

INSTRUCTION MANUAL

AQ101, AQ101D, AQ110P, AQ1000, AQ01,
AQ02

Revision History

Revision	Public EN1.0
Date	9. Feb 2017
Changes	N/A

Revision	EN1.1
Date	17. January. 2019
Changes	<ul style="list-style-type: none"> • Separated chapter for door mounting and din-rail mounting products. See chapter 1.1.2 AQ101D arc flash protection relays. • Update AQ101D din rail mounting installation picture. See picture Figure 1-2. • Text correction in chapter 1.1.3 and 1.1.4. • Skip arc flash sensor mounting screw size information. • Rearrange the product instruction sequence for chapter 1.2. • Revise the AQ1000 pinout for chapter 1.2.3 • Add AQ1000 connection explanation figure to chapter 1.2.3 • Revise DIP switches definitions and add description to DIP switches in Chapter 2.1. • Change chapter 2.3 text to "Siemens Protection Scheme Logics"; Change AQ110P scheme text "IA and IB" to "Ia and Ib". • Add note to scheme matrix tables, mainly T3 and T4 identify the fault location for Siemens scheme. • Add description of maximum connected sensor to one sensor channel to sensor operation chapter 3.3. • Add Chapter 2.3.3 I/O Description. • Revise the LED indicator description about sensor channel S1 of AQ110P and AQ101 in Chapter 3.1.1. • Revise set button function Table 3-3: Set button function vs. indication behaviors. • Revise arc protection application pictures as vector graphic format.in chapter 5. • Add description to Table 6-1: troubleshoot function description. for power led blinking function. • Add Trip LED information to Table 3-5. • Revise the dipswitch factor weight information of scheme selection • Update Chapter 4.

Revision	Public EN1.2
Date	21. October 2019
Changes	<ul style="list-style-type: none"> • Add QD logic to the tripping table. • Revised the SF contact information for AQ110P, AQ101, AQ101D

Abbreviations

HSO – High speed output
BI – Binary input
BO – Binary output
CBFP – Circuit breaker failure protection
QD – Quenching device
IL – Phase current
I_o – Neutral sequence current
LED – Light emitting diode
L> – Light signal
I> – Overcurrent signal
MT – Master trip signal
SF – Self-supervision

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1 INSTALLATION

1.1 MECHANICAL INSTALLATION

1.1.1 AQ101, AQ110P ARC FLASH PROTECTION RELAYS

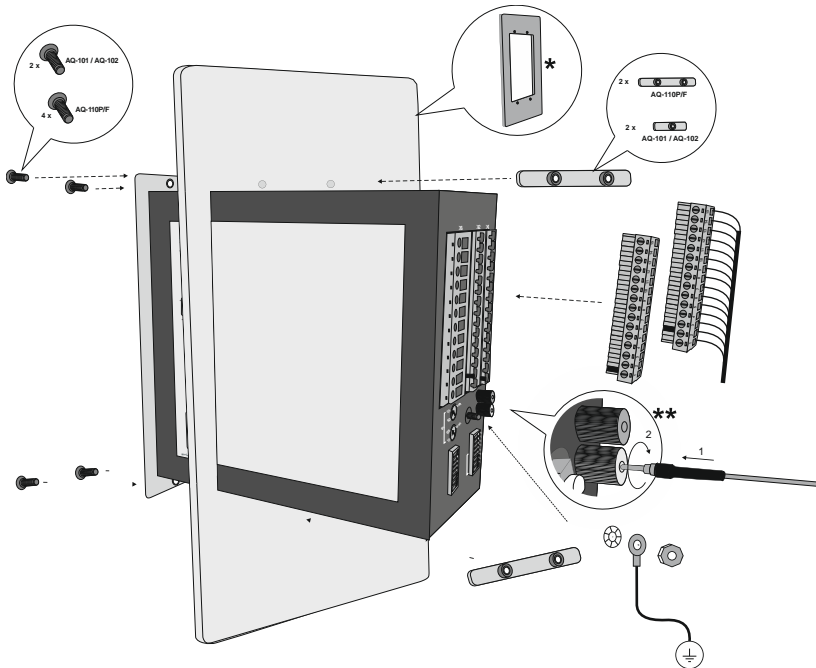


Figure 1-1: AQ101, AQ110P door mounting installation picture

1.1.2 AQ101D ARC FLASH PROTECTION RELAYS

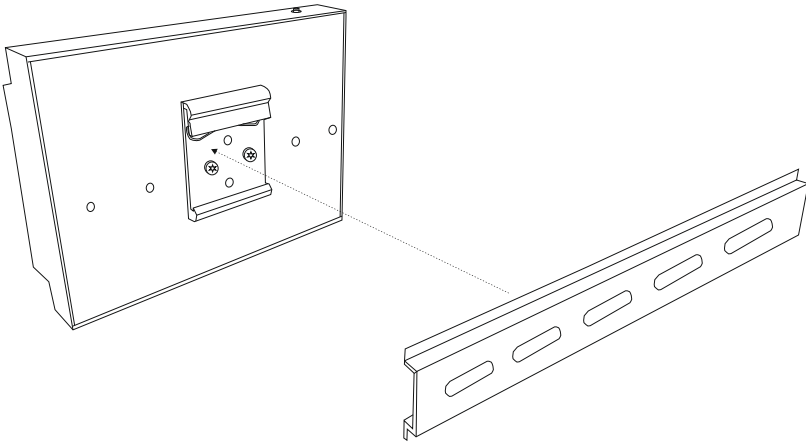


Figure 1-2: AQ101D din rail mounting Installation picture

*) See panel cut-out dimensions on separate cut-out sheet included with this manual.

**) Fiber sensors are optional in AQ101, AQ101D, AQ110P. Refer to ordering codes.



See installation and mounting related technical parameters refer to chapter 8.1.

1.1.3 AQ1000 ARC QUENCHING DEVICE

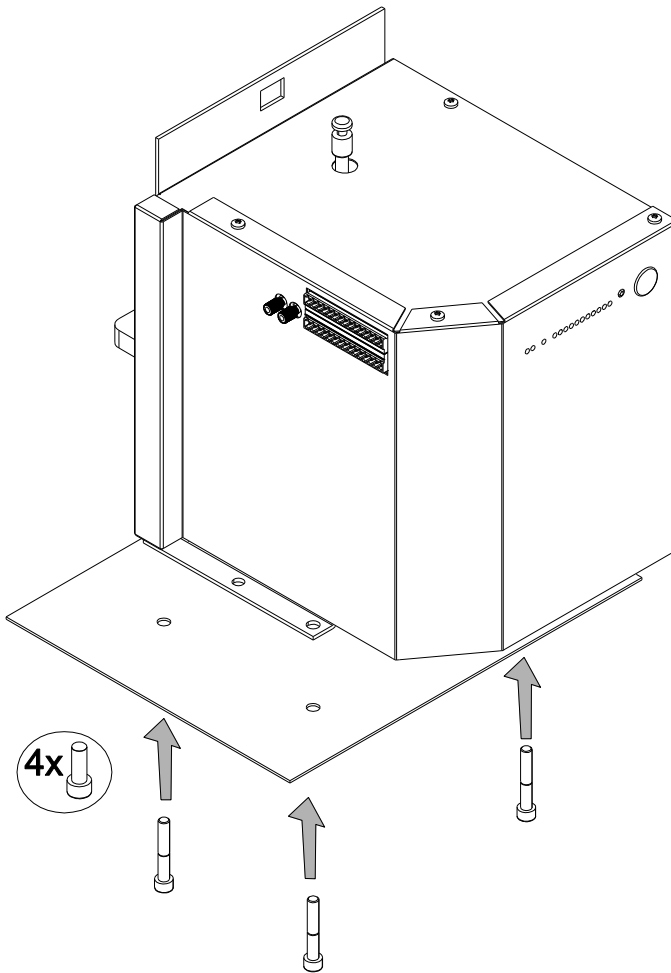


Figure 1-3: AQ1000 installation picture – tray assembly.



See installation and mounting related technical instructions in chapter 8.2.

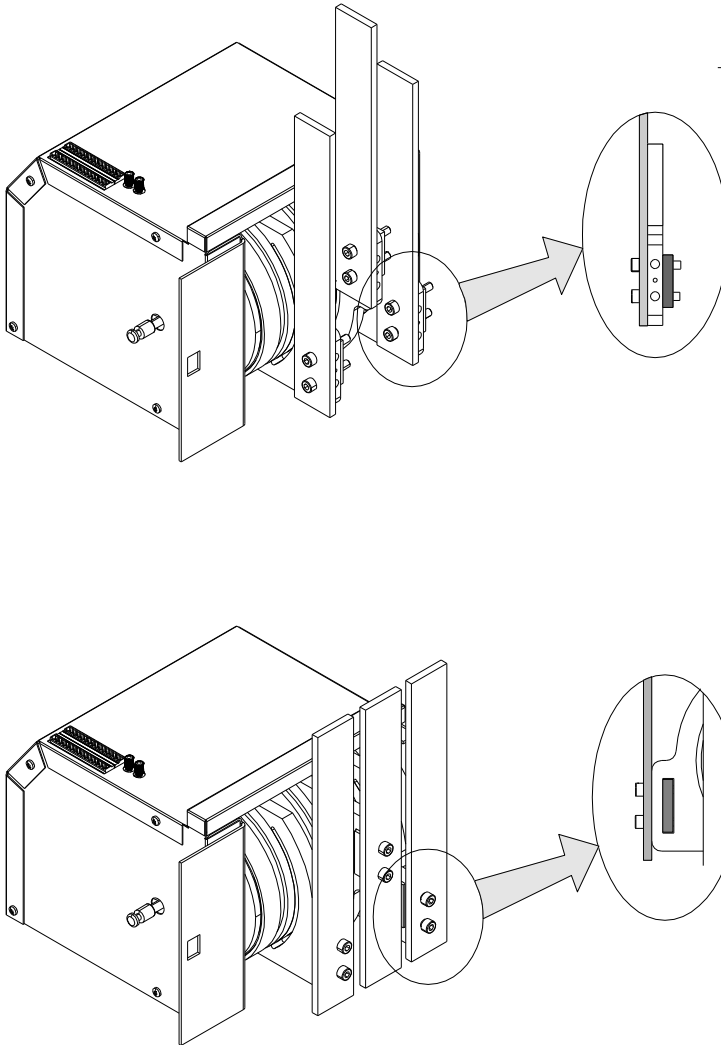


Figure 1-4: AQ1000 installation picture – bus bar mounting alternatives.



See installation and mounting related technical instructions in chapter 8.2.



Busbar sizing and clearance distances shall be dimensioned according to switchgear ratings and maximum short circuit current.

1.1.4 AQ01, AQ02 ARC FLASH SENSOR

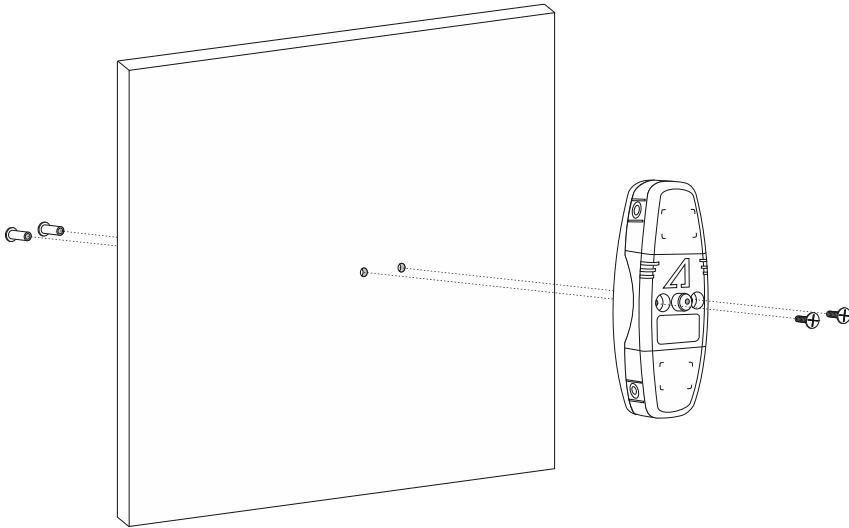


Figure 1-5: AQ01, AQ02 Installation picture



See installation and mounting related technical instructions in chapter 8.3.

