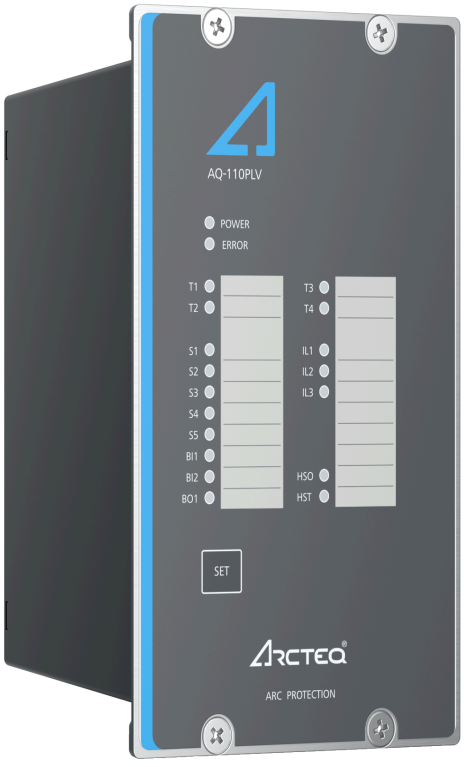
ARCTEQ®
RELAYABLE POWER

AQ-110xLV

Arc sensor unit with overcurrent



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1. Manual revision notes

Revision	1.00
Date	September 2020
Changes	- The first revision of the manual.

2. Abbreviations

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

QD – quenching device

RF – radio frequency

Rx – receiver

SAS – standard arc scheme

SF – system failure

Tx – transceiver

µP - microprocessor

3. General

The AQ-110xLV (AQ-110PLV and AQ-110FLV) device is a sophisticated microprocessor-based arc flash protection unit. It has a combined current and arc sensing which provides more criteria for tripping. The device is designed to minimize the damage caused by an arcing fault (arc flash) by tripping the circuit breaker which supplies current to the fault. The complete system self-supervision functionality of AQ-110xLV provides the highest level of dependability as it continuously monitors all internal system functions as well as all external connections.

The AQ-110xLV device 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. While AQ-110xLV is suitable for MV use, it is designed for LV switchgears and for motor control center applications in both new and retrofitted installations.

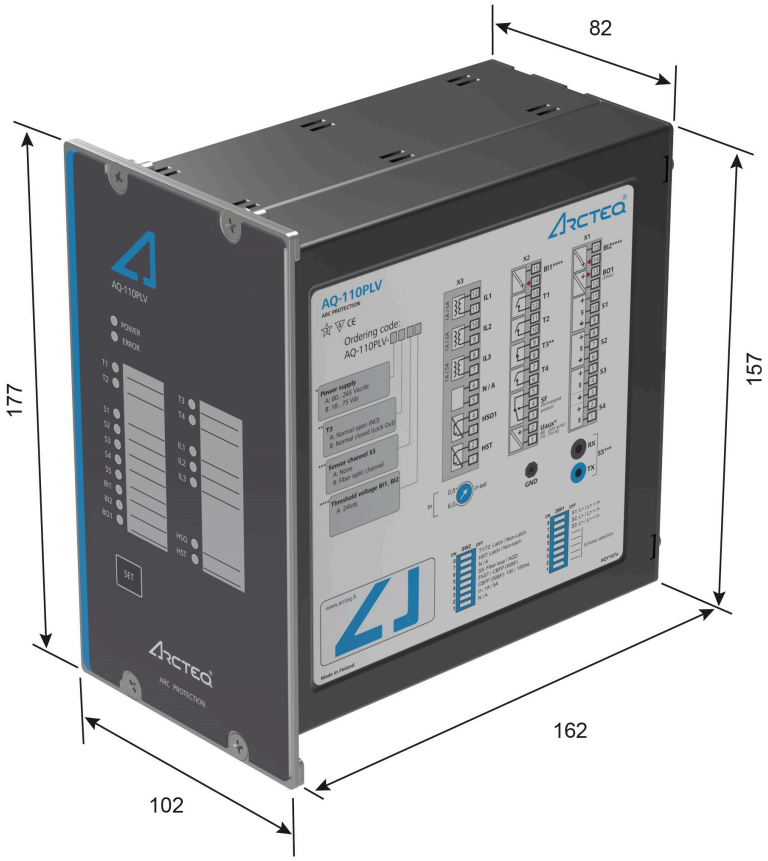
3.1. Dimensions and installation

AQ-110xLV can be either door-mounted or panel-mounted in a standard 19 inch rack. The unit's dimensions are as follows:

- Height: 177 mm (7.00")
- Width: 102 mm (4.02")
- Depth: 162 mm (6.38").

The figure below presents a side view of the device and gives the dimensions in more detail. Please note that all values are given in millimeters.

Figure. 3.1. - 1. Dimensions of the device.



The image below presents the dimensions of the cut-out needed for mounting the unit on a panel.

Figure. 3.1. - 2. Cut-out for panel-mounting a unit.

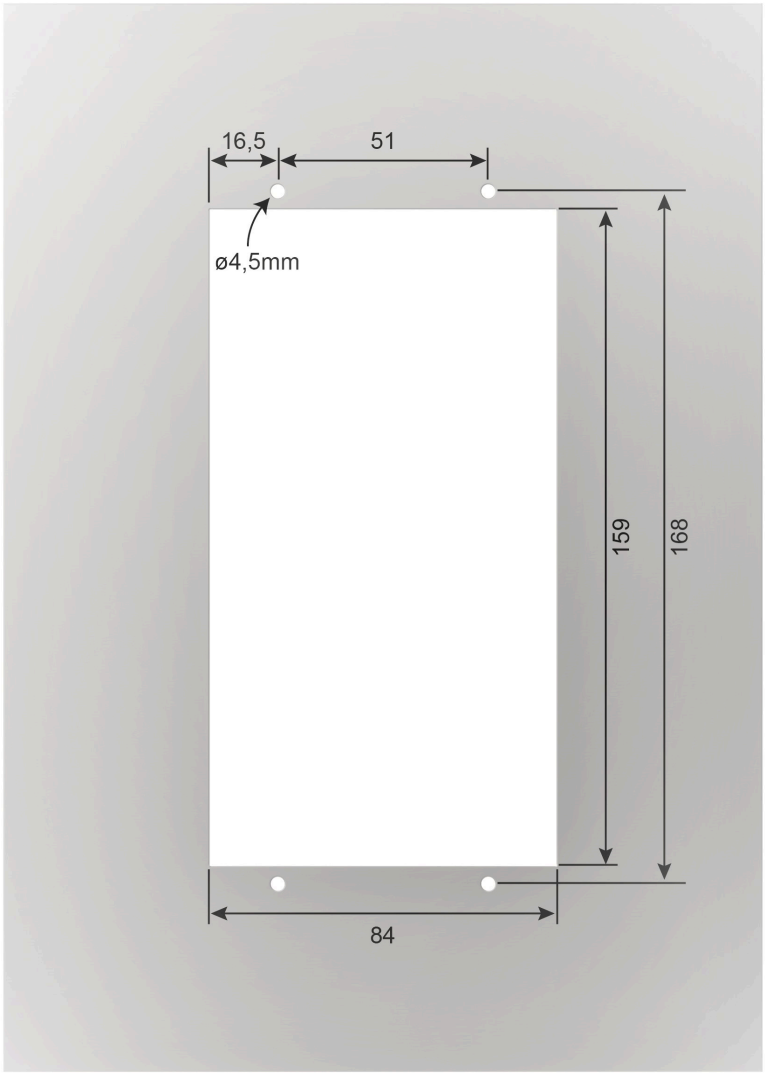


Figure. 3.1. - 3. Installing a unit into a cut-out.

3.2. Wiring

Figure. 3.2. - 4. Wiring diagram for AQ-110PLV.

