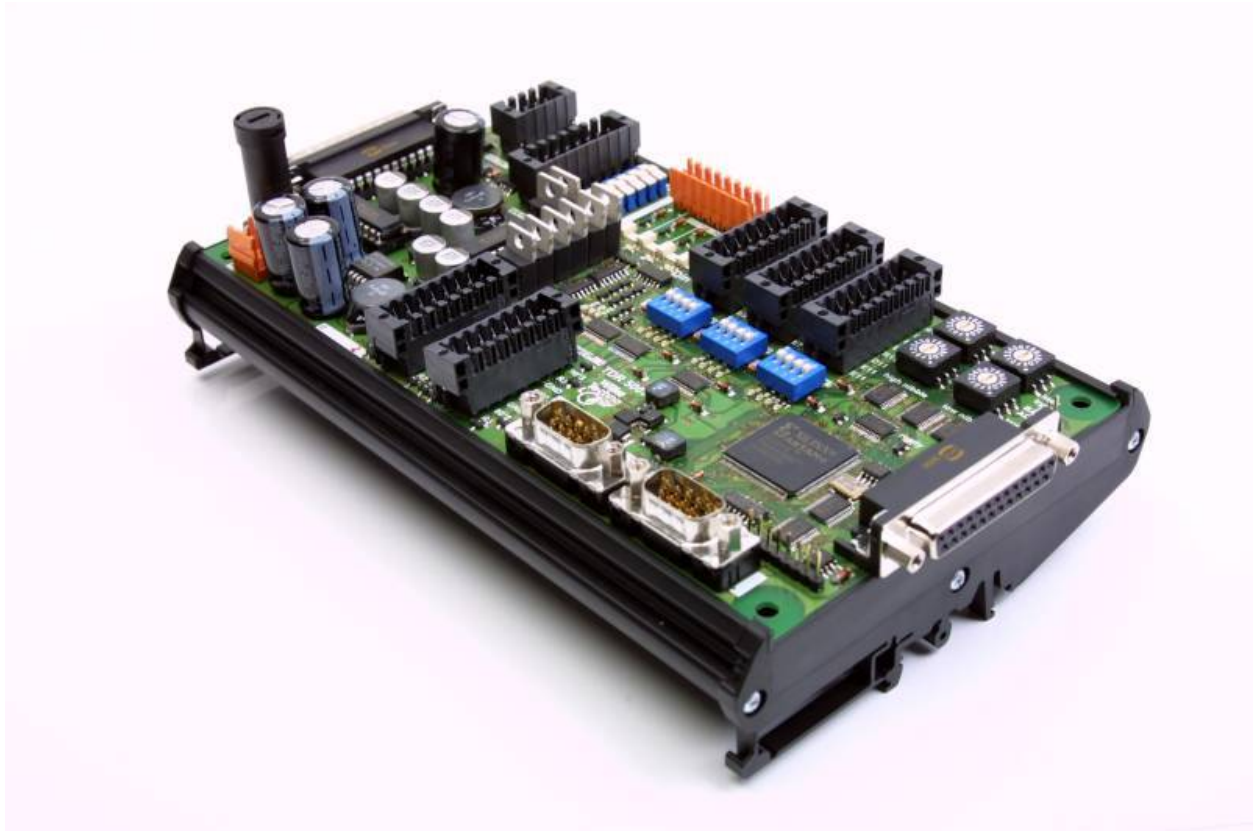


# TDR 5000 Tiger DIN Rail IO-Module

Version of Product: V1.0



### 1 Introduction

The TDR 5000 expansion I/O module is a part of the TDR series.

It provides Analog Inputs and outputs as well as digital IOs which can be used as encoder inputs or puls outputs to controll stepper motor drivers.

Up to 6 encoders with 90° phase shifted signals, a reference signal and an enable signal can be connected to the digital inputs. The position of each encoder is processed in a 32 bit counter which can be read as a long variable though the TIGER-X-Bus. It's also possible to read the digital inputs directly to use them as general purpose inputs.

The open drain outputs can be used as puls outputs or as general purpose outputs. You can add a pull up resistor parallel to the recovery diode using the DIP switches on the board.

The 12bit analog inputs can be switched to voltage inputs which can handle 0V...10V or to current inputs which can handle 0mA...20mA. The analog inputs can stand voltages up to 30V without being damaged.