1.2 WIRING

1.2.1 AQ110P ARC FLASH PROTECTION RELAY

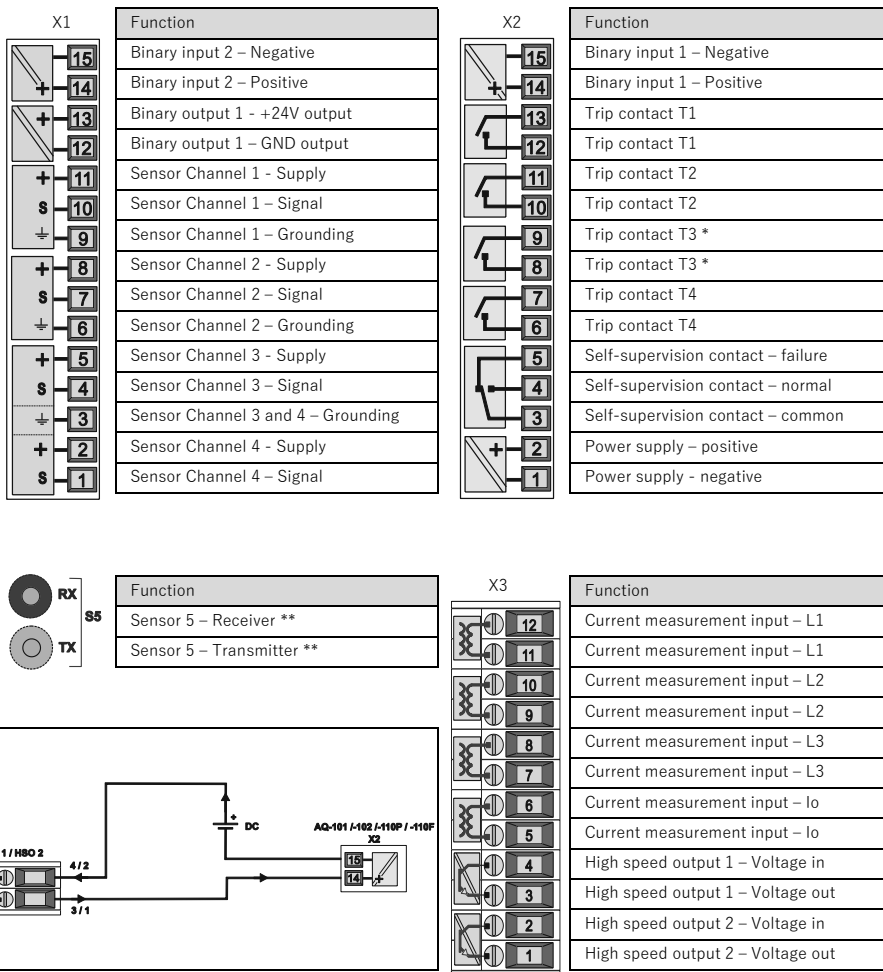


Figure 1-6: HSO connection example

*) Trip contact T3 may be normally open or normally closed type. Refer to the ordering codes.

**) Sensor 5 is optional for fiber sensor or quenching device control. Refer to the ordering codes.



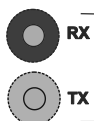
Always ensure that current measurement circuits are not energized during disconnection.



See rated voltages and connector tightening torques from chapter 7.1
“Technical data”.

1.2.2 AQ101, AQ101D ARC FLASH PROTECTION RELAYS

X1	Function	X2	Function
	Binary input 2 – Negative		Binary input 1 – Negative
	Binary input 2 – Positive		Binary input 1 – Positive
	Binary output 1 – +24V output		Trip contact T1
	Binary output 1 – GND output		Trip contact T1
	Sensor Channel 1 – Supply		Trip contact T2
	Sensor Channel 1 – Signal		Trip contact T2
	Sensor Channel 1 – Grounding		Trip contact T3 *
	Sensor Channel 2 – Supply		Trip contact T3 *
	Sensor Channel 2 – Signal		Trip contact T4
	Sensor Channel 2 – Grounding		Trip contact T4
	Sensor Channel 3 – Supply		Self-supervision contact – failure
	Sensor Channel 3 – Signal		Self-supervision contact – normal
	Sensor Channel 3 and 4 – Grounding		Self-supervision contact – common
	Sensor Channel 4 – Supply		Power supply – positive
	Sensor Channel 4 – Signal		Power supply – negative



S5

Function
Sensor 5 – Receiver **
Sensor 5 – Transmitter **

*) Trip contact T3 may be normally open or normally closed type. Refer to the ordering codes.

**) Sensor 5 is optional for fiber sensor. Refer to the ordering codes.



See rated voltages and connector tightening torques from chapter 7.1
“Technical data”.

1.2.3 AQ1000 ARC QUENCHING DEVICE

Function	X1	X2	Function
Binary input 1 (Clear) – Positive			Self-supervision – Closed; System alarm
Binary input 1 (Clear) – Negative			Self-supervision contact – Common
Binary input 2 (Not in use)- Positive			Self-supervision – Closed; System healthy
Binary input 2 (Not in use) – Negative			Device charging – Closed; Device charging
Binary input 3 (Not in use)- Positive			Device charging – Common
Binary input 3 (Not in use) – Negative			Device Ready – Closed; Device is not ready
Binary input 4 (Blocked) – Positive			Device Ready – Common
Binary input 4 (Blocked) – Negative			Device Ready – Closed; Device is ready
Not connected			Operation Blocked – Closed; Blocked
Not connected			Operation Blocked – Closed; Common
Not connected			Operation Blocked – Closed; Unblocked
Not connected			Trip contact
Not connected			Trip contact
Not connected			Auxiliary supply – Positive
Not connected			Auxiliary supply – Negative

Function
Receiving fiber connector (black)
Transmitting fiber connector (blue) *



*) Transmitting connector (TX) is not in use and does not need to be connected

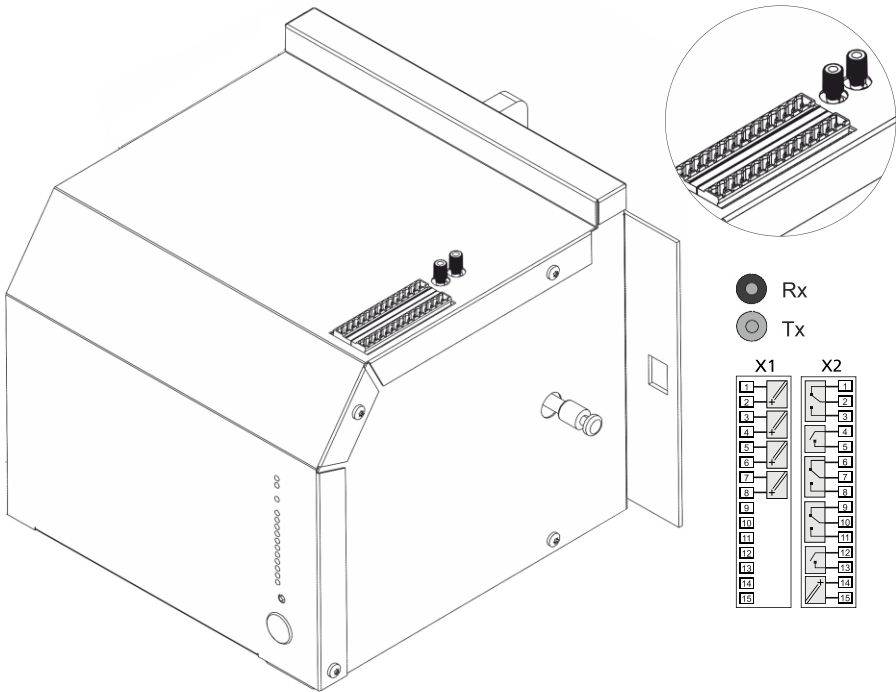
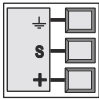


Figure 1-7 AQ1000 Arc quenching device connection explanation.



See rated voltages, wire sizing and connector tightening torques in chapter 7.2 “Technical data”.

1.2.4 AQ01, AQ02 ARC FLASH SENSORS



Sensor

Function
Sensor - Grounding
Sensor - Signal
Sensor - Supply



See rated voltages and connector tightening torques from chapter 7.3
"Technical data".

2 CONFIGURATION

2.1 DIP SWITCHES (AQ101, AQ101D, AQ110P)

Functionality such as tripping logic is configured using dipswitch settings. Tripping may be selected based on arc light only or arc light and current thresholds.



Scheme selection is made with dip switches by calculating the sum of weight factors

2.1.1 AQ101, AQ101D

2.1.1.1 Scheme 0


SW 1	no	Text	Function at ON position	Function at OFF position
<div> <div>ON</div> <div>OFF</div> </div>	8	$L > / L > + I >$	Tripping with light only criterion.	Tripping with light and current criterion.
	7	$S1: L > / L > + I >$	Sensor 1 tripping with light only criterion.	Sensor 1 tripping with light and current criterion.
	6	Latch: On / Off	Output relays latched.	Output relays not latched.
	5	100 / 150 ms*	Circuit breaker failure protection operating time 100 ms.	Circuit breaker failure protection operating time 150 ms.
	4	Scheme Select	Weight factor 8	Weight factor 0
	3		Weight factor 4	Weight factor 0
	2		Weight factor 2	Weight factor 0
	1		Weight factor 1	Weight factor 0

Table 2-1: AQ101, AQ101D scheme 0 DIP switches definition.

*) Circuit breaker failure protection function is not included in the scheme 0.

2.1.2 AQ110P

2.1.2.1 Scheme 1a

SW 1	no	Text	Function at ON position	Function at OFF position
<div> <div>ON</div> <div>OFF</div>  <div>8 7 6 5 4 3 2 1</div> </div>	8	S1: L> / L> + I>	Sensor 1 tripping with light only criterion.	Sensor 1 tripping with light and current criterion.
	7	S2: L> / L> + I>	Sensor 2 tripping with light only criterion.	Sensor 2 tripping with light and current criterion.
	6	L> / L> + I>	Tripping with light only criterion	Tripping with light and current criterion.
	5	a/b	Scheme a	Scheme b
	4	Scheme Select	Weight factor 8	Weight factor 0
	3		Weight factor 4	Weight factor 0
	2		Weight factor 2	Weight factor 0
	1		Weight factor 1	Weight factor 0



SW 2	no	Text	Function at ON position	Function at OFF position
<div> <div>ON</div> <div>OFF</div>  <div>8 7 6 5 4 3 2 1</div> </div>	8	T1/T2 Latch / non Latch.	Trip relays 1 and 2 latched.	Trip relays 1 and 2 not latched.
	7	HSO Latch / non Latch.	High speed outputs latched.	High speed outputs not latched.
	6	S1: P> & L>	Sensor 1 connected with AQ03 pressure and light sensor.	Sensor 1 connected with AQ01 light only sensor or AQ02 pressure and light sensor.
	5			
	4	S5: Fib. loop / Elim.	Sensor 5 connected with fiber loop sensor.	Sensor 5 connected with quenching device control (TX only).
	3	Fast / CBFP **	Fast mode tripping without circuit breaker failure protection.	Circuit breaker failure protection activated.
	2	100 / 150 ms *	Circuit breaker protection delay setting 100 ms.	Circuit breaker protection delay setting 150 ms.
	1	I> 1A / 5A	Phase current measurement channels nominal rating 1 A.	Phase current measurement channels nominal rating 5 A.

