AQ-0x

Arc sensors

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. Manual revision notes

Revision	1.00
Date	July 2010
Changes	- The first revision of the manual.
Revision	1.01
Date	July 2012
Changes	- The sensor chapter revised (fiber pictures and point sensor connections).
Revision	1.02
Date	July 2012
Changes	- Ordering code revised. - Point sensor max. wiring length updated to 200 meters.
Revision	1.03
Date	January 2020
	- Content completely rewritten to improve grammar and readability. - The AQ-02 point sensor chapter added to the "Arc sensors" chapter, and AQ-02's technical data added to the "Technical data" chapter. - Sensor–unit type dependency list updated. - The "Connecting sensors" chapter moved to the AQ-0x instruction booklet from the AQ-101 and AQ-110x instruction manuals. The chapter on how to connect fiber loop sensors added. - All technical data checked and updated where necessary. - Ordering information updated. - Images updated where necessary.

NOTE! This booklet only describes the AQ-0x series sensors used in the arc protection system in conjunction with AQ-100 units. It is important to read the instruction manuals for the AQ-100 units as well!

2. Arc sensors

The AQ-100 series provides different types of arc sensors to be used with different units and different switchgear types according to specific application requirements. There are two types of sensors: arc light point sensors and arc light fiber optic loop sensors.

Arc light point sensors are typically installed in metal-clad compartments, and they provide a quick and accurate location of the faulted 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.

2.1. 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. Only one sensor should be used per one closed metal-clad compartment. 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, the default threshold can also be set to 25,000 lux or 50,000 lux. An arc light sensor does not require further settings by the user. Its detection radius is 180 degrees.

Figure. 2.1. - 1. The AQ-01 light sensor.

An AQ-01 is installed either on the compartment wall or through the wall. When wall-mounting, the unit is placed on the wall (with the gray side against the wall) and then fixed to the wall with two screws from the back of the sensor. Through-the-wall mounting is similar: the unit is placed on the wall (with the blue side against the wall and the eye is pushed into the drilled compartment hole for protection) 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. 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.

NOTE!

The AQ-01 point sensor does <u>not</u> come with a connection cable!

2.2. 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. 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. Only one sensor should be used per one closed metal-clad compartment. The AQ-02 sensors <u>cannot</u> 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, the default threshold can also be set to 25,000 lux or 50,000 lux. An arc light sensor does not require further settings by the user. Its detection radius is 180 degrees. The pressure threshold is fixed at 0.2 bar above ambient pressure.

Figure. 2.2. - 2. AQ-02 arc light and pressure point sensor.

An AQ-02 can only be installed on the compartment wall as not to block pressure detection located next to "the eye". The unit placed on the wall (with the gray 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. 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.
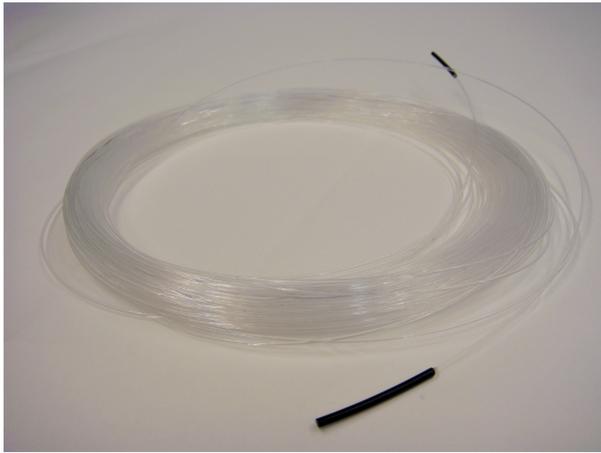
2.3. Arc light fiber optic loop sensor AQ-06

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 does not require further settings by the user. 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). It is not recommended to cut or splice the cable on-site. However, if cutting or splicing is necessary due to the cable breaking, please contact your nearest Arcteq representative for instructions.

When requested, the ends of an AQ-06 cable can be covered with black rubber to avoid light detection outside the protected zone (see the figure below). The covered area can be as large or small as necessary. For more information, please consult your nearest Arcteq representative.