The analog outputs can drive or sink up to 70mA

### 2 Features

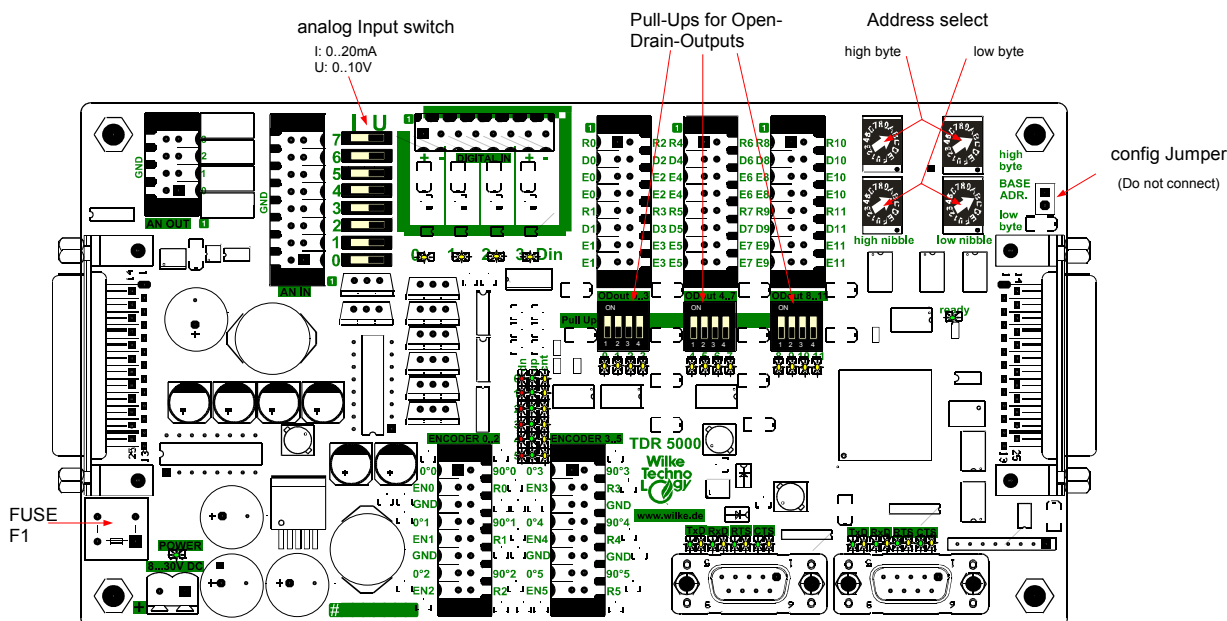
- 24 digital inputs
- 6 encoders connectable using 4 of the digital inputs each.
- 4 opto isolated digital inputs
- 12 open drain outputs
- 6 pulse generators for open drain outputs
- 8 analog inputs 12bit
- 8 switches to choose between current or voltage sensitive analog inputs
- 4 analog outputs 0V...10V at 70mA
- Connector to loop in the TIGER X-Bus (data bus)
- 4 pluggable input connectors
- 4 pluggable output connectors
- pluggable power connector
- 3 LEDs for each encoder input to indicate the enable states and the counting directions
- 12 LEDs at the outputs indicate the states
- power LED
- ready LED to indicate that the boot phase of the module has completed.
- 4 hex code switches to set the 16bit base address to use multiple modules at the same TIGER X-Bus

## Contents

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# TDR 5000 Tiger DIN Rail IO-Module

Version of Product: V1.0



## 3 Control Elements

### 3.1 Pull-Up for Open-Drain-Output

With these switches you can turn on or off Pull-Up resistors (12kΩ) for each of the 12 digital open drain outputs. If the switch is turn on the resistor is connected between the recovery input and the drain output. So you can use the drain output as logical output.

For detail information to connecting the load see chapter “Connectors and Screw-Terminals” sub chapter “Digital Open-Drain-Output”.

### 3.2 Analog Input switch

This switch choose each of the eight analog inputs (connector J12) between current and voltage inputs.

|       | Function                        |
|-------|---------------------------------|
| left  | analog current input (0...20mA) |
| right | analog voltage input (0...10V)  |

### 3.3 Fuse F1

The power supply is fused with the fuse F1. Only use Fuses of the same type, if it must be replaced. The value is specified in the chapter

## 3.4 Base Address selection

The two byte base address of the TDR 5000 module is selected by four hex-coding-switches. The high byte (top) and the low byte (bottom) is splitted in high nibble (left) and low nibble (right).

**Example:** The following table show the position of the 4 hex-coding-switches for the address 1248hex:

|           | high nibble | low nibble |
|-----------|-------------|------------|
| high byte | 1           | 2          |
| low byte  | 4           | 8          |

In this version of the TDR5000 not all base addresses are possible. You can use addresses where all switches have the same position and all combinations of the numerics 0, 1, 2, 4, 8.

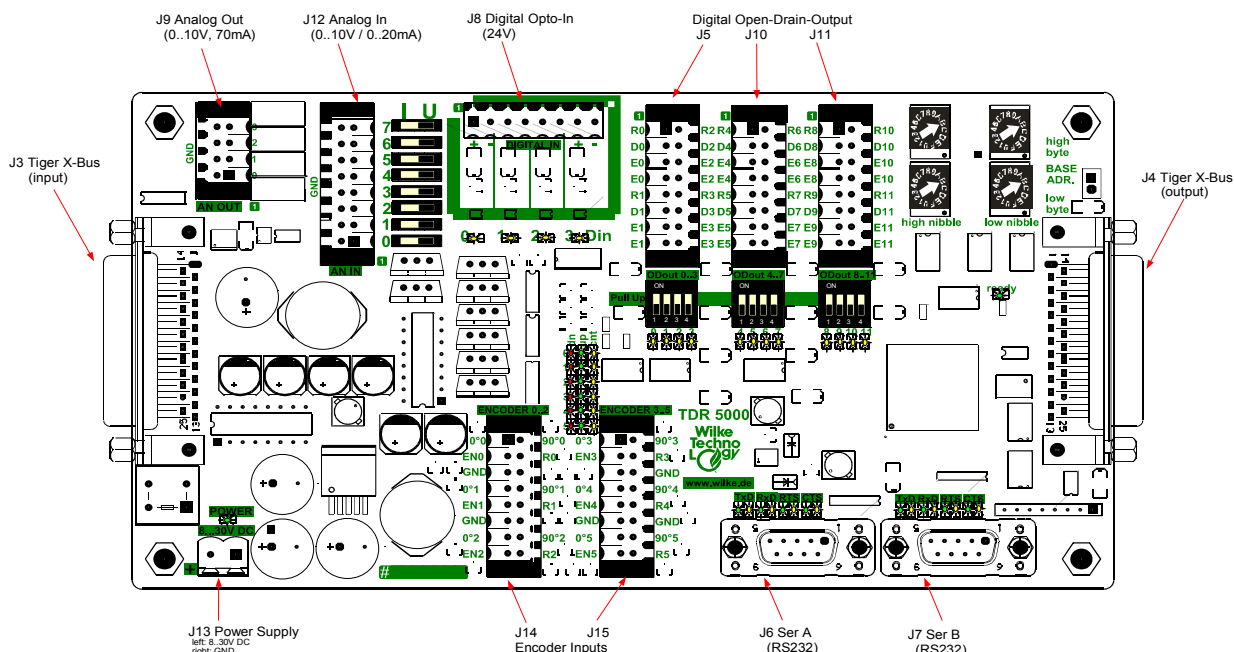
In the appendix you find a table which shows the valid combinations.

