

RedLab 204

Analog and Digital I/O

User's Guide

Table of Contents

Preface

About this User's Guide	4
What you will learn from this user's guide	4
Conventions in this user's guide	4
Where to find more information	4

Chapter 1

Introducing the RedLab 204.....	5
Device features	5
Functional block diagram	5

Chapter 2

Installing the RedLab 204.....	6
What comes with your shipment?.....	6
Hardware	6
Software.....	6
Documentation.....	6
Unpacking.....	6
Installing the software	6
Installing in a Windows environment	6
Installing the hardware	6
Installing on a Windows platform.....	6
Installing on an Android platform.....	7
Calibrating the hardware.....	7
Factory calibration	7
Field calibration	7

Chapter 3

Functional Details	8
Analog input acquisition modes	8
Software paced mode.....	8
Hardware paced mode.....	8
External components	8
Screw terminals.....	9
USB connector.....	9
LED indicators.....	9
Signal connections.....	10
Analog input	10
External pacer I/O.....	10
Digital I/O.....	10
Trigger input.....	11
Counter input	11
Voltage output	11
Ground.....	11
Mechanical drawings.....	12

Chapter 4

Specifications	14
Analog input	14
Accuracy.....	14
Analog input DC voltage measurement accuracy	14
Noise performance.....	15
Analog input calibration	15
Digital input/output.....	15

External digital trigger	16
External pacer input/output.....	16
Counter	17
Memory	17
Power.....	17
USB specifications	18
Environmental	18
Mechanical	18
Screw terminal connector	18

About this User's Guide

What you will learn from this user's guide

This user's guide describes the Meilhaus Electronic RedLab 204 data acquisition device and lists device specifications.

Conventions in this user's guide

For more information

Text presented in a box signifies additional information related to the subject matter.

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 204 hardware is available on our website at 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.com

Introducing the RedLab 204

The RedLab 204 is a USB 2.0 full-speed device supported under the following operating systems:

- Microsoft Windows 8, 7, Vista, XP (32-bit or 64-bit)
- Android™ 3.1 or later
- Macintosh (32-bit or 64-bit)
- Linux (32-bit or 64-bit)

The device is also compatible with USB 1.1 ports.

Device features

The RedLab 204 provides the following features:

- Eight single-ended 12-bit analog inputs
- 500 kS/s max sample rate
- Eight individually configurable digital I/O channels
- 32-bit counter input
- Digital trigger input
- External pacer clock input
- Internal/external pacer clock output
- User voltage output
- Two screw terminal banks for field wiring connections

The RedLab 204 is powered by the +5 V USB supply from your computer; no external power is required.

Functional block diagram

Device functions are illustrated in the block diagram shown here.