Figure. 2.3. - 3. AQ-06 sensor with covered ends.

2.4. 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). It is not recommended to cut or splice the cable on-site. However, if cutting or splicing is necessary due to the cable breaking, please contact your nearest Arcteq representative for instructions.

The fixed light intensity threshold of an AQ-07 sensor is 8,000 lux. The sensor does not require further settings by the user. The sensor's detection radius is 360 degrees.

When requested, the ends of an AQ-07 cable can be covered with black rubber to avoid light detection outside the protected zone (see the figure below). The covered area can be as large or small as necessary. For more information, please consult your nearest Arcteq representative.

Figure. 2.4. - 4. AQ-07 sensor with covered ends.

2.5. 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). It is not recommended to cut or splice the cable on-site. However, if cutting or splicing is necessary due to the cable breaking, please contact your nearest Arcteq representative for instructions.

The fixed light intensity threshold of an AQ-08 sensor is 8,000 lux. The sensor does not require further settings by the user. The sensor's detection radius is 360 degrees.

When requested, the ends of an AQ-08 cable can be covered with black rubber to avoid light detection outside the protected zone (see the figure below). The covered area can be as large or small as necessary. For more information, please consult your nearest Arcteq representative.

Figure. 2.5. - 5. AQ-08 sensor with covered ends and terminals.

2.6. Sensor—unit dependencies

Different sensor types can be used with different arc flash protection units of the AQ-100 series. The table below describes those dependencies.

Table. 2.6. - 1. Medium-voltage sensor—unit dependencies.

	AQ-01	AQ-02	AQ-06	AQ-07	AQ-08
AQ-101	Yes	Yes	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)
AQ-101D	Yes	Yes	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)
AQ-101S	Yes	Yes	No	No	No
AQ-102	No	No	Yes	Yes	Yes
AQ-103	Yes	Yes	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)
AQ-110P	Yes	Yes	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)

	AQ-01	AQ-02	AQ-06	AQ-07	AQ-08
AQ-110F	No	No	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)

Table. 2.6. - 2. Low-voltage sensor—unit dependencies.

	AQ-01	AQ-02	AQ-06	AQ-07	AQ-08
AQ-101LV	Yes	Yes	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)
AQ-101DLV	Yes	Yes	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)
AQ-102LV	No	No	Yes	Yes	Yes
AQ-103LV	Yes	Yes	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)
AQ-110PLV	Yes	Yes	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)
AQ-110FLV	No	No	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)	Yes (when the unit is equipped with the fiber option)

3. Connecting sensors

3.1. Point sensors

> **NOTE!**
>
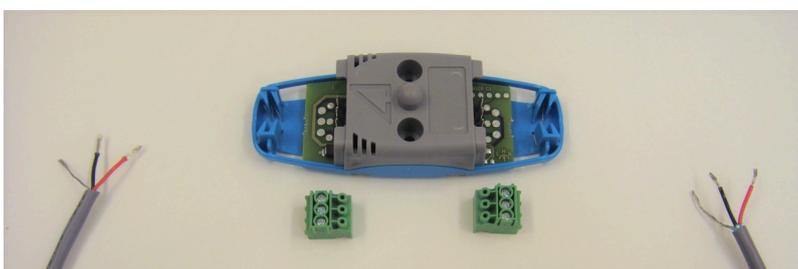> While the images and the text below refer to the AQ-01 sensor unit, these instructions are also applicable to an AQ-02 sensor unit.

1. Open the gray covers of the sensor and detach the green connectors from the sensor's PCB. Prepare the shielded twisted pair cable for connecting (see the image below).

Figure. 3.1. - 6. Preparing the cable and the sensor.

2. Before connecting the cable to the connector, make sure that the connecting order is correct (+, signal, shield). You can check the appropriate pins from the sensor, as the information is shown on the inside of the sensor's blue plastic cover (see the circled are in the image below, on the left). Next, plug the wires into the connector and fasten them with a screw driver (see the image below, on the right). Repeat for the other connector.

