HOTTINGER BRÜEL & KJÆR

ENGLISH

Operating Manual

digiBOX Industrial

HBM

Brüel & Kjær

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1 SAFETY INSTRUCTIONS

In addition to the safety instructions set out here, the supplementary safety instructions in the respective product operating manuals also apply. You will find operating manuals for our products on our website at www.hbkworld.com.

Intended use

The digiBOX is designed solely for measurement tasks and directly related control tasks (automation systems). Any use beyond this restriction is considered non-compliant with the intended use. To ensure safe operation, the device may only be operated in accordance with the instructions set out in the operating manual/mounting instructions.

The device may only be supplied with safety extra-low voltage (SELV, according to IEC 61140). The device can be operated with a supply voltage between 10 V DC and 30 V DC.

⚠ WARNING

Improper mounting/installation will render the product unusable. This can lead to death or serious injury.

- The product is only intended for installation and operation by qualified personnel.
- The product is not intended to meet the requirements of a safety system (functional safety). If the product is operated as part of a safety system, additional safety calculations must be carried out. The technical specifications must not be exceeded at any time.

⚠ WARNING

Danger of electric shock. Installation and operation of the product requires specialist qualifications on the part of the user. Failure comply with this requirement can lead to death or serious injury.

- Only put the product into operation if you are sure that it has been installed in accordance with the operating manual/mounting instructions.
- Only operate the product as intended, and within the limits given in the technical specifications. The specifications can be found on the data sheet and in the operating manual.
- The product requires a supply voltage compliant with the SELV definition as per IEC 61140.

⚠ CAUTION

Modifying the product may lead to unsafe operating conditions. This can result in minor or moderate injury.

- Do not open or modify the product.

- Do not carry out any maintenance on the product. The product is maintenance-free.
- Do not carry out any repairs to the product. The product does not contain any parts that can be repaired by the user.
- Do not operate the product if it is visibly damaged.

⚠ CAUTION

Danger of dropping if transported improperly. This can result in minor or moderate injury.

- Always transport the product in its original packaging. This will prevent the packaging from suffering breakages during transportation.
- Due to the weight of the product, the packaging and the product itself may be damaged by heavy shock impact.
- Do not reuse the packaging if it is visibly damaged.

Notice

Improper handling of the product can result in damage to it.

- The product is a highly accurate measuring device. Handle it with care to avoid damage during transportation, installation and operation.
- The product may only be operated in an environment that meets the specifications in the operating manual/mounting instructions.
- When tightening the fastening bolts, ensure that the specified torque values are not exceeded at any time.
- The piezoelectric connectors are highly sensitive to electrostatic discharge! So do not touch the piezoelectric connectors without taking ESD protection measures.
- Ensure that the air convection of the device's housing is not impeded.
- Always ensure that the product has been installed in accordance with the EMC protection measures described and the recommendations set out in the operating manual.
- When cleaning the product as and when necessary, do so only as stipulated in the operating manual. The product's protection level (IP rating code) must also be taken into account when cleaning it.

2 MARKINGS USED

2.1 Markings used in this document

Important instructions for your safety are highlighted. Following these instructions is essential in order to prevent accidents and damage to property.

Symbol	Meaning
⚠ **WARNING**	This marking warns of a *potentially* dangerous situation in which failure to comply with safety requirements *could* result in death or serious physical injury.
⚠ **CAUTION**	This marking warns of a *potentially* dangerous situation in which failure to comply with safety requirements *could* result in minor or moderate physical injury.
Notice	This marking draws your attention to a situation in which failure to comply with safety requirements *could* lead to property damage.
Important	This marking draws your attention to *important* information about the product or about handling the product.
Tip	This marking indicates tips for use or other information that is useful to you.
Information	This marking draws your attention to information about the product or about handling the product.
Emphasis *See …*	Italics are used to emphasize and highlight text and identify references to sections of the manual, diagrams, or external documents and files.
Device -> New	Bold text indicates menu items, as well as dialog and window headings in the program environment. Arrows between menu items indicate the sequence in which the menus and submenus are called up
Sample rate	Bold text in italics indicates inputs and input boxes in the user interfaces.
▶	This symbol indicates an action step.

2.2 Symbols on the device

Fig. 2.1 Symbols on the digiBOX Industrial (configuration shown: K-DBX-4M-AD-IE-I-ILT)

Electrostatic-sensitive devices (ESD notice)

Avoid touching the contacts:
The contacts of the 10-32 UNF (Microdot) piezo sensor connector sockets are designed to detect the smallest amounts of charge and, for functional reasons, cannot be provided with sufficient overvoltage protection.

The contacts of the piezo sensor connectors are also electrostatic-sensitive, and must be protected against touch. When the connectors are not in use, fit the supplied protective caps on them.

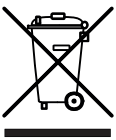
Information

The ESD notice is only relevant for the piezo inputs.

Ground symbol

The ground symbol indicates the need to integrate the device into the grounding design via the mounting holes – *see chapter 4.1 "Grounding and shielding design", page 22*.

Statutory waste disposal marking



Statutory waste disposal mark, *see chapter 24 "Disposal", page 184*.

Marking of pollutant emission limit values (for deliveries to China)

Statutory mark of compliance with emission limits in electronic equipment supplied to China.

CE mark

The CE mark enables the manufacturer to guarantee that the product complies with the requirements of the relevant EC directives. You can find the Declaration of Conformity on the HBK website: https://www.hbkworld.com.

UKCA mark

This product bears the UKCA mark and meets the applicable international requirements regarding product safety and electromagnetic compatibility in accordance with the following directives: Electromagnetic Compatibility Regulation 2016, No. 1091. The associated Declaration of Conformity is available at the end of this document.

Follow instructions

Read and observe the information given in this manual.

2.3 Calibration label and factory calibration certificate

The placeholder indicates where to affix the calibration label. Once factory calibration has been completed as part of the digiBOX's manufacturing process, a calibration label is affixed to it.

The calibration label contains the unique five-digit calibration number of the calibration certificate and the date of calibration.

The factory calibration certificate for the digiBOX Industrial can be downloaded from our website at https://www.hbkworld.com/en/services-support/services/calibration/resources/download-calibration-certificates

You need to fill out two of the four input boxes in order to download the factory calibration certificate. Available input boxes:

- Calibration Certificate Number
- Serial Number (see label on the device)

- HBK Customer Number
- Case Number

The calibration number is printed on the device's calibration label. The serial number can be found on the device's type plate. The customer number is assigned once you have placed an order with HBK, and may be issued by your purchasing department or the HBK sales department. A case number is generated when the digiBOX is to be recalibrated, and is communicated to you before you send in your device.

3 OVERVIEW

The following content in this operating manual refers to the *Industrial* version of the digiBOX. The *Industrial* firmware is specially designed for force measurement applications and processes. The digiBOX *Industrial* is offered as a configurable product – *see chapter 3.4 "Device types", page 19.*

3.1 Overview of modules and functionality

The digiBOX *Industrial* is a multi-channel signal conditioner for analyzing piezoelectric force sensors and sensors based on strain gauges. The device has an IP67 protection rating when unplugged, and as such is designed for installation alongside sensors in the field. An Industrial Ethernet connector integrates the device into the control environment. PROFINET®, EtherCAT®[1)] and EtherNet/IP™ are available as fieldbus protocols.

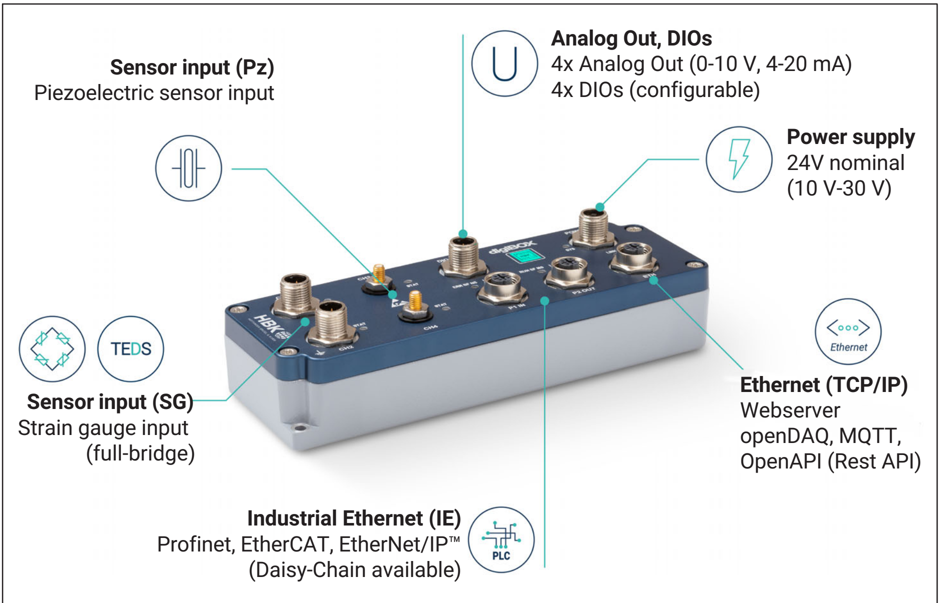


Fig. 3.1 Overview of digiBOX Industrial features (configuration shown: K-DBX-4M-AD-IE-I-ILT)

The digiBOX has an integrated web server by which it can be parameterized and controlled. The web server provides intuitive visual display of the measured values and parameters, and is used for efficient start-up of the device. The web server is accessed

1) EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

via TCP/IP by an Ethernet connector. All operators in the web server can also be controlled via the digiBOX object dictionary – *see chapter 18 "Object dictionary", page 154*. Device control using the object dictionary can also be carried out via the fieldbus interface from the PLC and via the available IT protocols.

For conventional process control, 4x DIOs and 4x freely scalable analog outputs (± 10 V, 4-20 mA, switchable) are available via the IO port. For more information on the analog and digital I/Os refer to *chapter 13.2 "Analog output", page 113*.

TCP/IP-based protocols such as openDAQ, MQTT and Rest:API (openAPI) can be implemented via the Ethernet connection for bidirectional data communication in IT-level applications – *see chapter 17 "Ethernet protocols (TCP/IP)", page 144*.

3.2 Overview of connections

All the digiBOX's connections are located on the top of the device.

Fig. 3.2 Overview of digiBOX Industrial connections (configuration shown: K-DBX-4M-AD-IE-I-ILT)

The table below provides an overview of the connections on the digiBOX.

Connection name	Description
CH1	Strain gauge input, M12 plug, 8-pin, A-coded, male (also available as piezo input depending on K-DBX configuration)
CH2	Strain gauge input, M12 plug, 8-pin, A-coded, male (also available as piezo input depending on K-DBX configuration)
CH3	Piezo input, Microdot, 10-32 UNF, female (also available as strain gauge input depending on K-DBX configuration)
CH4	Piezo input, Microdot, 10-32 UNF, female (also available as strain gauge input depending on K-DBX configuration)

Connection name	Description
IO	Connection for DIOs and Analog Out (±10 V, 4-20 mA) M12 plug, 12-pin, A-coded, male
POWER	Supply voltage connection, M12 plug, 4-pin, T-coded, male, 24 V nominal (min. 15 V, max. 30 V)
P1 IN	Industrial Ethernet connection, M12 plug, 4-pin, D-coded, female
P2 OUT	Industrial Ethernet connection, M12 plug, 4-pin, D-coded, female
ETH	Ethernet connection, M12 plug, 4-pin, D-coded, female

Fig. 3.3 digiBOX Industrial connections table (configuration shown: K-DBX-4M-AD-IE-I-ILT)

3.3 Health monitoring and status LEDs

The digiBOX has status LEDs indicating the status of the device, the channel inputs and the Industrial Ethernet connections.

LED name	Assignment
STAT	Status LED for each sensor input channel CH1, CH2, CH3, CH4
SYS	System LED
LINK	Ethernet communication (activity indicator)
ERR	EtherCAT, ERR LED
BF	PROFINET, BF LED
NS	EtherNet/IP™ Network Status
Link/Act	Ethernet, Link Level
RUN	EtherCAT, RUN LED
SF	PROFINET, SF LED
MS	EtherNet/IP™ module status

Fig. 3.4 digiBOX Industrial LEDs and labeling (configuration shown: K-DBX-4M-AD-IE-I-ILT)

The LEDs on the device can be switched by a command in the web server to a mode in which they continuously flash green – *see chapter 7.1 "Home screen", page 47*.

Device SYS LED (status) on the POWER connector plug

SYS LED	Status	Meaning (SYS LED)
	On	In operation. The device is working without error, within the specification.
	Flashing (1 Hz)	The LED flashes when the device is initializing.
	On	The device has a system error. Check the sensor connection, supply voltage and settings.
	Flashing	A firmware update is being installed

Channel LED (status) on each of the available channel inputs CH1, CH2, CH3, CH4

Channel LED	Status	Meaning (channel LED)
	On	The device or channel is working without error, within the specification.
	Flashing (5 Hz)	The LED flashes if this is a piezo channel and it is in reset mode, waiting for the "Operate" command.
	Flashing (5 Hz)	The LED flashes in the event of a signal overload or underload.
	On	There is a measured value error at the channel input. Check the sensor connection/pin assignment. (DMS) Measurement error = ADC overflow (Pz) Signal out of set measuring range

PROFINET LEDs (P1 IN: BF and P2 OUT Links: SF)

BF LED	Status	Meaning (bus error LED)
	Off	No error.
	Flashing (1 Hz, 3 sec.)	A DCP signal service is triggered via the bus.
	On	Watchdog timeout: There is a system error or a channel, generic or extended diagnostic.

EtherCAT LEDs (P1 IN: ERR and P2 OUT Links: RUN)

ERR LED	Status	Meaning (ERR LED)
	Off	No error. The EtherCAT communication is running and error-free.
	Flashing (2.5 Hz)	Invalid configuration. Possible cause: A change specified by the master is not possible.
	Single flash	Local error: The digiBOX has autonomously changed the EtherCAT status. Possible causes: - A host watchdog timeout has occurred. - Synchronization error. In this case the device switches automatically to the SAFE-OPERATIONAL state.
	Double flash	A process data watchdog timeout has occurred. Possible cause: A synchronization timeout (Sync Manager watchdog).

RUN LED	Status	Meaning (RUN LED)
	Off	The digiBOX is in the INIT state.
	Flashing (2.5 Hz)	The digiBOX is in the PRE-OPERATIONAL state.
	Single flash	The digiBOX is in the SAFE-OPERATIONAL state.
	On	The digiBOX is in the OPERATIONAL state.

EtherNet/IP™ LEDs (P1 IN Links: MS and P2 OUT NS)

MS LED	Status	Meaning
	Off	The digiBOX is not on.
	Flashing (2.5 Hz)	Standby: The digiBOX has not been configured.
	On	The digiBOX is running and error-free.
	Flashing (1 Hz)	The digiBOX is running a self-test.
	Flashing (1 Hz)	Simple error. The digiBOX has detected a reparable error, e.g. an incorrect configuration.
	On	Serious error: There is an irreparable error, please contact HBK.

NS LED	Status	Meaning
	Off	The digiBOX is not on, or has no IP address.
	Flashing (2.5 Hz)	No network connection. But the digiBOX has been assigned an IP address.
	On	The digiBOX is connected to a network device, e.g. a switch.
	Flashing (1 Hz)	The digiBOX is running a self-test.
	Flashing (1 Hz)	Connection timeout. One or more connections to this digiBOX are in timeout. This status will only be terminated when all connections have been restored or you reset the digiBOX.
	On	Duplicate IP address. The digiBOX has detected that the IP address assigned to it (and set) is already being used in the network.

Ethernet LINK LED

Channel LED	Status	Meaning (channel LED)
	Off	No link
	On	Link present
	Flashing	Communication on the line

3.4 Device types

The digiBOX is available as a configurable product. Various combinations of number of channels (2-4) and sensor input for strain gauge-based sensors and/or piezoelectric sensors are available. Below is a configuration overview showing the corresponding ordering code structure:

K-DBX		
1	**Code**	**Option 1: Sensor input**
	2P	2 piezo inputs
	2S	2 strain gauge inputs
	4M	2 piezo and 2 strain gauge inputs
	4P	4 piezo inputs
	4S	4 strain gauge inputs
2	**Code**	**Option 2: Conventional process control**
	AD	4x DIO and 4x analog out (+10 V, 4...20 mA, switchable)
3	**Code**	**Option 3: Fieldbus**
	IE	Industrial Ethernet
4	**Code**	**Option 4: Firmware**
	I	Industrial
5	**Code**	**Option 5: Firmware version**
	ILT	Industrial current version
	I01	Industrial V1.nn
	I...	Industrial V

K-	-			-			-	**I**	**E**	-		-			
		1			**2**			**3**			**4**			**5**	

Example ordering code: **K-DBX-4M-AD-IE-I-ILT**

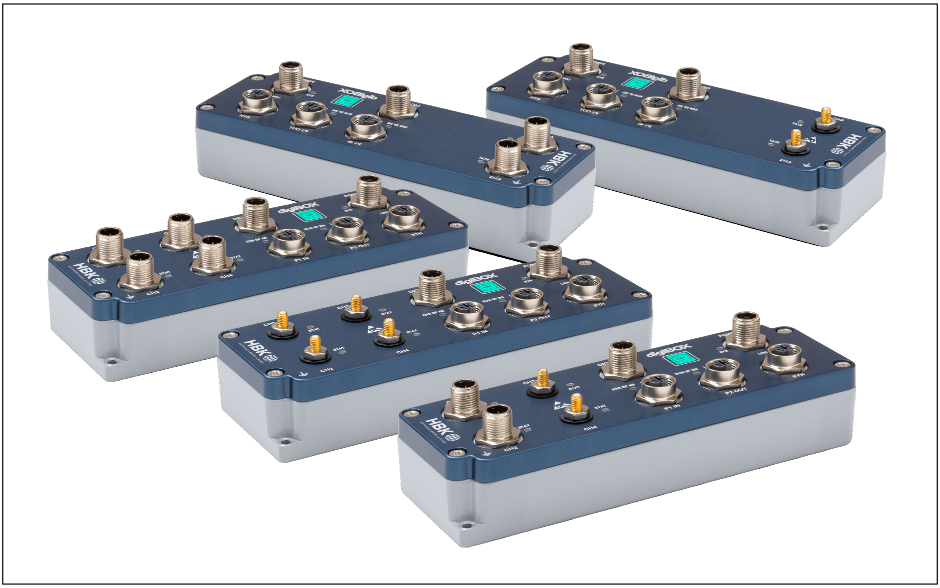


Fig. 3.5 Overview of digiBOX Industrial variants

3.5 Scope of supply

Included in the scope of supply:

- digiBOX (device according to ordered K-DBX configuration)
- Sealing caps for piezo inputs (only on ordering a K-DBX variant with piezo inputs)
- digiBOX Quick Start Guide
- Safety instructions

Caps for unused connections and other accessories for the digiBOX are detailed in *chapter 21 "Accessories", page 179*.

3.6 Dimensions and ePLAN Macros

The dimensions of the digiBOX Industrial are shown in the diagram below. All digiBOX configurations have the same housing dimensions.

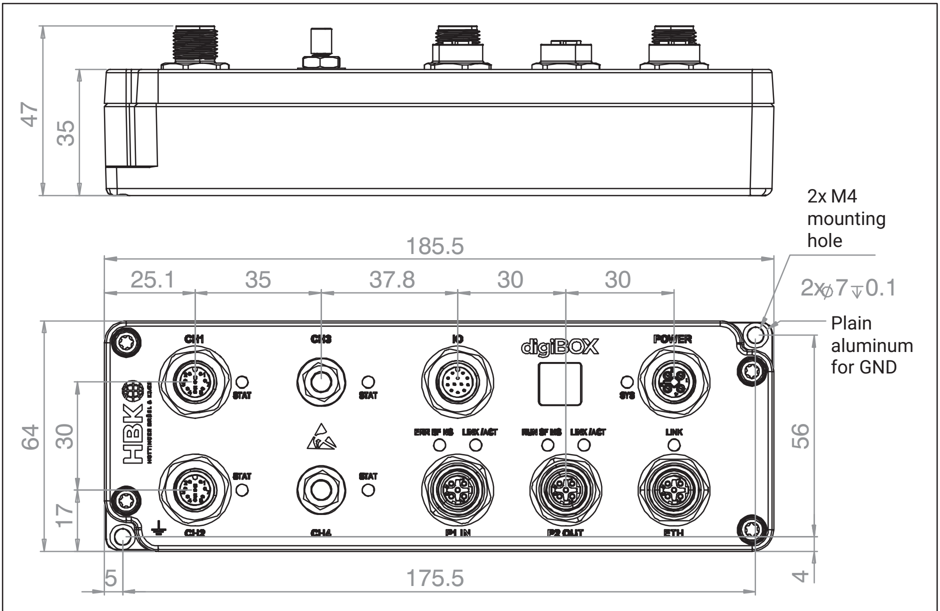


Fig. 3.6 digiBOX Industrial technical drawing (configuration shown: K-DBX-4M-AD-IE-I-ILT)

Information

Complete ePLAN macros (without a license) and 3D-STEP files to support the construction are available to download from the digiBOX website: https://www.hbkworld.com/en/products/instruments/industrial-electronics/multi-channel/digibox-industrial#Downloads-faecdb6aac

4 MOUNTING

The digiBOX must be firmly screwed to a flat surface by two M4 bolts. It can be mounted in any orientation.

The housing bolt connections fix the device in place and provide its grounding. To implement grounding, an M4 toothed lock washer must be fitted between the head of the fastening bolt and the digiBOX housing, thereby creating a connection to a grounded base surface. The fastening bolt must be tightened with a torque of at least 3 Nm to ensure an electrically conductive connection.

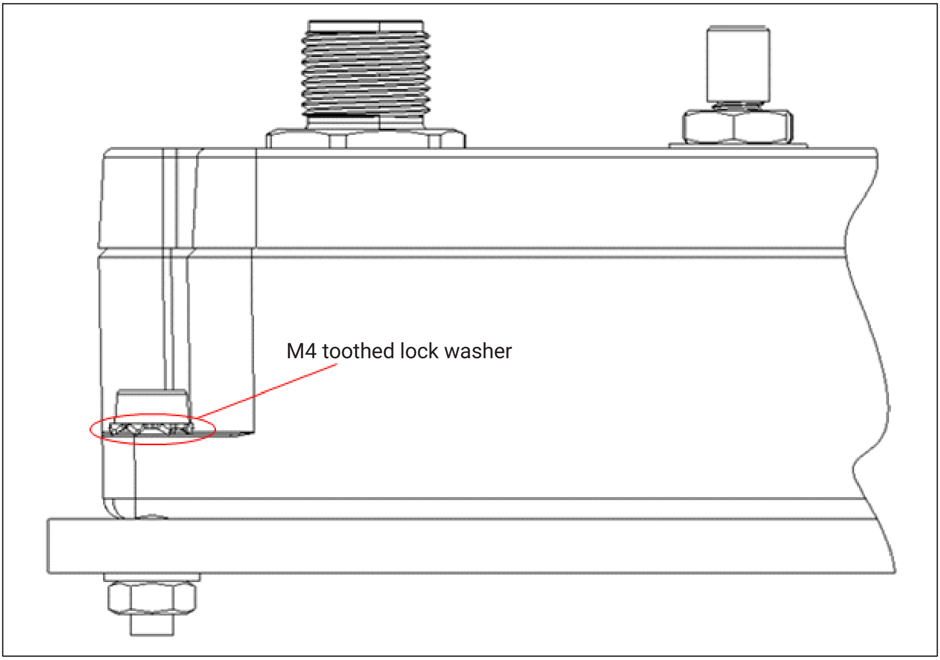


Fig. 4.1 digiBOX housing mounting with M4 toothed lock washer

4.1 Grounding and shielding design

The digiBOX essentially requires grounding. The digiBOX's housing is explicitly included in the grounding system. A simple ground screw connection, as shown in figure *Fig. 4.1* with a toothed lock washer, is only sufficient if the mounting plate on which the digiBOX is placed is electrically conductive, and unwanted potential equalization currents can be discharged. If this is not the case, a grounding cable lug must be fitted on one of the two bolt connections. In this case, an additional lock nut and two toothed lock washers must be used, as shown in the diagram below.

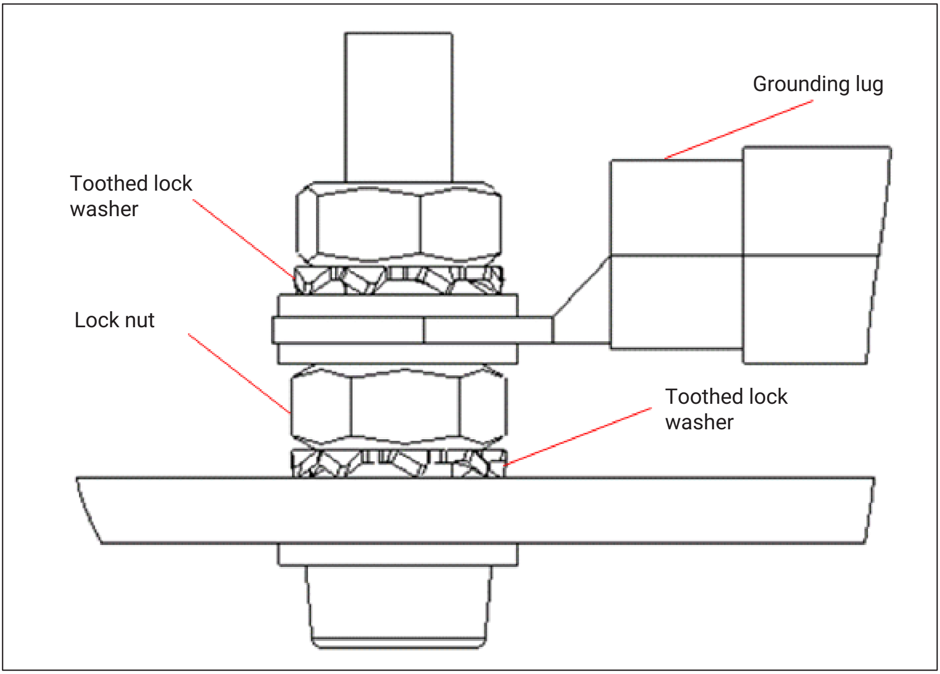


Fig. 4.2 *Housing bolted connections with grounding cable lug and additional nut and toothed lock washer*

Unwanted potential equalization currents must be avoided. For this reason, the sensor and amplifier are connected to the same potential. Instructions for sensor-side grounding of strain gauge transducers are given in *chapter 5.1.1 "Strain gauge sensor connection and shielding design", page 24*. Specific instructions for grounding of piezoelectric sensors can be found in *chapter 5.2.2 "Grounding design for piezo sensors", page 32*.

5 ELECTRICAL CONNECTION

All the digiBOX's connections are located on the top of the device. The assignment of the connections is shown in *chapter 3.1 "Overview of modules and functionality", page 13*. You will find accessory connecting cables and plugs in *chapter 21 "Accessories", page 179*.

5.1 Strain gauge input

The digiBOX's strain gauge sensor connection is an 8-pin M12 plug (A-coded, male).

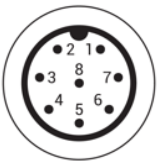
Strain gauge connection	Pin	Description	HBK color code – sensor cable
	1	Measurement signal +	wh
	2	TEDS (1-WIRE)	
	3	Sense lead +	gn
	4	NC	
	5	Sense lead -	gy
	6	Excitation voltage -	bk
	7	Excitation voltage +	bu
	8	Measurement signal -	rd
Connector socket	M12, 8-pin, A-coded (male)		

Fig. 5.1 Input for strain gauge full bridges, with channel specification depending on K-DBX device configuration

Information

Strain gauge full bridges in 4- or 6-wire configurations with a transducer impedance of 80 to 5000 ohms can be connected.

5.1.1 Strain gauge sensor connection and shielding design

The supply connection and the signal cables and sense lead of the strain gauge sensors must be installed such that no electromagnetic interference impairs the measurement signal. The HBK Greenline shielding design serves as a guide for correct implementation.

In the Greenline design, the measurement chain is completely enclosed in a Faraday cage by suitable routing of the cable shield. The cable shield is extensively connected with the sensor housing, and is routed via the conductive plug connectors to the signal conditioner's housing. This minimizes the effects of electrical and magnetic fields.

When connecting to the digiBOX with transducers that have a connection cable with free ends, the cable shield must be laid flat on the housing of the fitted M12 connector plug. To complete the Greenline shielding, the digiBOX's housing must be equalized to the potential of the sensor housing in accordance with the regulations – *see chapter 4.1 "Grounding and shielding design", page 22*.

Tip

The cable shields of HBK force transducers with a fixed cable are connected to the sensor housing at the factory. If the HBK sensor is preconfigured with a connection cable and matching M12 connector plug for the digiBOX, the Faraday cage is closed by screwing the enclosure of the M12 connector plug to the digiBOX socket.

5.1.2 Strain gauge full bridge in 6-wire configuration

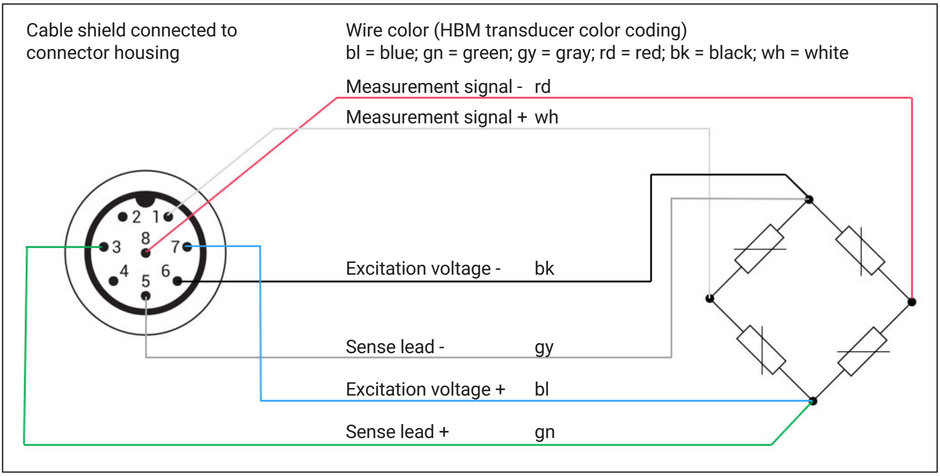


Fig. 5.2 Electrical connection, 6-wire configuration of a strain gauge sensor

Important

The cable shield must be applied over the full surface area in the plug– *see chapter 3.4 "Device types", page 19*.

5.1.3 Strain gauge full bridge in 6-wire configuration with TEDS

The digiBOX supports the connection of 0-wire and 1-wire TEDS modules for each strain gauge input.

The connection of a strain gauge full bridge in a 6-wire configuration with a 1-wire TEDS module (1-TEDS-PAK) is shown below.

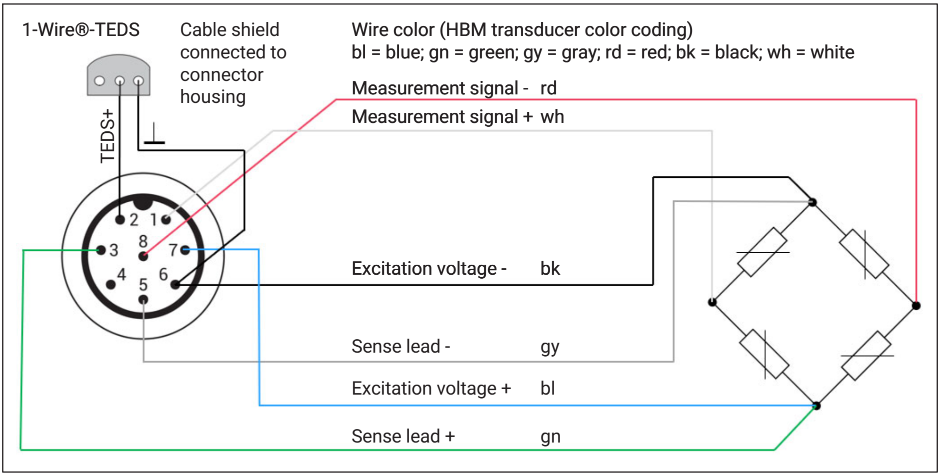


Fig. 5.3 *Electrical connection, 6-wire configuration of a strain gauge sensor and 1-wire TEDS module, view from below (solder side)*

Configuration 1-WIRE TEDS (1-TEDS-PAK):

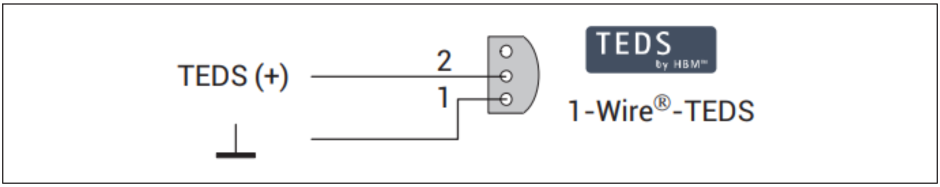


Fig. 5.4 *View of the TEDS chip from below (solder side)*

The TEDS+ wire is connected to pin 2. The second connector is connected to pin 6 (supply voltage -).

As shown in the diagram below, 0-wire TEDS can also be connected to the digiBOX strain gauge input.

