

# RedLab E-DIO24

Ethernet-based Digital I/O

## User's Guide

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## About this User's Guide

### What you will learn from this user's guide

This user's guide describes the Meilhaus Electronics RedLab E-DIO24 data acquisition device and lists device specifications.

### Conventions in this user's guide

#### For more information

Text presented in a box signifies additional information and helpful hints related to the subject matter you are reading.

**Caution!** Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

**bold text**      **Bold** text is used for the names of objects on a screen, such as buttons, text boxes, and check boxes.

*italic text*      *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase.

### Where to find more information

Additional information about RedLab E-DIO24 hardware is available on our website at [www.meilhaus.com](http://www.meilhaus.com). You can also contact Meilhaus Electronic GmbH with specific questions.

- Phone: +49 (0) 81 41/52 71-0
- Fax: +49 (0) 81 41/52 71-129
- E-Mail: [support@meilhaus.de](mailto:support@meilhaus.de)

# Introducing the RedLab E-DIO24

The RedLab E-DIO24 is an Ethernet based digital I/O data acquisition device that is compatible with TCP (IPv4 only) and UDP network protocols. The RedLab E-DIO24 provides the following features:

- 24 individually-configurable digital I/O bits
- $\pm 24$  mA drive capability
- Software-paced transfer rates up to 5 kHz (typical throughput on a local network)
- One 32-bit event counter (shared with a DIO pin)
- Remote network access, configuration, and alarm
- Screw terminals for field wiring connections
- DIN-rail mountable
- Functionally equivalent to USB-DIO24 Series and USB-1024 Series hardware.

The RedLab E-DIO24 is powered by an external 5 volt power adapter included with the shipment.

## Ethernet interface

The RedLab E-DIO24 has one built-in 10/100 BASE-T auto-negotiation, high-speed communication port. You can remotely access and configure your RedLab E-DIO24 from anywhere on the network. Only one computer can control the RedLab E-DIO24 at one time. The networking protocols are TCP and UDP.

A unique *media access control* (MAC) address is assigned to each device at the factory. You configure the Ethernet connection settings through software. A network name in the format RedLab E-DIO24-xxxxxxx, is assigned to the device, where xxxxxx represents the lower six characters of the device MAC address.

## Functional block diagram

RedLab E-DIO24 functions are illustrated in the block diagram shown here.

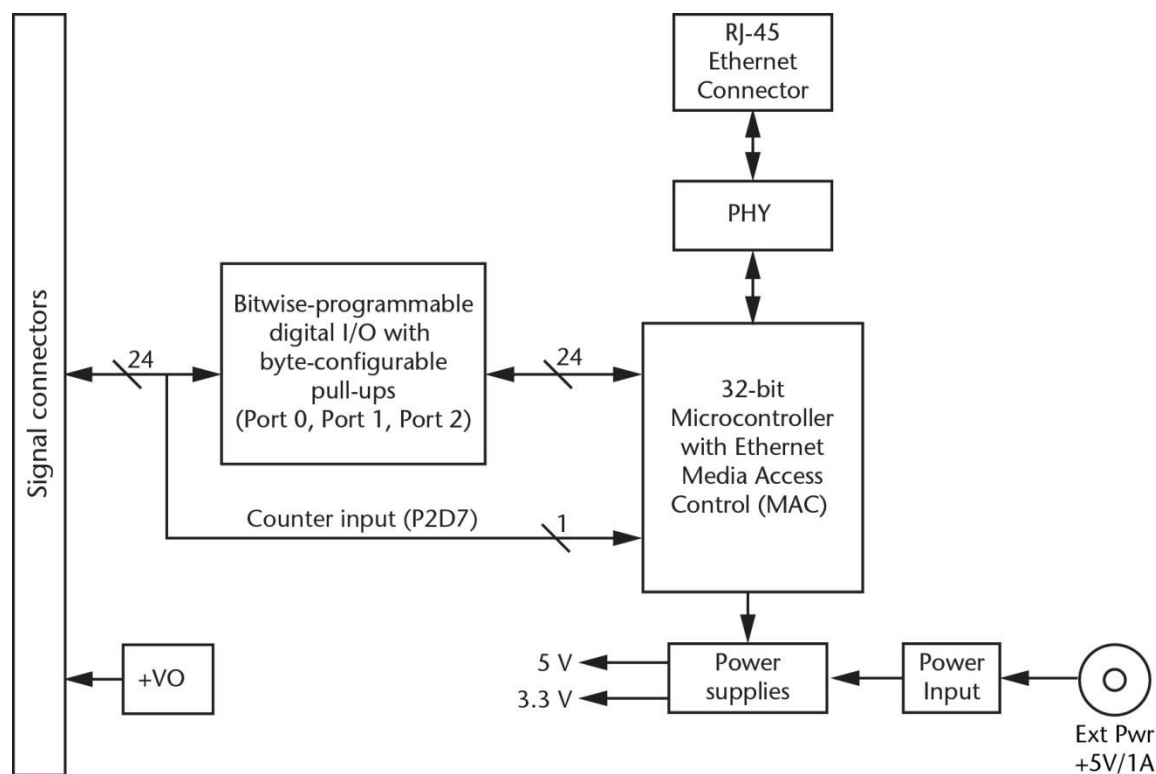


Figure 1. Functional block diagram

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**Chapter 2**

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# Installing the RedLab E-DIO24

## Unpacking

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the device from its packaging, ground yourself using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge.

