



INSTRUCTION MANUAL

AQ 2000 – Arc Quenching System

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Changes	-

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

EMC – Electromagnetic compatibility

LED – Light emitting diode

ms – Millisecond

2 GENERAL

AQ 2000 is an arc quenching system for rapid arc extinguishing of arc faults within the metal-clad and metal enclosed switchgear. It is rated up to 40kA for 1 second at up to 17.5kV.

AQ 2000 is an add-on system to AQ 100 series arc protection system. While AQ 100 system is detecting an arcing fault within the switchgear and taking the appropriate tripping action it is signaling the AQ 2000 to operate. The AQ 2000 is extinguishing the arc fault by closing all three phases to ground in order to create a parallel low-impedance path for fault current. The maximum total arc quenching time from detection to closing is 6ms.

The fault current flows through the main busbar to the quenching system until the fault is cleared by AQ 100 tripping the circuit breaker sourcing the fault current. The clearing time is a sum of AQ 100 trip time plus CB opening time. The AQ 100 trip time is 2 or 7ms depending on type of trip contact utilized and typical CB opening time varies between 40 and 100ms depending on type of CB utilized. For more information on AQ 100 arc protection system refer to AQ 100 instruction manual.

AQ 2000 may be installed to new switchgear or retrofitted to existing switchgear. When installing the quenching system the precautions have to be taken to make sure to operate within the ratings of the primary equipment.

3 AQ 2000 SYSTEM COMPONENTS

The AQ 2000 system consists of two main modules, AQ 2000-Q and AQ 2000-T. AQ 2000-Q is the primary arc quenching device and AQ 2000-T is the trigger unit of the system. The AQ 100 arc protection system is utilized for detecting the arc fault and initiating the eliminating arc action through fiber optic connection to AQ 2000-T.

The AQ 2000-Q operation is based on a Thomson coil mechanism along with patented field control system allowing limited creeping distance between the phases even with higher fault currents.

The AQ 2000-T is a capacitive trigger unit releasing a high current pulse to operate the AQ 2000-Q mechanism. AQ 2000-T in turn is operating when AQ 100 system detects an arcing fault and the AQ 110 unit sends the initiating pulse (trip) to AQ 2000-T.