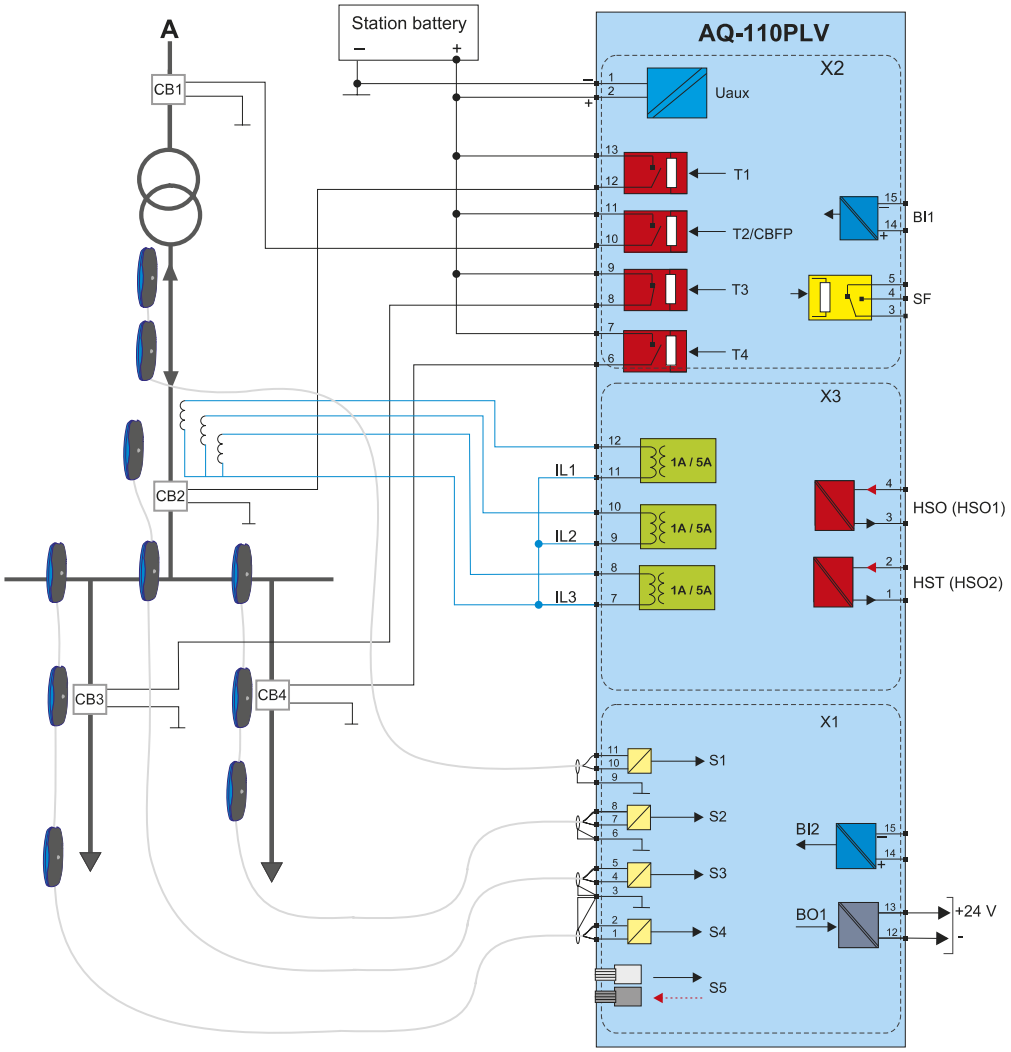
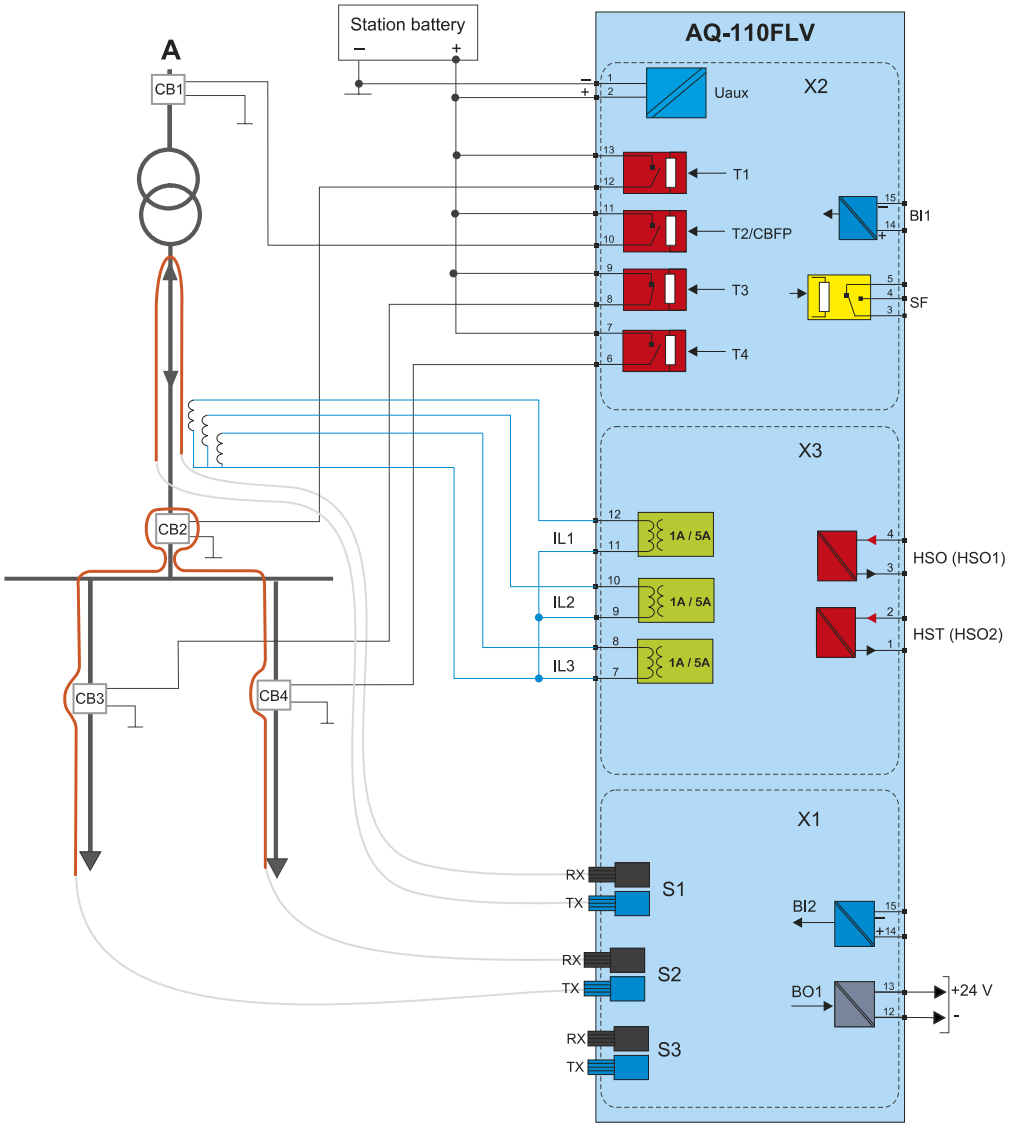


Figure. 3.2. - 5. Wiring diagram for AQ-110FLV.



3.3. Unit features

AQ-110xLV is a multipurpose arc flash protection unit and can be applied to a variety of applications. It can be used on its own as a stand-alone unit, or it can be a part of a more complex arc protection system through the binary bus.

AQ-110xLV comes in two variants. The AQ-110PLV variant supports four (4) point sensor channels as well as one (1) optional fiber sensor channel. The AQ-110FLV variant supports three (3) fiber sensor channels. All other features are the same in both variants.

The following list presents the main features of the 110PLV unit:

- 92…265 V AC/DC auxiliary power supply or 18…72 V DC auxiliary power supply (optional)
- three (3) phase current inputs with one fifths of the nominal current
- four (4) arc point sensor channels
- one (1) fiber loop sensor channel (optional)
- two (2) binary inputs with nominal operation voltage of 24 V DC
- two (2) high-speed semiconductor trip outputs (HSO [HSO1] and HST [HSO2])
- three (3) normally open trip relay outputs

- one (1) normally open trip relay output or one (1) normally closed trip relay output (electronic lock-out)
- one (1) binary output (24 V DC)
- one (1) system failure output
- nineteen (19) indication LEDs
- one (1) push-button.

The following list presents the main features of the 110FLV unit:

- 92…265 V AC/DC auxiliary power supply or 18…72 V DC auxiliary power supply (optional)
- three (3) phase current inputs with one fifths of the nominal current
- three (3) fiber loop sensor channels
- two (2) binary inputs with nominal operation voltage of 24 V DC
- two (2) high-speed semiconductor trip outputs (HSO [HSO1] and HST [HSO2])
- three (3) normally open trip relay outputs
- one (1) normally open trip relay output or one (1) normally closed trip relay output (electronic lock-out)
- one (1) binary output (24 V DC)
- one (1) system failure output
- eighteen (18) indication LEDs
- one (1) push-button.

Figure. 3.3. - 6. Arc protection unit AQ-110PLV.

Figure. 3.3. - 7. Arc protection unit AQ-110FLV.

3.4. Simplified block diagram

The figures below presents the main components that can be found in the AQ-110xLV units (AQ-110PLV and AQ-110FLV).

Figure. 3.4. - 8. Simplified block diagram of AQ-110PLV.

