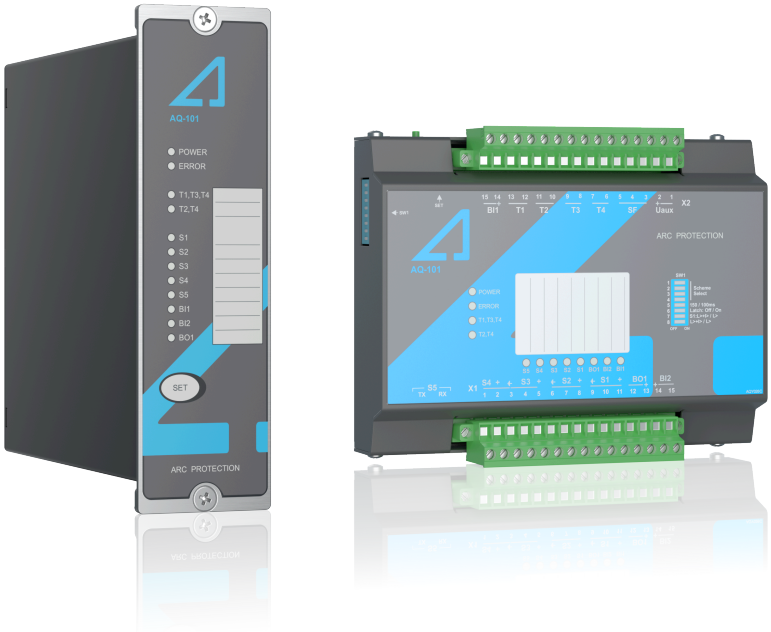
ARCTEQ
PART OF ENSTO GROUP

AQ-101(D)

Arc flash protection device

Instruction manual



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Disclaimer

Please read these instructions carefully before using the equipment or taking any other actions with respect to the equipment. Only trained and qualified persons are allowed to perform installation, operation, service or maintenance of the equipment. Such qualified persons have the responsibility to take all appropriate measures, including e.g. use of authentication, encryption, anti-virus programs, safe switching programs etc. necessary to ensure a safe and secure environment and usability of the equipment. The warranty granted to the equipment remains in force only provided that the instructions contained in this document have been strictly complied with.

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1 Document information

Table. 1 - 1. History of Revision 1.

Revision	1.00
Date	October 2010
Changes	- The first revision of the manual.
Revision	**1.01**
Date	June 2011
Changes	- Sensor chapter revised. - DIP switch definition updated. - "Dimensions and installation" chapter edited: the depth of the unit is changed from 170 mm to 175 mm.
Revision	**1.02**
Date	May 2012
Changes	- One selective scheme and the non-selective scheme are updated. - DIP switch definition is changed to scheme selection. - AQ-101 DIN rail version added.
Revision	**1.03**
Date	November 2012
Changes	- AQ-101 simplified block diagram revised: the name of the BI2 on X1 connector is corrected.

Table. 1 - 2. History of Revision 2.

Revision	2.00
Date	October 2020
Changes	- Content completely rewritten to improve grammar and readability. - The "Available logic schemes" chapter updated. - The AQ-02 point sensor chapter added to the "Arc sensors" chapter, and AQ-02's technical data added to the "Technical data" chapter. - The sensor-type dependency list updated. - The original "Connecting sensors" chapter moved to the AQ-0x instruction booklet, and replaced with a summary of how to connect point sensors. A summary of connecting fiber sensors also added to the chapter. - All technical data checked and updated where necessary. - Ordering information updated. - Images updated where necessary.
Revision	**2.01**
Date	November 2021

Changes	- Panel cut-out image added. - Dimension measurements updated. - Wiring diagram, simplified block diagram, DIP switch diagram & application image(s) updated. - Push button image added. - End covering description added to AQ-07, removed from AQ-08. - Cut-and-slice text in all fiber descriptions removed. - Connections image updated. - The test plan example updated. - All table layouts unified in "Technical data". - The IP classification of point sensors updated. - The AWG value updated. - "Disturbance tests" table reformatted. - Order code images updated. - The number for Arcteq's technical support added to the reference information.
Revision	**2.02**
Date	January 2023
Changes	- Updated the Arcteq logo on the cover. - Added startup inrush currents to auxiliary voltage tech data. - Updated the distance between the flash and the sensor in the "Testing the unit operation time" chapter. - Unified terminology used througout the manual (e.g. unit and device means the same thing. Now all AQ 100 series relays are called "devices"). - Improved many existing drawings. - Rearranged topics into a more logical order. - Added connection drawings to input and output descriptions under "Connections" chapter. - Added hyperlinks to chapters. (e.g. "See Device features chapter for more information") - Listed more features in Device features chapter. - T3 is now considered to be normally open by default and normally closed as an order option. - Added information about binary output pulse messages. - Many tables have been simplified and made easier to read. - Scheme matrixes and simplified logic diagrams have been made more detailed in "Available schemes" chapter.
Revision	**2.03**
Date	April 2023
Changes	- Small changes to visual style. - Small improvements to descriptions. - Added SS:4 scheme.
Revision	**2.04**
Date	September 2024
Changes	- Added point sensor dimensions.

2 Safety information

This document contains important instructions that should be saved for future use. Read the document carefully before installing, operating, servicing, or maintaining this equipment. Please read and follow all the instructions carefully to prevent accidents, injury and damage to property.

Additionally, this document may contain four (4) types of special messages to call the reader's attention to useful information as follows:

NOTICE!
"Notice" messages indicate relevant factors and conditions to the the concept discussed in the text, as well as to other relevant advice.

CAUTION!
"Caution" messages indicate a potentially hazardous situation which, if not avoided, **could** result in minor or moderate personal injury, in equipment/property damage, or software corruption.

WARNING!
"Warning" messages indicate a potentially hazardous situation which, if not avoided, **could** result in death or serious personal injury as well as serious damage to equipment/property.

DANGER!
"Danger" messages indicate an imminently hazardous situation which, if not avoided, **will** result in death or serious personal injury.

These symbols are added throughout the document to ensure all users' personal safety and to avoid unintentional damage to the equipment or connected devices.

Please note that although these warnings relate to direct damage to personnel and/or equipment, it should be understood that operating damaged equipment may also lead to further, indirect damage to personnel and/or equipment. Therefore, we expect any user to fully comply with these special messages.

3 Abbreviations

AQD – arc quenching device

BI – binary input

BO – binary output

CB – circuit breaker

CBFP – circuit breaker failure protection

CT – current transformer

EPROM – erasable, programmable read-only memory

HSO – high-speed output

LED – light emitting diode

LV – low-voltage

MV – medium-voltage

NC – normally closed

NO – normally open

PCB – printed circuit board

RF – radio frequency

Rx – receiver

SAS – standard arc scheme

SF – system failure

Tx – transceiver

µP - microprocessor

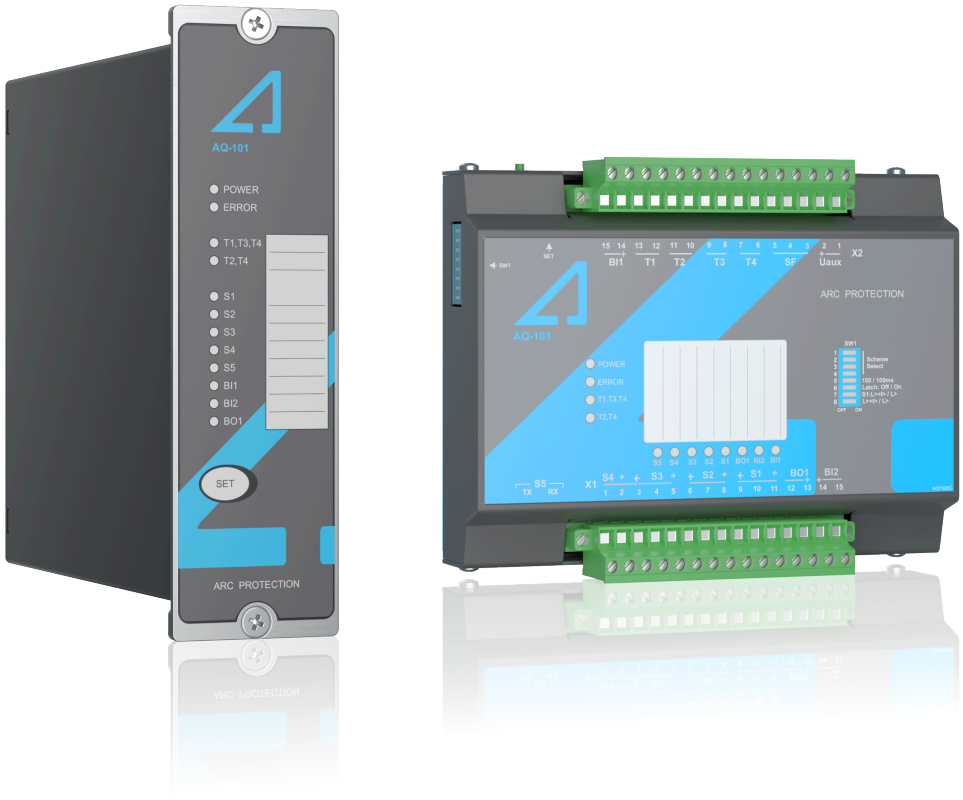
4 General

The AQ-101 is a sophisticated microprocessor-based arc flash protection device with point sensor channels and a fiber loop sensor channel (order option). The device is designed to minimize the damage caused by an arc fault. This is done by tripping the circuit breaker which supplies current to the fault when sensors detect arc light.

The device includes complete system self-supervision functionality which provides the highest level of dependability as it continuously monitors all internal system functions as well as all external connections.

AQ-101 comes in two variants. The AQ-101 variant is door and panel-mounted, while the AQ-101D variant is mounted on a DIN rail.

Figure. 4 - 1. Arc protection devices AQ-101 (left) and AQ-101D (right).



The AQ-101 is designed according to the latest protection relay standards and is therefore suitable for installations in rough environments. These include utilities and power plants (both traditional and renewable), various heavy industry applications (off-shore, marine, oil, gas, mining, steel, etc.) as well as commercial and institutional electrical systems. AQ-101 is suitable for MV and LV switchgears as well as for motor control center applications in both new and retrofitted installations.

5 Device features

AQ-101 is an arc flash protection device which can be applied to a variety of applications. It can be used on its own as a stand-alone device, or it can be a part of a more complex arc protection system by using binary inputs and outputs to connect multiple AQ 100 series devices together.

The following list presents the main features of the device:

- 92…265 V AC/DC auxiliary power supply or 18…72 V DC auxiliary power supply (optional)
- four (4) arc flash point sensor channels, max. three (3) point sensors per channel
- one (1) arc flash fiber loop channel (optional)
- two (2) binary inputs with nominal operation voltage of 24, 110, or 220 V DC
- four (4) trip relay outputs
- one (1) binary output (with internal 24 V DC power supply)
- one (1) system failure output (change-over)
- twelve (12) indication LEDs
- eight (8) DIP switches for logic configuration
- one (1) push button.

6 Connections

The figures below depict the connections of AQ-101 and AQ-101D. Please note that the SF relay is in the de-energized position.

Figure. 6 - 2. Rear terminals of AQ-101.

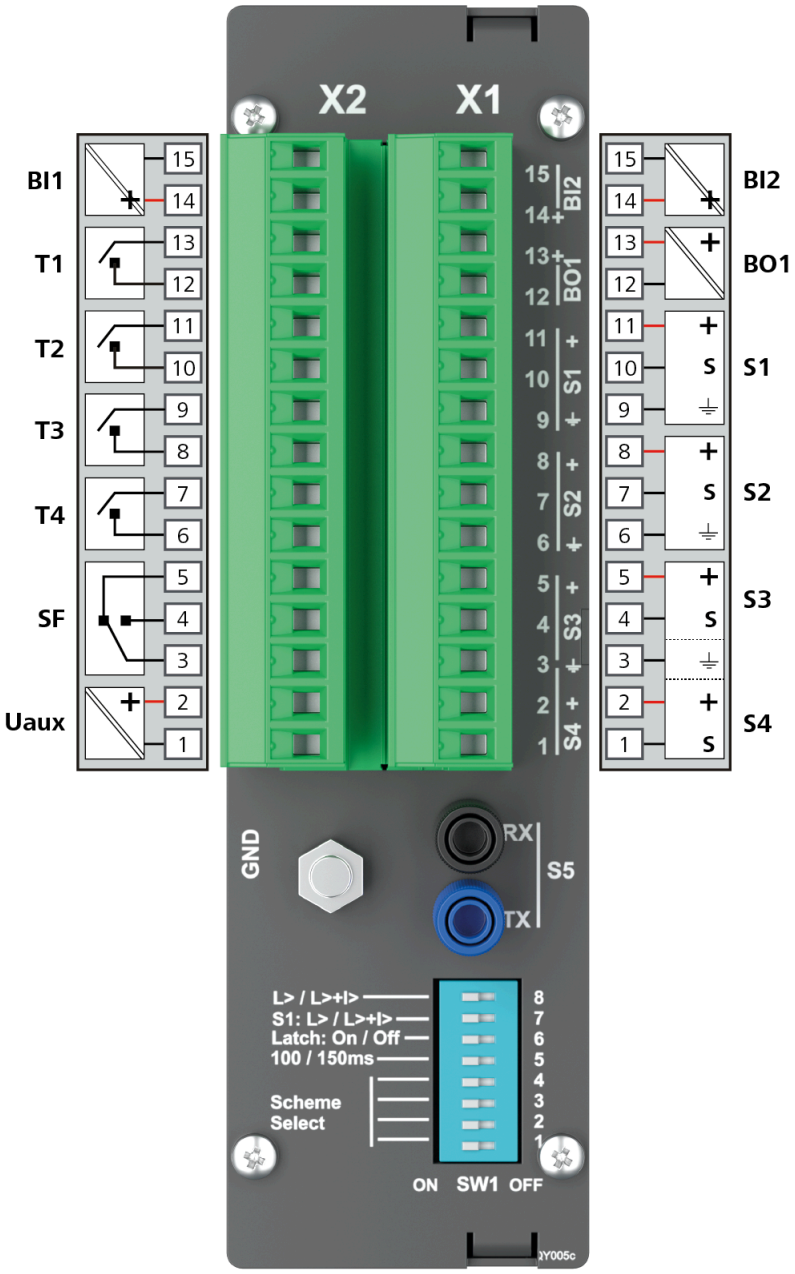
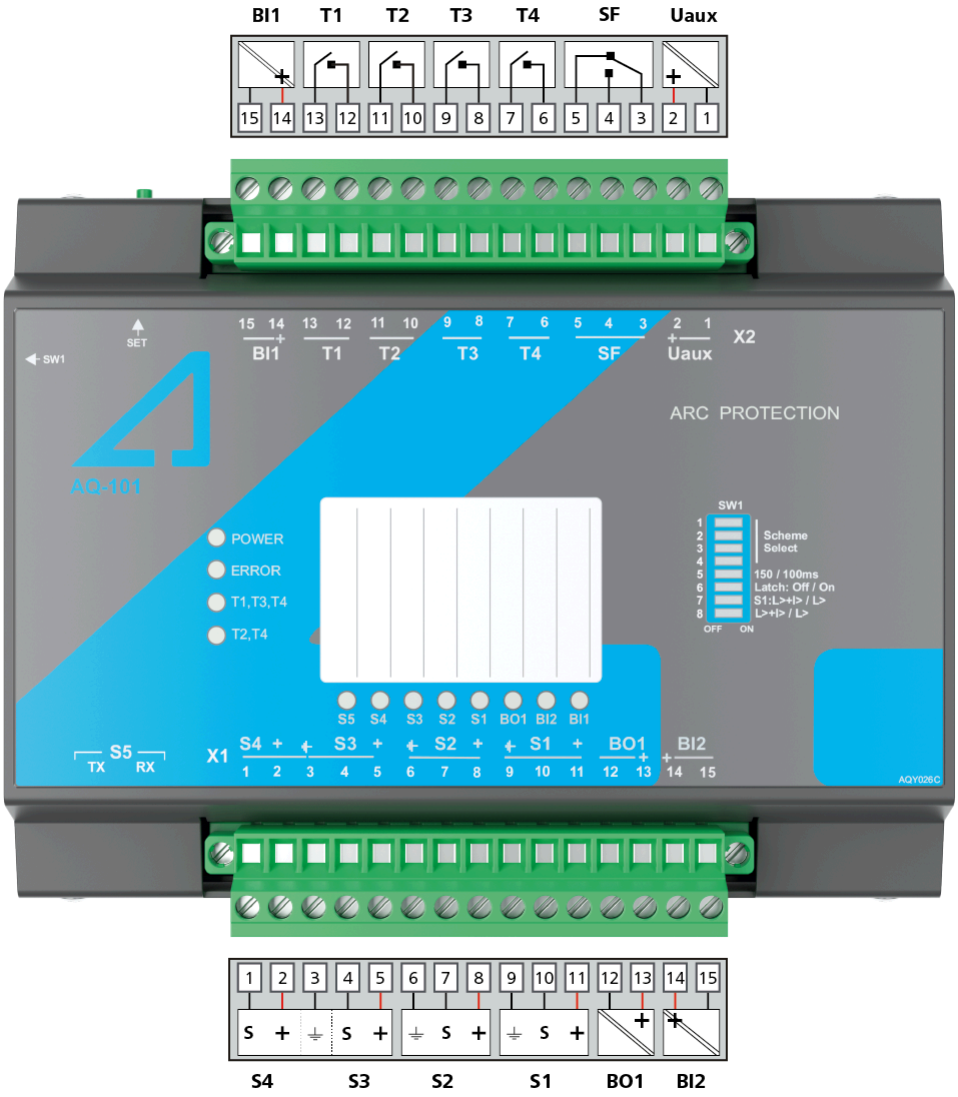


