



## **EDPS User Manual**

**Revision:** v.43

**Date:** 21-Sep-2017 14:53

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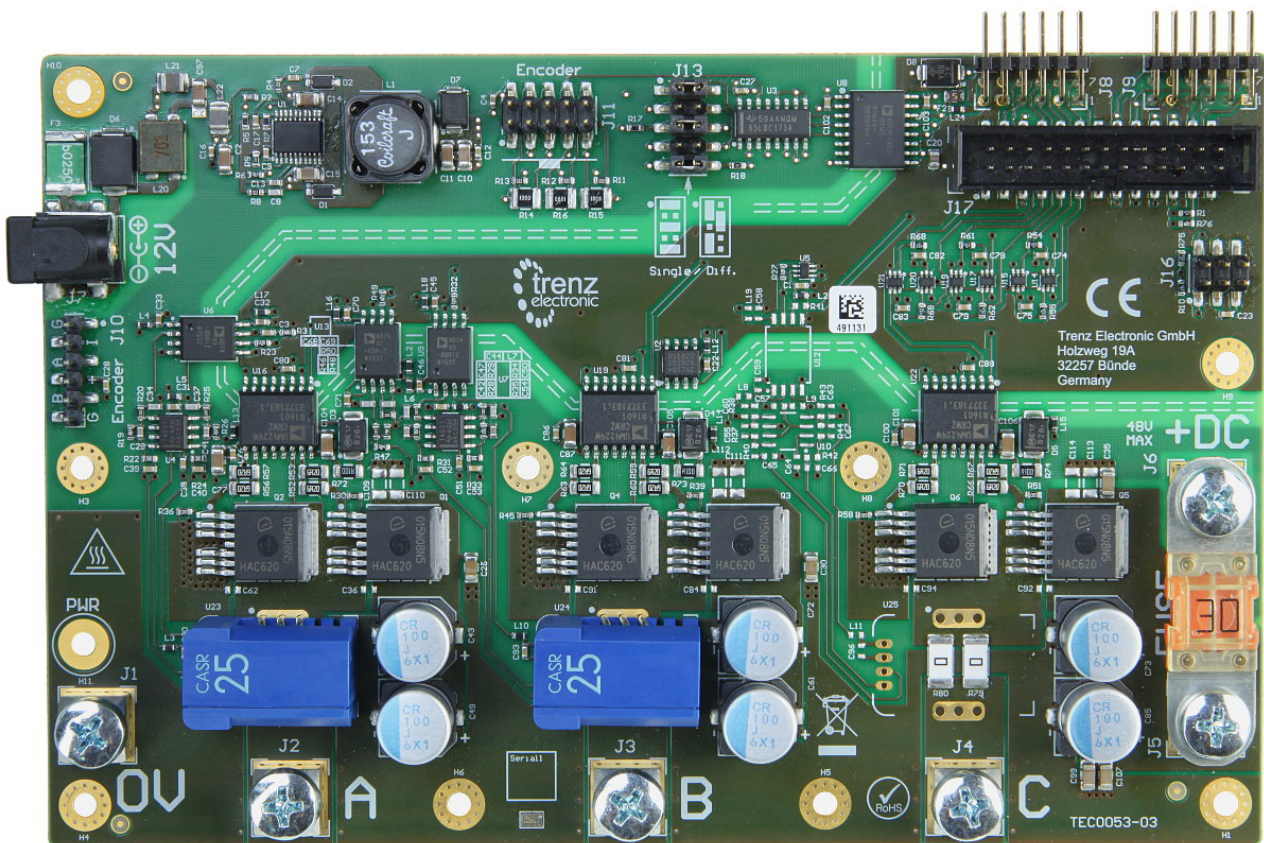
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## Overview

Refer to <https://wiki.trenz-electronic.de/display/PD/EDPS+User+Manual> for online version of this manual and additional technical documentation of the product. The Trenz Electronic TEC0053 is a Motor Driver board to be used together with the reference controller board for motor control evaluation.