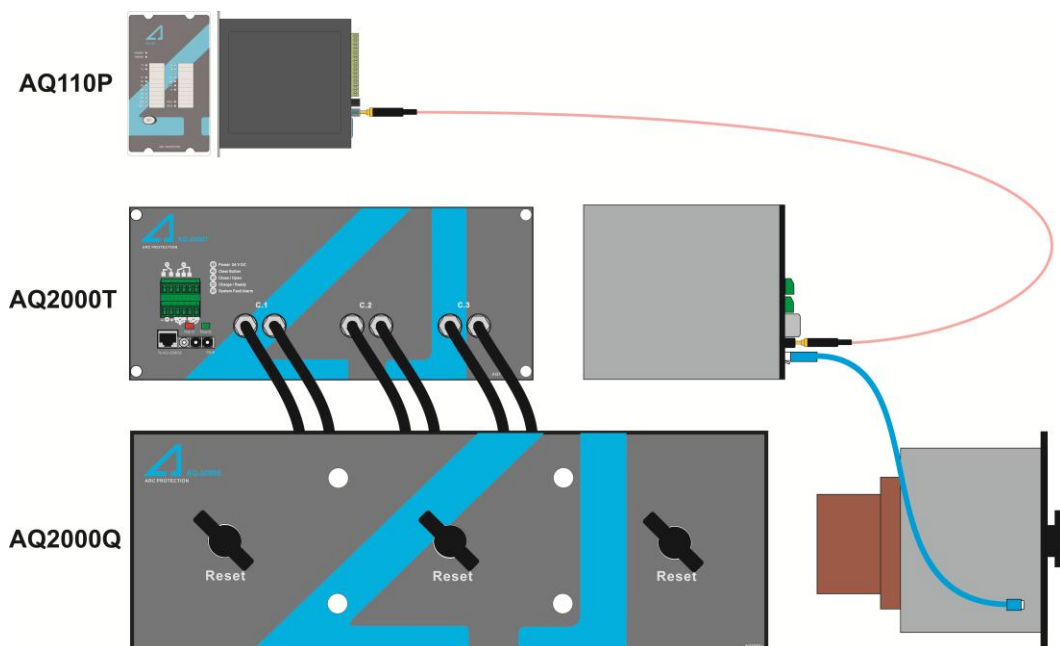


Figure 3-1: AQ 2000 Quenching system operation principle

4 OPERATION

4.1 AQ 2000-T LED INDICATOR FUNCTIONS

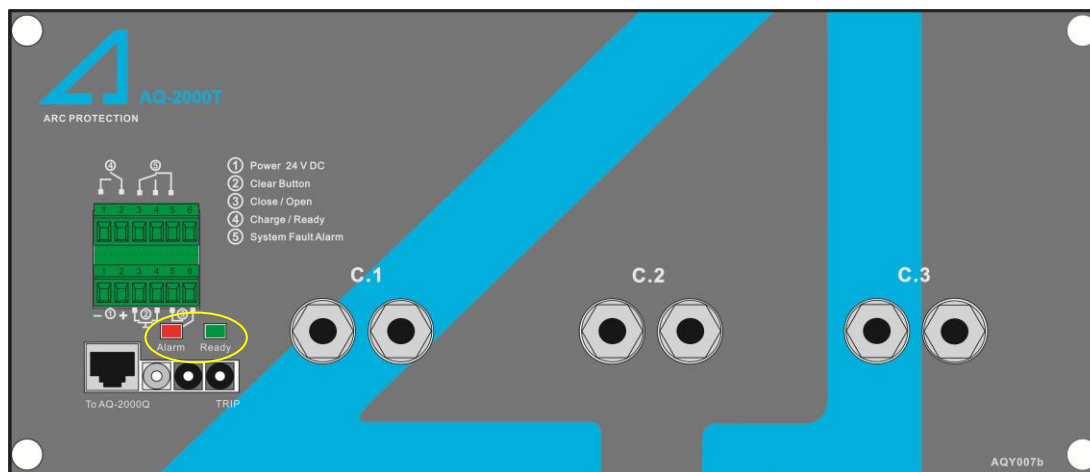


Figure 4-1 AQ2000T

As shown in above Figure 4-1, AQ 2000-T trigger unit concisely indicates operator by 2 LED indications. Additionally, all critical signaling status information is available to be wired using dry contacts.

In normal operation only the green power LED is ON.

As AQ100 series products by Arcteq, LED indications adopt non-volatile EPROM memory to store status 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.

4.2 AQ 2000-T LED OPERATION QUICK GUIDE

LED	OFF	STEADY ON	BLINKING
READY	Auxiliary supply disconnected	Auxiliary power connected and quencher charged	N/A
Green			
ALARM	System healthy	Quenching device closed	System failure
Red			

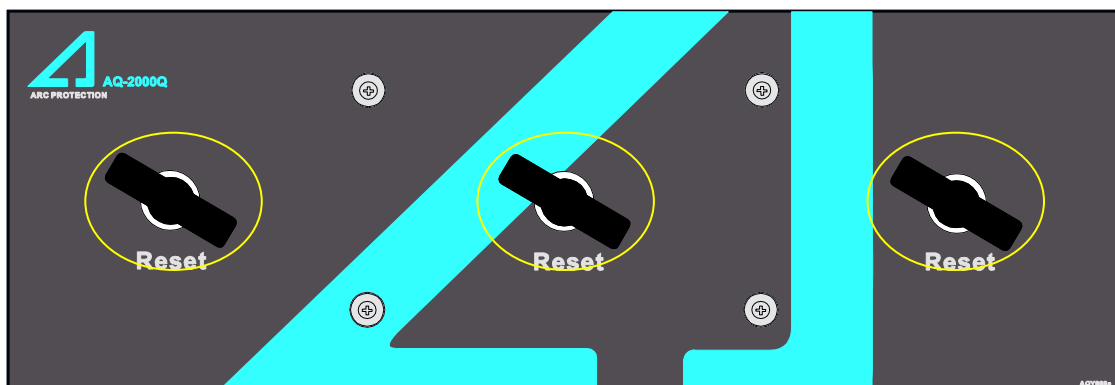
Table 4-1: LED operation quick guide

4.3 RESET OF INDICATIONS

For reset of LED indications an external push-button is needed to be connected to AQ 2000-T unit's connector X1-3 and X1-4.