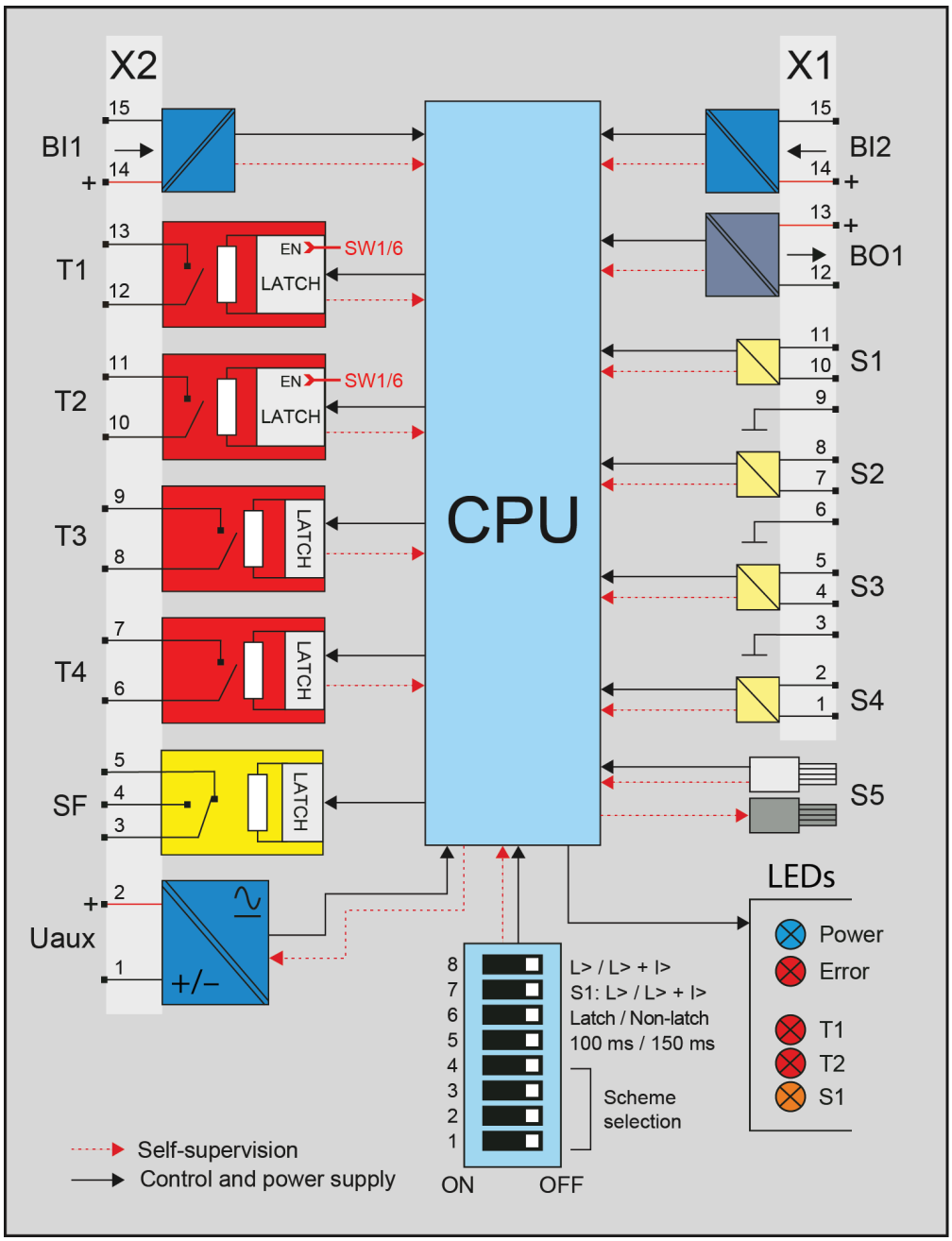
Figure. 6 - 3. Connections of AQ-101D.



6.1 Simplified block diagram

The figure below presents the main components that can be found in both the AQ-101 device and the AQ-101D variant.

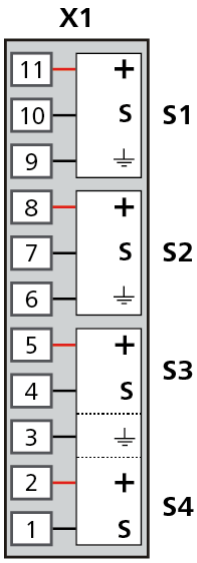
Figure. 6.1 - 4. Simplified block diagram of AQ-101 and AQ-101D.



6.2 Inputs

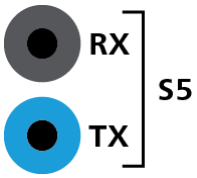
6.2.1 Arc sensor channels

Figure. 6.2.1 - 5. Arc point sensor connections



Both AQ-101 and AQ-101D have four (4) arc point sensor channels: S1, S2, S3 and S4. Up to three (3) arc point sensors can be connected to each channel. When the arc protection system has been set up, point sensor connections are constantly monitored. In case of sensor fault or disconnection, the device will go into Error mode. See System self-supervision chapter for more information.

Figure. 6.2.1 - 6. Optional fiber loop channel connection

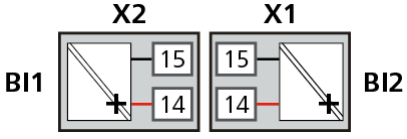


S5 is the optional fiber loop arc sensor channel with a transmitter (Tx) terminal and a receiver (Rx) terminal. When the fiber loop is connected to the device, one of its ends is connected to "Tx" and the other to "Rx". This sensor loop is then continuously monitored by a test light pulse that travels through the loop. If a discontinuity is detected, the device goes into Error mode. See System self-supervision chapter for more information.

For more information on sensors, please refer to the Arc sensors chapter as well as to the AQ-0x instruction booklet which can be found on Arcteq's website (https://www.arcteq.fi/downloads/).

6.2.2 Binary inputs

Figure. 6.2.2 - 7. Binary input connections



This device contains two (2) binary inputs. Typically, the binary inputs are used for receiving arc light signals, master trip commands or overcurrent signals. Function of binary inputs are configured using DIP switches. For more information, please refer to the DIP switch settings chapter.

Please note that when this device receives an overcurrent signal from a non-AQ 100 series device, the actual operating time depends on the operating time of the that device. Therefore, the total operating time cannot be specified in the technical data.

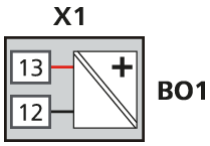
The binary inputs are activated when a connected DC signal reaches the specified nominal voltage level of the corresponding input. There are three (3) different nominal voltage levels available: 24, 110, or 220 VDC. The threshold value must be chosen and specified when ordering the unit. The actual activation threshold of the binary input is at a lower voltage than the specified nominal voltage value (see Techical Data chapter).

AQ 100 series devices monitor health of wiring between binary inputs and binary outputs. If binary input loses connection to any of the configured binary outputs, the device will go into Error mode. See System self-supervision chapter for more information.

6.3 Outputs

6.3.1 Binary outputs

Figure. 6.3.1 - 8. Binary output connection



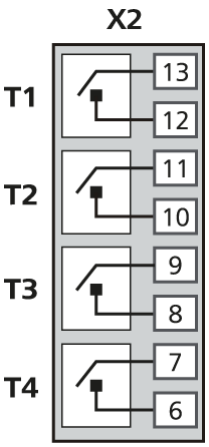
The device has one (1) binary output: BO1. AQ 100 series binary outputs have an internal 24 VDC power supply. This binary output is used for sending overcurrent, light detection, master trip and other signals to other AQ 100 series devices in the same system. The binary output function can be configured with the DIP switches. For more information on the configuration, please refer to the DIP switch settings chapter.

AQ 100 series device's binary outputs send out a short pulse every second. Binary inputs of the receiving AQ 100 series devices use these pulses to count the number of connected binary outputs. See System self-supervision chapter for more information.

NOTICE!
Please note that the binary ouputs are polarity-sensitive.

6.3.2 Trip relays

Figure. 6.3.2 - 9. Trip relay connections



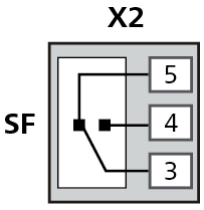
This device has four (4) normally open trip relay outputs. Trip relays T1 and T2 are used for tripping circuit breakers. T4 is generally used for tripping one additional disconnecting device, or as a trip alarm (local or remote) monitoring and alarming system.

T3 can alternatively be ordered as a normally closed trip relay (electronic lock-out relay). Once opened by fault detection it holds its open position until it receives a manual reset command or until auxiliary power supply is lost. When re-applying the auxiliary power supply, the electronic lock-out relay returns to the same position it had prior to the power loss. This normally closed relay output can also be used for tripping contactor-controlled devices.

T3 and T4 are always latching relays. Trip relays T1 and T2 can be set as latching relays by setting DIP switch SW1:6 ("Latching / Non-latching") to "Latch" position. Latched relays can be reset by pressing the "SET" button.

6.3.3 System failure relay

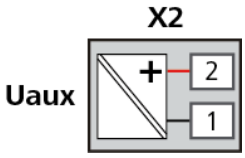
Figure. 6.3.3 - 10. System failure relay connection (de-energized position)



The system failure (SF) relay is of the change-over type (NO/NC) and it is energized when the device is in a healthy condition and powered on. Whenever the device detects a system error or the auxiliary power supply is disconnected, the SF relay changes its state. The state stays this way until the device returns to a healthy condition. See the System self-supervision chapter for more information.

6.4 Auxiliary voltage

Figure. 6.4 - 11. Auxiliary power supply connection



The auxiliary power supply voltage is 92….265 V AC/DC. Alternatively, the optional auxiliary power supply can be of 18…72 V DC. This choice must be specified when ordering.

7 Arc sensors

The AQ 100 series provides arc light point sensors and arc light fiber optic loop sensors. These sensors can be used with different devices and different switchgear types according to specific application requirements.

Arc light point sensors are typically installed in metal-clad compartments, and they provide a quick and accurate location of the fault area. Arc light fiber loop sensors typically cover a wider protected area with one fiber, when there is no need to pinpoint the exact location for a fault.

7.1 Arc light point sensor AQ-01

AQ-01 is an arc light point sensor with a light-sensitive photodiode element activated by arc light. The AQ-01 sensors should be mounted in the switchgear cubicles in such a way that the light-sensitive part covers the protected area as completely as possible. While multiple sensors can be installed, in most cases one sensor per closed metal-clad compartment is sufficient. In open spaces (such as a busbar section) the sensors should be mounted no more than two meters apart.

The default light intensity threshold for an AQ-01 sensor is 8,000 lux. Depending on the demand of the application, light point sensors can be ordered with 25,000 lux or 50,000 lux thresholds. Its detection radius is 180 degrees.

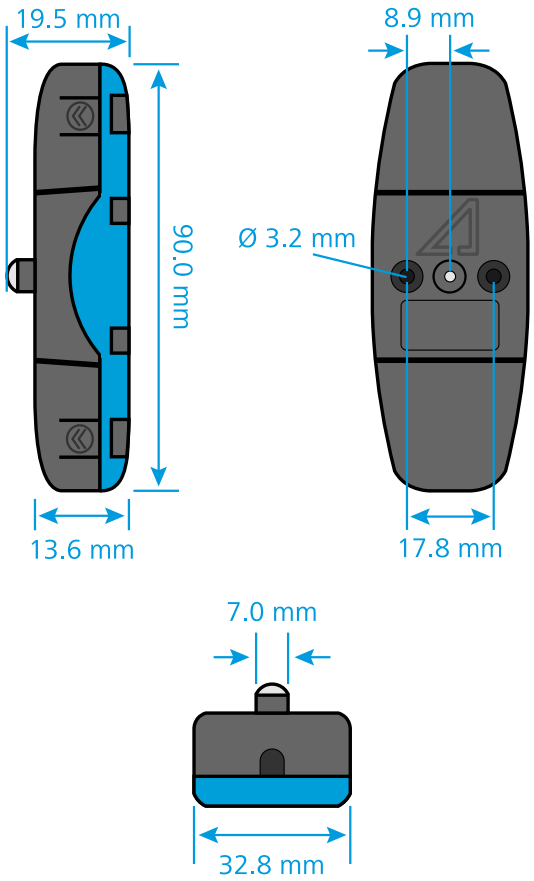
Figure. 7.1 - 12. The AQ-01 light sensor.