### 3.5 Config Jumper

This Jumper is used during production. Do not connect this Jumper. Connecting the Jumper may cause permanent damage.

# TDR 5000 Tiger DIN Rail IO-Module

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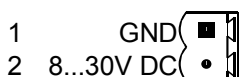


## 4 Connectors and Screw-Terminals

### 4.1 Power Supply

You can connect the power supply 8V...30V DC at connector J13. A power LED light up if power supply is connected.

After booting the ready LED will light up as well.



Connector J13

### 4.2 Encoder Inputs

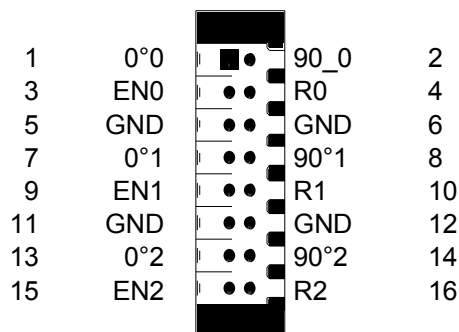
The TDR 5000 include six encoder inputs. Each of it includes two 90° shifted signals, an enable signal and a reference signal.

The Counter can be enabled with the Ei\_EN\_x signal or by software. If you have encoders with a reference output, then you can connect this signal to Ei\_REF\_x. You can programme the TDR5000 to load a start value or clear the counter at a rising or falling edge of this signal. Clearing or loading a start value can also be done by software.

### 4.2.1 Signal Names

| Name | Description                       |
|------|-----------------------------------|
| 0°x  | encoder input signal, not shifted |
| 90°x | encoder input signal, 90° shifted |
| ENx  | enable signal                     |
| Rx   | reference signal                  |
| GND  | signal ground                     |

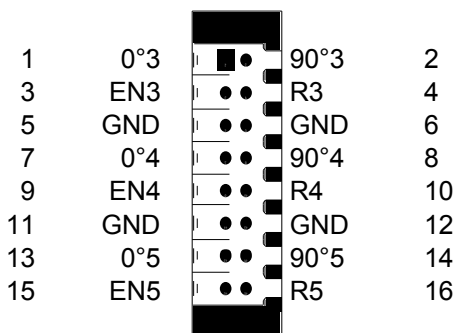
x: Chanel number 0...5



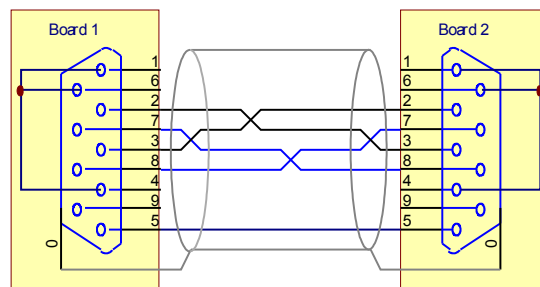
Connector J14

# TDR 5000 Tiger DIN Rail IO-Module

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Connector J15

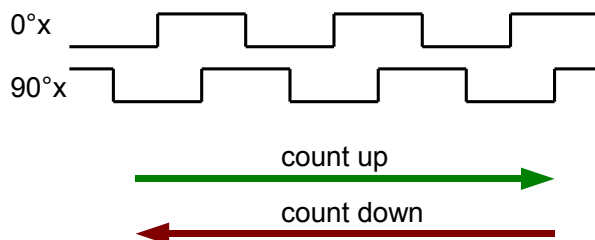


Cross linked cable for RS232

## 4.2.2 Counting directions

Tree LEDs per encoder input show you the status of this input. The yellow one will be light up if the encoder is enabled.

If the counter counts up then the green LED will light up. If the counter counts down then the red LED will light up.



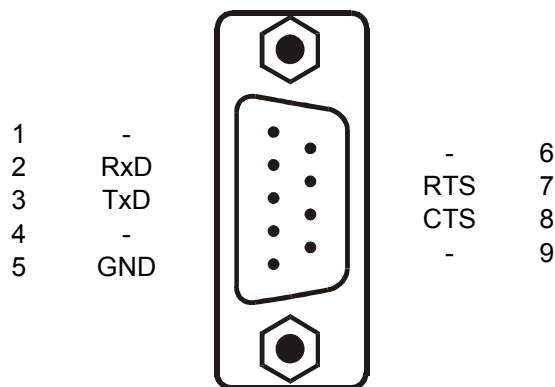
## 4.3 Ser A and Ser B

The TDR 5000 dispose of two full duplex RS232 interfaces. You can have a point to point connection to another device over one of the DB9 male connectors J6 or J7.