4.4 RESET OF AQ 2000-Q

AQ 2000-Q is reset by pulling the reset handles from the device front. Approx. 25kP is required. After the reset the trigger unit requires approx. 20 minutes to load the capacitor bank. During the charging period, the arc quenching device should avoid to be used. If the arc device has closed for an open arc fault for the second time it should be reset in the same way but in addition the insulation over the primary contacts should be checked. Two faults happen in the same switchgear are very infrequent and also mean that the switchgear has serious defects.



5 SYSTEM SELF-SUPERVISION

AQ 2000 arc quenching system 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, fiber loop and RJ45 cable problems.

In a healthy condition the green READY LED is on when the device is energized. If the self-supervision function detects a faulty condition or the power supply fails the self-supervision relay is released and the ALARM LED is lit.

If the signaling fiber loop or RJ45 cable is lost in a normal operation, the ALARM LED starts to blink.

6 INSTALLATION

6.1 AQ 2000-Q MOUNTING

AQ 2000-Q can be installed inside a switchgear cubicle, typically to the measurement section or PT drawer if space is available. Otherwise it can be installed partly inside a cubicle through a cut-out in the encapsulation, see Figure 6-1. The unit can be mounted either on horizontal or vertical direction, see Figure 6-2.

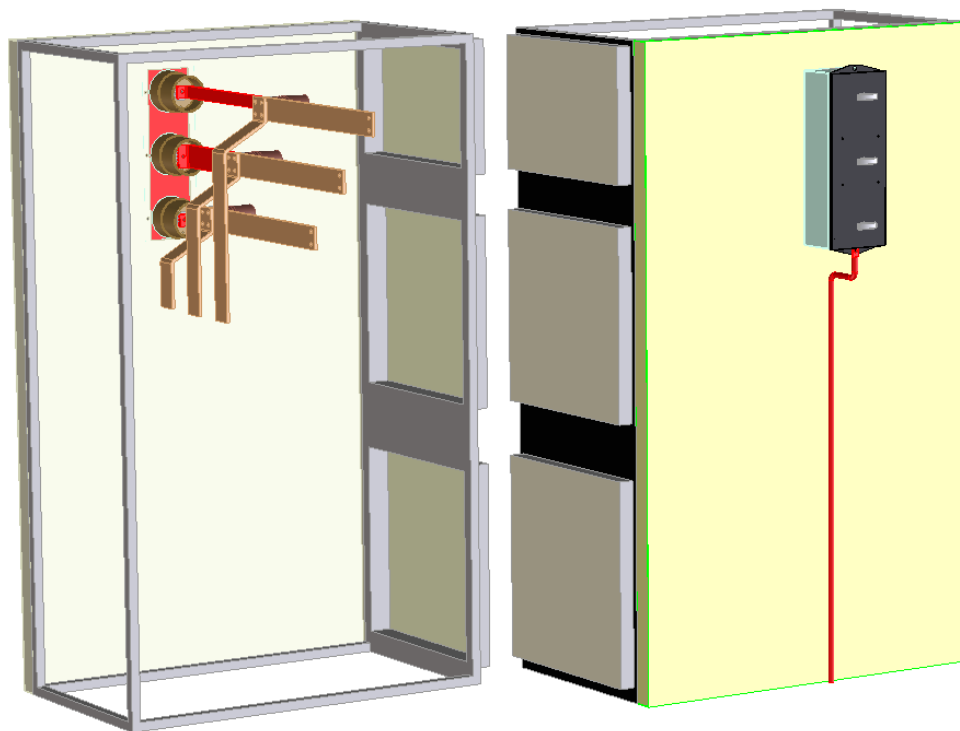


Figure 6-1: AQ 2000-Q installed through a cut-out.