An AQ-01 is installed either inside or outside the compartment wall. When mounting inside the wall, the sensor is placed on the wall with the colored side against the wall and then fixed to the wall with two screws. When mounting outside the wall the sensor is placed on the wall with the grey side against the wall and the eye is pushed into the drilled compartment hole and then fixed to the wall with two screws from the back of the sensor. No external mounting plates are needed regardless of the mounting type; however, mounting brackets can be used if so desired.

Up to three (3) sensors can be connected in series (with the exception of AQ-103 which can take only one point sensor per channel). Installing a connection cable is simple as each end of the sensor has a detachable cover over the cable connectors. Please remember to reattach the cover once the wires have been installed.

NOTICE!
The AQ-01 point sensor does not come with a connection cable!

Figure. 7.1 - 13. Dimensions of arc flash sensors.



7.2 Arc light and pressure point sensor AQ-02

AQ-02 is an arc light and pressure point sensor that comes with arc light detection and ambient pressure detection. AQ-02 point sensor activates when both light and pressure are detected. The AQ-02 sensors should be mounted in the switchgear cubicles in such a way that the light-sensitive part covers the protected area as completely as possible. While multiple sensors can be installed, in most cases one sensor per closed metal-clad compartment is sufficient. The AQ-02 sensors cannot be installed in open spaces.

The default light intensity threshold for an AQ-02 sensor is 8,000 lux. Depending on the demand of the application, AQ-02 can also be ordered with 25,000 lux or 50,000 lux thresholds. Its detection radius is 180 degrees. The pressure threshold is fixed at 0.2 bar above ambient pressure.

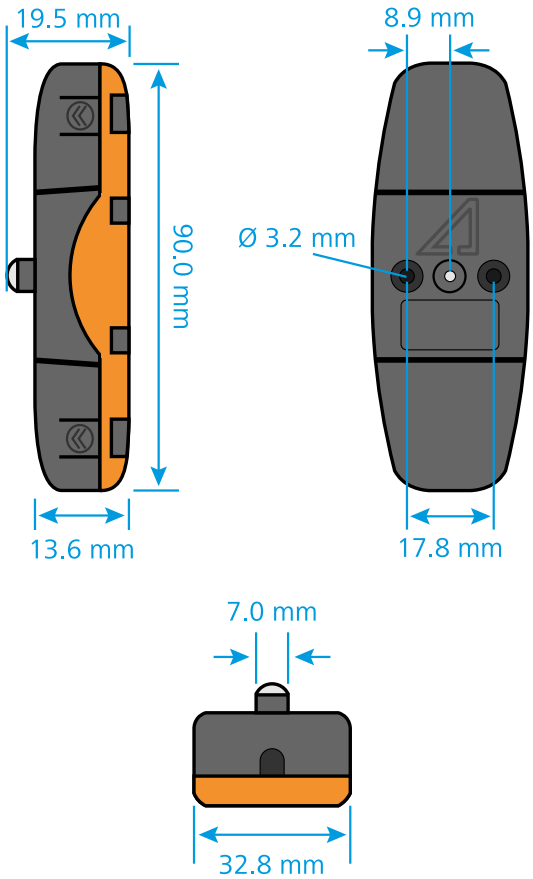
Figure. 7.2 - 14. AQ-02 arc light and pressure point sensor.

An AQ-02 can only be installed inside the compartment wall as not to block pressure detection located next to "the eye". The sensor is placed on the wall (with the colored side against the wall), and then fixed to the wall with two screws. No external mounting plates are needed regardless of the mounting type; however, mounting brackets can be used if so desired.

Up to three (3) sensors can be connected in series (with the exception of AQ-103 which can take only one point sensor per channel). Installing a connection cable is simple as each end of the sensor has a detachable cover over the cable connectors. Please remember to reattach the cover once the wires have been installed.

NOTICE!
The AQ-02 point sensor does not come with a connection cable!

Figure. 7.2 - 15. Dimensions of arc flash sensors.



7.3 Arc light fiber optic loop sensor AQ-06

AQ-06 is an arc light fiber optic loop sensor, which is a plastic fiber optic cable. Fiber sensors are distributed through the protected switchgear cells. The fixed light intensity threshold of an AQ-06 sensor is 8,000 lux. The sensor's detection radius is 360 degrees.

AQ-06 sensors can be ordered in pre-manufactured lengths of 3…40 meters (3 m, 5 m, 10 m, 15 m, 20 m, 25 m, 30 m, 35 m, 40 m).

7.4 Arc light fiber optic loop sensor AQ-07

AQ-07 is an arc light fiber optic loop sensor, which is a robust fiber optic cable with a practically unlimited bending radius. The sensor contains hundreds of glass fiber drains covered by a plastic tube, thus making it extremely strong and durable. Fiber sensors are distributed through the protected switchgear cells.

AQ-07 sensors can be ordered in pre-manufactured lengths of 3…50 meters (3 m, 5 m, 10 m, 15 m, 20 m, 25 m, 30 m, 35 m, 40 m, 45 m, 50 m).

The fixed light intensity threshold of an AQ-07 sensor is 8,000 lux. The sensor's detection radius is 360 degrees.

If necessary, the ends of an AQ-07 cable can be ordered with heat shrinking tubing to avoid light detection outside the protected zone. The covered area can be one (1) or two (2) meters by default; if other lengths are required, please consult the Arcteq sales team. You can find the Contact and reference information page at the end of this manual.

7.5 Arc light fiber optic loop sensor AQ-08

AQ-08 is an arc light fiber optic loop sensor. It is designed to withstand temperatures up to 125 ºC, which makes it suitable for e.g. wind turbine windings. AQ-08 is a robust fiber optic cable with a practically unlimited bending radius. The sensor contains hundreds of glass fiber drains that are covered by a plastic tube, thus making it extremely strong and durable. Fiber sensors are distributed through the protected switchgear cells.

AQ-08 sensors can be ordered in pre-manufactured lengths of 3…15 meters (3 m, 5 m, 10 m, 15 m).

The fixed light intensity threshold of an AQ-08 sensor is 8,000 lux. The sensor's detection radius is 360 degrees.

7.6 Sensor dependencies

Compatibility of arc sensor types depend on the hardware available in the AQ 100 series device. The table below describes those dependencies.

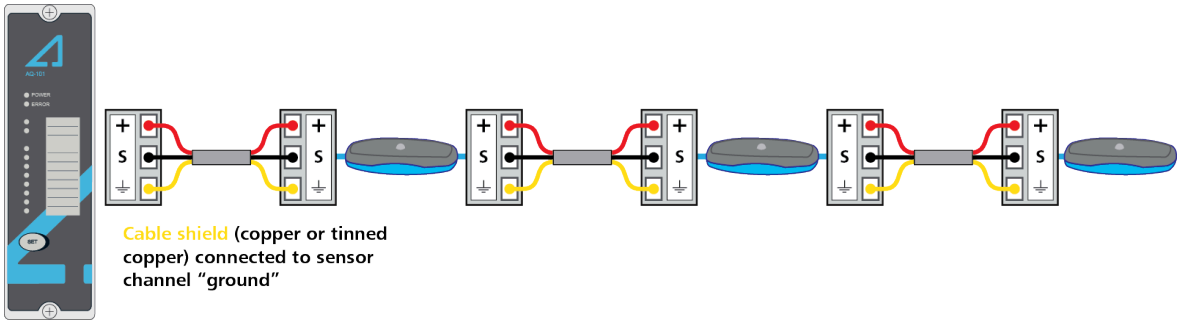
Table. 7.6 - 3. Sensor dependencies.

	Point sensors (AQ-01 & AQ-02)	Fiber loops (AQ-06, AQ-07 & AQ-08)
AQ-101	Yes	Order option
AQ-101D	Yes	Order option
AQ-101S	Yes	No
AQ-102	No	Yes
AQ-103	Yes	Order option
AQ-110P	Yes	Order option
AQ-110F	No	Yes

7.7 Wiring of point sensors

Point sensor connection with two-wire cable

Figure. 7.7 - 16. Point sensor connection with two wire cable.



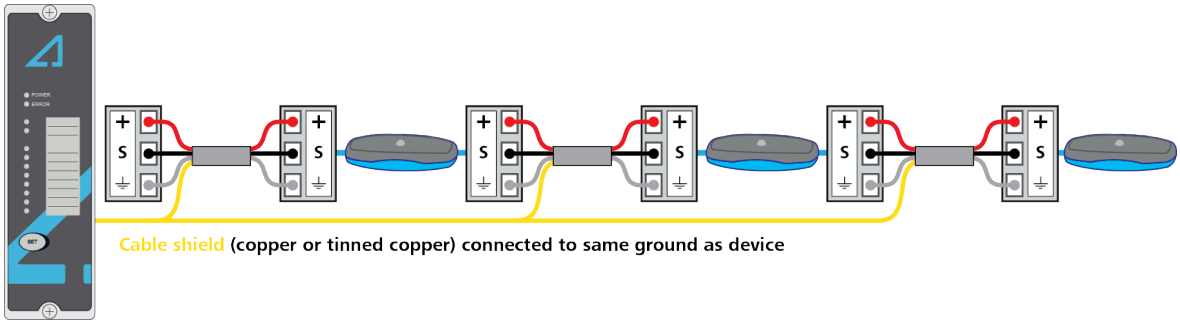
1. Open the sensor covers and detach the connectors.
2. Attach the cable to the connector and to the arc protection device.
3. Reattach the connectors to the sensor.
4. Run the auto-configuration procedure. See System setup for more details.

NOTICE!
Connect the cable shield to point sensor channel "ground" connector. Don't connect the cable shield to same ground as device.

NOTICE!
Shield of the cable must be either copper or tinned copper.

Point sensor connection with three-wire cable

Figure. 7.7 - 17. Point sensor connection with three wire cable.



1. Open the sensor covers and detach the connectors.
2. Attach the cable to the connector and to the arc protection device.
3. Reattach the connectors to the sensor.
4. Run the auto-configuration procedure. See System setup for more details.

NOTICE!
If the cable has a shield (copper or tinned copper), it is recommended to connect it to same ground as the device.

8 Operation and configuration

8.1 DIP switch settings

The DIP switches are used to easily configure various tripping logics and other functionalities for the device. The DIP switches are located at the back of the device. The figure below presents the DIP switch numbering, and the table below that gives a detailed description of the settings.

Protection logic can be defined by selecting a logic scheme with DIP switches 1 to 4. The scheme selection is based on binary arithmetic. Logic schemes are described in the next chapter.

Tripping can be set with DIP switches 7 and 8 to require either just arc light or both arc light and overcurrent simultaneously. Adding overcurrent criteria ensures the device trips when an arc fault occurs but not when a strong natural light source hits the light sensor (e.g. sunlight). Overcurrent signal comes from an external device (mainly AQ-110P or AQ-110F) and is connected to a binary input.

If the selected scheme uses CBFP (circuit breaker failure protection) its time delay (100 ms or 150 ms) can be set with DIP switch 5. CBFP logic depends on the chosen logic scheme. See Circuit breaker failure protection chapter for more information.

NOTICE!
Please note that while the switch numbers and their functions are the same for both AQ-101 and AQ-101D, in the DIN rail variant of the device the switches are "upside down" (that is, switch 1 is at the top of the DIP switch when normally switch 8 is at the top)!

Figure. 8.1 - 18. DIP switch diagram.

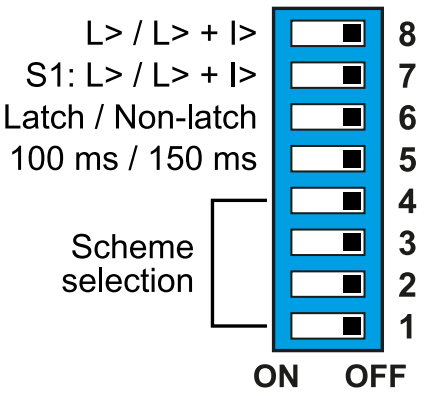


Table. 8.1 - 4. DIP switch settings.

Switch	Function selection	ON (left position)	OFF (right position)
8	The tripping criterion for the S2, S3, S4 (point sensors) and S5 (fiber loop) channels.	Tripping on light only (L>).	Light detection only trips if overcurrent is also detected at the same time (L> + I>).
7	The tripping criterion for the S1 point sensor channel.		

Switch	Function selection	ON (left position)	OFF (right position)
6	Enables or disables latching of T1 and T2 trip relays.	T1 and T2 operate as latching relays.	T1 and T2 latching is disabled.
5	The setting for the CBFP time.	The CBFP time is set to 100 ms.	The CBFP time is set to 150 ms.
4–1	Scheme selection. Please refer to the Available logic schemes chapter.	Switch 1: 1 Switch 2: 2 Switch 3: 4 Switch 4: 8	Switch 1: 0 Switch 2: 0 Switch 3: 0 Switch 4: 0

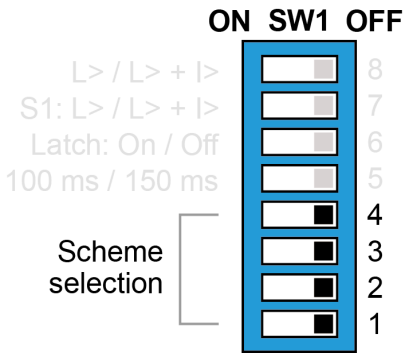
NOTICE!
The T3 and T4 trip relays are always latching. The BO1 binary output function is never latching.

8.2 Available logic schemes

The schemes described below are the most commonly used ones for AQ-101 devices. However, additional schemes are also available; please contact your nearest Arcteq representative for more information on those schemes. The schemes are configured using the DIP switches numbered 1…4 ("Scheme selection"). The scheme selection is based on binary arithmetic:

- Switch 1: 1
- Switch 2: 2
- Switch 3: 4
- Switch 4: 8

Figure. 8.2 - 19. DIP switches used for selecting the logic scheme.