Table 2-2: AQ110P scheme 1a DIP switches definition.

2.1.2.2 Scheme Ib

SW 1	no	Text	Function at ON position	Function at OFF position
<div> <div>ON</div> <div>OFF</div>  </div>	8	S1: L> / L> + I>	Sensor 1 tripping with light only criterion.	Sensor 1 tripping with light and current criterion.
	7	S2: L> / L> + I>	Sensor 2 tripping with light only criterion.	Sensor 2 tripping with light and current criterion.
	6	L> / L> + I>	Tripping with light only criterion.	Tripping with light and current criterion.
	5	a/b	Scheme a	Scheme b
	4	Scheme Select	Weight factor 8	Weight factor 0
	3		Weight factor 4	Weight factor 0
	2		Weight factor 2	Weight factor 0
	1		Weight factor 1	Weight factor 0


SW 2	no	Text	Function at ON position	Function at OFF position
<div> <div>ON</div> <div>OFF</div>  </div>	8	T1/T2 Latch / non Latch.	Trip relays 1 and 2 latched.	Trip relays 1 and 2 not latched.
	7	HSO Latch / non Latch.	High speed outputs latched.	High speed outputs not latched.
	6	S1: P> & L>	Sensor 1 connected with AQ03 pressure and light sensor.	Sensor 1 connected with AQ01 light only sensor or AQ02 pressure and light sensor.
	5			
	4	S5: Fib. loop / Elim.	Sensor 5 connected with fiber loop sensor.	Sensor 5 connected with quenching device control (TX
	3	Fast / CBFP **	Fast mode tripping without circuit breaker failure protection	Circuit breaker failure protection activated.
	2	100 / 150 ms *	Circuit breaker protection delay setting 100 ms.	Circuit breaker protection delay setting 150 ms.
	1	I> 1A / 5A	Phase current measurement channels nominal rating 1 A	Phase current measurement channels nominal rating 5 A
		Io> 1A / 5A	Neutral current measurement channels nominal rating 1 A	Neutral current measurement channels nominal rating 5 A

Table 2-3: AQ110P scheme Ib DIP switches definition.

*) Circuit breaker failure protection delay dip switch has no function if the device has been configured to Fast operating mode.

**) When CBFP mode is selected, the trip relay T2 will work as CBFP relay. If sensor channel (S2, S3, S4) or L> input (B1, B2) is activated for more than CBFP set time (100 or 150ms) the CBFP function activates trip relay T2.

2.2 POTENTIOMETERS (AQ110P ONLY)

Current pick-up setting (set point) is done with potentiometers on the back side of the device. Use flat head screw driver for moving the potentiometer to the desired set point. See chapter 4.1.2 for accurate setting of the current activation level.

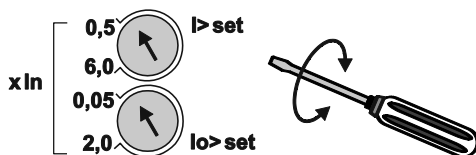


Figure 2-1: Current pick-up potentiometers.

2.3 SIEMENS PROTECTION SCHEME LOGICS (AQ101, AQ101D, AQ110P)

Following tables describes the basic functionality of scheme 0 (AQ101, AQ101D), scheme Ia and Ib (AQ110P).

Following tables doesn't segregate the light and light + current mode trip settings. In case light and current mode has been chosen with dip switches, corresponding sensor activation requires simultaneous overcurrent injection. For the CBFP operation, refer to the relevant dipswitch settings.



Activation table letters:

X = activation of output when signal is active

C = output activates according to the CBFP functionality

Y = output activation has more than one function depending on the setting of CBFP function. See dip switch settings on chapter 2.1.

For C and Y activation, refer to the scheme logic tables

Table 2-4 and Table 2-5.

2.3.1 AQ101, AQ101D

Scheme 0					
	T1	T2	T3**	T4***	B01
S1	X	X			X
S2	X	X	X		X
S3	X	X		X	X
S4	X	X	X	X	X
S5**					
BI1*					
BI2	X	X			

Table 2-4: AQ101 scheme 0 protection scheme logics.

*) BI1 is common over current measurement channel. BI1 is necessary to be activated simultaneously with light sensors for making trip with light + current settings. Refer to DIP switch configuration.

**) S5 is optional and may be used as fiber optic sensor input (AQ101 and AQ101D). Refer to the technical manual and ordering codes.

***) T3 and T4 are mainly for fault location identification.

2.3.2 AQ110P

	Scheme Ia								Scheme Ib							
	T1	T2**	T3**	T4**	B01	HS01	HS02	QD	T1	T2**	T3**	T4**	B01	HS01	HS02	QD
S1	X	X			X		X	X	X	X			X		X	X
S2	X	Y	X		X		X	X	X	Y	X		X		X	X
S3	X	Y		X	X		X	X	X	Y		X	X		X	X
S4	X	Y	X	X	X		X	X	X	Y	X	X	X		X	X
S5*	X	Y			X		X		X	Y			X		X	
BI1	X	Y					X	X	X	Y					X	X
BI2	X	Y			X		X	X	X	Y			X		X	X
IL1-3						X								X		
Io						X								X		

Table 2-5: AQ110 scheme Ia and Ib protection scheme logics.

*) S5 is optional and may be used as fiber optic sensor input or quenching device control. Refer to the technical manual and ordering codes.

**) T3 and T4 are mainly for fault location identification.

***) When DIP switch SW2:4 is set to FAST mode, the trip relay T2 is activated without CBFP function. When DIP switch SW2:4 is set to CBFP mode, the CBFP function activates trip relay T2 if sensor channel (S2, S3, S4) or L> input (BI1, BI2) is activated for more than CBFP set time (100ms or 150ms).

2.3.3 I/O DESCRIPTION

AQ110P	AQ101	I/O Description
IL1 / IL2 / IL3 / Io		Current inputs Phase IL1, IL2, IL3 and E/F Io, measuring current for incomer.
BI1		In scheme Ia and Ib, receive L> light signal from connected AQ110P.
BI2		Receive L> light signal from connected AQ101. In scheme Ia, it counts the amount of connected AQ101 units while supervising each BO1 connections from AQ101 units. In scheme Ib, it excludes the counting function and triggers the supervision alarm (SF relay) when loss of all connected AQ101 units.
S1		Detect arc flash light for incomer cable compartment.
S2 /S3 /S4		Detect arc flash light for feeder busbar compartment and cable compartment.
HSO1		Send I> overcurrent signal to connected AQ101 units; In normal operation, it is used to synchronize all connected AQ101 units.
HSO2		Send MT signal to connected AQ101 units; When it activates, the connected AQ101 units activate T1 and T2 trip relays.
BO1		In scheme Ia and Ib, send sensor channel (S1, S2, S3, S4) and binary input (BI2) L> signal to connected AQ110P. An incoming signal to BI1 is not forwarded to BO1 in same AQ110P.
T1		Trip relay for incomer circuit breaker.
T2		Trip relay for incomer upstream circuit breaker.
T3 /T4		Trip relays mainly for fault location identification.
	BI1	Receive I> overcurrent signal from connected AQ110P.
	BI2	Receive MT signal from connected AQ110P.
	S1/S2/S3/S4	Detect arc flash light for feeder busbar compartment and cable compartment.
	BO1	Send sensor channel (S1, S2, S3, S4) to connected AQ110P. In normal operation, it is used to send feedback pulse to connected AQ110P.
	T1/T2	Trip relay for feeder circuit breaker or tie breaker if available.
	T3/T4	Trip relays mainly for fault location identification.

3 OPERATION

3.1 AQ101, AQ101D, AQ110P ARC FLASH PROTECTION RELAYS

3.1.1 LED INDICATORS

All the devices contain LED indicators for operating states as per the latter definitions.

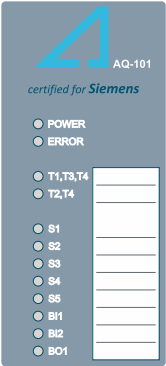
	LED	Color	OFF	Steady ON	Blinking
	Arcteq logo	Blue	Auxiliary supply disconnected	Auxiliary power connected	N/A
	Power	Blue	Auxiliary supply disconnected	Auxiliary power connected	N/A
	Error	Red	System healthy	System failure	Configuration mismatch. Protection partly operational
	T1, T3, T4	Red	Normal status	Trip relays T1,T3,T4 activated	N/A
	T2, T4	Red	Normal status	Trip relays T2, T4 activated	N/A
	S1	Amber	Normal status	Corresponding sensor channel activated.	Corresponding sensor channel have loose connection or system set-up not performed; Also activated by AQ02 (pressure + light) sensor.
	S2 / S3 / S4 / S5	Amber	Normal status	Corresponding sensor channel activated.	Corresponding sensor channel have loose connection or system set-up not performed;
	BI1 / BI2	Amber	Normal status	Corresponding binary input activated	Corresponding binary input lost connection
	BO1	Amber	Normal status	Binary Output activated	N/A

Table 3-1: AQ101, AQ101D LED indications definition.

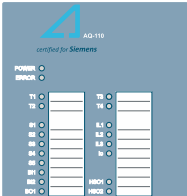
	LED	Color	OFF	Steady ON	Blinking
	Arcteq logo	Blue	Auxiliary supply disconnected	Auxiliary power connected	N/A
	Power	Blue	Auxiliary supply disconnected	Auxiliary power connected	N/A
	Error	Red	System healthy	System failure	Configuration mismatch. Protection partly operational.
	T1 / T2 / T3 / T4	Red	Normal status	Corresponding trip relay activated	N/A
	S1	Amber	Normal status	Corresponding sensor channel activated.	Corresponding sensor channel have loose connection or system set-up not performed; Also activated by AQ02 (pressure + light) sensor.
	S2 / S3 / S4	Amber	Normal status	Corresponding sensor channel activated.	Corresponding sensor channel have loose connection or system set-up not performed;
	S5 (AQ110P)	Amber	Normal status	Corresponding sensor or quenching device channel activated.	Corresponding sensor channel have loose connection or system set-up not performed;
	BI1 / BI2	Amber	Normal status	Corresponding binary input activated	Corresponding binary input have loose connection
	BO1	Amber	Normal status	Binary Output activated	N/A
	IL1 / IL2 / IL3	Amber	Normal status, measured current below set point	Corresponding current channel above set point. Overcurrent stage activated.	Unbalance alarm, corresponding channel CT connection is open, corresponding channel activated for over 10s
	Io	Amber	Normal status, measured current below set point	Residual current above set point. Overcurrent stage activated.	N/A
	HSO1 / HSO 2	Red	Normal status	HSO channel activated.	N/A

Table 3-2: AQ110P LED indications definition.

3.1.2 TEXT POCKET

All devices contain a text pocket for entering sensor specific information. Text pocket can be slide out and texts can be entered with a pen or with ready print paper or label.

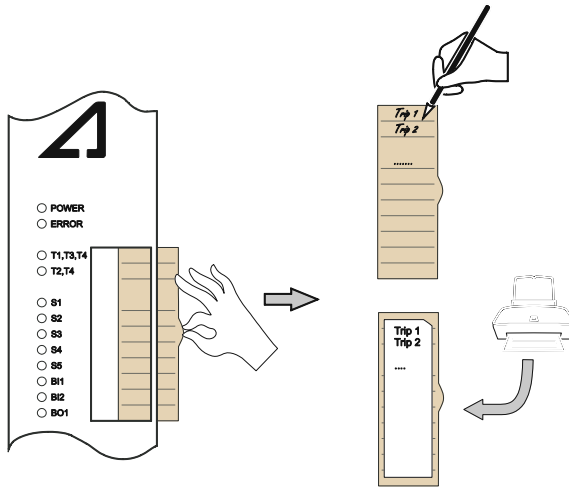


Figure 3-1: Using text pocket.

