

INSTRUCTION MANUAL

AQ 101S – Arc Protection Unit

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Read these instructions carefully and inspect the equipment to become familiar with it before trying to install, operate, service or maintain it.

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. Local safety regulations should be followed. No responsibility is assumed by Arcteq for any consequences arising out of the use of this material.

We reserve right to changes without further notice.

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1 ABBREVIATIONS

CB – Circuit breaker

CBFP – Circuit breaker failure protection

EMC – Electromagnetic compatibility

EPROM – Erasable programmable read only memory

HW – Hardware

LED – Light emitting diode

LV – Low voltage

ms – Millisecond

MV – Medium voltage

NC – Normally closed

NO – Normally open

SF – System failure

SW – Software

uP - Microprocessor

2 GENERAL

AQ 101S is a sophisticated micro-processor based arc flash protection unit including complete self-supervision functionality. It is designed to minimize the damage caused by an arcing fault (arc flash) by tripping the circuit breaker sourcing the fault current. The AQ 101S complete system self-supervision function provides the highest level of dependability by continuously monitoring all internal system functions along with external connections.

AQ 101S is designed according to the latest protection relay standards and is hence suitable for installations in rough environments, such as utility, traditional or renewable power plants, off shore, marine, oil and gas, mining, steel or any other heavy industry applications and as well commercial and institutional electrical systems. AQ 101S is suitable for either medium voltage or low voltage switchgear and motor control center applications in both new and retrofit installations.

2.1 ARC PROTECTION UNIT AQ 101S FEATURES

AQ 101S is a multipurpose arc flash protection unit and can be applied for variety of applications that requires a large number of data communication. AQ 101S can be used as a stand-alone unit or as part of a more complex arc protection system through the binary bus. Main features of AQ 101S, see Figure 2-1:

- 80-265Vac/dc auxiliary power supply or optional 18-72Vdc power supply
- 4 arc point sensor channels
- 6 binary inputs (nominal voltage of 24 or 110 or 220Vdc)
- 3 normally open trip relay outputs (direct trip circuit rated)
- 3 binary outputs (24Vdc)
- 1 system failure relay output
- 17 Indication LEDs
- Push-button

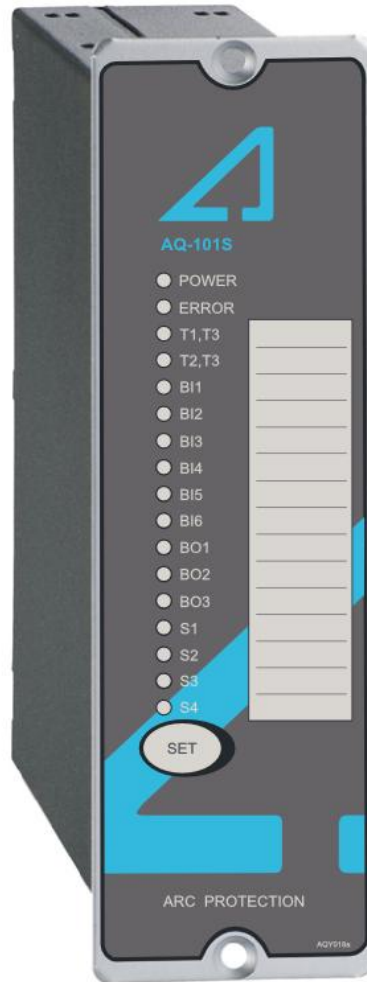


Figure 2-1: AQ101S Arc protection IO unit

2.2 SIMPLIFIED BLOCK DIAGRAM

AQ 101S simplified block diagram in Figure 2-2 shows the main components of the AQ 101S unit.

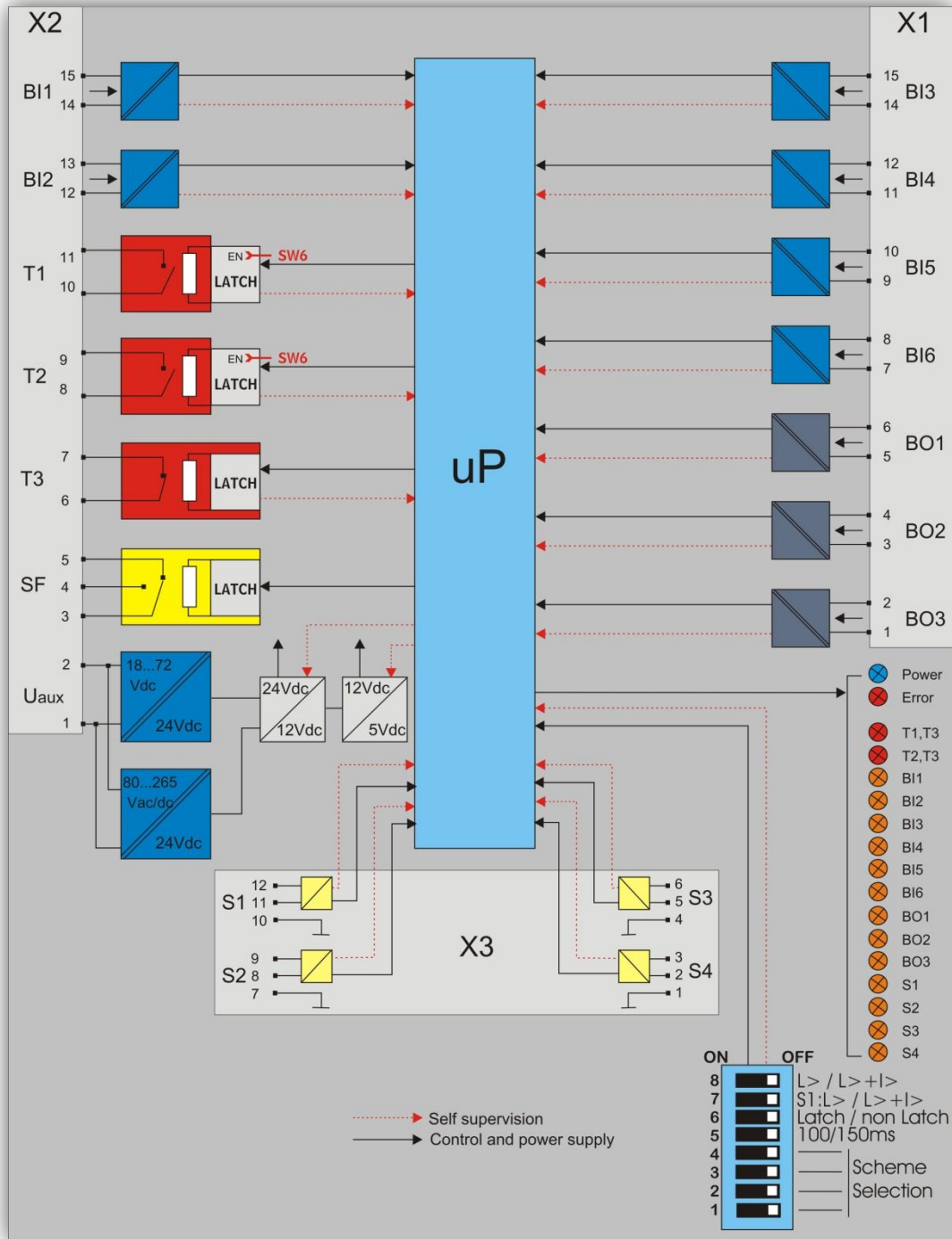


Figure 2-2: AQ 101S simplified block diagram

3 OPERATION AND CONFIGURATION

3.1 LED INDICATOR FUNCTIONS

AQ 101S contains 17 indication LEDs. A user definable text pocket can be slid in for identifying each LED function (except Power and Error LEDs). LED's are located at the front plate of the unit for clear viewing without a need for opening doors.

During power up the unit performs a LED-test. All LEDs are turned on for 2 seconds and then back off. Only the blue power LED will remain on. When powered up, the unit goes in 50ms into protection mode even while the LED test is being performed.

In normal operation only the blue power LED is ON.

The sensor LEDs in inactive condition are off. If an arc sensor is activated the corresponding sensor channel LED will turn on if the activation is longer than 1.5ms. The sensor LED activation function is latched (steady light). To clear the LED the "SET" button should be pressed.

In case of a loose sensor wire and binary inputs wire or configuration mismatch (new sensor attached without running auto-configuration system setup, see chapter 3.3.1) situation the corresponding LED will start flashing and the ERROR LED will activate.

The Binary I/O LEDs are indicating the I/O-line status. If any of the lines become active for more than 1.5ms the corresponding LED will turn on (latch).