Contact us immediately if any components are missing or damaged.

## Installing the software

Refer to the device product page on the Meilhaus Engineering website for information about the included and optional software supported by the RedLab E-DIO24.

**Install the software before you install your device**

The driver needed to run the RedLab E-DIO24 is installed with the software. Therefore, you need to install the software package you plan to use before you install the hardware.

## Connecting the external power adapter

Power to the RedLab E-DIO24 is provided with the 5 volt, 1 amp external power adapter (PS-5V1AEPS). Connect the adapter cord to the power connector on the RedLab E-DIO24, and plug the AC adapter into an electrical outlet.

The **Power** LED turns on when 5 V power is supplied to the RedLab E-DIO24. If the voltage supply is less than 4.2 V or more than 5.6 V, the **POWER** LED does not turn on. Refer to Figure 2 Seite 10 for the location of the **Power** LED.

## Connecting the RedLab E-DIO24

The RedLab E-DIO24 requires a TCP and UDP connection to a network or computer.

Using the Ethernet cable provided, connect the RedLab E-DIO24 to a 10Base-T- or 100Base-TX compatible Ethernet port, hub, or switch. When connecting the RedLab E-DIO24 for the first time, make sure that you connect to a local network with DHCP enabled. If you are unsure whether you have access to a local network or that DHCP is enabled on that network, you should connect directly to a Windows PC.

It may take a minute or two for the network DHCP server to detect the device and assign an address. The green **Link/activity** LED on the lower left of the Ethernet connector turns on when a valid Ethernet link is established, and blinks when network activity is detected.

Once the RedLab E-DIO24 is physically connected to the local network or PC, you can run the software (InstaCal for example) to establish a connection. If a connection cannot be established, make sure the device is using the default configuration by following the instructions in the [Restoring factory default network settings](#) Seite 8.

Once a connection is established and you can communicate with the device, you can change the configuration for other network scenarios.

## Configuring network settings

The following RedLab E-DIO24 network settings are software-selectable. One user at a time can connect to the device and configure network options. The default settings are recommended for typical local networks.

### Address mode

The address mode settings determine whether default IP parameters (IPv4 address, subnet mask, and gateway) are assigned to the RedLab E-DIO24, or whether an auto-addressing method is used to assign these parameters.

#### DHCP or Link-Local enabled (default)

If connected to a network with a DHCP server, the service automatically assigns IP addresses to the RedLab E-DIO24. If the connected network does not have a DHCP server, the address stored in the default IP address is assigned.

If the RedLab E-DIO24 is directly connected to a Windows PC or other host that supports link-local addressing, a link-local address is assigned. A link-local address is valid only for communications between the RedLab E-DIO24 and the PC to which it is connected.

#### DHCP Only

This setting enables configuration by a DHCP server, if one is available. The RedLab E-DIO24 is assigned an IP address shortly after it is powered up and attached to the network.

#### Link-Local Only

The RedLab E-DIO24 is assigned a link-local IP address by the Windows PC or other host that supports link-local addressing to which it is connected. A link-local address is valid only for communications between the RedLab E-DIO24 and the PC to which it is connected.

#### Static

The default **IPv4 Address** is manually configured on the RedLab E-DIO24.

### IP address

The default IP address settings are assigned when automatic addressing is either disabled or not available (DHCP or link-local, for example):

- **IPv4 address** – The IP address stored on the device. The default IPv4 address is 192.168.0.101.
- **Subnet mask** – The subnet mask stored on the device. The subnet mask determines the number of bits of the IP address that is used for the host portion of the address vs. the number of bits used for the network portion. The default subnet mask is 255.255.255.000.
- **Gateway** – The gateway IP address stored on the device. The gateway address of the device bridges subnets within a network. The default gateway is 192.168.0.1.

### Connection code

The connection code is number between 0 (default) and 999999999. Change this number from its default to prevent other users from connecting to and configuring the device. When the code is set to a value other than 0, the device remains visible to other users on the network, but connection by another user is not allowed.

## Configuring the network router for communication across networks

To communicate with the RedLab E-DIO24 from a computer connected to a different network – such as over the Internet – you must change the network configuration of the network router.

**Caution!** This procedure should only be performed by a network administrator or computer professional. Incorrect settings can significantly disrupt a network.

Complete the following steps to configure the network router for communication across networks. In this procedure, the RedLab E-DIO24 is installed on the *host* LAN, and the computer is installed on the *client* LAN.

1. Connect the RedLab E-DIO24 to a local network and determine its IP address.  
If the address was assigned by DHCP, we recommend that you change it to a static address: set the default address to the address assigned, and set the device network configuration to a static value.
2. Configure the firewall/router to forward incoming traffic to the following ports to the IP address assigned to the device:
  - UDP:54211 (discovery)
  - TCP:54211 (commands)
3. On the computer connected to the client LAN, enter the WAN address of the host router, and specify the ports that were forwarded to connect to the remote RedLab E-DIO24.

You can select a different port if the port above is not available on your router; however make sure that the same port is configured for both UDP and TCP.

## Network alarm

You can configure a digital output bit to change state when a host is connected to or disconnected from the RedLab E-DIO24. All alarm settings are selectable with software.

## Restoring factory default network settings

The reset button is used to restore the factory default network settings. This button is located next to the LEDs on the top edge of the enclosure; see Figure 2 Seite 10.