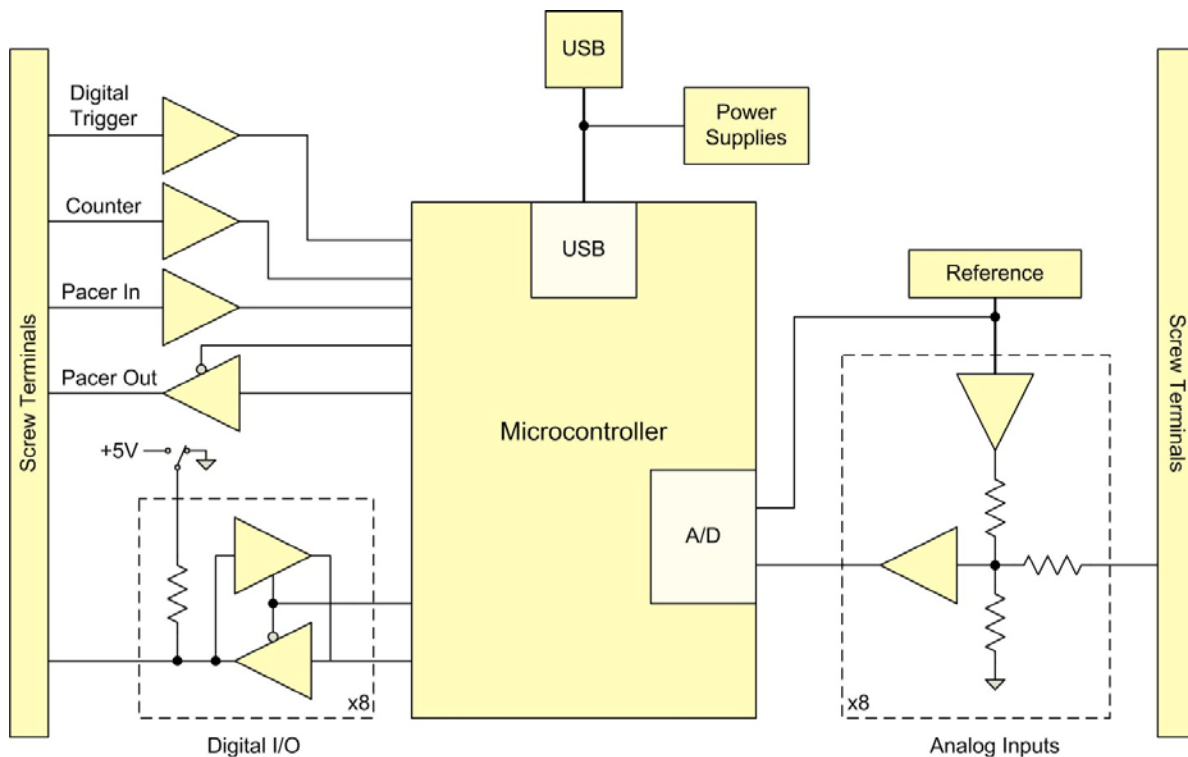


Figure 1. RedLab 204 functional block diagram

Installing the RedLab 204

What comes with your shipment?

Verify that the following hardware components are included in the shipment:

Hardware

- RedLab 204
- USB cable

Software

Documentation

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.

If any components are missing or damaged, contact us immediately using one of the following methods:

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

Installing the software

Note: Before installing the RedLab 204, first install the software you plan to use with the device.

Installing in a Windows environment

Universal Library, Universal Library for Android, and InstaCal

Universal Library and InstaCal software are included on the CD that ships with the device. Install Universal Library and InstaCal when you want to develop data acquisition applications using Windows programming languages.

Universal Library for Android is a software API that installs with the Universal Library and InstaCal. Use this programming library to develop apps on the Windows platform for deployment to Android-based devices. For instructions about deploying apps from Windows to an Android environment, refer the *UL for Android Example Projects* topic in the *Universal Library for Android Help* included in the installation.

Installing the hardware

Installing on a Windows platform

Install the software before you install your device

The driver needed to run the RedLab 204 device is installed when you install the software. Therefore, you need to install the software package you plan to use before you install the hardware.

For operation on a Windows operating system, we recommend that you run Windows Update to update your operating system with the latest USB drivers.

Connect the RedLab 204 to a to an available USB port on the computer running Windows, connect the USB cable to an available USB port on the computer or to an external USB hub connected to the computer. Connect the other end of the cable to the USB connector on the device. No external power is required.

When connected for the first time, a **Found New Hardware** dialog opens when the operating system detects the device. When the dialog closes, the installation is complete. The device **Status** LED turns on after the device is successfully installed.

If the Status LED turns off

If communication is lost between the device and the computer, the **Status** LED turns off. To restore communication, disconnect the USB cable from the computer and then reconnect it. This should restore communication, and the **Status** LED should turn on.

Installing on an Android platform

Many Android devices include a standard A-type USB port to connect to the RedLab 204. If your device does not have a USB port, you may need a USB OTG cable in order for your Android device to host a USB device. Refer to your Android device documentation for more information.

Calibrating the hardware**Factory calibration**

The Meilhaus Electronic Manufacturing Test department performs the initial factory calibration. Return the device to Meilhaus Electronic GmbH when calibration is required. The recommended calibration interval is one year.

Field calibration

Field calibration is not supported.

Functional Details

Analog input acquisition modes

The RedLab 204 can acquire analog input data in two different modes – software paced and hardware paced.

Software paced mode

You can acquire one analog sample at a time in software paced mode. You initiate the A/D conversion with a software command. The analog value is converted to digital and returned to the computer. You can repeat this procedure until you have the total number of samples that you want.

The maximum throughput sample rate in software paced mode is system-dependent.

Hardware paced mode

You can acquire data from up to eight channels in hardware paced mode. The analog data is continuously acquired and converted to digital values until you stop the scan. Data is transferred in blocks of 32 samples from the device to the memory buffer on your computer.

The maximum continuous scan rate is an aggregate rate. The total acquisition rate for all channels cannot exceed 500 kS/s. The following table lists the scan rate when scanning from one to eight channels.