In trip situation the corresponding trip LED will turn on. Trip outputs are controlled by dipswitch settings. (See chapter 3.5.)

All activation and trip indication LEDs are latched, even if the dipswitch setting is in non-latched mode. They have to be cleared by pushing the "SET" button.

LED indications are stored in non-volatile EPROM memory for identifying the trip information in case the auxiliary power is lost. When re-powering the unit after power supply loss the actual LED status can be visualized from the front of the unit.

3.2 LED OPERATION QUICK GUIDE

LED	OFF	STEADY ON	BLINKING	ACTION IF ABNORMAL
POWER Blue	Auxiliary supply disconnected	Auxiliary power connected	N/A	Check the power source
ERROR Red	System healthy	System failure	Configuration mismatch. Protection partly operational	Verify system condition. see chapter 11: Troubleshooting guide and chapter 5: System self-supervision
T1,T3 Red	Normal status	Trip relays T1,T3 activated	N/A	Check the reason for trip. Clear the fault and reset indications by pushing SET button
T2, T3 Red	Normal status	Trip relays T2,T3 activated	N/A	Check the reason for trip. Clear the fault and reset indications by pushing SET button
B1 Amber	Normal status	Binary input 1 activated	Binary input 1 loose connection	Check the binary input wiring.
B12 Amber	Normal status	Binary input 2 activated	Binary input 2 loose connection	Check the binary input wiring.
B13 Amber	Normal status	Binary input 3 activated	Binary input 3 loose connection	Check the binary input wiring.
B14 Amber	Normal status	Binary input 4 activated	Binary input 4 loose connection	Check the binary input wiring.
B15 Amber	Normal status	Binary input 5 activated	Binary input 5 loose connection	Check the binary input wiring.
B16 Amber	Normal status	Binary input 6 activated	Binary input 6 loose connection	Check the binary input wiring.
BO1 Amber	Normal status	Binary Output activated	N/A	
BO2 Amber	Normal status	Binary Output activated	N/A	
BO3 Amber	Normal status	Binary Output activated	N/A	
S1 Amber	Normal status	Sensor channel 1 activated by light information	Sensor channel 1 loose connection or system set-up not performed; also activated by pressure information	Check why sensor activated or check the sensor wire connection or perform system set-up (see chapter: 3.3.1 Auto configuration (system setup))
S2 Amber	Normal status	Sensor channel 2 activated by light information	Sensor channel 2 loose connection or system set-up not performed; also activated by pressure information	Check why sensor activated or check the sensor wire connection or perform system set-up (see chapter: 3.3.1 Auto configuration (system setup))

<p>S3 Amber</p>	<p>Normal status</p>	<p>Sensor channel 3 activated by light information</p>	<p>Sensor channel 3 loose connection or system set-up not performed; also activated by pressure information</p>	<p>Check why sensor activated or check the sensor wire connection or perform system set-up (see chapter: 3.3.1 Auto configuration (system setup))</p>
<p>S4 Amber</p>	<p>Normal status</p>	<p>Sensor channel 4 activated by light information</p>	<p>Sensor channel 4 loose connection or system set-up not performed; also activated by pressure information</p>	<p>Check why sensor activated or check the sensor wire connection or perform system set-up (see chapter: 3.3.1 Auto configuration (system setup))</p>

Table 3-1: LED operation quick guide

3.3 PUSH-BUTTON DESCRIPTION

AQ 101S contains one single push-button (SET) that can be used for all operational functions of the unit. The push-button is utilized for auto-configuration of the system (see chapter 3.3.1) and for resetting the indicators and latched output relays.

3.3.1 AUTO CONFIGURATION (SYSTEM SETUP)

When all sensors and binary lines have been connected an auto-configuration procedure must be executed. The initialization sequence is performed by pressing the “SET”-button for 2 seconds, and the AQ 101S sensor LEDs and all binary LEDs start blinking. The unit scans these inputs to see if they are connected and when input is detected the corresponding LEDs are lit up to mark that a connection was found. The inputs without connection continue blinking during the remaining 3 seconds. After total time of 5 seconds, all LEDs are turned off. During this system setup the dipswitches setting are also stored in non-volatile memory.

All sensor inputs will remain operational even when not auto-configured. The auto-configuration is only used for self-supervision purposes.

Note: in order to redo auto-configuration for a unit containing less connections (binary inputs/outputs or sensors) than in previous memorized set-up a dipswitch (anyone) must be moved back and forth prior to performing auto-configuration.

Timeout allowing new configuration is 1 minute. Reconfiguration with more connections is allowed without moving the dip-switch.

3.4 RESET

All LED indications and latched trip relays are reset by pressing the “SET” button for 1 second. Otherwise the latched trip relays will remain activated until auxiliary power is disconnected. All LED indications will remain active until reset is performed by the operator even when auxiliary power supply is disconnected (see chapter 3.6 Non-volatile memory).

3.5 DIPSWITCH SETTINGS

AQ 101S functionality such as tripping logic is configured using dipswitch settings. Different trip schemes can be easily programmed by selecting the appropriate dipswitch positions. This gives users the flexibility to change settings dependent on application. Tripping may be selected based on arc light only or arc light and current thresholds (or other tripping criteria such as undervoltage, or similar). Current threshold or other tripping criteria may be applied to binary input BI1 for blocking trip caused by natural light sources. Also the CBFP scheme may be enabled using the dipswitches (the dipswitch number 4 is enabling CBFP function for corresponding scheme selection). The dipswitch number 1...4 are used as scheme selection. The scheme number is according to binary arithmetic. Dipswitches are located at the back of the unit for easy access. See Figure 3-1: AQ 101S dipswitch and Table 3-2 AQ 101S dipswitch setting for details of settings.

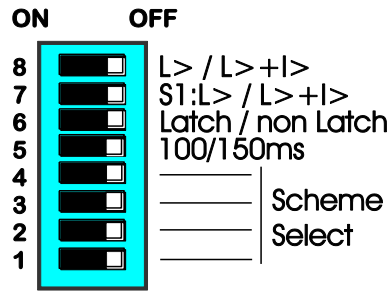


Figure 3-1: AQ 101S dipswitches

Dipswitch	Function selection	ON (LEFT POSITION)	OFF (RIGHT POSITION)
8 L> / L>+I>	Sensor channels S2, S3, S4 and FIBER channel trip criteria	Trip on light only (L>).	Trip on light and overcurrent (L> + I>). Both signals are required simultaneously to trip.
7 S1: L> / L>+I>	Sensor channel S1 trip criteria	Trip on light only (L>).	Trip on light and overcurrent (L> + I>). Both signals are required simultaneously to trip.
6 Latch / non-latch	Latch or non-latch for trip relays T1 and T2	T1 and T2 operate as latched. Note: Trip relay T3 is always latched. Binary output BO1 function is always non-latched.	T1 and T2 operate as non-latched.
5 100 / 150ms	CBFP time setting	CBFP time is set to 100ms.	CBFP time is set to 150ms.
4 Scheme select	Scheme selection	The scheme with CBFP function. Scheme selection number is according to binary arithmetic.	The scheme without CBFP function. Scheme selection number is according to binary arithmetic.
3 Scheme select	Scheme selection	Scheme selection number is according to binary arithmetic.	Scheme selection number is according to binary arithmetic.
2 Scheme select	Scheme selection	Scheme selection number is according to binary arithmetic.	Scheme selection number is according to binary arithmetic.
1 Scheme select	Scheme selection	Scheme selection number is according to binary arithmetic.	Scheme selection number is according to binary arithmetic.

Table 3-2 AQ 101S dipswitch setting selection

3.5.1 SCHEME SELECT DIP-SWITCH SETTINGS

The scheme selection of AQ101S can be configured by using the dip-switch number 1...4. Most of the schemes are designed for double busbar arc protection. The detailed instruction is described in AQ SAS™ Booklet.

- Logic Scheme 1

The AQ101S scheme 1 is utilized in selective arc protection solution. The point sensor S1 monitors the outgoing feeder cable compartment. S2 is used for monitoring the corresponding feeder breaker compartment. S3 and S4 monitor the busbar compartment. The contact T1 is responsible for tripping circuit breaker of the outgoing feeder. BI3 receives overcurrent information from the AQ110P of incoming feeder. BO1 sends light information to AQ110P of incoming feeder when there is any arc fault detected by AQ101S.