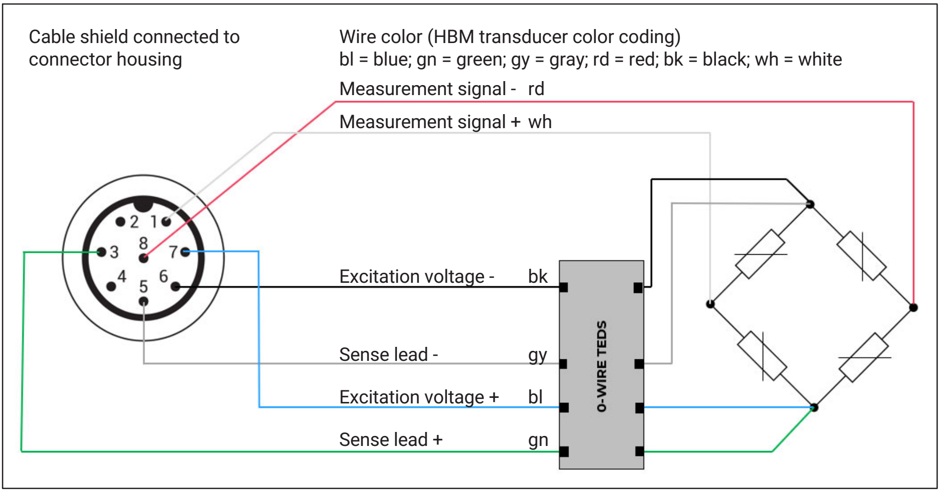


Fig. 5.5 Electrical connection, 6-wire configuration of a strain gauge sensor and 0-wire TEDS module (generic view)

Tip

HBK offers a range of strain gauge based force transducers with integrated 0-wire TEDS. This option is available for the following force transducer families via the configurable K-Mat variants: U10M, C10, U10F, C6B, U93A, C2, U2, Z30A, U15 and C15.

Information

The channel settings for TEDS detection and functionality can be made in the digiBOX web server – see chapter 10.1.7 "TEDS functionality", page 68.

Tip

HBK also offers various 0-wire TEDS boards (1-TEDS-BOARD-L, 1-TEDS-BOARD-HD15). With the 1-TEDS-BOARD-HD15, 0-wire TEDS can be integrated via SUBHD15 plug connectors. This makes it possible to equip force transducers from the S2M, S9M, U9C, C9C and MCS10 series with 0-wire TEDS. You will find the specific product and connection information at https://www.hbkworld.com/en/products/instruments/industrial-electronics/accessories/teds.

5.1.4 Strain gauge full bridge in 4-wire configuration

Strain gauge sensors in 4-wire configuration are connected by bridging the sense leads at the channel input.

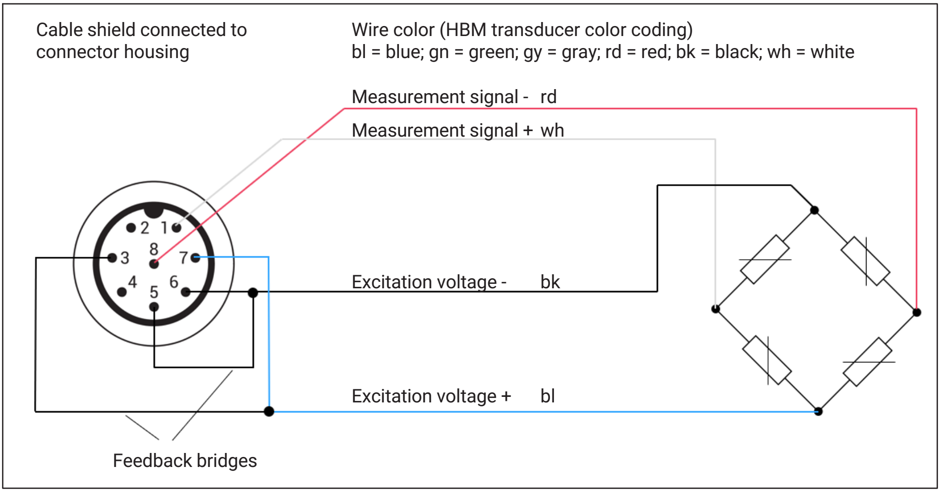


Fig. 5.6 Electrical connection, 4-wire configuration of a strain gauge sensor with feedback bridges

Important

If you connect a strain gauge sensor in a 4-wire configuration, it is essential that you bridge the "sense lead +" with the "supply voltage +" (pins 7-3) and the "sense lead -" with the "supply voltage -" (pins 6-5), for example by using jumpers or feedback bridges on the sensor or in the plug, otherwise the measurement channel will be overloaded.

Information

If you extend the connection cable, do it in a 6-wire configuration, and lay the cable shields flat on the plug enclosure.

5.1.5 Strain gauge full bridge in 4-wire configuration with TEDS

The digiBOX supports the connection of 0-wire and 1-wire TEDS modules for each strain gauge input, including for strain gauge sensors with a 4-wire connection.

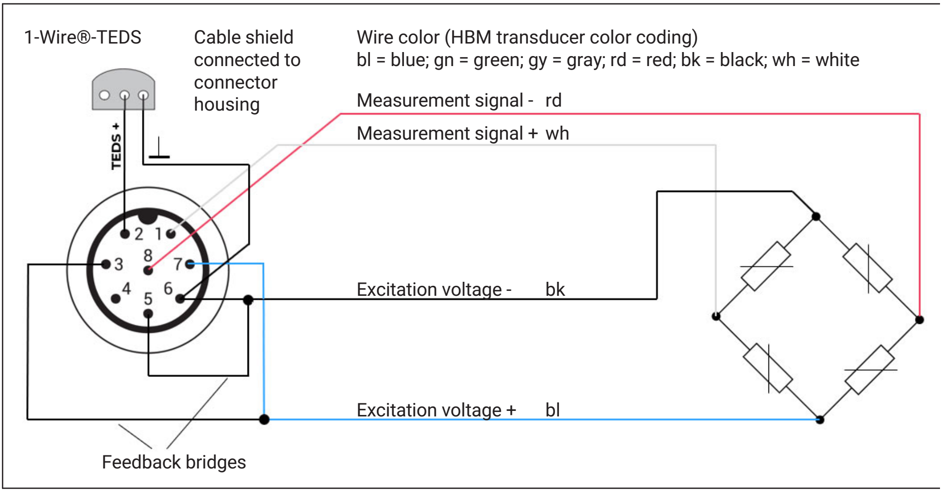


Fig. 5.7 Electrical connection, 4-wire configuration of a strain gauge sensor with feedback bridges and 1-wire TEDS module (1-TEDS-PAK), view from below (solder side)

Strain gauge connection in 4-wire configuration with 0-wire TEDS

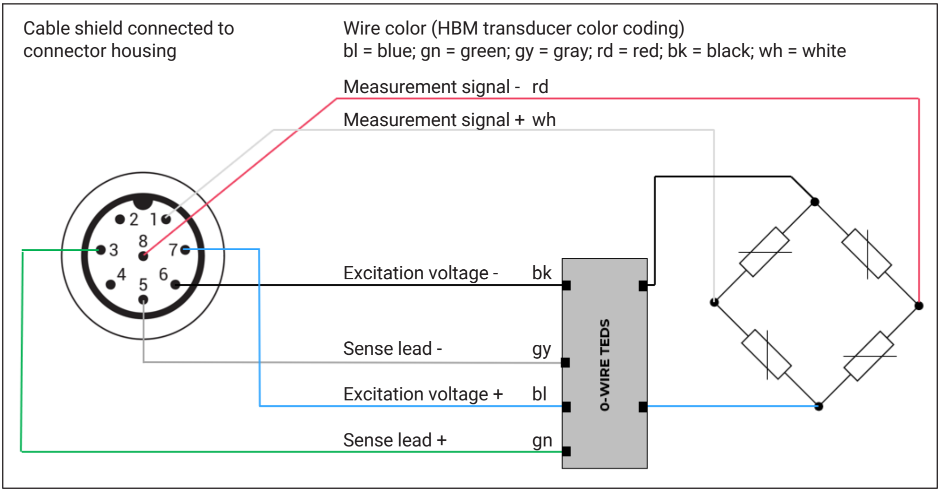


Fig. 5.8 Electrical connection, 4-wire configuration of a strain gauge sensor and 0-wire TEDS module

Information

The channel settings for TEDS detection and functionality can be made in the digiBOX web server – see chapter 10.1.7 "TEDS functionality", page 68.

Tip

HBK also offers various 0-wire TEDS boards (1-TEDS-BOARD-L, 1-TEDS-BOARD-HD15). The bridging of the two 0-wire TEDS modules 1-TEDS-BOARD-L and 1-TEDS-BOARD-HD15 is realized by jumpers on the circuit boards. You will find the specific product and connection information at https://www.hbkworld.com/en/products/instruments/industrial-electronics/accessories/teds

5.2 Piezo charge input

Piezo sensors are connected to the digiBOX via a 10-32 UNF Microdot socket.

Piezo connection	Pin	Description
	Central pin	Internal contact for signal transmission (charge)
	Outer sleeve	Ground contact, used for shielding
Connector socket	10-31 UNF, Microdot (female)	

Fig. 5.9 digiBOX Industrial piezo connector plug 10-32 UNF Microdot

Only one sensor can be connected to a socket. Up to four piezo sensors can be connected to one connection via a summing box (1-CSB4/1) in parallel mode. When using a summing box, the charges of the individual sensors are added together. The summing box can be procured as a connection accessory – *see chapter 21 "Accessories", page 179.*

Important

Observe the maximum tightening torque of 1.5 Nm for the 10-32 UNF socket.

5.2.1 Notes on connecting piezoelectric sensors

Piezoelectric sensors consist of quartz crystal elements (quartz, gallium phosphate), and are based on the piezoelectric principle. The quartz crystal elements are pre-stressed either by a housing (e.g. CFT/CFT+, CST) or as measuring rings in the mounting scenario (CLP, CFW, CHW, CSW). If compressive forces are applied to the quartz or gallium phosphate measuring elements via the pre-stressed force application surfaces, the charges are separated proportional to the force applied.

Important

Once fitted, the cable should remain connected. Close off unused connections on the digiBOX with protective caps. They are available as digiBox accessory. The cables should also be laid vibration-free.
If required, the plug connector contacts should be cleaned with a clean, lint-free cloth and a cleaning agent (pure isopropanol). The cleaning agent RMS1 from HBK is not suitable for cleaning 10-32 UNF plugs and sockets.

To ensure zero-drift signal transmission, it must be ensured that the sensor and cable connections, and the amplifier's connector sockets, are clean. Do not touch or handle the connection elements (plug face/pins) with your fingers. No conductive dust may accumulate to create an electrical connection is between the housing and the plug. Damp and dirt will impair insulation. This can lead to increased drift and incorrect measurement results.

An indicator of inadequate insulation resistance is a positive or negative signal drift of the nominal output span in the unloaded state that exceeds the drift specified in the data sheet.

Information

The digiBOX has IP67 equipment protection rating. Strain gauge connection IP67; piezo connection IP65, in each case with connected plugs or protective caps (see Accessories).

5.2.2 Grounding design for piezo sensors

To achieve EMC resistance, the housing of the digiBOX must always be grounded – *see chapter 4.1 "Grounding and shielding design", page 22*.

The piezoelectric measurement chain (sensors, connection cable, charge amplifier) must also be protected against capacitive coupling and interference.

Piezoelectric sensors are usually electroconductively connected to the machine potential via the housing and the force application elements. Unwanted potential equalization currents can be prevented by this grounding measure. The two sensor inputs are electrically interconnected on the piezo input board. The piezo input board is grounded to the housing by capacitive coupling.

Important

When connecting two piezo sensors to one digiBOX piezo input board, the sensors must be connected to the same potential. If this is not possible, the sensors must be electrically insulated in the installation scenario.

5.3 Power supply

The power supply for the digiBOX is connected to the POWER connection. The power supply connector is an M12 plug, 4-pin, T-coded. A 24 VDC (nominal) supply is required. A minimum 10 VDC and maximum 30 VDC are permissible.

Power supply connection	Pin	Description	Color code – power cable 1-KAB2150-1
	1	Supply voltage + (Vsys)	bn
	2	NC	wh
	3	GND	bu
	4	NC	bk
Connector socket	M12, 4-pin, T-coded (male)		

Fig. 5.10 digiBOX Industrial supply voltage connection

5.4 IO port (digital I/Os and Analog Out)

The 4x DIOs and 4x freely scalable analog outputs (± 10 VDC, 4 ... 20 mA, switchable) for conventional process control are connected to the IO. This connector is an M12, 12-pin, A-coded plug.

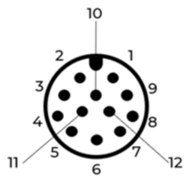
IO port (DIO, Analog Out)	Pin	Description	HBK color code – 1-KAB180-X
	1	Analog Out 1	bn
	2	Analog Out 2	bu
	3	Analog Out 3	wh
	4	DIO 1	gn
	5	DIO 2	pk
	6	GND DIO	ye
	7	DIO 3	bk
	8	DIO 4	gy
	9	Analog Out 4	rd
	10	GND Analog Out	vt
	11	NC	gy/pk
	12	Supply voltage DIO	rd/bu
Connector socket	M12, 12-pin, T-coded (male)		

Fig. 5.11 digiBOX Industrial Analog Out, DIO pin assignment (configuration shown: digiBox-IPC)

Important

A separate DIO power supply (10 ... 30 VDC) is required to operate the digital I/O. This supply voltage must be connected to pin 12 (Supply voltage DIO) and pin 6 (GND DIO).

Information

It is possible to connect a separate ground to the IO port (pin 6, GND DIO).

5.5 Fieldbus connection

The Industrial Ethernet connection for PROFINET and EtherCAT is made via the two ports, P1 IN and P2 OUT. The connectors are M12, 4-pin, D-coded plugs.

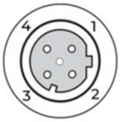
Fieldbus connection	Pin	Description
	1	TX + Transmit
	2	RX + Receive
	3	TX - Transmit
	4	RX - Receive
Connector socket	M12, 4-pin, D-coded (female)	

Fig. 5.12 Fieldbus connection, pin assignment

P1 IN is used for a direct Industrial Ethernet connection (e.g. star topology). To connect further digiBOX devices in a daisy-chain topology, the devices are connected via P2 OUT from the first device to the next device in the chain in P1 IN.

5.6 Ethernet (TCP/IP) connection

The Ethernet (TCP/IP) connection to the digiBOX is made via the ETH connector, which is an M12, 4-pin, D-coded plug.

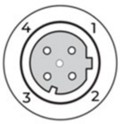
Fieldbus connection	Pin	Description
	1	TX + Transmit
	2	RX + Receive
	3	TX - Transmit
	4	RX - Receive
Connector socket	M12, 4-pin, D-coded (female)	

Fig. 5.13 digiBOX Industrial Ethernet connection pin assignment

6 STARTING UP

6.1 Power-up and operating behavior

The very first time the device is started, the factory parameter set is loaded and enabled (initialization). Thereafter, the last active parameter set is loaded upon initialization. The analog outputs and digital I/Os behave according to the factory parameter set, and are set as follows.

Analog outputs

The analog outputs are disabled according to the factory parameter set.

Digital inputs and outputs

All digital inputs and outputs are set to input mode according to the factory parameter set.

Behavior on device start-up

When the digiBOX is started up, the analog outputs are first initialized. The analog output might operate for a brief moment (a few ms) while this happens, but does not display the true measured value. Depending on the mA or V setting, 0 V or 0 mA may consequently be present at the analog output for a short time. This behavior also occurs if the analog outputs have been disabled according to the parameter set setting.

6.2 Cybersecurity

Only the digiBOX's MQTT protocol is encrypted via TLS. All other protocols are unencrypted (no https). So run the digiBOX only on a secure network with no Internet access, or secure access by suitable firewalls or VPN connections.

6.3 Enabled ports

The following ports must be enabled on the network in order to access the corresponding digiBOX services:

- Website, Streaming: 80 TCP
- UPnP: 1900 UDP
- mDNS: 5353, 5355 UDP
- HBM Device Discovery: 31416, 31417 UDP
- NTP: 123 UDP
- MQTT: any port between 1024 and 49151 TCP

If you have any questions, contact your network administrator.

6.4 IP address assignment

The digiBOX can be accessed in the network via the device's host name or a device IP address. The digiBOX is factory-set to DHCP, so does not initially have a fixed IP address.

The digiBOX offers three configuration options for IP address assignment: DHCP, APIPA, and static IP address assignment.

6.4.1 DHCP (Dynamic Host Configuration Protocol)

The digiBOX is factory-set to DHCP, and acts as a DHCP client in a network. After connecting to a network/switch, the digiBOX waits for the DHCP server to assign it an IP address. If this address assignment does not take place after 45 seconds, such as if the DHCP server is not available, the digiBOX switches to the APIPA protocol for automatic self-assignment of an IP address.

6.4.2 APIPA (Automatic Private IP Addressing)

The APIPA protocol is enabled after a digiBOX timeout of 45 seconds if no IP address has been assigned by a DHCP server. After about 60 seconds, the digiBOX will have set an IP address according to the APIPA protocol. In accordance with the APIPA protocol standard, a network IP address is selected in the address range from 169.254.1.0 to 169.254.254.255. The digiBOX's firmware attempts to implement the following IP address format when an automatic IP address is first assigned by APIPA:

The first two blocks of digits of the IP address correspond to the start of the IP address range according to the APIPA protocol: 169.254.X.X

The last two digit blocks of the IP address are made up of the last two pairs of digits of the digiBOX's unique serial number. The last two pairs of digits of the serial number are in hexadecimal format. Converting the pairs of digits to decimal produces the two numbers of the last two digit blocks.

Example:

digiBOX serial number = 0009E50083AB

The last two pairs of digits in the serial number 83 and AB in the hexadecimal system correspond to 131 and 171 in the decimal system. So according to the APIPA protocol the digiBOX will set the following IP address: 169.254.131.171.

Important

The IP address given in the example is only set by the APIPA protocol if the selected IP address is not already assigned or blocked in the network. It is also possible that the APIPA protocol might have been blocked by your IT administrator. If so, please contact your IT administrator.

Ensure that the following ports are open to use the corresponding digiBOX services:

- Website, Streaming: 80 TCP
- UPnP: 1900 UDP
- mDNS: 5353, 5355 UDP
- HBM Device Discovery: 31416, 31417 UDP
- NTP: 123 UDP
- MQTT: any port between 1024 and 49151 TCP

Tip

The serial number of the digiBOX corresponds to the MAC address of the device.

Example

digiBOX serial number = 0009E50083AB
MAC address: 00:09:E5:00:83:AB

The serial number of the digiBOX can be found on the device's type plate and on its packaging. An example of a digiBOX type plate is shown below.

Fig. 6.1 digiBOX type plate with example serial number

Information

The serial number of the digiBOX is indicated on the device's type plate, as well as on the packing label on its outer packaging, and on the delivery note.

6.4.3 Fixed IP address

The digiBOX can be assigned a static ("Fixed") IP address. The relevant network setting is made in the web server under **Device** → **Network**.

The DHCP option must be disabled for this. Once it has been disabled, an IP address, subnet mask and gateway address can be assigned.

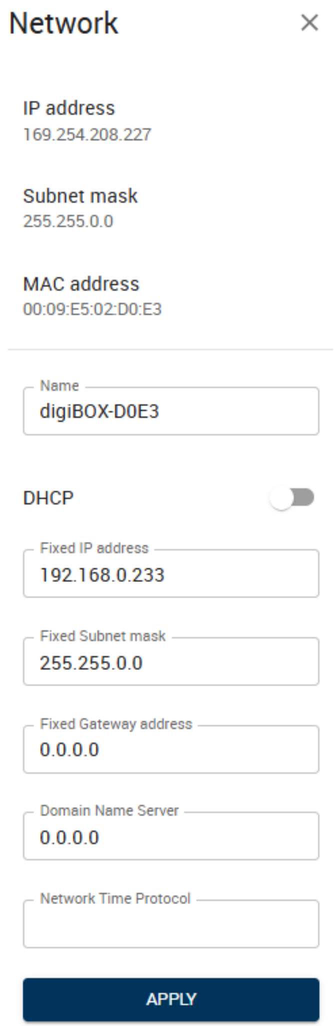


Fig. 6.2 Web server network settings, static IP address

The adjacent screenshot shows the settings for an example static ("Fixed") IP address.

Input of a Domain Name System (DNS) and a Network Time Protocol (NTP) is only relevant if the digiBOX is being used as an MQTT client. You will find more information on this in *chapter 17.2 "MQTT", page 145.*

Tip

A static IP address can also be set using the Device Discovery Tool – see chapter 6.5.4 "Access via Device Discovery Tool", page 42.

Information

The digiBOX only supports IPv4 (Internet Protocol version 4), not IPv6 (Internet Protocol version 6).

6.5 Web server access via Ethernet (TCP/IP)

The web server can be accessed in the network via the device's host name or a device IP address. The digiBOX is factory-set to DHCP, so does not initially have a fixed IP address.

The following access options via the **device host name**, the **Device Discovery Tool** and the **Upnp** protocol are available, and are described in this chapter.

Information

Only one device at a time can access the digiBOX web server via the Ethernet connection.

6.5.1 Access via device host name

The digiBOX can be accessed via the device host name regardless of the connection topology being used (direct connection or network/switch).

The factory default device host name of the digiBOX is in the following syntax: http://digi-box-83ab.local

The characters *83ab* correspond to the last four characters of the device's unique serial number.

Tip

The serial number corresponds to the MAC address of the device. The MAC address always has twelve digits (in six pairs), and always starts with 00:09:E5. The next six digits (three pairs) vary, and are unique to each device.

Example:

digiBOX serial number = 0009E50083AB
MAC address: 00:09:E5:00:83:AB

The serial number of the digiBOX can be found on the device's type plate and on its packaging. An example of a digiBOX type plate is shown below.

Fig. 6.3 digiBOX type plate with example serial number

Information

The device host name is accessed via the mDNS protocol (Bonjour). The multicast IP address and ports for Microsoft and Apple operating systems are as follows:
Microsoft
multicast IP: 224.0.0.251 Port: 5353
Apple
multicast IP: 224.0.0.252 Port: 5355

The device host name is entered in the address bar of the user's own web browser.

Example:

Important

The digiBOX web server does not use https encryption. Please use only http://digiBOX-XXXX.local

The device host name of the digiBOX can be changed in the web server – see Web server chapter.

Important

If the device host name has been changed, and the new device host name is not known, you can access the device via the Device Discovery Tool or using the UPnP protocol, and reset the device host name.

6.5.2 Access via IP address

If the IP address is known, the digiBOX web server can be accessed via the address line in the web browser. This is an example of an address entry: http://169.254.219.47

Fig. 6.4 Web browser IP address entry

6.5.3 Access via UPnP protocol

The UPnP (Universal Plug and Play) network protocol is implemented on the digiBOX, enabling automatic discovery of devices in a network. If network device discovery is enabled in your computer's network settings, the digiBOX is automatically listed as a device in the Windows network view.

Information

When using the UPnP protocol, the displayed device name corresponds to the device host name of the digiBOX.

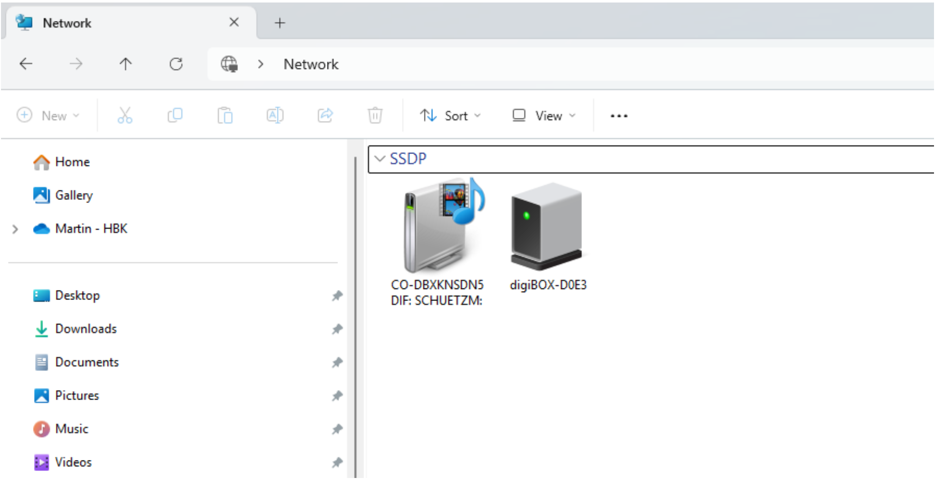


Fig. 6.5 Network device discovery, device display with UPnP

Right-click on the digiBOX device icon to open the web server, create a shortcut icon, and view the device properties. Next to "Model", the K-MAT product configuration is shown, without the letter K identifier, and with no spaces. The "Model number" corresponds to the firmware version. The "Troubleshooting Information" area lists the serial number, MAC address and IP address.

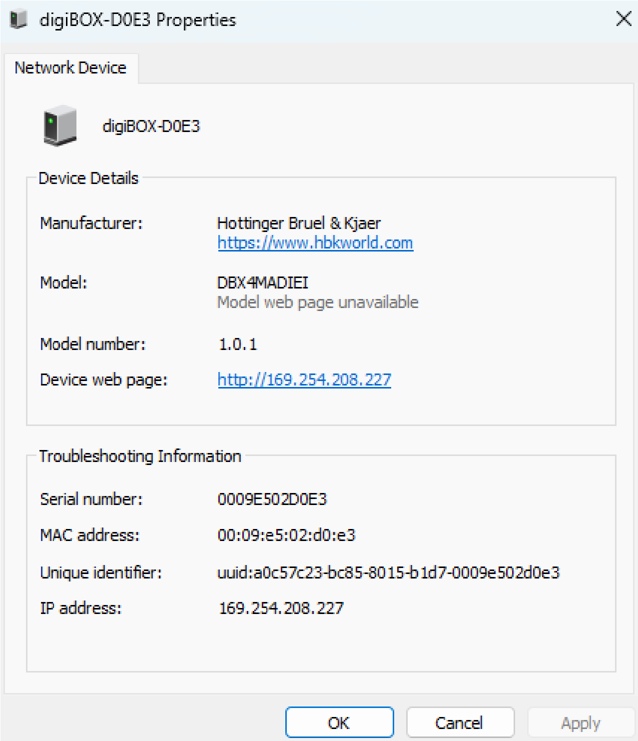


Fig. 6.6 Device properties via UPnP

Tip

If the digiBOX is not displayed in the network discovery, it is possible that device discovery in your network has been disabled by your network administrator. In that case, please contact your IT department.

6.5.4 Access via Device Discovery Tool

HBK offers a downloadable Device Discovery Tool which can be used to manage device access to the digiBOX.

Download the Device Discovery Tool from www.hbkworld.com/digibox-industrial.

The Device Discovery Tool is a Java application. The Device Discovery Tool requires an up-to-date Java Runtime Environment installation on the computer being used. You can download the Java Runtime Environment from https://www.java.com/.

The Device Discovery Tool scans the network for connected HBK signal conditioners. The screenshot below shows a functional overview of the Device Discovery Tool.

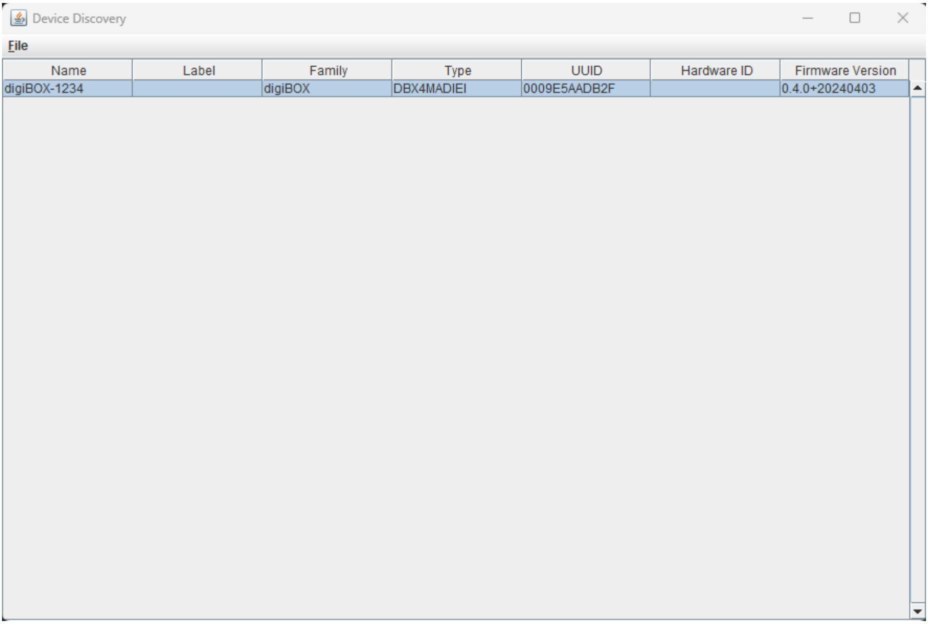


Fig. 6.7 Device Discovery Tool overview

The **Name** tab displays the current set device host name of the digiBOX. **Type** shows the K-MAT product configuration, without the letter K identifier, and with no spaces. **UUID** shows the device's MAC address, which is also its serial number.

Right-click on the device name to open the web server.

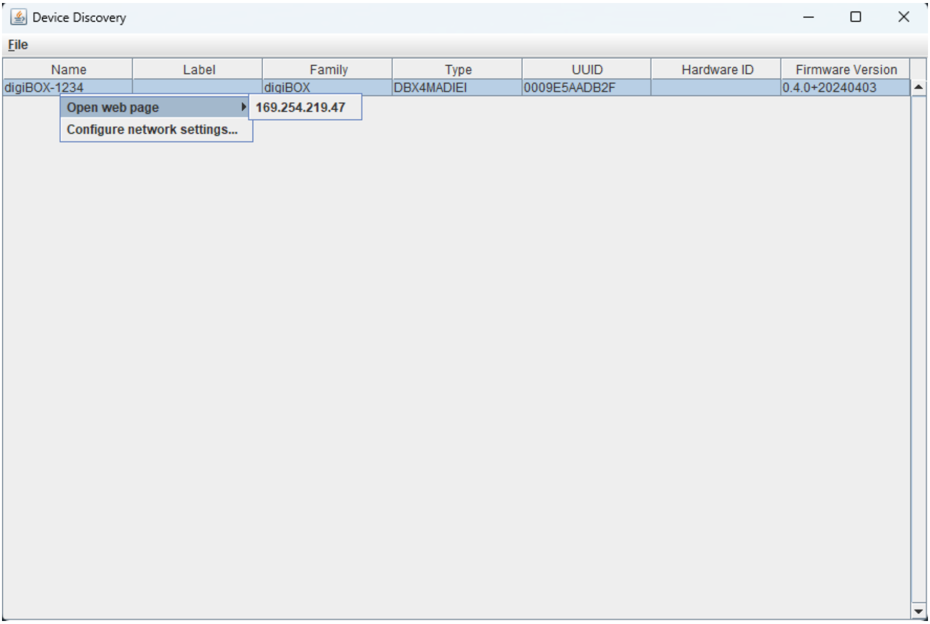


Fig. 6.8 Device Discovery Tool / Web server access

Click on **Configure network settings** to make the IP address settings. You can either set DHCP or assign a static IP address.

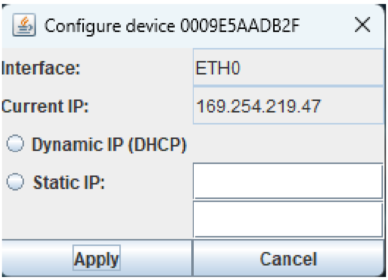


Fig. 6.9 Device Discovery Tool / IP address settings

6.6 No device found?

If you cannot connect to the digiBOX, this may be due to several possible causes. Please check the following possible causes of errors.

- Is the Ethernet connection cable attached to the correct digiBOX port (ETH label)?
- Are all cables correctly connected and screwed tight?

- Is the power turned on, within the specified voltage range, and not current-limited?
- Is the SYS LED on the digiBOX lit green?
- Is the LINK LED on the digiBOX lit (on or flashing)?
- Is at least one of the LEDs in the network port on your PC lit?
- Have you enabled the correct interface or correct interface adapter on the PC?
- If your PC has multiple Ethernet ports, try disabling all the other Ethernet ports.
- If a WLAN is also active with your PC, test whether the device is found when you switch off the WLAN for the duration of the scan. With some WLAN configurations, problems can occur if multiple Ethernet ports are enabled.
- If you are using the device in a large network, contact your network administrator. There are a range of options in managed networks to limit or completely prevent data transmission between the individual nodes. Administrator permissions may be required here.
- When making a 1:1 connection between the PC and digiBOX, wait 60 seconds until both devices have received their APIPA address in the 169.254.X.X range, then try to connect via the APIPA address.
- If the digiBOX is set to a fixed IP address and it is not known, use the HBK Device Discovery Tool to scan the network on existing digiBOXes. This can be used to set the IP address or DHCP.
- The following ports must be enabled on the network in order to access the corresponding digiBOX services:
  - Website, Streaming: 80 TCP
  - UPnP: 1900 UDP
  - mDNS: 5353, 5355 UDP
  - HBM Device Discovery: 31416, 31417 UDP
  - NTP: 123 UDP
  - MQTT: any port between 1024 and 49151 TCP

7 DIGIBOX WEB SERVER (DEFAULT SETTINGS)

Full parameterization of the device is carried out in the digiBOX web server. This chapter describes the layout and default settings of the web server. The chapter content is divided into the following sections:

- Home screen
- Device
- Parameter sets
- Device storage

The other areas of the web server are described in the relevant chapters based on the sensor parameterization and settings of the individual functions:

- Amplifiers – *see chapter 10 "Strain gauge signal processing, parameterization", page 59*
- Peak values, capture values, limit switches – *see chapter 12 "Statistical and calculation functions", page 88*
- Summation channel - *see chapter 12.4.1 "Summation channel", page 101*
- Digital I/O – *see chapter 13.1 "Digital I/Os", page 108*
- Analog output – *see chapter 13.2 "Analog output", page 113*
- Fieldbus – *see chapter 14 "Fieldbus (Industrial Ethernet)", page 117*
- User flags – *see chapter 15 "Flag actions", page 136*
- MQTT – *see chapter 17.2 "MQTT", page 145*
- openDAQ - *see chapter 17.3 "openDAQ", page 151*
- PTP - *see chapter 17.4 “PTP synchronization", page 153*

7.1 Home screen

The digiBOX home screen and its visualization elements are on permanent display, regardless of the selected submenu, in the sidebar. The digiBOX home screen is shown below.