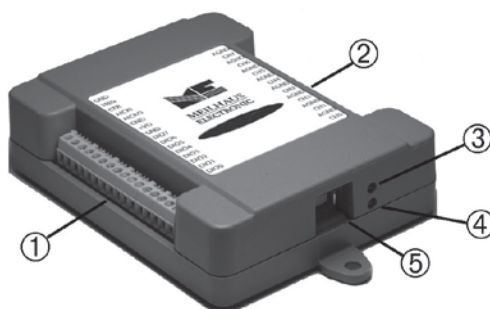
Maximum continuous scan rate

# channels scanned	Scan rate (kS/s)
1	500
2	250
3	166.67
4	125
5	100
6	83.33
7	71.43
8	62.50

You can start a hardware paced continuous scan with either a software command or with an external hardware trigger event.

External components

The external components on the RedLab 204 are shown in Figure 2.



- | | | | |
|---|------------------------------|---|---------------|
| 1 | Screw terminal pins 1 to 16 | 4 | Activity LED |
| 2 | Screw terminal pins 17 to 32 | 5 | USB connector |
| 3 | Status LED | | |

Figure 2. RedLab 204 external components

Screw terminals

The screw terminals provide the following connections:

- Eight single-ended analog inputs (**CH0** to **CH7**)
- Eight digital I/O (**DI00** to **DI07**)
- External pacer clock input (**AICKI**)
- External pacer clock output (**AICKO**)
- Digital trigger input (**TRIG**)
- Counter input (**CTR**)
- User voltage output (**+VO**)
- Analog ground reference (**AGND**) and digital ground reference (**GND**)

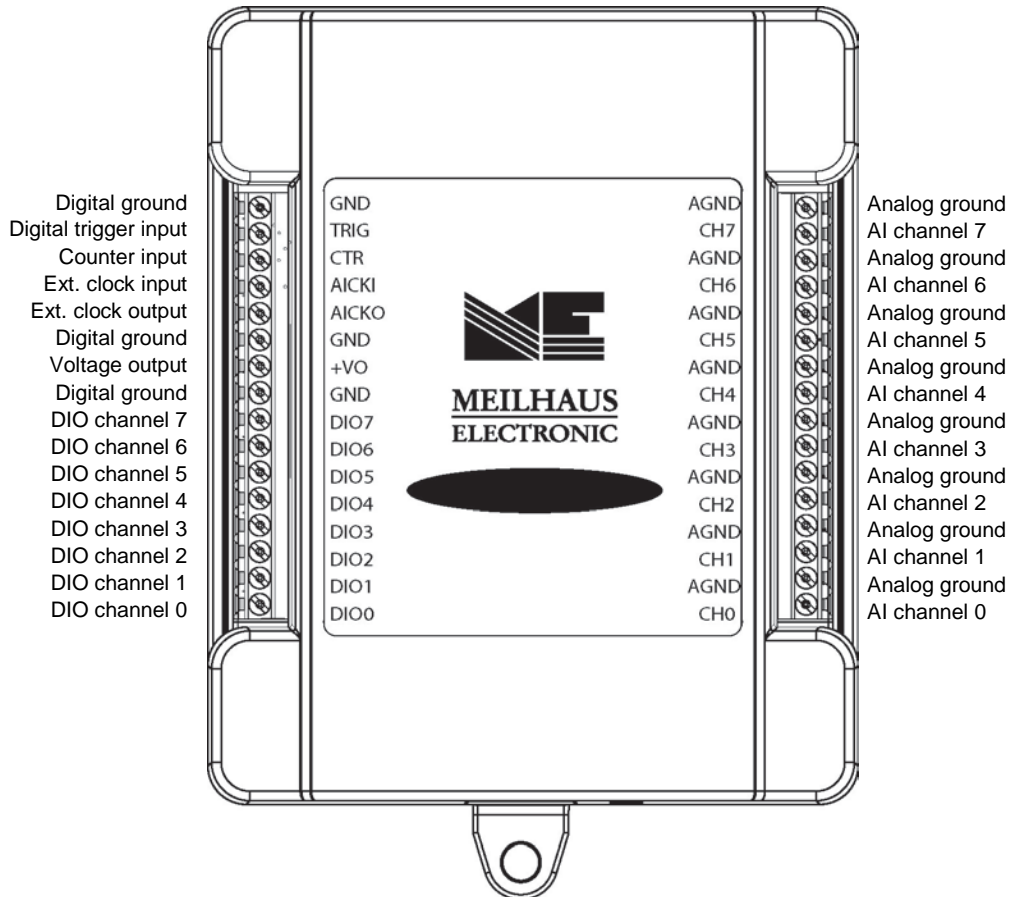


Figure 3. RedLab 204 pinout

USB connector

The USB connector provides +5 V power and communication. No external power supply is required.

LED indicators

The device has two LED indicators – **Status** and **Activity**.

