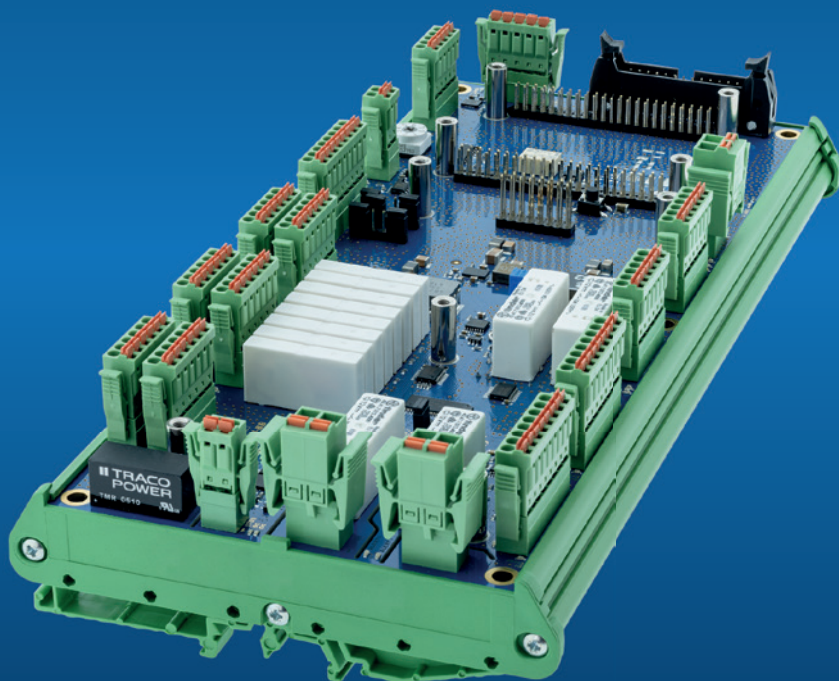




ADQ-CDI-BB v2 1.3 Manual



ALLDAQ Control and Measuring Unit

Imprint

Manual ADQ-CDI-BB v2 1.3

Date: 06.12.2023

Manufacturer and support

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All information contained in this manual has been compiled with the greatest care and to the best of our knowledge. Nevertheless, errors cannot be completely ruled out. Specifications and contents of this manual are subject to change without notice.

We are grateful at any time for notification of possible errors.

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1. Introduction

Please check the packaging and contents for damage and completeness before commissioning. Should any defects occur, please inform us immediately.

- Does anything on the packaging indicate that something was damaged during transport?
- Are there any signs of use on the device?

You must not operate the device under any circumstances if it is damaged. If in doubt, contact our technical customer service.

Please read this manual carefully - before installing and programming the device!

1.1 Scope of delivery

- ALLDAQ Baseboard ADQ-CDI-BB

1.2 Safety instructions



Be sure to observe the following instructions:

- **If voltages above 42V (VDE standard) are connected, the module must only be operated in the DIN-RAIL.**
- **The DIN-RAIL should only be opened by a qualified person.**
- **Operation without the DIN-RAIL is only permitted if all voltages below 42V (VDE standards) are connected.**
- Avoid touching cables and connectors-
- Never expose the device to direct sunlight during operation.
- Never operate the device near heat sources.
- Protect the device from moisture, dust, liquids and vapors.
- Do not use the device in damp rooms and under no circumstances in areas subject to explosion hazards.
- Repairs may only be carried out by trained, authorized personnel.



- When commissioning the device, please observe the installation regulations and all relevant standards (incl. VDE standards), especially when operating with voltages greater than 42 V.
- We recommend to always connect unused inputs to the corresponding reference ground to avoid crosstalk between the input channels.



- Ensure that no static discharge can take place via the device when handling the card. Follow the standard ESD protection measures.
- Never connect the devices to live parts, especially not to mains voltage.

- Precautions to avoid unforeseeable misuse must be taken by the user.

ALLNET® GmbH Computersysteme accepts no liability for any damage resulting from improper use.

1.3 Installation and assembly

The module is intended for installation in measuring and test systems by qualified personnel. Relevant installation regulations and standards must be observed.

The module may only be used in dry rooms. Ensure sufficient heat dissipation. Ensure that the connection cables are securely seated. Installation must be carried out in such a way that the cables are not under tension, otherwise they may come loose.

1.4 Brief description

The ADQ-CDI-BB control and measurement unit has been developed for control in test systems and for automation processes. The numerous digital inputs and outputs as well as analog inputs and relays easily cover most standard requirements. For further tasks there is the possibility to set up project specific HATs or to connect further standard extensions of ALLDAQ via the ADQ-Link.

This manual applies to the following hardware versions of the ADQ-CDI-BB:

- Rev. 2.2
- Rev. 2.3

Features:

- 8 digital inputs 24VDC with programmable input filter
- 8 digital outputs 24VDC / 650mA (parallelizable)
- 1 switchable power measuring channel 30VDC with two switchable current measuring ranges 8mA and 10A
- 1 temperature measuring channel for various thermocouples with temperature-dependent programmable alarm outputs
- 8 relays for up to 30VDC / 6A (optionally exchangeable with small signal relays for digital and analog signals)
- 3 analog single inputs up to 36VDC
- 3 differential analog inputs ± 20.48 VDC
- Onboard temperature monitoring (programmable) with possibility to connect a 12V fan
- 1 ADQ-Link output for further ALLDAQ peripherals like relay board, load box or current sink
- Simple power supply 24VDC
- Numerous signal LEDs for easy commissioning and troubleshooting
- Onboard power supply up to 10A DUT voltage, manually adjustable via trimmer
- Slot for HAT1 (audio, digital inputs and outputs, analog inputs, I2C, voltage supply)
- Slot for HAT2 (I2C, power supply, GPIO)
- Controllable with ADQ-Link (USB/PXIe) or various single board computers (SBC) such as Beagle Bone Black, RockPi X (I2C) etc.

2. System overview

2.1 Digital inputs and outputs

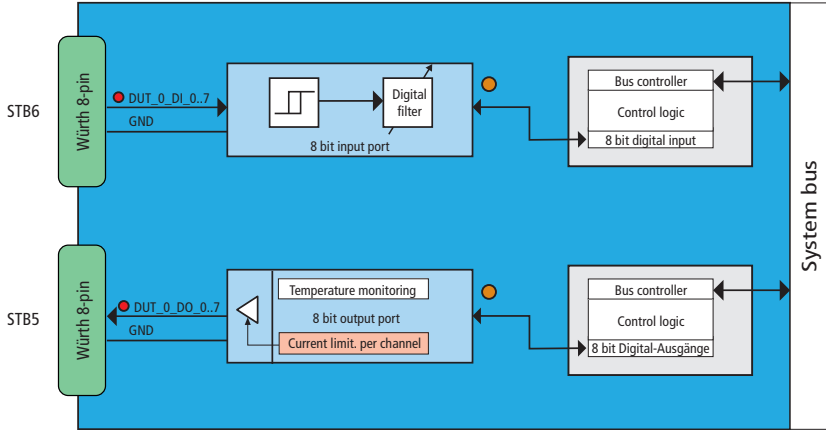


Figure 1: Block diagram digital inputs and outputs

2.1.1 Digital inputs

The ADQ-CDI-BB has 1 digital input port with 8 bits. The inputs have a Schmitt trigger characteristic according to IEC 61131-2 (type 1) and are designed for an input voltage of 24V. All inputs are equipped with status LEDs.