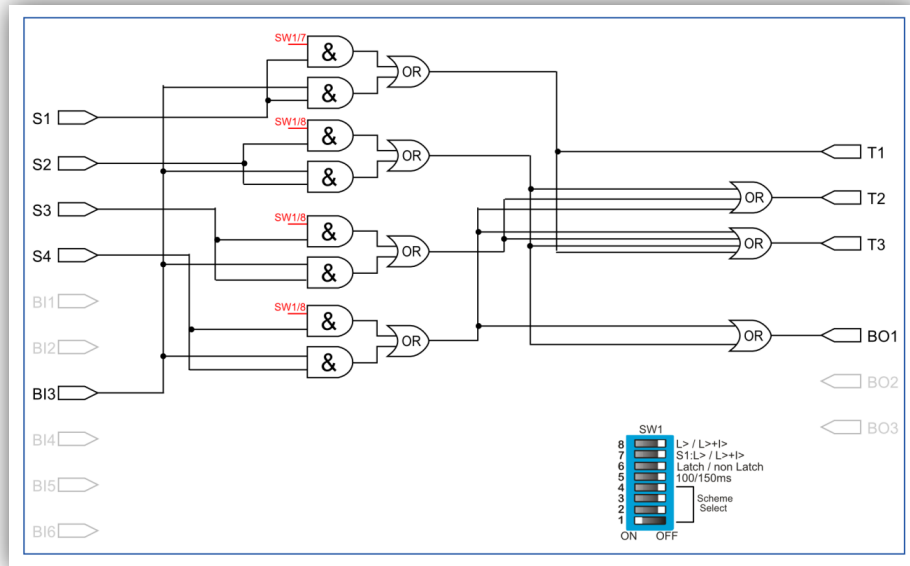


Figure 3-2: AQ101S logic scheme 1

General trip logic for AQ 101S (SS: 1)

TRIPPING SIGNALS FAULT LOCATION	T1	T2	T3	BO1	BO2	BO3
S1	×		×			
S2		×	×	×		
S3		×	×			
S4		×	×	×		

- Logic Scheme 2

The AQ101S scheme 2 is utilized in selective arc protection solution. S2 is used for monitoring the incoming feeder breaker compartment. S3 monitors reserve busbar; S4 monitors the main busbar compartment. The contact T1 is responsible for tripping section circuit breaker. T2 is responsible for tripping coupler circuit breaker. BI1 and BI2 are responsible for recognizing the incoming circuit breaker position. BI3 receives overcurrent information from the AQ110P of incoming feeder. BI4, BI5 and BI6 are used for sending light information from different location of the busbars. BO1, BO2 and BO3 send arc fault information to incoming feeder units and intermediate units.

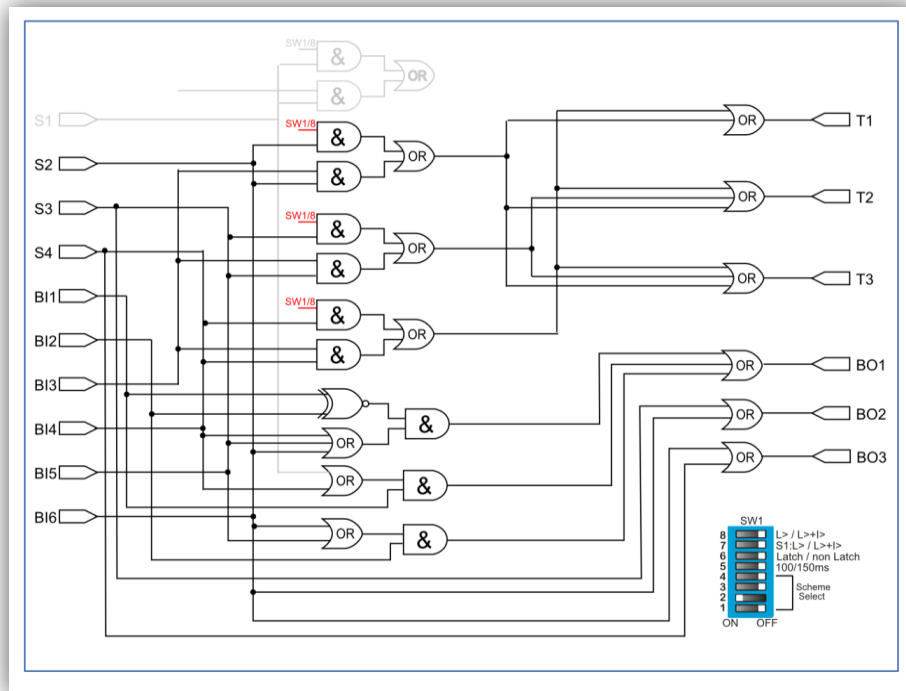


Figure 3-3: AQ101S logic scheme 2

General trip logic for AQ 101S (SS: 2)

TRIPPING SIGNALS FAULT LOCATION	T1	T2	T3	BO1	BO2	BO3
S2	x	x	x	x	x	x
S3		x	x	x	x	
S4	x	x	x	x		x

- Logic Scheme 3

The AQ101S scheme 3 is very similar to scheme 2. S2 is used for monitoring the incoming feeder breaker compartment. S3 monitors reserve busbar; S4 monitors the main busbar compartment. The contact T1 is responsible for tripping section circuit breaker. T2 is responsible for tripping coupler circuit breaker. BI1 and BI2 are responsible for recognizing the incoming circuit breaker position. BI3 receives overcurrent information from the AQ110P of incoming feeder. BI4, BI5 and BI6 are used for sending light information from different location of the busbars. BO1, BO2 and BO3 send arc fault information to incoming feeder units and intermediate units.

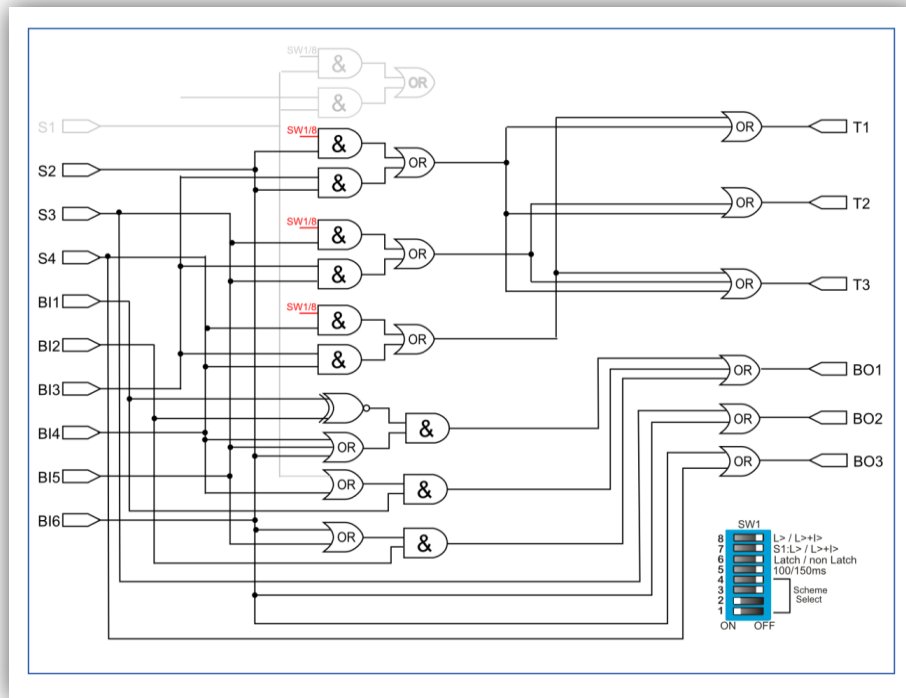


Figure 3-4 AQ101S logic scheme 3

General trip logic for AQ 101S (SS: 3)

TRIPPING SIGNALS FAULT LOCATION	T1	T2	T3	BO1	BO2	BO3
S2	x	x	x	x	x	x
S3		x	x	x	x	
S4	x		x	x		x

- Logic Scheme 4

The AQ101S scheme 4 is used as intermediate unit. Sensors are monitoring section circuit breaker and the busbar between the section circuit breaker. BI3 and BI4 receive over current information from two main busbar sections reprehensively. BO1 and BO3 represent the arc fault detected at both main busbar sections.