- The **Status** LED turns on when the device is detected and installed on the computer.
- The **Activity** LED blinks when data is transferred, and is off otherwise.

Refer to Figure 2 Seite 8 for the location of each LED.

Signal connections

Analog input

You can connect up to 8 single-ended inputs to screw terminals **CH0** to **CH7**. The input voltage range is ± 10 V. Single-ended mode requires two wires; connect one wire to the signal you want to measure (**CHx**), and connect a second wire to the analog ground reference (**AGND**).

External pacer I/O

The RedLab 204 provides one external clock input (**AICKI**) and one clock output (**AICKO**) for the analog input pacer. You can connect an external clock signal to **AICKI**.

When using the internal clock, **AICKO** outputs the ADC sample clock.

Digital I/O

You can connect up to eight digital I/O lines to **DIO0** through **DIO7**. The digital I/O terminals can detect the state of any TTL-level input. Refer to the schematic shown in Figure 4.

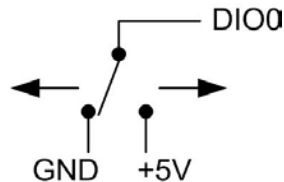


Figure 4. Schematic showing switch detection by digital channel DIO0

If you set the switch to the +5 V input, DIO0 reads *TRUE* (1). If you move the switch to GND, DIO0 reads *FALSE* (0).

Internal pull-up/down configuration

The digital port has 47 k Ω resistors that you can configure as pull-up or pull-down with an internal jumper. Unconnected inputs are pulled low by default to 0 V through 47 k Ω resistors. The pull-up/pull-down voltage is common to all 47 k Ω resistors.

You can change the configuration with an internal jumper. You must remove the cover from the device in order to access the jumper. To remove the cover, unscrew the four screws on the device bottom.

Caution! The discharge of static electricity can damage some electronic components. Before removing the device from its housing, either ground yourself using a wrist strap or touch the computer chassis or other grounded object to eliminate any stored static charge.

Figure 5 shows the location of the pull-up/down jumper in relation to the USB connector.

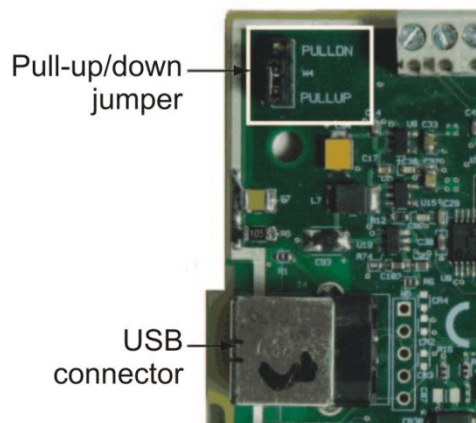


Figure 5. Pull-up/down jumper location

Figure 6 shows the jumper configured for pull-down.

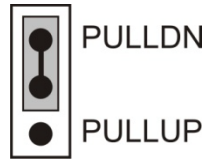


Figure 6. Pull-down jumper

Configure the jumper for pull-up to pull the digital inputs high (+5V).

Proper LED alignment

When placing the circuit board within the housing, align the board LEDs with the top of the housing before attaching the housing bottom.

Trigger input

The **TRIG** terminal is an external digital trigger input. The trigger mode is software-selectable for edge- or level-sensitive. The trigger is automatically re-armed after it is activated.

Counter input

The **CTR** terminal is a 32-bit event counter that can accept frequency inputs up to 1 MHz. The internal counter increments when the TTL levels transition from low to high.

Voltage output

The user voltage output (**+VO**) terminal can output up to 100 mA maximum at approximately +5V. 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 analog ground (**AGND**) terminals provide a common ground for all analog channels. The digital ground (**GND**) terminals provide a common ground for the digital, counter, pacer I/O, and power terminal.