Digital input filter

To prevent unwanted effects caused by contact bounce, you can program one digital filter per input port. Choose between the following values:

10 ms ($N = 1248$) / 3.2 ms ($N = 400$) / 1.0 ms ($N = 125$) / 10 μ s (bypass). The scan frequency is 100 kHz (typ.).

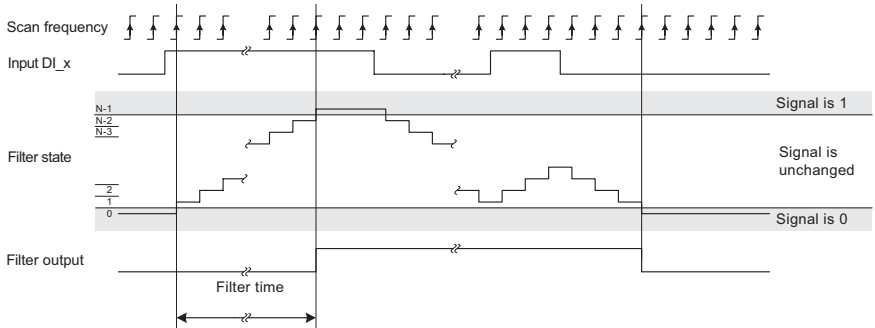


Figure 2: Digital input filter

Wiring

The isolated inputs have a Schmitt trigger characteristic according to IEC 61131-2 (type 1) and are designed for the input high level UIH of typ. 24 V, which is common in control engineering. Observe the following conditions:

- Threshold voltage L → H: > 15 V @ U_{IN} = 24 V
- Threshold voltage H → L: < 11 V @ U_{IN} = 24 V
- Hysteresis: typ. 1 V

Note that a ground connection must always be made from the ext. circuitry to the reference ground of the isolated digital inputs (GND). The digital input section and the digital output section use GND together.

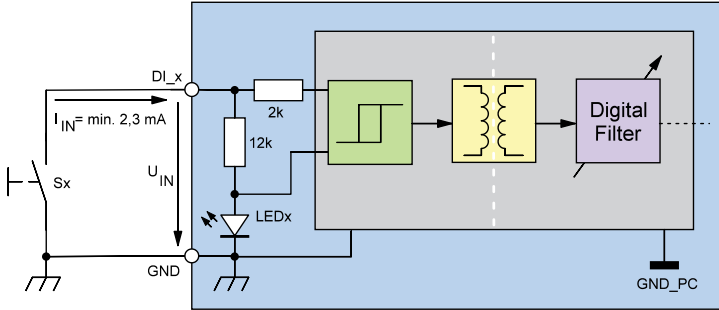


Figure 3: Wiring of the isolated digital inputs

2.1.2 Digital outputs

The output voltage of the digital output is equal to the supply voltage U_{IN} (24VDC). Up to 650mA can be driven per output. To increase the output current, parallel connection of several outputs is possible. A ground reference to the external output circuitry must be established via GND. The output stage offers comprehensive overload protection, short-circuit proof outputs (current limitation per channel) as well as thermal overload protection with automatic reconnection. In case of thermal overload (typ. 135°C) the respective channel switches off and switches on again automatically as soon as the junction temperature has dropped by 10°K.

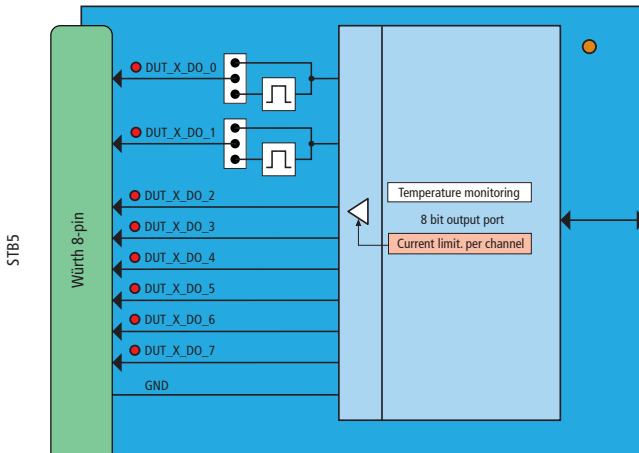


Figure 4: Digital output in detail

The first two outputs of each driver stage (DUT_X_DO__0..1) can also be used in pulse mode in addition to normal operation. When the output is switched high (rising edge), the stage outputs a high pulse of approx. 1 second. For this, the jumpers DO_0 / DO_1 must be set to strobe accordingly.

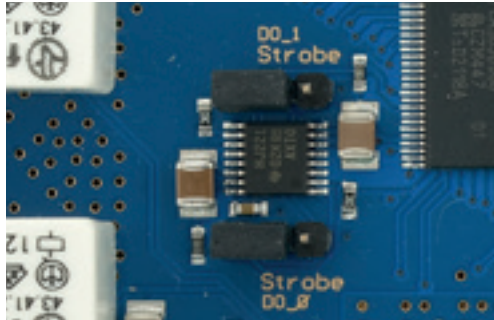


Figure 5: Jumper DO_0 / DO_1 Strobe

2.2 Power measurement channel

The ADQ-CDI-BB offers 1 independent power measurement channel, for example to switch 1 DUT and to monitor the power consumption.

On the path the voltage and the current can be measured up to max. 8-18VDC/10A. Each measurement is done with 16 bit resolution and optionally the acquired values can be preprocessed (e.g. averaging).

To achieve the highest possible resolution for various standard measurement requirements such as quiescent current or maximum current consumption, there are two switchable current measurement ranges. Typically these are 8mA and 10A.

As soon as the current becomes too high in the small current measuring range, the ADQ-CDI-BB automatically switches to the large measuring range without interruption.