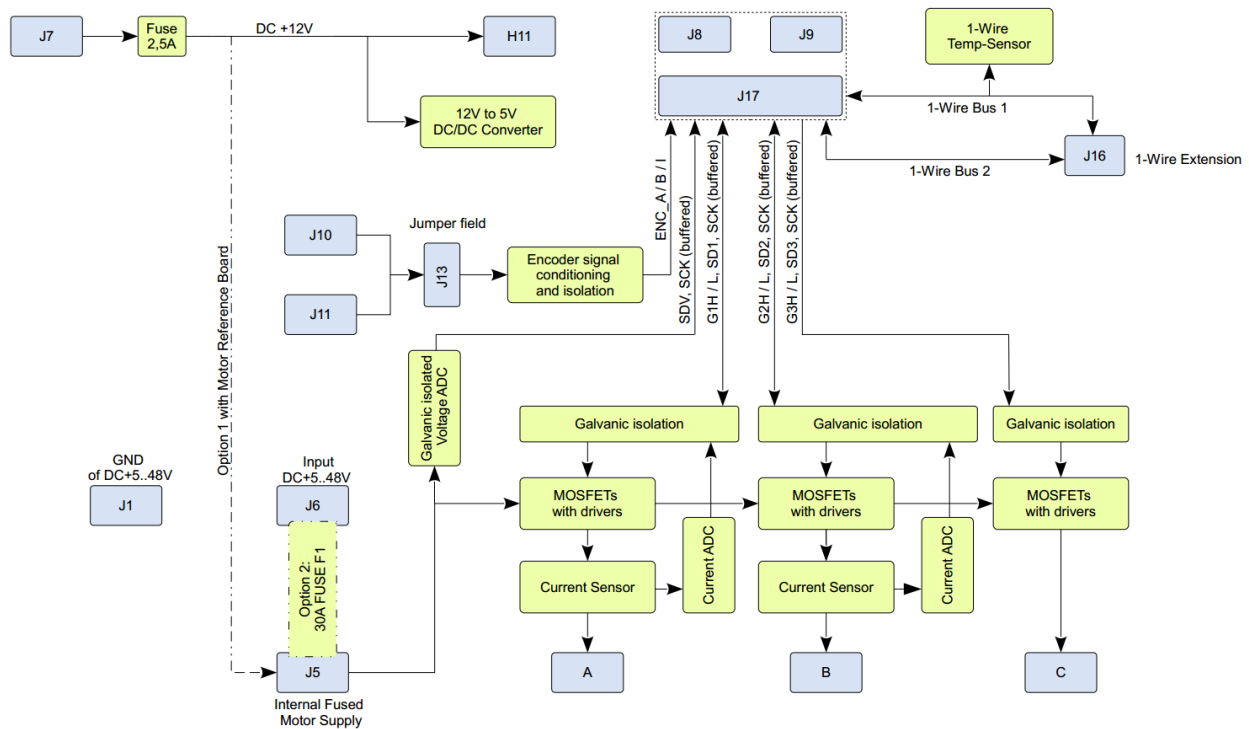
## Key Features

- Evaluation of the Motor control with the 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 TEC0053 PCB.

## Block Diagram



**Figure 2:** Block diagram of the TEC0053 board.

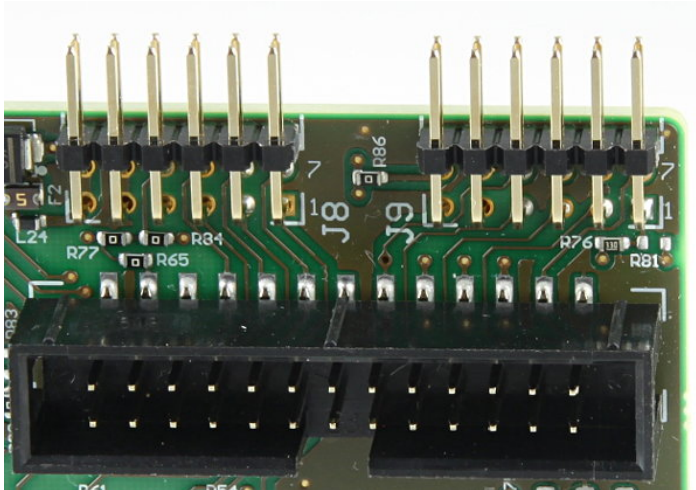
## General Safety Instructions

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- This product should be operated only by qualified electrical specialist.
- Never leave operating board unattended.
- There is a possible risk of burns due to the hot surfaces while operating the Board. Reason for this could be the high currents present in the motor driving outputs.
- 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 indoor, dry 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.