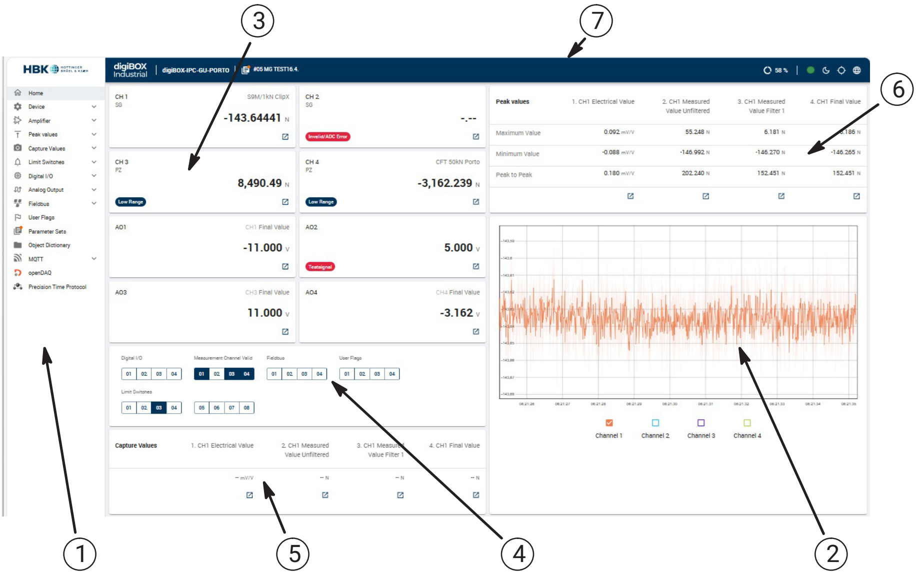


Fig. 7.1 digiBOX web server GUI, general layout, overview

The main elements of the home screen are:

- Sidebar (1)
- Chart recorder (2)
- Overview of measurement channels and Analog Out (3)
- Overview of flag actions (4)
- Overview of capture values (5)
- Overview of peak values (6)
- Header (7)

Various submenus can be selected in the **sidebar** (1).
The signals for each selected channel are displayed in the **chart recorder** (2). The final value from the selected signal chain is always displayed. The digiBOX streams measurement data at a 40kS/s sample rate per measurement channel to visualize the chart recorder.

The lighter line visualizes the maximum and minimum values. The line in bold represents the average values. The chart recorder has an auto-scaling function that adjusts to the current measured values within the time window.

An overview of the input channels and analog outputs is shown in the top left area (**Overview of measurement channels and Analog Out** (3)). The current measurement signal for each input channel is displayed according to the unit selected in the channel settings and the underlying source signal. The **channel status** for each measurement channel is also displayed at the bottom left. The corresponding channel status objects from the object dictionary are listed in *chapter 18.3 "System and device status", page 157*. The analog outputs display the respective output voltage or output current according to the set scaling. A shortcut icon can be used to go directly to the respective channel and analog output settings.

Below the channel and analog output displays is an **overview of flag actions** (4) for digital I/O, measurement channel status, fieldbus flags, user flags, and of the limit switches. These flags can be used to trigger or initiate various statistical and measurement channel functions. The flag action functions are explained in *chapter 15 "Flag actions", page 136*.

The statistical functions such as peak values (maximum value, peak-to-peak, minimum value) and capture values are on permanent display at the top right (**Overview of peak values** (6)) or (**Overview of capture values** (5)). A shortcut icon below the displayed values can be used to go directly to the settings of the respective statistical functions in the submenu.

The current processor load and the status of the SYS LED are shown in the top right area of the **header** (7). The displayed **status of the SYS LED** in the web server corresponds to the SYS LED display status on the device. Additionally, the view can be switched between a **Dark Mode** and a bright **Standard Mode**. The device LEDs can also be set to a flashing mode to identify the devices.

The web server language can be switched between **German and English in the header**. The currently set device host name is displayed at the top left in the header. **The parameter set icon** is displayed with a yellow dot if settings have been made in the web server that have not yet been saved as a parameter set. If the device is disconnected or the power is cut, any parameter settings that have been made up to then and have not been saved as a parameter set will be lost.

7.2 Device settings

On the left side of the home screen is the sidebar with the tabs for setting the specific device functions. The downward-pointing arrows indicate dropdown menus containing further submenus. The home screen elements remain on permanent display regardless of which submenu you navigate to via the sidebar.

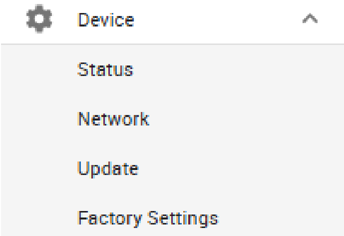


Fig. 7.2 Device submenu

In the drop down menu **Device** tab, you can view and make specific settings relating to the device status, network settings, device firmware updates, as well as resetting the device to its default factory settings.

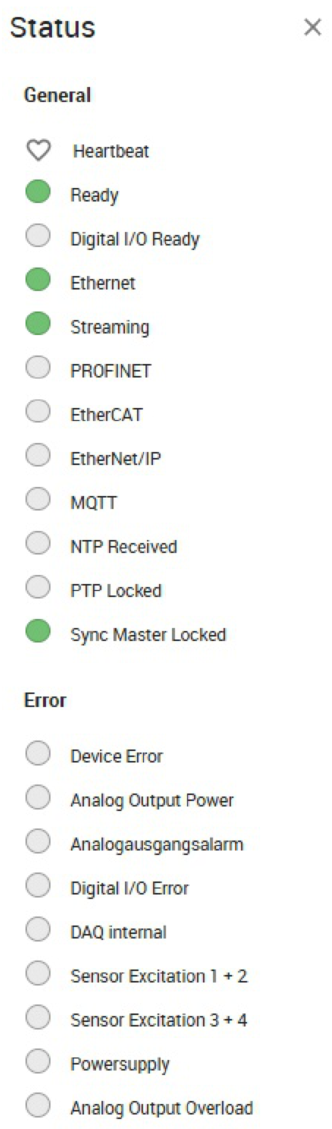


Fig. 7.3 Web server; Status – General / Error

7.2.1 Device and error status

The **Device → Status** submenu indicates the current status of various device functions, including the channel inputs and device outputs, as well as listing various device errors.

Descriptions of the specific status and error information items are set out in the following two tables. The corresponding objects for reading from the object dictionary are described in *chapter 18.3 "System and device status", page 157*.

Status – General	Description
Heartbeat	Flashes to indicate the device is working.
Ready	Switches on after initialization is complete.
DIO Ready	Digital I/O are activated, and the separate power supply (V+DIO) for the digital I/O is connected
Ethernet	Ethernet link is present on the Ethernet port (TCPIP), including with web server connection
Streaming	Streaming connection is open
PROFINET	A PROFINET Application has been set up
EtherCAT	EtherCAT AL state is beyond INIT
EtherNet/IP™	An EtherNet/IP™ connection is active
MQTT	An MQTT connection has been made
NTP received	A time query via NTP has been made
PTP synchronizing	Synchronization via PTP completed
Measured value synchronizing	Synchronization via internal clock or fieldbus completed

Tab. 7.1 Web server; Status – General, descriptions

Error status	Description
Device error	Group error for all of the individual errors
Analog output power	Incorrect analog supply voltage, indicating a device hardware fault (send device in to be checked).
Analog output alarm	Alarm at the analog output, e.g. short circuit at the voltage output or open circuit at the current output or overheating; check wiring and settings!
Digital I/O error	Faulty digital input or output, e.g. short circuit or overheating; check wiring and settings!
DAQ Internal	Internal error (send device in to be checked).
Sensor excitation CH1 + CH2	Incorrect bridge excitation voltage on channel 1 and channel 2 (SG only), possibly caused by defective sensor or incorrect wiring
Sensor excitation CH3 + CH4	Incorrect bridge excitation voltage on channel 3 and channel 4 (SG only), possibly caused by defective sensor or incorrect wiring

Error status	Description
Power supply	digiBOX supply voltage outside the nominal range (too high or too low)
Analog output overload	Protection of the analog output activated. The analog output is therefore no longer operational; check wiring!

Tab. 7.2 Web server; Error status, descriptions

Important

An error (red) on the DIO and analog output is shown as soon as the error is detected on a single DIO or analog output. The other DIOs and analog outputs are not necessarily affected in this case.

7.2.2 Network settings

The IP address of the digiBOX can be set in the **Device → Network** submenu. The current set IP address, subnet mask and MAC address are displayed at the top. In the **Name** box you can change the device host name of the digiBOX.

The digiBOX's default setting is DHCP – *see chapter 6.4.1 "DHCP (Dynamic Host Configuration Protocol)", page 36*. If the DHCP setting is enabled, the settings for a static ("Fixed") IP address are grayed out. The settings for a static IP address are explained in *chapter 6.4.3 "Fixed IP address", page 37*.

Important

When a static IP address is set, the browser loses its connection to the web server. The web server can be accessed again using the device host name or the previously set static IP address.

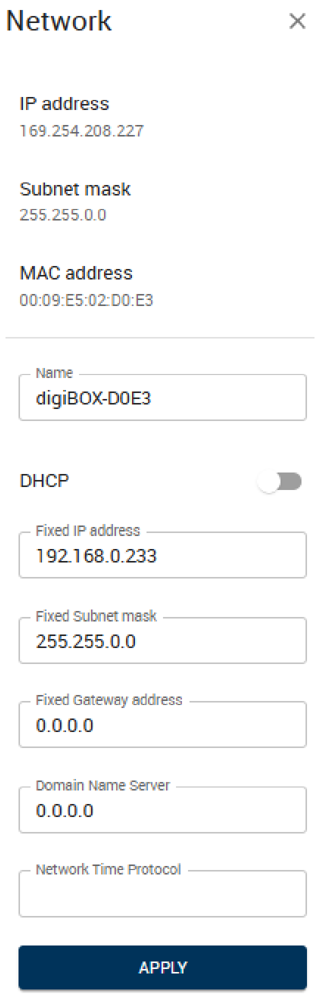


Fig. 7.4 Network settings

7.2.3 Firmware update

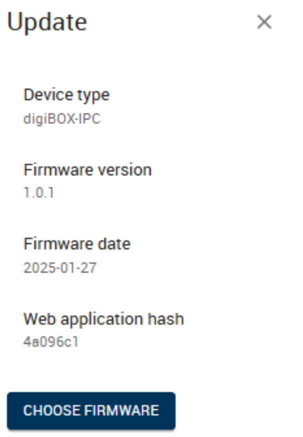


Fig. 7.5 Firmware update

The digiBOX firmware can be updated in the **Device** → **Update** submenu. The status and release date of the currently installed firmware are displayed under "Firmware version" and "Firmware date". "Web application hash" describes the version status of the web server application. Click on the **Choose firmware** button to install new firmware on the digiBOX.

Information

The latest firmware update for the digiBOX is available to download from the digiBOX product page (www-hbkworld.com/digibox-industria). Using the configurable K-Mat structure, the digi-BOX can be ordered with all previously released firmware versions.

7.2.4 Factory settings

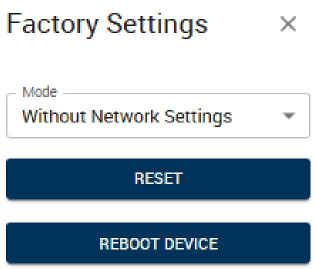


Fig. 7.6 Reset to factory default settings

In the **Device** → **Factory Settings** submenu the digiBOX can be reset to its default settings. In the **Mode** dropdown box you can choose whether to also reset the network settings to their defaults when you click **Reset**. If you choose to reset including the network settings, the digiBOX will be set to DHCP. The device host name will also be reset to its default setting. If you reset without including the network settings, the current set device host name and the accompanying IP settings will be retained.

If you click **Reboot device**, the device will be restarted. The connection to the device is temporarily interrupted for this purpose.

7.3 Object dictionary (web server)

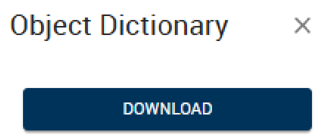


Fig. 7.7 Download object dictionary

Choose **Object Dictionary** to download the digiBOX object dictionary. A list of objects requiring explanation, and descriptions of them, can be found in *chapter 18 "Object dictionary", page 154*.

8 SIGNAL CHAIN AND INTERFACES

The signal chain shown corresponds to a K-DBX-4M variant with two strain gauge and two piezo charge inputs.

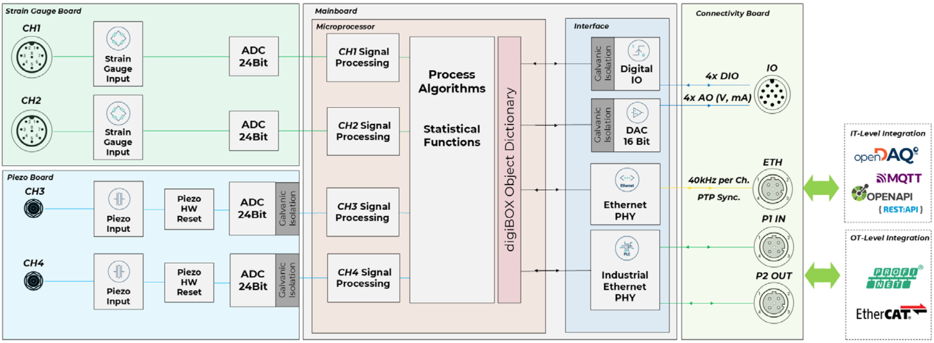


Fig. 8.1 digiBOX Industrial signal chain, variant K-DBX-4M

Strain gauge input

The two strain gauge inputs are located on a strain gauge input board, which has a full bridge amplifier and a 24-bit A/D converter for each channel. The digiBOX K-DBX-2S variant has only one strain gauge input board, while the K-DBX-4S has two.

Piezo charge input

The two piezo inputs are located on a piezo input board, which uses a charge amplifier with two range capacitors and hardware reset function as well as a 24-bit A/D converter for each channel. The piezo input board is galvanically isolated from the digiBOX mainboard. The digiBOX K-DBX-2P variant has only one piezo input board, while the K-DBX-4P has two.

Microprocessor

Regardless of the digiBOX configuration used, the measurement signals of the strain gauge and piezo inputs are recorded synchronously at 40 kS/s, and made available for further processing in the microprocessor. The linearization, scaling and sensitivity settings of the sensor types used are available for signal conditioning. Based on the individual source signals of the respective strain gauge and piezo signal chains, the microprocessor can perform various statistical functions and calculations, as detailed in *chapter 12 "Statistical and calculation functions", page 88*. The statistical functions are calculated at an update rate of 25 µs per sample.

Interface

The processed signals are made available to the various interfaces for output. 4x digital I/O and 4x analog outputs are available for conventional process control. The update rate of the analog outputs and the digital I/Os is 10 kHz. Individual process algorithms and statistical functions can also be controlled via the digital inputs. The digital I/Os and the analog output are galvanically isolated from each other and from the mainboard.

There is also a dedicated Ethernet port for TCP/IP-based protocols, for IT-level connectivity. The implemented openDAQ protocol enables device searching and a streaming function at a 40 kS/s sample rate per channel. You will find more information on the openDAQ protocol in *chapter 17.3 "openDAQ", page 151*. The MQTT and openAPI (Rest:API) protocols can be used to read and write to the objects (device functions) in the digiBOX object dictionary.

Two Industrial Ethernet ports for direct connection and daisy-chaining are available for connecting to the control level.

You will find the specific protocol descriptions in *chapter 17 „Ethernet protocols (TCP/IP)", page 144* and *chapter 14 „Fieldbus (Industrial Ethernet)", page 117*.

Object dictionary

The digiBOX's object dictionary describes the collection of data objects that are used to read and/or write to various functions, parameters, calculation results and items of measurement data. The individual source signals of the signal chains and calculation results in the statistical functions can also be read out by the object dictionary. Protocol mapping, handled by the respective protocol stacks, translates the object dictionary into the corresponding IT and OT application protocols.

You will find a list of the key objects, with functional descriptions, in *chapter 18 "Object dictionary", page 154*

Information

A device-specific object dictionary for the respective K-DBX variant can be downloaded via the web server on the "Device Storage" tab – see chapter 18 "Object dictionary", page 154.

Tip

All setting options from the digiBOX web server are mapped as individual objects in the object dictionary, and can be read and written by the implemented IT and OT protocols.

9 MEASURED VALUE SYNCHRONIZATION

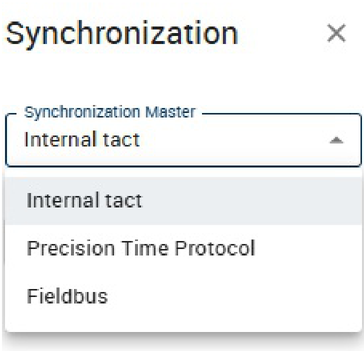


Fig. 9.1 Synchronization menu

The measured values of the digiBOX are all recorded at the same time (synchronous sample) at 40 kS/s and with a jitter of <1 µs. The synchronization method can be set in the **Amplifier -> Synchronization** menu.

- Internal clock: the synchronization interval is set by the internal digiBOX clock (factory setting)
- PTP: A PTP master clock controls the synchronization (e.g. GPS signal). The Ethernet transmission parameters are set in the PTP menu.
- Fieldbus: the fieldbus master controls the synchronization (e.g. distributed clocks on EtherCAT controls)

10.1 Strain gauge signal chain

Only strain gauge full-bridge transducers in 4- and 6-wire configurations can be connected to the digiBOX strain gauge input. The strain gauge signal chain is shown below:

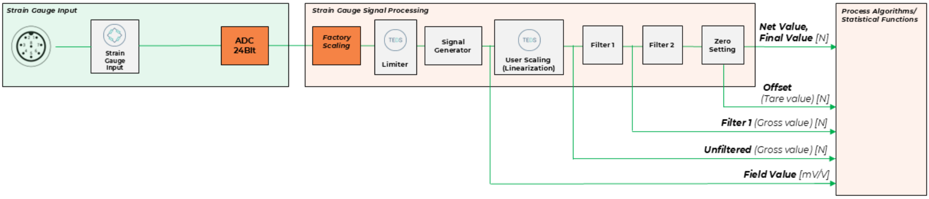


Fig. 10.1 Strain gauge signal chain, function blocks and source signals

10.1.1 Source signals of the strain gauge signal chain

Various source signals from the signal chain are available for calculating the statistical functions and for output via the various device interfaces:

Field value

The field value is outputted in the electrical unit mV/V, and corresponds to the measured value after factory calibration, i.e. prior to user scaling. Where a signal generator is used, this signal is outputted as a field value.

Unfiltered

The unfiltered signal represents the measurement signal (gross value) according to the custom scaling setting (table, polynomial) and pre-set unit.

Filter 1

The Filter 1 value corresponds to the measurement signal (gross value) after custom scaling and the first filter stage.

Filter 2 and final measured value

The final measured value in the signal chain is the one generated by zeroing after filter level 2 following the subtraction or addition of the zero value.

Below is a table of the corresponding source signals from the object dictionary of the strain gauge signal chain.

Offset (zero value)

The offset or zero value corresponds to the difference in amount between the measurement result prior to zeroing (zero value setting) and the value zero, and is a static result.

Object dictionary – strain gauge channel source signals					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
CH1-2 Field value	0x2014	01 .. 02	FLOAT	RO	Field value of the corresponding strain gauge channel 1-2
CH3-4 Field value	0x2015	01 .. 02	FLOAT	RO	Field value of the corresponding strain gauge channel 3-4
CH1-2 Process value unfiltered	0x2016	01 .. 02	FLOAT	RO	Unfiltered process value of the corresponding piezo channel 1-2 after user scaling
CH3-4 Process value unfiltered	0x2017	01 .. 02	FLOAT	RO	Unfiltered process value of the corresponding piezo channel 3-4 after user scaling
CH1-2 Process value Filter 1	0x2018	01 ... 02	FLOAT	RO	Process value after filter stage 1 (gross value) of the corresponding strain gauge channel 1-2
CH3-4 Process value Filter 1	0x2019	01 ... 02	FLOAT	RO	Process value after filter stage 1 (gross value) of the corresponding strain gauge channel 3-4
CH1-2 Zeroing net value	0x201C	01 .. 02	FLOAT	RO	Offset value of the corresponding strain gauge channel 1-2
CH3-4 Zeroing net value	0x201D	01 .. 02	FLOAT	RO	Offset value of the corresponding strain gauge channel 3-4
CH1-2 Final value	0x201E	01 .. 02	FLOAT	RO	Final value after filter stage 2 for channel 1-2 and after zeroing.
CH3-4 Final value	0x201F	01 .. 02	FLOAT	RO	Final value after filter stage 2 for channel 3-4 and after zeroing.

10.1.2 Factory calibration, sensor limits and signal generator

After digitization of the measured values by the 24-bit ADC, the values are available as digits, i.e. as dimensionless unscaled values. In the digiBOX manufacturing process, the strain gauge inputs are calibrated **(Factory Scaling)** in mV/V, and the results are stored in the device. The device's factory calibration (scaling) cannot be changed by the customer.

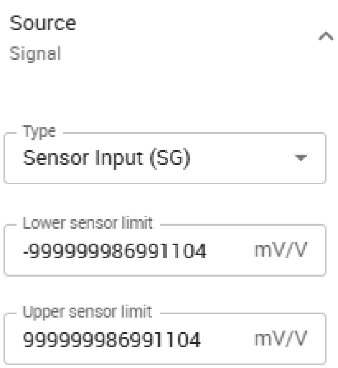


Fig. 10.2 Sensor limit function, strain gauge signal chain

There is a sensor limit block in the strain gauge signal chain which can be used to set custom lower and upper sensor limits in mV/V. In the web server, the sensor limit block is written to via the sidebar in the submenu under **Amplifier** → **Channel** → **Source**. The sensor limit setting for strain gauge sensors relates to the factory calibration for the field value in mV/V, not to the user scaling. If the set limit is exceeded, the measured value is invalidated, and set numerically to the limit.

Important

The sensor limits are only displayed if the signal type is set to Sensor input (strain gauge). If the measurement signal falls outside these limits, the measured value is displayed as "Overload" or "Underload", and the corresponding channel LED on the digiBOX flashes yellow.
For a piezo channel, "Invalid" is displayed if the measurement range is exceeded, and the corresponding channel LED on the digiBOX lights up red.
If a 0-Wire or 1-Wire TEDS is connected to the strain gage input, the sensor limits stored in the TEDS are read, and the digiBOX saves them.

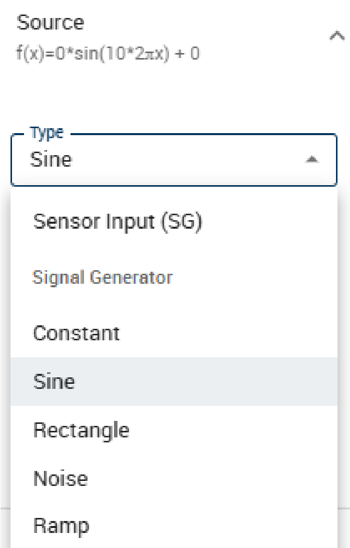


Fig. 10.3 Selection of test signals, signal generator

The sensor limit block is followed by a signal generator that can be used for test purposes. The signal generator is set in the digiBOX web server submenu under **Amplifier** → **Channel** → **Source**. Various signal forms are available (Constant, Sine, Rectangle, Noise, Ramp), with the respective settings for the associated signal characteristic.

10.1.3 Measurement channel parameterization of the strain gauge sensors

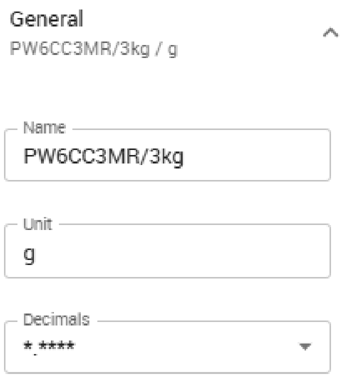


Fig. 10.4 General channel settings – strain gauge input

Once the strain gauge sensor has been connected to the digiBOX, it can be parameterized on the corresponding channel on the **Amplifier → Channel** tab. First, under **Amplifier → Channel → General** set the sensor name, the unit of measurement, and the number of decimal places to be displayed.

Information

The setting of the displayed decimal places is only relevant for the display in the web server. All of the values are usually calculated and output with full resolution.

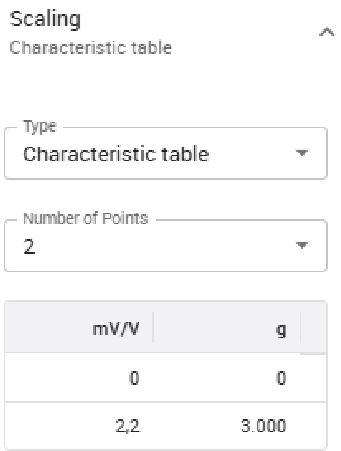


Fig. 10.5 Example of strain gauge measurement channel scaling with set two-point scaling

In the next step, the scaling of the connected strain gauge sensor must be entered. Under **Amplifier → Channel → Scaling** you can enter the sensitivity (rated output) and values from a test record or sensor calibration certificate. It is possible to store a characteristic table with up to 21 interpolation points, a polynomial function, or polynomial functions for both tension and compression or the positive and negative directions of a characteristic curve.

Information

If a sensor with 0-WIRE or 1-wire TEDS and a stored sensor scaling is connected, the scaling can be read out automatically. Automatic readout of TEDS information depends on the TEDS function setting for the channel concerned – see *chapter 10.1.7 "TEDS functionality", page 68.*

10.1.4 Calibrating the strain gauge sensor channel using Teach-In mode

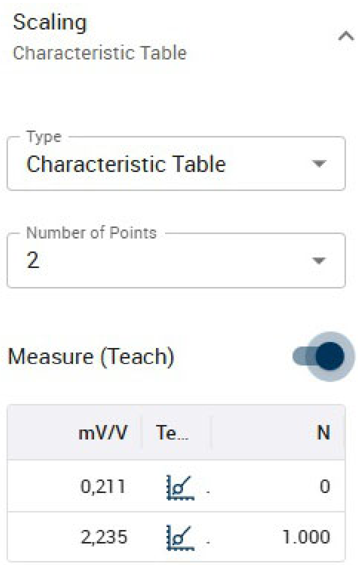


Fig. 10.6 Teach-In

Calibration (Teach-In) mode enables the applied field values (mV/V) of the measurement channel to be transferred directly into the line in the characteristic table by pressing the button. The size of the characteristic table can be set from two (2-point scaling) to 21 points.

Enter the physical value (e.g. in N) and load the sensor before calibrating the characteristic curve point accordingly. Repeat this process while applying the corresponding load to the sensor until all of the characteristic curve points in your characteristic table have been recorded.

By clicking the **APPLY** button, the scaling is then transferred and applied in the device.

10.1.5 Display of the field value/electric measured value (mV/V)

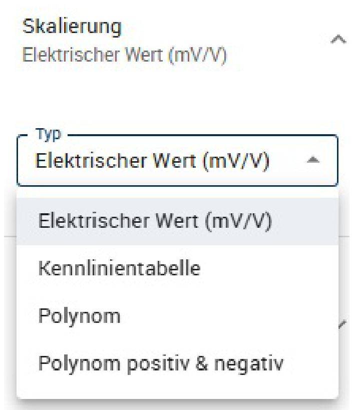


Fig. 10.7 Field value

The electric measured value of the measurement channel can be displayed directly by switching the scaling to **Electric value (mV/V)**.

Information

While the electrical measured value is displayed, measured value scaling is disabled, as are the derived values of the measurement channel (e.g. limit values, peak values,...).

10.1.6 Signal processing (filters, zeroing)

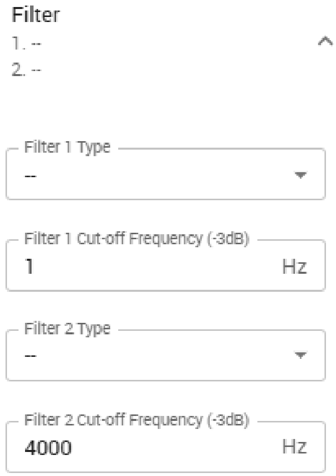


Fig. 10.8 Strain gauge signal chain filter settings

Two digital filter stages, cascaded in series according to the signal chain, are available for each strain gauge measurement channel. The filter settings are made under **Amplifier** → **Channel** → **Filter**.

A Bessel or Butterworth high-pass or low-pass filter can be selected for each filter stage. The following filter frequencies are available:

Bessel low-pass filter =	0.1 Hz - 4000 Hz
Butterworth low-pass filter =	0.1 Hz – 4000 Hz
Bessel high-pass filter =	0.1 Hz – 100 Hz
Butterworth high-pass filter =	0.1 Hz – 100 Hz

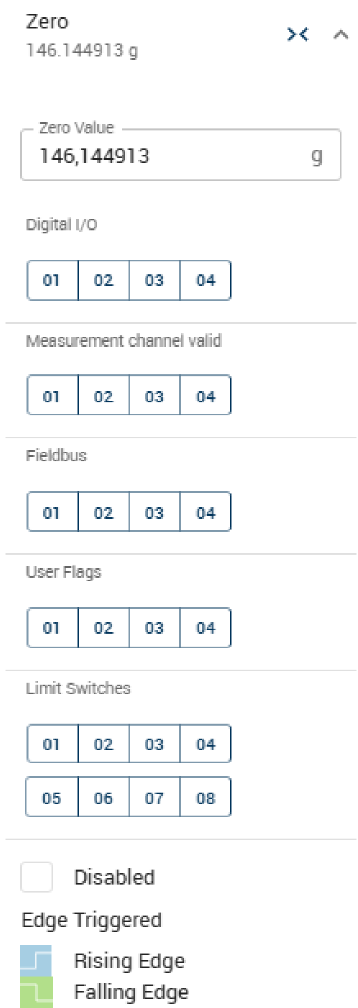


Fig. 10.9 Strain gauge signal chain, zeroing, and source signals to trigger zeroing

The last element in the strain gauge signal chain is the **Zero** function. This zeroing can be triggered directly in the web server under **Amplifier** → **Channel** → **Zero** by a switch, or using the flags shown in the adjacent screenshot here.

Zeroing sets the current measurement signal to zero. It is also possible to enter a user-defined zero, or offset, value in the **Zero Value** input box.

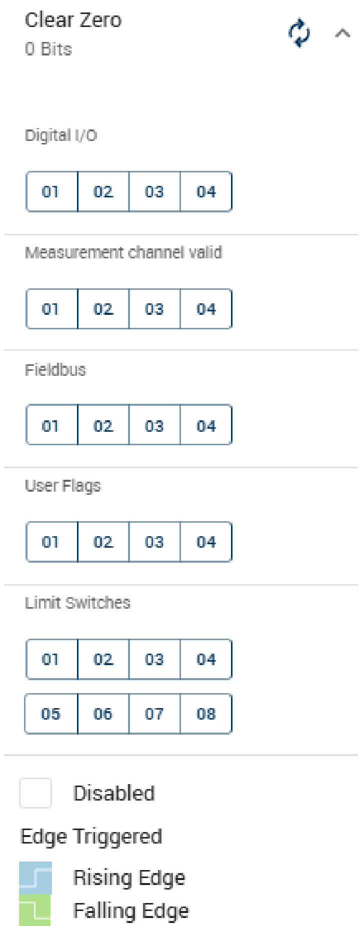


Fig. 10.10 Clear zero

The measured value at the point of zeroing is saved as a zero value, or offset, and can also be cleared in the web server by a switch, or by setting the corresponding flags under **Amplifier → Channel → Clear Zero**.

Zeroing and resetting of the zero value can be triggered by flag actions, or by writing to the corresponding objects. You will find more information on triggering by flags in *chapter 15 "Flag actions", page 136*.

Zeroing and resetting of the zero value by flag actions is edge-controlled. If you click to select it once, the action will be triggered on a rising edge. If you click to select it twice, the action will be triggered on a falling edge.

Important

It is possible to trigger zeroing and resetting of the zero value by multiple flag signals. In this case, the functional control is always determined by the last trigger signal input detected.

⚠ CAUTION

Although the measured value display shows zero after a zero reset, this does not mean that the sensor is no longer under load. Attention must be paid here to risks for the operating personnel and the system. Implement appropriate safety measures to avoid overloading and to protect against resulting dangers.

The table below lists the individual objects, as well as the objects of the channel functions for zeroing and resetting the zero value.

Object dictionary – strain gauge channels zero set, zero reset					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
CH1-4 SG Zeroing set zero	0x2130	01 .. 04	ZERO	WO	Using RestAPI, MQTT write "null" to set zero. Using the fieldbus it does not matter what is written in the fieldbus container.
CH1-4 SG Zeroing reset zero	0x2031	01 .. 04	ZERO	WO	Using RestAPI, MQTT write "null" to reset zero. Using the fieldbus it does not matter what is written in the fieldbus container.
CH1-4 SG Zeroing offset	0x2032	01 .. 04	FLOAT	RW	A user defined offset value can be entered for the corresponding strain gauge channels 1-4.