To reset network configuration settings to factory default values, press and hold the **Factory reset** button for at least four seconds until both the **Power** and **Activity** LEDs blink. When you release the button, the device starts up with network settings restored to the factory default values. If you release the button before the two LEDs blink, the settings are not affected and the device starts up normally. If InstaCal is open when default settings are restored, click the **Refresh Boards** toolbar button to reflect the changes.

## Updating firmware

Contact Meilhaus Electronic GmbH for information on available firmware updates.

- Phone: +49 (0) 81 41/52 71-0
- Fax: +49 (0) 81 41/52 71-129
- E-Mail: [support@meilhaus.de](mailto:support@meilhaus.de)

### Firmware update mode

If a firmware update fails, you can force the device into firmware update mode and use InstaCal to recover from the failure.

To put the device into firmware update mode, press and hold the device reset button and apply power. The device LEDs will continuously blink. InstaCal will detect a device in this mode as a bootloader device. Run InstaCal and download the firmware. After downloading the firmware, refresh the device list and add the device to InstaCal again.



# Functional Details

## External components

The RedLab E-DIO24 has the following external components:

- Screw terminals
- LED status indicators
- Ethernet connector
- External power connector
- Factory reset button

## Screw terminals

The RedLab E-DIO24 device screw terminals provide the following connections:

- 24 digital I/O connections (**P0D0** to **P2D7**)
- One counter input (access with **P2D7**)
- One voltage output (**+VO**)
- Ground (**GND**) connections

The location of each signal is shown in Figure 2.

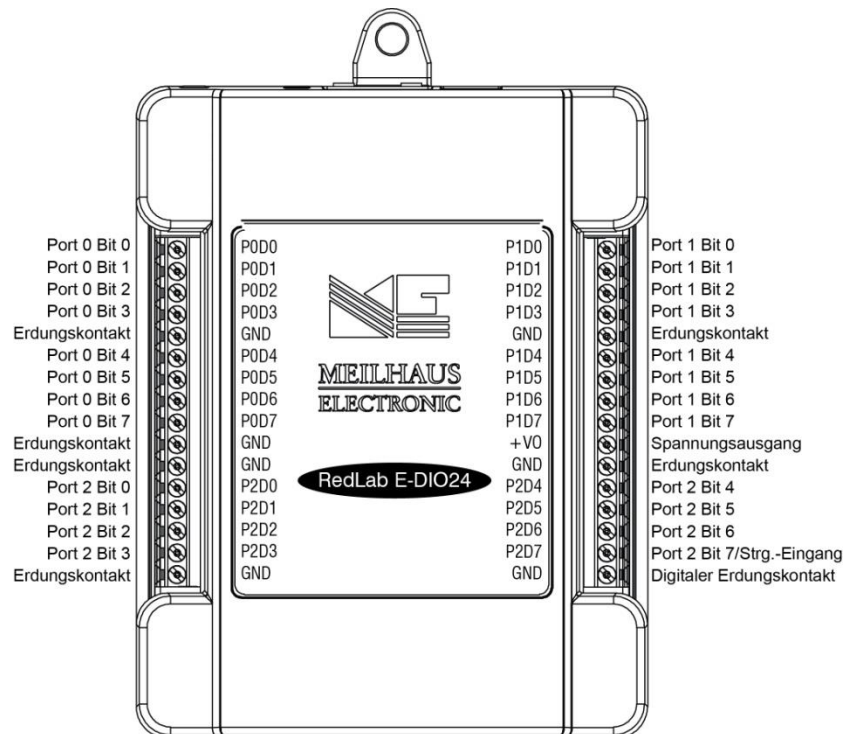
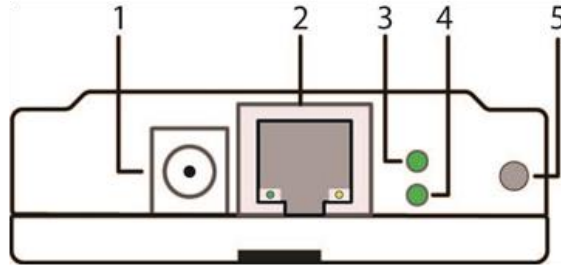


Figure 2. RedLab E-DIO24 pinout

The remaining components are on the top edge of the enclosure; refer to Figure 2:



- |   |   |   |                       |
|---|---|---|-----------------------|
| 1 | External power connector  | 4 | Activity LED (bottom) |
| 2 | Ethernet connector with green Link/activity LED (left) and yellow Speed LED (right) | 5 | Factory reset button  |
| 3 | Power LED (top)   |   |                       |

Figure 2. RedLab E-DIO24 connectors, reset button, and status LEDs

## LED status indicators

The RedLab E-DIO24 has two LED indicators that indicate the status of power and host communications:

- The **Power** LED is on when external power between 4.2 V to 5.6 V is supplied.  
This LED is off when the external power supply is not connected, or the input power is outside of the 4.2 V to 5.6 V voltage range of the external supply, causing a power fault.  
The RedLab E-DIO24 has an onboard voltage supervisory circuit that monitors the 5 V external power supply.
- The **Activity** LED is on when a valid host connection is detected.  
This LED blinks when a command is received.

Both Power and Activity LEDs blink once when factory default settings are restored. Refer to [Restoring factory default network settings](#) Seite 8 for more information.