AQ 100 series arc protection devices can be used as a stand-alone device or as a part of a more complex arc portection system with multiple AQ 100 series devices. The most convenient way to set the device to a more complex arc protection system is to use Standard Arc Schemes (SAS). For detailed instructions on each of the available Standard Arc Schemes please refer to the AQ-SAS™ booklet (can be found at arcteq.fi/downloads/).

8.2.1 SS:0 Non-selective arc protection

The logic scheme SS:0 can be applied as a stand-alone arc protection scheme, but it can also be used for protecting outgoing feeder compartments non-selectively. If any of the light sensor channels detect light, all trip contacts are closed and BO1 sends a light signal to any connected external devices. BI2 can be used for receiving light signals from external devices. BI1 can be used for receiving overcurrent signals from external devices.

Figure. 8.2.1 - 20. Example connection for AQ-101 (SS:0).

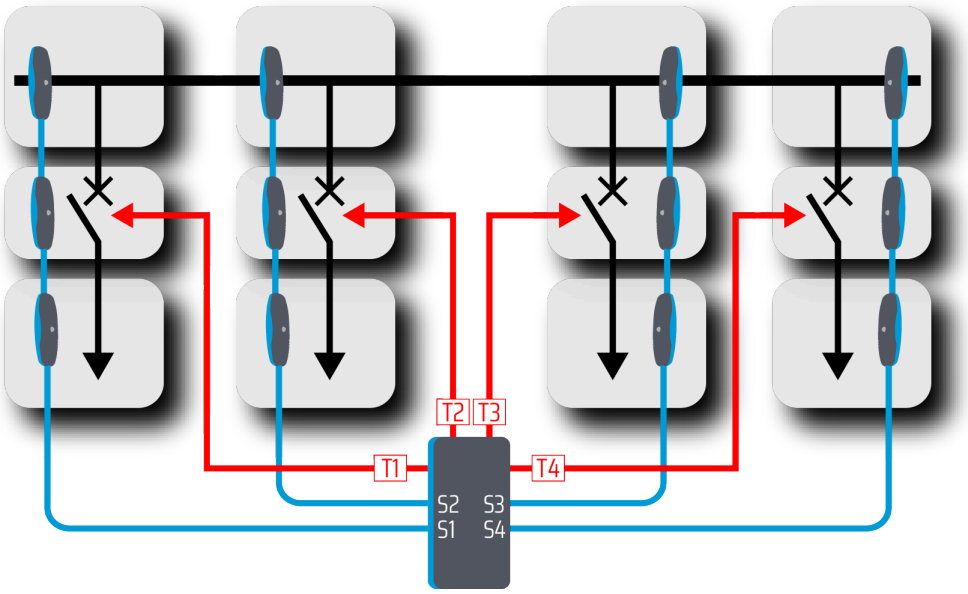
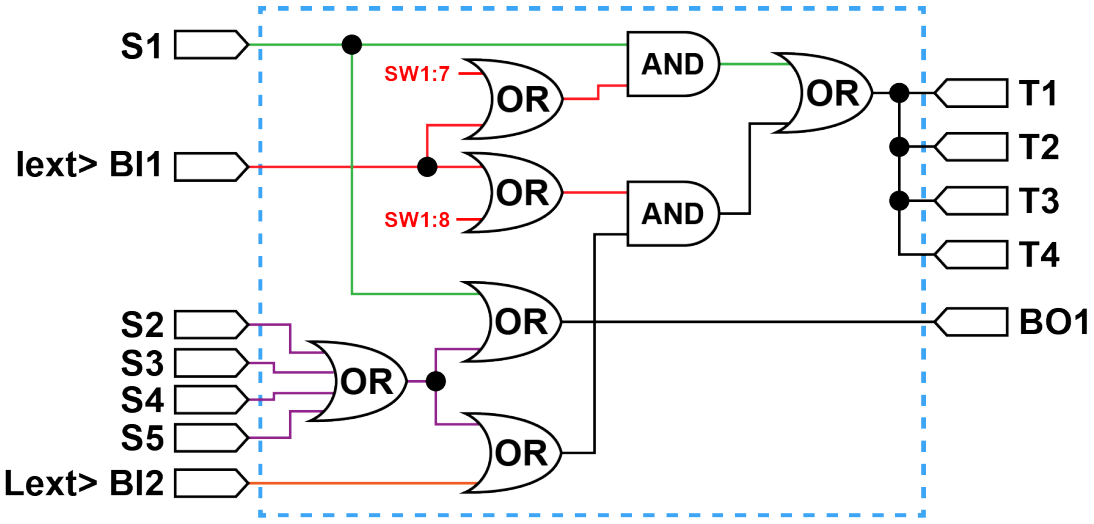


Figure. 8.2.1 - 21. Logic matrix of SS:0.

SS:0		OUTPUTS				
		T1	T2	T3	T4	BO1
INPUTS	S1 - S5	x[1]	x[1]	x[1]	x[1]	x
	Lext> (BI2)	x[1]	x[1]	x[1]	x[1]	

1. Activates only if channel has been set to light only mode or overcurrent signal (BI1) is ON.

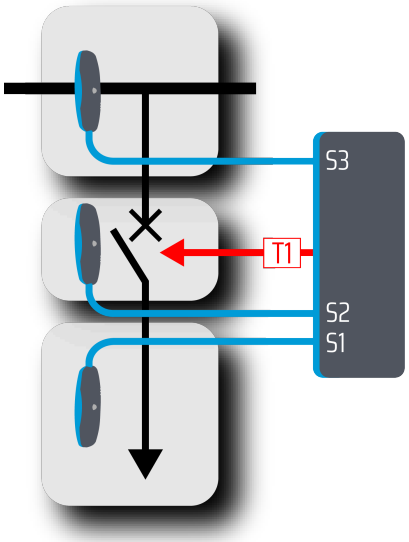
Figure. 8.2.1 - 22. Simplified logic diagram of SS:0.



8.2.2 SS:1 One outgoing feeder per device

The logic scheme SS:1 is mainly used in selective outgoing feeder arc protection solutions. With this scheme it is possible to protect one outgoing feeder per device.

Figure. 8.2.2 - 23. Example application with AQ-101 (SS:1).



If a fault is detected in the outgoing feeder cable compartment with S1, the circuit breaker of the outgoing feeder will be tripped with T1. If the fault is not cleared on time, BO1 sends a light signal to the master device at the incoming feeder after the CBFP time delay has passed.

If a fault is detected in the circuit breaker compartment (S2) or in the busbar compartment (S3), BO1 sends the light signal to the master device at the incoming feeder. BI2 can be used for receiving a master trip command from an incoming feeder device. BI1 can be used for receiving overcurrent signals from external devices.

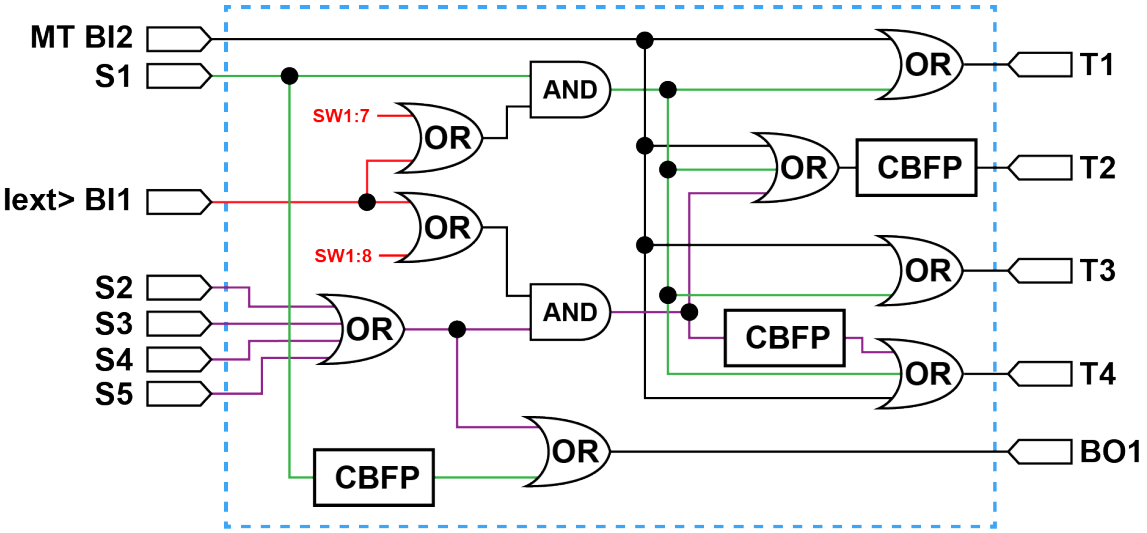
You can find a more detailed description of this scheme in the AQ-SAS^{TM} booklet.

Figure. 8.2.2 - 24. Logic matrix of SS:1.

SS:1		OUTPUTS				
		T1	T2	T3	T4	BO1
INPUTS	S1	x[1]	CBFP[1]	x[1]	x[1]	CBFP
	S2 - S5		CBFP[1]		CBFP[1]	x
	Master Trip (BI2)	x	CBFP	x	x	

1. Activates only if channel has been set to light only mode or overcurrent signal (BI1) is ON.

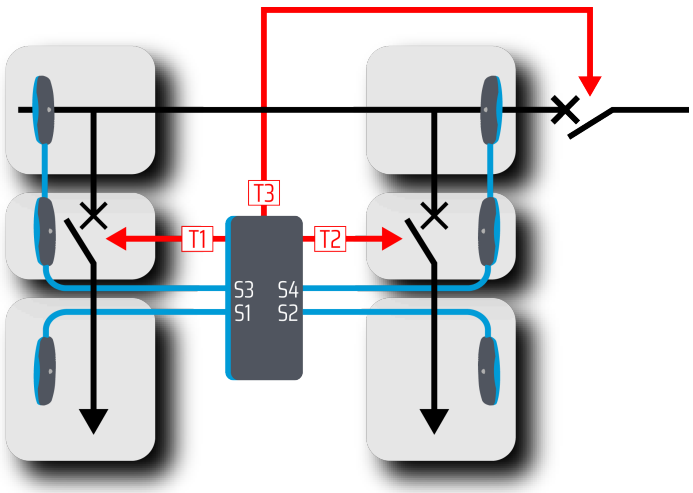
Figure. 8.2.2 - 25. Simplified logic diagram of SS:1.



8.2.3 SS:4 Two outgoing feeders per device

The logic scheme SS:4 is mainly used in selective outgoing feeder arc protection solutions. Protection logic is similar to SS:1 but SS:4 is able to protect two outgoing feeders and can also trip the bus bar section tie breaker (if applicable).

Figure. 8.2.3 - 26. Example application with AQ-101 (SS:4).



If a fault is detected in either of the outgoing feeder cable compartments (S1 or S2), the the circuit breaker of the outgoing feeder with the fault will be tripped with T1 or T2. If the fault is not cleared on time, T3 can trip the tie breaker and BO1 sends light signal to the master device at the incoming feeder after the CBFP time delay has passed.

If a fault is detected at either of the circuit breaker compartments or in the busbar compartment (S3, S4 or S5), BO1 sends the light signal to the master device at the incoming feeder. BI2 can be used for receiving a master trip command from incoming feeder device. BI1 can be used for receiving overcurrent signals from external devices.

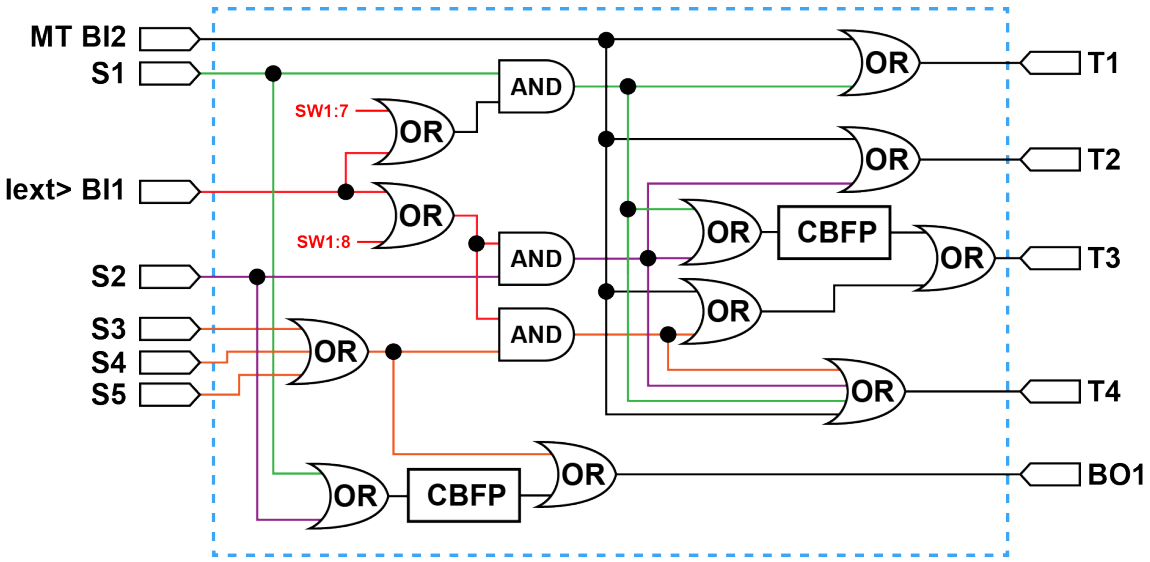
You can find a more detailed description of this scheme in the AQ-SAS™ booklet.

Figure. 8.2.3 - 27. Logic matrix of SS:4.

SS:4		OUTPUTS				
		T1	T2	T3	T4	BO1
INPUTS	S1	x[1]		CBFP[1]	x[1]	CBFP
	S2		x[1]	CBFP[1]	x[1]	CBFP
	S3 - S5			x[1]	x[1]	x
	Master Trip (BI2)	x	x	x	x	

1. Activates only if channel has been set to light only mode or overcurrent signal (BI1) is ON.

Figure. 8.2.3 - 28. Simplified logic diagram of SS:4.