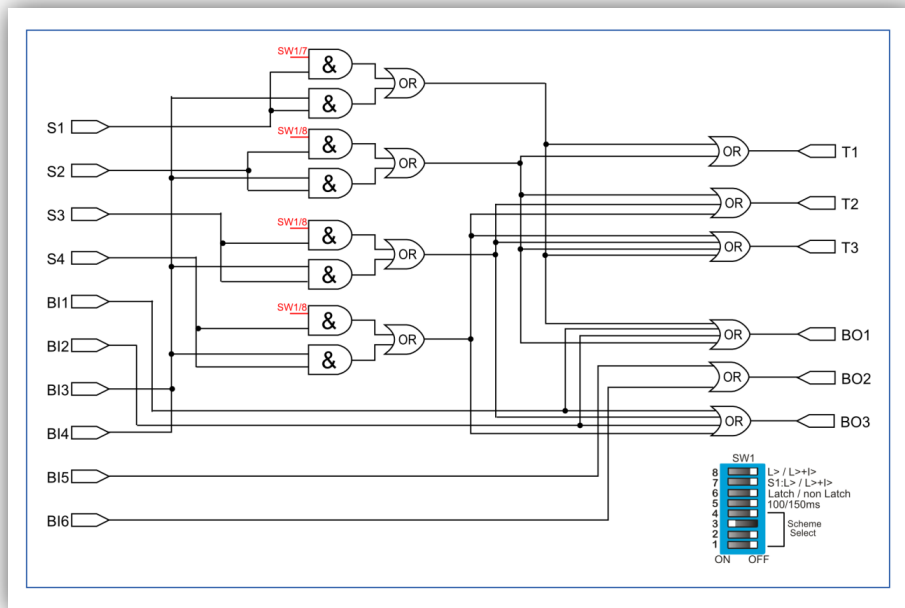


Figure 3-5: AQ101S logic scheme 4

General trip logic for AQ 101S (SS: 4)

TRIPPING SIGNALS FAULT LOCATION	T1	T2	T3	BO1	BO2	BO3
S1	x		x	x		
S2	x	x	x	x		x
S3		x	x			x
S4		x	x			x

- Logic Scheme 5

The AQ101S scheme 5 is used in single busbar arc protection solution. Sensors are monitoring section circuit breaker and the busbar between the section circuit breaker. BI1 and BI2 receive MT signal from both incoming AQ110P units. BI3 and BI4 receive overcurrent information from both incoming AQ110P units. BO1 and BO3 sends detected arc fault information from busbar and section CB to both incoming AQ110P units.

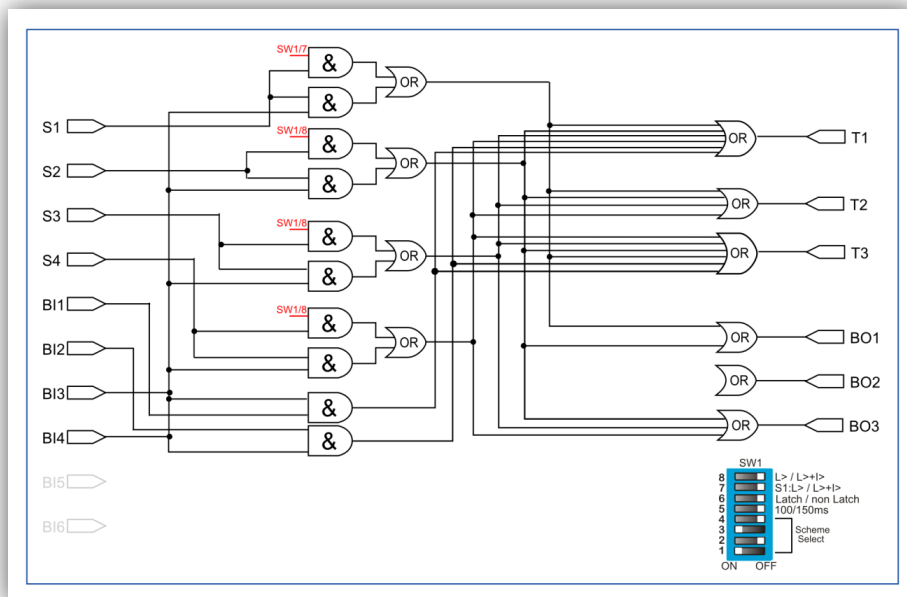


Figure 3-6: AQ101S logic scheme 5

General trip logic for AQ 101S (SS: 5)

TRIPPING SIGNALS FAULT LOCATION	T1	T2	T3	BO1	BO2	BO3
S1	x	x	x	x		
S2	x	x	x	x		x
S3	x	x	x			x
S4	x	x	x			x

3.6 NON-VOLATILE MEMORY

All critical system data including dipswitch settings and auto-configuration file described in chapter 3.3.1 are stored in EPROM non-volatile memory to ensure correct operation and full self-supervision even if auxiliary power is lost temporarily.

Also all LED indications described in chapter 3.1 are stored in non-volatile memory in order to provide quick recovery of the system status indication even if auxiliary power is lost temporarily. This feature is especially important if auxiliary power is lost after tripping.

Non-volatile memory does not require a power supply to maintain information and will retain settings and indications permanently without power.

4 ARC SENSORS

AQ 100 series provides choice of different types of arc sensors to be utilized in different units and different switchgear types according to specific application requirements. Available sensor types are arc light point sensors and arc light fiber optic loop sensors.

Arc light point sensors are typically installed in metal clad compartments providing quick accurate location of the faulted area. Arc light fiber loop sensors are installed typically to cover a wider protected area with one fiber when no need for more exact fault location exists.

4.1 ARC LIGHT POINT SENSOR AQ 01

AQ 01 is an arc light point sensor with a light sensitive photodiode element activated by arc light. AQ01 arc 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. One sensor per closed metal clad compartment should be utilized. In open spaces, such as the bus bar section, arc sensors should be mounted maximum 2 meters apart.

The factory default set light sensitivity of AQ01 sensor is 8000 Lux. This default set can be also designed as 25000 Lux and 50000 Lux according to the demand of user's application. Sensor does not require user settings. Detection radius is 180 degrees. See Figure 4-1.

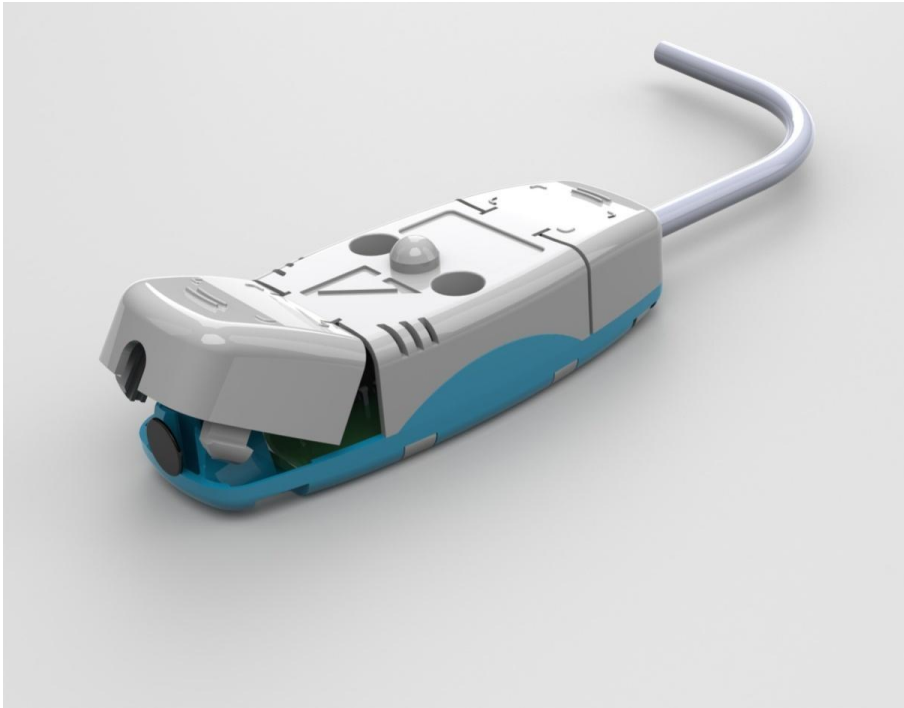


Figure 4-1: Arc sensor AQ 01

4.1.1 AQ 01 INSTALLATION AND WIRING

AQ 01 is installed either on the compartment wall or through wall. Example of wall mounting is seen in Figure 4-2. AQ 01 is fixed to the wall using two screws. The same screw pattern is utilized in through wall mounting arrangement as well. Unit is turned around and the eye is pushed to the compartment to be protected and two screws are attached from the back side of the sensor. No external mounting plates are needed in any case.

AQ01 comes without connection cable. Connection cable installation at site is simple. Cable connectors are located beneath the covers that can be conveniently detached for fastening the sensor wires. Cover shall be attached after installing the wires. Cable connectors are located at both ends of the sensor for series connecting maximum three sensors in one line.