Mechanical drawings

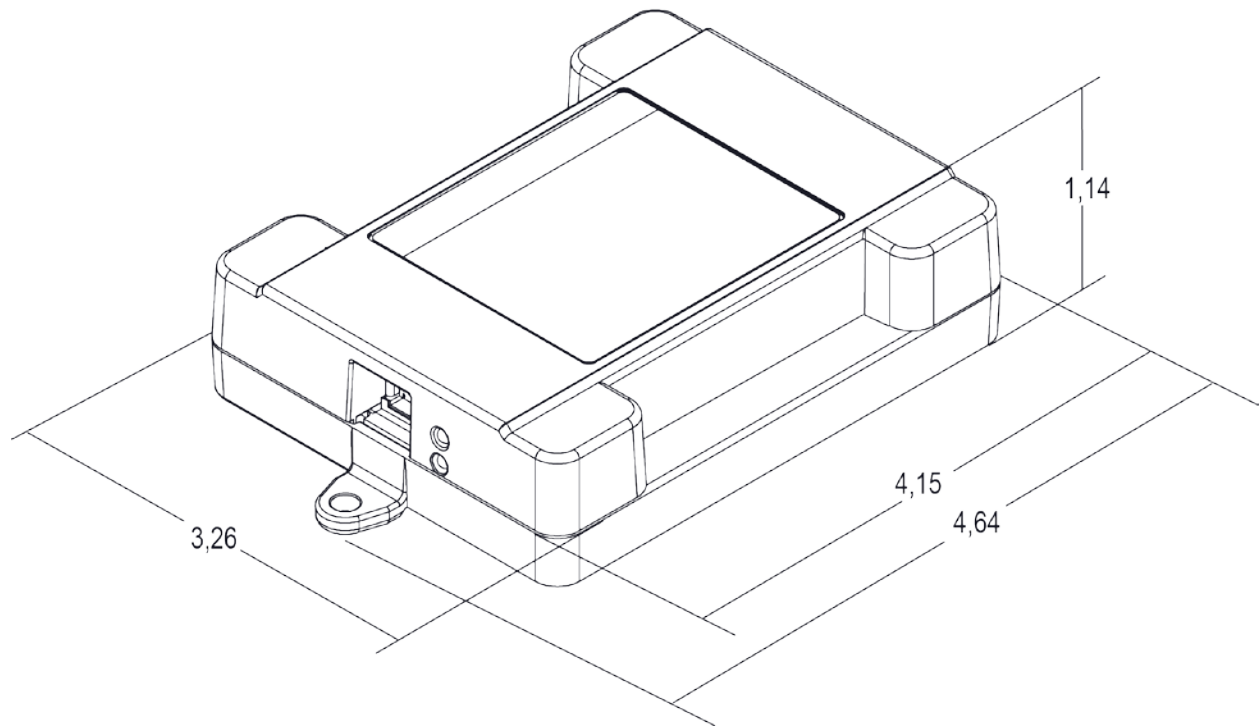
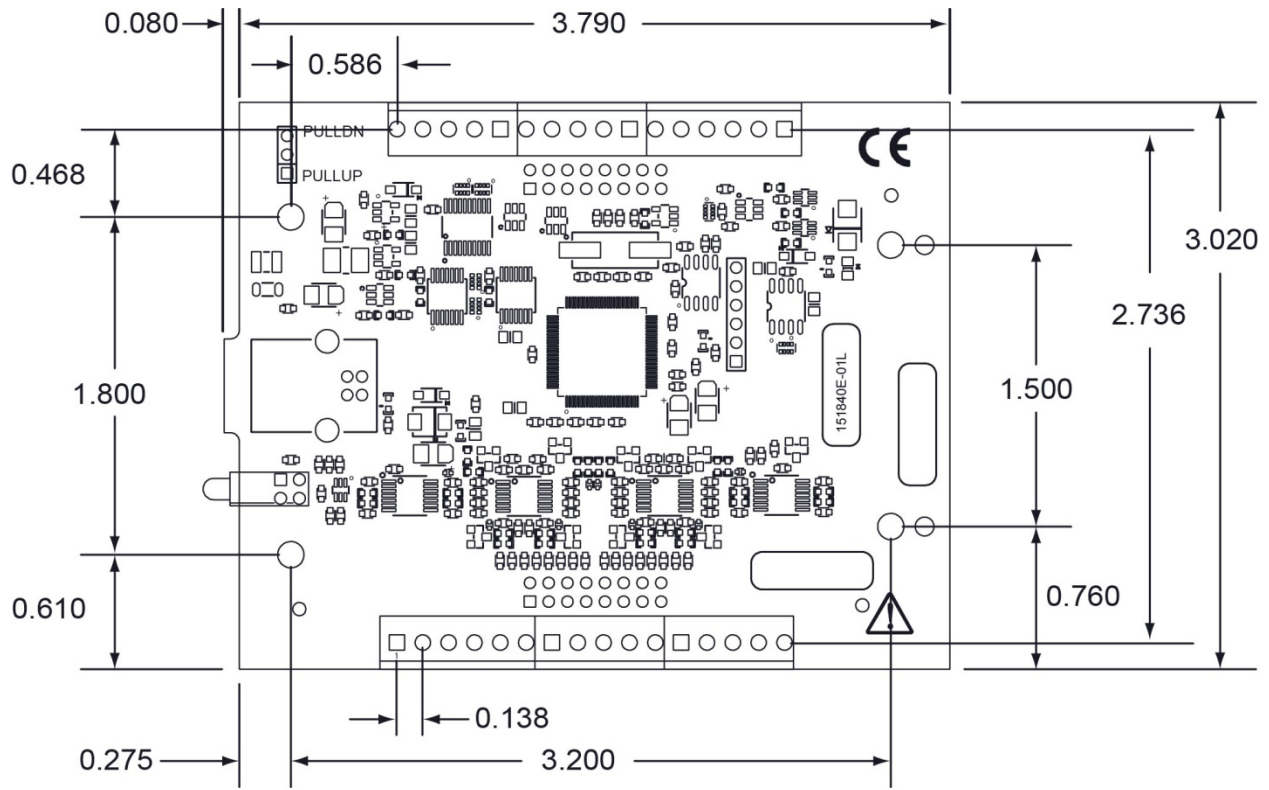