3.1.3 SET BUTTON

All devices contain a set button in the front panel, which is used for installing the system, checking the number of connected sensors and units, resetting the device after trip event and clear the alarm signals.



Figure 3-2: Set button.

Function	Instruction	Indications
Install (add binary input or sensor amount) the system configuration	Press the button for 3 seconds	All connected inputs LED's lit steadily during installation.
Install (reduce binary input or sensor amount) the system configuration	Switch any DIP switch back and forth one time, press the button for 3 seconds	All connected inputs LED's lit steadily during installation.
Clear the alarm signals	Press the button once	Respective blinking led indicators turns off
Check the number of installed sensors and unit connections (Binary inputs) *	Press the button 3 times within 2 seconds.	Corresponding connected input LED blinks showing amount of connected units and sensors.
Reset after trip or sensor or binary input activation	Press the button once	Corresponding activated signals and LED's turns off. Also latched outputs resets.

Table 3-3: Set button function vs. indication behaviors.

*) Only available at AQ101, AQ101D and AQ110P.

3.2 AQ1000 ARC QUENCHING DEVICE



AQ1000 contains no user settable or application dependent parameters or values.

3.2.1 OPERATING MODES

Mode	Definition
Charging	In charging mode, the device charges the energy storage with sufficient energy to move the contacts to the closed position. During normal operation, the charging occurs several times in hour as the charged energy level is constantly monitored and adjusted. During charging, the indication LED in the front panel is on.
Ready	In ready mode, the device's energy storage is charged to sufficient energy level and device is ready to operate.
Trip	In trip state, the device has operated and energy storage is empty. In trip mode, the LED indicators are showing trip and closed state.
Blocked	Blocked mode occurs when the binary input 4 is energized. During blocking the movement of quenching contacts is prevented.
Discharging	Discharging mode occurs when the device auxiliary power is disconnected. In discharging mode, the energy storage is safely discharged. LED indicator is showing the discharging mode until safe voltage level is reached and indicator turns off. Refer to 7.2.2 for discharging time specification.

Table 3-4: AQ1000 operating modes definition.

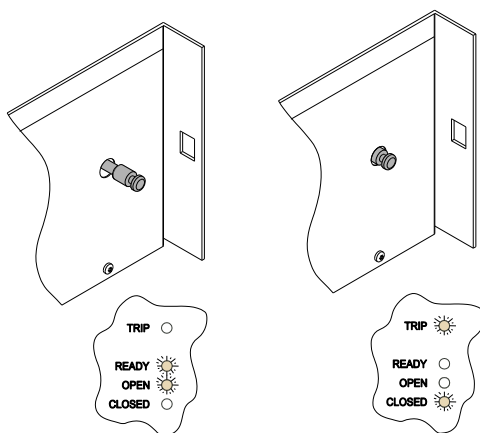


Figure 3-3: Operating modes ready and trip.

3.2.2 LED INDICATORS

AQ1000 contains LED indicators for operating states as per the following:

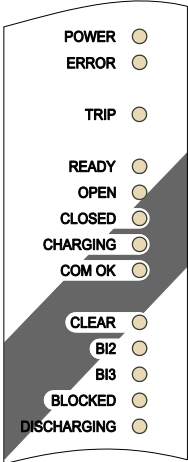
	LED	Color	OFF	Steady ON	Blinking
	Arcteq logo	Blue	Auxiliary supply disconnected	Auxiliary power connected	N/A
	Power	Blue	Auxiliary supply disconnected	Auxiliary power connected	Internal voltage error occurred
	Error	Red	System healthy	System failure	N/A
	Trip	Red	Device not tripped	Device tripped	N/A
	Ready	Green	Device not ready to trip	Device ready to trip	N/A
	Open	Green	Contact not open	Contact open	Contact not in fully closed or fully open position.
	Closed	Red	Contact not closed	Contact closed	
	Charging	Amber	Device not in charging mode	Device charging the energy storage	N/A
	COM OK	Green	N/A	Trip fiber connection healthy.	Trip fiber connection lost.
	Clear (BI1)	Green	N/A	Binary input activated	N/A
	BI2	Green	N/A	Not in use	N/A
	BI3	Green	N/A	Not in use	N/A
	Blocked (BI4)	Red	N/A	Binary input activated	N/A
	Discharging	Red	N/A	Device is discharging the energy storage	N/A

Table 3-5: AQ1000 LED indication definition.



When error LED is active, refer to above table for troubleshooting. Self-recovered error is indicated by blinking LED with error LED inactive.

3.2.3 BINARY INPUTS FUNCTIONS

Input	Function
Binary input 1	Clear/reset the indications after error or trip event.
Binary input 2	Not used. (Reserved for future purposes.)
Binary input 3	Not used. (Reserved for future purposes.)
Binary input 4	Blocking the trip activation during commissioning or any other circumstances where the tripping shall be prevented.

Table 3-6: AQ1000 binary inputs functions.

3.2.4 CLEAR BUTTON

AQ1000 contains a clear button in the front panel, which is used for resetting the indicators after trip event and to clear the alarm signals.



Figure 3-4: Clear button.



After the trip, reset of quenching contacts shall be done before pressing the clear button or activating external clear by energizing binary input 1.

3.2.5 RESET OF QUENCHING CONTACTS AFTER TRIP

When a trip has occurred, the quenching contacts have to be reset to the open position by using the handle provided with the device starting from handle position 1. Device is reset, when shaft is moved to complete open position using handle position 3 and then pressing the clear button. See Figure 3-5. Device indicates the open position with LED indicators. The typical charging time of the energy storage (empty to full) is less than 10 minutes.

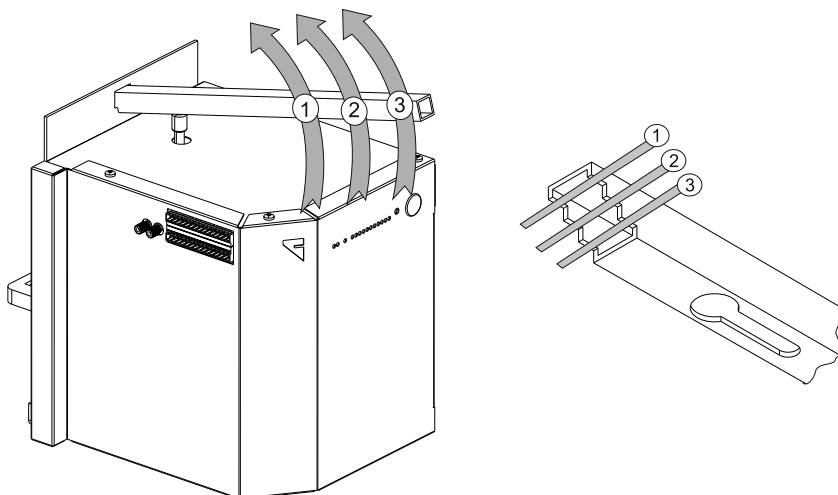


Figure 3-5: Reset of contacts.



Remove the handle after reset. If not removed the handle may fly off from its slot in event of trip and cause harm or damages.



Never attach the handle to device when shaft is in open position.

3.3 AQ01, AQ02 ARC FLASH SENSOR

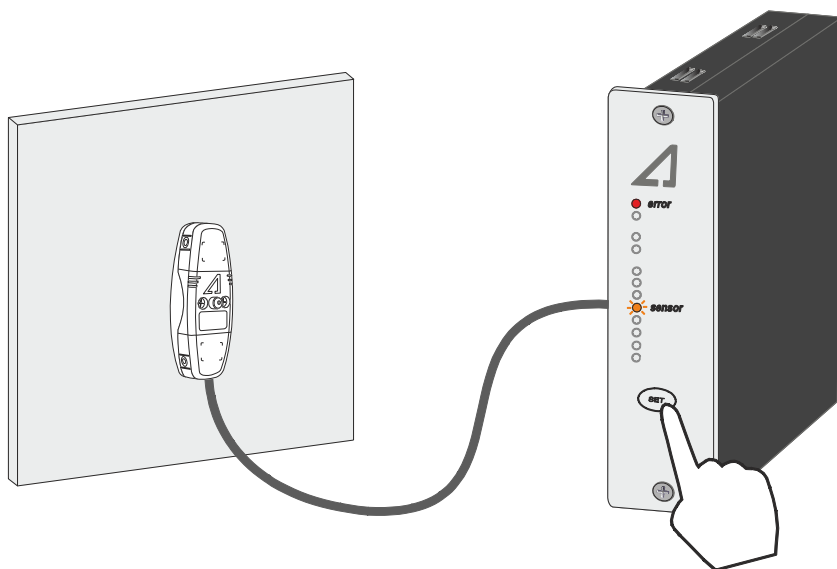


Figure 3-6: AQ01, AQ02 sensor configuration



Sensor connectors are located at both ends of the sensor for series connecting maximum three sensors in one line.

After connecting the sensor to relay, the ERROR LED turns on, and the appropriate sensor channel LED starts to blink.

Press and hold the SET button on the front panel for 3 seconds to run system auto-configuration setting.

See configuration related technical instructions in chapter 3.1.3.

4 COMMISSIONING

4.1 AQ101, AQ101D, AQ110P ARC FLASH PROTECTION RELAYS

4.1.1 SYSTEM INSTALLATION

When all the connections are done, the system shall be commissioned by installing the devices one by one by pressing the set button according to the instructions on chapter 3.1.3.

4.1.2 CURRENT MEASUREMENT (AQ110P ONLY)

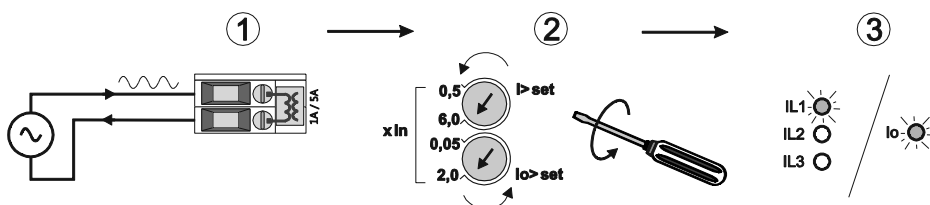


Figure 4-1: Current measurement commissioning procedure.

Current measurement channels should be adjusted to the pick-up setting value by:

- 1) Injecting the current level of desired pick-up value to IL1 and Io separately.
- 2) Starting from maximum setting, adjusting the potentiometer slowly down.
- 3) Corresponding current measurement channel LED lights steadily when the activation with injected current has occurred.



IL1 – IL3 measurement channels have a common adjustment potentiometer “I>set”. Therefore, each current channel is not necessary to commission separately. Alternatively, channels IL1 – IL3 can be injected with the same current in serial connection. After successful commissioning, the device has to be re-installed according to the instructions on chapter 3.1.