Figure 4-2: AQ 01 mounted to compartment wall.

4.1.2 AQ 01 TECHNICAL DATA

Light intensity threshold	8000Lux/ 25000Lux/ 50000Lux
Detection radius	180 degrees
Mechanical protection	IP 64
Sensor wiring arrangement	2 wires and shield
Sensor cable specification	Shielded twisted pair 0.75mm ²
Maximum sensor cable length per sensor channel	200 meters
Operating temperature	-20...+85° C

5 SYSTEM SELF-SUPERVISION

AQ 101S includes an extensive self-supervision feature. Self-supervision includes both internal functions and external connections. The self-supervision module monitors power supply, HW and SW malfunctions and binary input connection and sensor problems. Dipswitch settings are also supervised by comparing actual value with stored Non-volatile memory data (see chapter 3.3.1 Auto configuration (system setup))

In a healthy condition the power LED is on and the System failure (SF) relay is energized. If the self-supervision function detects a faulty condition or the power supply fails the self-supervision relay is released and the ERROR LED is lit.

If a sensor failure occurs, the unit will go into ERROR mode. The error LED will turn on, the SF relay will release and the corresponding faulty sensor channel LED will start blinking. In this situation the unit is still in protection mode, but with the faulty sensor channel blocked. If the error is resolved, the error LED will automatically clear the SF-status and failed sensor channel LED will remain as blinking status. This means that SF relay will energize and the error led will turn off. If one or more of the sensors are disconnected the healthy sensors remain in use and unit remains operational accordingly. The AQ 101S will remain in error mode until the disconnected sensors are repaired.

If a dip switch setting is changed after the auto-configuration function (see chapter 3.3.1 Auto configuration) has been executed, the unit will go into SF-alarm mode. The configured (stored) setting is however still valid and the unit is still operational.

6 APPLICATION EXAMPLES

AQ 101S may be applied to a variety of power switchgear and controlgear layouts and technologies. Some typical applications are described in this section. Please consult your nearest Arcteq representative for a solution to your particular application.

6.1 MV OR LV DOUBLE BUSBAR APPLICATION WITH CURRENT AND LIGHT CONDITION

AQ 101S may be applied requiring both overcurrent and arc light conditions for trip. In this case tripping is performed only if both conditions are fulfilled simultaneously. Typically the overcurrent condition is obtained from the AQ 110 unit or monitored by non-Arcteq products also (e.g. generic feeder protection relay) and the total operation time is then dependent on device feeding the overcurrent signal to AQ 101S.

Figure 6-1 shows an example of a double busbar arc protection system applying both overcurrent and arc light for tripping. S1 channel is typically monitoring the outgoing cable compartment. S2 channel is monitoring the breaker compartment. S3 and S4 are respectively monitoring Reserve busbar and Main busbar. The busbar arc light fault information is sent out through binary output channel BO1 (main busbar) and channel BO2 (reserve busbar)

The current monitoring signal is in this application coming from an external overcurrent relay through binary input channel BI3. The position of breaker can be manually connected with either main busbar or reserve busbar. For indicating the precise breaker location, its position information is sent to AQ101S via binary input channel BI1 (main busbar) or BI2 (reserve busbar).

The trip contact T1 is responsible for tripping the breaker. The trip contact T3 gives trip alarm information synchronically.

The connection of this example application is also shown in chapter 8 Wiring diagram.

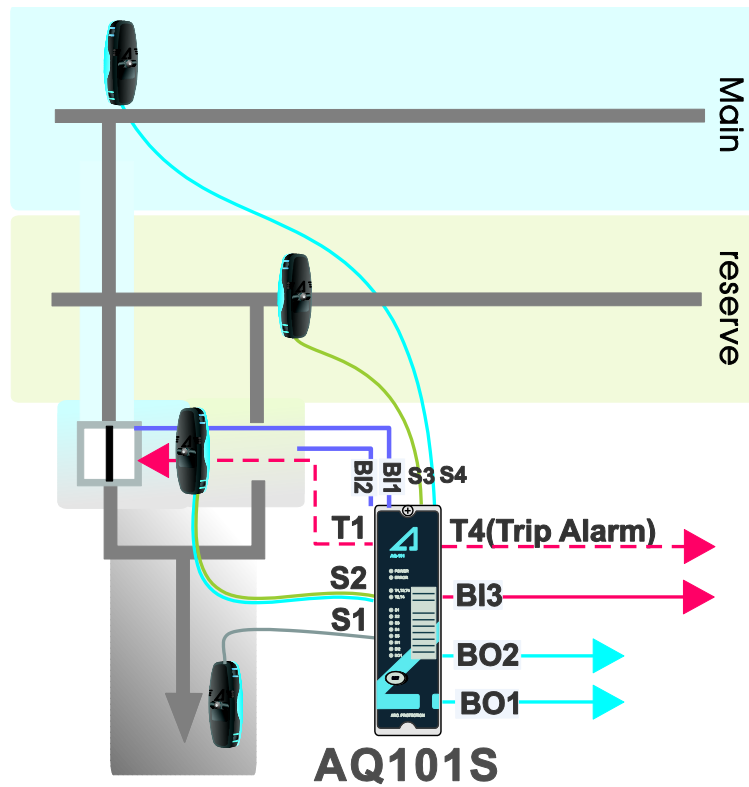
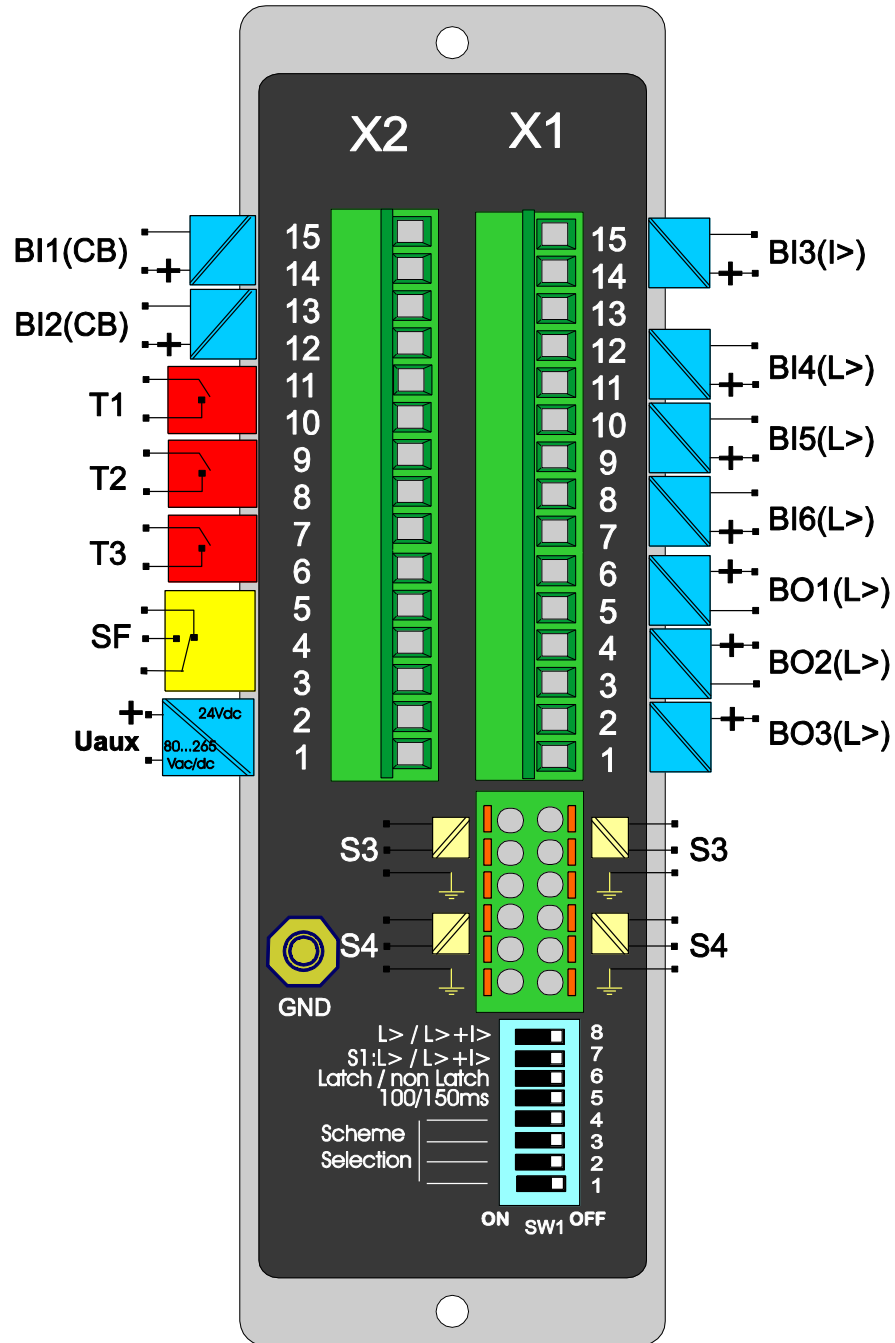


Figure 6-1 Double Busbar Application

6.2 CIRCUIT BREAKER FAILURE PROTECTION (CBFP)

AQ 101S includes a selective circuit breaker failure function which can be enabled by dipswitch setting (see chapter 3.5 Dipswitch settings). When enabled, the breaker failure function activates when the tripped breaker fails to operate. Breaker failure function is activated if AQ 101S detects the presence of light after a set operate time. When AQ 101S is set to operate on light and current both parameters must persist to activate CBFP. Breaker failure can be set to operate either on 100ms or 150ms delay (see chapter 3.5 Dipswitch settings).