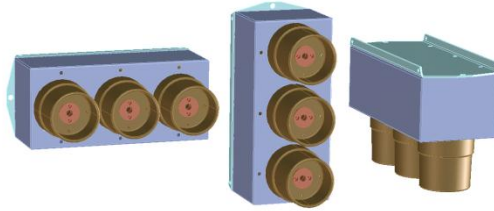
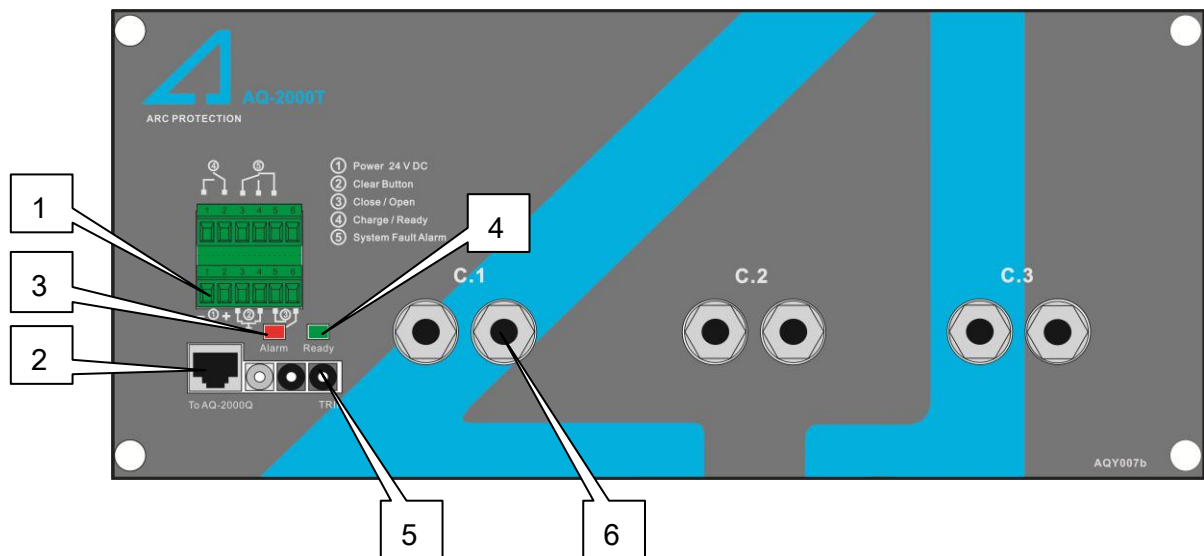