4.1.3 LIGHT CHANNEL ACTIVATION

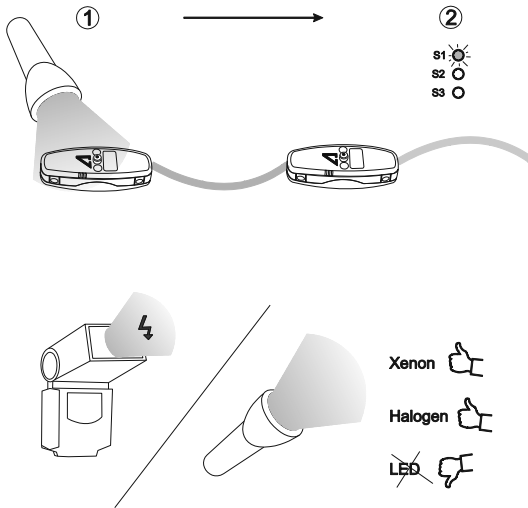


Figure 4-2: Light channel activation.

Light channels are commissioned by applying strong light to the light sensor detector area. For arc light simulation, use a superior camera flash type: Nissin Speedlite Di700 or equivalent. For testing of non-latched signals and CBFP function use Mini Maglite 2 CELL AAA or equivalent type of flashlight. Check that camera flash or flashlight has fully charged battery when testing.

- 1) Applying light to the sensor.
- 2) Corresponding light sensor channel LED lights steadily when light has been detected.



Use strong, non-LED, light source for light channel activation. Light sensors are available with different sensitivity levels. Least sensitive sensors require stronger light source. Refer to sensor ordering codes. Activation longer than 3s will initiate self-supervision error. Refer to trouble shooting and LED indications.

4.1.4 ACTIVATION OF OUTPUTS (TRIPPING)

Activation of output relays, electrical binary outputs and high-speed outputs (AQ110P/F only) is dependent on the application scheme of each device. Refer to chapter 2.3 for definition of scheme logics and related LED indicators in chapter 3.2.1.



Activation of outputs from light or light + current modes are chosen with dip switches. Refer to chapter 2.1 for more information.

4.1.5 TESTING

4.1.5.1 CARRYING OUT TESTING IN LIGHT ONLY MODE

- 1) Check that the dipswitch setting positions are in accordance to your application.
- 2) Activate the camera flash within 20cm (12 inches) of the AQ01 sensor unit.
- 3) Verify if the corresponding sensor channel indication LED status is changed to ON.
- 4) When light only tripping criteria is configured to the sensor channel, also verify if the relay output(s) activation(s) by checking the circuit breaker status or by monitoring trip contact status. Verify that the corresponding relay output indication LED(s) status is changed to ON.
- 5) When light only tripping criteria is configured to the sensor channel, verify if the high speed output (HSO2) signal activation by checking its indication LED or measuring the signal output voltage. Note that HSO2 can be set to latched. Refer to Chapter 2.1.2 for more detail.
- 6) Verify if the binary output (BO1) signal activation by checking its indication LED or measuring the signal output voltage. Refer to “carrying out testing in light and current mode” in Chapter 4.1.5.
- 7) When binary input BI1 or BI2 is used, verify the corresponding binary input and verify that trip has occurred by repeating 4 and 5.
- 8) Press SET push-button to reset all indications and latches.
- 9) Repeat the testing procedure for other sensors and sensor channels.

4.1.5.2 CARRYING OUT TESTING IN LIGHT AND CURRENT MODE

- 1) Check that the dipswitch setting positions are in accordance with your application.
- 2) Activate the camera flash within 20cm (12 inches) of the AQ01 sensor unit and inject current to current input channel simultaneously.
- 3) Verify if the sensor channel indication LED status is changed to ON
- 4) Verify if the corresponding current input or the binary input BI1 indication LED status is turned to ON.
- 5) Verify if the relay output(s) activation(s) by checking the circuit breaker status or by monitoring trip contact status. Verify that the corresponding relay output indication LED(s) status is changed to ON.
- 6) Verify if the binary output (BO1) signal activation by checking its indication LED or measuring the signal output voltage.
- 7) When overcurrent is injected to current input channel, verify if the high speed output (HSO1) signal activation by checking its indication LED or measuring the signal output voltage. When light and current tripping criteria is configured to the device, verify if HSO2 signal activation. Note that HSO2 can be set to latched. Refer to Chapter 2.1.2 for more detail.
- 8) When binary input BI1 or BI2 is used, verify the corresponding binary input and verify that trip has occurred by repeating 4 and 5.
- 9) Press SET push-button to reset all indications and latches.
- 10) Repeat the testing procedure for all sensors.

4.1.5.3 TESTING THE CBFP FUNCTION

Circuit breaker failure function is tested by leaving light signal and second trip criteria signal (e.g. overcurrent) if applicable active for above set CBFP time of either 100 or 150ms. Those trip relays binary outputs configured to operate as CBFP contacts shall be active after set time delay.

4.2 AQ1000 ARC QUENCHING DEVICE

Commissioning of the AQ1000 arc quenching device requires entire arc protection system to be installed and configured. Refer to chapter 5 Arc protection applications.

When commissioning, the blocked mode operation can be utilized for verifying the correct signal transmission to AQ1000 device. When BI4 is energized and the device is indicating the blocked mode, the commissioning trip can be performed without operation.



After the trip, also the trip LED is indicating successful trip command received, but contacts are not moving.

It is also recommended to perform commissioning trip(s) to verify the contact movement. De-energizing BI4 will return the device back to ready operating mode.



Remove the handle after reset. If not removed the handle may fly off from its slot in event of trip and cause harm or damages.



Verify that there is no voltage on busbars and all feeding circuits are disconnected and locked before performing commissioning trip to verify movement of contacts.

Figure 5-1: One incomer application

Figure 5-2: two incomers without tie breaker application

5.3 TWO INCOMERS WITH TIE BREAKER (SHARE $L >$ BETWEEN AQ110P UNITS)

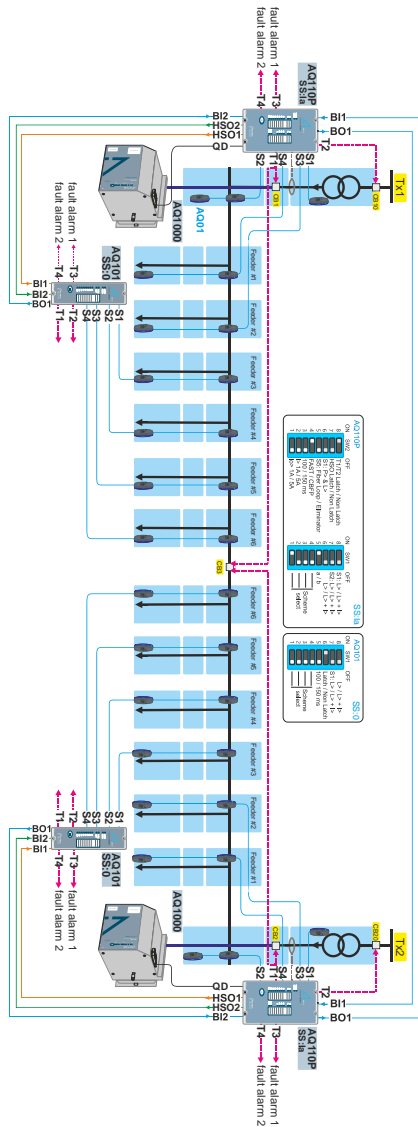


Figure 5-3: Two incomers with tie breaker application (share $L >$ between AQ110P units)

6 TROUBLE SHOOTING

6.1 AQ101, AQ101D, AQ110P ARC FLASH PROTECTION RELAYS

Led:	State	Error led state	SF relay state	Possible issues
Binary input or Sensor	Blink	ON	OFF	<ul style="list-style-type: none"> - Bad connection between sensors or other devices connected to BI - Damaged wire - Unit amount or sensor amount changed
Others than error	OFF	ON	OFF	<ul style="list-style-type: none"> - Dip switch settings changed or current pick-up potentiometer value changed > 20% (AQ110P only)
Power	OFF	ON	OFF	<ul style="list-style-type: none"> - Internal voltage too low. Auxiliary supply voltage may be less than specified
	Blink	OFF	OFF	<ul style="list-style-type: none"> - Input channels (binary inputs and sensor channel) connection verification. See set button function in chapter 3.1.3.
All	OFF	OFF	OFF	<ul style="list-style-type: none"> - Auxiliary supply voltage not connected.

Table 6-1: troubleshoot function description.

7 TECHNICAL DATA

7.1 AQ101, AQ101D, AQ110P ARC FLASH PROTECTION RELAYS

7.1.1 MOUNTING AND INSTALLATION

Panel material: Panel thickness (min-max):	Metal panel 1.0 – 5 mm / 1/16" – 13/64"
Panel mounting screw type: Key size: Tightening torque (min-max):	ISO 14581-M4x12 galvanized Torx T20 1.5 – 2.0 Nm / 13 – 18 in-lbs
Grounding nut type: Key size: Tightening torque (min-max):	DIN934-M5 galvanized 8 2.5 – 3.0 Nm / 22 – 26 in-lbs
Connectors X1 and X2 type: Wire cross section (solid and multicore) (min-max): Minimum stripping length: Screw tightening torque (min-max):	Phoenix contact MSTB 2,5/15-ST-5,08 0.2 – 2.5 mm ² / 24-12 AWG 7 mm / 0.275" 0.5 – 0.6 Nm / 4.4 – 5.3 in-lbs
Connector X3 (AQ110P only) Wire cross section (solid and multicore) (min-max): Minimum stripping length: Screw tightening torque (min-max):	0.5 – 6.0 mm ² / 20 – 10 AWG 14 mm / 0.55" 0.5 – 0.6 Nm / 4.4 – 5.3 in-lbs
Fiber connectors Nut tightening torque:	Light finger tightening

7.1.2 OPERATION TIMES

Tripping time using HSO (AQ110P/F only):	2 ms*
Tripping time using mechanical relays (T1-T4):	7 ms*
Reset time Light activation: Overcurrent measurement (AQ110P/F only):	1 ms 50 ms
Protection stages active after energization:	50 ms (typically)

*) Total trip time using arc light (L>) or phase/residual overcurrent (I>) and arc light (L>)

7.1.3 AUXILIARY VOLTAGE

Us (min-max): Us (nominal)	85 – 265V AC / DC 110, 220 V DC, 110, 115, 220, 230 V AC 50/60 Hz
	18 – 72 V DC 24, 36, 48, 60 V DC
Maximum interruption in normal operating state:	100 ms
Maximum power consumption:	5W (AQ110P) 4W (AQ101, AQ101D)

7.1.4 CURRENT MEASUREMENT CIRCUITS IL1-IL3, IO (AQ110P ONLY)

Nominal current	1 or 5A
Rated Frequency	2...1000Hz
Number of inputs	3 (phase) + 1 (residual)
Thermal withstand continuous	30A
Thermal withstand 1s	500A
Thermal withstand 10s	100A
Phase overcurrent setting range	0.5...6 x I _n
Residual overcurrent setting range	0.05...2 x I _n
Measurement accuracy	10%
Rated AC Burden (VA)	Input resistance <10mΩ

7.1.5 TRIP RELAYS T1, T2, T3, T4

Number	3 NO + 1 NC or 4 NO
Rated voltage	250V ac/dc
Continuous carry	5A AC / DC
Make and carry for 0.5s	30A DC
Make and carry for 3s	16A DC
Breaking capacity DC, when time constant L/R=40ms	40W (0.36A at 110 V DC)
Contact material	AgNi 90/10

7.1.6 HIGH SPEED OUTPUTS HSO1, HSO2 (AQ110P ONLY)

Number	2
Rated voltage	250 V DC
Continuous carry	0.5 A
Make and carry for 0.5s	15 A DC
Make and carry for 3s	6 A DC
Make and carry for 20s	2 A DC
Breaking capacity DC, when time constant L/R=40ms	110W (1A at 110V DC)
Contact material	Semiconductor

7.1.7 BINARY OUTPUT BO1

Number of outputs	1
Rated voltage	24 V DC (internally supplied)
Maximum burden	20mA / 480 mW

7.1.8 BINARY INPUTS BI1, BI2

Number of inputs	2
Rated voltage	24 or 110 or 220Vdc *
Rated burden	3 mA

*) *Refer to the ordering codes.*



Binary inputs are galvanically isolated from the device grounding. Attention shall be paid for avoiding galvanic loops via binary input ground.