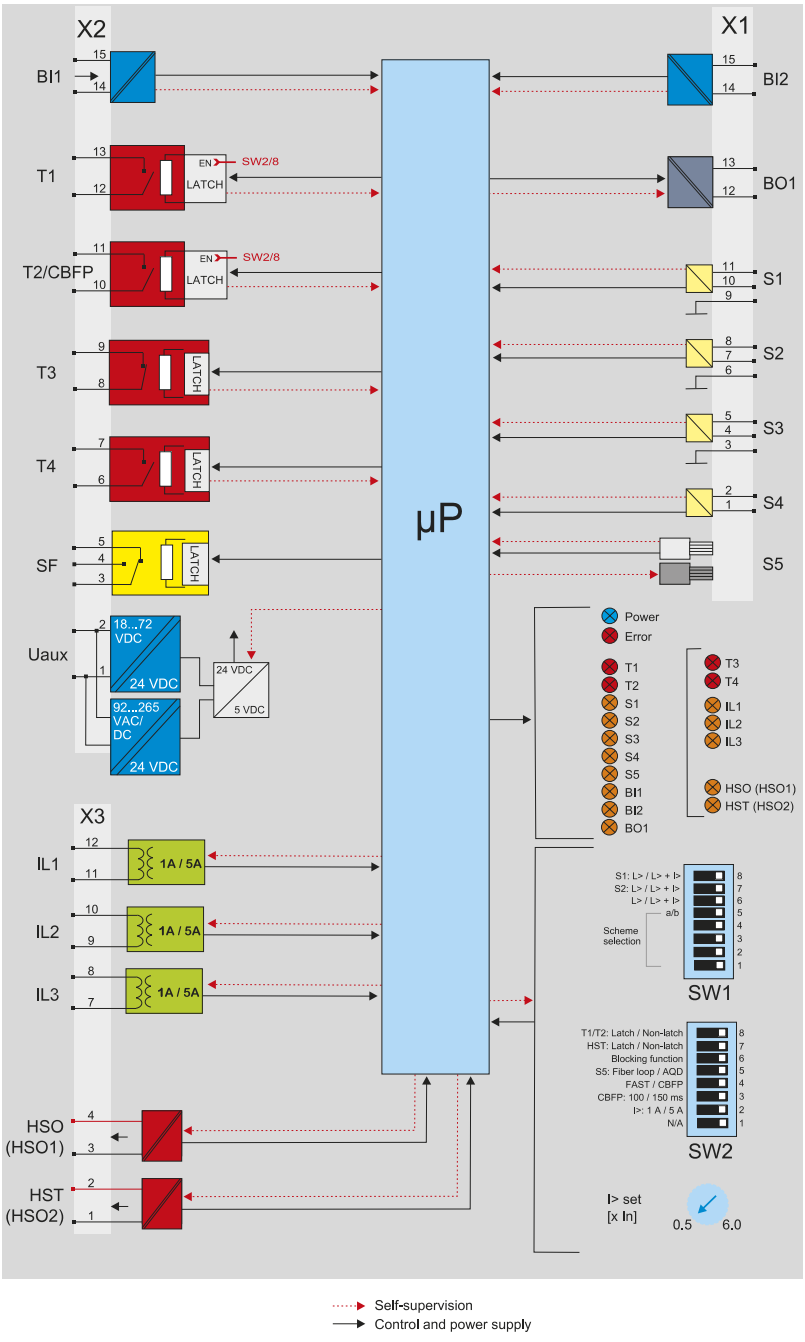
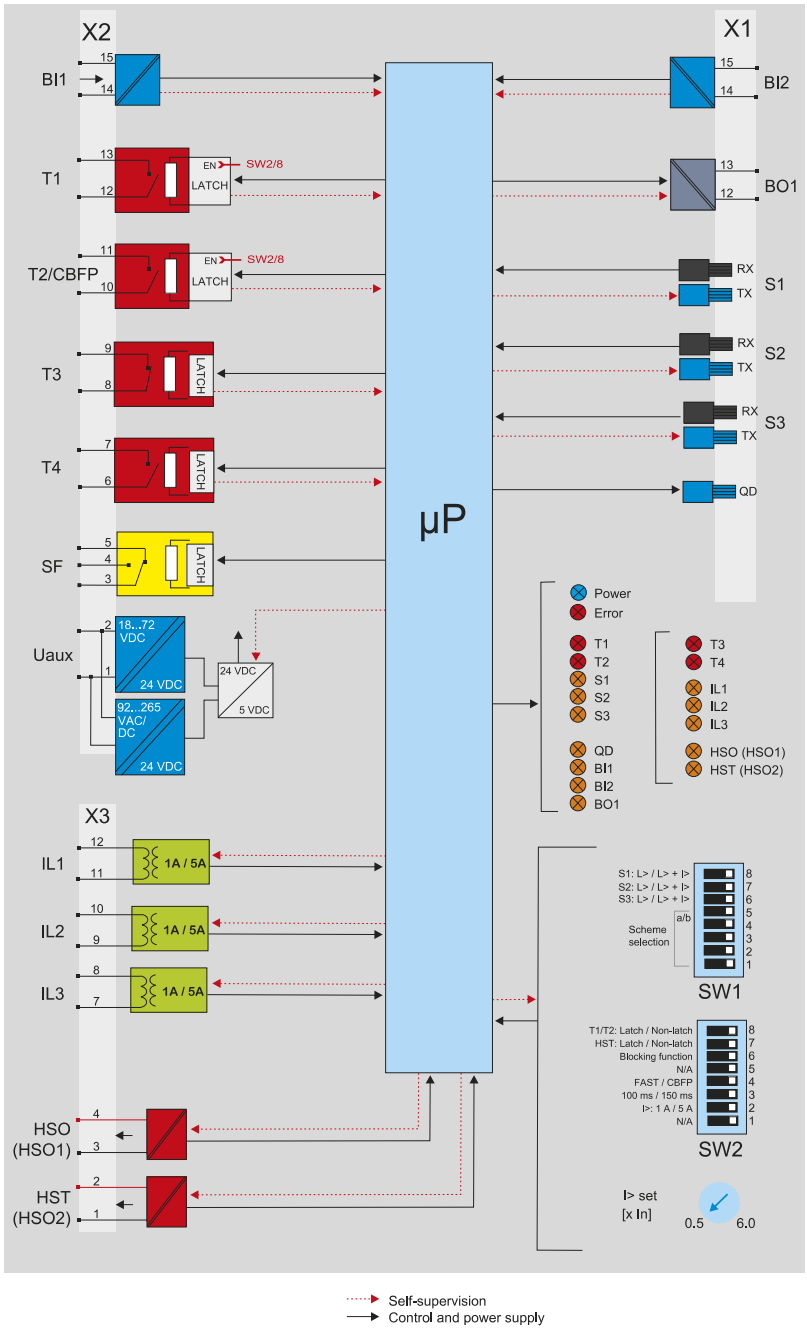


Figure. 3.4. - 9. Simplified block diagram of AQ-110FLV.



4. Operation and configuration

4.1. LED indicator functions

The AQ-110PLV unit has nineteen (19) indication LEDs and the AQ-110FLV unit has eighteen (18) indication LEDs. 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. The LEDs are on the unit's front panel to allow for a clear view without a separate need to open doors.

When the unit is powered up, it performs an LED test. All LEDs are turned on for two seconds and then turned off. Only the blue "Power" LED stays on.

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

All current measuring channels (that is, IL1, IL2 and IL3) have their own indication LEDs. When any channel measurement exceeds the set threshold value for longer than 1.5 ms, its corresponding LED turns on. In an open CT condition both the corresponding current channel indicator LED and the "Error" LED are blinking.

The LEDs of inactive sensors are off. If an arc sensor is activated for longer than 1.5 ms, its corresponding LED turns on. The activation function of the sensor LEDs is latched when the LED's light is not blinking.

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 for longer than 1.5 ms, the corresponding LED turns on (that is, they become latched). This also happens when a trip situation occurs. The trip outputs are controlled with DIP switch settings. All activation 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 if auxiliary power is lost. When the unit 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.

4.2. LED operations guide

The table below describes the function of each indicator LED in detail. Please note that the use of sensor channels differs between the two variants: the S4 and S5 sensor channels are not in use in the AQ-110FLV variant.

Table. 4.2. - 1. LED operations of AQ-110PLV and AQ-110FLV.

LED name (color)	Off	Steady light	Blinking	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).

LED name (color)	Off	Steady light	Blinking	Action if abnormal
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–S3 (amber)	Normal status.	Light information has activated the sensor channel.	There is a sensor channel discontinuity or a system setup has not been performed; or, pressure information has activated the sensor channel.	Check the sensor continuity or perform a system setup (see the "System setup" chapter); or, check what activated the sensor.
S4 (amber) NB! Only in AQ-110PLV!	Normal status.	Light information has activated the sensor channel.	There is a sensor channel discontinuity or a system setup has not been performed; or, pressure information has activated the sensor channel.	Check the sensor continuity or perform a system setup (see the "System setup" chapter); or, check what activated the sensor.
S5 (amber) NB! Only in AQ-110PLV!	Normal status.	The fiber sensor channel has been activated.	There is a fiber sensor discontinuity or a system setup has not been performed.	Check the sensor continuity or perform a system setup (see the "System setup" chapter); or, check what activated the sensor.
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	-
IL1–IL3 (amber)	Normal status (the actual current is below the set threshold).	The measured current is above the set threshold.	There is an open CT connection in the channel.	Check the set current thresholds, or check the CT wiring.
HSO (HSO1) (red)	Normal status.	The high-speed output has been activated.	N/A	Check what activated the output, clear the fault and reset the indicator LEDs with the bush-button.
HST (HSO2) (red)	Normal status.	The high-speed output has been activated.	N/A	Check what activated the output, clear the fault and reset the indicator LEDs with the push-button.