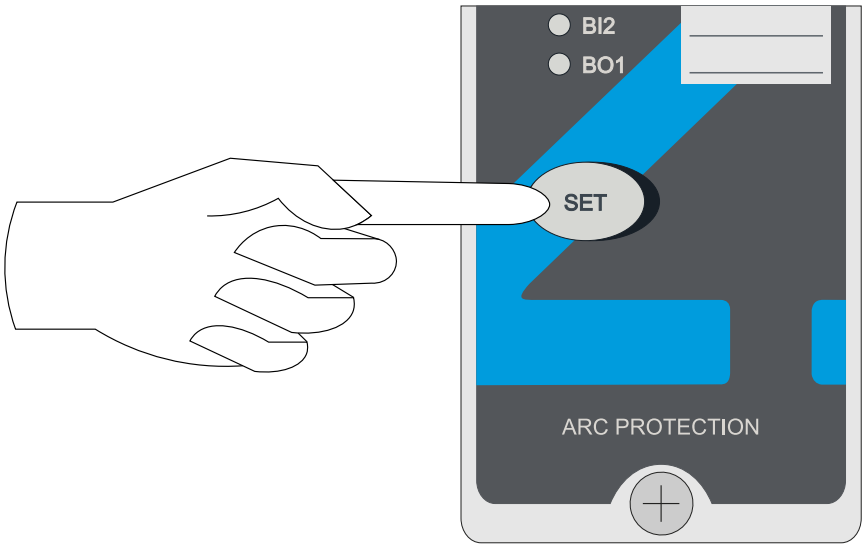
8.3 Push button (SET)

The device contains one push button, SET, and it can be used for all operational functions. The push button is used for:

1. Setting up the system (also known as auto-configuration)
2. Resetting the indicator LEDs
3. Resetting latched outputs
4. Checking the input connections

WARNING!
The SET button may require you to change the DIP switches before it works correctly. Do NOT use force when pushing the button, as this may cause the button to lodge deep inside the chassis!

Figure. 8.3 - 29. The "SET" push button on the device's front panel.



8.3.1 System setup (auto-configuration)

After DIP switches have been set to correct position and all sensors, binary inputs and binary outputs have been connected, a system setup procedure (also known as auto-configuration) must be performed. The sequence is initialized by pressing the SET push button for two seconds. This causes the sensor and binary I/O LEDs to start blinking. The device scans these inputs to see if they are connected; when an input is detected, the corresponding LED lights up to indicate that a connection was found. All inputs that are not connected continue to blink for three more seconds. Then, all LEDs are turned off. Additionally, the DIP switch setting are stored in the non-volatile memory after this sequence.

All arc sensors are operational even when they have not been auto-configured. System setup is only used for self-supervision purposes.

Please note that to reconfigure a device with fewer connections (BI/BO or arc sensors) than in the previously memorized setup, one of the DIP switches must be moved back and forth once before the system setup procedure is carried out. You can reconfigure a device with more connections at any time without having to move one of the DIP switches.

8.3.2 Reset

All LED indications and latched trip relays can be reset by pressing the SET push button.

8.3.3 Input connection check

After the system setup (auto-configuration) procedure is completed, you can verify the connectivity of all sensors and binary input channels by pressing the SET push button three (3) times within two (2) seconds. The LEDs of the corresponding sensors, binary input channels and the “Power” LED start blinking. The LEDs blink as many times as there are connected sensors and binary output channels from other devices.

8.4 Circuit breaker failure protection

The circuit breaker failure protection function is used for detecting a failure to open the circuit breaker when tripping command has been given by the arc protection relay. The CBFP function activates when the arc protection relay detects the presence of fault for a set duration (100 ms or 150 ms). In case of circuit breaker failure the arc protection relay will send a trip signal to the next available circuit breaker. Please note that if the device is set to operate on both arc light and overcurrent, both conditions must persist to activate the CBFP function. The CBFP function can be set to operate either on a 100-ms or a 150-ms delay (please refer to the DIP switch settings chapter for more information). The operation logic of CBFP function depends on the chosen logic scheme (see Scheme selection chapter for more information).

8.5 LED indicator functions

Both the AQ-101 and its AQ-101D variant have twelve (12) indication LEDs on the device's front panel. Apart from the "Power" and "Error" LEDs, the user can write their own identifications for each of the remaining LEDs on the text insert located in the transparent pocket next to the LEDs.

When the device is powered up, it performs an LED test. All LEDs turn on for two (2) seconds and then turn off; only the blue "Power" LED stays on.

When the device operates normally, only the blue "Power" LED is lit.

If an arc sensor is activated, its corresponding LED turns on. Activated arc sensor LEDs will stay on until user has reset them with "SET" push button.

If there is a loose sensor wire or if the self-supervision function detects a configuration mismatch (that is, a new sensor has been attached but the auto-configuration system setup has not been run), the corresponding LED starts flashing and the "Error" LED activates.

The binary I/O LEDs indicate the status of the input and output lines. If any of the lines become active, the corresponding LED turns on. All light channel and trip indication LEDs are latched, even if the DIP switch settings are in the non-latched mode.

All LED indications are stored in the non-volatile memory (EPROM) to help identify the necessary trip information even after auxiliary power is lost. When the device is re-powered after a power supply loss, the front panel shows the status of all LEDs.

You can clear the LEDs by pushing the SET button.

8.6 LED operations guide

The table below describes the function of each indicator LED in detail.

Table. 8.6 - 5. LED operations of AQ-101 and AQ-101D.

LED name (color)	Light off	Steady light	Blinking light	Action if abnormal
POWER (blue)	The auxiliary power supply is disconnected.	The auxiliary power supply is connected.	*(N/A)*	Check the power supply.
ERROR (red)	The system is healthy.	A system failure has occured.	A configuration mismatch has been detected. Protection is partially operational.	Verify the system condition (see the System self-supervision and Troubleshooting chapters).
T1—T4 (red)	Normal status.	The trip relay has activated.	*(N/A)*	Check what caused the trip, clear the fault and reset the indicator LEDs with the push button.
S1—S4 (amber)	Normal status.	Light information has activated the sensor channel.	There is a loose connection or a system setup has not been performed.	Check the sensor wire connection or perform a system setup (see the System setup chapter); or, check what activated the sensor.
S5 (amber)	Normal status.	The fiber sensor channel has been activated.	There is a loose fiber sensor connection or a system setup has not been performed.	Check the fiber continuity or perform a system setup (see the System setup chapter); or, check what activated the fiber channel.
BI1–BI2 (amber)	Normal status.	The binary input has been activated.	The binary input has a loose connection.	Check the binary input wiring.
BO1 (amber)	Normal status.	The binary output has been activated.	*(N/A)*	—

8.7 Non-volatile memory

All critical system data (such as DIP switch settings and the system setup file) are stored in the non-volatile memory (EPROM) to ensure accurate operation and full self-supervision even if auxiliary power is lost temporarily.

Additionally, all LED indications are stored in the non-volatile memory to provide a quick recovery of the system status indication. This feature is especially important if tripping causes the device to lose its auxiliary power.

The non-volatile memory does not require a power supply to maintain the information and it retains the settings and the indications permanently without power.

9 System self-supervision

AQ 100 series devices have an extensive self-supervision function, including both internal functions and external connections. The self-supervision function monitors the following:

- power supply
- hardware
- software
- binary input connection(s)
- sensor connection(s)
- DIP switch settings

When the device's condition is healthy and is powered on, the "Power" LED is lit and the system failure (SF) relay is energized. If the self-supervision function detects a faulty condition or if the power supply fails, the SF relay is released and the "Error" LED becomes lit.

Point sensor connection monitoring

If a point sensor failure occurs, the device will go into Error mode. The "Error" LED turns on, the SF relay releases, and the LED of the corresponding faulty sensor channel starts blinking. In this situation the device is still operational, although the faulty sensor channel is blocked. If the error is resolved, the device automatically energizes the SF relay and turns off the "Error" LED and the blinking sensor channel LED. If one or more of the sensors are disconnected, the healthy sensors remain in use and the device remains operational accordingly. However, the device remains in Error mode until the sensors are connected again.

Fiber loop connection monitoring

Fiber loop channel(s) is monitored by a test light pulse that travels through the loop from TX (transmitter) connector to RX (receiver) connector. If a discontinuity is detected, the "Error" LED turns on, the SF relay releases, and the LED of the corresponding faulty sensor channel starts blinking. If the error is resolved, the device automatically clears the system failure status, energizing the SF relay and turning off the "Error" LED. The device remains in Error mode until the sensors are connected again.

Binary input connection monitoring

During system setup (auto-configuration) AQ 100 series device checks how many AQ 100 device binary outputs or high-speed outputs have been connected to binary inputs. Each AQ 100 series device binary output and high-speed output constantly sends a short pulse every second which the receiving binary input uses to count the number of connected devices. If any of the outputs are disconnected after the system setup, the binary input will detect the mismatch and the device will go into Error mode and the binary input LED will blink. If the error is resolved, the device automatically clears the system failure status, energizing the SF relay and turning off the "Error" LED.

DIP switch setting monitoring

The device goes into Error mode, if a DIP switch setting is changed after the system setup procedure has been performed. However, the configured (stored) settings are still valid and the device is still operational.

10 Application examples

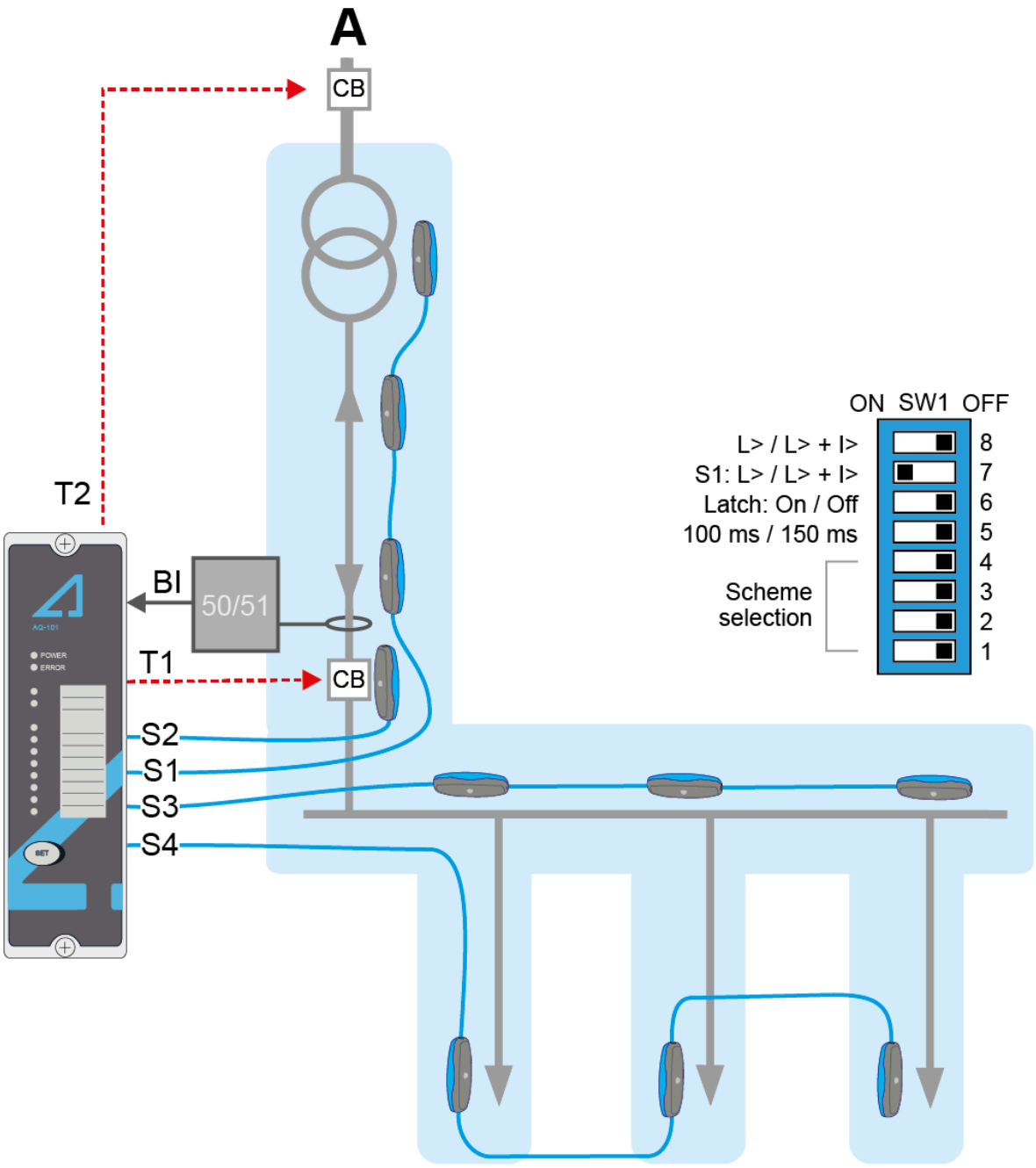
This device can be applied to a variety of power switchgear and controlgear layouts and technologies. This chapter describes some of the most typical applications. Please consult the AQ-SAS™ booklet (can be found at arcteq.fi/downloads/) or your nearest Arcteq representative for a solution to your particular application.

10.1 Application with overcurrent and arc light conditions (LV and MV)

AQ-101 and AQ-101D can be used for applications where tripping is performed only when both overcurrent (I>) and arc light (L>) are detected simultaneously. Typically, the overcurrent condition is obtained from an AQ-110 device. The I> condition can also be monitored by non-Arcteq products (such as a generic feeder protection relay); however, the total operating time cannot be guaranteed to be as stated in the technical data, as that is dependent on the device feeding the I> signal to the AQ-101 (or AQ-101D) device. Please note that the S1 sensor channel can be set to operate solely on the light condition, even if other channels are set to operate on both conditions.

The figure below presents an example system (for both LV and MV) that applies both I> and L> for tripping from the S2, S3 and S4 sensor channels, while the S1 sensor channel is set to only activate on the light condition. S1 monitors the transformer feeder's bus duct located above the current monitoring point. A maximum of three arc light point sensors (AQ-01 or AQ-02) can be connected to each sensor channel. In this application, the current monitoring signal comes from an external overcurrent relay, although it could also come from an AQ-110 device. An overcurrent relay (50/51) monitors the I> condition.

Figure. 10.1 - 30. Connections of the I> and L> application for AQ-101.



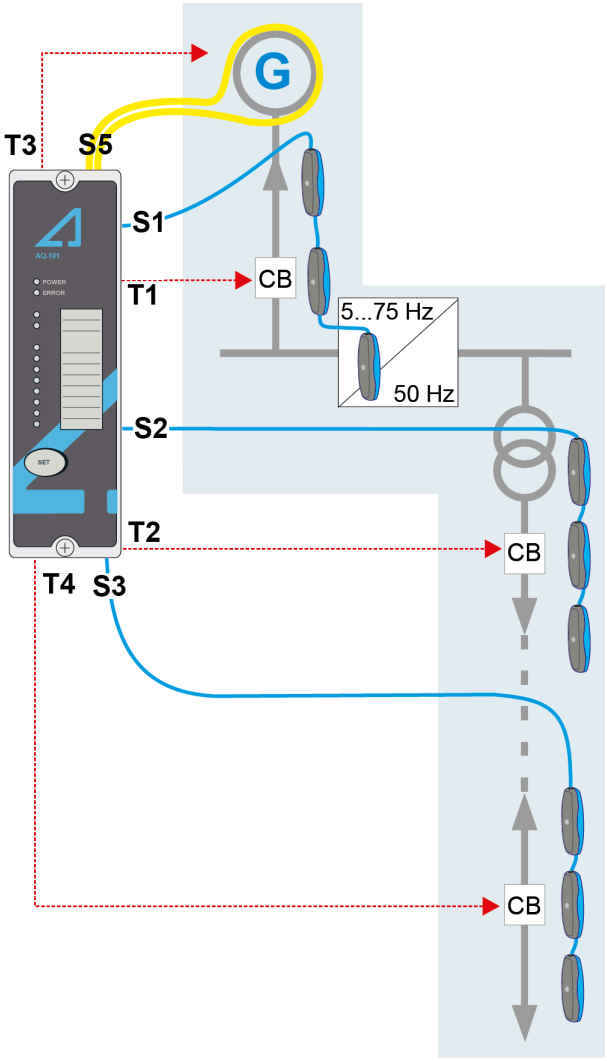
10.2 Wind power application (light only)

AQ-101 and AQ-101D can be applied by using arc light as the only tripping criterion. This example application describes a typical wind power scheme, where a permanent magnet synchronous generator is applied with a converter cabinet and an MV/LV transformer.