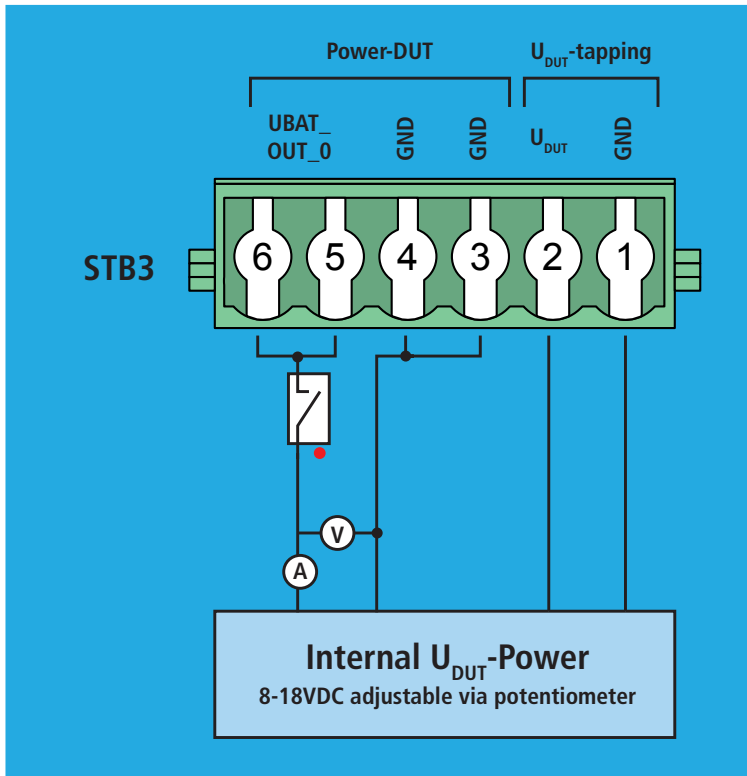


Figure 6: Block diagram power measurement channels

2.3 Temperature measuring channel

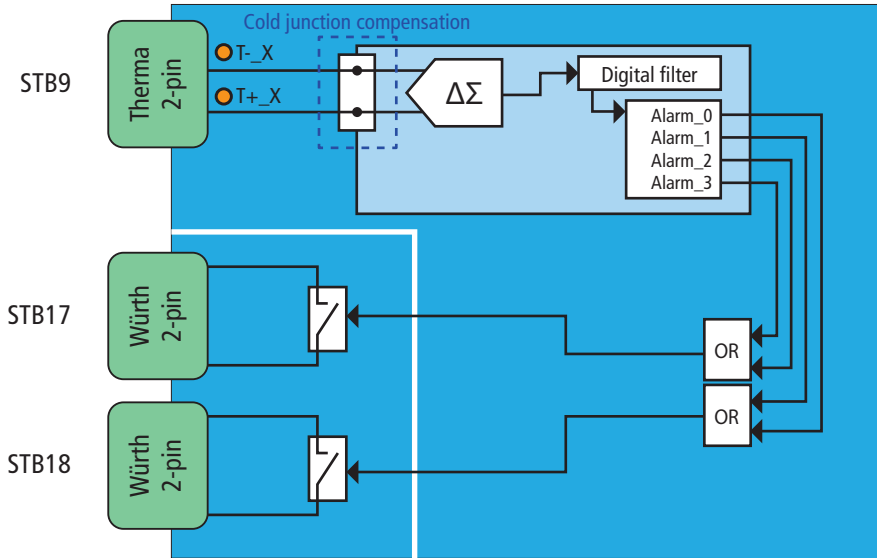


Figure 7: Block diagram temperature measuring channel incl. alarm relay

The ADQ-CDI-BB has 1 independent temperature measuring channel with integrated cold junction compensation. A thermocouple type K can currently be connected to this channel via the connector type CMJ of the company Therma (DIN IEC 584). Several thermocouple types of the company Therma with different classifications are available. For further information, see www.thermagmbh.de. If you want to connect type J, T, N, E, S, B or R, please contact us. LEDs and the software indicate short circuit and cable break at the thermocouple.

Due to the galvanic isolation between thermocouple and PC, interferences are effectively suppressed.

Independent of the system, two alarm outputs can be configured, which are triggered in hardware when defined threshold values are exceeded or undershot. For example, a fan, a heater or a signal tone can be switched on directly depending on the application (STB17/STB18).

Alarms

Up to four alarm thresholds with their own hysteresis can be set for each thermocouple. The alarms can be triggered when the thresholds are exceeded or not reached. Two alarms are always logically connected as OR. This makes it easy to trigger more complex alarm scenarios. Thus, two alarm outputs are available on the connector for each thermocouple. Once configured, the alarms are active independently of the system bus. Even if the system hangs up or is fully loaded, the alarm outputs function reliably.

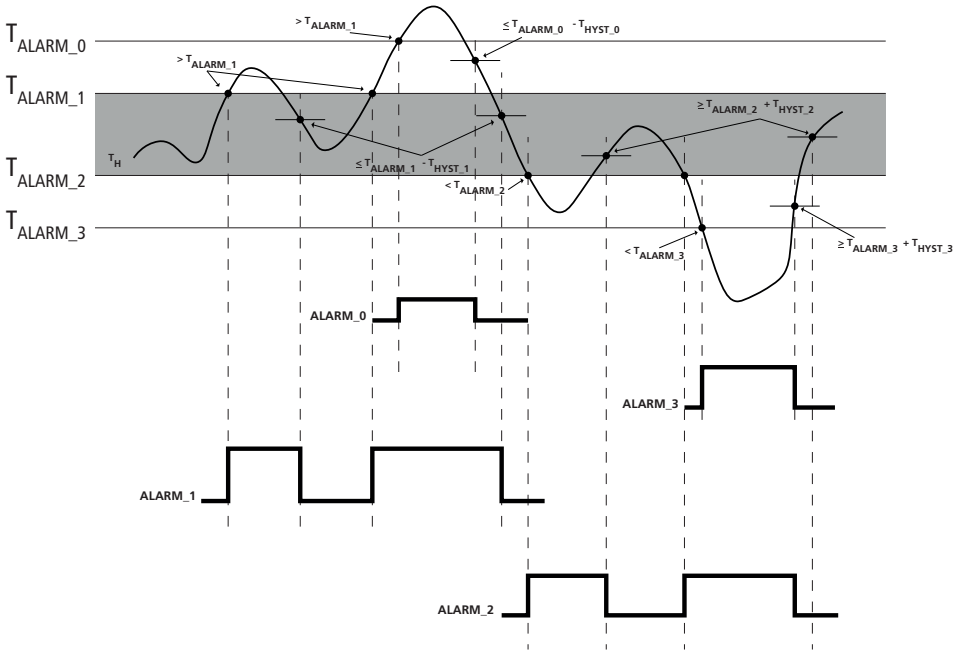


Figure 8: Alarm thresholds

2.4 Relays

- 8 power relays (SPDT) max. 30VDC/6A (default)
- 4 small signal relays (DPDT) max 30VDC/1A or 125VAC 0.3A (resistive); optional (on request)

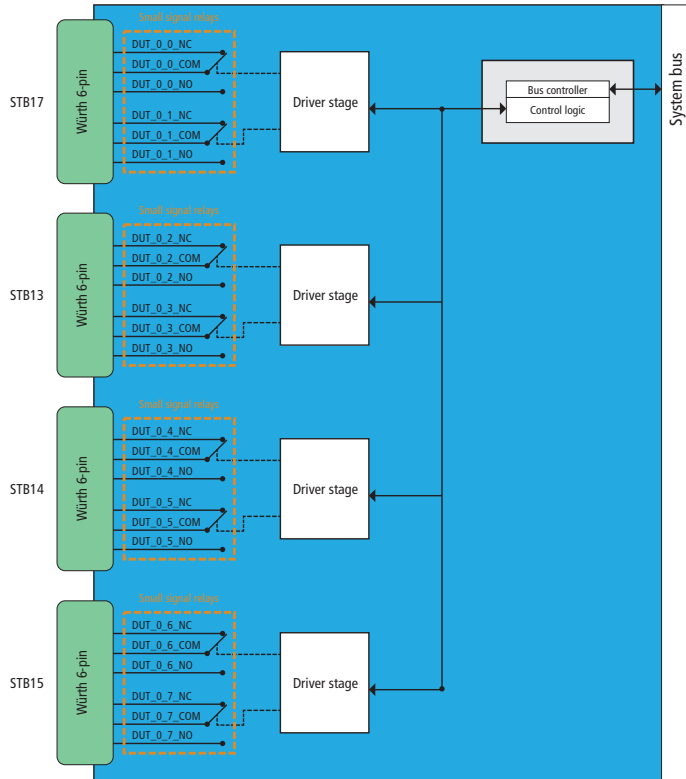


Figure 9: Block diagram relays

2.5 Analog inputs

A total of 6 analog inputs are available, 3x single-ended and 3x diff. With 16bit resolution and an input range up to 36VDC (single-ended) and $\pm 20.48\text{VDC}$ many measurement requirements can be met. In order to relieve the system and the bus, measured values can already be averaged in the converter chip.