4.3. Push-button (SET)

The unit contains one push-button, SET, and it can be used for all operational functions. The push-button is used for setting up the system (also known as auto-configuration), for resetting the indicator LEDs and the latched output relays, as well as for checking the input connection.

4.3.1. System setup (auto-configuration)

After all sensors and binary lines 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 LEDs to start blinking. The unit scans these inputs to see if they are connected; when an input is detected, the corresponding LED lights up to mark 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 during this sequence.

All sensor inputs remain operational even when they have not been auto-configured. System setup is only used for self-supervision purposes.

Please note that to reconfigure a unit with fewer connections (BI/BO or 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. After this, you must wait one minute before you begin the new auto-configuration sequence.

You can reconfigure a unit with more connections at any time without the wait and without having to move one of the DIP switches.

4.3.2. Reset

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

Unless the button is pressed, the latched trip relays remain active until the auxiliary power is disconnected. All LED indications also remain active even when the auxiliary power supply is disconnected unless the button is pressed. Please refer to the "Non-volatile memory" chapter for more information.

4.3.3. Input connection check

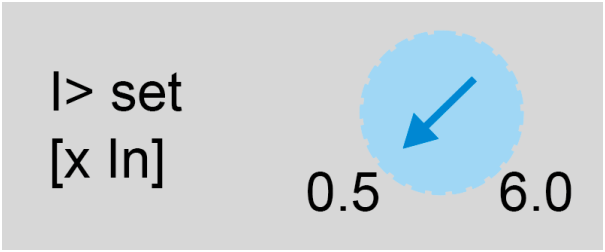
After the system setup (auto-configuration) procedure is completed, you can verify the connectivity of all sensors and binary input channels by pressing the SET push-button three (3) times within two (2) seconds. The LEDs of the corresponding sensors and binary input channels start blinking while the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

4.4. Current threshold settings

The AQ-110xLV units have three (3) phase current measurement inputs. The phase current measurements are used as secondary trip criteria in an arc protection system to avoid trips caused by natural light sources.

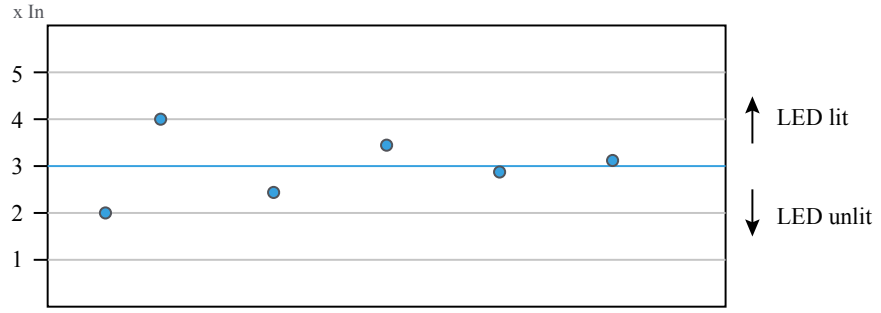
The threshold for phase overcurrent is typically set to 50 % above the highest load current. The set points are set by using the I> trimmer (see the image below). You can get an accurate setting by injecting the desired set current into the phase current inputs of the unit and by simultaneously adjusting the trimmer until the phase current indicator LEDs are lit.

Figure. 4.4. - 10. Overcurrent setting trimmer.



You can also fine-tune the current threshold setting by adjusting the trimmer and switching between lit and unlit LEDs (see the diagram below).

Figure. 4.4. - 11. Fine-tuning the current threshold setting.



The setting range for the phase overcurrent stage is 0.5…6 × I_n.

4.5. DIP switch settings

The DIP switches are used to configure the unit's tripping logic and other functionalities. The various trip schemes can be programmed easily by selecting the appropriate DIP switch positions. However, the most convenient way to set the AQ-110xLV unit or a more complex arc protection system is to use Standard Arc Schemes (SAS).

Tripping can be based on arc light only, or on both arc light and current thresholds, or on other tripping criteria (such as undervoltage, etc.). You can also enable the CBFP (circuit breaker failure protection) scheme with the DIP switches. Current threshold and other tripping criteria can also be applied to BI1 to block tripping caused by natural light sources.

Both AQ-110xLV variants contain two switch groups, SW1 and SW2. They are located at the back of the unit for easy access. The scheme selection number is based on binary arithmetic. The figure below presents the numbering of the two switch groups, and the tables below that give a detailed description of the settings for both switch groups.

Figure. 4.5. - 12. DIP switch diagram for AQ-110PLV (left) and AQ-110FLV (right).

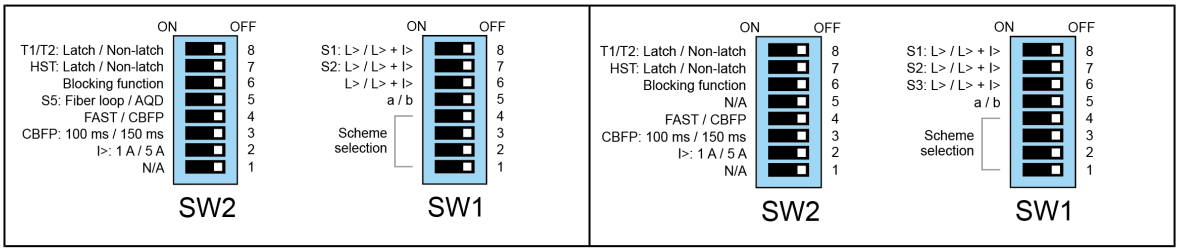


Table. 4.5. - 2. DIP switch settings for SW1.

Pin number (name)	Function selection	ON (left position)	OFF (right position)
8 (S1: L> or L> + I>)	The tripping criterion for the S1 sensor channel.	Tripping on light only (L>).	Tripping on light and overcurrent (L> + I>), both of which are required to occur simultaneously to trigger tripping.
7 (S2: L> or L> + I>)	The tripping criterion for the S2 sensor channel.	Tripping on light only (L>).	Tripping on light and overcurrent (L> + I>), both of which are required to occur simultaneously to trigger tripping.
6 (S3: L> or L> + I>) (L> or L> + I>)	The tripping criterion for the S3 sensor channel. (AQ-110F) The tripping criterion for the S3, S4 and S5 sensor channels. (AQ-110P)	Tripping on light only (L>).	Tripping on light and overcurrent (L> + I>), both of which are required to occur simultaneously to trigger tripping.
5 (a or b)	The selection of a standard arc scheme.	SAS type a.	SAS type b.
4 (scheme selection)	The selection of a standard arc scheme.	Please refer to the "Scheme selection" and "Application example" chapters.	Please refer to the "Scheme selection" and "Application example" chapters.
3 (scheme selection)	The selection of a standard arc scheme.	Please refer to the "Scheme selection" and "Application example" chapters.	Please refer to the "Scheme selection" and "Application example" chapters.
2 (scheme selection)	The selection of a standard arc scheme.	Please refer to the "Scheme selection" and "Application example" chapters.	Please refer to the "Scheme selection" and "Application example" chapters.
1 (scheme selection)	The selection of a standard arc scheme.	Please refer to the "Scheme selection" and "Application example" chapters.	Please refer to the "Scheme selection" and "Application example" chapters.

Table. 4.5. - 3. DIP switch settings for SW2.

Pin number (name)	Function	ON (left position)	OFF (right position)
8 (T1/T2: latch or non-latch)	Latches or non-latches the T1 and T2 trip relays.	T1 and T2 operate as latched.	T1 and T2 operate as non-latched.
7 (HST: latch or non-latch)	Latches or non-latches the HSO1 and HSO2 high-speed outputs.	HSO1 and HSO2 operate as latched.	HSO1 and HSO2 operate as non-latched.
6 (Blocking function)	Selects between the blocking function or a specific signal.	The blocking function is selected.	A specific signal is selected. The signal is scheme-dependent, and can be either an external current signal or an external light signal.
5 (S5: Fiber loop or AQD) Only in AQ-110P!	The selection between the fiber loop function and the arc quenching system (AQD) control.	The S5 fiber sensor channel operates as the fiber loop sensor function.	The S5 fiber sensor channel operates as the arc quenching system (AQD) control. The Tx terminal of S5 sends a test pulse signal to the quenching system.