AQ-101 and AQ-101D have four point sensor channels (each of which can have up to three sensors) and one optional fiber optic loop sensor channel. This example application uses three of the point sensor channels, each with three sensors. The application also uses the optional fiber loop sensor channel to monitor the generator windings and terminations.

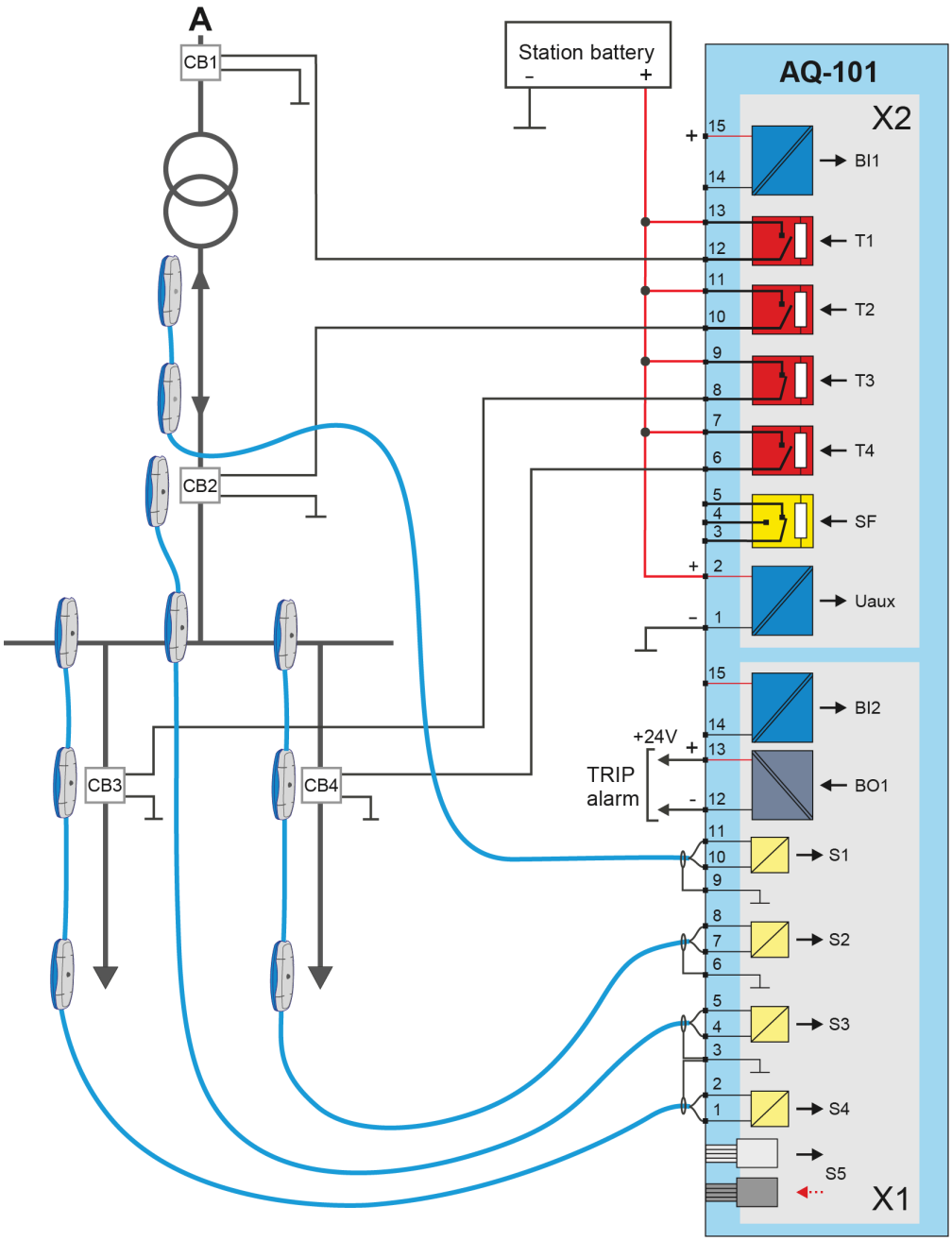
If arc light occurs in any of the compartments containing a sensor, the device executes a trip to all three circuit breakers. Additionally, the application uses the electronic lock-out relay T3 to provide a safety loop: it ensures that the fault is recognized and corrected before the generator is put back into service.

Figure. 10.2 - 31. The wind power application's wiring diagram for AQ-101.



11 Wiring example

Figure. 11 - 32. Example wiring diagram for AQ-101 and AQ-101D.



12 Dimensions and installation

The device can be either door-mounted or panel-mounted in a standard 19 inch rack. The device's dimensions (without connectors) are as follows:

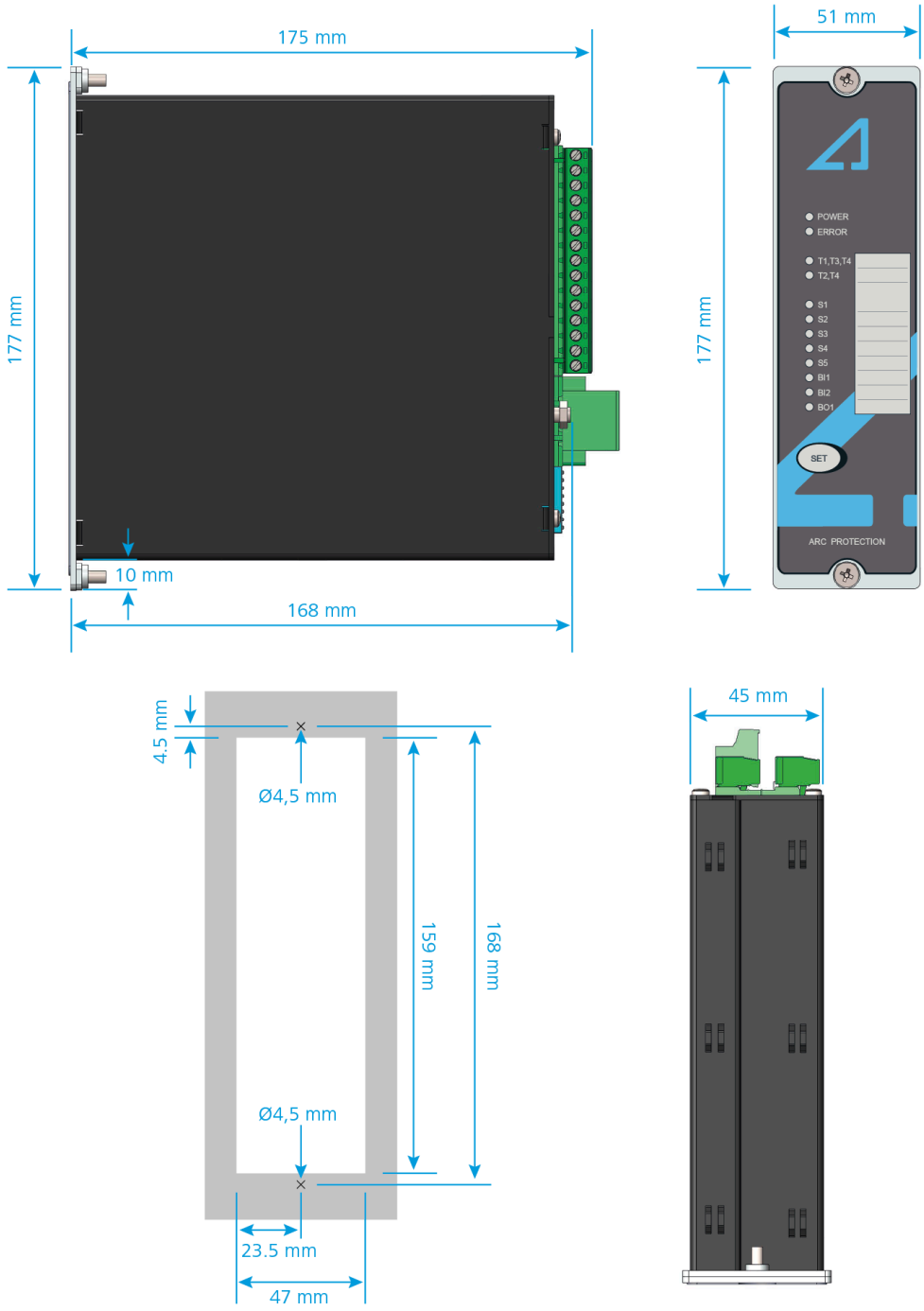
- Height: 177 mm (6.97 in)
- Width: 51 mm (2.00 in)
- Depth: 168 mm (6.61 in).

The dimensions of the AQ-101D variant are as follows:

- Height: 109 mm (4.29 in)
- Width: 145 mm (5.71 in)
- Depth: 34 mm (1.34 in).

The figure below presents the dimension of the device visually. It also shows the dimensions of the cut-out (bottom-left) required when mounting the device on a panel.

Figure. 12 - 33. Dimensions of the device and its cut-out panel.



DIN rail variant

The dimensions of the DIN-rail variant are as follows:

- Height: 109 mm (4.29 in)
- Width: 145 mm (5.71 in)
- Depth: 34 mm (1.34 in).

Figure. 12 - 34. Dimensions of the DIN rail variant of the device.

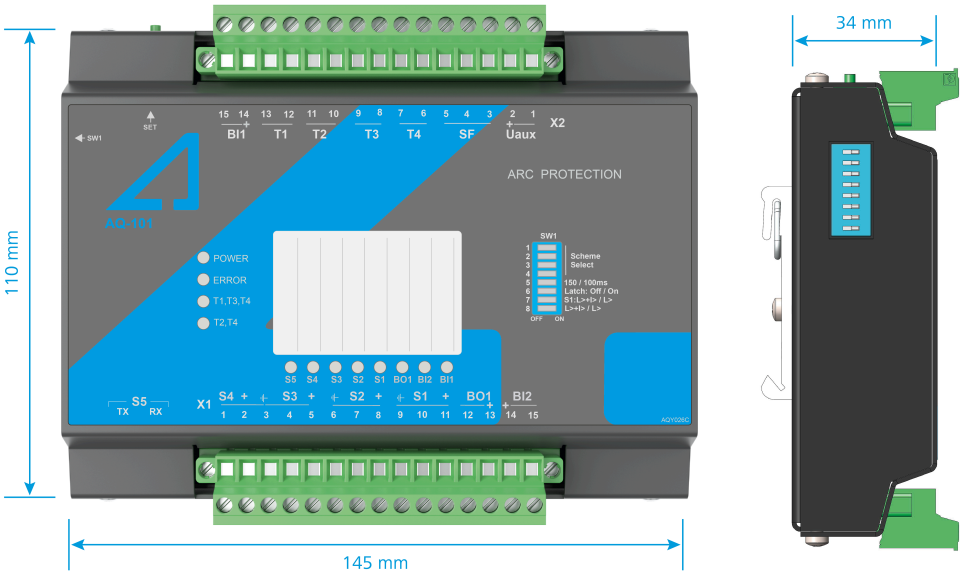


Figure. 12 - 35. Dimensions of the DIN rail variant of the device.

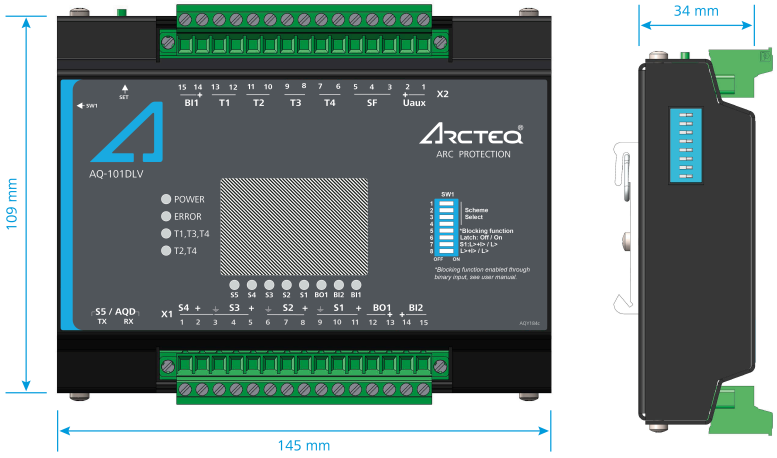


Figure. 12 - 36. Installing a AQ-100 series device to a door.