Figure 7. Circuit board (top) and housing dimensions

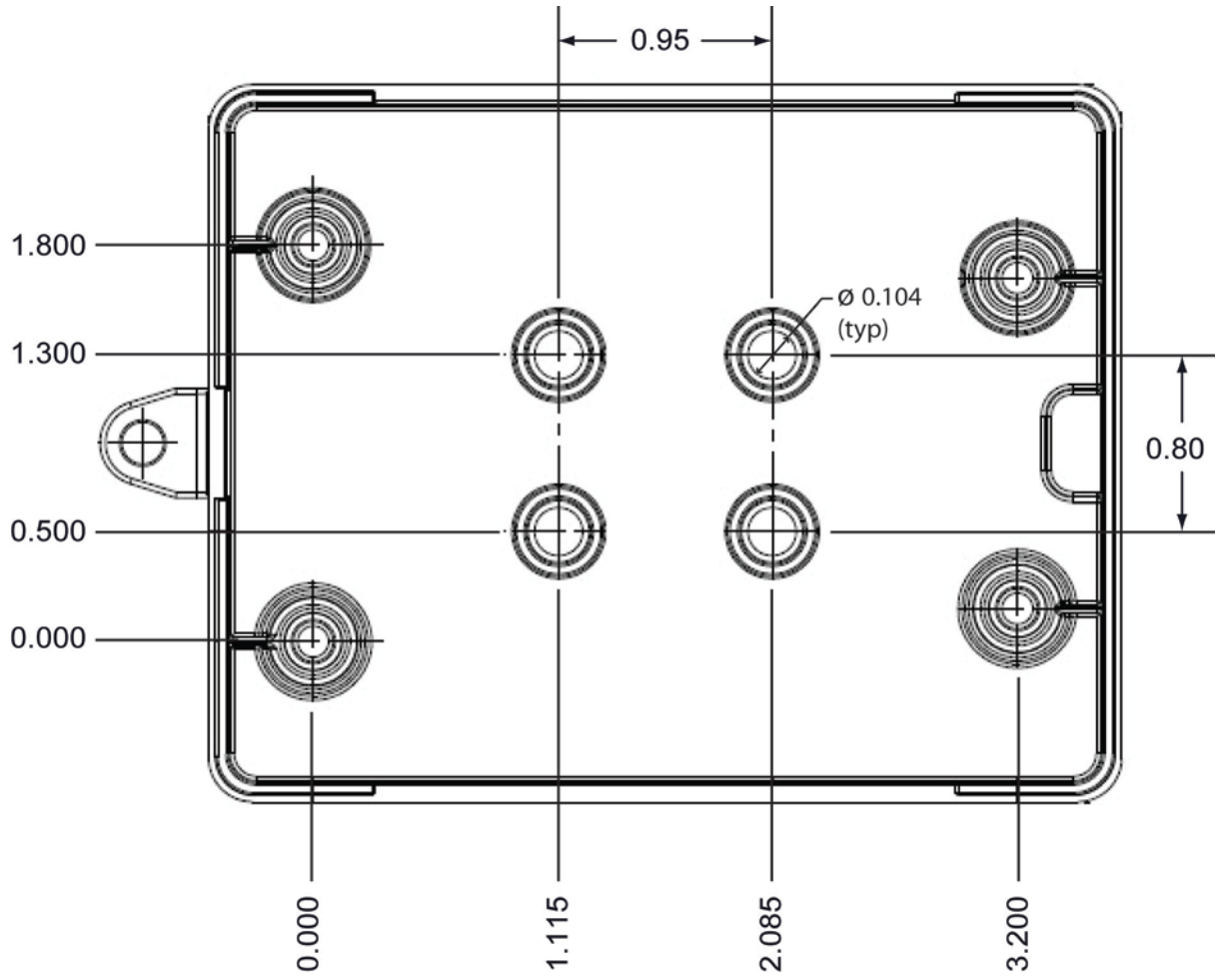


Figure 8. Housing bottom dimensions

Specifications

All specifications are subject to change without notice.