Eight LEDs (LED1...8) show you the status of the TxD, RxD, RTS and CTS signal. The yellow LED mean 'mark' and the green one mean 'space'.

For connecting the TDR 5000 to e.g. a modem or other TDR module you have to use a straight 1 to 1 cable.

For communication with the PC via a terminal program you have to use a cross linked cable with female connectors.



Connector J6 & J7 (male)

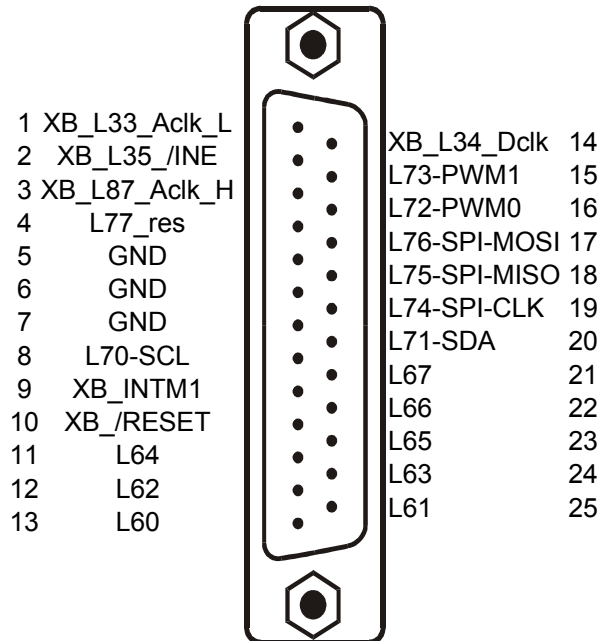
## 4.4 Tiger X-Bus

The Tiger X-Bus is used to connect expansion modules like this module to Tiger DIN Rail CPU modules such as TDR1000, TDR1010, TDR1020, TDR1xxx, TP1000, TP320.

The expansion module is clipped to the DIN rail at the right hand side of the CPU Module or at the right hand side of an already connected expansion module. Push the expansion module to the left to contact the Tiger X-Bus. It's also possible to connect an expansion module with a 25 pole 1:1 cable with sub D connectors. The cable length should not exceed 1.5m.

# TDR 5000 Tiger DIN Rail IO-Module

Version of Product: V1.0



Connector J3 (Tiger X Bus)

Switch off the power of all modules before connecting or disconnecting devices to or from the TIGER X Bus.

The signals of the Tiger X Bus are connected to or controlled by the TINY-Tiger™ 2 I/O-Ports. The functions of the signals are listed below. To avoid conflicts between expansion modules the signals of the Tiger X-Bus should only be used as described.

| Tiger X-Bus Signal Name | Used IO Port of TINY-Tiger | Input / Output | Pin No | Description                                                                                                                      |
|-------------------------|----------------------------|----------------|--------|----------------------------------------------------------------------------------------------------------------------------------|
| XB_L33_Aclk_L           | L33                        | Output         | 1      | Address clock (high active). If this signal is high then the address at L60...L67 is valid. IO modules should latch the address. |

| Tiger X-Bus Signal Name | Used IO Port of TINY-Tiger | Input / Output | Pin No | Description                                                                                                                       |
|-------------------------|----------------------------|----------------|--------|-----------------------------------------------------------------------------------------------------------------------------------|
| XB_L34_Dclk             | L34                        | Output         | 14     | Data clock (high active). If this signal is high then the data at L60...L67 is valid                                              |
| XB_L35_/INE             | L35                        | Output         | 2      | Input Enable (low active). If this signal is low then the input module which address is selected should put it's data to L60..L67 |
| L60                     | L60                        | IO             | 13     | Used as multiplexed address and data bus line.                                                                                    |
| L61                     | L61                        | IO             | 25     | Used as multiplexed address and data bus line.                                                                                    |
| L62                     | L62                        | IO             | 12     | Used as multiplexed address and data bus line.                                                                                    |
| L63                     | L63                        | IO             | 24     | Used as multiplexed address and data bus line.                                                                                    |
| L64                     | L64                        | IO             | 11     | Used as multiplexed address and data bus line.                                                                                    |
| L65                     | L65                        | IO             | 23     | Used as multiplexed address and data bus line.                                                                                    |
| L66                     | L66                        | IO             | 22     | Used as multiplexed address and data bus line.                                                                                    |