## Ethernet connector

The RedLab E-DIO24 has one 10/100 BASE-T, auto-negotiation, high-speed communication port. The port connector is an RJ-45, eight-position type that accepts CAT-5 shielded or unshielded twisted pair cable. The maximum communication distance without using a repeater is 100 meters (328 feet). You can send your data 100 meters at data speeds of up to 100 Mbps using only one Ethernet cable connected to the network.

### Ethernet connector LEDS

- The green **Link/activity** LED on the left of the connector is on when a valid Ethernet link is established, and blinks when network activity is detected.
- The yellow **Speed** LED on the right of the connector is on when the transmission speed is 100 Mbps, and off when the transmission speed is 10 Mbps or no Ethernet link is established.

## External power connector

Connect the supplied 5 volt, 1 amp power adapter (PS-5V1AEPS) to this connector. The RedLab E-DIO24 requires external power to operate.

## Factory reset button

Use the factory reset button to restore network configuration settings to the factory default values. Refer to [Restoring factory default network settings](#) Seite 8 for instructions.

The reset button can also used to put the device into firmware update mode to recover if a firmware update fails. Refer to [Firmware update mode](#) section Seite 8 for details.

## Signal connections

### Digital I/O

The RedLab E-DIO24 has 24 DIO lines configured as three 8-bit ports – port 0, port 1, and port 2. Each bit is individually configurable for input or output. The digital I/O transfer rate is 5 kHz, maximum for software-paced operation on a local network.

You can specify a digital bit configured for output as a network alarm and change state when an Ethernet connection with a host is established or lost. All alarm settings are selectable with software.

The digital I/O terminals can detect the state of any TTL-level input signal with CMOS output. Refer to the schematic shown in Figure 3.

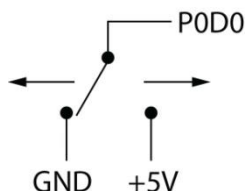


Figure 3. Schematic showing switch detection by digital channel P0D0

If you set the switch to the +5 V input, the digital bit reads *TRUE* (1). If you move the switch to GND, the bit reads *FALSE* (0).

### Hardware compatibility

The RedLab E-DIO24 is functionally equivalent to RedLab 1024LS and RedLab 1024HLS hardware. Software programs written for those hardware devices can be run with the RedLab E-DIO24.

### Pull-up/down configuration

All DIO lines are pulled high by default to 5 V through 47 kΩ resistors via jumpers **W3, W4, and W5** on the circuit board (see Figure 4). Each jumper configures a digital port for pull-up or pull-down.

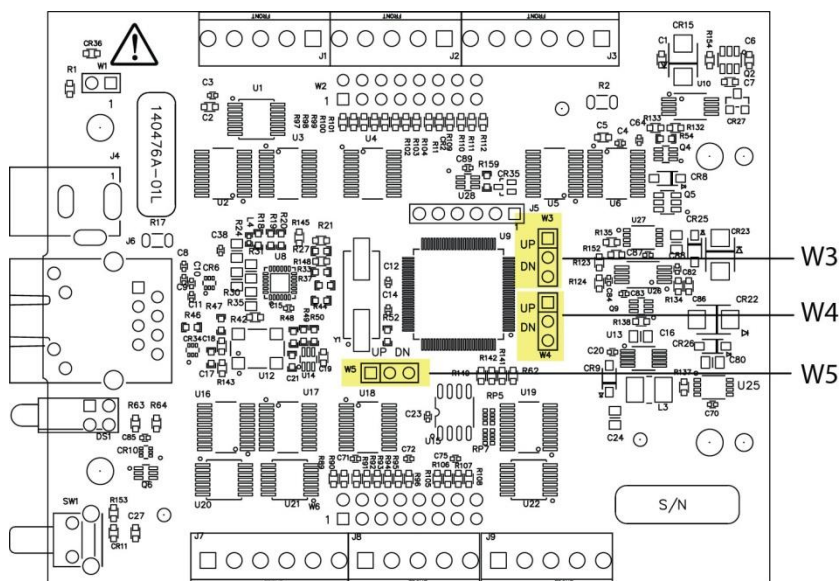


Figure 4. Pull-up/down jumper locations

The pull-up/down voltage is common to all 47 kΩ resistors. Each jumper is configured by default for pull-up. Figure 5 Seite 12 shows the jumper configured for pull-up and pull-down.

**Caution!** The discharge of static electricity can damage some electronic components. Take care when removing the enclosure. Before touching the board, ground yourself using a wrist strap or touch the computer chassis or other grounded object to eliminate any stored static charge.

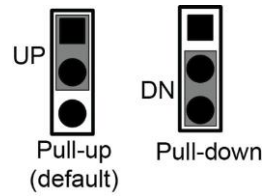


Figure 5. Pull-up/down jumper configurations, typical

## Counter input

The 32-bit event counter is accessed with digital port 2 bit 7 (P2D7). This pin accepts a frequency input up to 10 MHz. The internal counter increments when the TTL levels transition from low to high.

## Voltage output

The **+VO** terminal can output up to 10 mA maximum. You can use this terminal to supply power to external devices or circuitry.

**Caution!** The **+VO** terminal is an output. Do not connect to an external power supply or you may damage the device and possibly the computer.

## Ground

The ground (**GND**) terminals provide a common ground for the digital I/O, counter input, and power output terminal.