7.2 AQ1000 ARC QUENCHING DEVICE

7.2.1 MOUNTING AND INSTALLATION

Tray material: Tray thickness (recommended min): C-rail material: C-rail material thickness (recommended min):	Steel tray plate 3.0 mm / 1/8" Steel rail 2 mm / 1/16"
Device mounting screw type: Key size: Tightening torque (min-max):	ISO 4762-M8x30 galvanized Allen key 6 20 – 25 Nm / 177 – 220 in-lbs
Busbar mounting screw type: Key size: Tightening torque (min-max):	ISO 4762-M8x30 galvanized Allen key 6 20 – 25 Nm / 177 – 220 in-lbs
Connectors X1 and X2 type: Wire cross section (solid and multicore) (min-max): Minimum stripping length: Screw tightening torque (min-max):	Phoenix contact MSTB 2,5/15-ST-5,08 0.2 – 2.5 mm ² / 24-12 AWG 7 mm / 0.275" 0.5 – 0.6 Nm / 4.4 – 5.3 in-lbs
Fiber connectors Fiber type: Nut tightening torque:	Arcteq AX001 multicore glass fiber Light finger tightening

7.2.2 DEVICE RATINGS

Maximum busbar voltage (line to line or line to ground):	1000 V AC 50/60 Hz
Maximum short circuit current	50 kA / 1s 75kA / 500ms 100 kA / 200 ms
Typical operation time:	<3 ms
Number of permitted operations:	Maximum 2 loaded trip operations permitted Maximum 100 no-load trip operations permitted
Basic insulation level (BIL) (phase contacts): (For other circuits see following chapters.)	12 kV
AC dielectric voltage withstand (phase contacts): (For other circuits see following chapters.)	2,5 kV AC 50/60 Hz
Typical charging time of the energy storage (empty to full):	<10 minutes

Typical discharge time of the energy storage (full to empty, when no auxiliary power):	<15 minutes
Device dimensions: Weight (gross): Weight (net):	See chapter 8.2 for dimensions 20 kg / 44 lbs. 16,5 kg / 36,4 lbs.

7.2.3 AUXILIARY VOLTAGE

Option A*	
Us (min-max): Us (nominal) Impulse voltage withstand: AC dielectric voltage withstand:	85 – 265V AC / DC 110, 220 V DC, 110, 115, 220, 230 V AC 50/60 Hz 5 kV / 1,2/50µs 2 kV
Option B*	
Us (min-max): Us (nominal): Impulse voltage withstand: DC dielectric voltage withstand:	18 – 72 V DC 24, 36, 48, 60 V DC 1 kV / 1,2/50µs 450 V
Maximum interruption in ready operating mode (both options):	100 ms
Maximum power consumption (both options):	5W (Ready operating mode) 14W (Charging mode)

*) Refer to ordering codes for the options.

7.2.4 SIGNAL RELAYS TRIP, READY, BLOCKED, CHARGING

Number	4 NO
Rated voltage	250V ac/dc
Impulse voltage withstand: AC dielectric voltage withstand:	5 kV / 1,2/50µs 2 kV
Continuous carry	5A AC / DC
Contact material	AgNi 90/10

7.2.5 BINARY INPUTS BI1, BI2, BI3, BI4

Number of inputs	4
Nominal activation voltage (min – max)	24 – 240 V DC
Nominal activation threshold	24, 110 or 220V DC *
Impulse voltage withstand:	5 kV / 1,2/50µs
AC dielectric voltage withstand:	2 kV
Rated burden	3 mA

*) Refer to the ordering codes.



Binary inputs are galvanically isolated from the device grounding. Attention shall be paid for avoiding galvanic loops via binary input ground.

7.2.6 ENVIRONMENTAL RATINGS

Environmental operating temperature (min-max):	-5° C / 23° F to 70° C / 158° F
Humidity (max):	95%RH, no condensation allowed
Storage temperature (min-max):	-40° C / -40° F to 85° C / 185° F

7.3 AQ01, AQ02 ARC FLASH SENSOR

7.3.1 AQ01 ARC FLASH SENSOR

Supply voltage	24Vdc
Supply current (standby)	2mA
Pick up time ¹	<1ms
Sensor cable specification	Shield twisted pair Size: 0.5 ~ 0.75mm ² , AWG: 18 ~ 20 Cable cover: Ø 4.5 ~6.0 mm
Max. sensor cable length per sensor channel	200 meters
Operating temperature	-20°C ~ 85°C
Storage temperature	-20°C ~ 85°C
Mechanical protection for photodiode element	IP60
Mounting (screw, pop rivet):	e.g. Phillips Pan-head sheet metal screw, Diameter: M3, Length: 20mm.
Dimensions (W x H x D)	90.0 x 27.5 x 32.5 mm
Weight	20 g

¹ : Time for activation after exceeding the set light intensity level.

7.3.2 AQ02 ARC FLASH AND PRESSURE DETECTION SENSOR

Supply voltage	24Vdc
Supply current (standby)	2mA
Pressure threshold setting (fixed) ¹	0.2 bar above ambient pressure
Pick up time ²	<1ms
Pressure measuring accuracy	± 1.8 %FS (full scale)
Sensor cable specification	Shield twisted pair Size: 0.5 ~ 0.75mm ² , AWG: 18 ~ 20 Cable cover: Ø 4.5 ~ 6.0 mm
Max. sensor cable length per sensor channel	200 meters
Operating temperature	-20 °C ~ 85 °C
Storage temperature	-20 °C ~ 85 °C
Mechanical protection for photodiode element	IP60
Mechanical protection for pressure element	IP40
Mounting (screw, pop rivet):	e.g. Phillips Pan-head sheet metal screw, Diameter: M3, Length: 20mm.
Dimensions (W x H x D)	90.0 x 27.5 x 32.5 mm
Weight	20 g

¹: A standard atmospheric pressure is 1 bar.

²: Time for activation after exceeding the set threshold pressure.

8 DIMENSIONS

8.1 AQ101, AQ101D, AQ110P ARC FLASH PROTECTION RELAYS

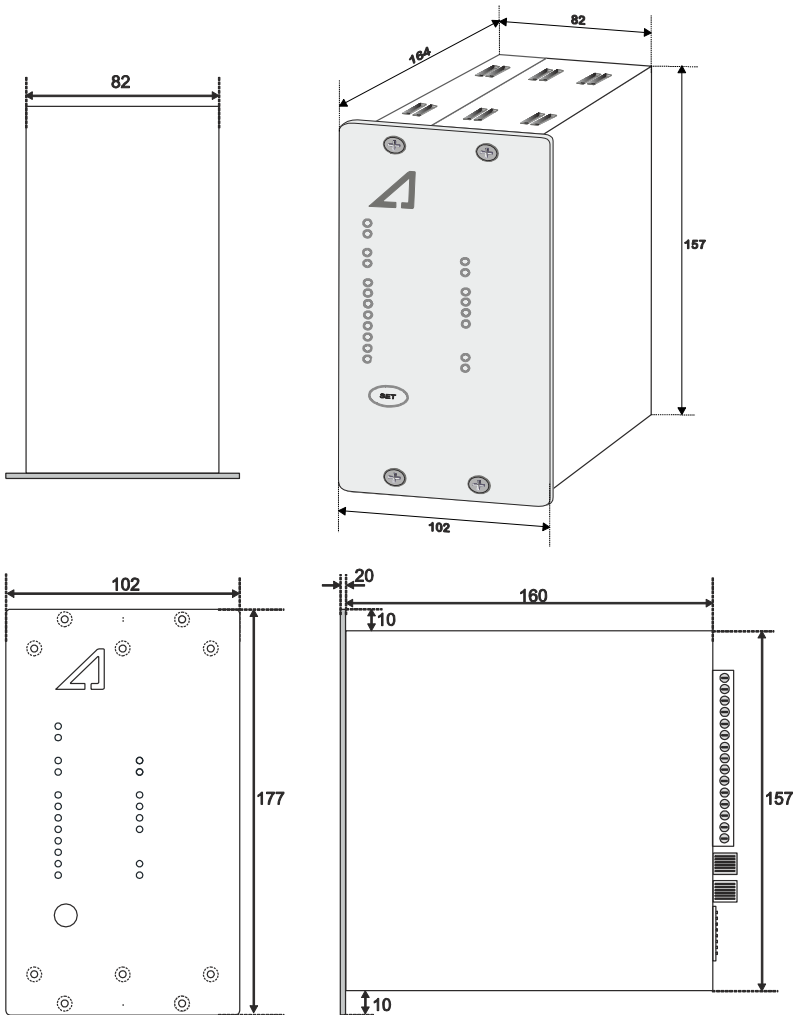


Figure 8-1: AQ110P device dimensions, all dimensions in millimeters.

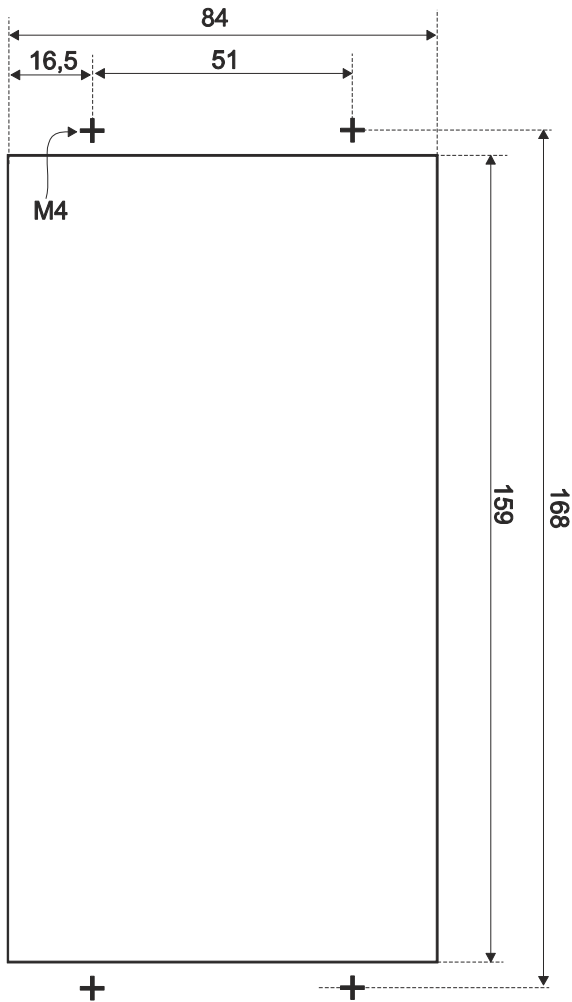


Figure 8-2: AQ110P cut out for panel mounting, scaling in millimeter.