7 CONNECTIONS



AQ101 connections.cdr

Figure 7-1: AQ 101S terminals at rear plate

7.1 OUTPUTS

7.1.1 TRIP RELAYS T1, T2 AND T3

The AQ 101S unit has integrated trip relays T1 and T2 for tripping of the circuit-breakers. T1 and T2 relays are normally open type (NO).

Trip relay T4 is a common trip relay that operates anytime T1 or T2 relay operates and can be used either for tripping one more disconnecting device or for trip alarm to local or remote monitoring and alarming system.

7.1.2 BINARY OUTPUT BO1, BO2 AND BO3

Three binary outputs are available (+24V dc). Binary output function can be configured using dipswitches (see chapter 3.5 Dipswitch settings).

Note: the binary output is polarity sensitive.

7.1.3 SYSTEM FAILURE RELAY SF

System failure relay SF is a changeover type (NO/NC) and is energized in healthy condition. Whenever AQ 101S detects a system error or disconnection of the auxiliary power supply the contact changes its state. The state of the SF relay remains the same until the unit returns to a healthy condition and SF relay is energized again.

7.2 INPUTS

7.2.1 ARC SENSOR CHANNELS S1, S2, S3, AND S4

AQ 101S has 4 arc point sensor channels. Maximum three arc point sensors (type AQ 01) may be connected to each channel.

For details on sensors refer to chapter 4 Arc Sensors.

7.2.2 BINARY INPUTS BI1, BI2, BI3, BI4, BI5 AND BI6

AQ 101S contains six binary inputs. Typically, BI1 and BI2 are reserved for breaker position signal information. In the most application the BI3 is responsible for receiving overcurrent from AQ110P. The BI4, BI5 and BI6 can be used for receiving a trip signal or arc light signal. See chapter 3.5 Dipswitch settings.

Note: when AQ 101S receives overcurrent signal from a non-Arcteq device the actual operation time depends on the operation time of the external device and so total operational time cannot be specified or guaranteed.

The inputs are activated by connecting a dc signal exceeding the specified nominal threshold level of the corresponding input. There are three different nominal threshold levels available, 24 or 110 or 220 Vdc. The desired threshold value has to be specified when ordering. The actual activation of the binary input occurs at 80% of the specified nominal threshold value (i.e. 16 Vdc, 88 Vdc or 178 Vdc).

7.3 AUXILIARY VOLTAGE

The auxiliary power supply voltage is 80...265Vac/dc. Optionally an 18...72Vdc version is available.

After powering up the unit protection is active and operational within 50ms.

8 WIRING DIAGRAM

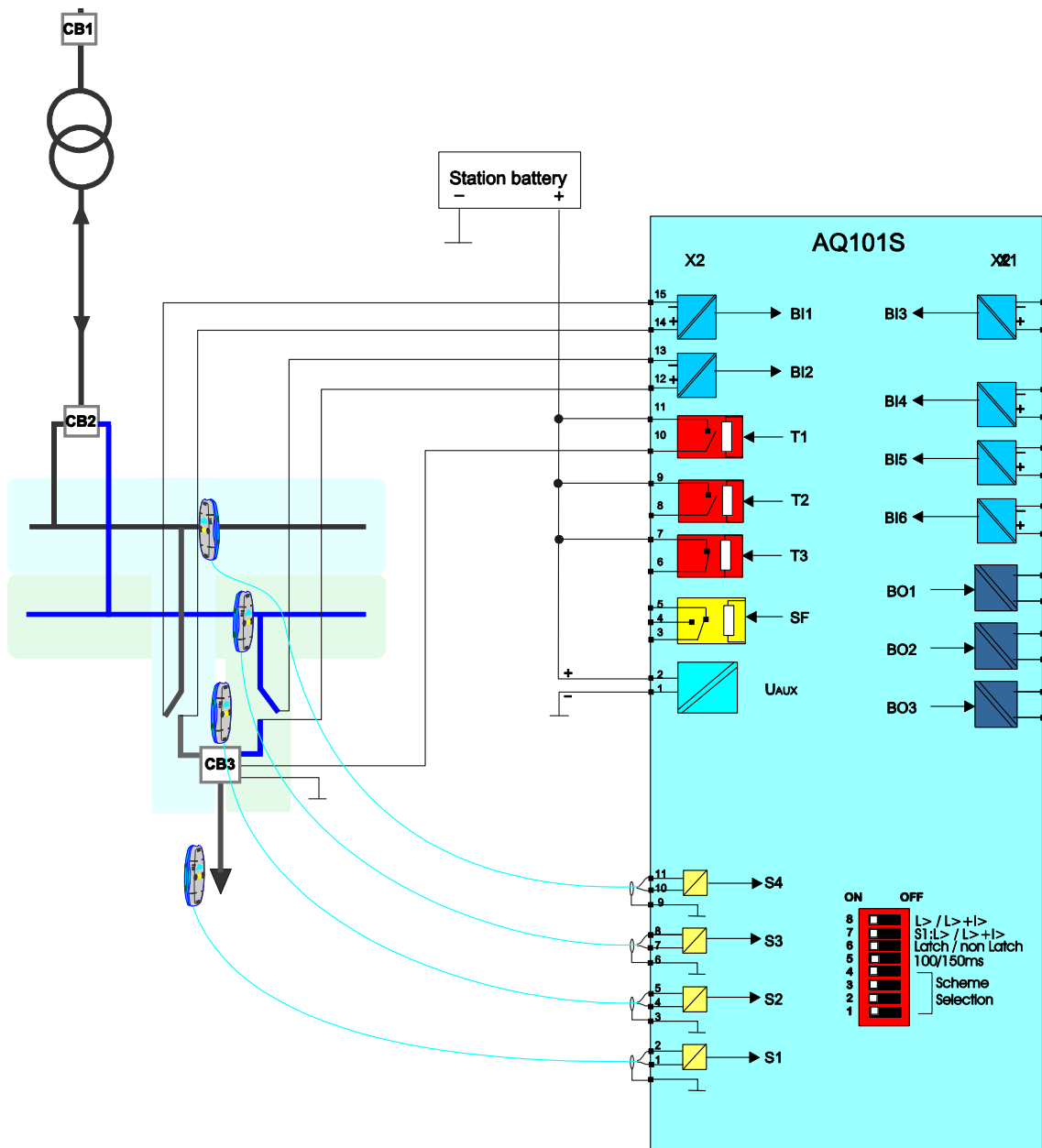


Figure 8-1: Wiring diagram of AQ 101S unit.

9 DIMENSIONS AND INSTALLATION

AQ 101S is either door mounted or panel mounted in standard 19 inch rack (height of 4U and 1/8 of a unit wide).