## Mechanical drawings

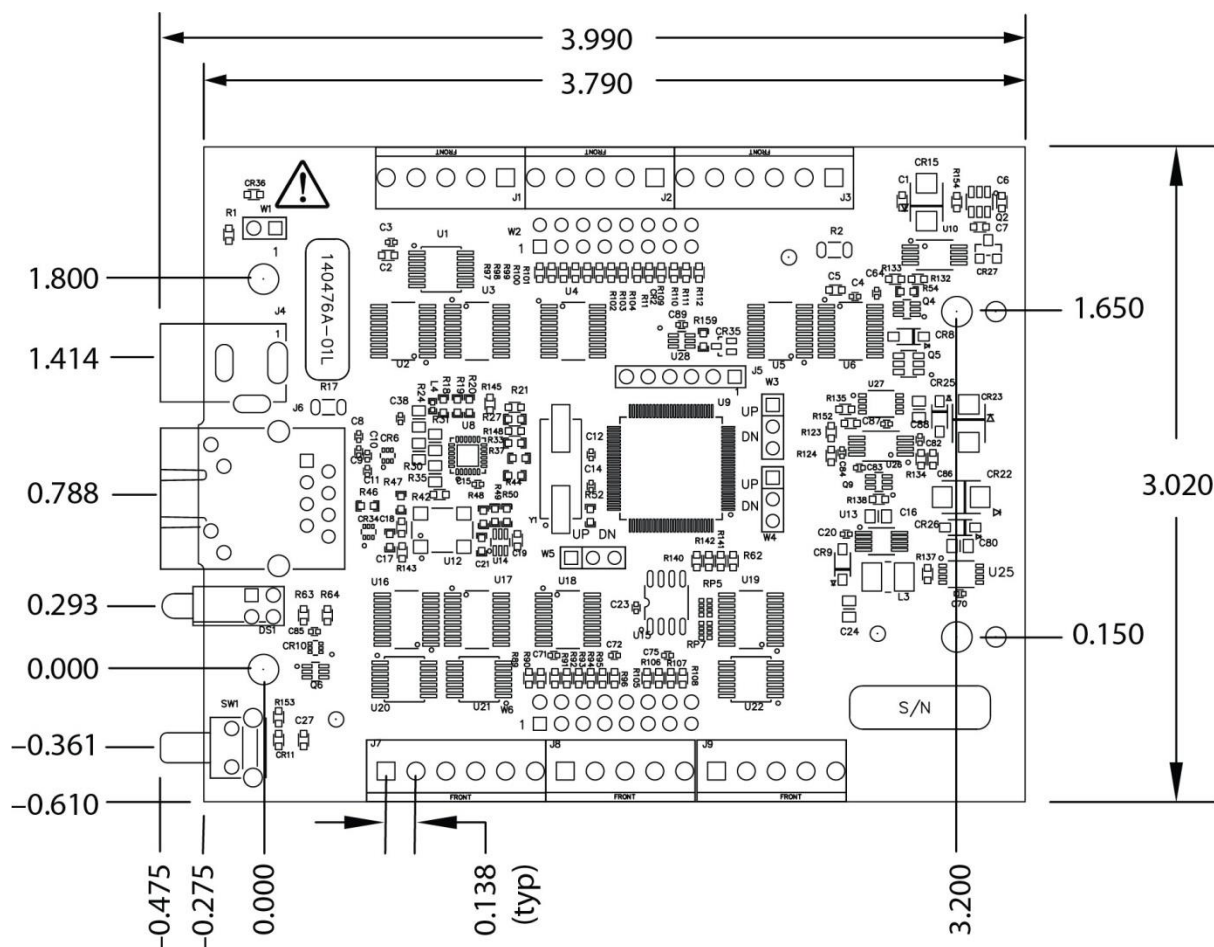


Figure 6. RedLab E-DIO24 device circuit board dimensions

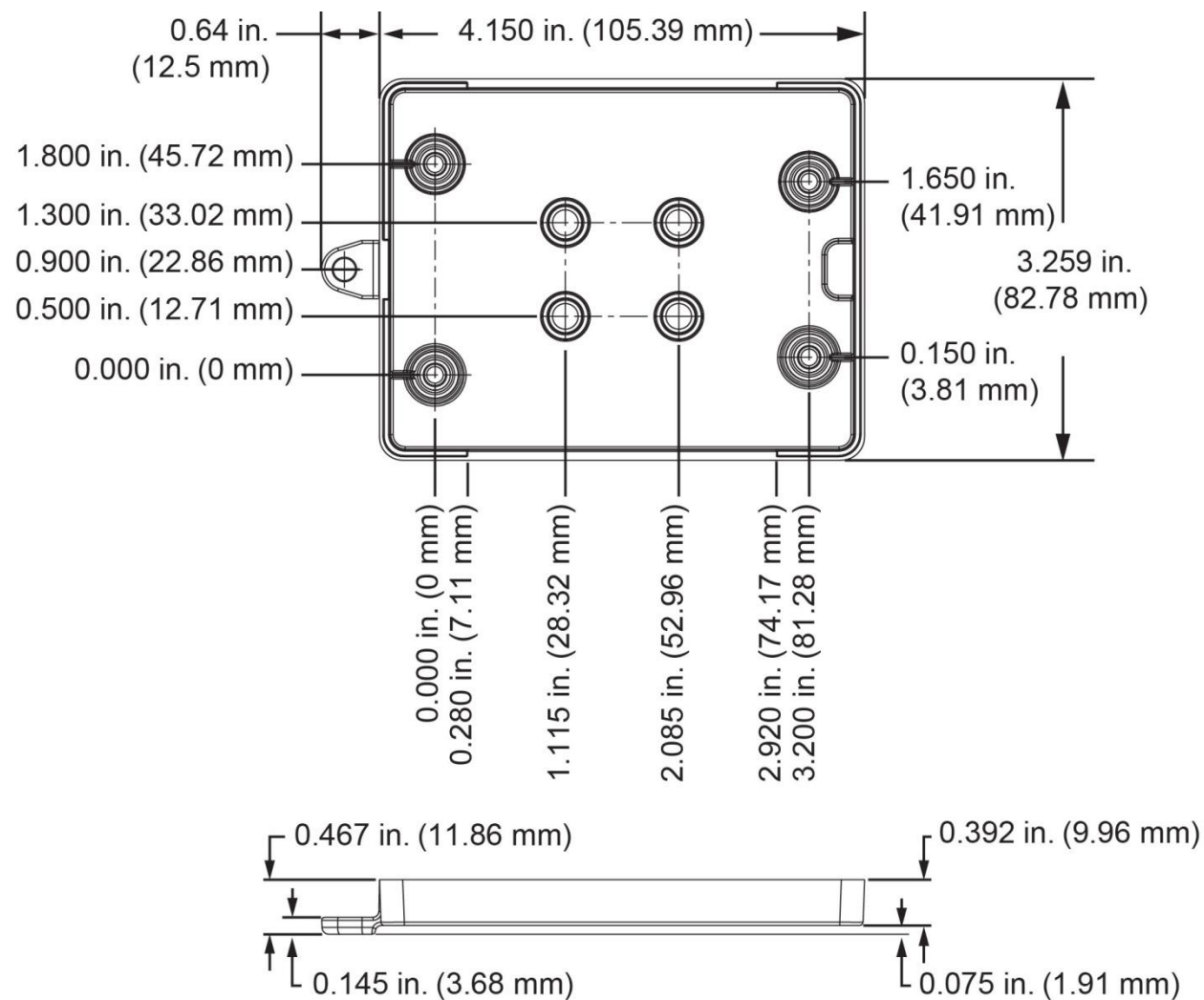


Figure 7. RedLab E-DIO24 bottom enclosure dimensions

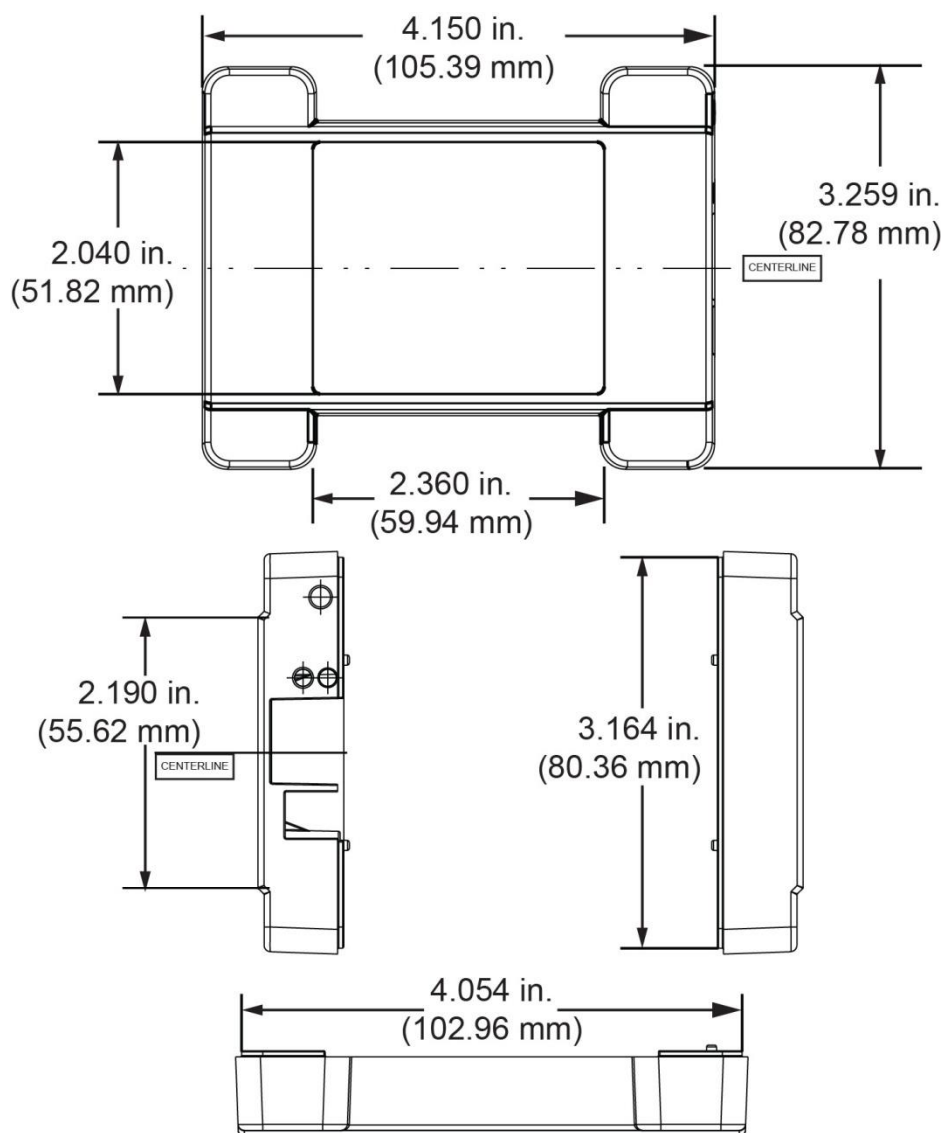


Figure 8. RedLab E-DIO24 top enclosure dimensions

### DIN-rail compatible

The RedLab E-DIO24 can be mounted on a DIN rail using the ACC-205 DIN-rail accessory kit. Refer to our website for more information.

# Specifications

All specifications are subject to change without notice.

Typical for 25 °C unless otherwise specified.

Specifications in *italic text* are guaranteed by design.

## Digital input/output

Table 1. Digital input/output specifications

Parameter	Specification
Digital type	5 V TTL input / CMOS output
Number of I/O	24, configured as 3 ports of 8 bits each (Port 0, Port 1, Port 2)
Configuration	Each bit can be independently configured for input or output
Pull-up configuration	Each port has 47 k $\Omega$ resistors configurable as pull-up (default) or pull-down via internal jumpers W3 (port 1), W4 (port 2), and W5 (port 0).
Digital I/O transfer rate (system-paced)	100 to 5000 reads/writes per second, typical, on a local network (Note 1)
Alarm functionality	Any combination of DIO bits may be configured to become outputs and go to defined values when an Ethernet connection with a host is established or lost.
Power on and reset state	All bits are input unless the alarm functionality is enabled for them.
Input high voltage threshold	2.0 V min (Note 2)
Input high voltage limit	5.5 V absolute max
Input low voltage threshold	0.8 V max (Note 2)