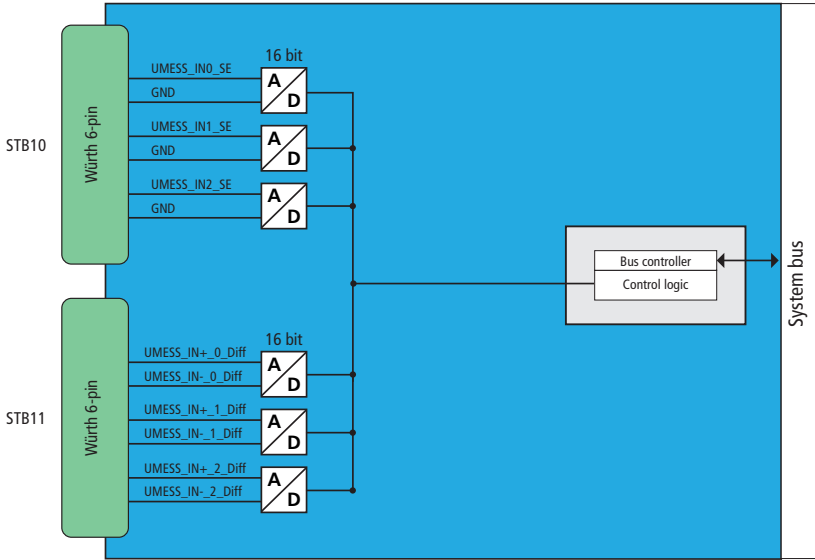


Figure 10: Block diagram analog inputs

2.6 Fan control

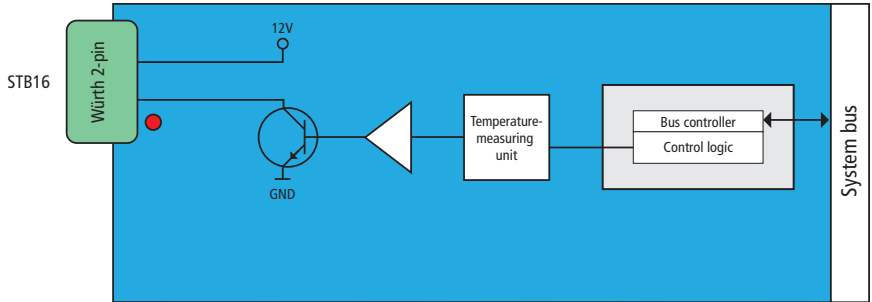


Figure 11: Block diagram fan control

A temperature transducer is located on the ADQ-CDI-BB, which measures the temperature of the module. It is recommended to cool the module actively. The temperature transducer has a programmable fan output (12VDC/500mA). The hysteresis can be used to set different threshold values for switching the fan on and off.

2.7 ADQ-Link

The ADQ link (point-to-point) allows two ALLDAQ products to be reliably and easily connected to each other and to establish communication. Physically, there is a differential connection. This makes the ADQ-Link perfectly suited for use in industrial environments. Even in compact control cabinets, where it is not always possible to maintain optimum cable routing and decoupling between power lines and analog or digital signal/control lines, the ADQ-Link operates stably. The ADQ-Link connects two participants up to 100m without loss of speed or robustness. For shorter distances, the power supply can also be looped from one station to the other through the same cable. The longer the cable, the higher the occurring displacement of the respective ground potentials. However, this is not a problem due to the capacitively isolated link cables.

As an alternative to the single board computer (BBB), the ADQ-CDI-BB can be controlled via an ADQ link input. In addition, an ADQ-Link output is available. In addition, the system can be easily expanded with a wide range of ALLDAQ peripherals. Standard modules include relay boards, current sinks or resistive loads. Additional project-specific hardware can also be connected.

2.8 Power supply

The complete module is supplied with a single supply voltage 24VDC (U_IN). Note: U_IN also corresponds to the output voltage for the digital outputs.

2.8.1 Internal power supply for DUT supply

The ADQ-CDI-BB offers beside the adjustable 8-18VDC/10A DUT voltage, two further voltages of 5VDC/8A and 12VDC/8A for the user. Optionally, another project-specific voltage can be implemented (only on request).

The output voltages 5VDC and 12VDC can be tapped via connector STB2 (see detailed picture).

3. Plug-on boards (HAT)

The ADQ-CDI-BB offers several possibilities for expansion. Among other things, a total of 2 slots for expansion boards (HATs) are available directly on the module.

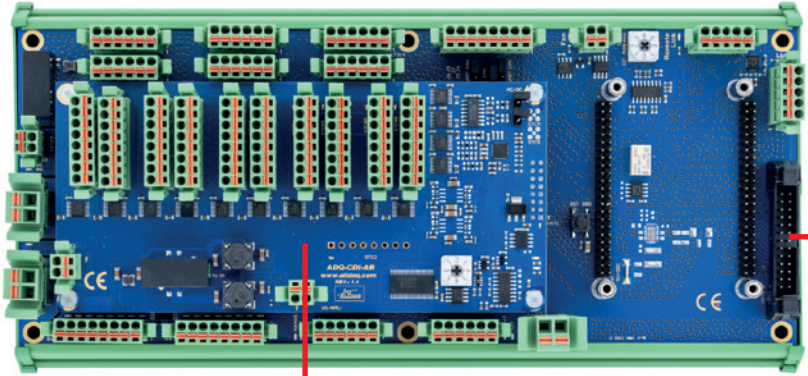


Figure 12: Position expansion boards (HATs)

3.1 HAT1 (for example ADQ-CDI-AB)

The ADQ-CDI-BB offers a slot for the HAT1. The dimensions are 160x75mm. Beside the voltages, 5VDC as well as 12VDC, there is the control bus (I2C,I2S).

3.2 HAT2

There is a connector for a simple HAT. The input voltage (U_{IN}), 5VDC as well as 12VDC and the system bus are available at the connector provided for this purpose.

4. Control

A standard I2C master can be used to control the ADQ-CDI-BB. This is available on the single board computer (default). In addition, the ADQ-CDI-BB can be controlled via the STB18 connector (ADQ link). If the ADQ-CDI-BB is controlled via an ADQ link using this connector, the I2C is automatically switched away from the single-board computer.

Rotary switch

Via the rotary switch you determine the main address of the complete module. The address may only occur once on an ADQ link or I2C bus. This also applies to other peripherals. All ADQ-Link products have an adjustable rotary switch.

Position	Address (7 bit)
0	0x70
1	0x71
2	0x72
3	0x73
4	0x74
5	0x75
6	0x76
7	reserviert*

* If occupied, then an orange ERROR LED lights up.