10.1.7 TEDS functionality

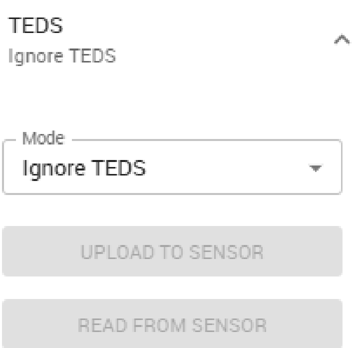


Fig. 10.11 TEDS setting modes in the strain gauge input channel, web server

When using TEDS (Transducer Electronic Data Sheet) it is possible to automatically parameterize the amplifier channel by connecting a sensor and thus carry out measurements immediately. The sensor data are saved on the TEDS chip in the sensor or connector plug for this purpose. Sensors without the TEDS functionality can also be retrofitted with it at a later date.

Each digiBOX strain gauge input can read and write to 0-wire and 1-wire TEDS. It is also possible to write a new TEDS parameter data set to the connected TEDS. The TEDS functionality can be set to three different modes for each channel in the sensor channel settings under **Amplifier → Channel → TEDS**.

Ignore TEDS

Regardless of the connected 0-wire or 1-wire TEDS, the TEDS data is not read out. The connected sensor is treated like a sensor without TEDS and the amplifier channel must be parameterized manually.

Use TEDS if available

When the sensor is connected, the system automatically searches for a connected TEDS – regardless of whether a 0-wire or 1-wire TEDS is connected.

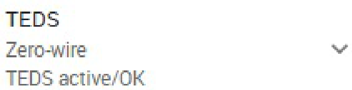
TEDS required

A sensor signal is only evaluated if a 0-wire or 1-wire TEDS is connected and can be read out correctly. If no TEDS can be read out, an error message is issued and the measurement channel switches to invalid.

Information

*The digiBOX is factory-set to "**Ignore TEDS**" by default.*

10.1.8 Applying TEDS and status messages



If a valid TEDS sensor is detected and read into the amplifier channel, this is indicated in the measured value display by the **TEDS** message. The message **Zero- or One-wire TEDS** and **TEDS active/OK** is displayed in the amplifier channel menu.

If errors occur while processing the TEDS data, **Invalid/TEDS error** is indicated in the measured value display and a description of the corresponding error is shown in the amplifier channel menu.

The following objects of the TEDS status and error messages can be read out of the object dictionary:

Index	Subindex	Type	Access	Bit	Description
0x5F0F	1 … 4 (dependent on channel index)	unit16	RO		See below

Status	Bit	Description
No TEDS found	0	Check that the TEDS module is correctly connected, if one is installed.
1-Wire	2	1-wire TEDS module detected.

Status	Bit	Description
Zero-Wire	3	Zero-wire TEDS module detected.
Invalid TEDS data	4	The TEDS module contains invalid data. Check the entries in the TEDS module (requires different hardware).
TEDS active/OK	5	All supported templates in the TEDS module have been read and the parameters are set.
Configuration failed	6	The settings in the TEDS module could not be set. Check the settings in the TEDS module – a sensor type or scaling that is not supported (requires different hardware) may be specified.
Read error	7	The TEDS module could not be read.
Checksum error	8	The information in the TEDS module contains errors and cannot be evaluated. Try to save the TEDS information in the module again.
No TEDS data	9	The TEDS module does not yet contain any data; the first 56 bytes are 0 or 255 (new unwritten module).

11.1 Charge amplifier piezo front-end

A charge amplifier acts as a charge-to-voltage converter. The force applied to the piezoelectric sensor generates a proportional charge, which in turn is converted into a proportional voltage via the front-end. The schematic diagram below shows the electrical circuit of the analog front-end of the digiBOX piezo board.

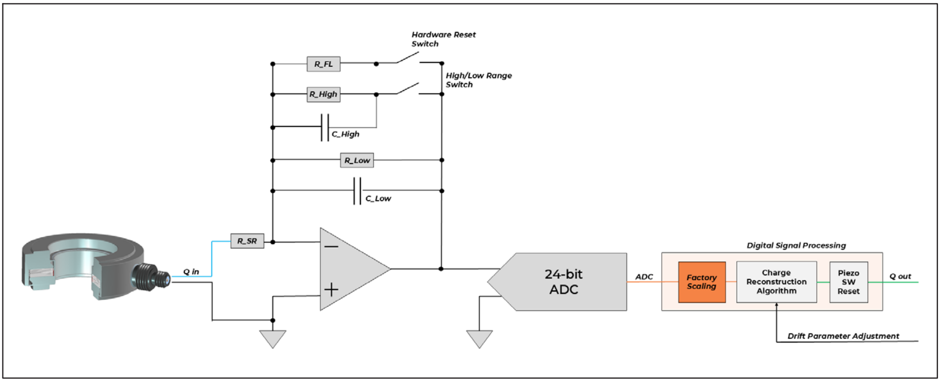


Fig. 11.1 Schematic of the digiBOX piezo front-end and the digital signal path

The charge amplifier front-end of the piezo board is galvanically isolated from the mainboard, but is capacitively coupled to the housing in order to improve the EMC properties. The front-end has two range capacitors per channel, with the respective measurement ranges:

- **Measurement range I**
  Low-range = ±10,000 pC
- **Measurement range II**
  High-range = ±1,000,000 pC

Closing the High/Low range switch activates the second range capacitor, and thus measurement range II. When the switch is open, only measurement range I is used.

Important

After switching from Low to High range, a software reset should be used to restore the zero point reference. After switching from High to Low range, a hardware reset must be performed.
Thanks to the permanently coupled time constant resistors, there is no risk of the range capacitors being saturated by low-frequency signal components such as drift.

Tip

The software reset offers significantly faster reset-operate and operate-reset times (50 µs) than conventional charge amplifiers, and is ideal for dynamic measurements.

11.2 Digital signal path (reconstruction algorithm, software reset, and drift adaptation)

The voltage output signal of the operational amplifier of each measurement channel is sampled and digitized by a 24-bit ADC at 40 kS/s.

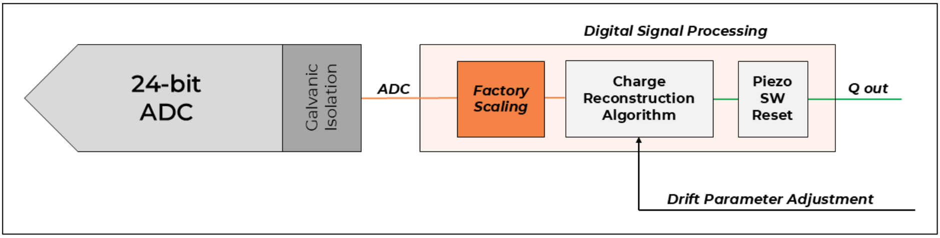


Fig. 11.2 Digital signal path, section of piezo signal chain

In the Factory Scaling block, the ADC values [digits] are rescaled to picocoulomb values [pC] in accordance with the factory adjustment. In the next block of the reconstruction algorithm, continuous digital drift correction is carried out to compensate for signal drift caused by temperature fluctuations, which would otherwise distort the measurement result.

Tip

It is possible to trigger the software reset once, or to hold it under level control (software reset hold function).

To achieve optimum reconstruction of the measurement signal by the reconstruction algorithm, the drift parameters of the connected sensors must be calibrated. The drift parameters are affected by all the cable and sensor connections, the length and quality of the sensor cables used, and the ambient temperature of the digiBOX. The chart below shows the influence of the drift parameters on the reconstruction algorithm.

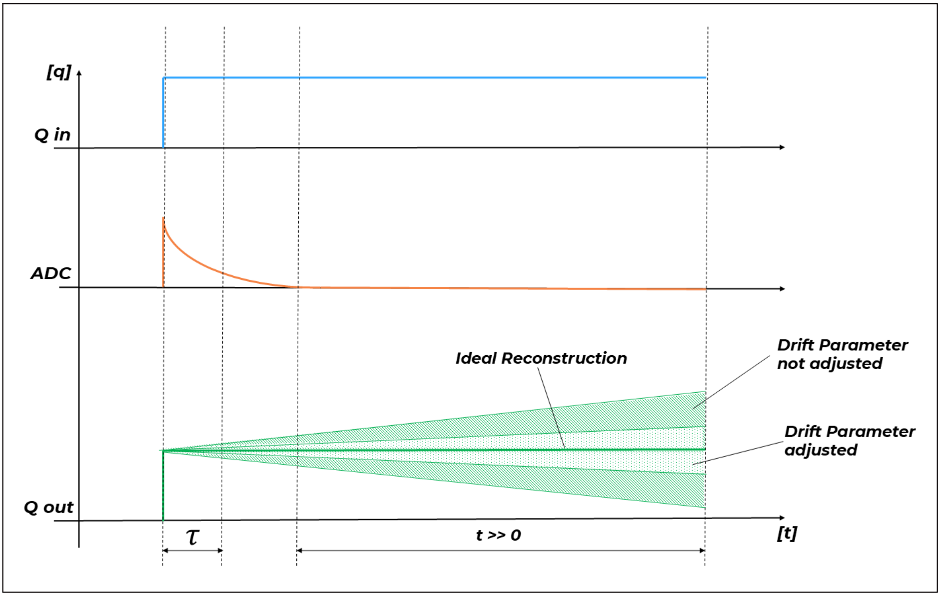


Fig. 11.3 Representation of the influence of the drift parameters on the reconstruction algorithm

The two differently shaded areas indicate the tolerance bands of the possible signal drift, with calibrated and uncalibrated drift parameters respectively. An 100 % reconstruction of the measurement signal is not possible due to physical influences such as leakage currents in the front-end.

Important

Drift adjustment (calibration) MUST be performed at least once after installation or modification of the sensor(s) and all measurement cables in order to attain the drift parameters specified in the data sheet.
The process can take up to 10 seconds, during which the sensor signal must be kept stable. This is automatically monitored by the calibration routine.
If it is not stable, a notification is displayed on the web server.

- Repeat the process until it completes successfully. Static pre-stressing of the sensor is permissible, and does not affect the calibration process.
- Then save the values in the parameter set (**Parameter Sets** menu) so that they are retained after powering off and back on. Otherwise, the calibration must be repeated.

11.3 Piezo signal chain

Piezoelectric sensors can be connected to the digiBOX piezo charge input. The piezo signal chain is shown below:

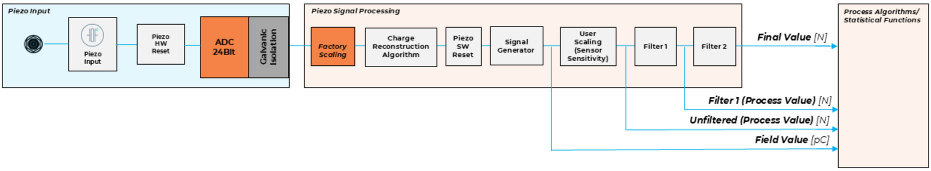


Fig. 11.4 Piezo signal chain

11.3.1 Source signals of the piezo signal chain

Various source signals from the piezo signal chain are available for calculating the statistical functions and for output via the various device interfaces:

Field value

The field value corresponds to the amount of charge in picocoulombs [pC] that is measured as a result of loading on a piezoelectric sensor.

Unfiltered (process value)

The unfiltered process value corresponds to the scaled measured value with a stored sensor sensitivity. The user-defined measurement quantity (e.g. N, kN, Nm etc.) can also be set.

Filter 1 (process value)

The Filter 1 process value corresponds to the scaled measured value after the first filter stage.

Final value

The final value corresponds to the scaled measured value after the second filter stage.

Important

The hardware and software reset functions are located in the signal chain before the output of the first source signal (field value). By triggering the reset functions, all source signals from the piezo signal chain are zeroed, or held at zero in level-controlled mode.

Below is a table of the corresponding source signals from the object dictionary of the piezo signal chain.

Object Dictionary – piezo channel source signals					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
CH1-2 Field value	0x2014	01 .. 02	FLOAT	RO	Field value of the corresponding piezo channel 1-2
CH3-4 Field value	0x2015	01 .. 02	FLOAT	RO	Field value of the corresponding piezo channel 3-4
CH1-2 Process value unfiltered	0x2016	01 .. 02	FLOAT	RO	Unfiltered process value of the corresponding piezo channel 1-2 after user scaling
CH3-4 Process value unfiltered	0x2017	01 .. 02	FLOAT	RO	Unfiltered process value of the corresponding piezo channel 3-4 after user scaling
CH1-2 Process value filter 1	0x2018	01 ... 02	FLOAT	RO	Process value after filter stage 1 of the corresponding piezo channel 1-2
CH3-4 Process value filter 1	0x2019	01 ... 02	FLOAT	RO	Process value after filter stage 1 of the corresponding piezo channel 3-4
CH1-2 Final value	0x201E	01 .. 02	FLOAT	RO	Final value of the piezo signal chain after filter stage 2 for channel 1-2
CH3-4 Final value	0x201F	01 .. 02	FLOAT	RO	Final value of the piezo signal chain after filter stage 2 for channel 3-4

11.3.2 Measurement channel parameterization, sensitivity setting, and filter

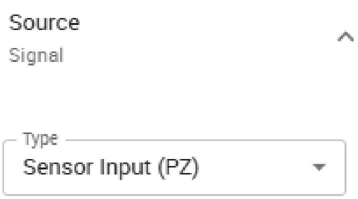


Fig. 11.5 Selection of source signal – piezo channel

Once the piezo sensor has been connected to the digiBOX, it can be parameterized on the corresponding channel on the **Amplifier → Channel** tab. Under **Amplifier → Channel → Source**, first select **Sensor Input (PZ)** from the **Type** drop-down menu.

Tip

In the dropdown menu under **Amplifier → Channel → Source** *it is possible to generate test signals via a signal generator.*

Fig. 11.6 Web server, piezo channel, general settings

Under **Amplifier → Channel → General** you can set the sensor name, the unit of measurement, and the number of decimal places to be displayed.

Information

The number of decimal places is only relevant for display in the web server, not for the calculations of statistical functions and measured value output.

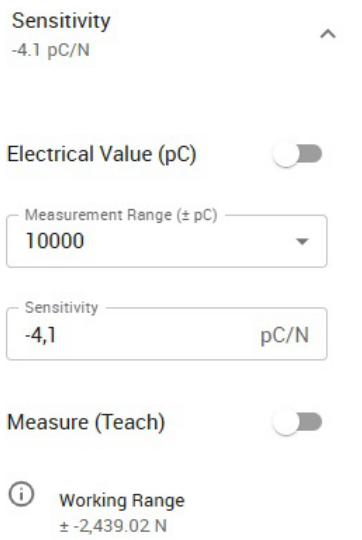


Fig. 11.7 Web server, piezo channel, measurement range and sensitivity setting

In the next step, the sensitivity of the connected piezo sensor must be entered. Under **Amplifier** → **Channel** → **Sensitivity** you can select the measurement range, and enter the sensitivity of the sensor in [pC/N]. The displayed working range of the digiBOX depends on the entered sensor sensitivity and the selected measurement range (Low, High).

11.3.3 Display of the field value/electric measured value (pC)

Fig. 11.8 pC direct display

The electric measured value of the measurement channel can be displayed directly by switching the scaling to the electric value (pC). The Filter and Reset/Operate functions are retained.

Information

While the electrical measured value is displayed, measured value scaling is disabled, as are the derived values of the measurement channel (e.g. limit values, peak values,...).

Important

The sensitivity of piezoelectric sensors is entered in the test records of HBK sensors with a negative sign. The sensitivity must be entered with a negative sign.

Example calculation:
Sensor sensitivity = -4.3 pC/N
Measurement range I (Low) = 10000 pC

In this configuration, the digiBOX can measure in a working range of ±2,325.58 N.
To measure in a higher range, the measurement range must be switched to High (measurement range II at 1000000 pC). In the High range, the digiBOX can measure with the specified sensitivity in a working range of ±232,558.13 N.

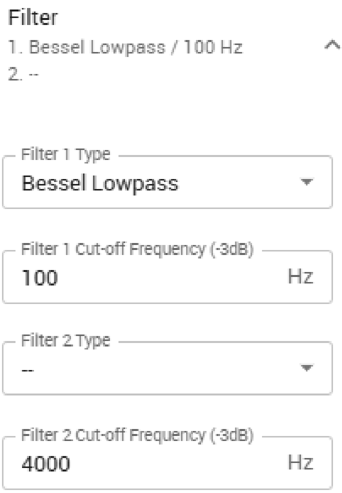


Fig. 11.9 Piezo signal chain filter settings

Two digital filter stages, cascaded in series according to the signal chain, are available for each piezo measurement channel. The filter settings are made under **Amplifier** → **Channel** → **Filter**.

A Bessel or Butterworth high-pass or low-pass filter can be selected for each filter stage. The cut-off frequencies can be set in the following ranges.

Bessel low-pass filter =	0.1 Hz - 4000 Hz
Butterworth low-pass filter =	0.1 Hz – 4000 Hz
Bessel high-pass filter =	0.1 Hz – 100 Hz
Butterworth high-pass filter =	0.1 Hz – 100 Hz

Tip

To significantly reduce the drift during long-term measurements of a piezo measurement channel, the software should be reset and a drift compensation should be completed before the measurement (see chapter 11.2, page 72).
This positive effect can be further increased by also connecting a high-pass filter.

11.3.4 Calibrating the sensor channel using Teach-In mode

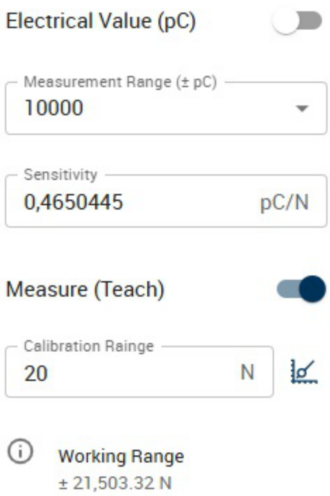


Fig. 11.10 Calibrating the Pz channel

Calibration (Teach-In) mode enables the applied field values (pC) of the measurement channel to be read in directly and the sensitivity (pC/N) to be calculated by pressing the  button.

Enter the physical value (e.g. in N) in the **Calibration Range** field, and load the sensor accordingly before calibrating the characteristic curve point. By clicking the **APPLY** button, the sensitivity is then transferred and applied in the device.

Important

The calibration also recalculates the working range (pC). If you want to use the full range, pay attention to the set measuring range of the channel (LOW: ±10,000pC or HIGH: ±1,000,000pC). Switch the measuring range as necessary so that the new working distance range is within the measuring range.
After switching from the high range to the low, a hardware reset should be triggered so that the stored charge can dissipate as quickly as possible. On switching from Low to High range, a software reset should be performed to restore the zero point reference.

11.3.5 Measurement range switching

The selected measurement range of the charge amplifier can be set and changed individually for each channel. The measurement range is set in the web server under **Amplifier → Channel → Sensitivity**.

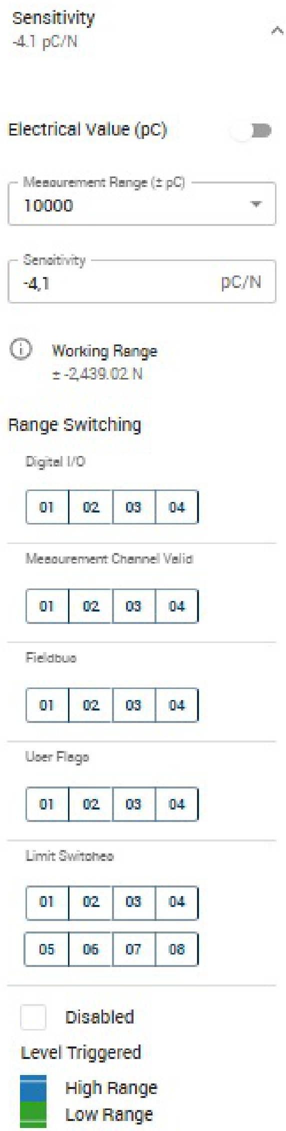


Fig. 11.11 Measurement range adjustment

Measurement range switching can also be controlled via the flag control. The switchover is level-controlled and either has the status "active" (logical 1) or "inactive" (logical 0). The Low range is active by default.

Example:
If user flag 1 is set to High level for switching to the High range, the switch to the High range takes place as soon as the status of user flag 1 becomes "active" (logical 1). The High range remains active until the status of user flag 1 changes back to "inactive" (logical 0).

Important

After switching from High to Low range, a hardware reset should be triggered so that the charge can flow off as quickly as possible. On switching from Low to High range, a software reset should be performed to restore the zero point reference.

The current status (Low range, High range) and the measurement range switch can be read and written via the following object.

Object dictionary – charge amplifier, capacitor range status and switching					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
CH1-4 Enable high range	0x2108	01 .. 04	BOOL	RW	If the status bit is logical 0 the Low range capacitor is currently active. If the status bit is logical 1 the High range capacitor is active.

11.3.6 Hardware reset

When the hardware reset is triggered, the active range capacitors are discharged via resistors according the operate-reset time. The hardware reset is parameterized in the digiBOX web server under **Amplifier** → **Channel** → **Hardware Reset**.

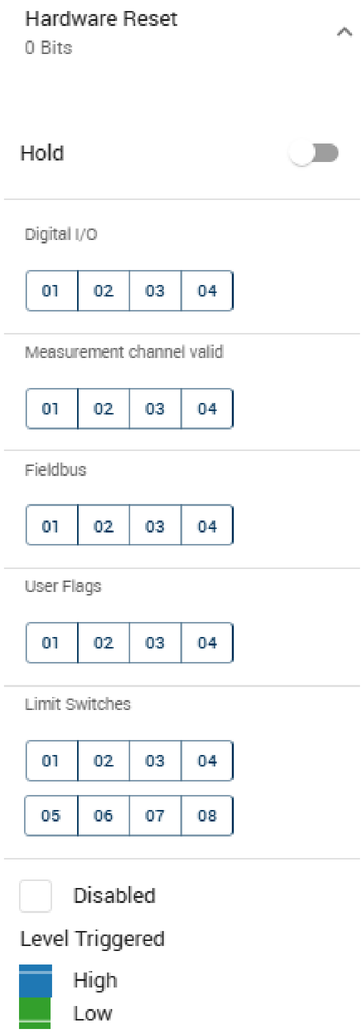


Fig. 11.12 Hardware reset

The hardware reset function is level-controlled, and can be executed by various trigger signal sources, such as digital inputs or flags. You will find more information on triggering by flags in *chapter 15 "Flag actions", page 136*.

The level-controlled function means that the hardware reset remains permanently in reset mode after detecting a trigger signal, such as a user flag with logical 1 status (High level), until a change in the trigger signal source to logical 0 (Low level) is detected. You can also choose whether the hardware reset is to be triggered at a High or Low level.

Important

It is possible to set multiple trigger signal sources for the hardware reset. In this case, the level-controlled function is always determined by the last trigger signal input.

The hardware reset can also be read and written via the following object.

Object dictionary – charge amplifier, hardware reset					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
CH1-4 Enable hardware reset	0x2107	01 .. 04	BOOL	RW	If the status bit is logical 0 then the charge amplifier is in the measurement mode. If the status bit is logical 1 the hardware reset is enabled and held (reset mode).

Important

Standard charge amplifiers only offer the option of a hardware reset to discharge the range capacitor and define the zero point, or starting point, of a measurement. This operation entails a time delay, as the capacitor must first discharge. This discharge time is indicated by the operate-reset time. For most applications the hardware reset is not necessary, so a dynamic software reset should be used – see chapter 11.2, page 72.

⚠ CAUTION

Although the measurement signal is zero after a hardware or software reset, this does not mean that the sensor is no longer under load. Attention must be paid here to risks for the operating personnel and the system. Implement appropriate safety measures to avoid overloading and to protect against resulting dangers.

11.3.7 Software reset

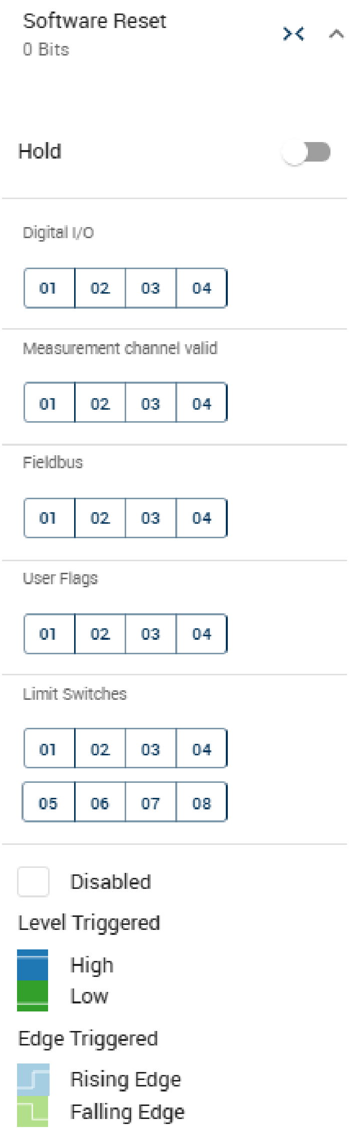


Fig. 11.13 Software reset function

The digiBOX Industrial offers a digital software reset. The measurement signal is digitally zeroed by the software reset. Contrary to a hardware reset, this operation has no latency, as there is no need to wait for the range capacitor to discharge. The software reset works as a channel function with a response time of 25 µs. If the software reset is triggered by an external trigger signal source, the delay of the source signal must be taken into account. The software reset is parameterized in the digiBOX web server under **Amplifier** → **Channel** → **Software Reset**.

The software reset can be executed as an edge-controlled or level-controlled action.

Edge-controlled software reset

In edge-controlled mode, the software reset is triggered once, and the measured value is zeroed. In this case, measuring resumes immediately after the reset. Depending on the trigger signal source, it is possible to trigger the software reset in edge-controlled mode on a rising or falling edge.

Level-controlled software reset

A level-controlled software reset zeroes the measurement signal and holds it at zero until the level of the trigger signal source changes its state. This function is based on the behavior in hardware reset mode, but switches faster between reset and measurement mode than the hardware reset. Depending on the trigger signal source, it is also possible to trigger the software reset in level-controlled mode at a High or Low level.

The software reset can be triggered by user flags as well as by writing to the corresponding objects. You will find more information on triggering by flags in *chapter 15 "Flag actions", page 136*.

Tip

The switching times in software reset mode are significantly faster than the operate-reset and reset-operate switching times of the hardware reset.

Important

It is possible to set multiple trigger signal sources for the software reset. In this case, the edge- or level-controlled function is always determined by the last trigger signal input detected.

⚠ CAUTION

Although the measured value display shows zero after a software reset, this does not mean that the sensor is no longer under load. Attention must be paid here to risks for the operating personnel and the system. Implement appropriate safety measures to avoid overloading and to protect against resulting dangers.

The objects for activating the software reset and software reset hold are listed in the following table.

Object dictionary – software reset and software reset hold					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Software reset CH1-4	0x2106	01 .. 04	ZERO	WO	Initiate the software reset for piezo channels 1-4 by writing null (edge-controlled action)
Software reset hold CH1-4	0x210A	01 .. 04	BOOL	RW	Set hold zero for piezo channels 1-4 (level-controlled action): (false) inactive (true) active

11.3.8 Drift parameter adjustment

The drift parameters of the reconstruction algorithm can be adjusted in the **Amplifier → Channel → Drift Adjustment** submenu. Calibrating the drift parameters reduces the signal drift, taking into account the current connected sensor and cable configuration.

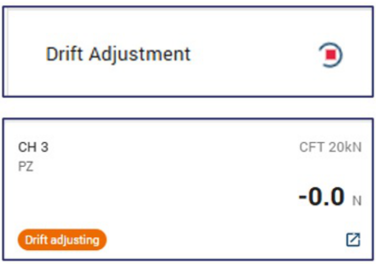


Fig. 11.14 Drift adjustment in the piezo channel

Click on the **Drift Adjustment** icon to start the calibration process. A popup dialog on the web server indicates that the process has started. Once the calibration process is complete, a corresponding message appears again.

Please note the following regarding the required state of the connected sensor, which is necessary for correct drift parameter adjustment.

Important

Drift adjustment (calibration) MUST be performed at least once after installation or modification of the sensor(s) and all measurement cables (including summing box, where appropriate) in order to attain the drift parameters specified in the data sheet.
The process can take up to 10 seconds, during which the sensor signal must be kept stable. This is automatically monitored by the calibration routine.
If it is not stable, a notification is displayed on the web server.

▶ Repeat the process until it completes successfully. Static pre-stressing of the sensor is permissible, and does not affect the calibration process.

- Then save the values in the parameter set (**Parameter Sets** menu) so that they are retained after powering off and back on. Otherwise, the calibration must be repeated.

The drift parameters are stored in the device at the factory in accordance with the factory adjustment and calibration. If you want the newly calibrated drift parameters also to be available when the power supply has been cut, *you must save the changes to the desired parameter set once calibration is complete*. On resetting to the defaults (the factory parameter set) the drift parameters from the factory calibration are loaded.

Tip

If measurements are taken at an approximately constant temperature level within the device specifications, calibration results in significantly less signal drift during measurement.

Drift parameter adjustment can be initiated by the following object.

Object dictionary – drift parameter adjustment					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Measure drift parameter	0x2117	01 .. 04	U32	R/W	Write number of samples for processing Write the number of samples "400000" to initiate the drift parameter adjustment over 10 seconds. Read returns the number of samples already processed to indicate the progress of the adjustment.

For more information on how drift adjustment works, and how to use it, see *chapter 11.2, page 72*.

12 STATISTICAL AND CALCULATION FUNCTIONS

The statistical and calculation functions are calculated per sample at an update rate of 25 µs. Source signals from the strain gauge and piezo signal chains, as well as the results already calculated in a loop function, can be used to perform the statistical and calculation functions.

The diagram below shows the available source signals, and the possible input and output interfaces for signal output and process control.

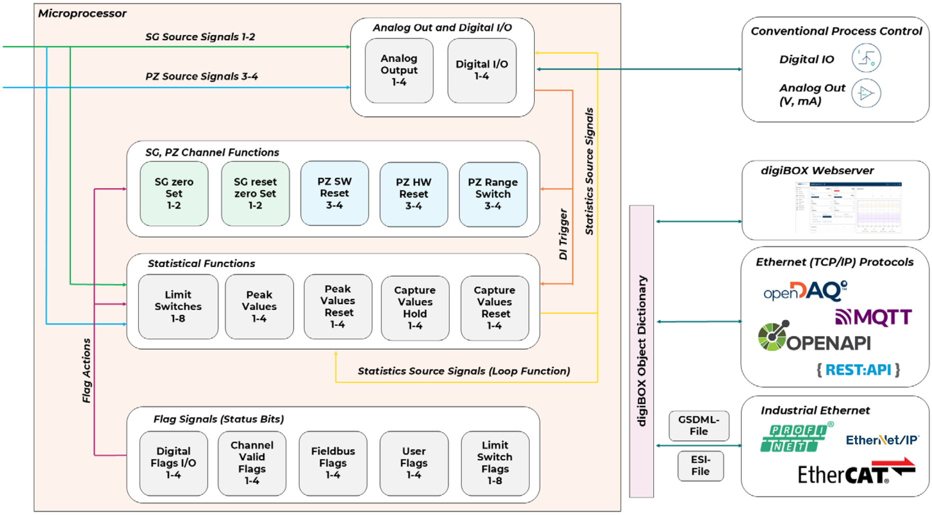


Fig. 12.1 Signal sources for statistical functions and signal and control input and output options, based on the example of a K-DBX-4M variant

12.1 Peak values

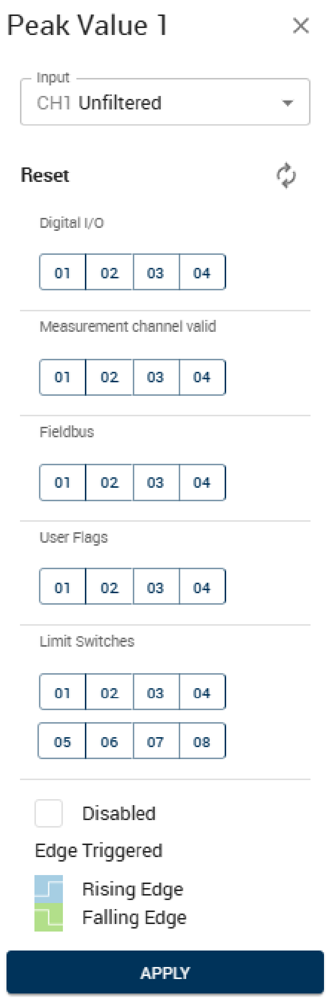


Fig. 12.2 Reset peak values, source signal selection and recorded values

Peak value recording can be set in the **Peak Values** submenu. Four peak value calculators (Peak Value 1-4) are available. The peak value calculator records the maximum, minimum and peak-to-peak values of the selected source signal per sample (25 µs). All source signals from the strain gauge and piezo signal chains are available as sources.

The current peak values are saved in the device, and can be read out and transferred for further signal processing. The recorded peak values can be reset by various trigger signal sources, such as digital I/Os and flags. Peak value resetting is implemented as an edge-controlled function. You can choose whether the reset is to be triggered by the detection of a rising or falling edge.

You will find more information on the option to control the statistical functions by flags in *chapter 15 "Flag actions", page 136*.

Information

When the source signal is changed, the previously stored peak values are reset.

The corresponding objects in the peak value memory are listed in the following table.