Typical for 25 °C unless otherwise specified.

Specifications in *italic text* are guaranteed by design.

Analog input

Table 1. General analog input specifications

Parameter	Conditions	Specification
A/D converter type		Successive approximation
ADC resolution		12 bits
Number of channels		8 single-ended
Input voltage range		± 10 V
<i>Absolute maximum input voltage</i>	<i>CHx relative to AGND</i>	<ul style="list-style-type: none"> ■ ± 25 V max (power on) ■ ± 25 V max (power off)
<i>Input impedance</i>		<ul style="list-style-type: none"> ■ $1\text{ M}\Omega$ (power on) ■ $1\text{ M}\Omega$ (power off)
<i>Input bias current</i>	<i>10 V input</i>	$-12\ \mu\text{A}$
	<i>0 V input</i>	$2\ \mu\text{A}$
	<i>-10 V input</i>	$12\ \mu\text{A}$
Input bandwidth	Small signal (-3 dB)	1.0 MHz
Maximum working voltage	Input range relative to AGND	± 10.1 V max
Crosstalk	Adjacent channels, DC to 10 kHz	-75 dB
Input coupling		DC
Sampling rate	Internal pacer	0.016 S/s to 500 kS/s, software-selectable
	External pacer	500 kS/s max
Sample clock source		<ul style="list-style-type: none"> ■ Internal A/D clock ■ Pacer input terminal AICKI
Channel queue		Up to eight unique, ascending channels
Throughput	Software paced	33 to 4000 S/s typ, system dependent
	Hardware paced	500 kS/s max, system dependent
Warm-up time		15 minutes min

Accuracy

Analog input DC voltage measurement accuracy

Table 2. DC Accuracy components and specifications. All values are (\pm)

Range	Gain error (% of reading)	Offset error (mV)	Absolute accuracy at Full Scale (mV)	Gain temperature coefficient (% reading/ $^{\circ}\text{C}$)	Offset temperature coefficient (mV/ $^{\circ}\text{C}$)
$\pm 10\text{V}$	0.098	11	20.8	0.016	0.87

Noise performance

For the peak to peak noise distribution test, the input channel is connected to AGND at the input terminal block, and 12,000 samples are acquired at the maximum throughput.

Table 3. Noise performance specifications

Range	Counts	LSBrms
±10 V	5	0.76

Analog input calibration

Table 4. Analog input calibration specifications

Parameter	Specification
Recommended warm-up time	15 minutes min
Calibration method	Factory
Calibration interval	1 year

Digital input/output

Table 5. Digital input specifications

Parameter	Specification
Digital type	TTL
Number of I/O	8
Configuration	Each bit may be configured as input (power on default) or output
Pull-up configuration	The port has 47 kΩ resistors that may be configured as pull-up or pull-down with an internal jumper. The factory configuration is pull-down.
Digital I/O transfer rate (system-paced)	33 to 4000 port reads/writes per second typical, system dependent
Input low voltage threshold	0.8 V max
Input high voltage threshold	2.0 V min
Input voltage limits	5.5 V absolute max -0.5 V absolute min 0 V recommended min
Output high voltage	4.4 V min (IOH = -50 μA) 3.76 V min (IOH = -24 mA)
Output low voltage	0.1 V max (IOL = 50 μA) 0.44 V max (IOL = 24 mA)
Output current	±24 mA max

External digital trigger

Table 6. External digital trigger specifications

Parameter	Specification
Trigger source	TRIG input
Trigger mode	Software configurable for edge or level sensitive, rising or falling edge, high or low level. Power on default is edge sensitive, rising edge.
Trigger latency	1 μ s + 1 pacer clock cycle max
Trigger pulse width	125 ns min
Input type	Schmitt trigger, 47 k Ω pull-down to ground
Schmitt trigger hysteresis	1.01 V typ 0.6 V min 1.5 V max
Input high voltage threshold	2.43 V typ 1.9 V min 3.1 V max
Input low voltage threshold	1.42 V typ 1.0 V min 2.0 V max
Input voltage limits	5.5V absolute max -0.5V absolute min 0V recommended min