| <i>Tiger X-Bus<br/>Signal Name</i> | <i>Used<br/>IO<br/>Port<br/>of<br/>TINY-<br/>Tiger</i> | <i>Input /<br/>Output</i>           | <i>Pin<br/>No</i> | <i>Description</i>                                                                                                    |
|------------------------------------|--------------------------------------------------------|-------------------------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------|
| L67                                | L67                                                    | IO                                  | 21                | Used as multiplexed address and data bus line.                                                                        |
| L70-SCL                            | L70                                                    | IO,<br>pull-up<br>open<br>collector | 8                 | I <sup>2</sup> C clock line.<br>To use this line an external pull-up resistor is necessary.                           |
| L71-SDA                            | L71                                                    | IO,<br>pull-up<br>open<br>collector | 20                | I <sup>2</sup> C data line.<br>To use this line an external pull-up resistor is necessary.                            |
| L72-PWM0                           | L72                                                    | Output                              | 16                | PWM output channel 0.                                                                                                 |
| L73-PWM1                           | L73                                                    | Output                              | 15                | PWM output channel 1.                                                                                                 |
| L74-SPI-CLK                        | L74                                                    | Output                              | 19                | SPI clock line.<br>SPI devices should be enabled using a bit of an extended port.                                     |
| L75-SPI-MISO                       | L75                                                    | Input                               | 18                | SPI data input line.<br>SPI devices should be enabled using a bit of an extended port                                 |
| L76-SPI-MOSI                       | L76                                                    | Output                              | 17                | Serial Peripheral Interface (SPI) data output line.<br>SPI devices should be enabled using a bit of an extended port. |
| L77_res                            | L77                                                    | IO                                  | 4                 | Reserved for future use.                                                                                              |

| <i>Tiger X-Bus<br/>Signal Name</i> | <i>Used<br/>IO<br/>Port<br/>of<br/>TINY-<br/>Tiger</i> | <i>Input /<br/>Output</i>                  | <i>Pin<br/>No</i> | <i>Description</i>                                                                                                                                                                     |
|------------------------------------|--------------------------------------------------------|--------------------------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| XB_L87_Aclk_H                      | L87                                                    | Output                                     | 3                 | address clock high: high active<br>If this signal is high then the high address at L60...L67 is valid. IO Modules should latch the address.                                            |
| XB_INTM1                           | INTM1                                                  | Input<br>pull-up                           | 9                 | Expansion modules can pull up this signal to initiate a BASIC interrupt 1.                                                                                                             |
| XB_/RESET                          | INTM3                                                  | IO<br>open<br>collector<br>pull-up<br>360Ω | 10                | If the Reset button is pressed or at power up the TDR 1000 pulls this signal low. If any IO module pulls this signal low, the user program can recognize this using BASIC interrupt 3. |

### 4.5 Digital Open-Drain-Output

The TDR 5000 include 12 digital open drain outputs. You can connect your device to the TDR 5000 with the plugable connectors J5 for output 0 to 3, J10 for output 4 to 7 and J11 for output 8 to 11.

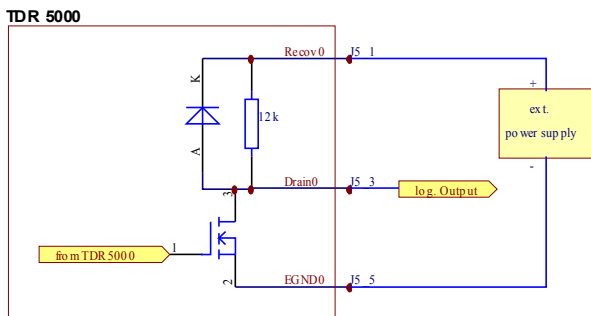
A yellow LED will show you the status of each open drain output. A light up LED means Drain and EGND will be connected.

# TDR 5000 Tiger DIN Rail IO-Module

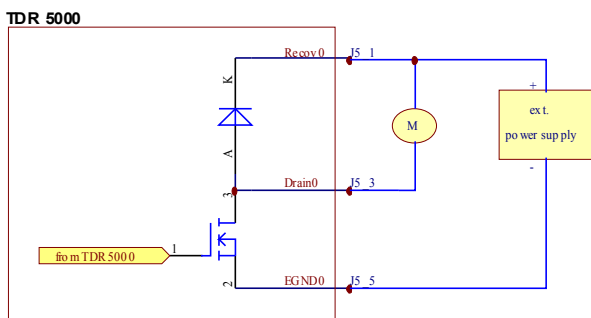
Version of Product: V1.0



In case of turn on the pull up resistor by DIP-Switch (for details see chapter "Control Elements") you can use this as logical output.



In case of turn of the pull up resistor by DIP-Switch you can control the load by connecting with Recv and Drain.



|    |        |        |    |
|----|--------|--------|----|
| 1  | Recv4  | Recv6  | 2  |
| 3  | Drain4 | Drain6 | 4  |
| 5  | EGND4  | EGND6  | 6  |
| 7  | EGND4  | EGND6  | 8  |
| 9  | Recv5  | Recv7  | 10 |
| 11 | Drain5 | Drain7 | 12 |
| 13 | EGND5  | EGND7  | 14 |
| 15 | EGND5  | EGND7  | 16 |

Connector J10

|    |        |         |    |
|----|--------|---------|----|
| 1  | Recv8  | Recv10  | 2  |
| 3  | Drain8 | Drain10 | 4  |
| 5  | EGND8  | EGND10  | 6  |
| 7  | EGND8  | EGND10  | 8  |
| 9  | Recv9  | Recv11  | 10 |
| 11 | Drain9 | Drain11 | 12 |
| 13 | EGND9  | EGND11  | 14 |
| 15 | EGND9  | EGND11  | 16 |

Connector J11

Each signal EGNDx is connected via a 10k resistor to GND of the power supply to prevent current loops though the PCB of the TDR5000.