Object dictionary – Min, Max, Peak-to-peak values, channel 1					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Source signal CH1	0x3010	01	U16	RW	Set the source signal index for the peak values channel 1. A list of the status bits for the available source signals can be found in *chapter 18.1 "Source signal indices", page 155*
Peak value CH1 reset	0x3010	02	ZERO	WO	Reset the peak values (Min, Max, Peak-to-Peak) of channel 1 to zero by writing null
Peak value CH1 max	0x3010	03	FLOAT	RO	Current maximum value of channel 1
Peak value CH1 min	0x3010	04	FLOAT	RO	Current minimum value of channel 1
Peak value CH1 peak-to-peak	0x3010	05	FLOAT	RO	Current peak-to-peak value of channel 1

Object dictionary – Min, Max, Peak-to-peak values, channel 2					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Source signal CH2	0x3011	01	U16	RW	Set the source signal index for the peak values channel 2. A list of the status bits for the available source signals can be found in *chapter 18.1 "Source signal indices", page 155*
Peak value CH2 reset	0x3011	02	ZERO	WO	Reset the peak values (Min, Max, Peak-to-Peak) of channel 2 to zero by writing null

Object dictionary – Min, Max, Peak-to-peak values, channel 2					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Peak value CH2 max	0x3011	03	FLOAT	RO	Current maximum value of channel 2
Peak value CH2 min	0x3011	04	FLOAT	RO	Current minimum value of channel 2
Peak value CH2 peak-to-peak	0x3011	05	FLOAT	RO	Current peak-to-peak value of channel 2

Object dictionary – Min, Max, Peak-to-peak values, channel 3					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Source signal CH3	0x3012	01	U16	RW	Set the source signal index for the peak values channel 3. A list of the status bits for the available source signals can be found in *chapter 18.1 "Source signal indices", page 155*
Peak value CH3 reset	0x3012	02	ZERO	WO	Reset the peak values (Min, Max, Peak-to-Peak) of channel 3 to zero by writing null
Peak value CH3 max	0x3012	03	FLOAT	RO	Current maximum value of channel 3
Peak value CH3 min	0x3012	04	FLOAT	RO	Current minimum value of channel 3
Peak value CH3 peak-to-peak	0x3012	05	FLOAT	RO	Current peak-to-peak value of channel 3

Object Dictionary – Min, Max, Peak-to-peak values, channel 4					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Source signal CH4	0x3013	01	U16	RW	Set the source signal index for the peak values channel 4. A list of the status bits for the available source signals can be found in *chapter 18.1, "Source signal indices", page 155.*
Peak value CH4 reset	0x3013	02	ZERO	WO	Reset the peak values (Min, Max, Peak-to-Peak) of channel 4 to zero by writing null
Peak value CH4 max	0x3013	03	FLOAT	RO	Current maximum value of channel 4
Peak value CH4 min	0x3013	04	FLOAT	RO	Current minimum value of channel 4
Peak value CH4 peak-to-peak	0x3013	05	FLOAT	RO	Current peak-to-peak value of channel 4

12.2 Capture values

The Capture Values function offers the option of saving (capturing) any source signal by activating a trigger signal. The Capture Values function is available four times (Capture Value 1-4). The value is held until it is overwritten by another trigger or reset by another trigger signal.

Tip

This function can be used if specific measured values, such as user-defined limit values or process-related press-fit forces, need to be saved and transferred for downstream analysis or control.
The function is particularly useful if multiple capture values (e.g. measured value channel 1 and 2) are triggered with the same trigger signal (e.g. a flag). In this case, the two values are acquired at exactly the same sampling time.

Capture values 1-4 are set in the web server menu under **Capture Values**. All source signals from channels 1-4, as well as peak values, fieldbus values and the capture values themselves, can be used as sources for the **Capture Values** function.

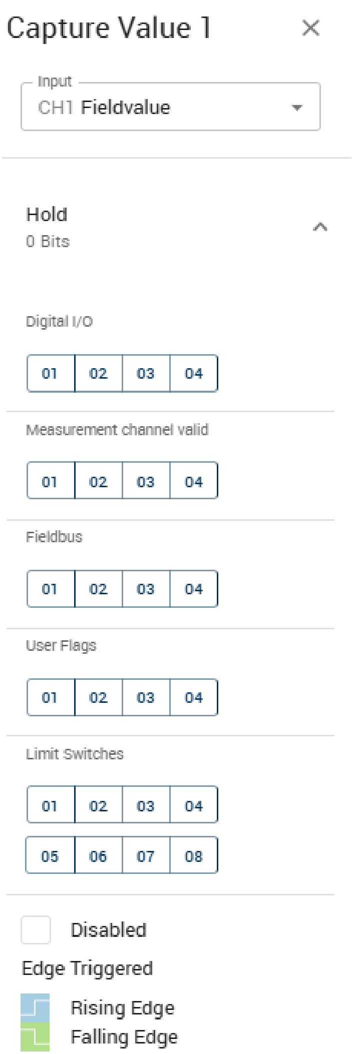


Fig. 12.3 Capture values, hold by trigger signal

The capture values can be reset by trigger signals in the **Capture Values → Reset** submenu.

Both the triggering of the hold function and the resetting of the capture values can be reset by various trigger signal sources, such as digital I/Os and flags. Both functions are implemented as edge-controlled functions. You can choose whether the functions are to be triggered by the detection of a rising or falling edge. You will find more information on the option to control the statistical functions by flags in *chapter 15 "Flag actions", page 136*.

The capture values and their status can be read out in the following objects.

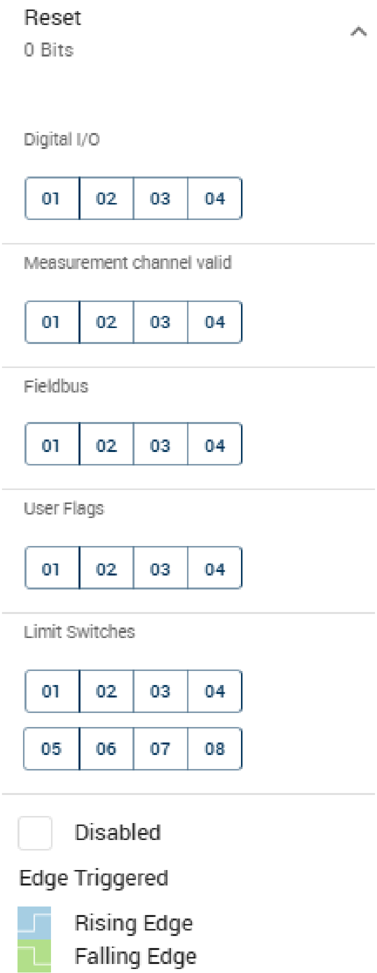


Fig. 12.4 Reset capture values

Object dictionary – capture values and status, channels 1-4					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Capture value CH1-CH4	0x2500	01 .. 04	FLOAT	RO	The current capture values for channel 1-4
Capture value status CH1-CH4	0x2505	01 .. 04	U32	RO	The current status of the capture values 1-4

12.3 Limit switches

The digiBOX provides a total of eight limit switches. The limit switches can be accessed in the web server from the **Limit Switch** submenu. Any source signals can be selected for each limit switch. The following three limit switch states are defined:

- **on**
  The limit switch is "on" (active) as long as the selected source signal is greater than/ equal to the defined threshold value.
- **off**
  The limit switch is "off" (inactive) as long as the selected source signal is below the defined threshold value.
- **undefined**
  This is the initialization state when the device is starting up, and is no longer reached subsequently (not even when the device is switched off).

Tip

The limit switches can be inverted, meaning you can decide whether the limit switch is set to "on" (active) or "off" (inactive) after a defined threshold value is exceeded.

The state of the limit switches can be read out via the objects below.

Object dictionary – limit switches, state					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Limit switch 1 state	0x3030	01	I8	RO	The status of the limit switches 1-8 is defined by four different possible states: off(0) on(1) undefined(-1) A limit switch on (1) status leads to an activated flag status. If the limit switch status is off (0) then the correspond-ing flag status is deactivated. If the limit switch status is undefined (-1) then the flag status is deactivated.
Limit switch 2 state	0x3031	01	I8	RO	
Limit switch 3 state	0x3032	01	I8	RO	
Limit switch 4 state	0x3033	01	I8	RO	
Limit switch 5 state	0x3034	01	I8	RO	
Limit switch 6 state	0x3035	01	I8	RO	
Limit switch 7 state	0x3036	01	I8	RO	
Limit switch 8 state	0x3037	01	I8	RO	

In the web server, the status of the limit switches is indicated in the user flag display, as shown in the screenshot below:

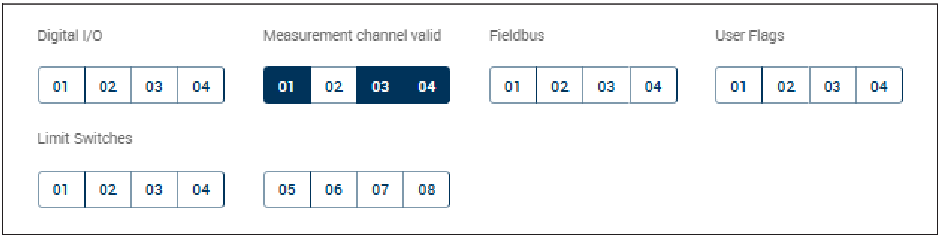


Fig. 12.5 Fig. Web server, home screen, user flags of the limit switches

The flag of the flag bits of the corresponding limit switch is only "active" in the limit switch "on" state, and so is highlighted in dark blue. If the limit value status is "unde-fined", "off" or "error", the corresponding flag bit is "inactive", and has a white back-ground in the display. The limit switch's on/off switching logic can be reversed using the "Invert" option.

The limit switch function has a total of four operating modes:

Inactive

The limit switch is inactive (disabled).

Hysteresis (Single Point)

In Hysteresis mode, a single threshold force (with or without hysteresis) is set. This corresponds to a single-point limit switch. First, select the signal source for the limit switch. In the. **Limit 1** box, enter the threshold value at which the limit switch state is active as soon as it is reached or exceeded. The switching logic can be inverted using the **Invert** button.

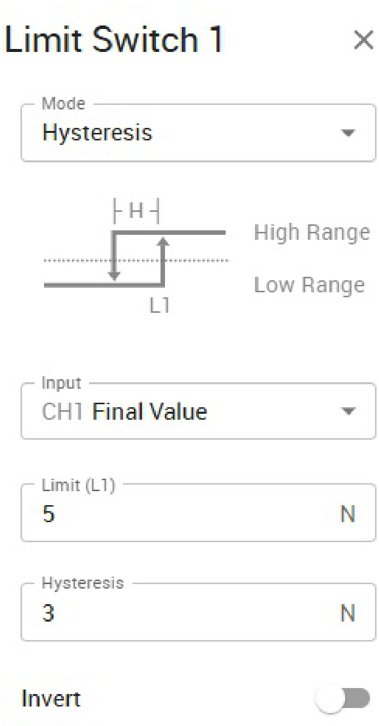


Fig. 12.6 Limit switches, Hysteresis mode

In th **Hysteresis** box you can set a value so that the limit switch switches to "disabled" when the force is lower than the defined threshold value. If no hysteresis value is entered, the limit switch switches back to "disabled" when the value falls below the threshold.

There follows an example chart of the switching logic in Hysteresis mode for an increasing force with defined hysteresis. The limit value and the hysteresis are entered as positive values, and the limit switch is not inverted.

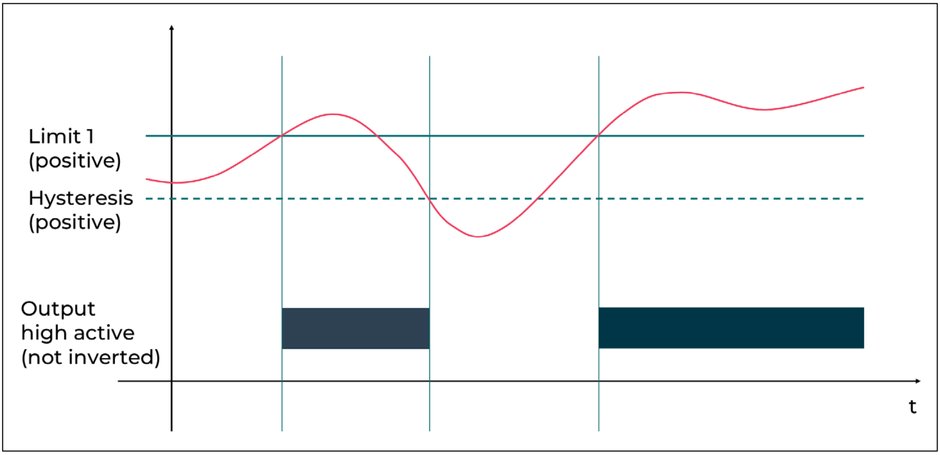


Fig. 12.7 Hysteresis mode (Single Point, increasing load with defined hysteresis)

To trigger a limit switch to the "on" (active) state, when the value falls below a threshold value (e.g. a negative threshold value) the limit switch must be inverted. If you also want to define a hysteresis at which the limit switch remains active after the threshold value has been exceeded, the hysteresis value must be entered with a negative sign.
This switching logic is shown in the chart below.

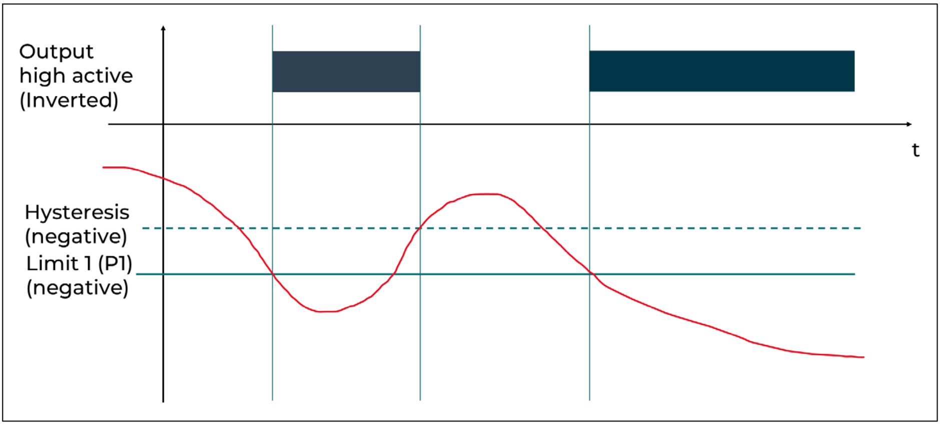


Fig. 12.8 Hysteresis mode (Single Point, falling load with defined hysteresis)

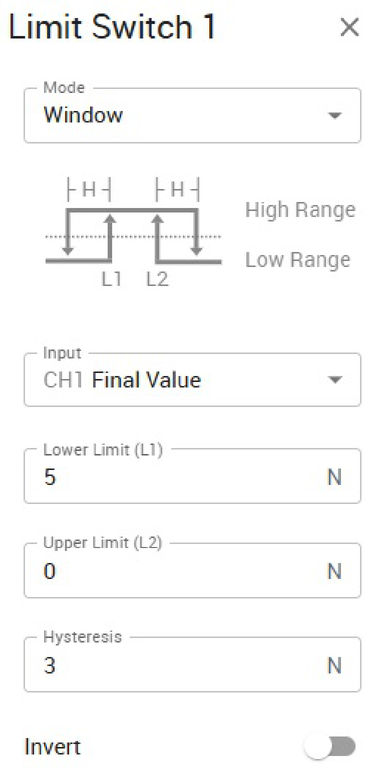


Fig. 12.9 Limit switches, Window mode

Window

In Window mode, a range can be defined whereby the limit switch is triggered as soon as the value exceeds or falls below it. If the limit switch is not inverted, the limit switch state switches to "active" within the defined range. If the limit switch is inverted, the limit switch state switches to "inactive" within the defined range.

In the **Limit 1** and **Limit 2** boxes you can define the two switching points of the window – in any order. The range between the two entered values is defined as the window. It is also irrelevant whether you enter positive or negative limit values.

In the **Hysteresis** box you can enter a hysteresis that is identical for the upper and lower switching points. If the limit switch is inverted, the limit switch switches to "inactive" within the defined range, and to "active" outside it.

There follows an example chart of the switching logic in Window mode for an increasing force with defined hysteresis. The two limits are entered as positive values. The hysteresis value is also entered as a positive. The switching logic is not inverted.

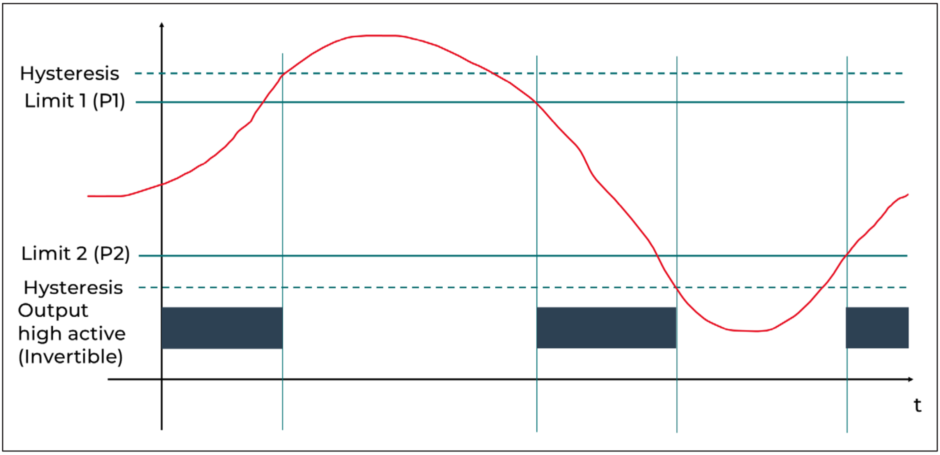


Fig. 12.10 Window mode (with defined hysteresis)

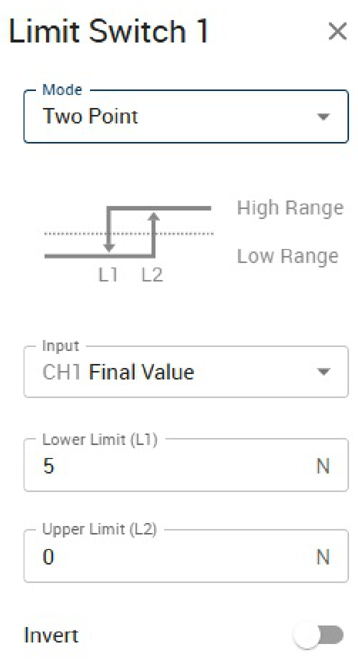


Fig. 12.11 Limit switches, Two Point

Two Point

In Two Point mode, two switching points are defined – a switching point and a reset point. It does not matter whether you enter the switching point and reset point respectively in the **Limit 1** or **Limit 2** box. According to the definition of the two-point limit switch, the switching point is set to the value corresponding to the higher of the two entered values. The lower value is defined as the reset point. The difference between the switching and reset points corresponds to the hysteresis.

The chart below shows the two-point switch with both switching points entered as positive values. The limit switch is not inverted.

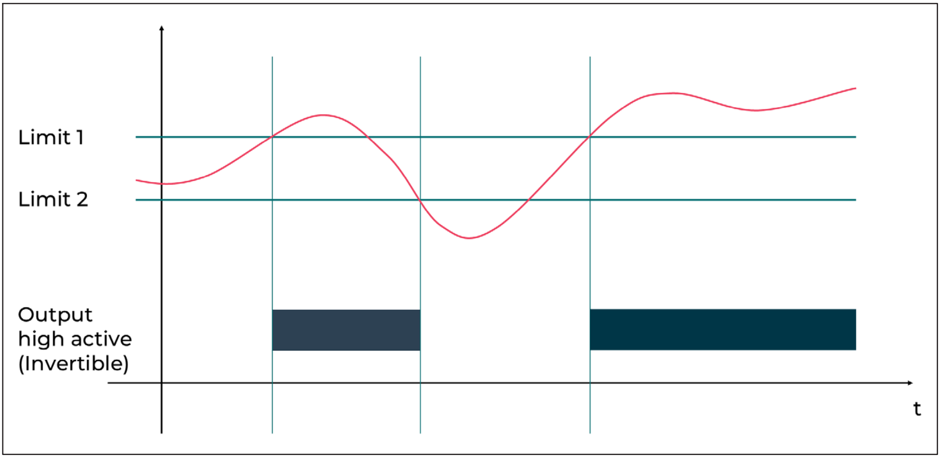


Fig. 12.12 Limit switches, Two Point, positive limit value input, not inverted

12.4 Calculation channels

12.4.1 Summation channel

Summation can be activated and configured in this menu. To do this, 2, 3, or 4 source signals can be selected in the "Settings" submenu. Once the settings have been configured and activated using "Apply," the visualization appears, displaying all associated individual values.

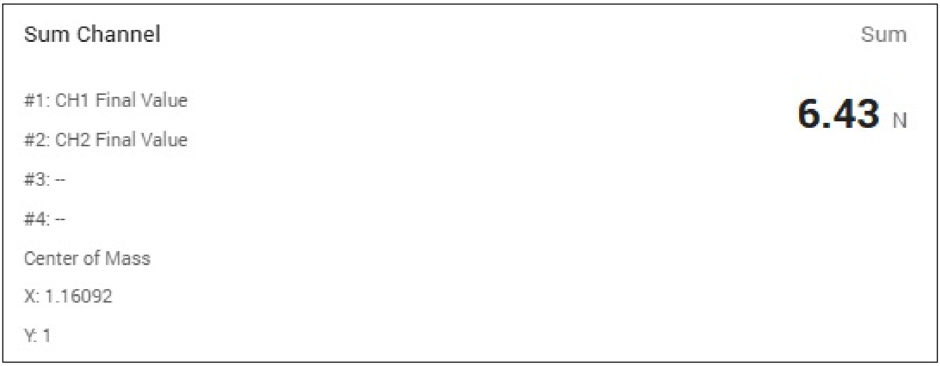


Fig. 12.13 Summation channel

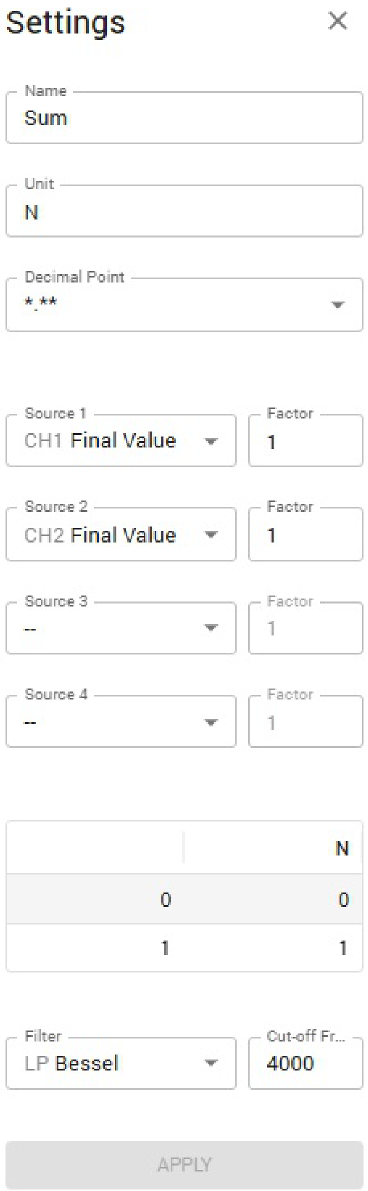


Fig. 12.14 Summation channel settings

The summation signal is calculated at 40 kHz. All values from this calculation channel are also available in the signal selection list for further use (e.g., peak values, etc.).

The summation signal can be scaled and filtered independently of the individual source signals. By default, the filter is disabled and the gain is set to 1.

Tip

When selecting and scaling the individual signals, ensure that they all belong to the same domain (e.g., force) and that the values are in the same units (e.g., all values in N). Automatic unit conversion does not take place! You can adjust for differences using the value in the "Factor" field (e.g., if all values are to be calculated in Newtons—if signal source 1 corresponds to 0.5 N, applying a factor of 1000 results in a value of 500 N).

12.4.2 Signal Center Point

The sum channel can also calculate the resulting center point of the individual signals used. This allows the deviation of the sum signal from its center value to be calculated and used for analysis—an important criterion in applications such as press operations, weighing, or structural monitoring.

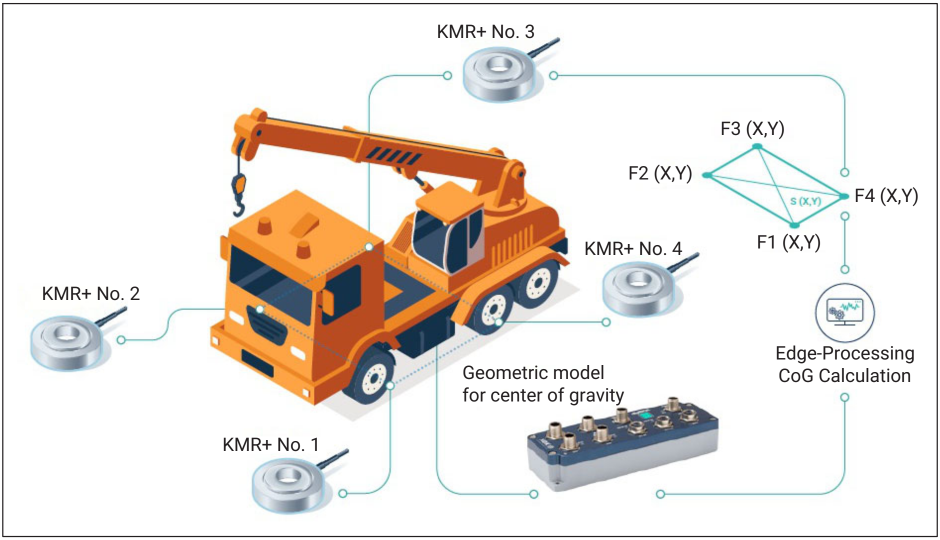


Fig. 12.15 Summation channel application

Fig. 12.16 Summation channel coordinates

The calculation is performed using between 2 and 4 source signals. To accurately reflect the application's actual dimensions, the coordinates of the load application points for each individual source signal can be specified. The factory default setting for these is 1.

Calculation example for resultant total force

The center of force (also known as the resultant or the center of parallel forces) is calculated using the principle of moments, which states that the sum of the individual moments must equal the moments of the total forces.

If all forces act vertically downwards, the system is one of parallel forces.

1. Calculating the total force: All individual forces are added (F1, F2, ..., F4), to obtain the resultant total force F{total}.

$$F_{total} = \sum_{i=1}^{n} F_i = F_1 + F_2 + \dots + F_n$$

2. Select a reference point: Choose any point (origin) for determining positions.

Tip

Place the origin (x = 0) at the position of the first force F{1} to simply subsequent calculations.
Determine the distances (x1, x2, ..., x4) of all forces from this reference point.

3. Calculating the coordinates of the center of force: The distance of the center of force ({x} and {y}) from the reference point is calculated by dividing the sum of the individual loads multiplied by their respective distances by the total force.

For the x-coordinate: $x = \dfrac{F_1 \cdot x_1 + F_2 \cdot x_2 + \dots + F_n \cdot x_n}{F_{total}}$

For the y-coordinate: $y = \dfrac{F_1 \cdot y_1 + F_2 \cdot y_2 + \dots + F_n \cdot y_n}{F_{total}}$

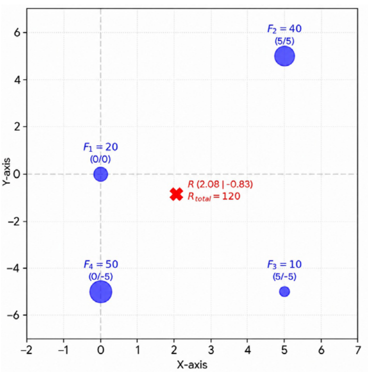


Fig. 12.17 Example: Shifted center of force with 4 forces

The sum channel parameters can be read and configured via the following objects:

Object Dictionary Sumchannel					
Name	**Index**	**Sub-Index**	**Type**	**Access**	**Description**
Sum	0x2030	01	FLOAT	RO	Sum value and status
Sum state	0x2030	02	U32	RO	
Sum x-coord	0x2030	03	FLOAT	RO	Sum value center point
Sum y-coord	0x2030	04	FLOAT	RO	
Summand #1	0x2031	01	U16	RW	Source signals for sum value
Summand #2	0x2031	02	U16	RW	
Summand #3	0x2031	03	U16	RW	
Summand #4	0x2031	04	U16	RW	
Summand factor #1	0x2032	01	FLOAT	RW	Valuation factor for each source signal
Summand factor #2	0x2032	02	FLOAT	RW	
Summand factor #3	0x2032	03	FLOAT	RW	
Summand factor #4	0x2032	04	FLOAT	RW	
Sum scaling point x0	0x2033	01	FLOAT	RW	Scaling vales for sum value
Sum scaling point y0	0x2033	02	FLOAT	RW	
Sum scaling point x1	0x2033	03	FLOAT	RW	
Sum scaling point y1	0x2033	04	FLOAT	RW	

Object Dictionary Sumchannel					
Name	**Index**	**Sub-Index**	**Type**	**Access**	**Description**
Summand #1 x-coord	0x2034	01	FLOAT	RW	Physical coordinates of used source signal
Summand #1 y-coord	0x2035	01	FLOAT	RW	
Summand #2 x-coord	0x2034	02	FLOAT	RW	
Summand #2 y-coord	0x2035	02	FLOAT	RW	
Summand #3 x-coord	0x2034	03	FLOAT	RW	
Summand #3 y-coord	0x2035	03	FLOAT	RW	
Summand #4 x-coord	0x2034	04	FLOAT	RW	
Summand #4 y-coord	0x2035	04	FLOAT	RW	
Sum filter mode	0x2036	01	U16	RW	Filter settings for sum signal,off(0), LP Bessel(1), LP Butterw(2), HP Bessel(3), HP Butterw(4)
Sum filter cutoff frequency	0x2036	02	FLOAT	RW	
Sum filter fast track	0x2036	03	NULL	WO	
Sum name	0x2040	54	STR	RW	Sum signal: Name, unit, decimals indicated in Webserver
Sum unit	0x2041	54	STR	RW	
Sum decimals	0x2042	54	U8	RW	

13 IO INTERFACE

Four digital I/Os and four analog outputs (±10 V, 4 … 20 mA, switchable) are available at the digiBOX Industrial's IO port for conventional process control.

13.1 Digital I/Os

A separate power supply (pin 12, Supply voltage DIO) must be connected to the IO port to operate the digital I/Os. The power supply may be between a minimum of 10 V and a maximum of 30 V. It is possible to connect a separate ground to the IO port (pin 6, GND DIO).

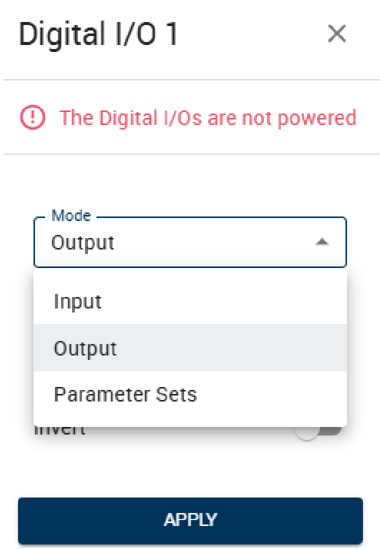


Fig. 13.1 Digital I/Os, setting the various operating modes

The digital I/Os are parameterized in the web server's **Digital I/O menu.**

Each DIO can be set to one of the following three operating modes:

- Input
- Output
- Parameter Sets

The DIOs are factory-set to **Input** mode by default.

Important

To operate the digital I/Os, a power supply must be connected to the IO port pin 12 (Supply voltage DIO) and pin 6 (GND DIO). If no power supply is connected, a notification indicating the fact is displayed above the dropdown menu.

Information

DIO – An active switching bit may be briefly created when the voltage source is disconnected.

Next, the three operating modes of the digital I/Os are described.

13.1.1 Digital inputs

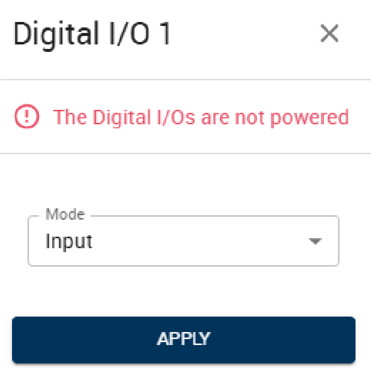


Fig. 13.2 DIO setting, Input mode

To enable the digital input, the mode must be set to Input in the **Digital I/O → Digital I/O Channel** menu.

The switching logic of the digital inputs is implemented as follows:

Low level, state (logical 0) = 0 .. 5 V (or open)
High level, state (logical 1) = 10 … 30 V

The digital inputs 1-4 can be used to control the corresponding channel and statistical functions of the digiBOX. This is done via the corresponding flag actions of the digital inputs. You will find more information on this in *chapter 15 "Flag actions", page 136*.

13.1.2 Parameter set selection

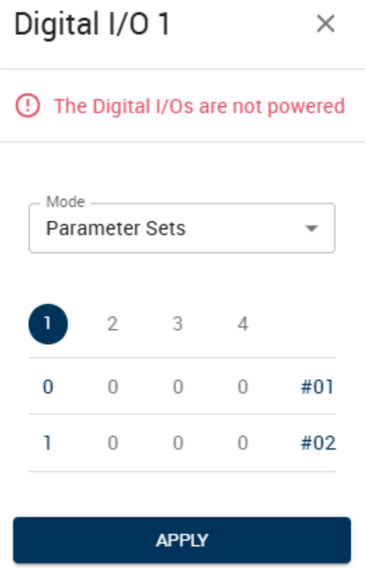


Fig. 13.3 Digital input 1, Parameter Sets switching mode (the three remaining digital inputs are set to Input mode)

The digiBOX's parameter sets can also be switched via the digital inputs. To do this, the corresponding digital inputs must be set to **Parameter Sets** mode.