Pin number (name)	Function	ON (left position)	OFF (right position)
4 (fast or CBFP)	The selection for the function of the T2 trip relay.	The trip time of the T2 trip relay is 7 ms.	The T2 trip relay operates as a CBFP relay. If any sensor or L> input (BI2) is activated for longer than the set CBFP time (that is, 100 or 150 ms), the CBFP function activates the T2 trip relay and the BO1 binary output. Please note that the master trip command (BI2) will not activate T2 when this dipswitch is set to the CBFP mode.
3 (100 ms or 150 ms)	The setting for the CBFP time.	The CBFP time is set to 100 ms.	The CBFP time is set to 150 ms.
2 (I>: 1 A or 5 A)	The nominal current selection for the phase currents IL1, IL2 and IL3.	The nominal current is 1 A.	The nominal current is 5 A.
1 (N/A)	*(Reserved for future use.)*	-	-

4.5.1. Scheme selection

This chapter describes the schemes available for both variants of the unit. The schemes are configured using the first DIP switch (SW1) and its pins numbered 1…4 ("Scheme selection") and 5 ("a or b"). For detailed instructions on each of the available schemes please refer to the AQ-SAS™ booklet (can be found at arcteq.fi/downloads/). Please note that there are four booklets: two are for schemes based on IEC standards (MV and LV versions) and the other two for schemes based on ANSI standards (MV and LV versions).

4.5.2. Available logic schemes

The schemes described below are the most important ones for this unit. However, additional schemes are also available; please contact your nearest Arcteq representative for more information on those schemes.

Activation table symbols are as follows:

x = output activation when the signal is active

o = output activation has more than one function depending on the settings of the CBFP function

• = output activation performed only when the FAST mode is enabled with SW2: 4 ("FAST / CBFP")

SS:0a

SS:0a			OUTPUTS							
			T1	T2[1]	T3[1]	T4	HSO1	HSO2[1]	BO1[1]	AQD[1]
INPUTS	IL1–3						x			
		S1	x	x	o	x	x	o	o	o
		S2	x	x	x	x	x	x	x	x
		S3	x	o	x	x	x	x	x	x
		S4[3]	x	o	x	x	x	x	x	x
		S5[2]	x	o	x	x	x	x	x	
		BI1[4]	x	o	x	x	x	x		x
		BI2	x	o	x	x	x	x	x	x

1) When the DIP switch SW2: 4 is set to "FAST", the trip relay is activated without the CBFP function. When the DIP switch SW2: 4 is set to "CBFP", the CBFP function activates the trip relay for longer than what is set in the CBFP time setting (100 ms or 150 ms).

2) The sensor channel S5 is optional for AQ-110PLV (and not included in AQ-110FLV). It may be used as a fiber optic sensor input or as a quenching device control. Please refer to the "Arc sensors" chapter and the "Ordering information" of this manual.

3) The sensor channel S4 is only available for AQ-110PLV.

4) If the blocking function (SW2: 6) is OFF, the binary input BI1 can be used to receive an external *light* signal. The tripping criterion can be selected to be light only (L>) or both light and current (L> + I>).

SS:0b

SS:0b			OUTPUTS							
			T1	T2[1]	T3[1]	T4	HSO1	HSO2[1]	BO1	AQD[1]
INPUTS	IL1–3						x		x	
		S1	x	x	o	x	x	o	x	o
		S2	x	x	x	x	x	x	x	x
		S3	x	o	x	x	x	x	x	x
		S4[3]	x	o	x	x	x	x	x	x
		S5[2]	x	o	x	x	x	x	x	
		BI2	x	o	x	x	x	x	x	x
	BI1[4]						x			
		S1	x	x	o	x	x	o		o
		S2	x	x	x	x	x	x		x
		S3	x	o	x	x	x	x		x
		S4[3]	x	o	x	x	x	x		x
		S5[2]	x	o	x	x	x	x		
		BI2	x	o	x	x	x	x		x

1) When the DIP switch SW2: 4 is set to "FAST", the trip relay is activated without the CBFP function. When the DIP switch SW2: 4 is set to "CBFP", the CBFP function activates the trip relay for longer than what is set in the CBFP time setting (100 ms or 150 ms).

2) The sensor channel S5 is optional for AQ-110PLV (and not included in AQ-110FLV). It may be used as a fiber optic sensor input or as a quenching device control. Please refer to the "Arc sensors" chapter and the "Ordering information" of this manual.

3) The sensor channel S4 is only available for AQ-110PLV.

4) If the blocking function (SW2: 6) is OFF, the binary input BI1 can be used to receive an external *current* signal. The tripping criterion can be selected to be light only (L>) or both light and current (L> + I>).

SS:1a

SS:1a			OUTPUTS							
			T1	T2[1]	T3[1]	T4	HSO1	HSO2[1]	BO1[1]	AQD
INPUTS	IL1–3						x			
		S1	x	x	o	x	x	o	o	
		S2	x	x	x	x	x	x	x	x
		S3	x	o	x	x	x	x	x	x
		S4[3]	x	o	x	x	x	x	x	x
		S5[2]	x	o	x	x	x	x	x	
		BI1[4]	x	o	x	x	x	x		x
		BI2	x	o	x	x	x	x	x	x

1) When the DIP switch SW2: 4 is set to "FAST", the trip relay is activated without the CBFP function. When the DIP switch SW2: 4 is set to "CBFP", the CBFP function activates the trip relay for longer than what is set in the CBFP time setting (100 ms or 150 ms).

2) The sensor channel S5 is optional for AQ-110PLV (and not included in AQ-110FLV). It may be used as a fiber optic sensor input or as a quenching device control. Please refer to the "Arc sensors" chapter and the "Ordering information" of this manual.

3) The sensor channel S4 is only available for AQ-110PLV.

4) If the blocking function (SW2: 6) is OFF, the binary input BI1 can be used to receive an external *light* signal. The tripping criterion can be selected to be light only (L>) or both light and current (L> + I>).

SS:1b

SS:1b			OUTPUTS							
			T1	T2[1]	T3[1]	T4	HSO1	HSO2[1]	BO1	AQD
INPUTS	IL1–3						x		x	
		S1	x	x	o	x	x	o	x	
		S2	x	x	x	x	x	x	x	x
		S3	x	o	x	x	x	x	x	x
		S4[3]	x	o	x	x	x	x	x	x
		S5[2]	x	o	x	x	x	x	x	
		BI2	x	o	x	x	x	x	x	x
	BI1[4]						x			
		S1	x	x	o	x	x	o		
		S2	x	x	x	x	x	x		x
		S3	x	o	x	x	x	x		x
		S4[3]	x	o	x	x	x	x		x
		S5[2]	x	o	x	x	x	x		
		BI2	x	o	x	x	x	x		x

1) When the DIP switch SW2: 4 is set to "FAST", the trip relay is activated without the CBFP function. When the DIP switch SW2: 4 is set to "CBFP", the CBFP function activates the trip relay for longer than what is set in the CBFP time setting (100 ms or 150 ms).

2) The sensor channel S5 is optional for AQ-110PLV (and not included in AQ-110FLV). It may be used as a fiber optic sensor input or as a quenching device control. Please refer to the "Arc sensors" chapter and the "Ordering information" of this manual.

3) The sensor channel S4 is only available for AQ-110PLV.

4) If the blocking function (SW2: 6) is OFF, the binary input BI1 can be used to receive an external *current* signal. The tripping criterion can be selected to be light only (L>) or both light and current (L> + I>).

SS:2a

SS:2a			OUTPUTS							
			T1	T2[1]	T3	T4	HSO1	HSO2[1]	BO1[1]	AQD
INPUTS	IL1–3						x			
		S1	x	x	x	•	x	o	o	•
		S2	x	x	x	x	x	x	x	x
		S3	x	o	•	x	x	x	x	x
		S4[3]	x	o	•	x	x	x	x	x
		S5[2]	x	o	•	x	x	x	x	
		BI1[4]	x	o	•	x	x	x		x
		BI2	x	o	•	x	x	x	x	

1) When the DIP switch SW2: 4 is set to "FAST", the trip relay is activated without the CBFP function. When the DIP switch SW2: 4 is set to "CBFP", the CBFP function activates the trip relay for longer than what is set in the CBFP time setting (100 ms or 150 ms).

2) The sensor channel S5 is optional for AQ-110PLV (and not included in AQ-110FLV). It may be used as a fiber optic sensor input or as a quenching device control. Please refer to the "Arc sensors" chapter and the "Ordering information" of this manual.

3) The sensor channel S4 is only available for AQ-110PLV.

4) If the blocking function (SW2: 6) is OFF, the binary input BI1 can be used to receive an external *light* signal. The tripping criterion can be selected to be light only (L>) or both light and current (L> + I>).