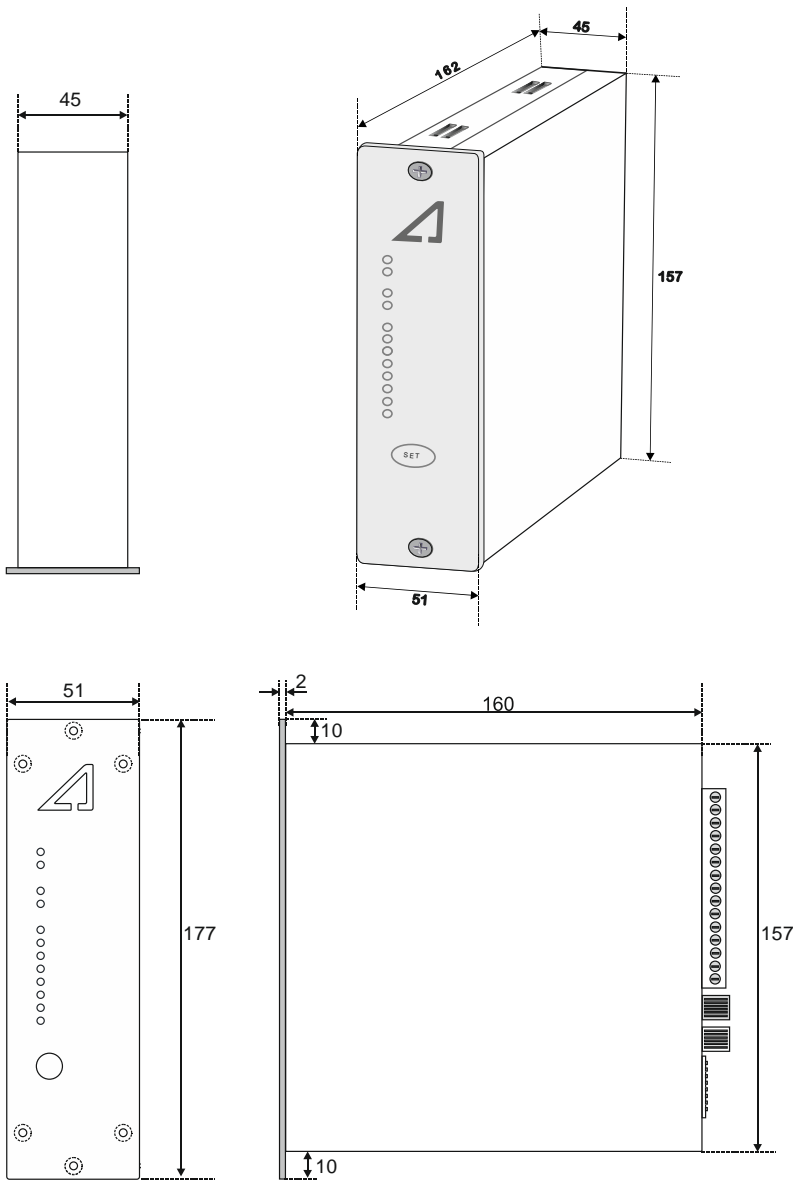


Figure 8-3: AQ101 device dimensions, all dimensions in millimeters.

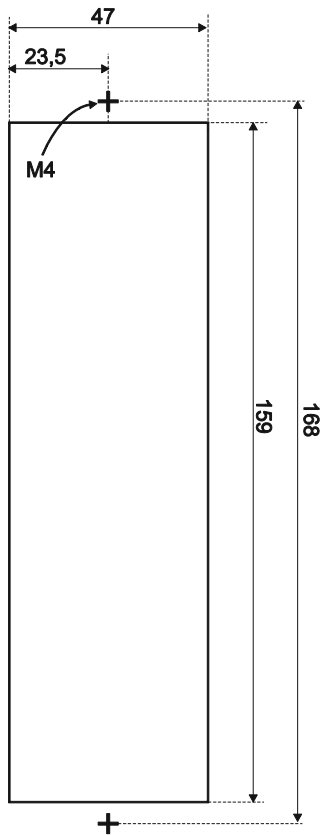


Figure 8-4: AQ101 cut out for panel mounting, scaling in millimeter.

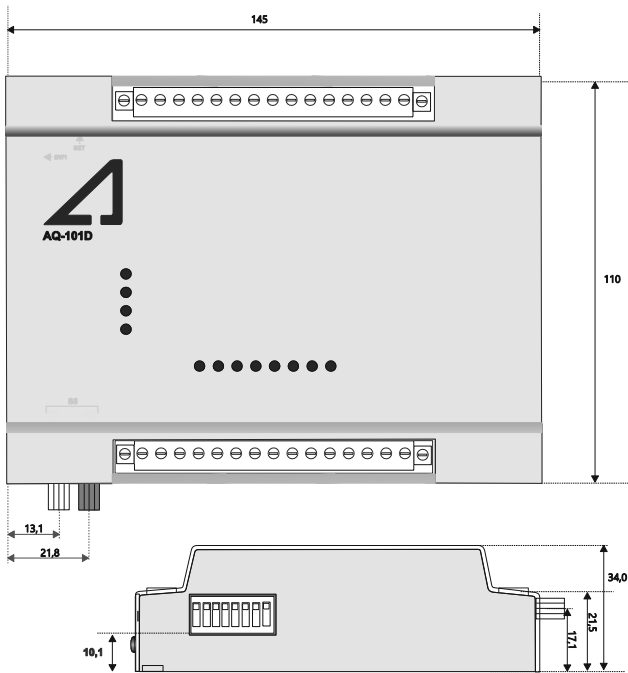


Figure 8-5: AQ101D device dimensions, all dimensions in millimeters.

8.2 AQ1000 ARC QUENCHING DEVICE

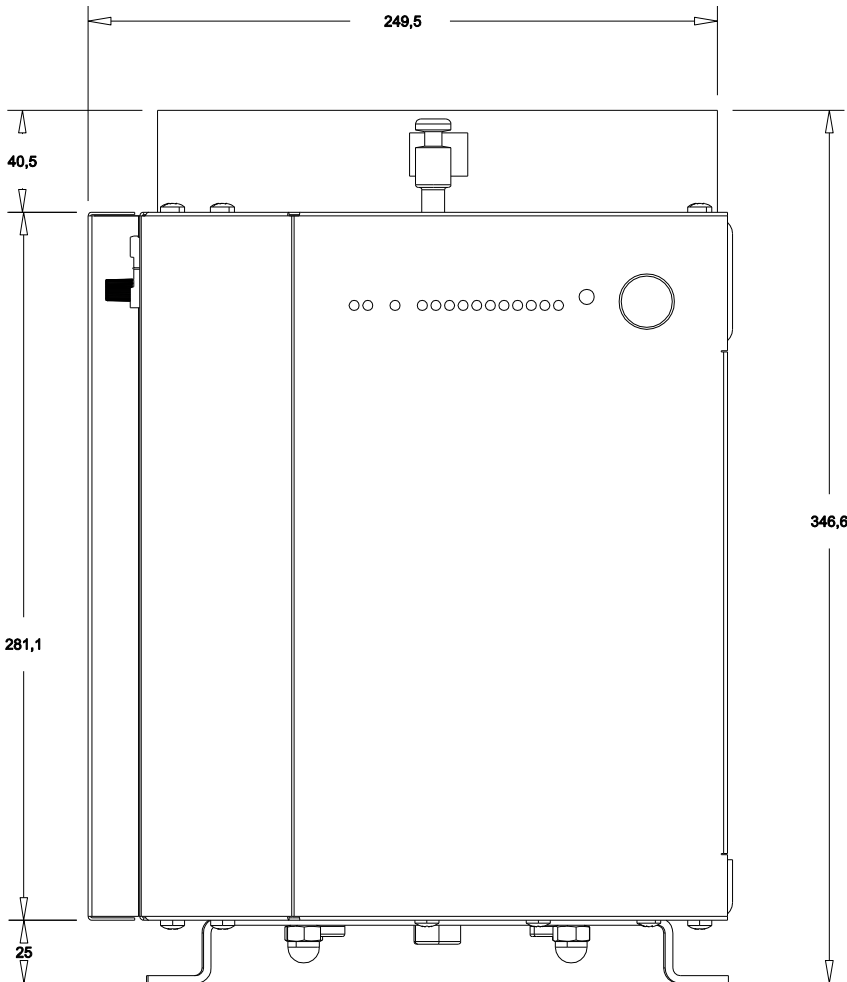


Figure 8-6: Device dimensions from front. All dimensions in millimeters.



See installation and mounting related technical instructions in chapter 1.1.3.

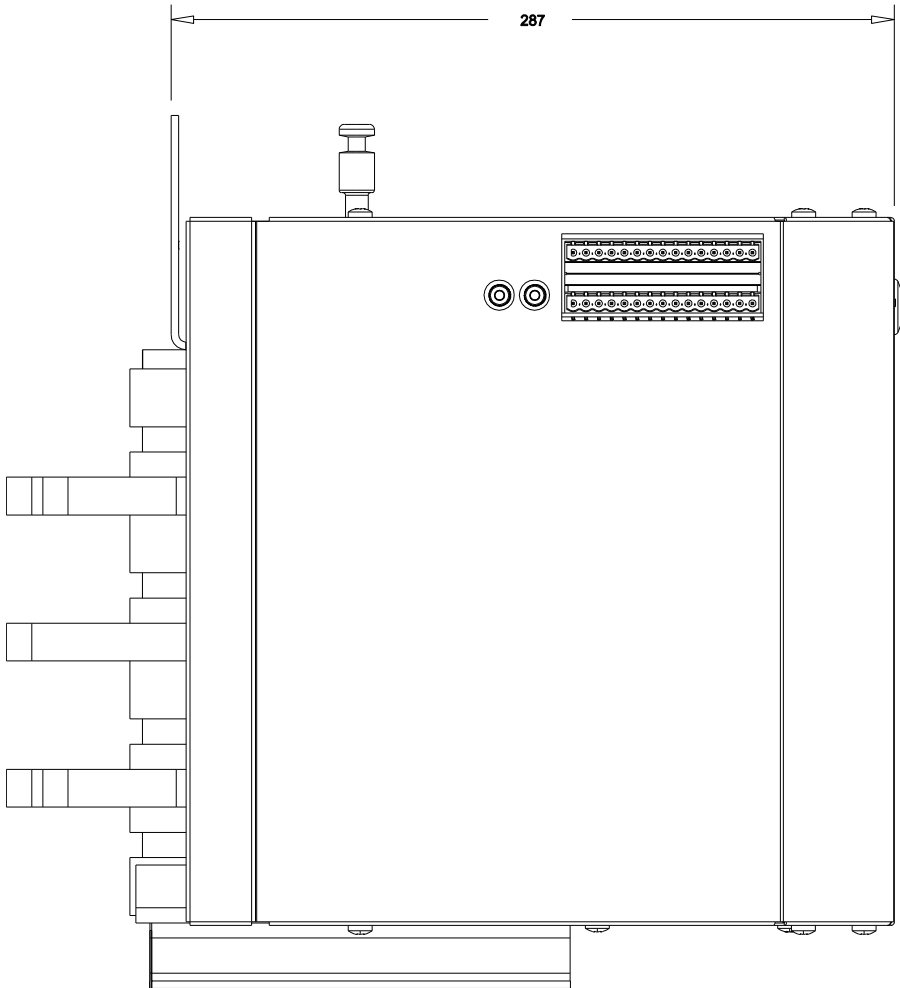


Figure 8-7: Device dimensions from left side. All dimensions in millimeters.



See installation and mounting related technical instructions in chapter 1.1.3.

