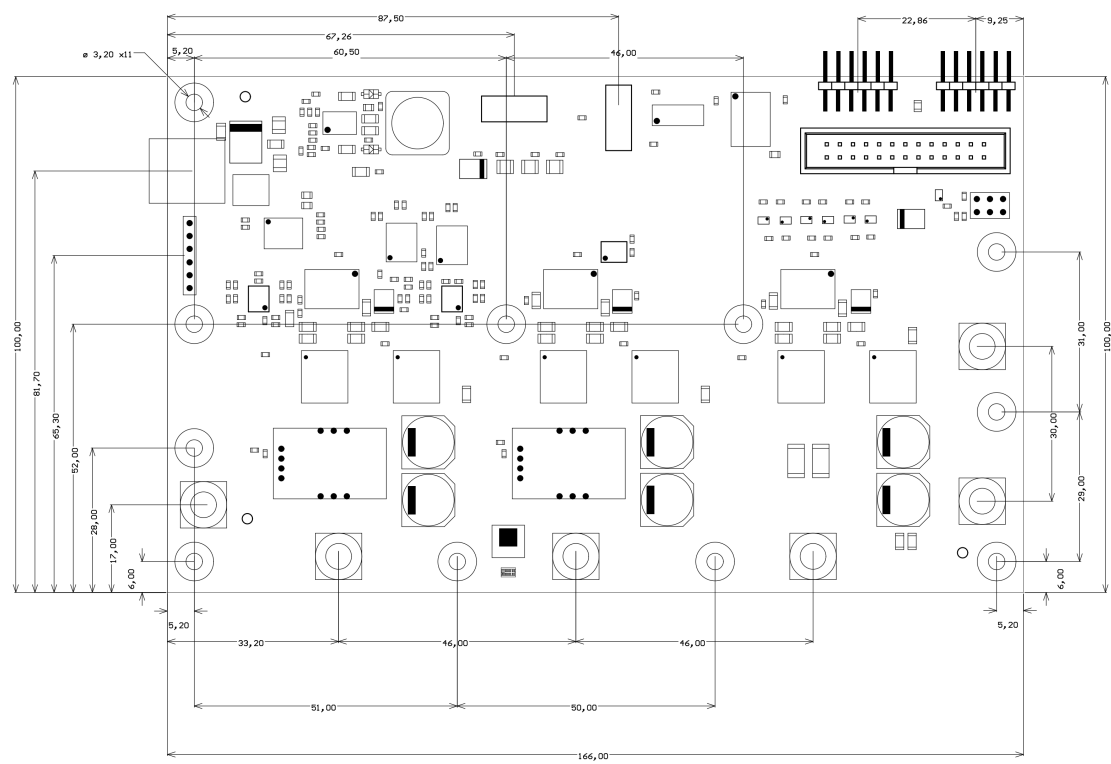


Figure 9: Physical Dimensions of the EDPS Board.

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 |
|---|--------------------------------------|--|---|
| <div><div>Error rendering macro 'page-info'</div><div>Ambiguous method overloading for method jdk. proxy244.\$Proxy3589#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]</div></div> | <div>Unknown macro: 'metadata'</div> | Jan Kumann | General formatting changes and small corrections. |
| 2017-08-14 | v.10 | Antti Lukats, Andrei Errapart | Initial version. |

Table 7: Document change history.

Disclaimer

Document Warranty

The material contained in this document is provided “as is” and is subject to being changed at any time without notice. Trenz Electronic does not warrant the accuracy and completeness of the materials in this document. Further, to the maximum extent permitted by applicable law, Trenz Electronic disclaims all warranties, either express or implied, with regard to this document and any information contained herein, including but not limited to the implied warranties of merchantability, fitness for a particular purpose or non infringement of intellectual property. Trenz Electronic shall not be liable for errors or for incidental or consequential damages in connection with the furnishing, use, or performance of this document or of any information contained herein.

Limitation of Liability

In no event will Trenz Electronic, its suppliers, or other third parties mentioned in this document be liable for any damages whatsoever (including, without limitation, those resulting from lost profits, lost data or business interruption) arising out of the use, inability to use, or the results of use of this document, any documents linked to this document, or the materials or information contained at any or all such documents. If your use of the materials or information from this document results in the need for servicing, repair or correction of equipment or data, you assume all costs thereof.

Copyright Notice

No part of this manual may be reproduced in any form or by any means (including electronic storage and retrieval or translation into a foreign language) without prior agreement and written consent from Trenz Electronic.

Technology Licenses

The hardware / firmware / software described in this document are furnished under a license and may be used /modified / copied only in accordance with the terms of such license.

Environmental Protection

To confront directly with the responsibility toward the environment, the global community and eventually also oneself. Such a resolution should be integral part not only of everybody's life. Also enterprises shall be conscious of their social responsibility and contribute to the preservation of our common living space. That is why Trenz Electronic invests in the protection of our Environment.

REACH, RoHS and WEEE

REACH

Trenz Electronic is a manufacturer and a distributor of electronic products. It is therefore a so called downstream user in the sense of [REACH](#). The products we supply to you are solely non-chemical products (goods). Moreover and under normal and reasonably foreseeable circumstances of application, the goods supplied to you shall not release any substance. For that, Trenz Electronic is obliged to neither register nor to provide safety data sheet. According to present knowledge and to best of our knowledge, no [SVHC \(Substances of Very High Concern\) on the Candidate List](#) are contained in our products. Furthermore, we will immediately and unsolicited inform our customers in compliance with REACH - Article 33 if any substance present in our goods (above a concentration of 0,1 % weight by weight) will be classified as SVHC by the [European Chemicals Agency \(ECHA\)](#).

RoHS

Trenz Electronic GmbH herewith declares that all its products are developed, manufactured and distributed RoHS compliant.

WEEE

Information for users within the European Union in accordance with Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE).

Users of electrical and electronic equipment in private households are required not to dispose of waste electrical and electronic equipment as unsorted municipal waste and to collect such waste electrical and electronic equipment separately. By the 13 August 2005, Member States shall have ensured that systems are set up allowing final holders and distributors to return waste electrical and electronic equipment at least free of charge. Member States shall ensure the availability and accessibility of the necessary collection facilities. Separate collection is the precondition to ensure specific treatment and recycling of waste electrical and electronic equipment and is necessary to achieve the chosen level of protection of human health and the environment in the European Union. Consumers have to actively contribute to the success of such collection and the return of waste electrical and electronic equipment. Presence of hazardous substances in electrical and electronic equipment results in potential effects on the environment and human health. The symbol consisting of the crossed-out wheeled bin indicates separate collection for waste electrical and electronic equipment.

Trenz Electronic is registered under WEEE-Reg.-Nr. DE97922676.