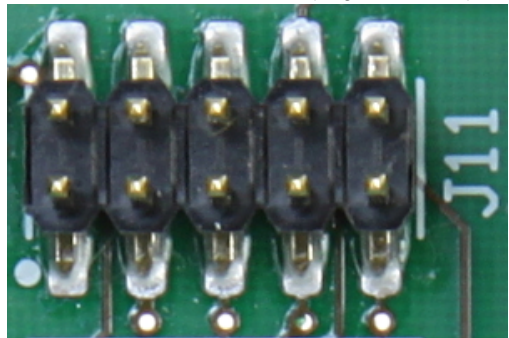
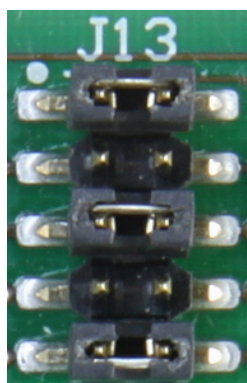
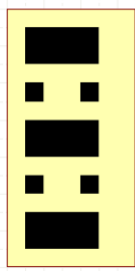
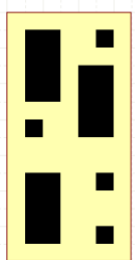
Signal names	Connector J8	Connector J9	Connector J17
Digital Supply to EDPS	Pin 6, 12: +3.3V Pin 5, 11: GND	Pin 6, 12: +3.3V Pin 5, 11: GND	Pin 5, 6, 21, 22: +3.3V Pin 1, 2, 25, 26: GND
Motor Driver PWM Signals to EDPS  <b>High and Low Side control signals are hardware protected against simultaneously ON switching of the MOSFETs</b>	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:

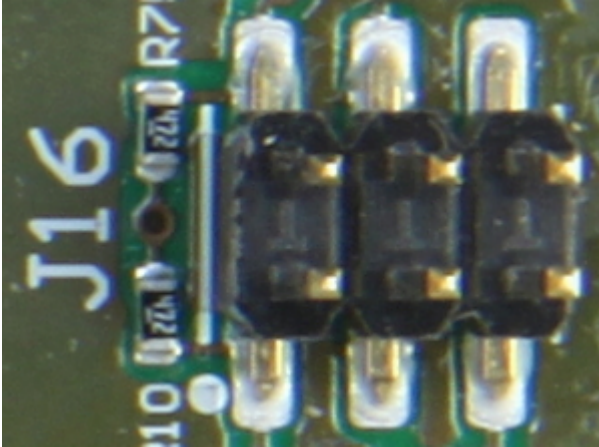
Detail	Option 1: Reference Motor Board with DC +12V Supply	Option 2: Customer Motor at individual DC +5..48V	Comments
Motor Supply	From DC +12V Input J7 via fuse F3 via Motor Reference Board to J5 of Drive board	From customer DC power supply to J6 via F1 on Drive Board	
Motor Connection	Motor wires connected 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 J10:</p>  <p><b>J10 single ended:</b></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><b>J11 single ended:</b></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><b>Single Ended:</b> SINGLE ENDED ENCODER</p> 
Encoder Connection Differential		<p><b>J11 differential with 100R terminated:</b></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><b>DIFFERENTIAL ENCODER</b></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

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### DC 12V power supply for the Motor and Driver board

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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.