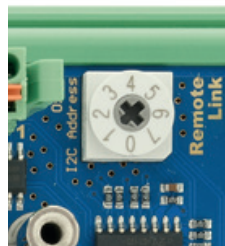


Abb. 13: Rotary switch

4.1 ADQ-Link

For example, the ADQ-CDI-BB can be conveniently and reliably controlled via USB by an ADQ-153. The ADQ link is implemented via a twisted 2-wire cable.

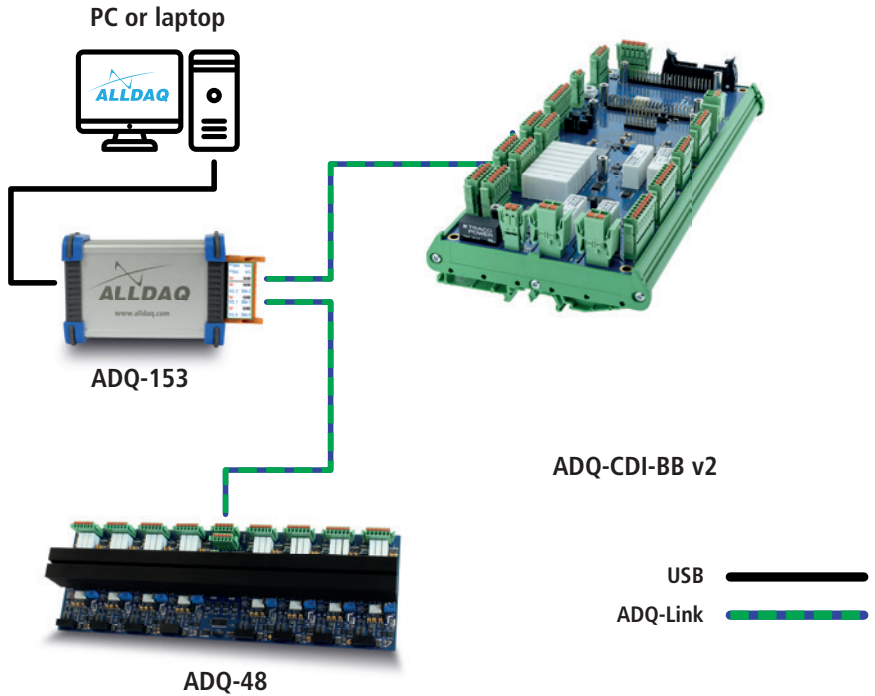


Abb. 14: ADQ-153 als Steuercontroller

4.2 Single Board Computer

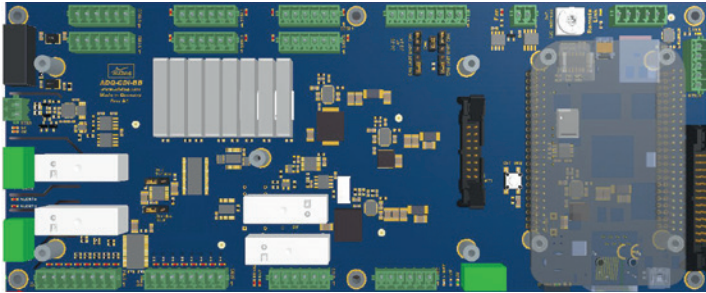


Figure 15: ADQ-CDI-BB with Beagle Bone Black single board computer

To make the complete system as compact as possible, different single board computers can be used as control center. The Beagle Bone Black can be mounted directly on the ADQ-CDI-BB. (see Figure 16)

For other single board computers adapter boards can be used to mount them.

5. Pin assignments

5.1 Connector position

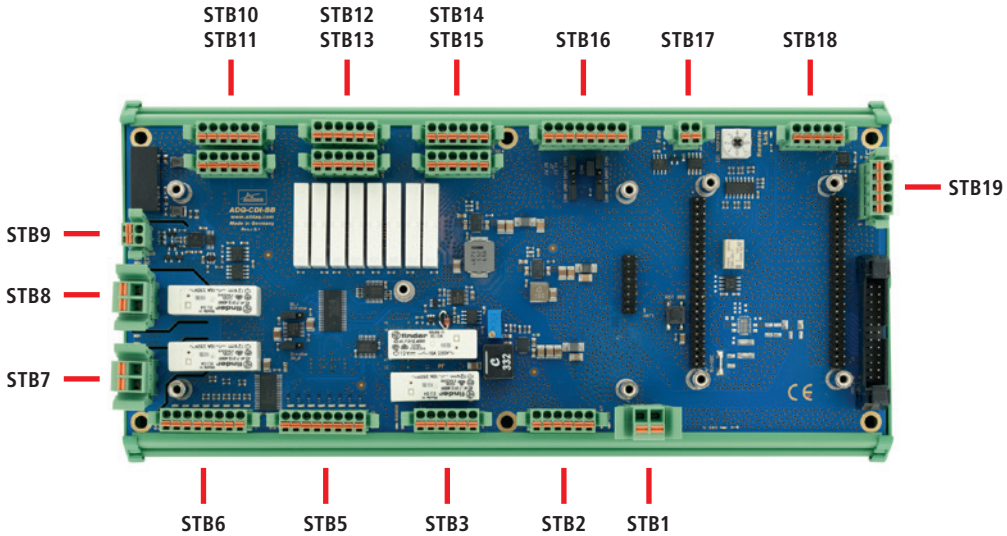


Figure 16: ADQ-CDI-BB v2 with connector position

5.2 Connector types overview

5.2.1 Type Würth/Therma

Therma/Würth 69130513.... series connectors with various numbers of poles are used.

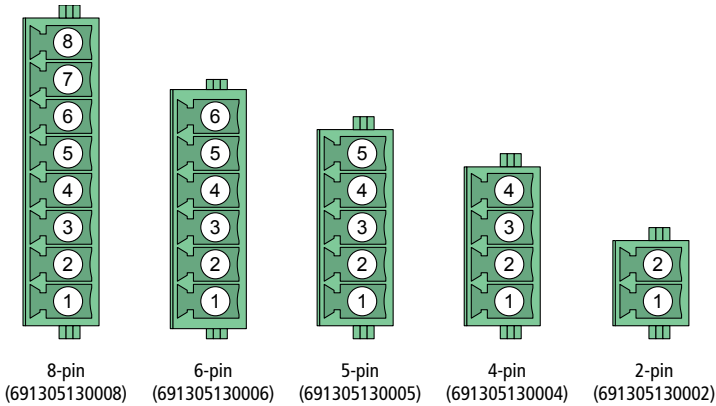


Figure 17: Würth base strip type WR-TBL 3051 (top view)

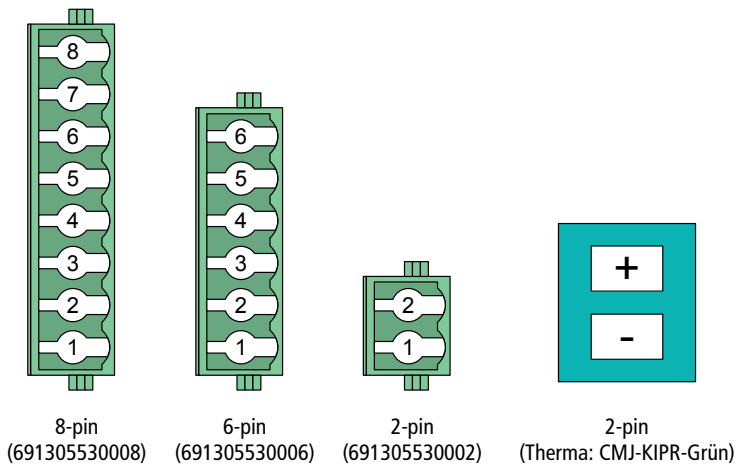


Figure 18: Würth/Therma base strip type WR-TBL 3055 (top view)