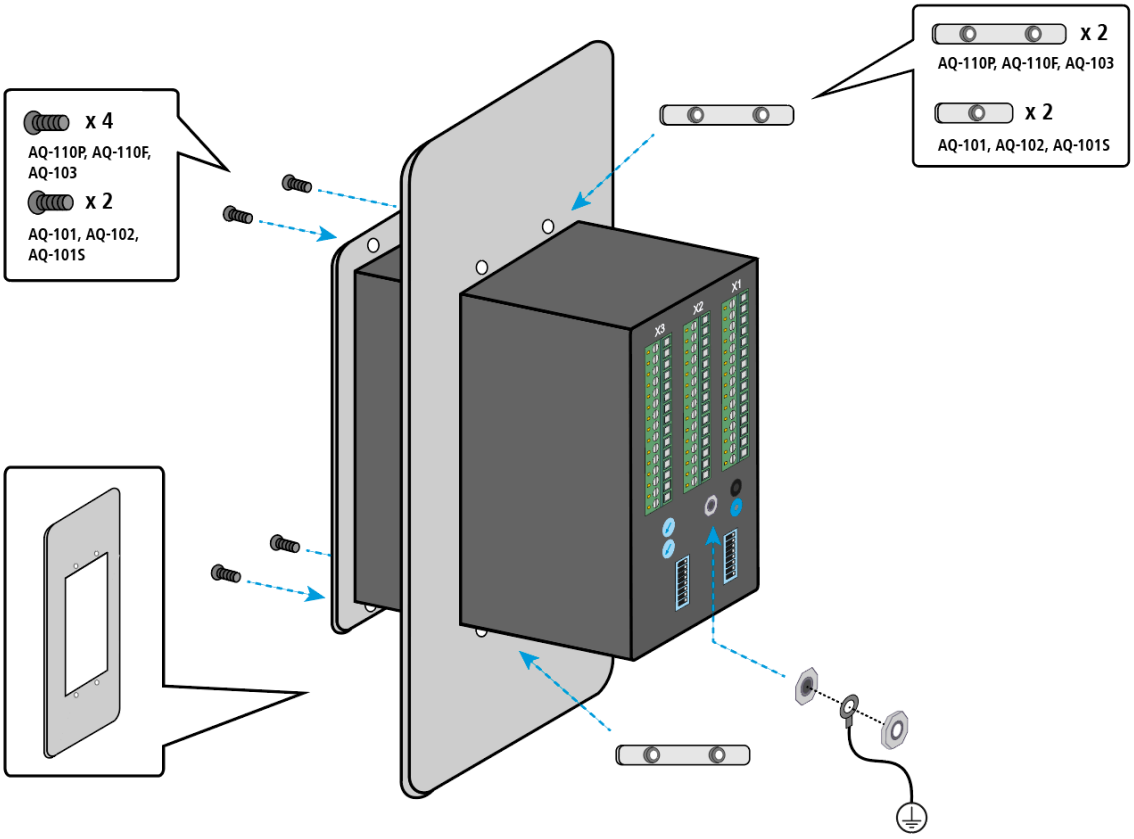
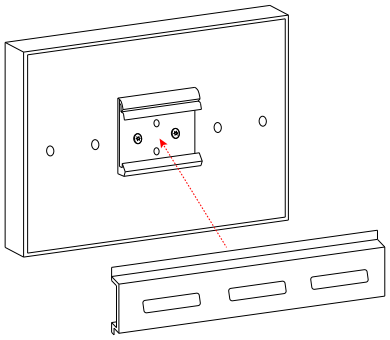


Figure. 12 - 37. Installing the DIN rail variant.



Point sensors

Figure. 12 - 38. Dimensions of arc flash sensors.

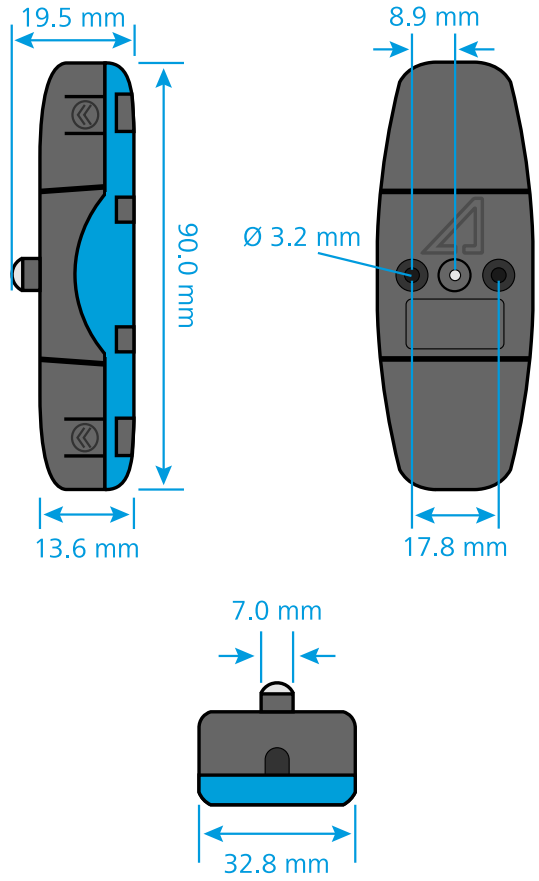
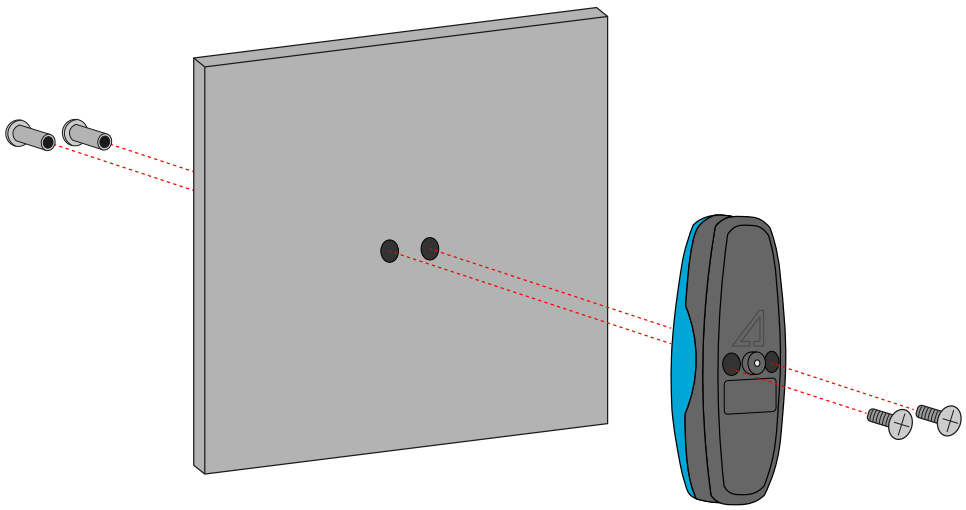


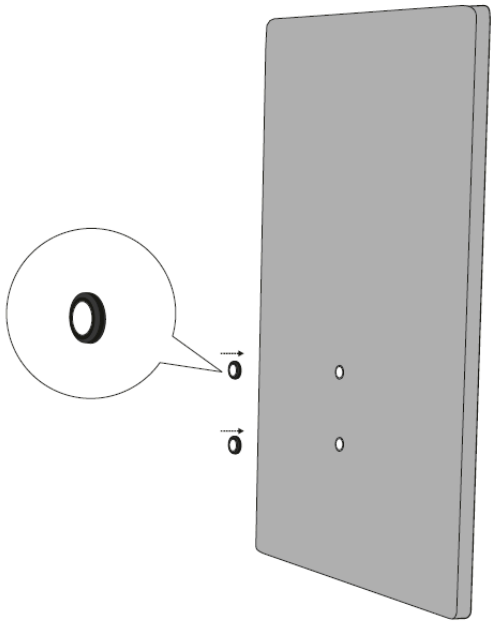
Figure. 12 - 39. Installing an arc flash sensor.



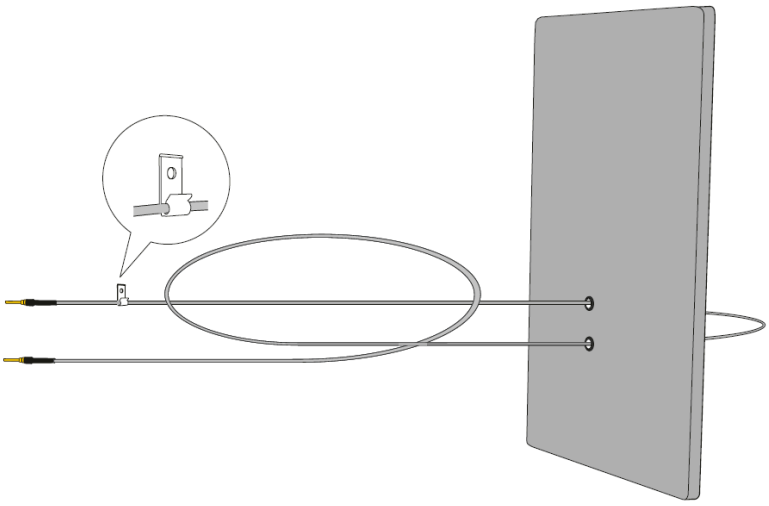
NOTICE!
Although the image above depicts the installation of an AQ-01 point sensor, please note that an AQ-02 pressure and point sensor is installed in the same way.

Fiber loops

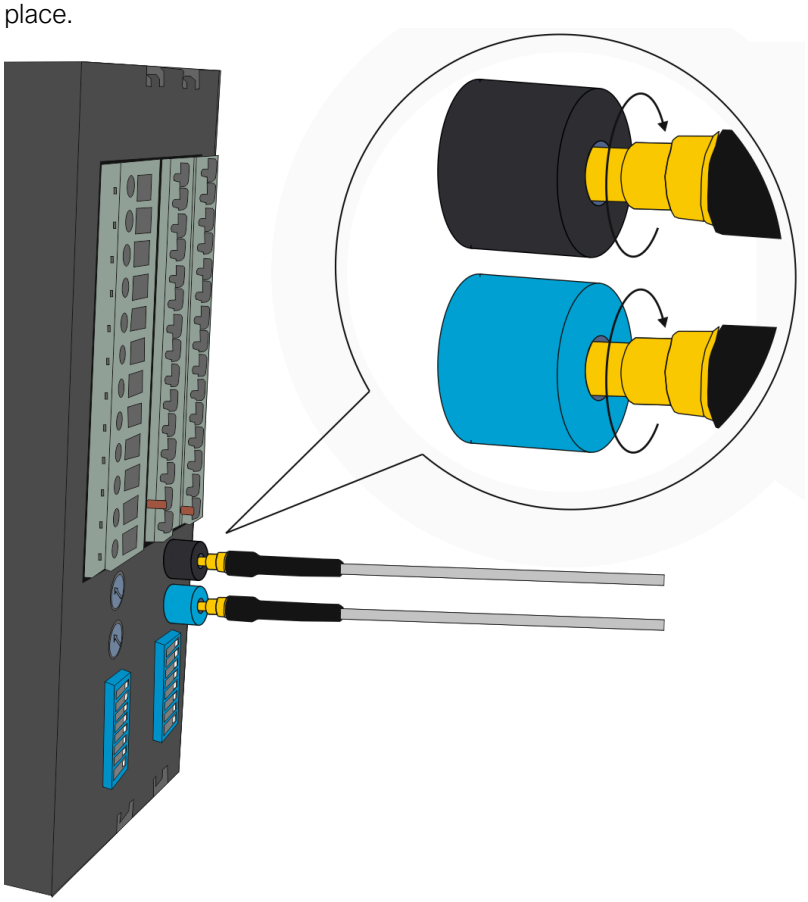
1. Drill holes on the wall for the sensor cable to enter the protected compartment.
2. Install protective covers in the holes to ensure the sensor cable remains unharmed by rough edges.



3. Run the sensor cable through the holes and along the protected area. Fasten it to the compartment walls with cable clips or some other appropriate anchoring method.



4. Turn the black and blue receiver (“Rx”) and transceiver (“Tx”) screws counter-clockwise and plug in the sensor cable terminals. Then turn the screws clockwise to secure the terminals in their place.



13 Testing

It is recommended that the device is tested prior to substation energizing. Testing is carried out by simulating an arc light for each sensor and verifying that the correct trip contact(s) tripped and that the correct indicator LED(s) turned on.

Any strong camera flash works well to simulate arc light. Please note that small LED lights like smartphone flashes are not strong enough to activate a point sensor or a fiber loop. Having a self-timer helps with the testing process because it can be connected to the test kit. Any strong flashlight works to test non-latched signals and the CBFP function. Before testing please check that the equipment used has a fully charged battery.

13.1 Testing the light-only mode

1. Check that the DIP switch settings are positioned according to your application.
2. Activate the camera flash within 30 cm (12 inches) of the sensor that is being tested.
3. Verify that the indicator LED of the corresponding sensor channel is lit.
4. Verify the activation(s) of the relay output(s) by checking the circuit breaker's status, or by monitoring the trip contact's status. The circuit breaker should open, or the contacts operate. Please note that you achieve the best test results when you operate the circuit breaker while testing.
5. Verify that the indicator LED(s) of the corresponding relay output(s) is lit.
6. If you are using the BO1 binary output, verify its signal activation either through the status change of the relevant input, or by measuring the signal output voltage. Please note that BO1 is of the non-latched type.
7. If you are using the BO1 binary output, also verify that the "BO1" LED is lit.
8. Press the SET push button to reset all indications and latches.
9. If you are using the BI2 binary input as the master trip, activate it and verify that the trip has occurred by repeating the steps 4 and 5.
10. Press the SET push button to reset all indications and latches.
11. Repeat the steps 1 through 10 for all sensors.

13.2 Testing the light and current mode

1. Check that the DIP switch settings are positioned according to your application.
2. Activate the following two things simultaneously: the camera flash within 30 cm (12 inches) of the sensor that is being tested, and the binary input used for the overcurrent condition (I>).
3. Verify that the indicator LED of the corresponding sensor channel is lit.
4. Verify that the indicator LED of the binary input is lit.
5. Verify the activation(s) of the relay output(s) by checking the circuit breaker's status, or by monitoring the trip contact's status. The circuit breaker should open, or the contacts operate. Please note that you achieve the best test results when you operate the circuit breaker while testing.
6. Verify that the indicator LED(s) of the corresponding relay output(s) is lit.
7. If you are using the BO1 binary output, verify its signal activation either through the status change of the relevant input, or by measuring the signal output voltage. Please note that BO1 is of the non-latched type.
8. If you are using the BO1 binary output, also verify that the "BO1" LED is lit.
9. Activate the camera flash within 30 cm (12 inches) of the sensor but do not activate the binary input used for the overcurrent condition (I>).
10. Verify that no trip has occured and only the indicator LED of the sensor activation is lit.
11. If you are using the BO1 signal and have configured it to send light information, verify that it is activated.

12. Press the SET push button to reset all indications and latches.
13. If you are using a binary input as the master trip, activate it and verify that the trip has occurred by repeating the steps 5 and 6.
14. Press the SET push button to reset all indications and latches.
15. Repeat the steps 1 through 13 for all sensors.

13.3 Testing the CBFP function

The circuit breaker failure protection (CBFP) function is tested by taking the light signal and the additional trip criterion signal (if applicable) and leaving them active for longer than the set CBFP time (that is, 100 or 150 ms). Check that the correct outputs activated after the set delay time.

13.4 Testing the operation time

An operation time test is not required at commissioning as it is performed by the manufacturer both as a type test and as a routine production test. If you want to have more information of these tests, please refer to the routine test reports sent with the AQ-101 device and/or consult your nearest Arcteq representative for the type test reports.

However, if it is deemed necessary, you can conduct an on-site timing test with the following instructions.