SS:2b

SS:2b			OUTPUTS							
			T1	T2[1]	T3	T4	HSO1	HSO2[1]	BO1	AQD
INPUTS	IL1–3						x		x	
		S1	x	x	x	•	x	o	x	•
		S2	x	x	x	x	x	x	x	x
		S3	x	o	•	x	x	x	x	x
		S4[3]	x	o	•	x	x	x	x	x
		S5[2]	x	o	•	x	x	x	x	
		BI2	x	o	•	x	x	x	x	x
	BI1[4]						x			
		S1	x	x	x	•	x	o		•
		S2	x	x	x	x	x	x		x
		S3	x	o	•	x	x	x		x
		S4[3]	x	o	•	x	x	x		x
		S5[2]	x	o	•	x	x	x		
		BI2	x	o	•	x	x	x		x

1) When the DIP switch SW2: 4 is set to "FAST", the trip relay is activated without the CBFP function. When the DIP switch SW2: 4 is set to "CBFP", the CBFP function activates the trip relay for longer than what is set in the CBFP time setting (100 ms or 150 ms).

2) The sensor channel S5 is optional for AQ-110PLV (and not included in AQ-110FLV). It may be used as a fiber optic sensor input or as a quenching device control. Please refer to the "Arc sensors" chapter and the "Ordering information" of this manual.

3) The sensor channel S4 is only available for AQ-110PLV.

4) If the blocking function (SW2: 6) is OFF, the binary input BI1 can be used to receive an external *current* signal. The tripping criterion can be selected to be light only (L>) or both light and current (L> + I>).

4.6. 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 unit 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.

5. 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.

5.1. 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. 5.1. - 13. 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 not come with a connection cable!

5.2. 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 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, 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. 5.2. - 14. 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.

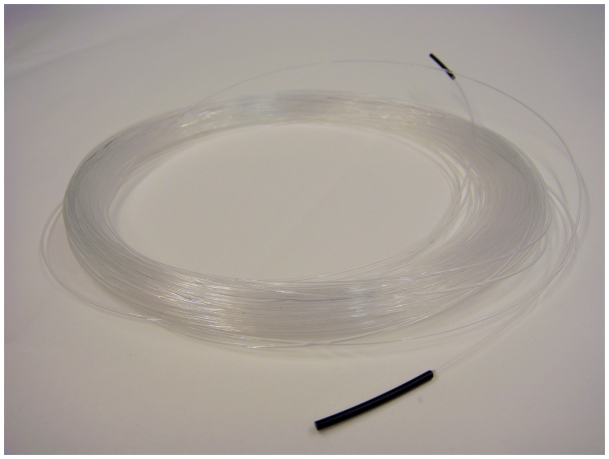
5.3. Arc light fiber optic loop sensor AQ-06

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. 5.3. - 15. AQ-06 sensor with covered ends.



5.4. 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. 5.4. - 16. AQ-07 sensor with covered ends.

5.5. 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. 5.5. - 17. AQ-08 sensor with covered ends and terminals.

5.6. 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. 5.6. - 4. 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)

5.7. Connecting sensors

How to connect point sensors

1. Open the sensor covers and detach the connectors.
2. Attach the cable to the connector and to the unit.
3. Reattach the connectors to the sensor.
4. Run the auto-configuration procedure.
5. Once the auto-configuration has been successfully completed, put the sensor covers back in place.

For more detailed instructions, please refer to the "Connecting sensors" chapter in the AQ-0x instruction booklet (arcteq.fi/downloads).

How to connect fiber sensors

1. Drill holes on the compartment wall and cover any sharp edges.
2. Run the fiber through the holes and fasten it to the protected area.
3. Connect the sensor terminals into the Tx and Rx slots at the back of the unit.

Please note that AQ-07 and AQ-08 glass fibers can be covered with additional tubing, if the fiber sensor's placing requires the blocking of unwanted light activation.

For more detailed instructions on both the installation and the tubing processes, please refer to the "Connecting sensors" chapter in the AQ-0x instruction booklet (arcteq.fi/downloads).

6. System self-supervision

Both AQ-110 variants have an extensive self-supervision feature, including both internal functions and external connections. The self-supervision module monitors the power supply, hardware and software malfunctions, as well as problems with the binary input connection(s) and sensor(s). Additionally, the module supervises the DIP switch settings by comparing actual values with the data stored in the non-volatile memory.

When the unit's condition is healthy, 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.

If a sensor failure occurs, the unit 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 unit is still in the protection mode, although the faulty sensor channel is blocked. If the error is resolved, the unit automatically clears the system failure status, enegizing the SF relay and turning off the "Error" LED. If one or more of the sensors are disconnected, the healthy sensors remain in use and the unit remains operational accordingly. However, the unit remains in Error mode until the disconnected sensors are repaired.

The unit goes into SF alarm 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 unit is still operational.

In AQ-110 units the self-supervision module also monitors the current transformer circuit. If the current flow exceeds $0.2 \times I_n$, the unit assumes that the switchgear is energized and the module monitors the phases for an open connection. If at least one of the phases remains above $0.2 \times I_n$ while the others are at zero, the unit issues an open CT alarm: the SF relay is released, the "Error" LED is turned on and the LED of the faulty phase(s) starts blinking.

7. Connections

Figure. 7. - 18. Rear terminals of AQ-110PLV.

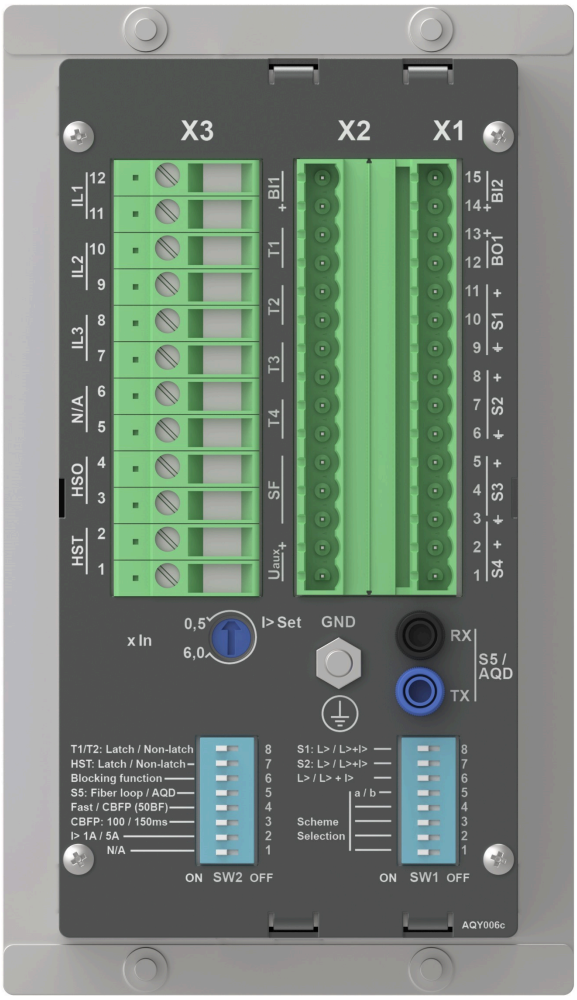


Figure. 7. - 19. Connections of the AQ-110PLV (with SF in de-energized position).

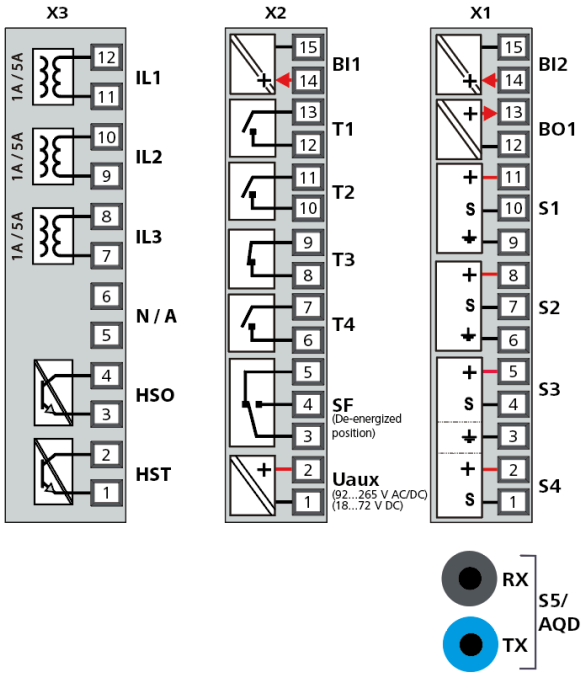


Figure. 7. - 20. Rear terminals of AQ-110FLV.