5.2.2 Type pin plug

5.2.3 For the connection between baseboard and plug-on modules, 10- and 5-pin male connectors are used (pitch: 2.54 mm).

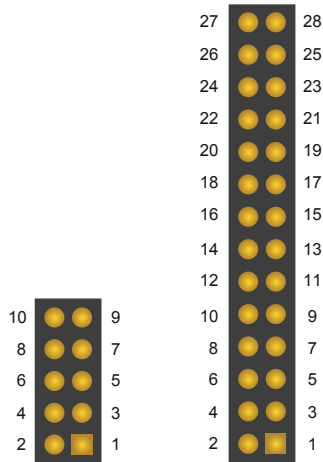


Figure 19: Pin connector, 2.54mm (top view)

5.3 Pin assignment

STB19 - ADQ-Link OUT

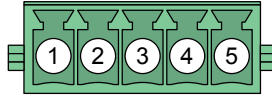


Figure 20: Würth 691305130005

Pin	Assignment	Description
1	ADQ-Link+ OUT_0	Positive ADQ link output (isolated)
2	GND	Mass reference
3	5V	Internal 5VDC
4	ADQ-Link- OUT_0	Positive ADQ link output (isolated)
5	12V	Internal 12VDC

Table 1: Pin assignment STB19

STB17 - Fan output

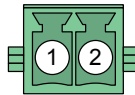


Figure 21: Würth 691305130002

Pin	Assignment	Description
1	12V (max. 500mA)	Positive connection for 12VDC fan
2	GND	Negative connection for 12VDC fan

Table 2: Pin assignment STB17

STB18 - ADQ-Link IN

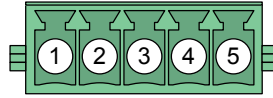


Figure 22: Würth 691305130005

Pin	Assignment	Description
1	ADQ-Link+ IN	Positive ADQ-Link input
2	GND	Mass reference
3	-	not connected
4	ADQ-Link- IN	Negative ADQ-Link input
5	-	not connected

Table 3: Pin assignment STB18

STB1 - Supply voltage

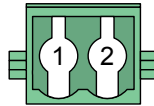


Figure 23: Würth 691305530002

Pin	Assignment	Description
1	GND	Mass reference
2	U_IN	Supply voltage 24VDC

Table 4: Pin assignment STB1

STB16 - CAN/UART (TTL-Level)

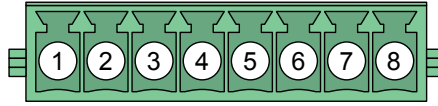


Figure 24: Würth 691305130008

Pin	Assignment	Description
1	P8_38	Beagle Bone
2	P8_37	Beagle Bone
3	GND	Mass reference
4	CAN1_H_RX	CAN1_H/UART_RX
5	CAN1_L_TX	CAN1_H/UART_TX
6	GND	Digital Mass reference
7	CAN0_H	CAN-BUS
8	CAN0_L	CAN-BUS

Table 5: Pin assignment STB16

STB5 - Digital outputs

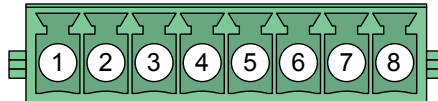


Figure 25: Würth 691305130008

Pin	Assignment	Description
1	DO_EXT_7	Digital output
2	DO_EXT_6	Digital output
3	DO_EXT_5	Digital output
4	DO_EXT_4	Digital output
5	DO_EXT_3	Digital output
6	DO_EXT_2	Digital output
7	DO_EXT_1	Digital output
8	DO_EXT_0	Digital output

Table 6: Pin assignment STB5

STB6 - Digital inputs

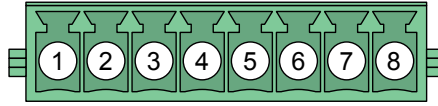


Figure 26: Würth 691305130008

Pin	Assignment	Description
1	DI_EXT_7	Digital input
2	DI_EXT_6	Digital input
3	DI_EXT_5	Digital input
4	DI_EXT_4	Digital input
5	DI_EXT_3	Digital input
6	DI_EXT_2	Digital input
7	DI_EXT_1	Digital input
8	DI_EXT_0	Digital input

Table 7: Pin assignment STB6

STB12 - AUX-Relays

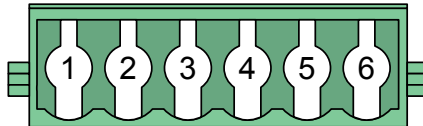


Figure 27: Würth 691305530006

Pin	Assignment	Description
1	REL_1_NC	Relay normally closed contact
2	REL_1_COM	Umschaltkontakt von Relais
3	REL_1_NO	Relay normally open contact
4	REL_0_NC	Relay normally closed contact
5	REL_0_COM	Relay changeover contact
6	REL_0_NO	Relay normally open contact

Table 8: Pin assignment STB12

STB13 - AUX-Relays

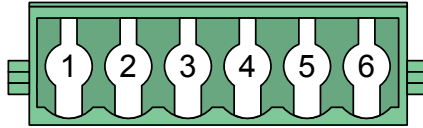


Figure 28: Würth 691305530006

Pin	Assignment	Description
1	REL_3_NC	Relay normally closed contact
2	REL_3_COM	Relay changeover contact
3	REL_3_NO	Relay normally open contact
4	REL_2_NC	Relay normally closed contact
5	REL_2_COM	Relay changeover contact
6	REL_2_NO	Relay normally open contact

Table 9: Pin assignment STB13

STB14 - AUX-Relays

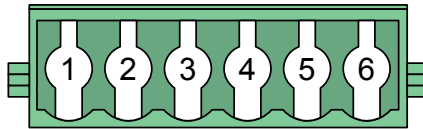


Figure 29: Würth 691305530006

Pin	Assignment	Description
1	REL_5_NC	Ruhekontakt von Relais
2	REL_5_COM	Relay changeover contact
3	REL_5_NO	Relay normally open contact
4	REL_4_NC	Relay normally closed contact
5	REL_4_COM	Relay changeover contact
6	REL_4_NO	Relay normally open contact

Table 10: Pin assignment STB14

STB15 - AUX-Relays

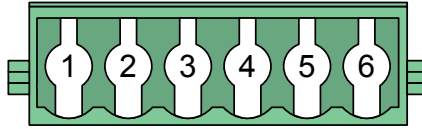


Figure 30: Würth 691305530006

Pin	Assignment	Description
1	REL_7_NC	Relay normally closed contact
2	REL_7_COM	Relay changeover contact
3	REL_7_NO	Relay normally open contact
4	REL_6_NC	Relay normally closed contact
5	REL_6_COM	Relay changeover contact
6	REL_6_NO	Relay normally open contact