Each EGNDx signal must be connected externally to GND.

|    |        |        |    |
|----|--------|--------|----|
| 1  | Recv0  | Recv2  | 2  |
| 3  | Drain0 | Drain2 | 4  |
| 5  | EGND0  | EGND2  | 6  |
| 7  | EGND0  | EGND2  | 8  |
| 9  | Recv1  | Recv3  | 10 |
| 11 | Drain1 | Drain3 | 12 |
| 13 | EGND1  | EGND3  | 14 |
| 15 | EGND1  | EGND3  | 16 |

Connector J5

## 4.6 Digital Opto-In

The TDR 5000 include four opto isolated digital inputs. You can connect signals up to 24V AC or DC directly to connector J8.

A LED for each input show you the status of the input. LED light up means signal is connected.

# TDR 5000 Tiger DIN Rail IO-Module

Version of Product: V1.0



|   |        |
|---|--------|
| 1 | D_in0  |
| 2 | D_GND0 |
| 3 | D_in1  |
| 4 | D_GND1 |
| 5 | D_in2  |
| 6 | D_GND2 |
| 7 | D_in3  |
| 8 | D_GND3 |

Connector J8

## 4.7 Analog In

The TDR 5000 support eight analog inputs. You can directly connect sensors to connector J12.

Before using the inputs you have to configure the analog inputs as current or voltage inputs. See also chapter "Control Elements".

|    |     |       |    |
|----|-----|-------|----|
| 16 | GND | AnIn7 | 15 |
| 14 | GND | AnIn6 | 13 |
| 12 | GND | AnIn5 | 11 |
| 10 | GND | AnIn4 | 9  |
| 8  | GND | AnIn3 | 7  |
| 6  | GND | AnIn2 | 5  |
| 4  | GND | AnIn1 | 3  |
| 2  | GND | AnIn0 | 1  |

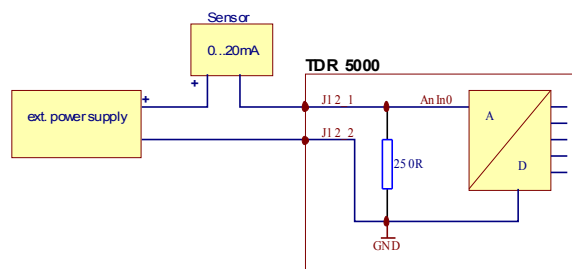
Connector J12

### 4.7.1 Analog In 0...20mA

In case of switching current input you can directly connect sensors with current outputs of 0mA...20mA to connector J12.

The current is measured at a 250Ω resistor. A 12Bit analog to digital converter converts the signal to a digital value. The maximum value is 4095 at 20mA input current.

In case of a short cut at the sensor a current limit circuit of the TDR5000 protects the shunt resistor from damage.

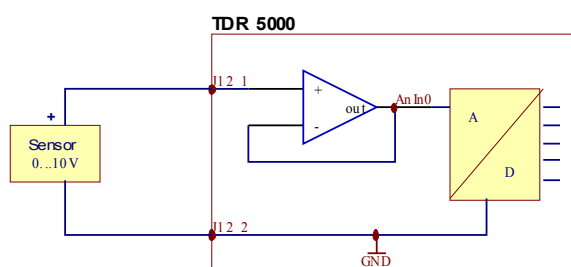


### 4.7.2 Analog In 0V...10V

In case of switching voltage input you can directly connect sensors with voltage outputs of 0...10V to connector J12.

The input signal is connected through an amplifier to the analog to digital converter.

The maximum value is 4095 at 10V input voltage.



## 4.8 Analog Out

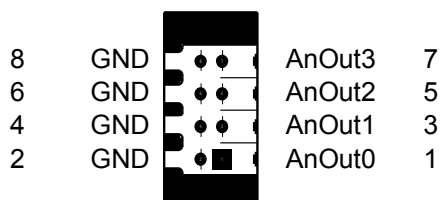
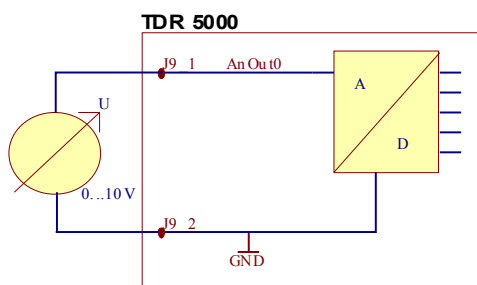
The TDR 5000 include four analog outputs. It can drive loads with maximal 70mA current per channel. Each channel is fused with 0.14A and operate in a output range of 0 to 10V.

The digital-to-analog transfer function can be used to calculate the output voltage:

$$V_{out} = \frac{k}{65520} \cdot 10V$$

where k can be set to 0 ... 65520 in steps of 16. (the 4 least significant bits of k will be ignored.)

The output voltage (0...10V) is available at connector J9



Connector J9

## 5 Technical Specifications

### 5.1 Absolute Maximum and Minimum Ratings

(beyond which permanent damage may occur)

|                                                                                |              |
|--------------------------------------------------------------------------------|--------------|
| maximum supply voltage U <sub>in</sub><br>(screw terminal 1 in respect of GND) | 30V DC       |
| maximum current at each open drain output                                      | 100mA        |
| input voltage at analog inputs 0mA...20mA                                      | -0.3V...30V  |
| input voltage at analog inputs 0V...10V                                        | -0.3V...30V  |
| maximum current at each analog output                                          | 70mA         |
| input voltage at all inputs                                                    | 30V          |
| operating temperature                                                          | -20°C...80°C |

Do not connect any signal connector of the TDR 5000 directly to wires which are outside a building.  
Replace fuses only with fuses which have the same technical characteristics.