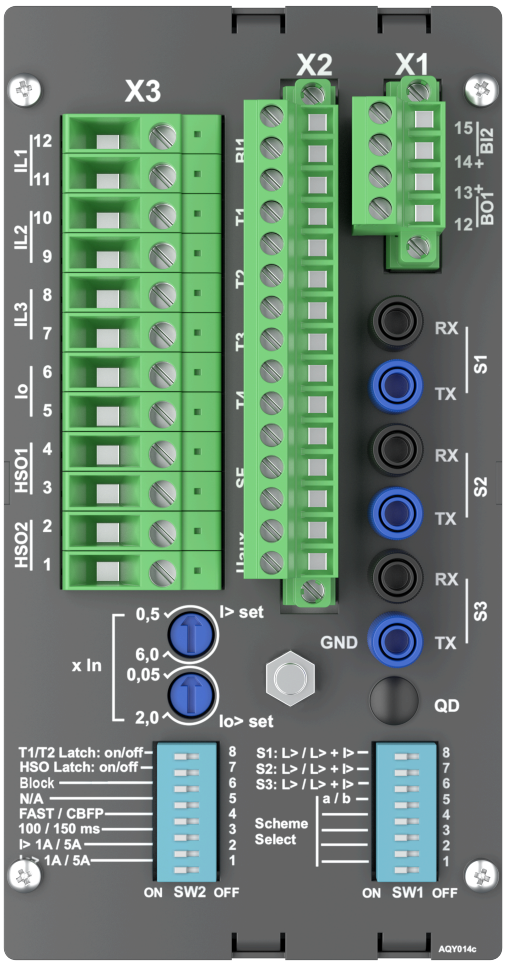
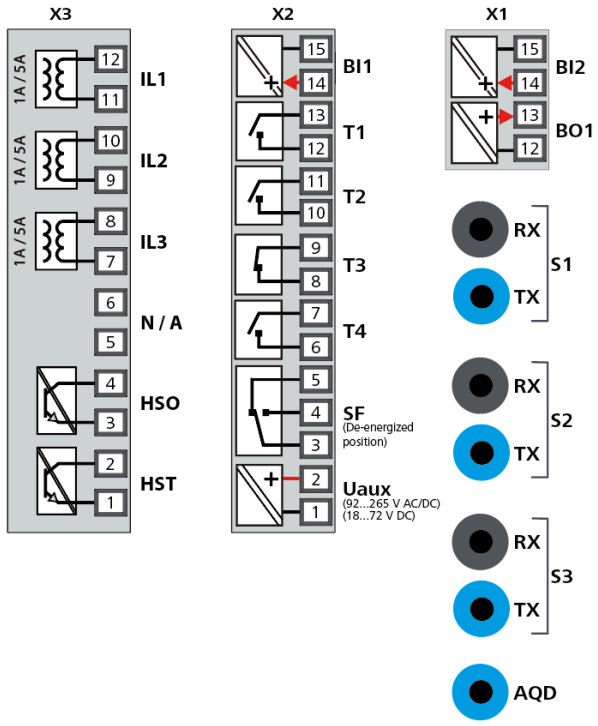


Figure. 7. - 21. Connections of the AQ-110FLV (with SF in de-energized position).



7.1. Outputs

7.1.1. Trip relays

This unit has two (2) integrated trip relays for tripping circuit breakers, namely T1 and T2. Their type is normally open (NO).

T3 can function either as an electronic lock-out relay or as a trip relay. When T3 is configured as an electronic lock-out relay, its type is normally closed (NC) and it holds its 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 contact condition it had prior to the power loss. This normally closed relay output can also be used for tripping contactor-controlled devices. If the application so requires, T3 can also be ordered as normally open (NO) from the factory. This choice is specified when ordering this unit.

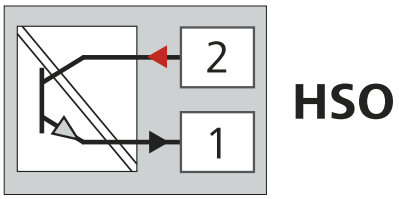
T4 is a common trip relay that operates whenever T1 or T2 operates. It can be used either for tripping one additional disconnecting device, or as a trip alarm in a (local or remote) monitoring and alarming system.

7.1.2. High-speed output(s)

The unit contains two (2) high-speed semiconductor outputs, namely HSO and HST. These outputs can used either for direct tripping of an LV circuit breaker with a DC opening/trip coil up to 220 V DC, or as heavy-duty signaling outputs. Due to their high current-carrying capacity, HSO and HST can supply current or light information to a maximum of twenty (20) pieces of AQ-100 series units without a need for signal amplifiers. The operation of these high-speed outputs depends on the DIP switch settings (for more information, please refer to the "DIP switch settings" chapter).

The output's direction of rotation is as follows: the signal goes in the even pin and out from the odd pin (see the image below, as detailed in the unit's side sticker).

Figure. 7.1.2. - 22. The high-speed output's direction of rotation.



Please note that the high-speed output is polarity-sensitive (see the "Wiring" chapter for more information).

7.1.3. Binary outputs

The unit has one (1) binary output: BO1 (+24 VDC). 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.

Please note that the binary ouput is polarity-sensitive (see the "Wiring" chapter for more information).

7.1.4. System failure relay

The system failure (SF) relay is of the change-over type (NO/NC) and it is energized when the unit is in a healthy condition. Whenever the unit detects a system error or a disconnection between the auxiliary power supply and the contacts, the SF relay changes its state. The state stays this way until the unit returns to a healthy condition and the SF relay is energized again.

7.2. Inputs

7.2.1. Current measurement inputs

Both AQ-110xLV variants have three (3) CT inputs for measuring the three phase currents. The phase current inputs can be configured to a nominal current of 1 A or 5 A with the DIP switches (for more information, please refer to the "DIP switch settings" chapter). The "System self-supervision" chapter describes the setting of current threshold levels in more detail. The same chapter also describes the open circuit detection feature included in the AQ-110xLV units.

7.2.2. Arc sensor channels

AQ-110PLV has four (4) arc point sensor channels: S1, S2, S3 and S4. You can connect a maximum of three (3) arc point sensors to each channel.

S5 is the optional fiber optic loop sensor channel with a transceiver (Tx) terminal and a receiver (Rx) terminal. The function of S5 is controlled with the DIP switches (please refer to the "DIP switch settings" chapter for more information). When S5 is configured as a fiber optic loop sensor, one of its ends is connected to "Tx" and the other to "Rx". This sensor loop is then continuously monitored by a 60-µs test light pulse that travels through the loop. If a discontinuity is detected, the unit goes into Error mode and activates the "Error" LED and the SF relay output.

Alternatively, S5 can be configured to control the arc quenching system. Similarly, the unit sends a continuous light pulse to the arc quenching system for self-supervision purposes.

AQ-110FLV has three (3) arc fiber loop sensor channels: S1, S2 and S3. Each channel has a transceiver (Tx) terminal and a receiver (Rx) terminal. Also, there is an additional transceiver (Tx) terminal available for arc quenching system control.

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/).

7.2.3. Binary inputs

Both AQ-110x variants (MV and LV) contain two (2) binary inputs, BI1 and BI2.

The function of the binary inputs is selected with the DIP switches according to the SAS application used (for more information, please refer to the "DIP switch settings" chapter in this manual). Typically, the binary inputs are used for receiving arc light information from AQ-101 and AQ-102 units as well as for receiving overcurrent information from other AQ-110x units.

The binary inputs are activated when a connected DC signal exceeds the specified nominal threshold level of the corresponding input. The nominal threshold level for AQ-110x units is 24 VDC. The actual activation of the binary input occurs at 80 % of the specified nominal threshold value (i.e. 19 V DC).

7.3. Auxiliary voltage

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.

8. Testing

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

A high-quality camera flash (Canon Speedlite 430EX or equivalent) is used to simulate arc light. You can use a flashlight (Mini Maglite 2 CELL AAA or equivalent) to test non-latched signals and the CBFP function. Before testing please check that the equipment used has a fully charged battery.

8.1. 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 and/or one or both of the high-speed outputs, verify their 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 and/or one or both of the high-speed outputs, also verify that their corresponding 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.

8.2. 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 unit that is being tested, and the BI1 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 BI1 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 or a high-speed output (HSO1 and/or HSO2), verify the signal activation either through the status change of the relevant input, or by measuring the signal output voltage.
8. If you are using the BO1 binary output or a high-speed output (HSO1 and/or HSO2), also verify that the corresponding LED is lit. Please note that BO1 is of the non-latched type.
9. If you are using the BO2 binary input, verify its correct operations by activating the input.
10. Activate the camera flash within 30 cm (12 inches) of the point sensor unit but do not activate the binary input used for the overcurrent condition (I>).
11. Verify that no trip has occured and only the indicator LED of the sensor activation is lit.

12. If you are using the BOUT signal and have configured it to send light information, verify that it is activated.
13. Press the SET push button to reset all indications and latches.
14. 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.
15. Press the SET push button to reset all indications and latches.
16. Repeat the steps 1 through 15 for all sensors.

8.3. Testing the CBFP function

The circuit breaker failure protection (CBFP) function is tested by taking the light signal and the secondary trip criterion signal (if applicable) and leaving them active for longer than the set CBFP time (that is, 100 or 150 ms). The T2 trip relay and the BO1 binary output must be active after the set time delay has passed to confirm the CBFP function operates correctly.

8.4. Testing the unit 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-110 unit 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 camera flash (Canon xx or equivalent) to initialize the flash and to configure the set's timer to start simultaneously with the flash.
3. Connect one of the AQ-110 unit's trip outputs (T1, T2, T3, T4) or high-speed outputs (HSO1, HSO2) to a test set input and configure the input to stop the timer.
4. Place the camera flash within 20 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.