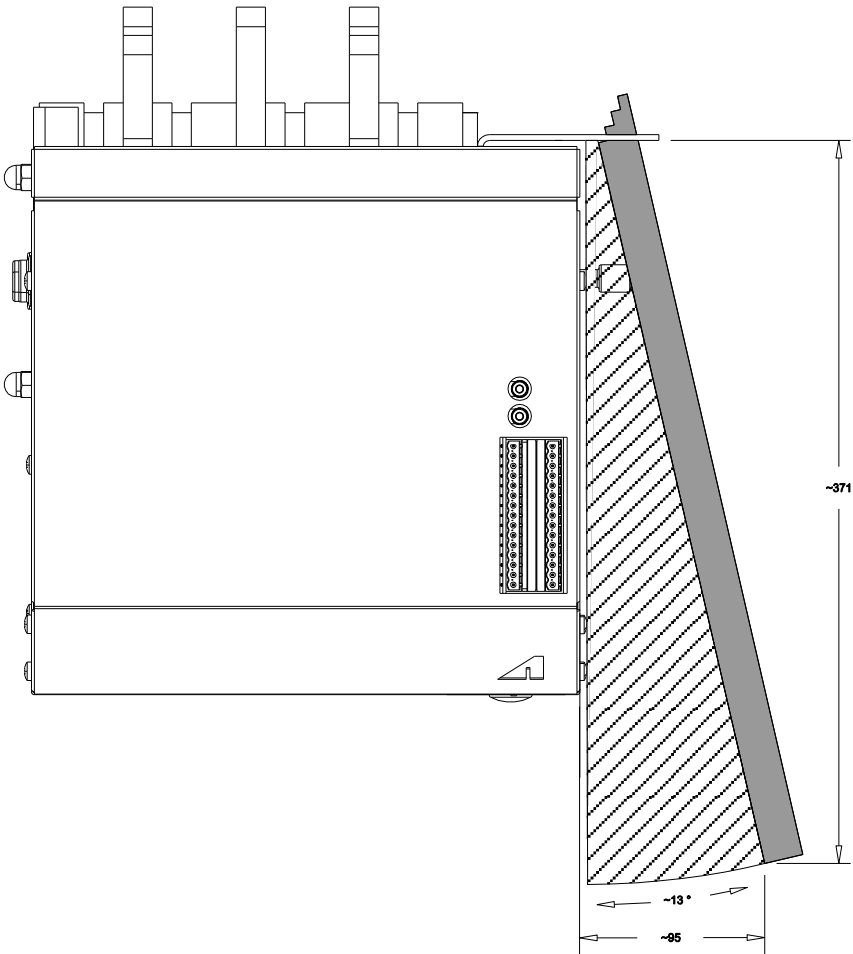


Figure 8-8: Reset handle movement area and space reservation. All dimensions in millimeters.



See installation and mounting related technical instructions in chapter 1.1.3.

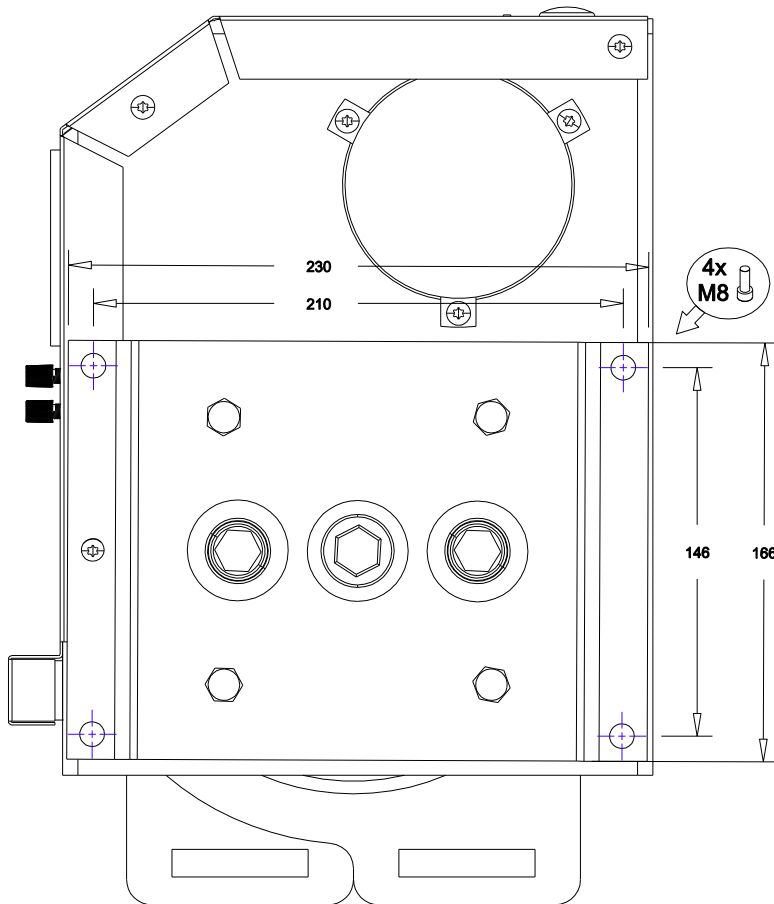


Figure 8-9: Mounting dimensions from bottom side. All dimensions in millimeters.



See installation and mounting related technical instructions in chapter 1.1.3.

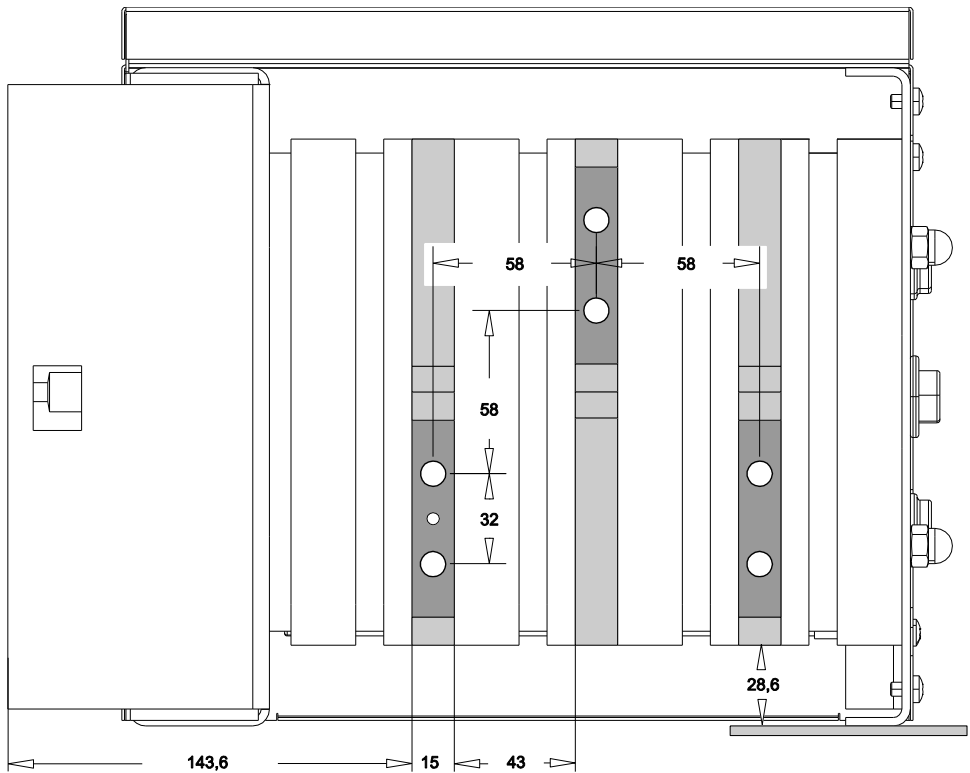


Figure 8-10: Busbar joint dimension form back side. All dimensions in millimeters.



See installation and mounting related technical instructions in chapter 1.1.3.

8.3 AQ01, AQ02 ARC FLASH SENSOR

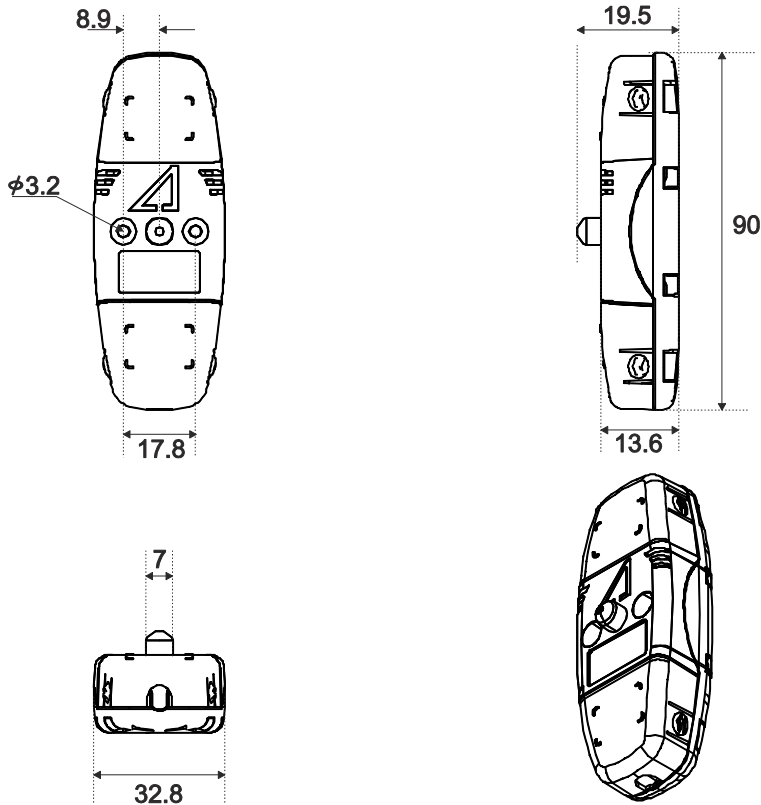


Figure 8-11: AQ01, AQ02 sensor dimensions, all dimensions in millimeters.

9 ORDERING CODES

9.1 AQ101, AQ101D, AQ110P ARC FLASH PROTECTION RELAYS

AQ - 1 0 1 - X X X X - S

Auxiliary power supply

- A 80...265 Vac/Vdc
B 18...72 Vdc

Trip relay T3 characteristic

- A Normally open type (NO)

Additional sensor channels

- A None
- B Fiber optic sensor channel

Binary input threshold voltage

- A 24 Vdc
- B 110 Vdc
- C 220 Vdc

Certifications

- S Certified for Siemens

AQ - 1 0 1 D - X X X X - S

Auxiliary power supply

- A 80...265 Vac/Vdc
- B 18...72 Vdc

Trip relay T3 characteristic

- A Normally open type (NO)

Additional sensor channels

- A None
- B Fiber optic sensor channel

Binary input threshold voltage

- A 24 Vdc
- B 110 Vdc
- C 220 Vdc

Certifications

- S Certified for Siemens

AQ - 1 1 0 X - X X X X - S

Sensor card version

P Point sensor unit

Auxiliary power supply

A 80...265 Vac/Vdc

B 18...72 Vdc

Trip relay T3 characteristic

A Normally open type (NO)

Arc quencher option

A None

B Fiber optic sensor channel for AQ1000

Binary input threshold voltage

A 24 Vdc

Certifications

S Certified for Siemens

9.2 AQ1000 ARC QUENCHING DEVICE

AQ - 1 0 0 0 - X X - S

Auxiliary power supply

- A 80...265 Vac/Vdc
- B 18...72 Vdc

Binary input threshold voltage

- A 24 Vdc
- B 110 Vdc
- C 220 Vdc

Certifications

- S Certified for Siemens

Accessories

Connection fiber lenght 3m	A X	0 0 1 - 3
Connection fiber lenght 5m	A X	0 0 1 - 5
Connection fiber lenght 10m	A X	0 0 1 - 10



The device is supplied with 3m trip fiber. If longer fiber is needed, the longer cable length shall be separately ordered according to the ordering codes above.

9.3 AQ 0x ARC FLASH SENSORS

AQ - 0 X X

Sensor function

- 1 Light point sensor unit
- 2 Pressure & light point sensor unit

Light intensity threshold

- a 8000 Lux
- b 25000 Lux
- c 50000 Lux

10 REFERENCE INFORMATION

Manufacturer information:

Arcteq Relays Ltd. Finland

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