Figure. 3.1. - 7. Pin information (left) and fastening wires (right).
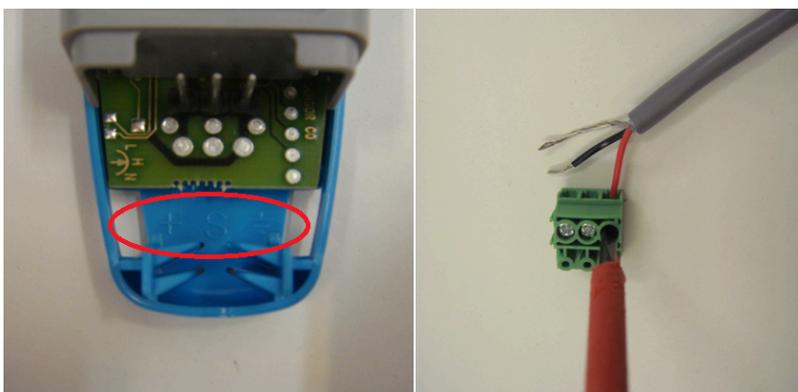
3. Connect the other end of the cable into a sensor channel of an appropriate AQ-100 unit (AQ-101 variants, AQ-103 variants and AQ-110P, or their LV versions). See the image below, where the cable is connected to an AQ-101 unit.

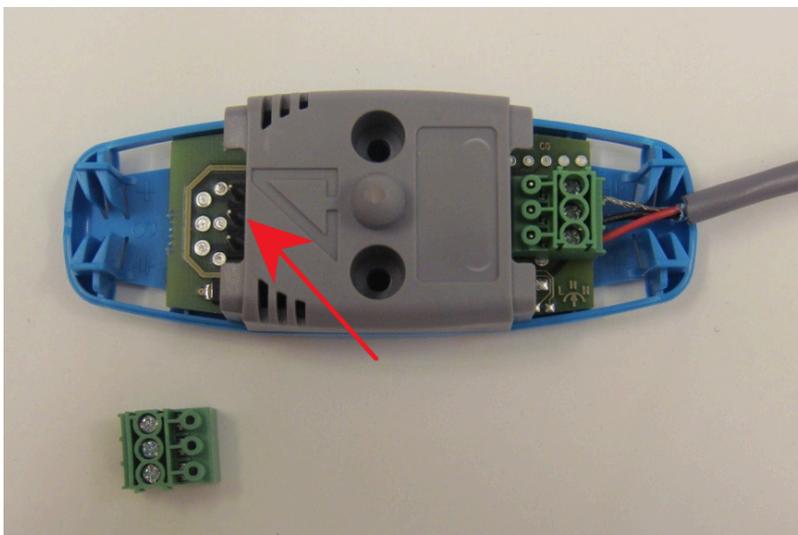Figure. 3.1. - 8. Connecting the cable to a unit.
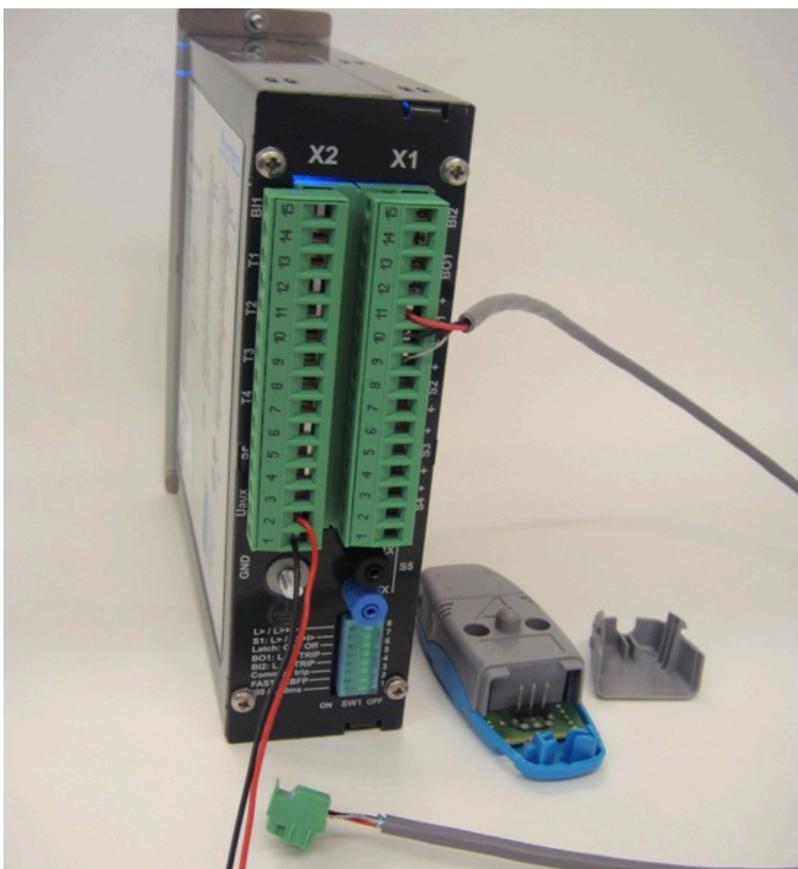
4. Check the unit's front panel that only the "Power" LED is lit (see the image below).