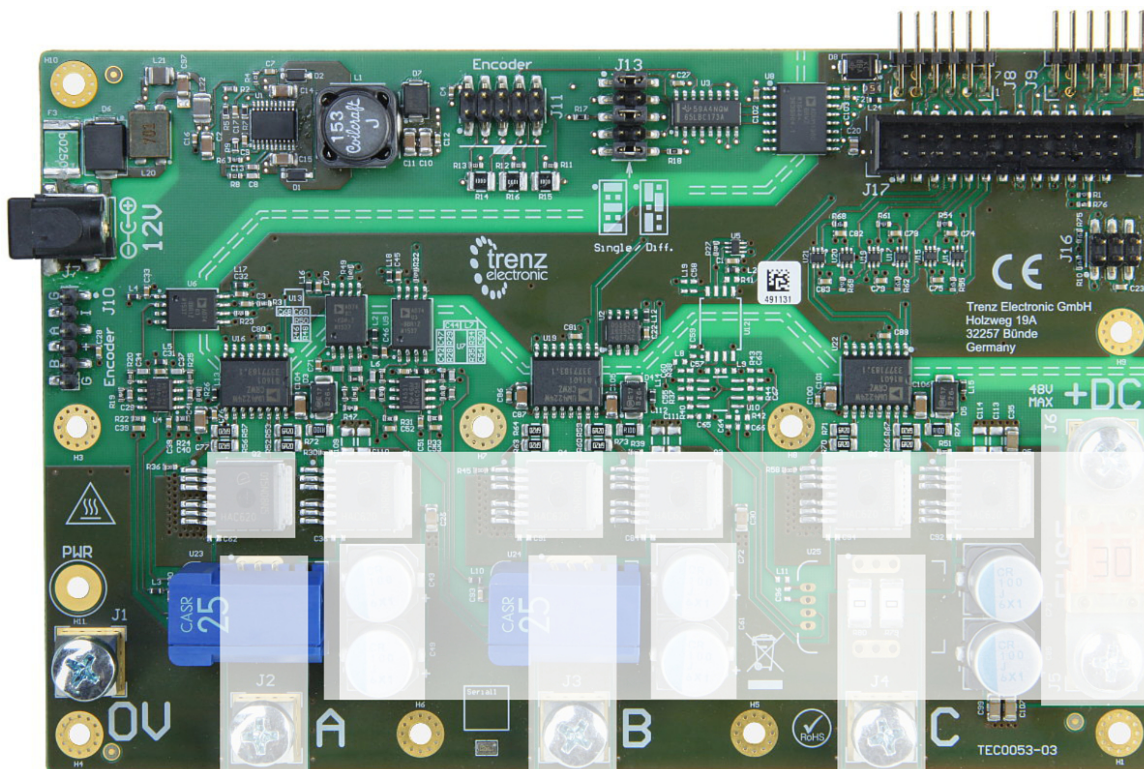
### DC 5...48V power supply for the Motor only

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#### **SAFETY INSTRUCTIONS:**

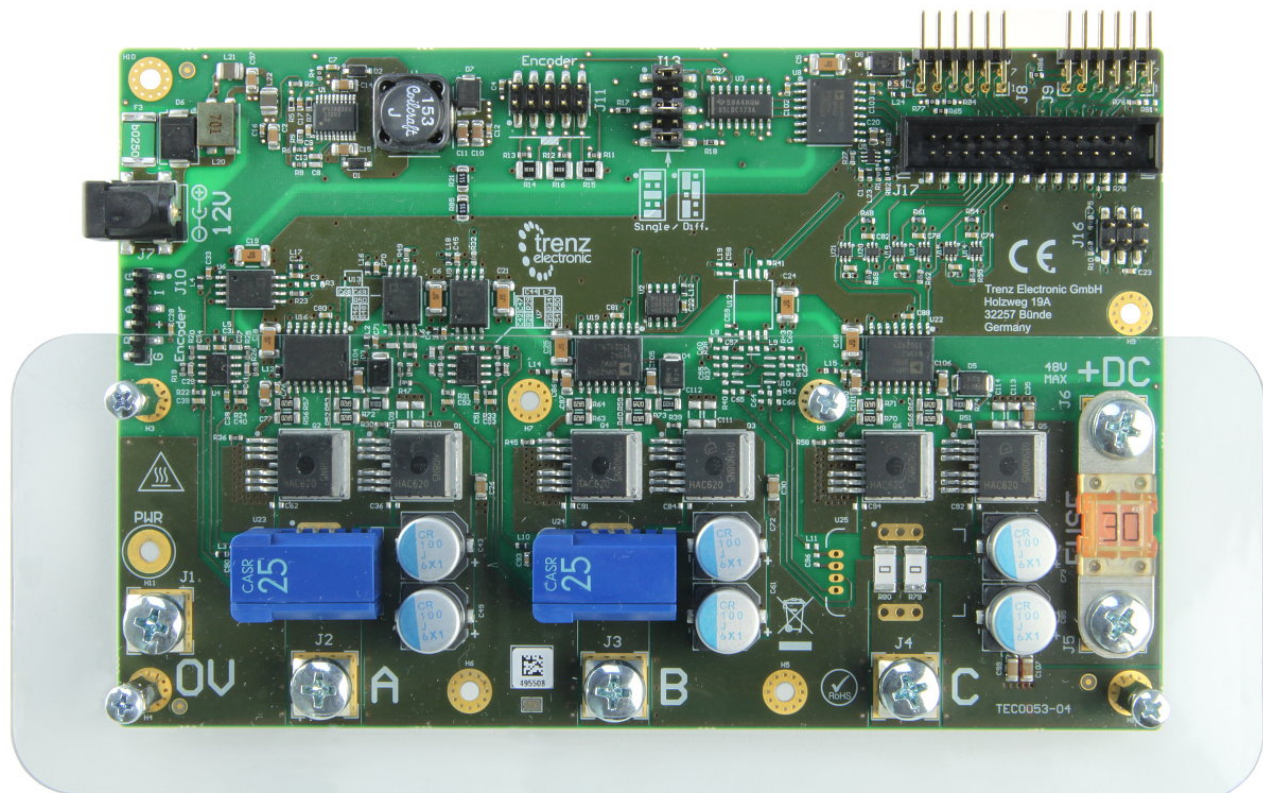
External power supply for the motor must be SELV (Separated or safety extra-low voltage) protected.