Table 11: Pin assignment STB15

STB2 - Voltage taps of the internal power supplies

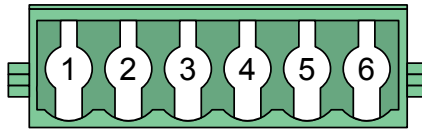


Figure 31: Würth 691305530006

Pin	Assignment	Description
1	5V	Internal 5VDC
2	12V	Internal 12VDC
3	U_BAT	U_BAT
4	GND	Mass reference
5	GND	Mass reference
6	GND	Mass reference

Table 12: Pin assignment STB2

STB3 - Power measurement channels output

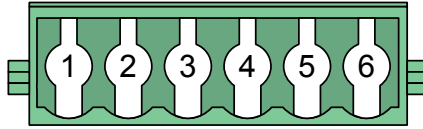
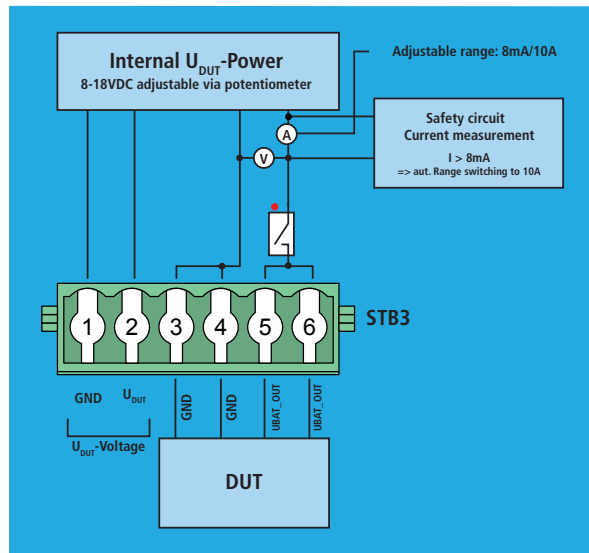


Figure 32: Würth 691305530006

Pin	Assignment	Description
1	GND	Mass reference
2	UDUT _{mess}	Tapping: Real DUT voltage
3	GND	Mass reference
4	GND	Mass reference
5	UBAT_OUT	Output power measurement
6	UBAT_OUT	Output power measurement

Table 13: Pin assignment STB3



STB10 - Analog input

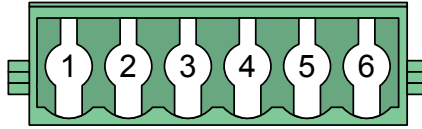


Figure 33: Würth 691305530006

Pin	Assignment	Description
1	GND	Mass reference
2	UMESS_SE_2	Analog input
3	GND	Mass reference
4	UMESS_SE_1	Analog input
5	GND	Mass reference
6	UMESS_SE_0	Analog input

*SE (Single Ended)

Table 14: Pin assignment STB10

STB11 - Analog input

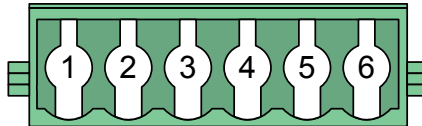


Figure 34: Würth 691305530006

Pin	Assignment	Description
1	UMESS_Diff+_2	Analog input
2	UMESS_Diff-_2	Analog input
3	UMESS_Diff+_1	Analog input
4	UMESS_Diff-_1	Analog input
5	UMESS_Diff+_0	Analog input
6	UMESS_Diff_0	Analog input

*Diff (Differential Input)

Table 15: Pin assignment STB11

STB9 - Thermoelements

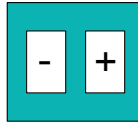
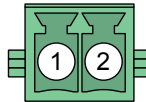


Figure 35: Therma CMJ-KIPR green

Pin	Assignment	Functions
1	-	Connection thermocouple -
2	+	Connection thermocouple +

Table 16: Pin assignment STB9

STB7 - 230V/Fan (potential-free switching contact)



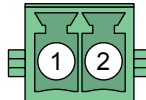
(see chapter Safety instructions)

Figure 36: Würth 691305130002

Pin	Assignment	Functions
1	Fan_NO	potential-free switching contact
2	Fan_COM	potential-free switching contact

Table 17: Pin assignment STB7

STB8 - 230V/Heating element (potential-free switching contact)



(see chapter Safety instructions)

Figure 37: Würth 691305130002

Pin	Assignment	Functions
1	Heating element_NO	potential-free switching contact
2	Heating element_COM	potential-free switching contact

Table 18: Pin assignment STB8

HAT2

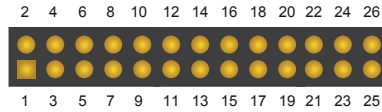


Figure 38: Pin plug HAT2

Pin	Assignment	Description
1	5V	Internal 5V/fused via Polyfuse 1.1A
2	12V	Internal 12V/fused via Polyfuse 1.1A
3	U-IN	Supply voltage 24VDC
4	U-IN	Supply voltage 24VDC
5	GND	Mass reference
6	GND	Mass reference
7	GND	Mass reference
8	P8_7	Beeagle Bone I/O
9	P8_8	Beeagle Bone I/O
10	P8_9	Beeagle Bone I/O
11	P8_10	Beeagle Bone I/O
12	P8_11	Beeagle Bone I/O
13	P8_12	Beeagle Bone I/O
14	P8_13	Beeagle Bone I/O
15	P8_14	Beeagle Bone I/O
16	P8_15	Beeagle Bone I/O
17	P8_16	Beeagle Bone I/O
18	P8_19	Beeagle Bone I/O
19	GND	Mass reference
20	RX_4	Beeagle Bone I/O
21	GND	Mass reference
22	TX_4	Beeagle Bone I/O
23	GND	Mass reference
24	SCL_2	I2C-CLK
25	GND	Mass reference
26	SDA_2	I2C-DATA

Table 19: Pin assignment HAT2

6. Specifications

Conditions: $T_A = 25^\circ\text{C}$ unless otherwise specified; warm-up time: 30 minutes.

General

Element	Condition	Specifications
Control and signal processing	recommended	ADQ-CDI-BB for analog and digital input/output, as well as control via (I2C-Bus/Beagle Bone Black) or ADQ-Link
Supply	STB1	24 V supply via Würth connector with $\pm 5\text{ V}$, $\pm 15\text{ V}$, $\pm 24\text{ V}$, $\pm 10\%$
Voltage taps of the internal power supplies	STB2	Via Würth connector 5 V, 12 V, UBAT, $\pm 10\%$ (max. 1A per voltage)
Quiescent current consumption	ADQ-CDI-BB/no relay energized, without SCB	24 V: max. 27 A
Quiescent current consumption	ADQ-CDI-BB with ADQ-CDI-AB/no relay energized, without SCB	24 V: max. 32 A
Sicherungen für schaltbare Hilfsspannungen via STB19, HAT2	+5 V	Fused by Polyfuse 16R 400g (littelfuse)
	+12 V	Fused by Polyfuse 16R 400g (littelfuse)
Temperature range	Operation	0..60 °C (standard)
Humidity	Operation	20%..55% (non-condensing)
Dimensions (W x D x H)	ADQ-CDI-BB	270 x 135 x 55 mm Top-hat rail
	ADQ-CDI-AB	160 x 75 x 30 mm Attachment HAT
	Total height	75 mm incl. top hat rail
Manufacturer warranty		36 months

Analog IN/OUT ADQ-CDI-BB

Voltage-Channels

Element	Condition	Specification
Channels		3 single-ended analog Inputs STB10
ADC Full Scale Range (FS)		40,96V
Measurement Input Range	Single Range	0..36V*
Resolution		LSB: 1,25mV
Overall accuracy	0V-36V	$\pm 0,013\%FS$ (5,4mV)**
	0V-20,48V	$\pm 0,007\%FS$ (2,9mV)**
	0V-10,24V	$\pm 0,0035\%FS$ (1,43mV)**
	0V-5,12V	$\pm 0,003\%FS$ (1,25mV)**
	0V-5,12V	$\pm 0,00175\%FS$ (0,716mV)***
Input Impedance		830K

*While the input range is 36V, the full-scale range of the ADC scaling is 40.96V.