Figure. 3.1. - 9. Front panel check.

5. Attach the connector back into its slot in the sensor PCB (see the red arrow in the image below; the connector is already in place on the right side).

Figure. 3.1. - 10. Reattaching the connector into the sensor PCB.

6. Now, the "Error" LED should be lit and the LED for the appropriate sensor channel should start blinking ("S1", for example; see the image below).

Figure. 3.1. - 11. LEDs.
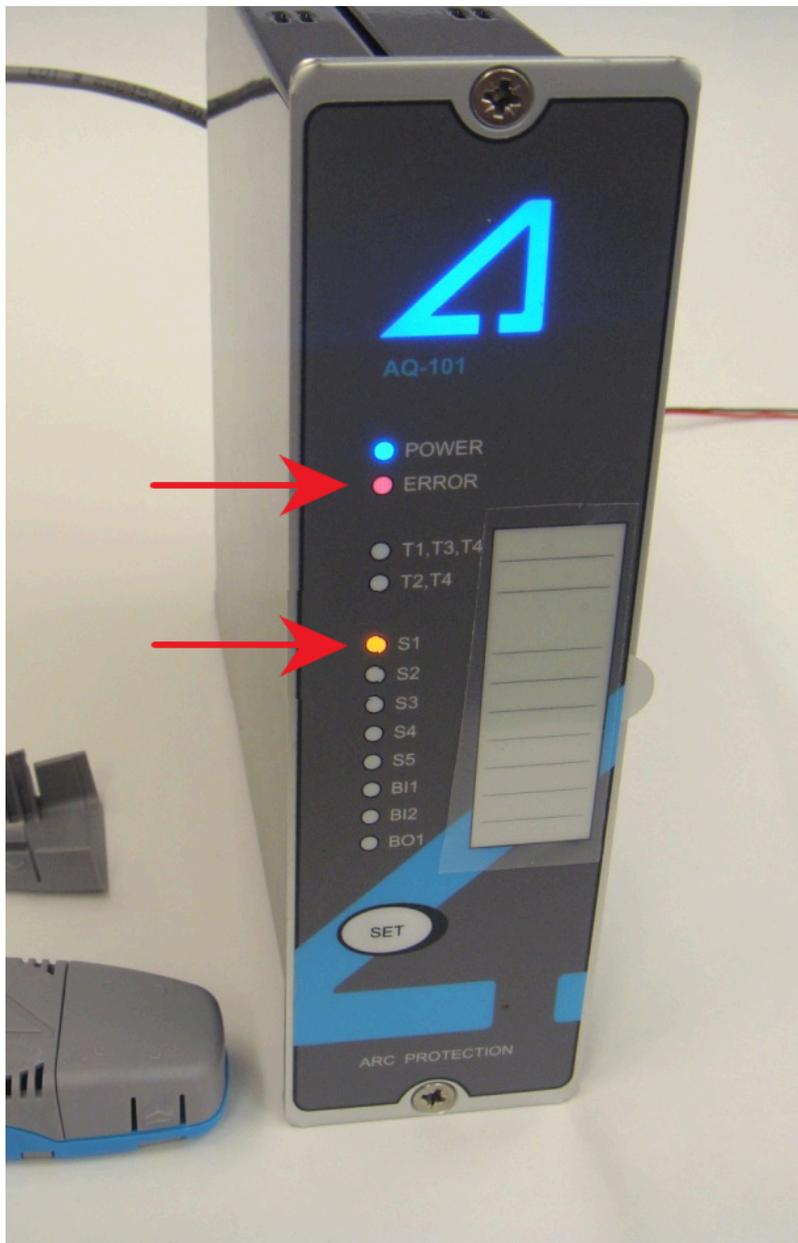