8.5. Test plan example

Date:	
Substation:	
Switchgear:	
AQ-110 serial number:	

Preconditions	**Light-only**	**Light and current**	**Comments**
Sensor channel 1 setting			
Sensor channel 2, 3, 4 setting			
Circuit breaker failure protection in use (Yes / No):			

Object activated		**LED indication**	**T1, T2, T3, T4 active**	**BO1 active**	
Sensor channel 1	Sensor 1				
	Sensor 2				
	Sensor 3				
Sensor channel 2	Sensor 1				
	Sensor 2				
	Sensor 3				
Sensor channel 3	Sensor 1				
	Sensor 2				
	Sensor 3				
Sensor channel 4	Sensor 1				
	Sensor 2				
	Sensor 3				
Fiber sensor channel (option)					
BIN 1					
BIN 2					
Phase current IL1, IL2, IL3					
Residual current I0					

Tested by :	
Approved by:	

9. Troubleshooting

Table. 9. - 5. Troubleshooting guide for AQ-110x variants.

Problem	Possible solution(s)
The sensor does not activate during testing.	Check the sensor's cable wiring (see the "Arc sensors" chapter for more information). 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.	Check the DIP switch settings (see the "DIP switch settings" chapter for more information).
The current measurement's indicator LED is continuously lit.	Check the set current threshold (see the "Current threshold settings" chapter for more information).
The current measurent's indicator LED is blinking.	Check that the connections of the three phase currents are correct (see the "System self-supervision" for more information).

10. Technical data

10.1. Protection

Trip time using HSO	2 ms*
Trip time using mechanical trip relays	7 ms*
Reset time - light stage - overcurrent stages	 1 ms 50 ms

*) The total trip time when using both the arc light (L>) or phase/residual overcurrent (I>) from this unit and the arc light (L>) from an AQ-101 variant or an AQ-102 unit.

10.2. Outputs

10.2.1. Trip relays

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.

10.2.2. Binary output(s)

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

10.2.3. High-speed output(s)

Number of outputs	2
Rated voltage	250 VDC
Carry: - continuous - make and carry for 3 s - make and carry for 0.5 s	 2 A 6 A 15 A
Breaking capacity DC*	1 A/110 W
Contact material	Semiconductor

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

10.2.4. System failure relay

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.

10.3. Binary inputs

Nominal threshold voltage	24 VDC
Threshold: - pick-up - drop-off	 ≥ 16 VDC ≤ 15 VDC
Rated current	3 mA
Number of inputs	2

10.4. Auxiliary voltage

Auxiliary power supply	92…265 V AC/DC 18…72 V DC (optional)
Maximum interruption	100 ms
Maximum power consumption	5 W, < 10 mΩ
Standby current	90 mA

10.5. 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

10.6. Disturbance tests

Electromagentic compatibility test	

CE-approved and tested according to EN 50081-2 and EN 50082-2	
Emission	
Conducted (EN 55011, class A)	0.15…30.00 Hz
Radiated (EN 55011, class A)	30…1,000 MHz
Immunity	
Electrostatic discharge (IEC 244-22-2 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 (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

10.7. 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

10.8. 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, 1,000 bumps/dir.

10.9. Environmental conditions

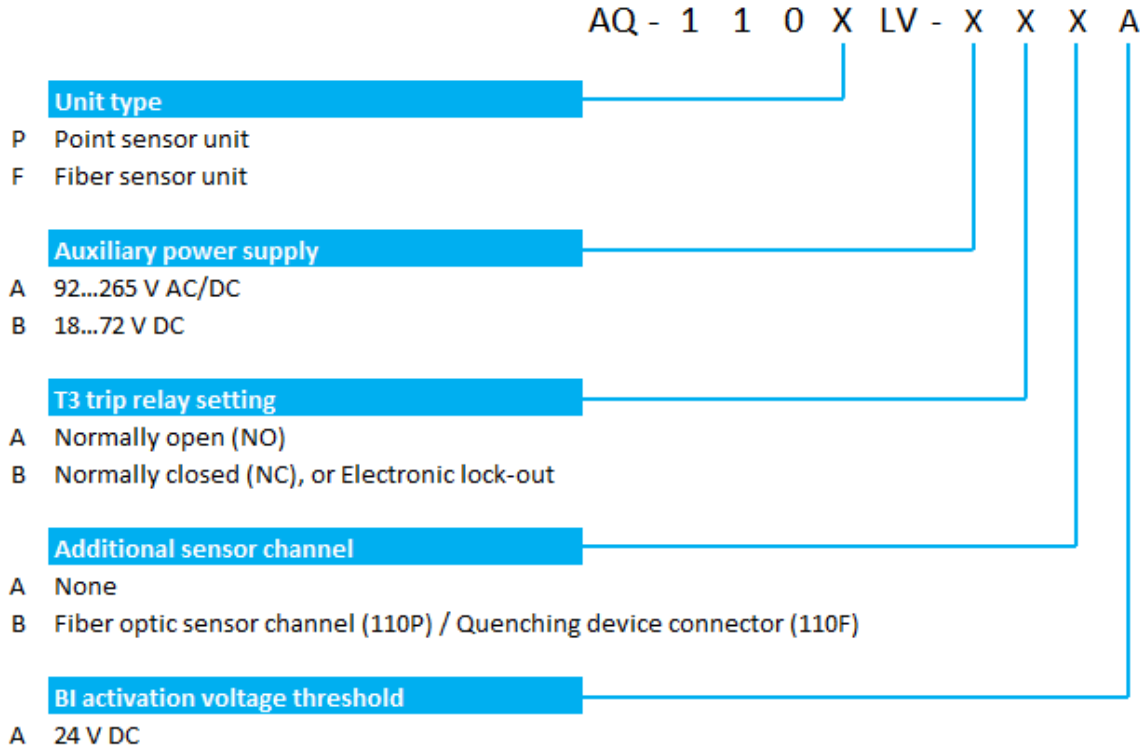
Specified ambient service temperature	–35…+70 ºC
Transportation and storage temperature	–40…+70 ºC
Relative humidity	Up to 97 %
Altitude	Up to 2,000 m above sea level

10.10. Casing and packaging

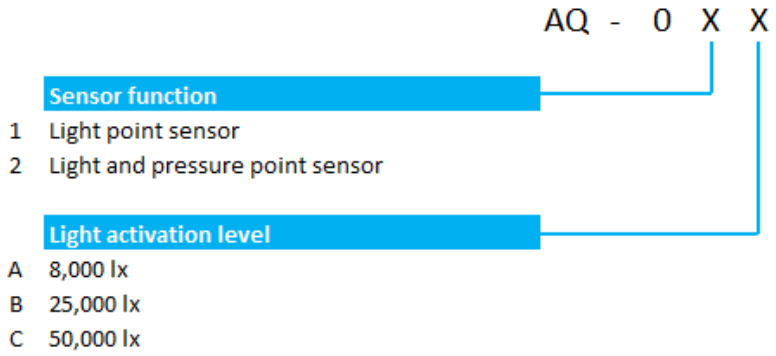
Protection: - front - back	 IP 50 IP 20
Dimensions (W × H × D): - device - package	 102 × 177 × 162 mm 230 × 120 × 210 mm
Weight	1.2 kg 1.5 kg (with package)

11. Ordering information

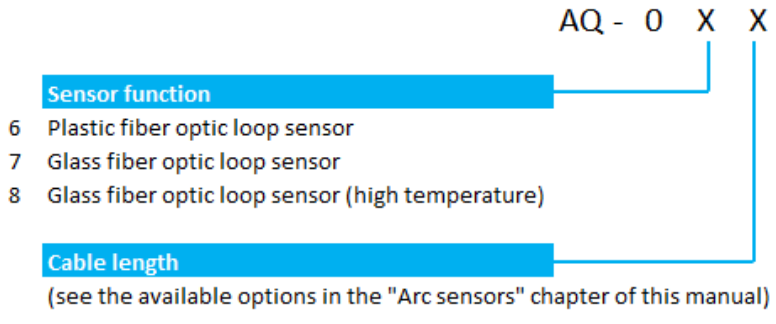
AQ-110xLV current measurement and arc sensing unit



AQ-0x point sensors



AQ-0x fiber optic loop sensors



Accessories

Order code	Description	Note	Manufacturer
AQX099	Wall bracket	For AQ-101, AQ-101S and AQ-102 units (MV and LV).	Arcteq Ltd.
AQX100	Wall bracket	For AQ-103 and AQ-110x variants (MV and LV).	Arcteq Ltd.

12. Contact and reference information

Manufacturer

Arcteq Relays Ltd.

Visiting and postal address

Kvartsikatu 2 A 1

65300 Vaasa, Finland

Contacts

Phone:	+358 10 3221 370
Fax:	+358 10 3221 389
Website (general):	arcteq.fi
Website (technical support):	support.arcteq.fi
E-mail (sales):	sales@arcteq.fi