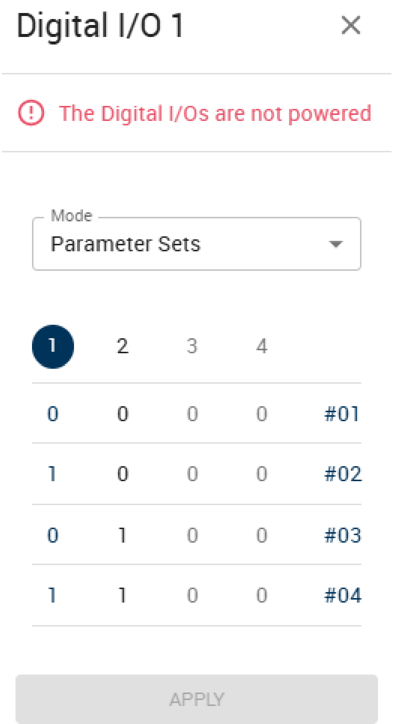


Fig. 13.4 Example: Digital input 1, Parameter Sets switching mode (digital input 2 Parameter Set mode, digital input 3-4 Input mode)

The combination shown above, for example, allows switching between parameter sets 1-4. To enable the respective parameter sets, and switch parameter sets, the corresponding switching logics displayed for digital inputs 1 and 2 must be followed.

13.1.3 Digital outputs

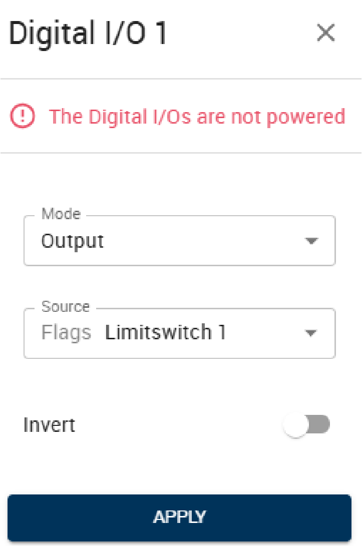


Fig. 13.5 Digital output 1, Output mode

To enable the digiBOX's digital outputs, the respective digital I/Os must be set to Output mode in the **Digital I/O → Digital I/O Channel** menu.

The digital outputs are executed as high-side switches. The output voltage level is defined by the supply voltage V+DIO connected to pin 12 of the IO port. The switching logic resulting from this is:

State (logical 0) = high impedance, no voltage level
State (logical 1) = 10 … 30 V (depending on supply voltage DIO)

The following source signals can be selected as output signals for the digital output:

Status bits – General

Status bits – Error
Flags
Constant [0.1]

The sample rate of the digiBOX is 40 kHz, which is higher than the maximum output rate at the digital output (10 kHz). Consequently, four states are combined in one cycle, and outputted as a single result state. This ensures that changes in the measurement signal, intended to trigger a limit switch for example, are correctly reproduced at the digital output.

Important

To operate the digital I/Os, a power supply must be connected to the IO port pin 12 (Supply voltage DIO) and pin 6 (GND DIO).

The switching logic of the digital outputs can be inverted. When inversion is enabled, the switching logic is inverted as follows:

State (logical 0) = 10 … 30 V (depending on *Supply voltage DIO*)
State (logical 1) = high impedance, no voltage level

13.2 Analog output

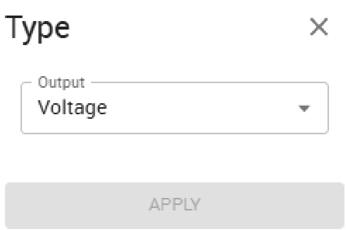


Fig. 13.6 Setting current or voltage output

The digiBOX has four analog outputs. All four analog outputs can be configured either as voltage outputs or as current outputs.
The setting can be made in the web server under **Analog Output** → **General**.

Important

It should also be noted that the output rate at the current and voltage output is 10 kHz in each case. Since the digiBOX samples at a rate of 40 kHz, aliasing may occur. To prevent aliasing, a low-pass filter should be set for the source signal being used.

Information

*The parameter settings of the current or voltage mode are **not** saved in the parameter set data.*

13.2.1 Voltage output

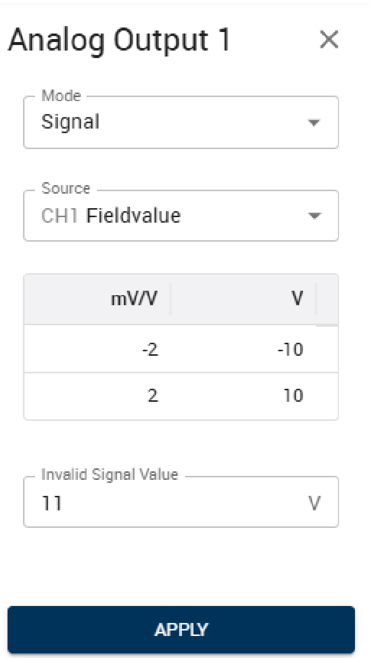


Fig. 13.7 Voltage output settings

The voltage outputs are parameterized in the **Analog Output → Analog Output 1-4** menu.

Any of three voltage output modes can be selected from the **Mode** dropdown menu.

- Disabled (factory setting)
- Test Signal
- Signal

If Disabled mode is selected, there is no voltage level at the output – the voltage output is inactive. In Test Signal mode, a user-defined constant voltage signal between ±11.5 V can be set. In Signal mode, a source signal can be selected from the **Source** dropdown menu. The following source signals are available:

- Source signals from channel 1-4
- Peak values 1-4
- Fieldbus values 1-4
- Capture values 1-4
- Summensignal
- Signalwerte für X- und Y-Koordinate

Information

The input box for the Invalid Signal Value defines which voltage signal should be output if the maximum values of ±11 V are exceeded. A value between ±11.5 V can be output.

13.2.2 Current output

The current outputs are parameterized in the **Analog Output → Analog Output 1-4** menu.

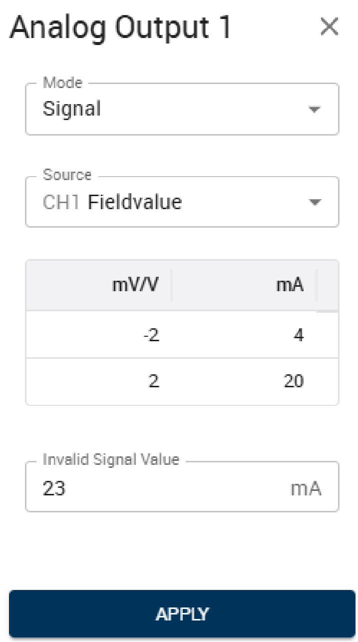


Fig. 13.8 Current output settings

Any of three current output modes can be selected from the **Mode** dropdown menu.

- Disabled (factory setting)
- Test Signal
- Signal

If **Disabled** mode is selected, there is no current at the output – the current output is inactive. In **Test Signal** mode, a user-defined constant current signal between 1 and 23 mA can be set. In **Signal** mode, a source signal can be selected from the **Source** dropdown menu. The following source signals are available:

- Source signals from channel 1-4
- Peak values 1-4
- Fieldbus values 1-4

- Capture values 1-4
- Summensignal
- Signalwerte für X- und Y-Koordinate

The current output is freely scalable between 2 and 22 mA. The desired measurement range for the scale can be set in the left-hand column of the scaling table. The desired span for the output current can be set in the right column of the scaling table.

Information

In the **Invalid Signal Value** *input box you define which current signal should be output if the maximum values 2 mA or 22 mA are exceeded. A value between 1 and 23 mA is output.*

14 FIELDBUS (INDUSTRIAL ETHERNET)

This chapter covers the process data, data accessing of the digiBOX object dictionary, as well as the settings of the fieldbus protocols.

14.1 Fieldbus protocol switching (web server)

The fieldbus settings can be made in the digi-BOX web server. The desired protocol can be selected in the **Fieldbus → Info** menu.

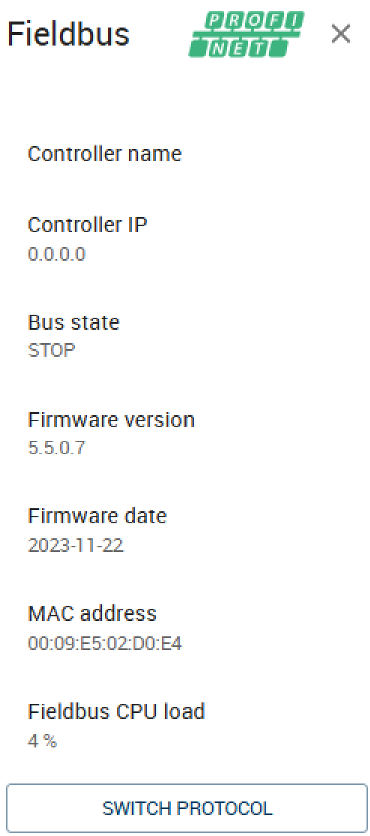


Fig. 14.1 Fieldbus settings, PROFINET defaults

The default protocol is PROFINET. Click the **Switch protocol** button to switch to the EtherCAT protocol and disable the fieldbus.

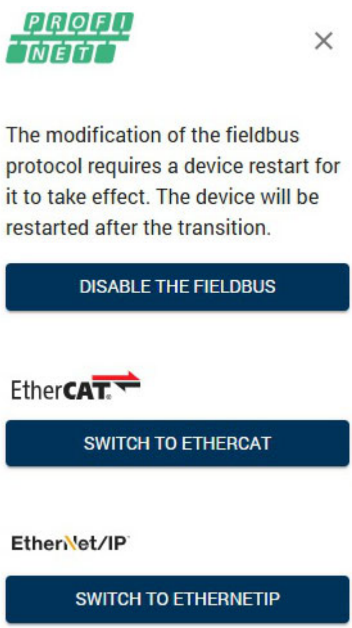


Fig. 14.2 Switch protocol, disable fieldbus

Information

When the protocol is switched the digiBOX automatically restarts.

14.2 Cyclic process data

Cyclic process data and acyclic on-demand data can be sent and received via the fieldbus. Cyclic and acyclic data can be of different types. The following table lists all the available data types of digiBOX objects.

Data type	Description
Zero	Zero element (no quantity)
F32	32 bits, floating-comma number (float)
F64	64 bits, floating-comma number (float)
I8	8 bits, signed integer
I16	16 bits, signed integer
I32	32 bits, signed integer

Data type	Description
I64	64 bits, signed integer
U8	8 bits, unsigned integer
U16	16 bits, unsigned integer
U32	32 bits, unsigned integer
U64	64 bits, unsigned integer
Boolean	Logical value, 0 or 1
String	Character string

Tab. 14.1 Data types used in the digiBOX

The process data sent from the controller to the digiBOX is listed in the following table.

Name	Data type	Function
CH1-4 control	U8	Channel-specific control bits, *see Tab. 14.3 "Channel control", page 120*.
CH1-4 offset	F32	Offsets of the strain gauge measurement channels. They can also be changed using the "Set zero" and "Reset zero" control bits. Not available for piezo channels.
Device ctrl bits	U32	Device-specific control bits, *see Tab. 14.4 "Device control bits", page 122*.
Parameter set	U8	Switches parameter sets.
Fieldbus flags	U8	Bits 4...7 are copied to user flag bits 4...7. This can be used to control functions in the digiBOX. Bits 0...3 have no function.
OS source A..D signal index	U16	Selecting measured values for oversampling channels A to D, *see Tab. 18.2 "Source signal indices", page 155.*
Fieldbus value 1..4	F32	Floating point values that can be used in the digiBOX. For output to an analog output for example, *see Tab. 18.2 "Source signal indices", page 155* (index 44-47).

Tab. 14.2 Process data from the controller to the digiBOX

The status bits of the channel control byte 1-4 are listed in the table below.

Bit #	Value	Function	Description
0	0x01	Piezo high range	Switches the piezo input range between high and low. Level-controlled. No function for strain gauge inputs.
1	0x02	Piezo reset active	Discharges the capacitor at the piezo input level-controlled. No function for strain gauge inputs.
2	0x04	Set zero	Zero the measured value. Edge-controlled. The digiBOX does not send an acknowledgment.
3	0x08	Reset zero	Cancels the zeroing. Edge-controlled. No function for piezo inputs.
4	0x10	Reset hold	Level-controlled (permanent zero for píezo inputs). No function for strain gauge inputs.

Tab. 14.3 Channel control

The process data sent from the digiBOX to the controller is listed in the following table.

Name	Data type	Function
ch1…4 signal status	U32	Status of the measurement channel, see "Channel status" table.
ch1…4 field value	F32	The unfiltered field value in mV/V (for strain gauges) or pC (for piezo transducers).
ch1…4 unfiltered	F32	The unfiltered process value in the target unit (e.g. N or kg).
ch1…4 filtered	F32	The filtered process value.
ch1…4 final value	F32	The final process value. For piezo "filtered". For strain gauges the zeroed value, where applicable, equal to "filtered" - "offset".
ch1…4 offset	F32	The offset for strain gauges. Not available for piezo.
ch1…4 control	U8	For piezo the control bits, see "Channel control" table. Not available for strain gauges.

Name	Data type	Function
Analog out 1…4	F32	The current value in V or mA of the analog outputs. These values should only be used if no error is indicated for the analog outputs in the error flags (0x4200.2).
Max 1…4 Min 1…4 Peak-to-peak 1…4	F32 F32 F32	The values of extreme value blocks 1 to 4.
System status	U32	System status bits, see object 0x4200.1 System status.
Error flags	U32	System error bits, see object 0x4200.2 System error.
User flags	U32	The system flags, see "System flags" table.
Current param set	U8	The number of the active parameter set.
Capture value 1…4	F32	Capture values 1 to 4.
Captured status 1…4	U32	The status of the capture value. See "Channel status" table.

Information

For strain gauge channels, the bits sent to the digiBOX are executed but not acknowledged!

The device control bits are listed in the table below.

Bit #	Value	Function	Description
0	0x00000001	Reset peak 1	Resets the extreme value (Max/ Min/Peak-to-peak).
1	0x00000002	Reset peak 2	
2	0x00000004	Reset peak 3	
3	0x00000008	Reset peak 4	
4	0x00000010	Fast track channel 1	Initializes the channel filters so that the filter output immediately assumes the value of the input. This can shorten lengthy filter settling times.
5	0x00000020	Fast track channel 2	
6	0x00000040	Fast track channel 3	
7	0x00000080	Fast track channel 4	
31	0x80000000	LED identify	The LEDs on the device flash to identify it.

Tab. 14.4 Device control bits

Important

To avoid aliasing, the transmitted signals should be filtered with a low-pass filter. The filter cut-off frequency must not exceed half of the send cycle.

Example:
The send cycle is 1 ms, i.e. 1000 Hz. The low pass should be set to a maximum of 500 Hz, preferably less.
Exception 1: If it is ensured that there are no frequency components of 500 Hz or more in the useful signal anyway, the filter can be omitted.
Exception 2: When oversampling, the full rate is transmitted at 40 kS/s with no sub-sampling. No anti-aliasing low pass is needed.

14.3 Acyclic data (object dictionary read/write)

You can use the two modules "Object Dictionary Read" and "Object Dictionary Write" to access each object in the object dictionary listed here. Depending on the object, it can either be read, written, or both.

In accordance with the method required by CiA461 and standard for CAN communication, the selection of the individual objects is based on Index and Subindex.

To be able to read a specific object, a write command must be written to the "Object Dictionary Read" module by the controller. Using object 0x3030 (Limit switch #1 mode) as an example, this can look as follows:

Module	R/W	Type	Number of bytes	Value
Object Dictionary Read	WO	OD Index	2	0x3030
		OD Subindex	1	02

As the response, the digiBOX sends the following object to the controller:

Module	R/W	Type	Number of bytes	Value
Object Dictionary Read	RO	OD Index	2	0x3030
		OD Subindex	1	02
		Error code	1	Error flags when reading or writing the object dictio-nary, see **Error flags table**
		Value	2	This shows the current value indicating the mode of limit switch 1

Important

After a request via the "Object Dictionary Read" module, send another request with OD index = 0x0000 and OD subindex = 0x00 and wait until the data appears in the response. Only then is the digiBOX ready for a new request.

Follow the same procedure to write a value to the object from the controller. To do this, send a write command from the controller to the digiBOX's "Object Dictionary Write" module, which might look like this based on the example of object 0x3030 (Limit switch #1 mode):

Module	R/W	Type	Number of bytes	Value
Object Dictionary Write	WO	OD Index	2	0x3030
		OD Subindex	1	02
		Value	2	e.g. 1 (to set "Hysteresis" mode)

As the response, the digiBOX sends the following object to the controller:

Module	R/W	Type	Number of bytes	Value
Object Dictionary Read	RO	OD Index	2	0x3030
		OD Subindex	1	02
		Error code	1	Error flags when reading or writing the object dictionary, see *Error flags table (Tab. 14.5)*

Important

After a request via the "Object Dictionary Write" module, send another request with OD index = 0x0000 and OD subindex = 0x00 and wait until the data appears in the response. Only then is the digiBOX ready for a new request.

The error flags when reading or writing the object dictionary are listed in the table below:

Bit	Flag [hex]	Function
0	0x01	Access error, e.g. attempt to write to a read-only device.
1	0x02	Format error, e.g. unsupported data type.
2	0x04	Not found. Object does not exist.
3	0x08	Object too large, the value does not fit in the response field (e.g. in the case of fields).
4	0x10	The value was truncated. The value is valid, but had to be truncated to fit into the response field (e.g. in the case of strings).
5	0x20	The value is invalid.

Tab. 14.5 Error flags when reading or writing the object dictionary

14.4 EtherCAT®

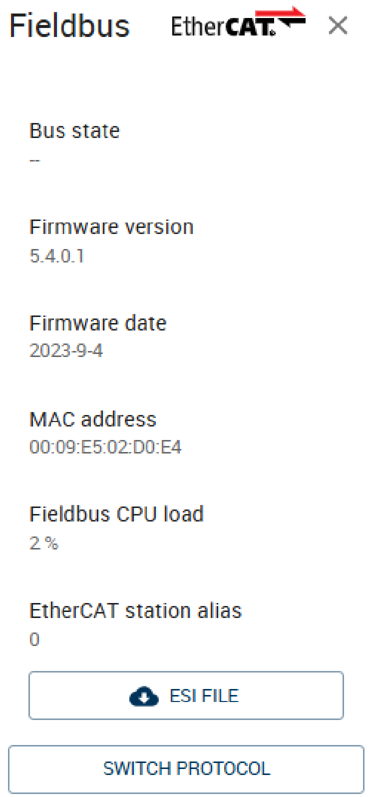


Fig. 14.3 Download ESI file

14.4.1 ESI file

The ESI file is generated by the digiBOX itself. The content depends on the installed measurement inputs, so it should be created anew for each digiBOX.

▶ In the user interface, click the **ESI file** button in the **Fieldbus** → **Info** menu. The file is generated, and downloaded to your PC's Downloads folder.

Operation mode

Operation mode (selected in EtherCAT master)	Synchronization	Supported cycle times
Free Run	No fixed cycle time	-
SM Sync	Sync Manager	>= 0.2 ms possible >= 0.25 ms recommended With short cycle times and large volumes of process data, pay attention to the digiBOX's load indicator!

Operation mode (selected in EtherCAT master)	Synchronization	Supported cycle times
DC Sync	Distributed Clock	0.25 / 0.5 / 1 / 2 / 4 ms
20 times oversampling	Distributed Clock	0.5 ms

Tab. 14.6 Operation mode

14.4.2 Distributed Clocks

The synchronization cycle of the SYNC 0 and SYNC 1 signals must be one of the following values: 0.25 / 0.5 / 1 / 2 / 4 ms

SYNC 1 must be on, and have the same rate as SYNC 0.

In TwinCAT it looks like this, for example:

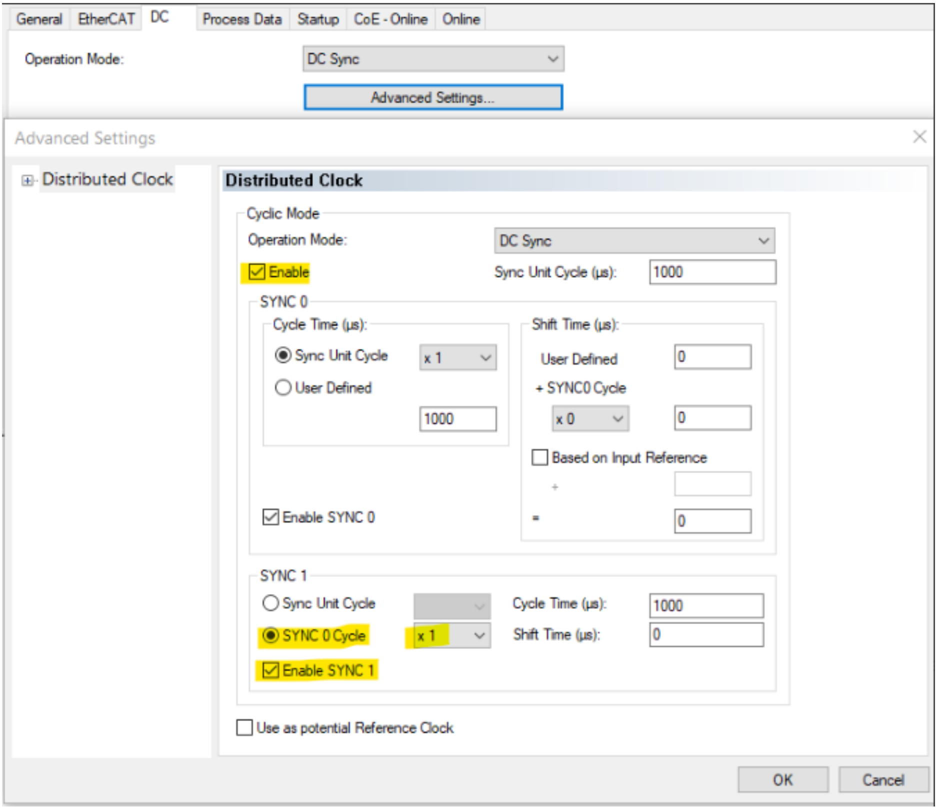


Fig. 14.4 Distributed Clocks in TwinCAT

14.4.3 Oversampling

When oversampling, the last 20 measured values are sent in an EtherCAT message. The receiver can seamlessly record up to four measurement channels at 40 kSamples/s, i.e. with no undersampling.

PDO assignment

Up to four signals can be included in the oversampling. The number is selected via Operation Mode.

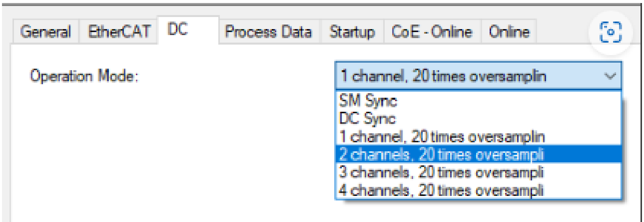


Fig. 14.5 Operation mode

The PDOs with the oversampling values are enabled automatically.

Over-sampling channel	Signal selection (master -> digiBOX)	20 oversampling values in PDOs (digiBOX -> master) Data type F32
A	OS source A signal index	0x1A20 … 1A33
B	OS source B signal index	0x1A40 … 1A53
C	OS source C signal index	0x1A60 … 1A73
D	OS source D signal index	0x1A80 … 1A93

Tab. 14.7 Oversampling

The oldest value of a channel is in the lowest PDO.

Signal selection

The output object 0x160c (Device Control) must be included in the process data for selection.

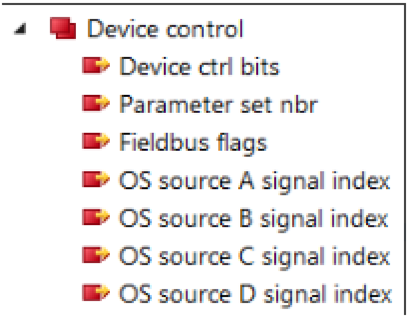


Fig. 14.6 Output objects

The desired signal index for oversampling channels A to D is sent to the digiBOX under "OS source A..D signal index". The indices are defined in the relevant table in *chapter 18.1 "Source signal indices", page 155*.

Example: The unfiltered process value of channel ch2 has the index 9.

Monitoring

Optionally, the input PDO 0x1A1F "OS sources" can be enabled (digiBOX -> master).

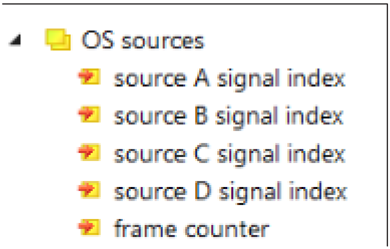


Fig. 14.7 OS sources

The four indices of the source signals are returned. The frame counter counts the transmitted EtherCAT messages. The value increases by one on each send cycle (0.5 ms). Overflow 0xFFFF -> 0x0000. This can be used to monitor the data stream.

Validity of values

Only the values without validity information are transmitted. Subindex "CH1..4 signal status" of the underlying measurement channel should be analyzed where necessary. It only ever indicates the status of the last value in the buffer however.

14.5 PROFINET

This chapter describes the specific integration of the digiBOX into PROFINET. First, the protocol in the digiBOX web server must be switched to PROFINET – *see chapter 14.1 "Fieldbus protocol switching (web server)", page 117*.

Information

The digiBOX's default protocol is PROFINET.

14.5.1 GSDML file

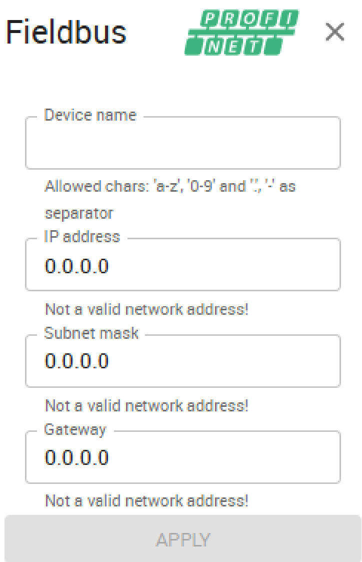


Fig. 14.8 Download GSD file

The GSDML file is generated by the digiBOX itself. The content depends on the installed measurement inputs, so it should be created anew for each digiBOX.

▶ In the user interface, click the **"GSD file"** → **Fieldbus** → **Settings** menu.

The file is generated, and downloaded to your PC's Downloads folder.

14.5.2 Oversampling

Measured values can be sent to the PROFINET controller at full rate (40 kSamples/s) using PROFINET too. The template is EtherCAT oversampling. Due to the processor load, with PROFINET oversampling is limited to one measurement channel.

Module (slot 14)	Send clock to be set in the controller	Number of values (of the oversampling channel) per PROFINET frame
Oversampling, 44 values	1 ms (1 kHz)	40 (plus 4 reserve)
Oversampling, 24 values	0.5 ms (2 kHz)	20 (plus 4 reserve)

Fig. 14.9 Oversampling

In order to use oversampling, exactly one of the "Oversampling" modules must be configured, and the corresponding Send clock set.

IRT mode should be selected. RT is also possible, but then data loss is more likely. When using RT, a point-to-point connection to the controller, with no other nodes in the network, is recommended.

In RT mode, the processing program in the controller should run at a higher rate than the Send clock. This will reduce the likelihood of frames being lost.

Submodules

▾ Oversampling, 44 values_1	0	14			Oversampling, 44 ...
Source value select	0	14 1	232...233	84...85	Source value select
Samples count	0	14 2	234...235		Samples count
Frame number	0	14 3	236...237		Frame number
padding word	0	14 4	238...239	86...87	padding word
Values	0	14 5	240...415		Values

Fig. 14.10 Submodules 1

Submodule	Access from the controller	Function
Source value select	read/write	The index of the signal transmitted with oversampling, see "Signal indices". This value must be set in the PROFINET controller.
Samples count	read	Number of valid values in the "Value" submodule. If the value is greater than 44 (at 1 ms) or 24 (at 0.5 ms), a buffer overflow has occurred. In this case, the values have been lost.
Frame number	read	Counts the PROFINET frames sent. The value increases by one on each send cycle. Overflow 0xFFFF -> 0x0000. This allows duplicate or omitted frames to be detected.
Padding word	read/write	No function. Used to align the following data to 4 divisible addresses.
Values	read	The oversampling values in Float32 format. The oldest value is at the lowest address.

Tab. 14.8 Submodules 2

Validity of values

The values are transmitted without validity information. The "Signal status" submodule of the "CH1..4 ..." modules of the underlying measurement channel should be analyzed where necessary. It only ever indicates the status of the last value in the buffer however.

14.6 EtherNet/IP™

14.6.1 Address assignment

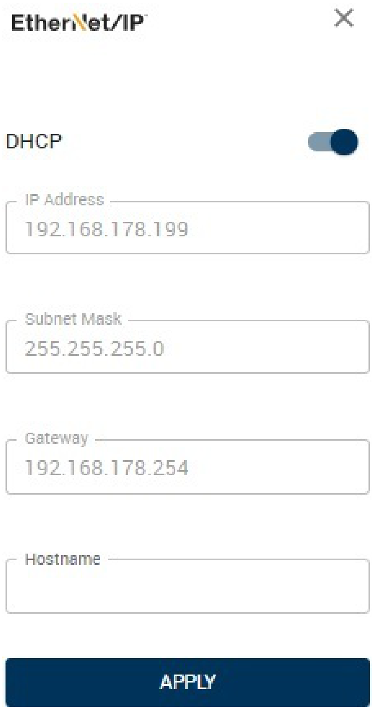


Fig. 14.11 DHCP – IP address assignment

The IP address settings can either be assigned automatically (DHCP) or permanently. DHCP is set ex works. The DHCP setting requires a DHCP server in the network. If 0.0.0.0 is displayed everywhere, then the address has not (yet) been assigned.

Information

BOOTP is not supported.

Fig. 14.12 Fixed IP address

If a fixed address is required, DHCP must be switched off and the required address must be entered. The subnet mask and gateway address must be valid; 0.0.0.0 is not permissible.

The host name is optional and has no other function.

To apply the setting, click twice on ***APPLY***. No changes can be implemented in the ***CONNECTED*** state.

14.6.2 Process data

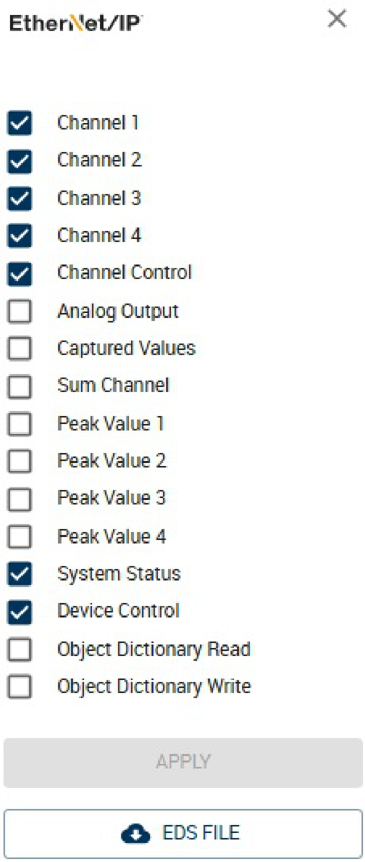


Fig. 14.13 Selected process data on a digiBOX with 4 measurement channels

The process data is selected via the digiBOX user interface and not via the EtherNet/IP™ scanner. The modules and process data to be transmitted are selected via the checkboxes. Every module contains several process data.

Changes are applied by clicking twice on ***APPLY***. No changes can be implemented in the ***CONNECTED*** state.

The EDS file for the EtherNet/IP™ scanner is then generated with the selected modules.

14.6.3 EDS file

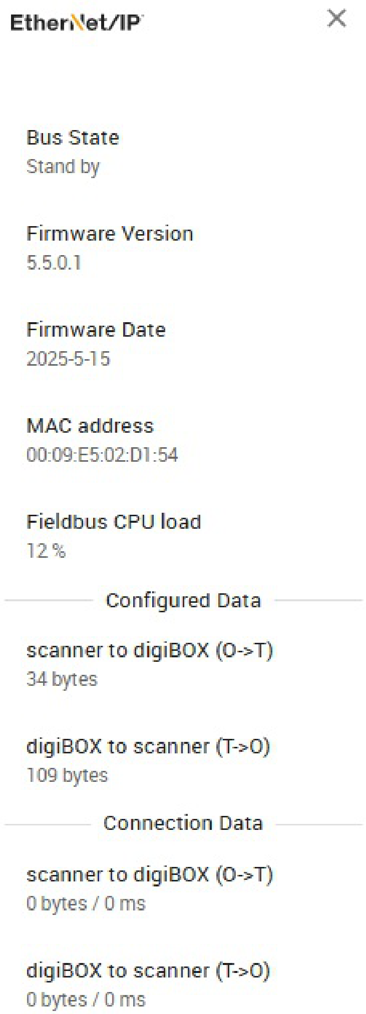


Fig. 14.14 Properties of the EtherNet/IP™ connection

The EDS file is generated by the digiBOX itself. The content is based on the selected process data.

Clicking on **EDS file** in the user interface of the **Fieldbus – Settings** menu will generate the EDS file and save it in the computer's Download folder.

The EDS file can be created and downloaded at any time by selecting **New EDS FILE**. The process data image is documented in the EDS file.

Important

After making changes to the process data, the file must be recreated and imported in the scanner.

The size of the process data can be checked in this view.

15 FLAG ACTIONS

15.1 User flags

The user flags represent states that can be either active (logical 1) or inactive (logical 0). The flags can be used to control various statistical and channel functions. It is also possible to trigger single or multiple functions using one or more flags. An overview of flag states is displayed in the web server's home screen, as shown below. Flags with a dark blue background are active; flags with a white background are inactive.