1. Use a calibrated relay test set.
2. Connect one of the test set's outputs to a strong camera flash to initialize the flash and to configure the set's timer to start simultaneously with the flash.
3. Connect one of the AQ-101 device's trip outputs (T1, T2, T3, T4) to a test set input and configure the input to stop the timer.
4. Place the camera flash within 30 cm (12 inches) of the sensor.
5. Initiate the flash and the timer by using the test set output.
6. Read the measured time between the simulated arc light and the operation of the trip contact.
7. Subtract the digital input delay of the test set from the final measured time (if applicable). For specific test instructions, please consult the manufacturer of the relay test set.

13.5 Test plan example

Basic data	
Date:	
Substation:	
Switchgear:	
Serial number:	

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AQ-101

Preconditions		Additional notes
Trip mode (channel 1):	___ L> ___ L> + I>	
Trip mode (channels 2, 3, 4):	___ L> ___ L> + I>	
BI master trip in use:	___ Yes ___ No	
CBFP in use:	___ Yes ___ No	
CBFP time setting:	___ 100 ms ___ 150 ms	

Object activated		LED active	T1, T2, T3, T4 active	BO1 active	Additional notes
Sensor channel 1	S1				
	S2				
	S3				
Sensor channel 2	S1				
	S2				
	S3				
Sensor channel 3	S1				
	S2				
	S3				
Sensor channel 4	S1				
	S2				
	S3				
Fiber sensor channel					
Binary inputs	BI1				
	BI2				

Involved personnel	
Tested by:	
Approved by:	

14 Troubleshooting

Table. 14 - 6. Troubleshooting guide for AQ-101 variants.

Problem	Possible solution(s)
The sensor does not activate during testing.	Check the sensor's cable wiring. or Check the testing equipment, especially the camera flash intensity (see the Testing chapter for more information).
The trip relay does not operate even when the sensor is activated.	Tripping might require overcurrent signal simultaneously with light signal. Check the DIP switch settings (see the DIP switch settings chapter for more information).

15 Technical data

15.1 Mounting and installation

Table. 15.1 - 7. Technical data for relay mounting and installation (AQ-101 & AQ-101LV).

Panel: - material - thickness (min...max)	 metal 1.0...5.0 mm (0.04...0.20 in)
Panel mounting: - screw type - key size - tightening torque (min...max)	 ISO 14581 M4x12, galvanized Torx T20 1.5...2.0 N·m (13.3...17.7 lbf·in)
Grounding: - nut type - key size - tightening torque (min...max)	 DIN934-M5 galvanized 8 2.5...3.0 N·m (22.1...26.6 lbf·in)
Connectors X1 and X2 : - connector type - wire cross section (min...max) - minimum stripping length - screw tightening torque (min...max)	 Phoenix Contact MSTB 2,5/15-ST-5,08 BD:1-15 0.2...2.5 mm^2 (24...13 AWG) 7 mm (0.28 in) 0.5...0.6 N·m (4.4...5.3 lbf·in)
Fiber connectors: - nut tightening torque	 light finger tightening

Table. 15.1 - 8. Technical data for relay mounting and installation (AQ-101D & AQ-101DLV).

Panel: - material - thickness (min...max)	 metal 1.0...5.0 mm (0.04...0.20 in)
Panel mounting: - screw type - key size - tightening torque (min...max)	 ISO 14581 M4x12, galvanized Torx T20 1.5...2.0 N·m (13.3...17.7 lbf·in)
Grounding: - nut type - key size - tightening torque (min...max)	 DIN934-M5 galvanized 8 2.5...3.0 N·m (22.1...26.6 lbf·in)
Connectors X1 and X2: - connector type - wire cross section (min...max) - minimum stripping length - screw tightening torque (min...max)	 Phoenix Contact FRONT-MSTB 2,5/15-STF-5,08 0.34...2.5 mm^2 (24...12 AWG) 10 mm (0.39 in) 0.5...0.6 N·m (4.4...5.3 lbf·in)
Fiber connectors: - nut tightening torque	 light finger tightening

15.2 Operating times

Table. 15.2 - 9. Technical data for relay operating times.

Trip time using mechanical trip relays	7 ms*
Reset time (arc light stage)	2 ms

*) The total trip time when using both the arc light (L>) or phase/residual overcurrent (I>) from an AQ-110 device and the arc light (L>) from this device.

15.3 Auxiliary voltage

Table. 15.3 - 10. Technical data for the relay auxiliary voltage (Uaux).

Auxiliary power supply	92…265 V AC/DC 18…72 V DC (optional)
Maximum power consumption	5 W, < 10 mΩ
Standby current	90 mA
Start-up inrush current	<150 ms (110 V DC) <600 ms (24 V DC)

15.4 Binary inputs

Table. 15.4 - 11. Technical data for the binary inputs (BI1, BI2).

Nominal threshold voltage	24 V DC or 110 V DC or 220 V DC
Threshold: - pick-up - drip-off	 Approximately 16 V DC or 88 V DC or 178 V DC Approximately 15 V DC or 75 V DC or 155 V DC
Rated current	3 mA
Number of inputs	2

15.5 Trip relays

Table. 15.5 - 12. Technical data for the trip relays (T1, T2, T3, T4).

Number of trip relays	4 NO or 3 NO + 1 NC
Voltage withstand	250 V AC/DC
Carry: - continuous carry - make-and-carry for 3 s - make-and-carry for 0.5 s	 5 A 16 A 30 A
Breaking capacity DC*	40 W (0.36 A at 110 V DC)

Contact material	AgNi 90/10

*) When the time constant L/R = 40 ms.

15.6 Binary output(s)

Table. 15.6 - 13. Technical data for the binary output (BO1).

Number of outputs	1
Rated voltage	+24 V DC (internal power supply)
Rated current (max.)	20 mA

15.7 System failure relay

Table. 15.7 - 14. Technical data for the system failure relay (SF).

Number of SF relays	1
Rated voltage	250 V AC/DC
Carry: - continuous carry - make-and-carry for 3 s - make-and-carry for 0.5 s	 5 A 16 A 30 A
Breaking capacity DC*	40 W (0.36 A at 110 V DC)
Contact material	AgNi 90/10

*) When the time constant L/R = 40 ms.

15.8 Point sensors

AQ-01 point sensor

Table. 15.8 - 15. Technical data for the AQ-01 light point sensor.

Light intensity threshold	8,000 lux 25,000 lux 50,000 lux
Detection radius	180º
Mechanical protection	IP 20
Sensor cable specification	Shielded twisted pair 0.75 mm^2 (AWG: 18)
Maximum sensor cable length (per channel)	200 m
Operating temperature	–20…+85 ºC

AQ-02 point sensor

Table. 15.8 - 16. Technical data for the AQ-02 light and pressure point sensor.

Light intensity threshold	8,000 lux 25,000 lux 50,000 lux
Pressure threshold (fixed)	0.2 bar above ambient pressure
Pressure measuring accuracy	±1.8 % (of full scale)
Detection radius	180º
Mechanical protection	IP 20
Sensor cable specification	Shielded twisted pair 0.75 mm^2 (AWG: 18)
Maximum sensor cable length (per channel)	200 m
Operating temperature	–20…+85 ºC

15.9 Fiber optic loop sensors

AQ-06 fiber optic loop sensor

Table. 15.9 - 17. Technical data for the AQ-06 fiber optic loop sensor.

Material	Plastic fiber
Light intensity threshold	8,000 lux
Cable length (min…max)	3…40 m
Cable diameter	1.0 mm
Detection radius	360º
Bending radius	5 cm
Operating temperature	–40…+85 ºC

AQ-07 fiber optic loop sensor

Table. 15.9 - 18. Technical data for the AQ-07 fiber optic loop sensor.

Material	Covered glass fiber
Light intensity threshold	8,000 lux
Cable length (min…max)	3…50 m
Cable diameter	1.2 mm
Detection radius	360º

Bending radius	1 cm
Operating temperature	–40…+85 ºC

AQ-08 fiber optic loop sensor

Table. 15.9 - 19. Technical data for the AQ-08 fiber optic loop sensor.

Material	Covered glass fiber
Light intensity threshold	8,000 lux
Cable length (min…max)	3…15 m
Cable diameter	1.2 mm
Detection radius	360º
Bending radius	1 cm
Operating temperature	–40…+125 ºC

15.10 Disturbance tests

Table. 15.10 - 20. Technical data for the disturbance tests.

Electromagnetic compatibility test	CE-approved and tested according to EN 50081-2 and EN 50082-2
Conducted emission (EN 55011, class A)	0.15…30.00 Hz
Radiated emission (EN 55011, class A)	30.00…1,000.00 MHz
Electrostatic discharge immunity (IEC 244-222 and EN 61000-4-2, level 4)	Air discharge: 15 kV Contact discharge: 8 kV
Electrical fast transients (EN 61000-4-4, class III & IEC 801-4, level 4)	Power supply input: 4 kV, 5/50 ns Other inputs and outputs: 4 kV, 5/50 ns
Surge immunity (EN 61000-4-5, level 4)	Between wires: 2 kV, 1.2/50 µs Between wire and earth: 4 kV, 1.2/50 µs
RF electromagnetic field (EN 61000-4-3, level 3)	f = 80…1,000 MHz, 10 V/m
Conducted RF field (EN 61000-4-6, level 3)	f = 150 kHz…80 MHz, 10 V/m

15.11 Voltage tests

Table. 15.11 - 21. Technical data for the voltage tests.

Insulation test voltage (IEC 60255-5)	2 kV, 50 Hz, 1 min

Impulse test voltage (IEC 60255-5)	5 kV, 1.2/50 µs, 0.5 J

15.12 Mechanical tests

Table. 15.12 - 22. Technical data for the mechanical tests.

Vibration test	2…13.2 Hz (± 3.5 mm) 13.2…100 Hz (±1.0 g)
Shock/bump test (IEC 60255-21-2)	20 g and 1,000 bumps/dir.

15.13 Environmental conditions

Table. 15.13 - 23. Technical data for the environmental conditions.

Specified ambient service temperature	–35…+70 ºC
Transportation and storage temperature	–40…+70 ºC
Relative humidity	Up to 97 %
Altitude	Up to 2,000 m above sea level

15.14 Casing

Table. 15.14 - 24. Technical data for the device casing.

Protection: - front - back	 IP 50 IP 20
Device dimensions (W × H × D)	50 × 157 × 160 mm 145 × 109 × 34 mm (the DIN rail variant)
Weight	0.7 kg

16 Ordering information

AQ-101 point sensor device (panel mounted)

AQ - 1 0 1 - X X X X

Auxiliary power supply
- A 92...265 V AC/DC
- B 18...72 V DC

T3 trip relay setting
- A Normally open (NO)
- B Normally closed (NC), or Electronic lock-out

Additional sensor channel (S5)
- A None
- B Fiber optic sensor channel

BI activation voltage threshold
- A 24 V DC
- B 110 V DC
- C 220 V DC

AQ-101D point sensor device (DIN rail mounted)

AQ - 1 0 1 D - X X X X

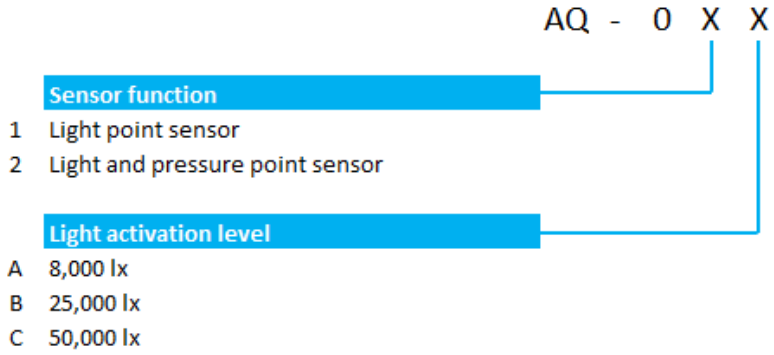
Auxiliary power supply
- A 92...265 V AC/DC
- B 18...72 V DC

T3 trip relay setting
- A Normally open (NO)
- B Normally closed (NC), or Electronic lock-out

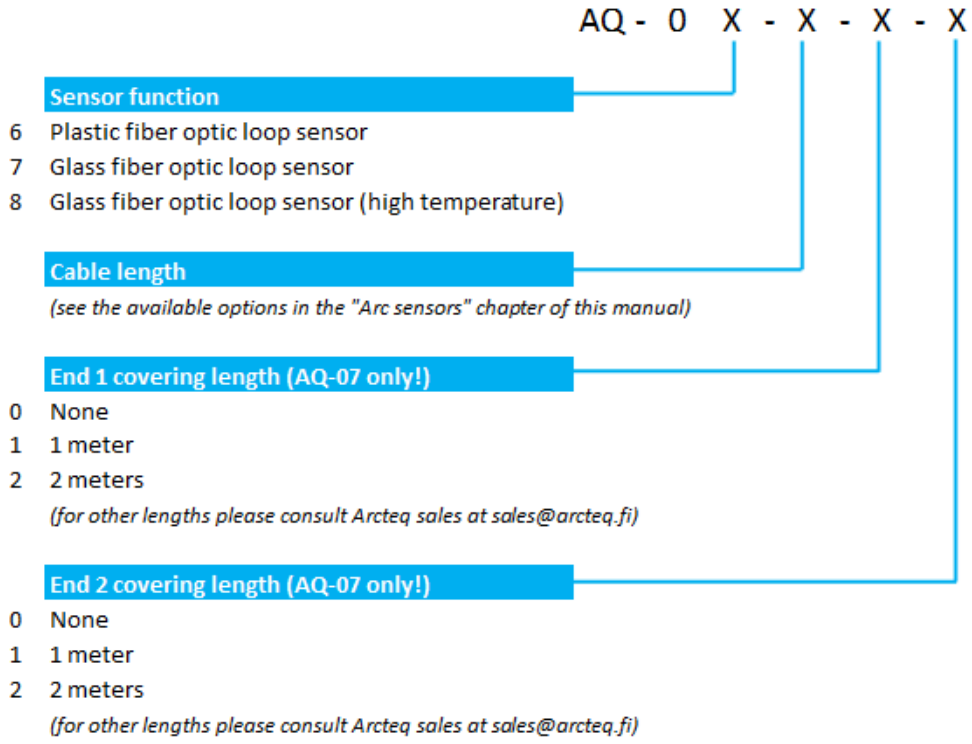
Additional sensor channel (S5)
- A None
- B Fiber optic sensor channel

BI activation voltage threshold
- A 24 V DC
- B 110 V DC
- C 220 V DC

AQ-0x point sensors



AQ-0x fiber optic loop sensors



Accessories

Order code	Description	Note	Manufacturer
AQX006	Wall mounting bracket	For AQ-103 and AQ-110x variants (MV and LV).	Arcteq Ltd.
AQX016	Wall mounting bracket	For AQ-101, AQ-101S and AQ-102 devices (MV and LV).	Arcteq Ltd.

17 Contact and reference information

Manufacturer

Arcteq Relays Ltd.

Visiting and postal address

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