Figure 6-2: Different mounting alternatives

6.2 AQ 2000-T MOUNTING

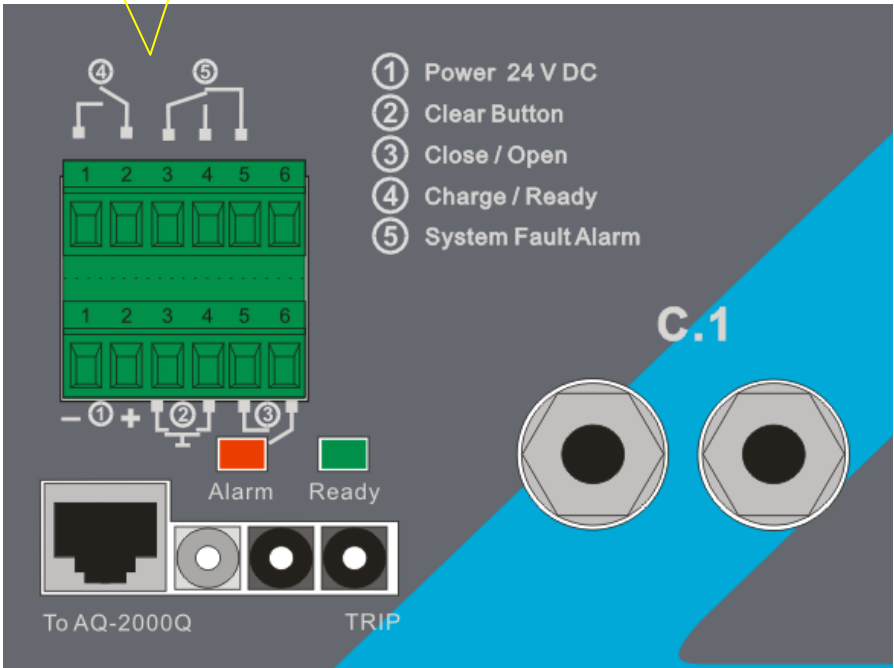
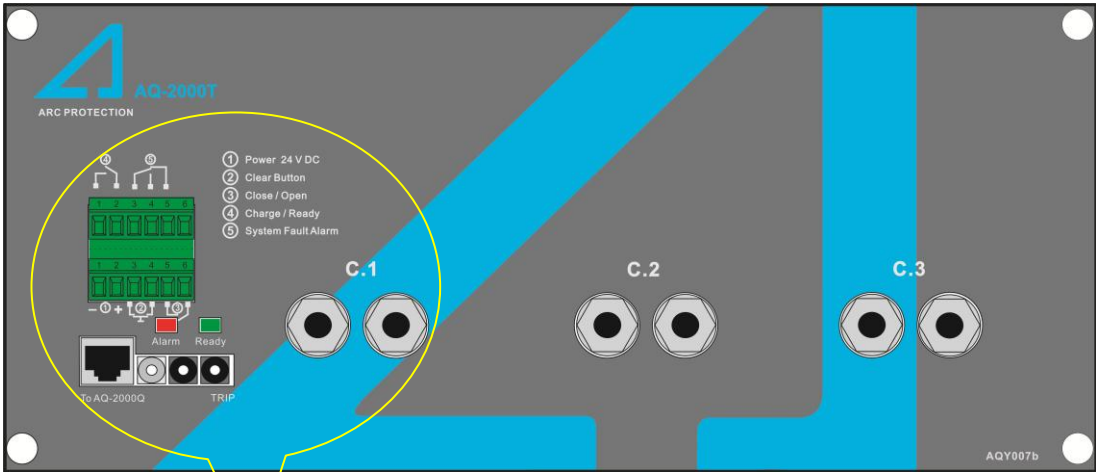
AQ 2000-T unit has to be mounted horizontally as it contains heavy components. There are six high current carrying cables at AQ 2000-Q unit. These cables have to be connected to AQ 2000-T unit using screw connectors inside the unit. In order to access the terminals and connect the cables the front plate of AQ 2000-T unit has to be removed.

The connection cables are mounted at the factory. The maximum length of the cables is 1.5 meters. This has to be considered when selecting the location of the quenching system.



1. 24Vdc auxiliary power supply
2. RJ 45 connection to the arc quenching device AQ 2000-Q
3. Red LED. Flashing = self-supervision alarm. Steady red = Quenching device is closed.
4. Green LED. Steady ON = Trigger unit ready for operation.
5. Fiber connection to AQ 110 arc protection unit
6. 6 cables for triggering of the arc quenching device.

7 CONNECTIONS



7.1 OUTPUTS

7.1.1 OUTPUT RELAYS (CLOSED / OPEN)

The (Close / Open) relay output is acting a switch feature for AQ2000T trigger device. When relay status is changed to Closed, the Quencher is energized. When the relay stays in Open status, the Quencher is de-energized.

7.1.2 OUTPUT RELAYS (CHARGE / READY)

The (Charge / Ready) relay output is used to charge the capacitor bank inside the AQ2000T trigger device. When relay is closed, the Quencher is in charging status. When the loading is completed after approx. 20 minutes, the relay is turned to open mode, meanwhile, the Ready indication LED is turned ON.

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 2000T 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 FIBER INTER-CONNECTION FOR QUENCHER TRIP CONTROL

The Fiber inter-connection is used for sending trip control signal from Arcteq AQ110P Quencher terminal to AQ2000T Trip control terminal. In normal status, AQ110P sends a 10us test pulse per 100ms to AQ2000T for guaranteeing the connection between two devices. The missing or interrupted test pulse signal will result AQ2000T to self-supervision mode. In activation mode, the test pulse sending will stop and be turned to latch on light.

7.3 AUXILIARY VOLTAGE

The auxiliary power supply voltage is a 24 V dc.