Input low voltage limit	-0.5 V absolute min 0 V recommended min
Output high voltage	4.4 V min (IOH = -50 $\mu$ A) 3.76 V min (IOH = -24 mA)
Output low voltage	0.1 V max (IOL = 50 $\mu$ A) 0.44 V max (IOL = 24 mA)

**Note 1:** This is the typical throughput when the device and host are both connected by Ethernet to the same local network. Throughput can vary significantly, and typical throughput is not guaranteed, if a wireless connection is involved or data is sent over the internet.

**Note 2:** The digital input thresholds (P2D7 only) and counter input thresholds are different due to different buffer types.



## Counter

Table 2. Counter specifications

Parameter	Specification
Pin name	P2D7 (shared with digital I/O)
Counter type	Event counter
Number of channels	1
Input type	Schmitt trigger; uses port 2 digital I/O pull-up/down selection.
Resolution	32 bits
Schmitt trigger hysteresis	1.01 V typ 0.6 V min 1.5 V max
Input high voltage threshold	2.43 V typ (Note 3) 1.9 V min 3.1 V max
Input high voltage limit	5.5 V absolute max
Input low voltage threshold	1.42 V typ (Note 3) 1.0 V min 2.0 V max
Input low voltage limit	−0.5 V absolute min 0 V recommended min
Input frequency	10 MHz max
High pulse width	50 ns min
Low pulse width	50 ns min

**Note 3:** The digital input thresholds (P2D7 only) and counter thresholds are different due to different buffer types.

## Memory

Table 3. Memory specifications

Parameter	Specification
Non-volatile memory	4,096 bytes (272 bytes for settings, 3,824 bytes for user)

## Power

Table 4. Power specifications

Parameter	Condition	Specification