External pacer input/output

Table 7. External pacer I/O specifications

Parameter	Specification
Terminal names	AICKI, AICKO
Terminal types	AICKI: Input, active on rising edge AICKO: Output, power on default is 0 V, active on rising edge
Terminal descriptions	AICKI: Receives pacer clock from external source AICKO: Outputs internal pacer clock
Input clock rate	500 kHz max
Clock pulse width	AICKI: 400 ns min AICKO: 400 ns min
Input type	Schmitt trigger, 47 k Ω pull-down to ground
Schmitt trigger hysteresis	1.01 V typ 0.6 V min 1.5 V max
Input high voltage threshold	2.43 V typ 1.9 V min 3.1 V max
Input low voltage threshold	1.42 V typ 1.0 V min 2.0 V max
Input voltage limits	5.5 V absolute max -0.5 V absolute min 0 V recommended min
Output high voltage	4.4 V min (IOH = -50 μ A) 3.80 V min (IOH = -8 mA)
Output low voltage	0.1 V max (IOL = 50 μ A) 0.44 V max (IOL = 8 mA)
Output current	\pm 8 mA max

Counter

Table 8. CTR specifications

Parameter	Specification
Pin name	CTR
Number of channels	1 channel
Resolution	32-bit
Counter type	Event counter
Input type	Schmitt trigger, 47 k Ω pull-down to ground
Counter read/write rates (software paced)	33 to 4,000 reads/writes per second typ, system dependent
Schmitt trigger hysteresis	1.01 V typ 0.6 V min 1.5 V max
Input high voltage threshold	2.43 V typ 1.9 V min 3.1 V max
Input low voltage threshold	1.42 V typ 1.0 V min 2.0 V max
Input voltage limits	5.5 V absolute max -0.5 V absolute min 0 V recommended min
Input frequency	1 MHz max
High pulse width	25 ns min
Low pulse width	25 ns min

Memory

Table 9. Memory specifications

Parameter	Specification
Data FIFO	12 K (12,288) analog input samples
Non-volatile memory	2 KB (768 B calibration storage, 256 B UL user data, 1 KB DAQFlex user data)

Power

Table 10. Power specifications

Parameter	Conditions	Specification
Supply current	Typical (Note 1)	150 mA
	Maximum (including user voltage, DIO and AICKO loading)	500 mA
User voltage output terminal (+VO)		4.25 V min, 5.25 V max
User voltage output current		100 mA max

Note 1: This is the total quiescent current requirement for the device which includes up to 10 mA for the Status LED. This value does not include any potential loading of the digital I/O bits, AICKO, or user voltage.

USB specifications

Table 11. USB specifications

Parameter	Specification
USB device type	USB 2.0 (full-speed)
Device compatibility	USB 1.1, USB 2.0
USB cable type	A-B cable, UL type AWM 2725 or equivalent. (minimum 24 AWG VBUS/GND, minimum 28 AWG D+/D-)
USB cable length	3 m (9.84 ft) max

Environmental

Table 12. 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 13. Mechanical specifications

Parameter	Specification
Dimensions (L × W × H)	117.86 × 82.80 × 28.96 mm (4.64 × 3.26 × 1.14 in.) max

Screw terminal connector

Table 14. Screw terminal connector specifications

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

Table 15. Screw terminal pinout

Pin	Signal name	Pin description	Pin	Signal name	Pin description
1	GND	Digital ground	17	AGND	Analog ground
2	TRIG	Digital trigger input	18	CH7	Channel 7
3	CTR	Counter input	19	AGND	Analog ground
4	AICKI	External clock pacer input	20	CH6	Channel 6
5	AICKO	External clock pacer output	21	AGND	Analog ground
6	GND	Digital ground	22	CH5	Channel 5
7	+VO	User voltage output	23	AGND	Analog ground
8	GND	Digital ground	24	CH4	Channel 4
9	DIO7	DIO channel 7	25	AGND	Analog ground
10	DIO6	DIO channel 6	26	CH3	Channel 3
11	DIO5	DIO channel 5	27	AGND	Analog ground
12	DIO4	DIO channel 4	28	CH2	Channel 2
13	DIO3	DIO channel 3	29	AGND	Analog ground
14	DIO2	DIO channel 2	30	CH1	Channel 1
15	DIO1	DIO channel 1	31	AGND	Analog ground
16	DIO0	DIO channel 0	32	CH0	Channel 0

**Meilhaus Electronic GmbH
Am Sonnenlicht 2
D-82239 Alling, Germany
Phone: +49 (0)81 41 - 52 71-0
Fax: +49 (0)81 41 - 52 71-129
E-Mail: sales@meilhaus.com
<http://www.meilhaus.com>**