### 5.2 Electrical Specifications

|                                                         |                       |
|---------------------------------------------------------|-----------------------|
| supply voltage U <sub>in</sub>                          | 8V...30V DC           |
| supply current at reset state, all outputs switched off |                       |
| at 8V input voltage                                     | 250mA                 |
| at 12V input voltage                                    | 150mA                 |
| at 24V input voltage                                    | 70mA                  |
| max. supply current                                     |                       |
| at 8V input voltage                                     | 1100mA                |
| at 12V input voltage                                    | 710mA                 |
| at 24V input voltage                                    | 350mA                 |
| Tolerances of analog inputs at 25°C                     | < 0.3%                |
| max. offset error                                       | 33mV                  |
| temperature drift                                       | < 5ppm/°C             |
| Input resistance of 0V...10V analog inputs              | 100kΩ                 |
| Input resistance of any encoder input                   | 66kΩ                  |
| Low level input voltage at any encoder input            | -0.2...5V             |
| High level input voltage at any encoder input           | 5V...24V              |
| FUSE F1                                                 | 5x20mm<br>2A time-lag |

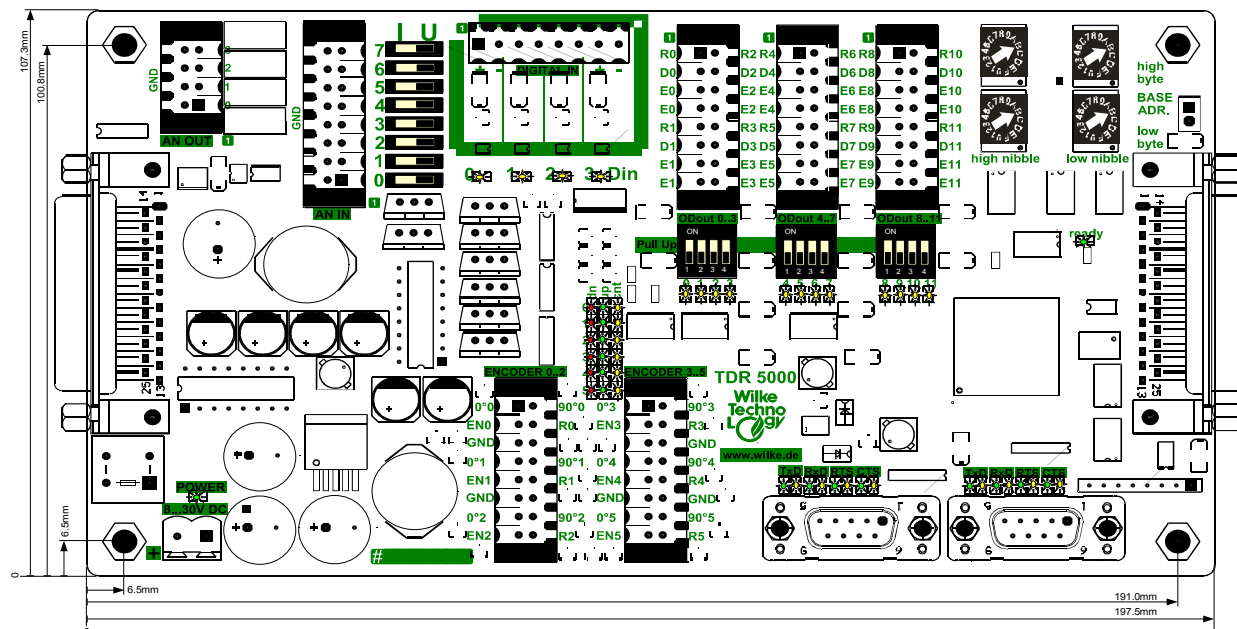
# TDR 5000 Tiger DIN Rail IO-Module

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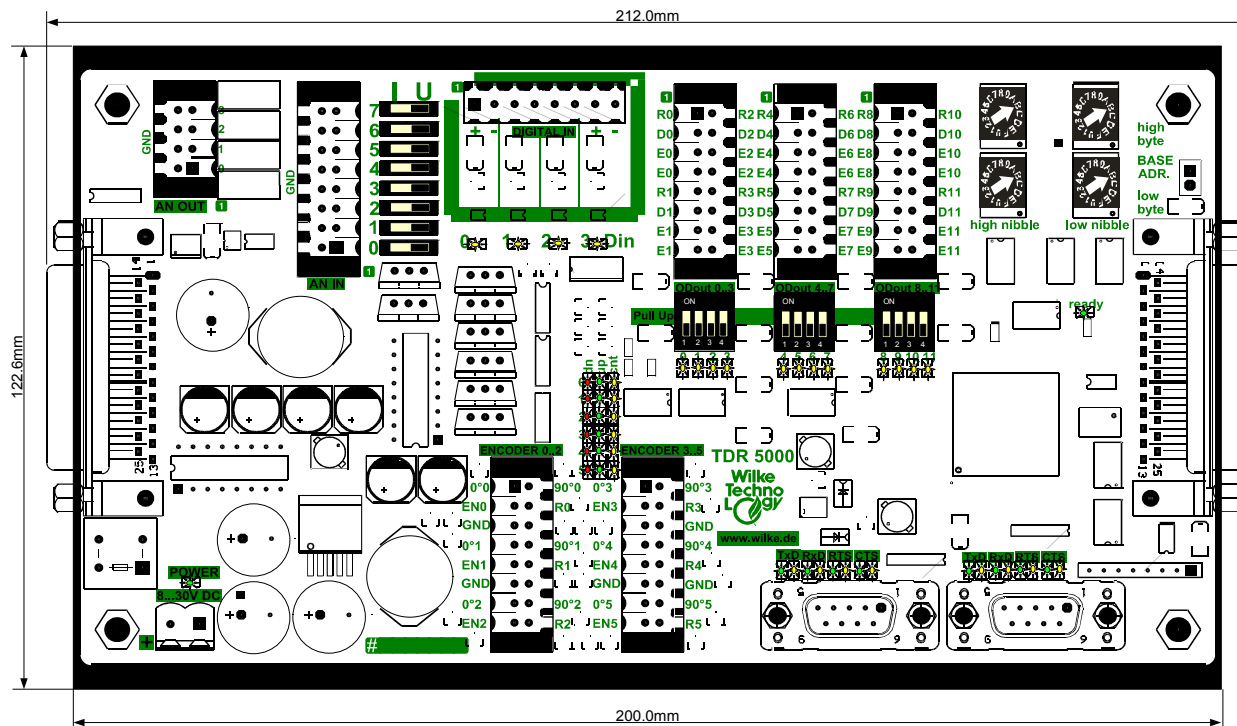


## 5.3 Module Dimensions

### 5.3.1 Board Dimensions



### 5.3.2 DIN Rail Dimensions



# TDR 5000 Tiger DIN Rail IO-Module



Version of Product: V1.0

## 6 Documentation History

| <i>Version of Documentation</i> | <i>Product Version</i> | <i>Description / Changes</i>                                      |
|---------------------------------|------------------------|-------------------------------------------------------------------|
| V000                            | V1.0 beta              | preliminary version                                               |
| V001                            | V1.0 beta              | preliminary version, several specifications added                 |
| V002                            | V1.0                   | preliminary version, Data sheet updated due to a circuit revision |

## 7 Appendix

### 7.1 Valid Base Addresses

| high byte   |            | low byte    |            |
|-------------|------------|-------------|------------|
| high nibble | low nibble | high nibble | low nibble |
| 0           | 0          | 0           | 0          |
| 1           | 1          | 1           | 1          |
| 2           | 2          | 2           | 2          |
| 3           | 3          | 3           | 3          |
| 4           | 4          | 4           | 4          |
| 5           | 5          | 5           | 5          |
| 6           | 6          | 6           | 6          |
| 7           | 7          | 7           | 7          |
| 8           | 8          | 8           | 8          |