7. Press and hold SET push button on the front panel for two seconds to run the system's auto-configuration procedure (see the image below). The unit memorizes the number of connected sensors and the connected binary input lines (if any). Please note that auto-configuration is a part of the system self-supervision function, which continuously ensures that all connectors and sensors are fully functional and ready to operate.
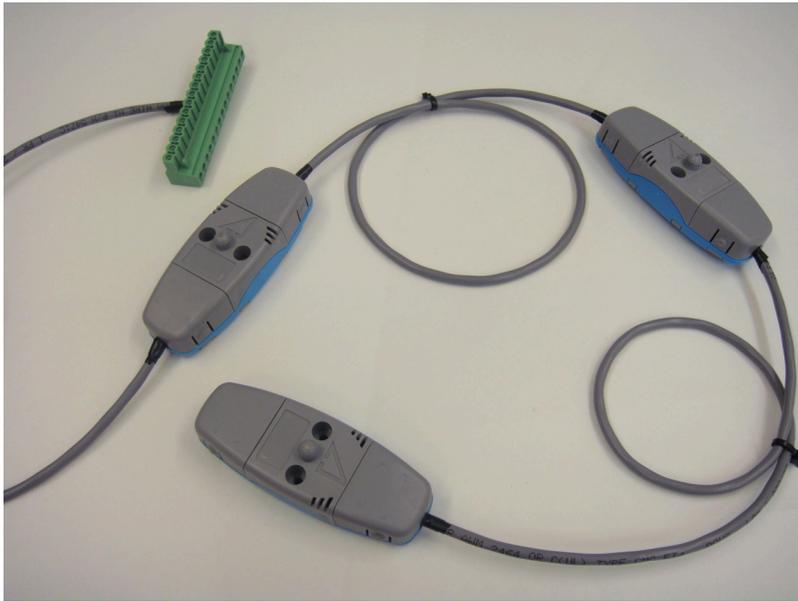
8. Once the auto-configuration procedure is completed and only the blue "Power" LED is lit, click the two gray covers back in place on the sensor (see the image below).