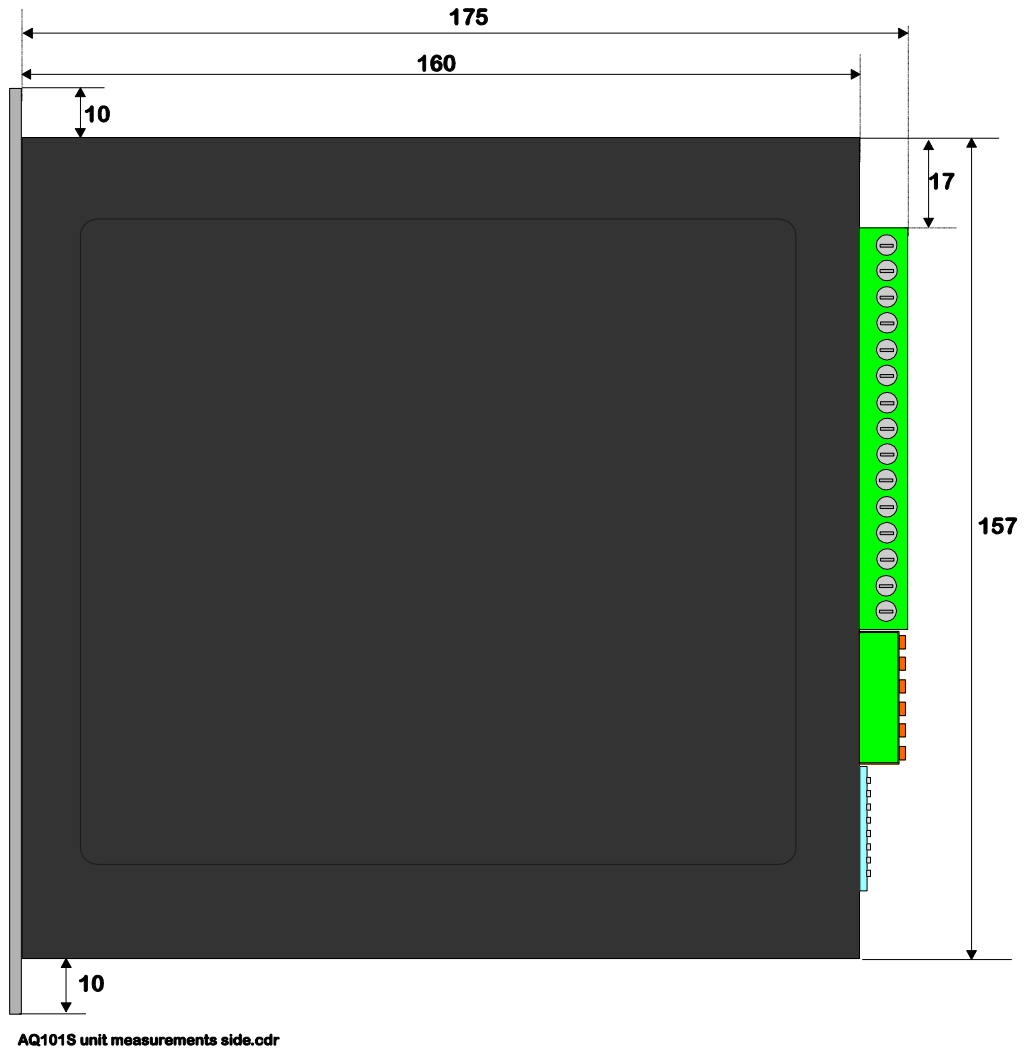


Figure 9-1: AQ 101S dimensions in millimetres (side view)

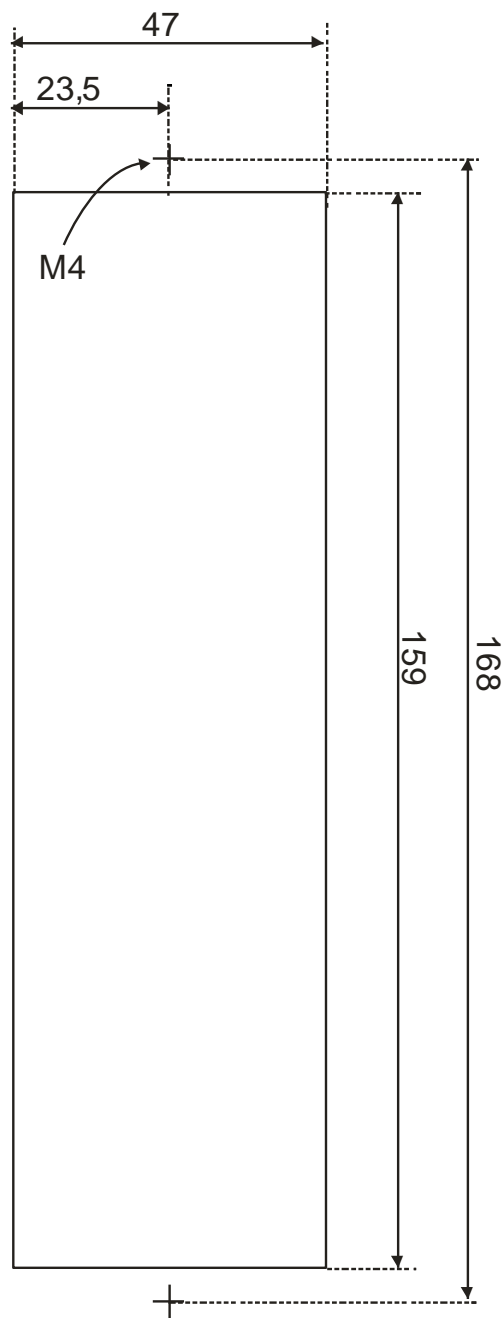


Figure 9-2: AQ 101S cut out for panel mounting (millimeters)

10 TESTING

It is recommended that the AQ 101S unit is tested prior to substation energizing. Testing is carried out by simulating arc light to each sensor and verifying the tripping and LED indication. For arc light simulation uses a superior camera flash type: Canon Speedlite 430EX 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.

10.1 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 or AQ FLG fiber loop sensor if in use.
- 3) Verify that the corresponding sensor channel indication LED status is changed to ON.
- 4) Verify the relay output(s) activation(s) by checking the circuit breaker status or by monitoring trip contact status. The circuit breaker should open or contacts operate. Note: A best practice is to operate the circuit breaker at testing.
- 5) Verify that the corresponding relay output(s) LED(s) indication status is changed to ON
- 6) If binary output (BO1, BO2 and BO3) signals are utilized verify the BO signal activation by status change of relevant input where binary output signal is connected or by measuring the signal output voltage. Note that BO signal is a non-latched type.
- 7) If binary output signals are utilized verify that binary output LEDs are lit.
- 8) Press SET push-button to reset all indications and latches.

10.2 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 activate the binary input BI3 used for overcurrent condition simultaneously.
- 3) Verify that the sensor channel indication LED status is changed to ON
- 4) Verify that the binary input indication LED status is changed to ON
- 5) Verify the relay output(s) activation(s) by checking the circuit breaker status or by monitoring trip contact status. Note: A best practice is to operate circuit breaker at testing. The circuit breaker should open or contacts operate.
- 6) Verify that the corresponding relay output(s) LED(s) indication status is changed to ON.
- 7) If binary output (BO1, BO2 and BO3) signals are utilized verify the BO signal activation by status change of relevant input where binary output signal is connected or by measuring the signal output voltage.
- 8) Verify that the corresponding relay output(s) LED(s) indication status is changed to ON.
- 9) If the dipswitch no.8 and no.7 are both set as light only mode, activate the camera flash within 20cm from the AQ01 sensor unit and do not activate the binary input used for overcurrent condition.
- 10) Verify that no trip has occurred and only sensor activation indication LED is ON.
- 11) Verify that BOUT signal is activated (if in use and configured to send light information)
- 12) Press SET push-button to reset all indications and latches.

10.3 TESTING ARC FLASH PROTECTION UNIT OPERATION TIME

The AQ 101S operation time test is not required at commissioning as it is performed by the manufacturer as a type test and routine production test. Refer to routine test reports sent with AQ 101S unit and consult your nearest Arcteq representative for type test reports.

However, if it is deemed necessary a site timing test may be conducted using below instructions.

- 1) Use a calibrated relay test set
- 2) Connect an output from the relay test set to camera flash type Metz 20B1 or equivalent input for initializing the flash and configure a relay test set timer to be started simultaneously with flash.
- 3) connect AQ 101S trip output T1, T2, or T3 to relay test set input and configure the input to stop the timer
- 4) Place camera flash to maximum 20cm (12 inch) distance of the AQ01.
- 5) Initiate flash and timer using relay test set output.
- 6) Read the measured time between simulated arc and trip contact operation.
- 7) Subtract the digital input delay of the relay test set from the final measured time if applicable. For specific test instructions consult the manufacturer of the relay test set.