High Speed Measurement, *High Accuracy Mode

Channels		3 differential analoge Inputs STB11
ADC Full Scale Range (FS)		40,96V
Measurement Input Range	Single Range	$\pm 20,48V$
Resolution		LSB: 1,25mV
Overall accuracy	$\pm 20,48V$	$\pm 1,5\%FS$ (62mV)**
	$\pm 10,24V$	$\pm 0,03\%FS$ (12,2mV)**
	$\pm 5,12V$	$\pm 0,03\%FS$ (12,2mV)**
Input Impedance		$3M\Omega \parallel 100pF$

**High Speed Measurement

Current measurement channel

Channel		1 Current measurement channel STB3
ADC Full Scale Range (FS1)	8m Ω Shunt	10A
Current Measurement Input	Range 10A	0..10A
Resolution		LSB: 153 μA
Overall accuracy	Range 10A	$\pm 0,05\%FS1$ (5mA)**

Element	Condition	Specification
ADC Full Scale Range (FS2)	10 Ω Shunt	8mA
Current Measurement Input	Range 8mA	0..8mA
Resolution		LSB: 122nA
Overall accuracy	0..8mA	$\pm 0,1\%FS2$ (8 μA)**
	0..1mA	$\pm 0,1\%FS2$ (8 μA)**
	0..1mA	$\pm 0,02\%FS2$ (1,6 μA)***
Overload protection current measurement	8mA Range	If I > 8mA the Hardware switch automatically to Range 10A

High Speed Measurement, *High Accuracy Mode

DUT-Voltage

Channel		1 STB3
ADC Full Scale Range (FS)		40,96V
Measurement Input Range	Single Range	0..18V
Resolution		LSB: 1,25mV
Overall accuracy	0V-18V (without DUT)	$\pm 0,007\%FS$ (2,9mV)**

**High Speed Measurement

Small signal relay for ADQ-CDI-BB (optional)

Element	Condition	Specification
Type		FTR-B3CA()Z Standard
Amount		up to 4 relays optional
Contact type		2-pin changeover contact (DPDT)
Contact material		Silver/nickel with gold plating
Contact resistance	1 A/6 VDC	max. 75 mΩ bei 1 A/6VDC
Switch time	Response time	max. 3 ms
	Fallback time	max. 3 ms
Switching cycles	mechanical	min. 50.000.000

Type-S34 relay on the ADQ-CDI-BB (for AUX relay)

Element	Condition	Specification
Amount/Type		8 changeover relay (SPDT), type: Finder Series 34
Contact material		Silver/Nickel
Switching time	Response time	max. 5 ms
	Fallback time	max. 3 ms
Switching cycles	mechanical	min. 10.000.000
Switching current DC1		max. 6 A / 30 VDC (limited to 4 A by polyfuse)
Min. switching load	mW (V/mA)	500mW (12V/10mA) must not be undercut, with a minimum current of 21mA at 24V or a minimum voltage of 50V at 10mA
Connection		STB12..15

Relay type-43.11 on the ADQ-CDI-BB (for heating element/fan)

Element	Condition	Specification
Amount/Type		2 changeover relays (SPDT), type: Finder Series 43.11
Contact material	Response time	max. 6 ms
Switching time	Fallback time	max. 3 ms
Switching cycles	mechanical	min. 10.000.000
Electrical life AC/DC		min. 10.000.00
Switching current DC1	30/110/220V	10/0.3/0.12A
Switching current AC1	max. switching capacity	2500VA
Min. switching load	mW (V/mA)	300mW (5V/5mA) must not be undercut

Element	Condition	Specification
Connection		STB7 / STB8

Isolated digital inputs via ADQ-CDI-BB

Element	Condition	Specification
Amount		1 x 8 bit digital input ports via STB6
Type		Isolated digital inputs (unidirectional) with Schmitt trigger characteristic according to IEC 61131-2 (type 1)
Switching voltage	U_IN	24 VDC for control technology
Mass reference		GND

Isolated digital outputs via ADQ-CDI-BB

Element	Condition	Specification
Amount		1 x 8 bit digital output ports via STB5
Type		Isolated digital outputs (unidirectional) according to IEC 61131-2 (type 1)
Supply	U_IN	24 VDC for control technology
Mass reference		GND

Thermocouple input ADQ-CDI-BB

Element	Condition	Specification
Ports	STB9	1 channel for thermocouple, 2 alarm outputs
Thermoelement	Type	K according to NIST ITS-90 with integrated cold junction compensation (J, T, N, S, E, B and R on request)
	Accuracy (ADQ-CDI-BB)	typical 1.5°C (max. 2°C)
	Accuracy (thermocouple)	Depending on the selected thermocouple (www.thermagmbh.de)
	Total-Accuracy	Accuracy (ADQ-CDI-BB) + (thermocouple)
	Resolution	12, 14, 16, 18bit
	Readout interval	330ms (max.)
	Filter	digital IIR or EMA
	Error detection	Short circuit and open circuit (SC-OC LED indicator)
Alarm output	Type	Relay switching outputs STB7, STB8 (see relay type 43.11 table)

I2C (HAT2)

Element	Condition	Specification
Frequency		100kHz
Input level	LOW	1,5V (max.)
	HIGH	3,5V (min.)
Output current	LOW ($V_{OL} = 0,4V$)	7mA (typ.)
	LOW ($V_{OL} = 0,6V$)	10mA (typ.)
Pull-up resistors	internal	3,3k Ω ($\pm 1\%$) an 5V

ADQ-Link Input STB18

Element	Condition	Specification
Frequency		100kHz
Isolation	ADQ-LINK+/-	50VDC
Cable length	2-core twisted	max. 100m

ADQ-Link Out STB19

Element	Condition	Specification
Frequency		100kHz
Isolation	ADQ-LINK+/-	50VDC
Cable length	2-core twisted	max. 100m
Tapping	+5V (Pin 3)	Fused by Polyfuse 16R 400g (littlefuse)
	+12V (Pin 5)	Fused by Polyfuse 16R 400g (littlefuse)

STB16

Element	Condition	Specification
GPIO	IOs	see Beagle Bone Black manual for specifications
CAN	IOs	see programming GPIOs in manual Beagle Bone Black
UART	IOs	see programming GPIOs in manual Beagle Bone Black
Tapping supply voltage	+5V (Pin 3)	Fused by Polyfuse 16R 400g (littlefuse)
	+12V (Pin 5)	Fused by Polyfuse 16R 400g (littlefuse)



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