- 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.
  - The maximum continuous current must not exceed 30A.
  - The delivered fuse "Littelfuse Tpye 142.5631.5302" must be used as current limiter between connector J5 and J6.
  - To limit the current for smaller motor loads an ADDITIONALLY 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 "Drive Board high current signals" conducting up to 30A nominal, are covered by isolating, mechanically stable, non-inflammable (UL V-1 or better) material
  - The "Drive Board high current signals" are the motor outputs A, B, C and Fuse F1 Connectors J5 and J6 and further internal connections shown white marked in the following picture:

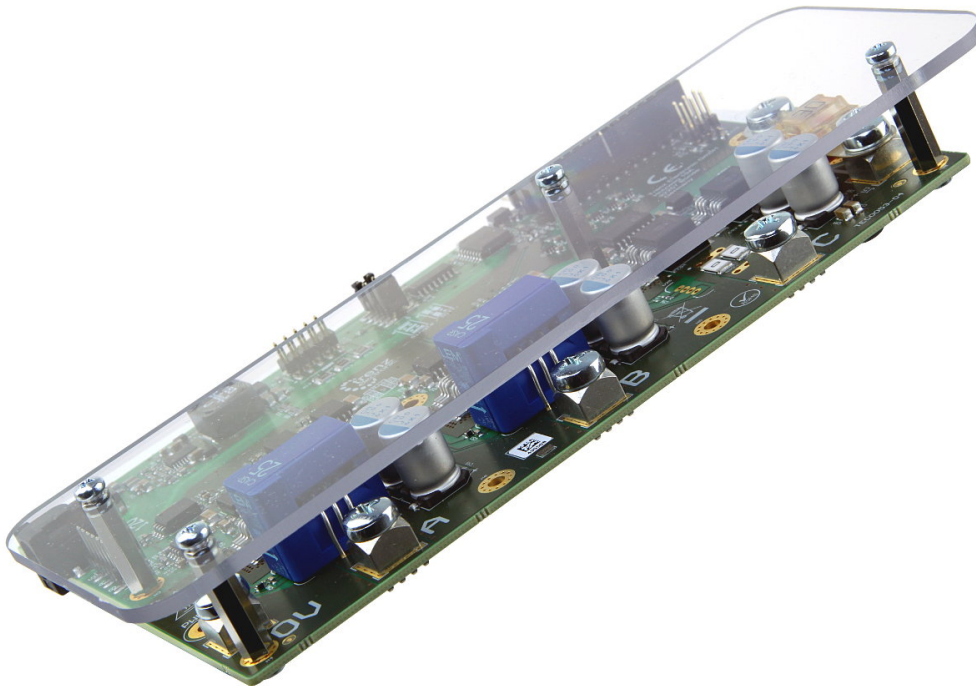


**Figure 5:** High-current parts of the TEC0053.

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 Board with isolating transparent plexiglass cover attached.