Figure. 3.1. - 12. Closing the sensor covers.
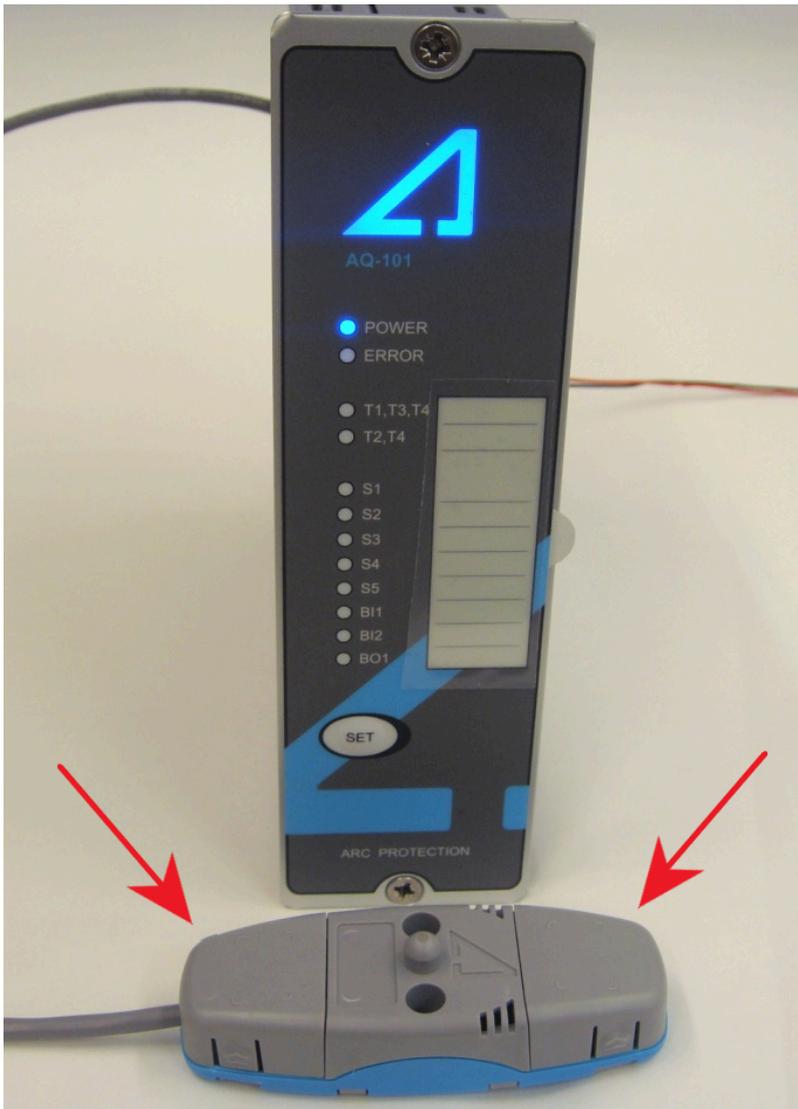
You can connect a maximum of three (3) point sensor in a series on one sensor channel (see the image below).

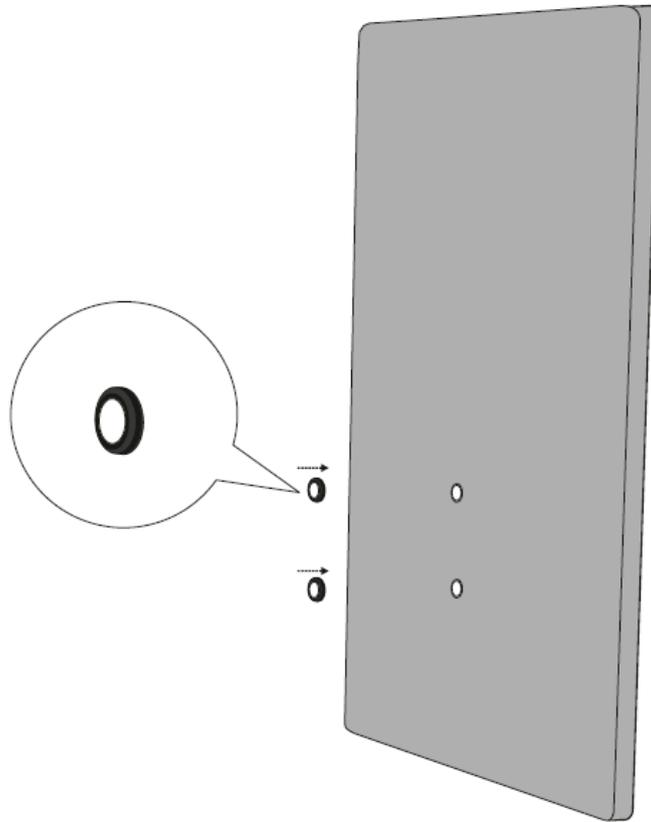Figure. 3.1. - 13. Three sensors connected in series.