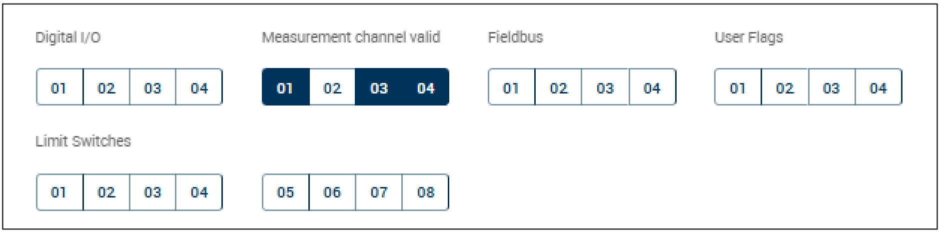


Fig. 15.1 digiBOX web server, example display of user flags

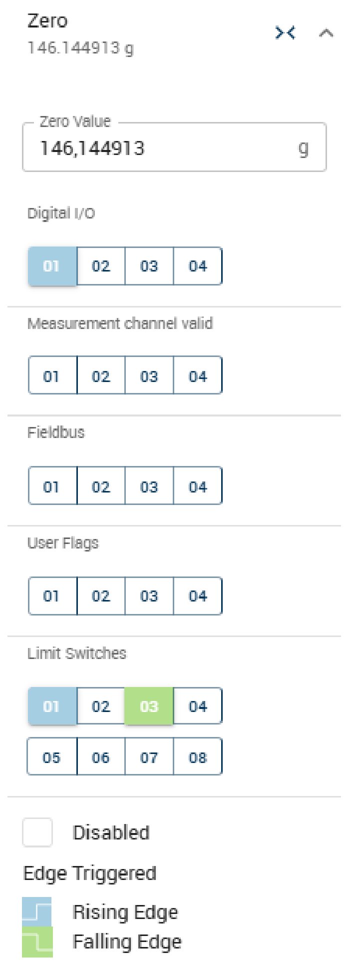


Fig. 15.2 Example, strain gauge channel zeroing by multiple flags

Example: Strain gauge channel zeroing by multiple user flags

The example of strain gauge channel zeroing shows how the Zero Set action can be triggered by multiple flags. In the adjacent screenshot, the following flags are set as triggers to initiate zeroing:

Digital I/O 1

As soon as the logical state of Digital I/O 1 changes from inactive (0) to active (1), this change in the state of the corresponding Digital I/O 1 flag is detected as a rising edge, and zeroing is triggered, regardless of whether the DIO channel mode is set to input or output.

Limit switch 1 (rising edge)

As soon as the logical state of the limit switch changes from inactive (0) to active (1), this change in the state of the corresponding Limit Switch 1 flag is detected as a rising edge, and zeroing is triggered.

Limit switch 3 (falling edge)

As soon as the logical state of the limit switch changes from active (1) to inactive (0), this change in the state of the corresponding Limit Switch 3 flag is detected as a falling edge, and zeroing is triggered.

Important

It is possible to set multiple trigger signal sources to control a single function. In this case, the functional control is always determined by the last trigger signal input.

The flags can be used to trigger statistical functions and settings in the strain gauge and piezo measurement channels. It is also possible to initiate multiple functions via the same user flag. The following functions can be triggered and controlled via the flags:

- **Zero** (strain gauge signal chain, edge-controlled)
- **Clear zero** (strain gauge signal chain, edge-controlled)
- **Software reset** (piezo signal chain, edge- and level-controlled)
- **Hardware reset** (piezo signal chain, level-controlled)
- **Reset peak values** (statistical function, edge-controlled)
- **Capture value** (statistical function, edge-controlled)
- **Reset capture value** (statistical function, edge-controlled)

The different functions of level-controlled and edge-controlled actions are described in the following table.

Signal type (trigger)	Description
Edge-controlled  Rising Edge Falling Edge	**Channel function: Edge-controlled functions are triggered once** Rising Edge: The measurement channel function is triggered when a rising edge is detected in the input signal. Falling Edge: The measurement channel function is triggered when a falling edge is detected in the input signal.
Level-controlled  High Low	**Channel function: Level-controlled functions can remain permanently active (e.g. HW/SW reset). They remain active as long as the level is high.** Rising Edge: The measurement channel function is triggered when a rising edge is detected in the input signal. Falling Edge: The measurement channel function is triggered when a falling edge is detected in the input signal.

Tip

The flags can also be used as source signals for the digital outputs.

Important

It is possible to set multiple trigger signal sources to control a single function. In this case, the functional control is always determined by the last trigger signal input.

The logical states of the user flags (status bits) are shown in the object dictionary object below.

Object dictionary user flag status					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
User flags (bits)	0x4210	01	U32	RO	This object contains the user flag status bits. The "User flags" table shows the order of status bits in the object.

The following table shows the arrangement of the status bits of user flag object 0x4210.

User flags		
Bit #	**Value**	**Description**
0	0x00000001	DIO 1
1	0x00000002	DIO 2
2	0x00000004	DIO 3
3	0x00000008	DIO 4
4	0x00000010	Fieldbus flag 1
5	0x00000020	Fieldbus flag 2
6	0x00000040	Fieldbus flag 3
7	0x00000080	Fieldbus flag 4
8	0x00000100	User flag 1
9	0x00000200	User flag 2
10	0x00000400	User flag 3
11	0x00000800	User flag 4
12	0x00001000	Valid-flag channel 1
13	0x00002000	Valid-flag channel 2
14	0x00004000	Valid-flag channel 3
15	0x00008000	Valid-flag channel 4
16	0x00010000	Limit switch 1
17	0x00020000	Limit switch 2
18	0x00040000	Limit switch 3

User flags		
Bit #	**Value**	**Description**
19	0x00080000	Limit switch 4
20	0x00100000	Limit switch 5
21	0x00200000	Limit switch 6
22	0x00400000	Limit switch 7
23	0x00800000	Limit switch 8

The criterion for determining the status of the respective flags depends on the underlying source signal. The individual flags and their source signals are described in the following.

Digital I/O

The flag Status of the digital I/O reflects the logical status (high or low) of the digital input/output, regardless of whether the DIO channel mode is set to input or output. You will find more information on the digital I/O protocol in *chapter 13.1 "Digital I/Os", page 108*.

Measurement channel valid

The measurement channel flag status depends on the channel status validity check of objects 0x2010, 0x2011. If the corresponding status bit 1 of the objects is logical 1, the corresponding status flag is set to active. If channel status bit 1 is set to logical 0, the status flag is set to inactive.

User Flags

The user flags status can be set directly by the user via the **User Flags** setting in the web server. The user flags can also be controlled via the object dictionary – see the following object:

Object dictionary – user flags (bits)					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
User Flags (bits 0 .. 3)	0x4210	04	U8	RW	The user flags can be read out and written with 0 or 1 for the bits 1-4. A bit with the logic value 1 corresponds to an active user flag. A bit with the logic status 0 means a deactivated user flag status.

Fieldbus flags

Four fieldbus flag status bits can be transmitted in the fieldbus process data. The status of the fieldbus flags is copied to user flag bits 4-7 (digiBOX fieldbus flags). This can be used to control functions in the digiBOX via the PLC.

Limit Switches

The limit switch status flag is set to active if the corresponding limit switch is set on (1). If the limit switch is set off (0) or undefined (-1), the corresponding flag status is disabled. You will find more information on this in *chapter 12.3 "Limit switches", page 95*.

16 PARAMETER SETS

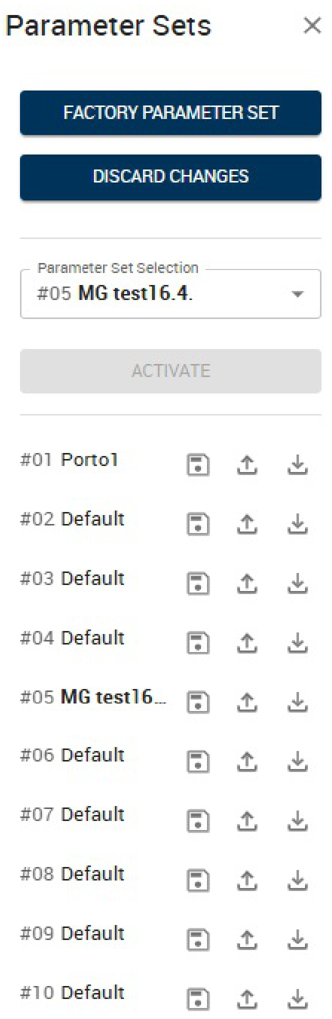


Fig. 16.1 Parameter sets, digiBOX web server

You can save up to 10 parameter sets using the **Parameter Sets** menu.

You can select the parameter set to activate in the **Parameter set selection** dropdown menu. Click on **Activate** to load the parameter set.

The switching time between two parameter sets is 100 ms plus the settling time of the set low-pass filters.

Click the Save icon (floppy disk) to save changes made in the web server in a parameter set.
An input box opens up in which you can enter the name of the parameter set. Click again on the checkmark to save the parameter set with the current settings.

If you would like to save the implemented changes in a different parameter set to the currently active one, this parameter set is automatically activated.

Important

Any unsaved parameter settings are lost when the device is rebooted or reset. Save the current settings to a parameter set first.

Will not be saved: The device name, network settings, and settings for the analog output, fieldbus, MQTT, and PTP.

Information

If you have made changes in the web server that have not yet been saved in the current parameter set, a small orange icon (bubble) appears on the Parameter Sets menu and at the top of the header. Any unsaved settings are lost when the web server connection is cut or the device is rebooted.

Click on the **Discard Changes** button to undo changes made in the web server. Click on the **Factory Parameterset** button to reset the active parameter set to the default.

Each parameter set can be downloaded individually. It is also possible to upload a saved parameter set to one of the ten parameter set positions.

It is also possible to switch parameter sets via the digital inputs – see *chapter 13.1.2 "Parameter set selection", page 110*.

Tip

You can download parameter sets and upload them to other devices. This enables efficient start-up commissioning of multiple devices.

17 ETHERNET PROTOCOLS (TCP/IP)

MQTT, openDAQ and openAPI (RestAPI) are implemented as protocols in the digiBOX. The dedicated ETH Ethernet connection enables the measurement data to be run via streaming (openDAQ) as well as read and write commands by accessing the object dictionary (MQTT, openAPI). The measurement data is outputted via the Ethernet connection parallel to the output via the analog outputs or digital I/O and the fieldbus. This makes it possible to operate the digiBOX in combination with a PLC, with parallel data output via the Ethernet port. The diagram below shows possible use cases of the digiBOX as an Edge signal conditioner for IT/OT applications.

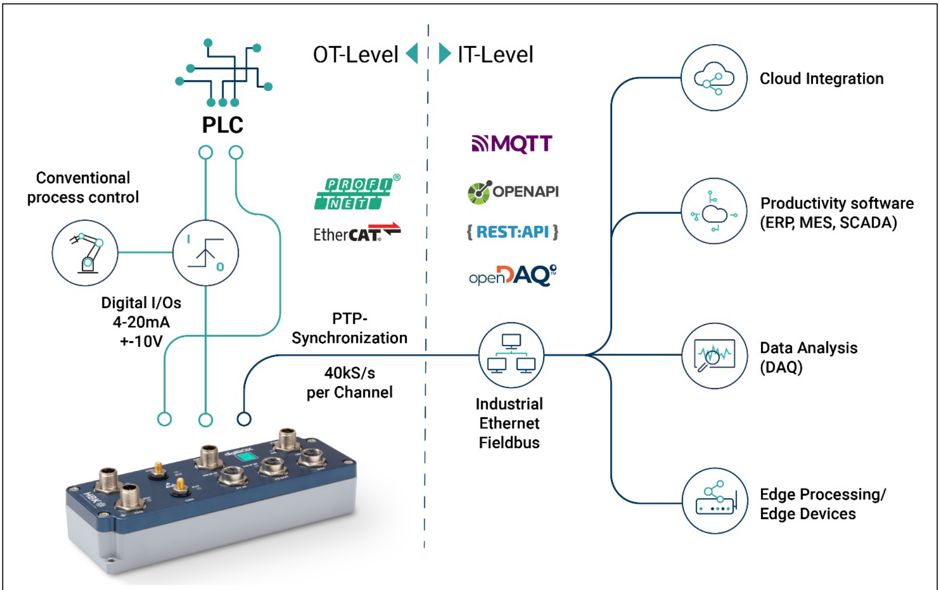


Fig. 17.1 digiBOX Edge signal conditioner with parallel IT/OT connectivity

17.1 Port enabling and data security

The corresponding ports must be enabled on the network in order to use the following digiBOX services. If you have any questions, contact your network administrator.

- Website, Streaming: 80 TCP
- UPnP: 1900 UDP
- mDNS: 5353, 5355 UDP
- HBM Device Discovery: 31416, 31417 UDP
- NTP: 123 UDP
- MQTT: any port between 1024 and 49151 TCP (TSL-encrypted)

Important

The transfer of commands and data is not encrypted or secure (no https). You should therefore run the digiBOX only on an internal network with no Internet connection or, if Internet access is required, connect via a VPN tunnel.
Only the digiBOX's MQTT protocol is TSL-encrypted.

17.2 MQTT

The digiBOX acts as an MQTT client, and supports protocol version V3.1.1 of the MQTT standard. TLS (Transport Layer Security) version 1.2 is implemented as the security standard. The maximum data transfer rate (sample rate) is 1 second.

The digiBOX supports two MQTT client access methods: cyclic data transfer and on-demand data via JSON-RPC. First, the general settings of the digiBOX MQTT client are detailed. Next, the two operating modes – cyclic data transfer and on-demand JSON-RPC data – are explained.

17.2.1 MQTT client settings (general)

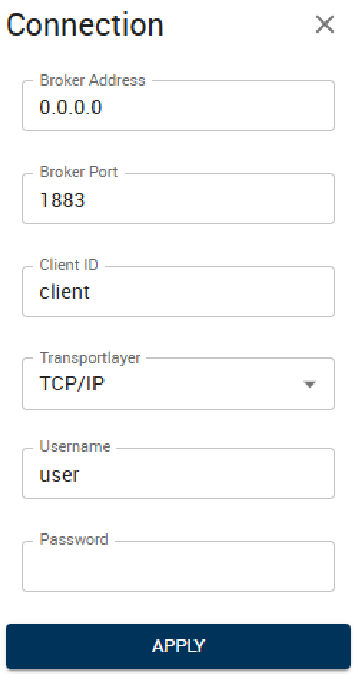


Fig. 17.2 MQTT, digiBOX client connection settings

The MQTT client settings can be made in the digiBOX web server, on the **MQTT** tab in the sidebar. Shown here is an overview of the connection settings that can be made in the **MQTT → Connection** submenu.

Enter the URL (IP address) of the MQTT broker in the **Broker Address** input box. Enter the port of the MQTT broker in the **Broker Port** box. Choose any client ID for the digiBOX and enter it in the **Client ID** box.

Important

To make an MQTT connection with a broker via a URL, you must specify a DNS server. If the digiBOX is set to DHCP, a DNS server is set automatically. If a static IP address is set, the DNS server must also be set manually.
The client ID used must be MQTT-compliant. Letters (A-Z, upper and lower case; no umlauts), numbers (0-9) and dashes are allowed. The total length must not exceed 23 characters.

From the **Transportlayer** dropdown menu you can select the TLS/SSL or TCP/IP encryption method for the connection to the MQTT broker. The required method is determined by the broker. It may be necessary to assign a user name and password in the MQTT broker settings. You can do this in the relevant **User** and **Password** input boxes.

Important

To make an MQTT connection with a broker via TLS encryption, an NTP server must be set. If the digiBOX is set to DHCP, an NTP server is set automatically. If a static IP address is set, the NTP server must also be set manually.

17.2.2 Cyclic data transfer

In cyclic topic data mode, up to four objects from the digiBOX object dictionary can be transferred cyclically to an MQTT broker.

The screenshot below shows the application settings of the digiBOX MQTT client.

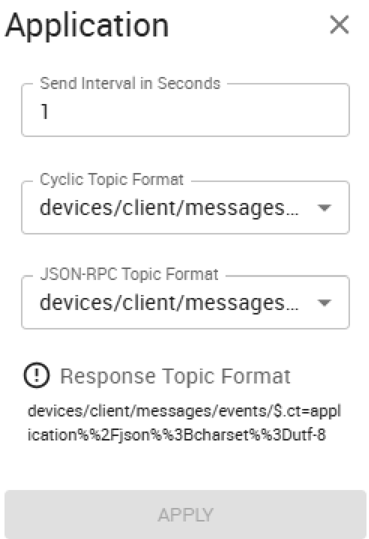


Fig. 17.3 Application settings, digiBOX MQTT client

In the **Send Interval in Seconds** input box you can set the update rate for data transfer to the MQTT broker. The maximum possible cyclic data transfer rate is 1 second.

Choose the desired/required topic format from the **Cyclic Topic Format** dropdown menu. The selected topic format determines the syntax which must be used on the broker and client side in order to subscribe to cyclic data from the digiBOX client.

The possible choices of topic format for cyclic data transfer are listed below.

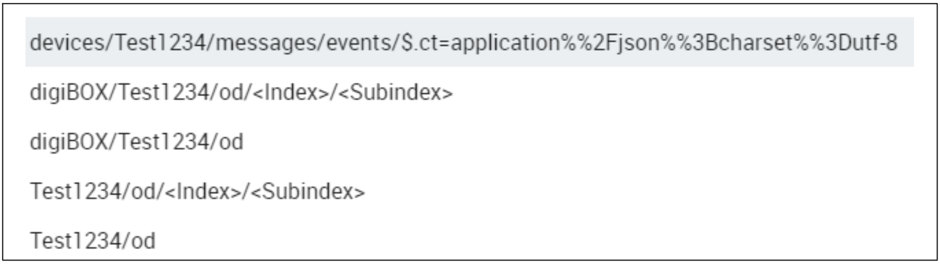


Fig. 17.4 Cyclic data, topic formats, syntax as per selected client ID "Test1234"

Important

The selected client ID is also used in the syntax of the topic formats for the cyclic topic data as well as for the JSON-RPC topic format. In the example above, the client ID "Test1234" was selected.
The values for <Index> and <Subindex> in the topic format are in hexadecimal format.

Information

For MQTT brokers on the Microsoft Azure Cloud (IoT Hub) the topic format to be used is predefined. When connecting to a Microsoft Azure broker, please use the first topic format in the pick list.

The submenu for selecting the cyclic data **MQTT → Cyclic Data** is shown below.

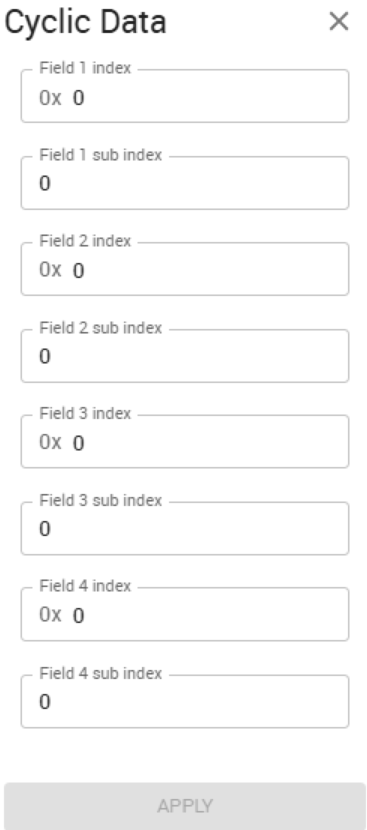


Fig. 17.5 MQTT settings, cyclic data

Up to four object entries can be selected to be sent to the MQTT broker or the clients for transfer of cyclic data. The objects are entered in hexadecimal format according to the syntax from the object dictionary.

The object values in the cyclic data and in JSON-RPC mode are outputted in JSON format, regardless of the data format of the object. The table below lists the relevant data types of the digiBOX object dictionary and the corresponding JSON formats.

digiBOX object dictionary data types	JSON format	Description
Zero	null	Zero element (no quantity)
F32	number	32 bits, floating-comma number (float)
F64	number	64 bits, floating-comma number (float)
I8	number	8 bits, signed integer
I16	number	16 bits, signed integer
I32	number	32 bits, signed integer
I64	number	64 bits, signed integer
U8	number	8 bits, unsigned integer
U16	number	16 bits, unsigned integer
U32	number	32 bits, unsigned integer
U64	number	64 bits, unsigned integer
Boolean	bool	Logical value, 0 or 1
String	string	Character string

17.2.3 On-demand data access (read/write)

Clients and the broker can send requests to the digiBOX in JSON-RPC mode. A request corresponds to a read/write command, and can be applied to all available objects in the digiBOX object dictionary. The digiBOX client sends a confirmation to the requester (client, broker) by a dedicated response mechanism.

The topic format for on-demand data access is selected in the **JSON-RPC Topic Format** dropdown menu.

```
devices/Test1234/messages/devicebound/#
digiBOX/Test1234/jsonrpc/request
Test1234/jsonrpc/request
```

The digiBOX subscribes to the selected request topic. The client wishing to read or write on-demand data publishes on the selected request topic format.

The digiBOX supports the two JSON-RPC methods odwrite and odread. Below is an example of a write and read command according to the JSON RPC syntax.

JSON-RPC syntax (odwrite example):
{"jsonrpc": "2.0", "id":"df","method":"odwrite", "params":{"index": 17024, "subindex": 1, "value": "test"}}

JSON-RPC syntax (odread example):
{"jsonrpc": "2.0", "id":23,"method":"odread", "params":{"index": 17024, "subindex": 1}}

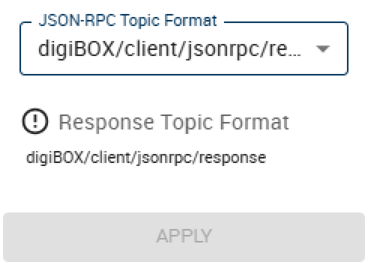
Important

Batches are not supported.

More information on transmission of the JSON-RPC protocol can be found in the relevant specification at https://www.jsonrpc.org/specification.

Information

On-demand data sent via the JSON-RPC protocol is transferred in JSON format. The relevant JSON formats are listed in the table in chapter 17.2.2 "Cyclic data transfer", page 147.



Below the dropdown menu, when you select a JSON-RPC request topic format a specific response topic format is displayed which must be used in order to subscribe to the digiBOX MQTT client's confirmation of a request.

Fig. 17.6 Response topic format

The request and response topic formats cannot be set independently of each other. The example above shows the specific response topic format corresponding to the JSON-RPC topic format selected from the dropdown menu.

17.3 openDAQ

openDAQ is a user-friendly software development kit (SDK). It allows users to easily find, set up and collect data from any openDAQ-compatible device using common programming environments such as C++, C#, Python, etc. The openDAQ SDK is versatile, and designed to work on different operating systems such as Linux, Windows and macOS, making it accessible to any host computer.

The digiBOX fulfills openDAQ compliance level C, and as such enables data streaming (openDAQ Streaming LT) and device discovery. Data streaming allows transmission of the 40 kS/s sample rate per measurement channel. Device discovery is based on mDNS (multicast DNS) for IPv4 networks.

The following openDAQ transmission parameters can be displayed in the **openDAQ** tab in the digiBOX web server:

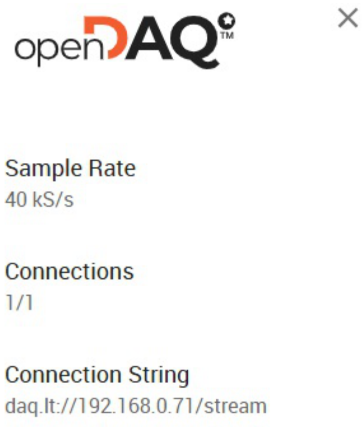


Fig. 17.7 openDAQ transmission parameters

All information about the openDAQ SDK, and its integration, can be found at https://opendaq.com.

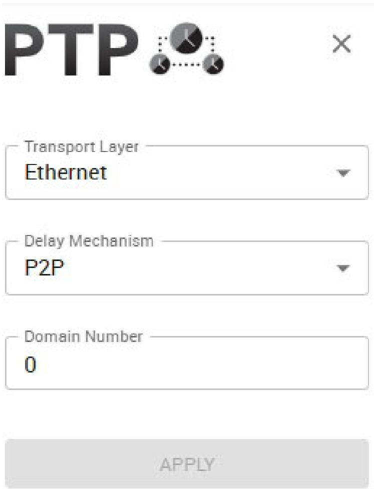
Information specific to integration of the SDK in the C#, C++ and Python programming environments can be found behind the following link in the User Guide section: https://docs.opendaq.com.

The download folder for the specifications and bindings can be found at https://docs-dev.opendaq.com.

Information

You will find Application Notes, with sample projects, on the digiBOX Industrial website at www.hbkworld.com/digibox-industrial.

17.4 PTP synchronization



The Precision Time Protocol (PTP) can be used to control the sampling times synchronization of the digiBOX measurement acquisition. The sync signal is transferred to the Ethernet port and comes from a PTP master clock, e.g. a GPS receiver. The Transport Layer, Delay Mechanism, and Domain Number transmission parameters are set here.

Information

The Internal Clock, Fieldbus Master, or PTP Master synchronization method is set in the amplifier menu (see chapter ??, page ??). In the factory setting, the synchronization is implemented by the internal clock.

18 OBJECT DICTIONARY

The object dictionary of the digiBOX contains all objects required for function control, and for reading and writing to the signal output and the device parameterization.
The object dictionary can be read and written via the MQTT and RestAPI (openAPI) protocols, as well as via the fieldbus protocols.

An Excel file (csv) of the complete device-specific object dictionary can be downloaded from the digiBOX web server in the **Object dictionary** menu. This file lists the index, subindex, data type, array length and read-only or read/write access type, as well as a brief function description, for each object.

The digiBOX objects can use the following data formats:

Data type	Description
Zero	Zero element (no quantity)
F32	32 bits, floating-comma number (float)
F64	64 bits, floating-comma number (float)
I8	8 bits, signed integer
I16	16 bits, signed integer
I32	32 bits, signed integer
I64	64 bits, signed integer
U8	8 bits, unsigned integer
U16	16 bits, unsigned integer
U32	32 bits, unsigned integer
U64	64 bits, unsigned integer
Boolean	Logical value, “true” or “false”
String	Character string

Tab. 18.1 Data formats in the object dictionary

Some of the key objects are listed below, with a description of their functions.

Important

Objects not listed in the operating manual are included in the complete object dictionary listing in csv file format downloadable from the digiBOX web server's "Object dictionary" menu.

18.1 Source signal indices

Some objects are used to set the source signals, such as for the analog output or the statistical functions. The following table provides an overview of the indices of available source signals.

Index	Signal
0...3	(reserved)
4...7	Field values (mV/V or pC), channels 1-4
8...11	Unfiltered process values (based on user scaling in N, kg, ...), channels 1-4
12...15	Process values (gross values for strain gauges) after filter 1, channels 1-4
16...19	Process values (gross values for strain gauges) after filter 2, channels 1-4
20...23	Process values following both filter levels, channels 1-4 (only available in the strain gauge signal chain)
24...27	Final values after zeroing, channels 1-4
28...31	Offset (zero values), channels 1-4 (only available in the strain gauge signal chain)
32...35	Maximum values 1-4
36...39	Minimum values 1-4
40...43	Peak-to-peak values 1-4
44...47	Fieldbus values 1-4
48...51	Capture values 1-4
52	Index 52 permanently returns 0.0 if "No input" is to be selected

Tab. 18.2 Source signal indices

18.2 Flag actions

A number of statistical and measurement channel functions can be triggered and controlled by activating flags. Each bit in the U32 value of an object for channel control or a statistical function has a specific meaning, and can be set or cleared independently of the other bits in order to control various functions. The flag actions that trigger the corresponding objects are determined by writing to the bitmasks of the objects concerned. The table below provides an overview, with their associated positions in the bitmask.

Bit #	Value	Description
0	0x00000001	DIO 1
1	0x00000002	DIO 2
2	0x00000004	DIO 3

Bit #	Value	Description
3	0x00000008	DIO 4
4	0x00000010	Fieldbus flag 1
5	0x00000020	Fieldbus flag 2
6	0x00000040	Fieldbus flag 3
7	0x00000080	Fieldbus flag 4
8	0x00000100	User flag 1
9	0x00000200	User flag 2
10	0x00000400	User flag 3
11	0x00000800	User flag 4
12	0x00001000	Valid-flag channel 1
13	0x00002000	Valid-flag channel 2
14	0x00004000	Valid-flag channel 3
15	0x00008000	Valid-flag channel 4
16	0x00010000	Limit switch 1
17	0x00020000	Limit switch 2
18	0x00040000	Limit switch 3
19	0x00080000	Limit switch 4
20	0x00100000	Limit switch 5
21	0x00200000	Limit switch 6
22	0x00400000	Limit switch 7
23	0x00800000	Limit switch 8

Tab. 18.3 digiBOX Industrial, flag signals

Example:
To trigger a statistical function via DIO1 and DIO3, you can write to the object with a matching bitmask 0x00000005 (hexadecimal). According to the table above, this means that bit 0 and bit 2 are set to logical 1, which enables DIO 1 and DIO 3.

18.3 System and device status

Object dictionary system/status					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
System status (bits)	0x4200	01	U32	RO	The individual status bits can be read out by extracting the specific status bitmasks (hexadecimal notation): SYSSTA_HEARTBEAT = 0x00000001, SYSSTA_DEVICE_READY = 0x00000002, SYSSTA_DIO_READY = 0x00000100, SYSSTA_ETH_LINK_UP = 0x00000200, SYSSTA_STREAMING_OPEN = 0x00000400, SYSSTA_PROFINET_AR_OPEN = 0x00000800, SYSSTA_ETHERCAT_OPEN = 0x00001000, EtherCAT AL state > INIT SYSSTA_ETHERNETIP_OPEN = 0x00002000, SYSSTA_MQTT_ESTABLISHED = 0x00004000, SYSSTA_NTP_RECEIVED = 0x00008000 SYSSTAT_PTP_SYNCHRONUZED = 0x00010000 SYSSTAT_Meas.val_SYNCHRONIZED = 0x00020000 An explanation of the system status bits can be found in *chapter 7.2.1 "Device and error status", page 50*
System error (bits)	0x4200	02	U32	RO	The individual error bits can be read out by extracting the specific error bitmasks (hexadecimal notation): SYSERR_DEVICE_ERROR= 0x80000000 SYSERR_DAC_POWER = 0x00000001, SYSERR_DAC_ALARM = 0x00000002, SYSERR_DIO_FAULT = 0x00000004, SYSERR_SLOT_DATA_XFER = 0x00000008, SYSERR_CH1+2_EXC_VOLTAGE = 0x00000010, SYSERR_CH3+4_EXC_VOLTAGE = 0x00000020, SYSERR_PWR.SUPPLY__FAULT = 0x00000040, SYSERR_ANALOG_FAULT = 0x00000080, An explanation of the system error bits can be found in *chapter 7.2.1 "Device and error status", page 50*

Object dictionary system/status					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
SYS LED mode	0x4200	05	U16	RO	The System and Channel (1-4) LED modes are defined by the following status definitions and are addressed by the values 0-16 for each LED: LED_MODE_OFF = 0 LED_MODE_SOLID_RED = 1 LED_MODE_SOLID_GRN = 2 LED_MODE_SOLID_YEL = 3 LED_MODE_FLASH_RED = 4 (0.5s on; 0.5s off; 1hz) LED_MODE_FLASH_GRN = 5 (0.5s on; 0.5s off; 1hz) LED_MODE_FLASH_YEL = 6 (0.5s on; 0.5s off; 1hz) LED_MODE_FLASH_RED_GRN = 7 (each color 0.5s on; 1hz) LED_MODE_FLASH_FAST_RED = 8 (0.1s on; 0.1s off; 5hz) LED_MODE_FLASH_FAST_GRN = 9 (0.1s on; 0.1s off; 5hz) LED_MODE_FLASH_FAST_YEL = 10 (0.1s on; 0.1s off; 5hz) LED_MODE_FLASH_FAST_RED_GRN = 11 (each color 0.1s on; 5hz) LED_MODE_FLASH_DOUBLE_RED = 12 (two short blinks, then pause; 1hz) LED_MODE_FLASH_DOUBLE_GRN = 13 (two short blinks, then pause; 1hz) LED_MODE_FLASH_DOUBLE_YEL = 14 (two short blinks, then pause; 1hz) LED_MODE_FLASH_DOUBLE_RED_GRN = 15 (each color short blink, then pause; 1hz) LED_MODE_SYSTEM_STATE = 16 (mode defined by system state (default))
CHx LED mode	0x4201	01…04	U16	RO	
LED identify timer	0x4200	06	U16	RW	Write n to let all LEDs flash for n/10 seconds of duration with LED_MODE_FLASH_FAST_GRN mode.