10.4 TEST PLAN EXAMPLE

Date:	
Substation	
Switchgear:	
AQ 101S serial number:	

Preconditions		Light only	Light + current			Remark	
Sensor channel 1 setting							
Sensor channel 2,3,4 setting							
CBFP time setting* (Yes/No): 100ms: _____ /150ms: _____							
Object activated		LED indication	T1,T2,T3 active	B01 active	B02 active	B03 active	Remark
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						
BIN 1							
BIN 2							

Tested by :	
Approved by:	

Note*: If the relevant scheme includes CBFP function, then the CBFP time setting is in use.

11 TROUBLESHOOTING GUIDE

Problem	Check	Cross reference
Sensor does not activate when testing	Sensor cable wiring	Chapter 4 of this manual
	Camera (or other test equipment) flash intensity	Chapter 10 of this manual
Trip relay(s) does not operate even if sensor is activated	Dipswitch settings	Chapter 3.5 of this manual

Table 11-1: Troubleshooting guide

12 TECHNICAL DATA

12.1 PROTECTION

Trip time using mechanical trip relays	7ms*
Reset time (arc light stage)	2ms
Protection operational after power up	88ms

*total trip time using arc light (L>) or phase/residual overcurrent (I>) from AQ 110 and arc light (L>)

12.2 AUXILIARY VOLTAGE

Us	80...265Vac/dc (option 18...72Vdc)
Maximum interruption	100ms
Maximum power consumption	5W
Standby current	90mA

12.3 TRIP RELAYS T1, T2, T3

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

12.4 BINARY OUTPUT BO1, BO2 AND BO3

Rated voltage	+24V dc
Rated current	20mA (max)
Number of outputs	3

12.5 BINARY INPUTS BI1, BI2, BI3, BI4, BI5 AND BI6

Rated voltage	24 or 110 or 220Vdc
Threshold Pick up	≥ 16Vdc or 88Vdc or 178 Vdc
Threshold Drop off	≤ 15Vdc or 75Vdc or 155 Vdc
Rated current	3 mA
Number of inputs	6

12.6 DISTURBANCE TESTS

EMC test	CE approved and tested according to EN 50081-2, EN 50082-2
Emission - Conducted (EN 55011 class A) - Emitted (EN 55011 class A)	0.15 – 30MHz 30 - 1000Mhz
Immunity - Static discharge (ESD) (According to IEC244-22-2 and EN61000-4-2, severity class 4) - Fast transients (EFT) (According to EN61000-4-4, class III and IEC801-4, level 4) - Surge (According to EN61000-4-5 [09/96], level 4) - RF electromagnetic field test (According. to EN 61000-4-3, class III) - Conducted RF field (According. to EN 61000-4-6, class III)	Air discharge 15kV Contact discharge 8kV Power supply input 4kV, 5/50ns other inputs and outputs 4kV, 5/50ns Between wires 2 kV / 1.2/50µs Between wire and earth 4 kV / 1.2/50µs f=80.....1000MHz 10V/m f=150 kHz.....80Mhz 10V

12.7 VOLTAGE TESTS

Insulation test voltage acc- to IEC 60255-5	2 kV, 50Hz, 1min
Impulse test voltage acc- to IEC 60255-5	5 kV, 1.2/50us, 0.5J

12.8 MECHANICAL TESTS

Vibration test	2 ... 13.2 Hz \pm 3.5mm 13.2 ... 100Hz, \pm 1.0g
Shock/Bump test acc. to IEC 60255-21-2	20g, 1000 bumps/dir.

12.9 CASING AND PACKAGE

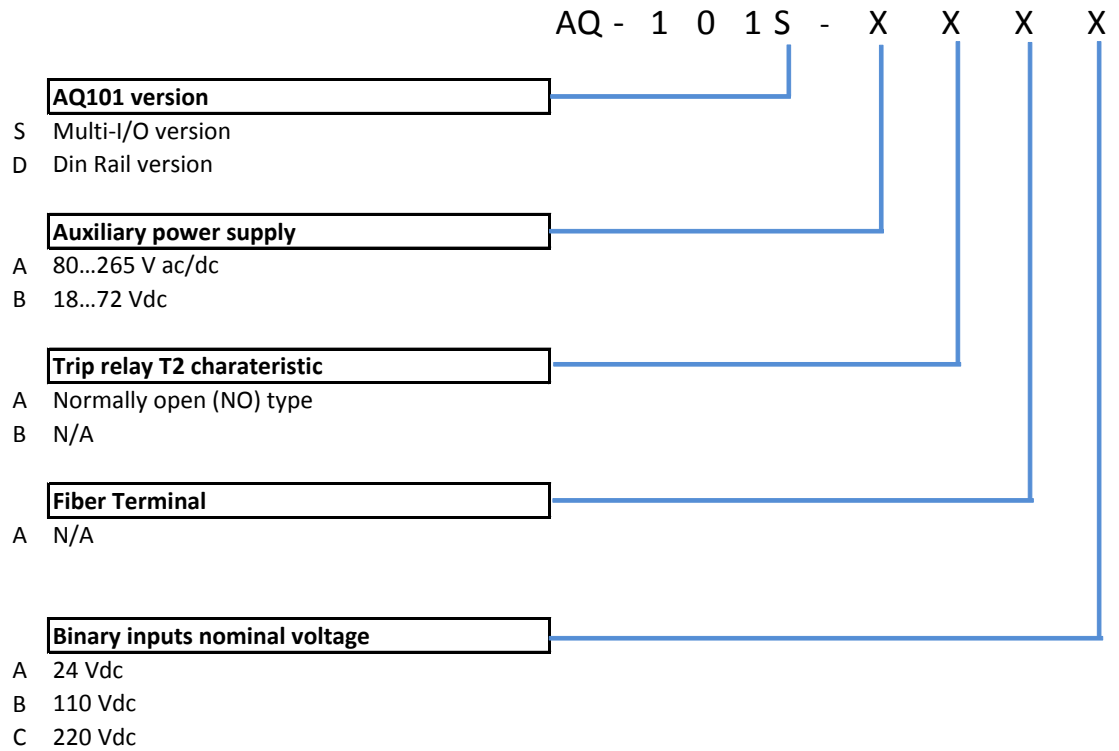
Protection degree (front)	IP 50
Protection degree (back)	IP 20
Dimensions (W x H x D mm)	45 x 164 x 157mm
Weight	0.7kg 1.0 kg (with package)

12.10 ENVIRONMENTAL CONDITIONS

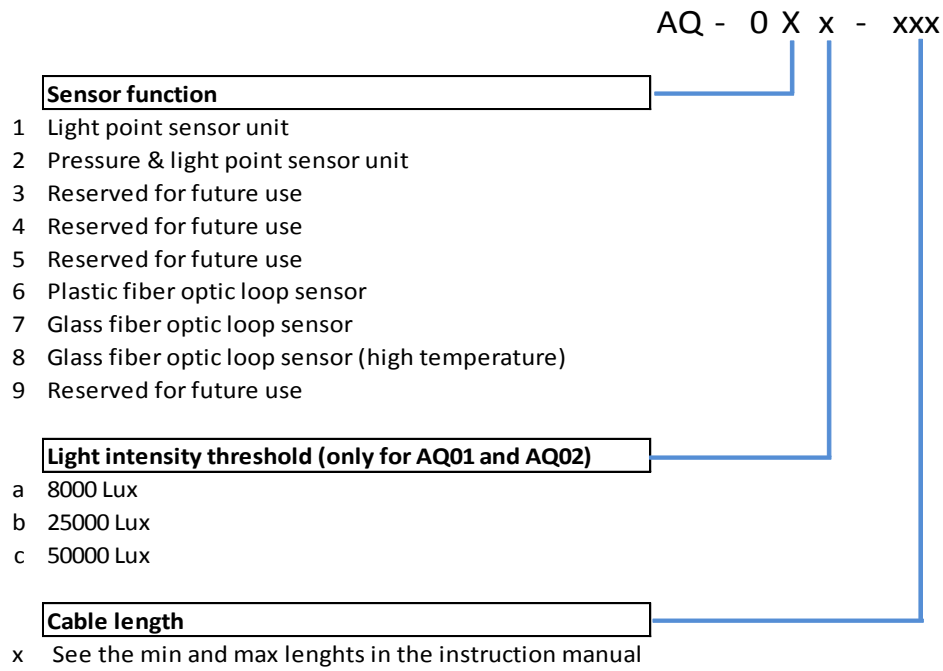
Specified ambient service temp. range	-35...+70°C
Transport and storage temp. range	-40...+70°C
Relative humidity	Up to 97%

13 ORDERING CODES

13.1 AQ 101S POINT SENSOR UNIT



13.2 AQ 0X ARC SENSORS



14 REFERENCE INFORMATION

Manufacturer information:

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