3.2. Fiber loop sensors

Installation

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.
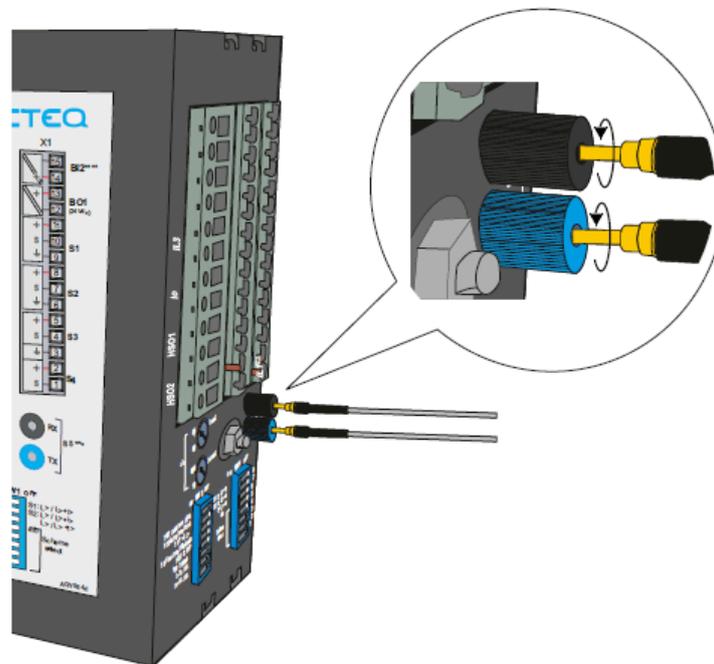

3. Run the sensor cable through the holes and along the protected area. Fasten it to the compartment walls with cable clips or some other appropriate anchoring method.
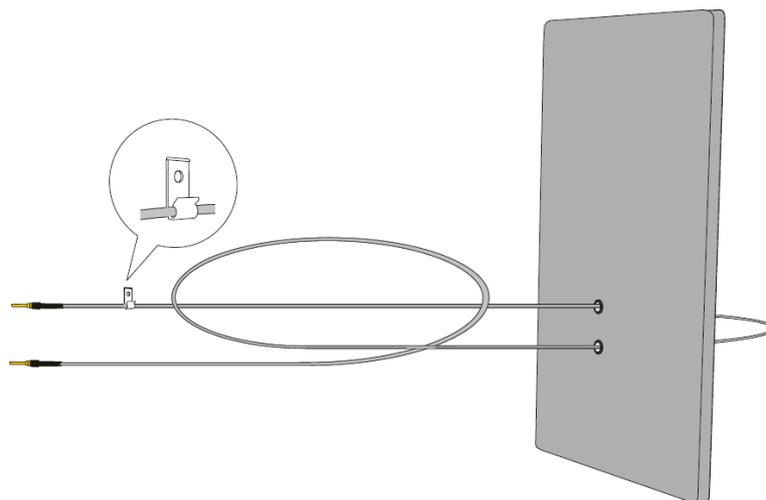
4. Turn the black and blue receiver ("Rx") and transceiver ("Tx") screws counter-clockwise and plug in the sensor cable terminals.
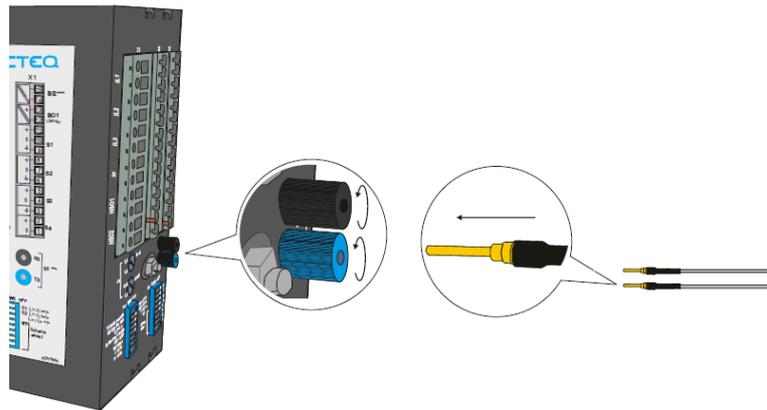
5. Turn the screws clockwise to secure the terminals in their place.