Object dictionary channel/status					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
CH1-2 signal status (bits)	0x2010	01 ... 02	U32	RO	The individual signal status bits from CH1 and CH2 can be read out by extracting the specific status bits (hexadecimal notation): Valid = 0x00000001 ADC error = 0x00000002 Overload = 0x00000004 Underload = 0x00000008 PZ low range (PZ only) = 0x00001000 PZ high range (PZ only) = 0x00002000 Invalid user scaling parameters = 0x00100000 hardware reset active (PZ only) = 0x00400000
CH3-4 signal status (bits)	0x2011	01 ... 02	U32	RO	The individual signal status bits from CH3 and CH4 can be read out by extracting the specific status bits (hexadecimal notation): Valid = 0x00000001 ADC error = 0x00000002 Overload = 0x00000004 Underload = 0x00000008 PZ low range (PZ only) = 0x00001000 PZ high range (PZ only) = 0x00002000 Invalid user scaling parameters = 0x00100000 hardware reset active (PZ only) = 0x00400000

Object Dictionary - Measuring value synchronization settings					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Measuring value Sync	0x1300	01	U16	RW	Synchronization for measuring value sampling 0 = Internal clock 1 = PTP 2 = Fieldbus

Object Dictionary - Teach-In settings					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
CH1...4 Enable user-scaling	0x2120	01...04	BOOL	RW	Activate/deactivate user scaling
CH1...4 Raw mean, nbr of samples	0x2115	01...04	U32	RW	Number of samples for calculating the raw-mean value (only for user-calibration)
CH1...4 Raw mean value	0x2116	01...04	FLOAT	RO	Raw mean value (for user-calibration only)

18.4 Strain gauge channels

Object dictionary – strain gauge channel source signals					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
CH1-2 Field value	0x2014	01 .. 02	FLOAT	RO	Field value (=electrical value mV/V) of the corresponding strain gauge channel 1-2
CH3-4 Field value	0x2015	01 .. 02	FLOAT	RO	Field value (=electrical value mV/V) of the corresponding strain gauge channel 3-4
CH1-2 Process value unfiltered	0x2016	01 .. 02	FLOAT	RO	Unfiltered process value of the corre-sponding piezo channel 1-2 after user scaling
CH3-4 Process value unfiltered	0x2017	01 .. 02	FLOAT	RO	Unfiltered process value of the corre-sponding piezo channel 3-4 after user scaling
CH1-2 Process value filter 1	0x2018	01 ... 02	FLOAT	RO	Process value after filter stage 1 (gross value) of the corresponding strain gauge channel 1-2
CH3-4 process value filter 1	0x2019	01 ... 02	FLOAT	RO	Process value after filter stage 1 (gross value) of the corresponding strain gauge channel 3-4
CH1-2 Zeroing value	0x201C	01 .. 02	FLOAT	RO	Offset value of the corresponding strain gauge channel 1-2

Object dictionary – strain gauge channel source signals					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
CH3-4 Zeroing value	0x201D	01 .. 02	FLOAT	RO	Offset value of the corresponding strain gauge channel 3-4
CH1-2 Final value	0x201E	01 .. 02	FLOAT	RO	Final value after filter stage 2 for channel 1-2. The final value after zeroing.
CH3-4 Final value	0x201F	01 .. 02	FLOAT	RO	Final value after filter stage 2 for channel 3-4. The final value after zeroing.

Object dictionary – strain gauge channels zero set, zero reset					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
CH1-4 SG Zeroing set zero	0x2130	01 .. 04	ZERO	WO	Using RestAPI, MQTT write "null" to set zero. Using the fieldbus it does not matter what is written in the fieldbus container.
CH1-4 SG Zeroing reset zero	0x2031	01 .. 04	ZERO	WO	Using RestAPI, MQTT write "null" to reset zero. Using the fieldbus it does not matter what is written in the fieldbus container.
CH1-4 SG Zeroing offset	0x2032	01 .. 04	FLOAT	RW	A user defined offset value can be entered for the corresponding strain gauge channels 1-4.

Object dictionary – strain gauge channels zero set flag actions					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
CH1 SG Set zero flags (bits)	0x2408	01	U32	RW	Write the bits from *chapter 18.2 "Flag actions", page 155* that should trigger the zero set of channel 1
CH1 SG Set zero level (bits)	0x2408	03	U32	RW	Bit =1: zero on rising edge Bit = 0: zero on falling edge
CH2 SG Set zero flags (bits)	0x2409	01	U32	RW	Write the bits from *chapter 18.2 "Flag actions", page 155* that should trigger the zero set of channel 2

Object dictionary – strain gauge channels zero set flag actions					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
CH2 SG Set zero level (bits)	0x2409	03	U32	RW	Bit =1: zero on rising edge Bit = 0: zero on falling edge
CH3 SG Set zero flags (bits)	0x240a	01	U32	RW	Write the bits from *chapter 18.2 "Flag actions", page 155* that should trigger the zero set of channel 3
CH3SG Set zero flags (bits)	0x240a	03	U32	RW	Bit =1: zero on rising edge Bit = 0: zero on falling edge
CH4 SG Set zero Flags (bits)	0x240b	01	U32	RW	Write the bits from *chapter 18.2 "Flag actions", page 155* that should trigger the zero set of channel 4
CH4 SG Set zero Flags (bits)	0x240b	03	U32	RW	Bit =1: zero on rising edge Bit = 0: zero on falling edge

Object dictionary – strain gauge channels zero reset flag actions					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
CH1 SG Reset zero Flags (bits)	0x240c	01	U32	RW	Write the bits from *chapter 18.2 "Flag actions", page 155* that should trigger the zero reset of channel 1
CH1 SG Reset zero level (bits)	0x240c	03	U32	RW	Bit =1: zero reset on rising edge Bit = 0: zero reset on falling edge
CH2 SG Reset zero Flags (bits)	0x240d	01	U32	RW	Write the bits from *chapter 18.2 "Flag actions", page 155* that should trigger the zero reset of channel 2
CH2 SG reset zero level (bits)	0x240d	03	U32	RW	Bit =1: zero reset on rising edge Bit = 0: zero reset on falling edge
CH3 SG reset zero Flags (bits)	0x240e	01	U32	RW	Write the bits from *chapter 18.2 "Flag actions", page 155* that should trigger the zero reset of channel 3
CH3 SG reset zero level (bits)	0x240e	03	U32	RW	Bit =1: zero reset on rising edge Bit = 0: zero reset on falling edge

Object dictionary – strain gauge channels zero reset flag actions					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
CH4 SG reset zero Flags (bits)	0x240f	01	U32	RW	Write the bits from *chapter 18.2 "Flag actions", page 155* that should trigger the zero reset of channel 4
CH4 SG reset zero level (bits)	0x240f	03	U32	RW	Bit =1: zero reset on rising edge Bit = 0: zero reset on falling edge

18.5 TEDS status and error messages (DMS channels only)

Object Dictionary – TEDS Status and Error Code				
Index	**Sub-index**	**Type**	**Access**	**Description**
0x5F0F	1 … 4 (dependent on channel index)	Unit16	RO	See below

Status	Bit	Description
No TEDS found	0	Check that the TEDS module is correctly connected, if one is installed.
1-Wire	2	1-wire TEDS module detected.
Zero-Wire	3	Zero-wire TEDS module detected.
Invalid TEDS data	4	The TEDS module contains invalid data. Check the entries in the TEDS module (requires different hardware).
TEDS active/OK	5	All supported templates in the TEDS module have been read and the parameters are set.
Configuration failed	6	The settings in the TEDS module could not be set. Check the settings in the TEDS module – a sensor type or scaling that is not supported (requires different hardware) may be specified.
Read error	7	The TEDS module could not be read.

Status	Bit	Description
Checksum error	8	The information in the TEDS module contains errors and cannot be evaluated. Try to save the TEDS information in the module again.
No TEDS data	9	The TEDS module does not yet contain any data; the first 56 bytes are 0 or 255 (new unwritten module).

18.6 Piezo channels

Object dictionary – piezo channel source signals					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
CH1-2 Field value	0x2014	01 .. 02	FLOAT	RO	Field value of the corresponding piezo channel 1-2
CH3-4 Field value	0x2015	01 .. 02	FLOAT	RO	Field value of the corresponding piezo channel 3-4
CH1-2 Process value unfiltered	0x2016	01 .. 02	FLOAT	RO	Unfiltered process value of the corre-sponding piezo channel 1-2 after user scaling
CH3-4 Process value unfil-tered	0x2017	01 .. 02	FLOAT	RO	Unfiltered process value of the corre-sponding piezo channel 3-4 after user scaling
CH1-2 Pprocess value filter 1	0x2018	01 ... 02	FLOAT	RO	Process value after filter stage 1 of the corresponding piezo channel 1-2
CH3-4 Process value filter 1	0x2019	01 ... 02	FLOAT	RO	Process value after filter stage 1 of the corresponding piezo channel 3-4
CH1-2 Final value	0x201E	01 .. 02	FLOAT	RO	Final value of the piezo signal chain after zeroing (reset/operate) for channel 1-2.
CH3-4 Final value	0x201F	01 .. 02	FLOAT	RO	Final value of the piezo signal chain after zeroing (reset/operate) for channel 3-4

Object dictionary – charge amplifier, capacitor range status and switching					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
CH1-4 Enable high range	0x2108	01 .. 04	BOOL	RW	If the status bit is logical 0 the low range capacitor is currently active. If the status bit is logical 1 the high range capacitor is active.

Object Dictionary – charge amplifier, hardware reset					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
CH1-4 Enable hard-ware reset	0x2107	01 .. 04	BOOL	RW	If the status bit is logical 0 then the charge amplifier is in the measurement mode. If the status bit is logical 1 the hardware reset is enabled and held (reset mode).

Object dictionary – software reset and software reset hold					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Software reset CH 1-4	0x2106	01 .. 04	ZERO	WO	Initiate the software reset for piezo chan-nels 1-4 by writing null (edge-controlled action)
Software Reset Hold CH1-4	0x210A	01 .. 04	BOOL	RW	Set hold zero for piezo channels 1-4 (level-controlled action): (false) inactive (true) active

Object dictionary – drift parameter adjustment					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Measure drift parameter	0x2117	01 .. 04	U32	R/W	Write number of samples for processing Write the number of samples "400000" to initiate the drift parameter adjustment over 10 seconds Read returns the number of samples already processed to indicate the progress of the adjustment

18.7 Statistic functions (peak limit values and capture values)

Object dictionary - source signals – captured values					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Capture Value 1 source signal index	0x2501	00	U16	RW	Set the signal source for the capture value functions. The possible source signal indices are listed in *chapter 18.1 "Source signal indices", page 155*.
Capture Value 2 source signal index	0x2502	00	U16	RW	
Capture Value 3 source signal index	0x2503	00	U16	RW	
Capture Value 4 source signal index	0x2504	00	U16	RW	

Object dictionary - source signals – limit-switches and source peak-values					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Limit switch 1 source signal index	0x3030	01	U16	RW	Set the signal source for the limit switches. The possible source signal indices are listed in *chapter 18.1 "Source signal indices", page 155*.
Limit switch 2 source signal index	0x3031	01	U16	RW	
Limit switch 3 source signal index	0x3032	01	U16	RW	
Limit switch 4 source signal index	0x3033	01	U16	RW	
Limit switch 5 source signal index	0x3034	01	U16	RW	
Limit switch 6 source signal index	0x3035	01	U16	RW	
Limit switch 7 source signal index	0x3036	01	U16	RW	
Limit switch 8 source signal index	0x3037	01	U16	RW	
Peak value 1 source signal index	0x3010	01	U16	RW	Set the signal source for the Peak values. The possible source signal indexes are listed in *chapter 18.1 "Source signal indices", page 155*.
Peak value 2 source signal index	0x3011	01	U16	RW	
Peak value 3 source signal index	0x3012	01	U16	RW	
Peak value 4 source signal index	0x3013	01	U16	RW	

Object dictionary – Min, Max, Peak-to-peak values, channel 1					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Source signal CH1	0x3010	01	U16	RW	Set the source signal index for the peak values channel 1. A list of the status bits for the available source signals can be found in *chapter 18.1 "Source signal indices", page 155.*
Peak value CH1 reset	0x3010	02	ZERO	WO	Reset the peak values (Min, Max, Peak-to-Peak) of channel 1 to zero by writing null
Peak value CH1 max	0x3010	03	FLOAT	RO	Current maximum value of channel 1
Peak value CH1 min	0x3010	04	FLOAT	RO	Current minimum value of channel 1
Peak value CH1 peak-to-peak	0x3010	05	FLOAT	RO	Current peak-to-peak value of channel 1

Object dictionary – Min, Max, Peak-to-Peak values, channel 2					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Source signal CH2	0x3011	01	U16	RW	Set the source signal index for the peak values channel 2. A list of the status bits for the available source signals can be found in *chapter 18.1 "Source signal indices", page 155.*
Peak value CH2 reset	0x3011	02	ZERO	WO	Reset the peak values (Min, Max, Peak-to-Peak) of channel 2 to zero by writing null
Peak value CH2 max	0x3011	03	FLOAT	RO	Current maximum value of channel 2
Peak value CH2 min	0x3011	04	FLOAT	RO	Current minimum value of channel 2
Peak value CH2 peak-to-peak	0x3011	05	FLOAT	RO	Current peak-to-peak value of channel 2

Object dictionary – Min, Max, Peak-to-Peak values, channel 3					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Source signal CH3	0x3012	01	U16	RW	Set the source signal index for the peak values channel 3. A list of the status bits for the available source signals can be found in *chapter 18.1 "Source signal indices", page 155*
Peak value CH3 reset	0x3012	02	ZERO	WO	Reset the peak values (Min, Max, Peak-to-Peak) of channel 3 to zero by writing null
Peak value CH3 max	0x3012	03	FLOAT	RO	Current maximum value of channel 3
Peak value CH3 min	0x3012	04	FLOAT	RO	Current minimum value of channel 3
Peak value CH3 peak-to-peak	0x3012	05	FLOAT	RO	Current peak-to-peak value of channel 3

Object dictionary – Min, Max, Peak-to-Peak values, channel 4					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Source signal CH4	0x3013	01	U16	RW	Set the source signal index for the peak values channel 4. A list of the status bits for the available source signals can be found in *chapter 18.1 "Source signal indices", page 155*
Peak value CH4 reset	0x3013	02	ZERO	WO	Reset the peak values (Min, Max, Peak-to-Peak) of channel 4 to zero by writing null
Peak value CH4 max	0x3013	03	FLOAT	RO	current maximum value of channel 4
Peak value CH4 min	0x3013	04	FLOAT	RO	current minimum value of channel 4
Peak value CH4 peak-to-peak	0x3013	05	FLOAT	RO	Current peak-to-peak value of channel 4

Object dictionary – capture values and status, channels 1-4					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Capture value CH1…CH4	0x2500	01 .. 04	FLOAT	RO	The current capture values for channel 1-4
Capture value status CH1…CH4	0x2505	01 .. 04	U32	RO	The current status of the capture values 1-4

Object dictionary – limit switches, state					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Limit switch 1 state	0x3030	01	I8	RO	The status of the limit switches 1-8 is defined by four different possible states: off(0) on(1) undefined(-1) A limit switch on (1) status leads to an activated flag status. If the limit switch status is off (0) then the corresponding flag status is deactivated. If the limit switch status is undefined (-1) then the flag status is deactivated.
Limit switch 2 state	0x3031	01	I8	RO	
Limit switch 3 state	0x3032	01	I8	RO	
Limit switch 4 state	0x3033	01	I8	RO	
Limit switch 5 state	0x3034	01	I8	RO	
Limit switch 6 state	0x3035	01	I8	RO	
Limit switch 7 state	0x3036	01	I8	RO	
Limit switch 8 state	0x3037	01	I8	RO	

18.8 Sumchannel

Object Dictionary Sumchannel					
Name	**Index**	**Sub-Index**	**Type**	**Access**	**Description**
Sum	0x2030	01	FLOAT	RO	Sum value and status
Sum state	0x2030	02	U32	RO	
Sum x-coord	0x2030	03	FLOAT	RO	Sum value center point
Sum y-coord	0x2030	04	FLOAT	RO	
Summand #1	0x2031	01	U16	RW	Source signals for sum value
Summand #2	0x2031	02	U16	RW	
Summand #3	0x2031	03	U16	RW	
Summand #4	0x2031	04	U16	RW	
Summand factor #1	0x2032	01	FLOAT	RW	Valuation factor for each source signal
Summand factor #2	0x2032	02	FLOAT	RW	
Summand factor #3	0x2032	03	FLOAT	RW	
Summand factor #4	0x2032	04	FLOAT	RW	
Sum scaling point x0	0x2033	01	FLOAT	RW	Scaling vales for sum value
Sum scaling point y0	0x2033	02	FLOAT	RW	
Sum scaling point x1	0x2033	03	FLOAT	RW	
Sum scaling point y1	0x2033	04	FLOAT	RW	
Summand #1 x-coord	0x2034	01	FLOAT	RW	Physical coordinates of used source signal
Summand #1 y-coord	0x2035	01	FLOAT	RW	
Summand #2 x-coord	0x2034	02	FLOAT	RW	
Summand #2 y-coord	0x2035	02	FLOAT	RW	
Summand #3 x-coord	0x2034	03	FLOAT	RW	
Summand #3 y-coord	0x2035	03	FLOAT	RW	
Summand #4 x-coord	0x2034	04	FLOAT	RW	
Summand #4 y-coord	0x2035	04	FLOAT	RW	
Sum filter mode	0x2036	01	U16	RW	Filter settings for sum signal,off(0), LP Bessel(1), LP Butterw(2), HP Bessel(3), HP Butterw(4)
Sum filter cutoff frequency	0x2036	02	FLOAT	RW	
Sum filter fast track	0x2036	03	NULL	WO	

Object Dictionary Sumchannel					
Name	**Index**	**Sub-Index**	**Type**	**Access**	**Description**
Sum name	0x2040	54	STR	RW	Sum signal: Name, unit, decimals indicated in Webserver
Sum unit	0x2041	54	STR	RW	
Sum decimals	0x2042	54	U8	RW	

18.9 Analog output

Object dictionary - source signals - analog output					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Analog output 1-4m source signal index	0x2606	01 ... 04	U16	RW	Set the signal source for the capture value functions. The possible source signal indexes are listed in *chapter 18.1 "Source signal indices", page 155*

18.10 Fieldbus settings

Object dictionary - fieldbus settings					
Name	**Index**	**Sub-index**	**Type**	**Access**	**Description**
Fieldbus protocol type	0x3F00	05	U16	RO	Active fieldbus protocol 0 = off 9 = EtherCAT 21 = PROFINET
Fieldbus protocol switch	0x3F00	09	U16	RW	Switch the Fieldbus protocol by setting the wanted protocol 9 = EtherCAT 10 = EtherNet/IP™ 21 = PROFINET The digiBOX will restart after switching to the protocol
Oversample source signal index 1-4	0x3F01	01 ... 04	U16	RW	Select the oversampled signals, see *chapter 18.1 "Source signal indices", page 155* PROFINET: only one oversampled channel is supported (subindex 1)

19 DIAGNOSTICS AND TROUBLESHOOTING

19.1 Possible errors

For the digiBOX to be operational, the LEDs must display the corresponding colors; *see section 3.3 "Health monitoring and status LEDs", page 15*. You can identify by this whether the device has (has been assigned) an IP address, whether the device itself was initialized without error, or whether the fieldbus is working correctly.

Quick check

- No LED on: Check power supply.
- System LED does not turn green: Check system LED states.
- Fieldbus LED red: Check fieldbus LED states.
- Is the correct fieldbus configured on the digiBOX?
- Check the fieldbus configuration software on the master to ensure that all addresses and parameters are correctly set.

Maximum permissible values, limit values for errors

If the values shown in the graph are exceeded or not attained, errors are signaled, and the values are shown as invalid.

19.2 Sensor input signaling on the web server and by the channel LED

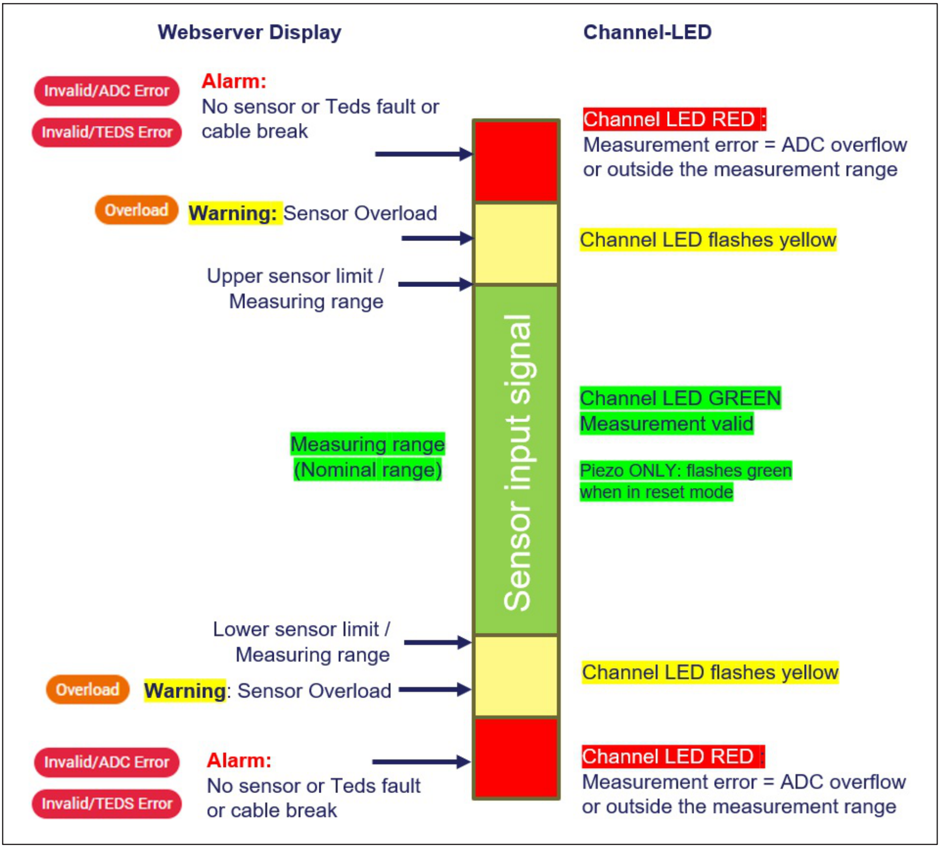


Fig. 19.1 Sensor input error signaling

19.3 Analog output signaling on the web server

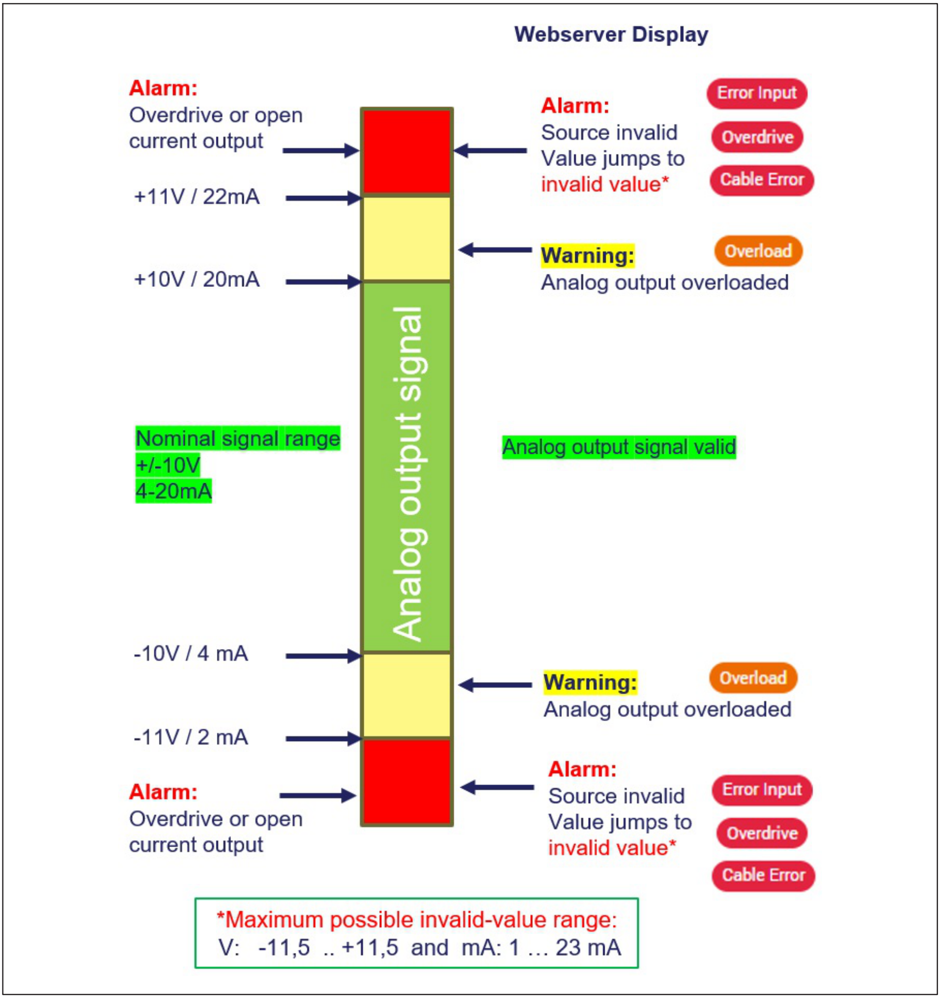


Fig. 19.2 Analog output error signaling

Does the digiBOX have any fuses that need to be replaced in the event of a fault (e.g. a short circuit)?

No. The digiBOX has an internal current limiter to automatically regulate the power consumption in the event of a fault.

Are there any parts that would have to be maintained?

No. The digiBOX has no fans or the like, and is maintenance-free.

Are the plugs protected to prevent accidental interchanging?

Yes, the M12 plugs have different codes, so they cannot be mixed up.

Do I have to install operating software?

No. The digiBOX has an internal web server for full parameterization. All you need is a web browser, such as Windows Edge, Firefox or Google Chrome.

What are the options for connecting the digiBOX to a web server?

You can use a direct 1:1 connection via Ethernet or an Ethernet connection over your network.

Can I reset the Ethernet network settings (IP address) to their factory defaults?

Yes. Use the HBK "Device Finder" software tool (Java tool) on your PC to do this. It displays all existing HBK devices on the network, even if they do not match the network settings. Right-click on the relevant device to launch its web server directly. Then change the network settings on the digiBOX web server > Menu: Network.

What are the options for adjusting the measuring amplifier channels?

The following options are available:

- Use strain gage sensors with TEDS (Transducer Electronic Datasheet).
- Enter sensor parameters (zero point/span) or the sensor sensitivity as numerical values.
- Teach-in sensor parameters.

How can I synchronize digiBOXes?

Multiple digiBOXes can be synchronized to within 1 us using the PTP protocol over Ethernet. This requires a PTP signal source in the network, and if the devices are connected via switches, they must also have PTP capability.

If the devices are connected to a PLC via a fieldbus (Profinet or EtherCAT®), the PLC can be used as the sync master.

The synchronization method used must be set on the digiBOX web server from the menu Amplifier > Synchronization. For PTP synchronization, additional parameters must be set in the "PTP" menu.

How many calculated channels are available?

The digiBOX IPC provides a sum channel comprising 2 to 4 single signals and optional calculation of the signal midpoint.

What are the sampling and processing rates in the digiBOX?

All measurement channels and statistical values (peak values, held values,...) are sampled and processed at 40 kHz. Values are outputted via the analog output at 10 kHz, and via the fieldbus interfaces at up to 4 kHz. The digital inputs and the flags or bits for the outputs are analyzed and outputted within 0.5 ms of a change.

What is the resolution and accuracy of the digiBOX?

The measurement channels have 32-bit resolution. This allows even very small signals in the partial-load range to be measured accurately and reliably. The accuracy class is 0.01% fs for full-bridge strain gage sensors and 0.5% fs for piezo sensors.

Can signals from nearby digiBOX devices be used?

No. It is, however, possible for a PLC on the network to send up to four values to the digiBOX, which then uses those "fieldbus values" for further calculation or output.

How many parameter sets/measurement programs are there in the digiBOX, and what are the switching times?

A maximum of 10 parameter sets can be used in the digiBOX. The switching time is <100 ms plus the settling time of the low-pass filters that are loaded with the parameter set.

What happens if the power supply fails while a parameter set is being saved?

In that case, the parameter set is not loaded, and the digiBOX boots up with its factory settings after power-on.

What happens if the power supply fails during a firmware update?

If an error, such as a power failure, occurs during a firmware update, the digiBOX will either restart with the old firmware or the device will load and initialize, depending on how far the update had progressed up to that point.

Where can I find the current firmware?

You can download the latest firmware version from HBK's digiBOX Industrial website. https://www.hbkworld.com/en/products/instruments/industrial-electronics/multi-channel/digibox-industrial?unit=metric#Downloads-faecdb6aac

Where can I find the latest device description files for the fieldbuses?

You can download the latest device description files for your fieldbus via the relevant Fieldbus menu of the digiBOX web browser.

Is there an electrical design tool for the digiBOX?

Yes. Pre-compiled ePLAN macros are available for the digiBOX on digiBOX Industrial, and can be used without a license.

Are there 3D (STEP) files for computer-aided engineering (CAE) for the digiBOX?

Yes. 3D STEP files for the digiBOX are available free of charge on digiBOX Industrial.

How do I get support if I have any problems?

If you have any technical queries, HBM Support (Technical Support Center TSC, support@hbkworld.com) is available.

If you have questions regarding technical project planning and design, our colleagues in Application Engineering will be glad to answer them (servicede@hbkworld.com) or visit you on-site.
See also *section 22 "Technical Support", page 182*.

21 ACCESSORIES

Information

The accessories listed are not included in the scope of supply.

Strain gauge sensor connection

Picture	Description	Ordering number
	Cable socket M12, 8-pin, with straight cable outlet, A-coded, IP67	1-CON-S3003
	M12 cable socket, 8-pin, A-coded, IP67, screw connections	1-CON-S1025
	PUR connection cable with M12 8-pin socket, 5 m long, opposite ends free	1-KAB168-5
	PUR connection cable with M12 8-pin socket, 20 m long, opposite ends free	1-KAB168-20

Piezoelectric sensor connection

Picture	Description	Ordering number
	Coaxial cable for connecting piezoelectric sensors to a charge amplifier, 0.5 m long, plug 10-32 UNF	1-KAB143-0.5
	Coaxial cable for connecting piezoelectric sensors to a charge amplifier, 2 m long, plug 10-32 UNF	1-KAB143-2
	Coaxial cable for connecting piezoelectric sensors to a charge amplifier, 3 m long, plug 10-32 UNF	1-KAB143-3
	Coaxial cable for connecting piezoelectric sensors to a charge amplifier, 7 m long, plug 10-32 UNF	1-KAB143-7
	Coaxial cable for connecting piezoelectric sensors to a charge amplifier, 10 m long, plug 10-32 UNF	1-KAB143-10

Picture	Description	Ordering number
	CSB4/1 summing box for connecting two to four piezoelectric sensors to a charge amplifier. Plug: 10-32 UNF	1-CSB4/1
	Coupling for piezoelectric charge cables. For connecting two coaxial cables with 10-32 UNF plugs	1-CCO

IO connection

Picture	Description	Ordering number
	Cable socket M12, 12-pin, with straight cable outlet, A-coded, IP67	1-CON-S1024
	M12 cable socket, 12-pin with molded cable (X = 3, 5, 10 m), A-coded, IP67	1-KAB180-X

Power supply

Picture	Description	Ordering number
	Cable socket M12, 4-pin, with straight cable outlet, T-coded, IP67	1-CON-S1023
	Euro plug-in power supply unit (100 ... 240 V) for connecting to cable socket 1-CON-S1023 Output DC 15 V, 530 mA	1-AC/DC15V/550MA
	Connection cable with M12 sockets on free ends, 4-pin, 1 m long, T-coded, IP67	1-KAB2150-1

Industrial Ethernet/Ethernet connection

Picture	Description	Ordering number
	Ethernet connection cable CAT5, M12 plug on both ends, 4-pin, D-coded, 0.3 m long, IP67	1-KAB2144-0.3
	Ethernet connection cable CAT5, M12 plug on RJ45, 4-pin, D-coded, 2 m long, IP67	1-KAB284-2
	Ethernet connection cable CAT5, M12 plug on RJ45 connector cable, 5 m long, IP67	1-KAB2129-5
	Ethernet connection cable CAT5, M12 plug on RJ45, 4-pin, D-coded, 10 m long, IP67	1-KAB2149-10

Plug and socket caps

Figure	Description	Ordering number
	Cap for M12 socket, IP67 (digiBOX: fieldbus, Ethernet connection)	1-CON-A2004
	Cap for M12 plug, IP67 (digiBOX: DIO, strain gauge sensor connection)	1-CON-A2005
	Cap for piezo sensor inputs (5 units = 1 pack)	1-CON-A1024

22 TECHNICAL SUPPORT

If problems occur when working with the digiBOX, you can use the following services:

E-mail support

support@hbkworld.com

Telephone support

Telephone support is available on all working days from 09:00 to 17:00 (CET):

+49 6151 803-0

The following options are also available

HBM Support and Sales International:

https://www.hbm.com/de/0051/worldwide-contacts/

Downloading firmware updates from HBK:

https://www.hbkworld.com/en/products/instruments/industrial-electronics/multi-channel/digibox-industrial?unit=metric#Downloads-faecdb6aac

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E-mail: hbmchina@hbm.com.cn

23 MAINTENANCE

The digiBOX is maintenance-free. You can load a new firmware in the device, if required, *see chapter 7.2.3 "Firmware update", page 54*.

Important

You must not open the device. Otherwise, any warranty will be voided.

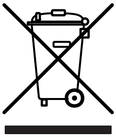
Cleaning

- Before cleaning, cut all connections, i.e. disconnect the (push-in or screw-type) plug terminals.
- Clean the housing with a soft, slightly damp (not wet!) cloth. You should never use solvents, since these could damage the labeling.
- Once fitted, the measurement cables should remain connected to the digiBOX. Close off unused connections on the digiBOX by protective caps. They are available as accessories from HBK.
- If required, the plug connector contacts should be cleaned with a clean, lint-free cloth and a cleaning agent (pure isopropanol). The cleaning agent RMS1 from HBK is not suitable for cleaning 10-32 UNF plugs and sockets.

24 DISPOSAL

All electrical and electronic products must be disposed of as hazardous waste, separate from normal household waste. The correct disposal of old equipment prevents ecological damage and health hazards, and helps with recycling to recover raw materials.

Statutory waste disposal marking



Waste disposal marking

The electrical and electronic devices that bear this symbol are subject to the European waste electrical and electronic equipment directive 2002/96/EC. The symbol indicates that the device must not be disposed of as household garbage.

As waste disposal regulations differ from country to country, please contact your local authority or HBK representative as necessary.

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