External power supply		5 V $\pm$ 5% required 5 V, 1 A supply provided (PS-5V1AEPS)
Supply current	Quiescent current	160 mA typical (Note 4) 840 mA max, including all external loading
User output voltage range	Available at +VO terminal	4.40 V min to 5.25 V max; assumes supplied AC adapter is used
User output current	Available at +VO terminal	10 mA max

**Note 4:** This is the total quiescent current requirement for the device that includes the LEDs. This value does not include any potential loading of the digital I/O bits or +VO terminal.

## Network

### Ethernet connection

Table 5. Ethernet connection specifications

Parameter	Specification
Ethernet type	100 Base-TX 10 Base-T
Communication rates	10/100 Mbps, auto-negotiated
Connector	RJ-45, 8 position
Cable length	100 meters (328 feet) max
Additional parameters	HP Auto-MDIX support

### Network interface

Table 6. Factory default specifications

Parameter	Specification
Protocols used	TCP (IPv4 only) and UDP
Network ports used	UDP: 54211 (discovery) UDP: 6234 (bootloader only) TCP: 54211 (commands)
Network IP configuration	DHCP + link-local, DHCP, static, link-local
Network name	E-DIO24-xxxxxx, where xxxxxx are the lower 6 digits of the device MAC address
Network name publication	By NBNS; responds to b-node broadcasts, therefore only available on the local subnet

### Network factory default settings

Table 7. Factory default specifications

Parameter	Specification
Factory default IP address	192.168.0.101
Factory default subnet mask	255.255.255.0
Factory default Gateway	192.168.0.1
Factory default DHCP setting	DHCP + link-local enabled