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

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

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

## Initial Operation

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To use a separate power supply for the motor supply perform the following steps:

1. Disconnect the reference motor board TEC0060 by unmounting its screws and the encoder cable from J10.
2. Mount the delivered 30A fuse to the connectors J5 and J6 with the delivered M5 screws.
  - a. For lower supply current requirements of the used motor a fuse with a suitable lower current rating integrated in the supply wiring is recommended.
3. Connect with cable lugs the DC of +5..48V to J6 and the corresponding GND to J1.
  - a. The cable length is limited to 3m.
4. Connect the three motor phases to J2 (A), J3 (B) and J4 (C).
  - a. The cable length is limited to 3m.
5. Optional: Connect the encoder to J10 or J11 and set jumper field according to signal specification (differential or single ended).

## Power-On Sequence

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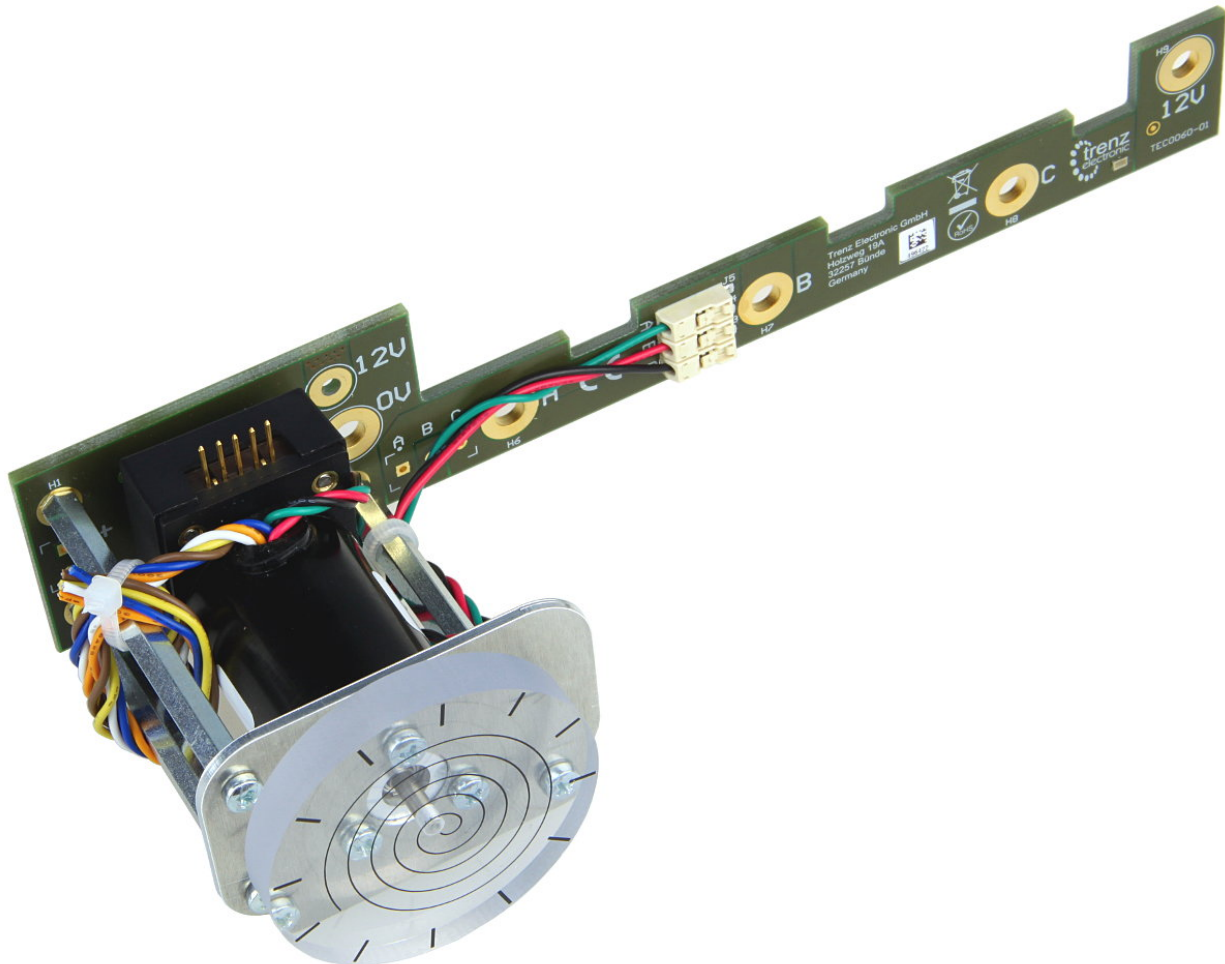
Any power sequence of the three supply sources is allowed:

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



## Reference Motor Board TEC0060

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



**Figure 8:** Reference Motor Board TEC0060 with the Motor attached.

## Reference Motor

The reference motor is 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	DC +3V3 = 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

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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.

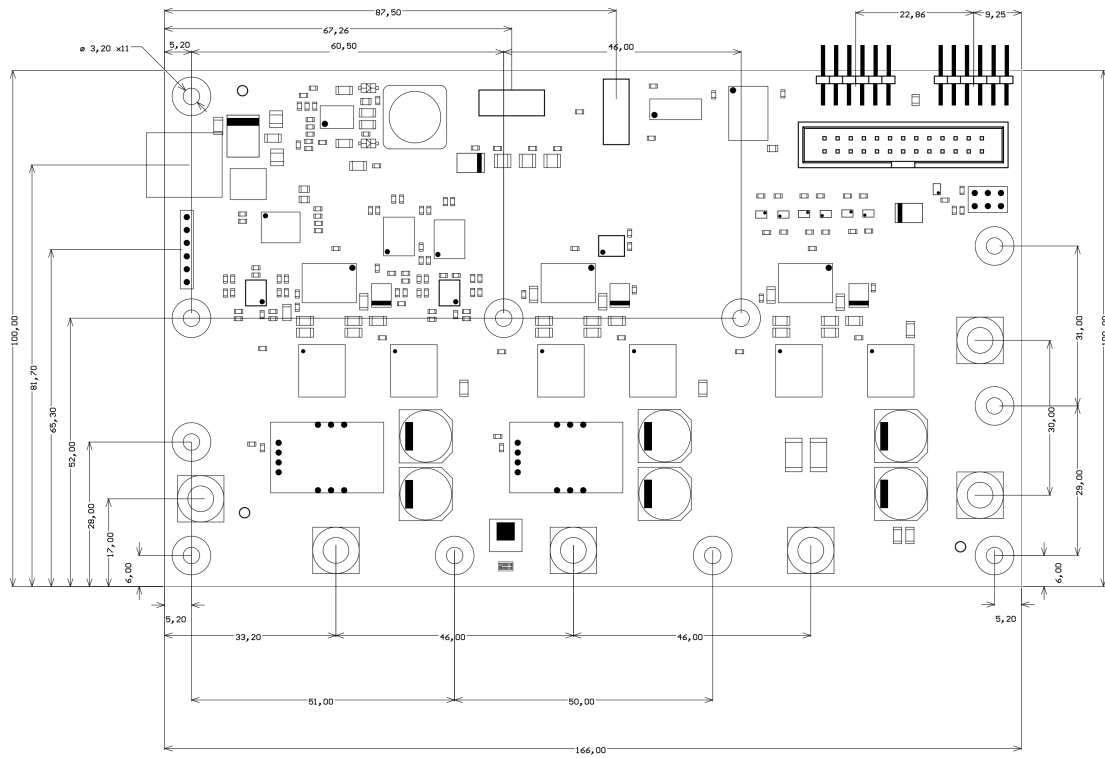
## Physical Dimensions

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

All dimensions are shown in millimeters. Additional sketches, drawings and schematics can be found [here](#).





**Figure 9:** Physical Dimensions of the TEC0053 board.

## Operating Temperature Ranges

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

## References

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

<http://trenz.org/EDDP>

## Revision History

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### Hardware Revision History

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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

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Date	Revision	Authors	Description
2017-09-21	v.43	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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