| 9           | 9          | 9           | 9          |
| A           | A          | A           | A          |
| B           | B          | B           | B          |
| C           | C          | C           | C          |
| D           | D          | D           | D          |
| E           | E          | E           | E          |
| F           | F          | F           | F          |
| 0           | 0          | 0           | 1          |
| 0           | 0          | 0           | 2          |
| 0           | 0          | 0           | 4          |
| 0           | 0          | 0           | 8          |
| 0           | 0          | 1           | 0          |
| 0           | 0          | 1           | 1          |
| 0           | 0          | 1           | 2          |
| 0           | 0          | 1           | 4          |
| 0           | 0          | 1           | 8          |
| 0           | 0          | 2           | 0          |
| 0           | 0          | 2           | 1          |
| 0           | 0          | 2           | 2          |
| 0           | 0          | 2           | 4          |
| 0           | 0          | 2           | 8          |
| 0           | 0          | 4           | 0          |
| 0           | 0          | 4           | 1          |

| high byte   |            | low byte    |            |
|-------------|------------|-------------|------------|
| high nibble | low nibble | high nibble | low nibble |
| 0           | 0          | 4           | 2          |
| 0           | 0          | 4           | 4          |
| 0           | 0          | 4           | 8          |
| 0           | 0          | 8           | 0          |
| 0           | 0          | 8           | 1          |
| 0           | 0          | 8           | 2          |
| 0           | 0          | 8           | 4          |
| 0           | 0          | 8           | 8          |
| 0           | 1          | 0           | 1          |
| 0           | 1          | 0           | 2          |
| 0           | 1          | 0           | 4          |
| 0           | 1          | 0           | 8          |
| 0           | 1          | 1           | 0          |
| 0           | 1          | 1           | 1          |
| 0           | 1          | 1           | 2          |
| 0           | 1          | 1           | 4          |
| 0           | 1          | 1           | 8          |
| 0           | 1          | 2           | 0          |
| 0           | 1          | 2           | 1          |
| 0           | 1          | 2           | 2          |
| 0           | 1          | 2           | 4          |
| 0           | 1          | 2           | 8          |
| 0           | 1          | 4           | 0          |
| 0           | 1          | 4           | 1          |
| 0           | 1          | 4           | 2          |
| 0           | 1          | 4           | 4          |
| 0           | 1          | 4           | 8          |
| 0           | 1          | 8           | 0          |
| 0           | 1          | 8           | 1          |
| ...         | ...        | ...         | ...        |
| 8           | 8          | 8           | 2          |
| 8           | 8          | 8           | 4          |
| 8           | 8          | 8           | 8          |