Tubing

Sometimes it is necessary to install the fiber in places where occasional non-arc light can cause unwanted activation of the sensor. When this is the case, the fiber needs to be covered. Please note that this can only be done to AQ-07 and AQ-08 glass fiber cables.

1. Take the necessary length of a heat shrinking tube and insert the sensor cable through it until the terminal is fully visible.

2. Place the tube so that it partially covers the small rubber section of the existing fiber terminal. 3. Use a heat blower to shrink the tube so that no unwanted light can reach the sensor. Be careful when applying the heat blower to avoid any injury to the fiber or to yourself!

3. When the required length of the fiber has been covered, begin connecting the sensor cable to the AQ-100 series unit according to the instructions given above.

4. Technical data

4.1. Sensors

AQ-01 point sensor

Light intensity threshold	8,000 lux 25,000 lux 50,000 lux
Detection radius	180º
Mechanical protection of the whole sensor Mechanical protection for the active light detection part of the sensor	IP 20 IP 60
Sensor cable specification	Shielded twisted pair 0.75 mm^2 (AWG: 20)
Maximum sensor cable length (per channel)	200 m
Operating temperature	–20…+85 ºC

AQ-02 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 for the whole sensor Mechanical protection for the active light detection part of the sensor Mechanical protection for the active pressure detection part of the sensor	IP 20 IP 60 IP 40
Sensor cable specification	Shielded twisted pair 0.75 mm^2 (AWG: 20)
Maximum sensor cable length (per channel)	200 m
Operating temperature	–20…+85 ºC

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

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

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

5. Ordering information

AQ-0x point sensors

```
AQ -  0  X  X
```

Sensor function

1   Light point sensor
2   Light and pressure point sensor

Light activation level

A   8,000 lx
B   25,000 lx
C   50,000 lx

AQ-0x fiber optic loop sensors

```
AQ -  0  X  X
```

Sensor function

6   Plastic fiber optic loop sensor
7   Glass fiber optic loop sensor
8   Glass fiber optic loop sensor (high temperature)

Cable length

(see the available options in the "Arc sensors" chapter of this manual)
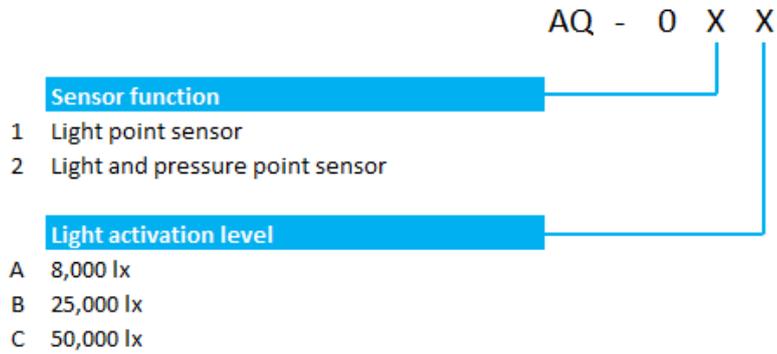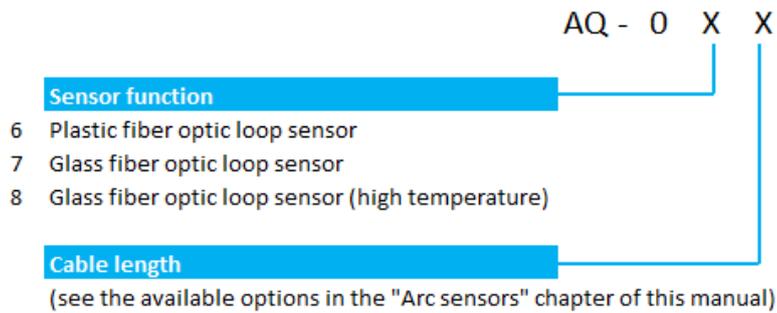
6. Contact and reference information

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