### Network security

Table 8. Factory default specifications

Parameter	Specification
Security implementation	TCP sockets are not opened unless application sends the correct PIN connection code; stored in non-volatile memory; may be changed by user; default value is 0000
Number of concurrent sessions	1
Vulnerabilities	TCP Sequence Number Approximation Vulnerability

## LED displays and the factory reset button

Table 9. LED and button configurations

Parameter	Specification
Power LED (top)	$4.2\text{ V} < V_{\text{ext}} < 5.6\text{ V}$ : On $V_{\text{ext}} < 4.2\text{ V}$ , $V_{\text{ext}} > 5.6\text{ V}$ : Off (power fault) Both LEDs blinking continuously: In firmware update mode
Activity LED (bottom)	On when there is a valid host connection. Blinks when a command is received. Both LEDs blinking continuously: In firmware update mode.
Ethernet connector LEDS	<ul style="list-style-type: none"> <li>■ Left (green) – Link/activity indicator: on when there is a valid Ethernet link, and blinks when network activity is detected.</li> <li>■ Right (yellow) – Speed indicator: on for 100 Mbps, off for 10 Mbps or no link.</li> </ul>
Factory reset button	Resets network and alarm configuration settings to factory default values. <ul style="list-style-type: none"> <li>■ Press and hold for 4 seconds. The Power and Activity LEDs will both blink twice and turn off to indicate that network settings have been restored to default values. Release the button to allow the device to reset and use the default settings. If the reset button is released before the two LEDs blink, settings are not affected.</li> <li>■ Holding the reset button at power on forces the device into firmware update mode in case of a failed firmware update. In this mode, both LEDs blink together constantly. The device may be returned to normal operation by cycling the power.</li> </ul>

## Environmental

Table 10. Environmental specifications

Parameter	Specification
Operating temperature range	0 °C to 55 °C max
Storage temperature range	–40 °C to 85 °C max
Humidity	0% to 90% non-condensing max

## Mechanical

Table 11. Mechanical specifications

Parameter	Specification
Dimensions (L × W × H)	117.9 × 82.8 × 29.0 mm (4.64 × 3.26 × 1.14 in.)

## Signal connector

Table 12. Screw terminal connector specifications

Parameter	Specification
Connector type	Screw terminal
Wire gauge range	16 AWG to 30 AWG

Table 13. Screw terminal pinout

Pin	Signal name	Pin description	Pin	Signal name	Pin description
1	P0D0	Port 0 bit 0	17	P1D0	Port 1 bit 0
2	P0D1	Port 0 bit 1	18	P1D1	Port 1 bit 1
3	P0D2	Port 0 bit 2	19	P1D2	Port 1 bit 2
4	P0D3	Port 0 bit 3	20	P1D3	Port 1 bit 3
5	GND	Ground	21	GND	Ground
6	P0D4	Port 0 bit 4	22	P1D4	Port 1 bit 4
7	P0D5	Port 0 bit 5	23	P1D5	Port 1 bit 5
8	P0D6	Port 0 bit 6	24	P1D6	Port 1 bit 6
9	P0D7	Port 0 bit 7	25	P1D7	Port 1 bit 7
10	GND	Ground	26	+VO	User voltage output
11	GND	Ground	27	GND	Ground
12	P2D0	Port 2 bit 0	28	P2D4	Port 2 bit 4
13	P2D1	Port 2 bit 1	29	P2D5	Port 2 bit 5
14	P2D2	Port 2 bit 2	30	P2D6	Port 2 bit 6
15	P2D3	Port 2 bit 3	31	P2D7	Port 2 bit 7 / Counter
16	GND	Ground	32	GND	Ground



## Declaration of Conformity

According to ISO/IEC 17050-1:2010

Manufacturer: Meilhaus Electronic GmbH  
 Address: Am Sonnenlicht 2  
 82239 Alling  
 Germany  
 Product Category: Electrical equipment for measurement, control and laboratory use.  
 Date and Place of Issue: October 15, 2015 Norton, Massachusetts USA  
 Test Report Number: EMI6779.15

Meilhaus Electronic GmbH declares under sole responsibility that the product

### ME-Redlab E-DIO24

Complies with the essential requirements of the following applicable European Directives:

Electromagnetic Compatibility (EMC) Directive 2004/108/EC  
 Low Voltage Directive 2006/95/EC  
 RoHS Directive 2011/65/EU

Conformity is assessed in accordance to the following standards:

#### EMC:

##### Emissions:

- EN 61326-1:2013 (IEC 61326-1:2012), Class A
- EN 55011:2009 + A1:2010 (IEC CISPR 11:2009 + A1:2010), Group 1, Class A

##### Immunity:

- EN 61326-1: 2013 (IEC 61326-1:2012), Controlled EM Environments
- EN 61000-4-2:2008 (IEC 61000-4-2:2008)
- EN 61000-4-3:2010 (IEC 61000-4-3:2010)
- EN 61000-4-4:2012 (IEC 61000-4-4:2012)
- EN 61000-4-5:2005 (IEC 61000-4-5:2005)
- EN 61000-4-6:2013 (IEC 61000-4-6:2013)
- EN 61000-4-11:2004 (IEC 61000-4-11:2004)

##### Safety:

- EN 61010-1 (IEC 61010-1)

#### Environmental Affairs:

Articles manufactured on or after the Date of Issue of this Declaration of Conformity do not contain any of the restricted substances in concentrations/applications not permitted by the RoHS Directive.

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