8 WIRING DIAGRAM

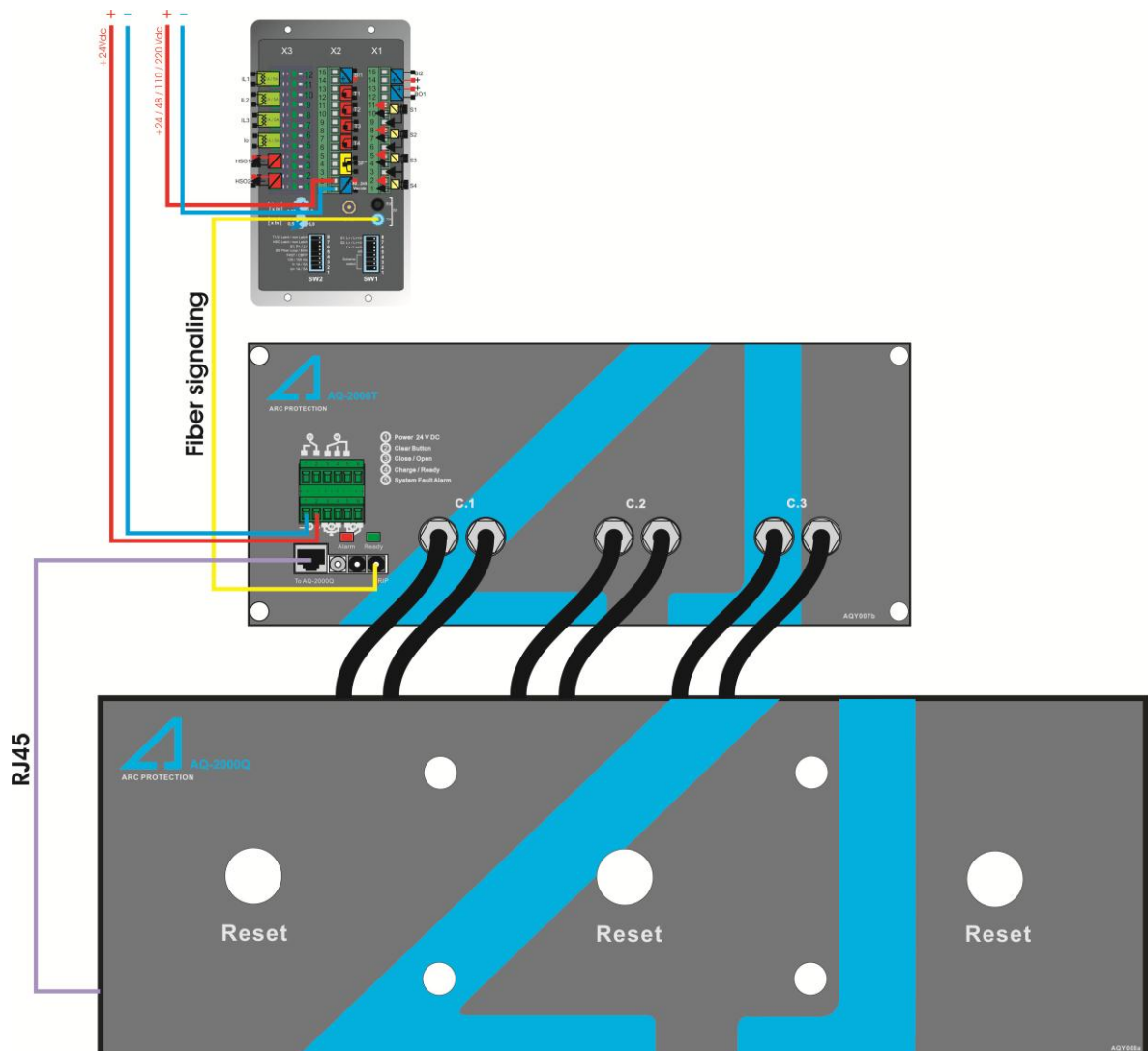


Figure 8-1: Wiring diagram of AQ 110P, AQ 2000T and AQ2000Q unit.

9 DIMENSIONS

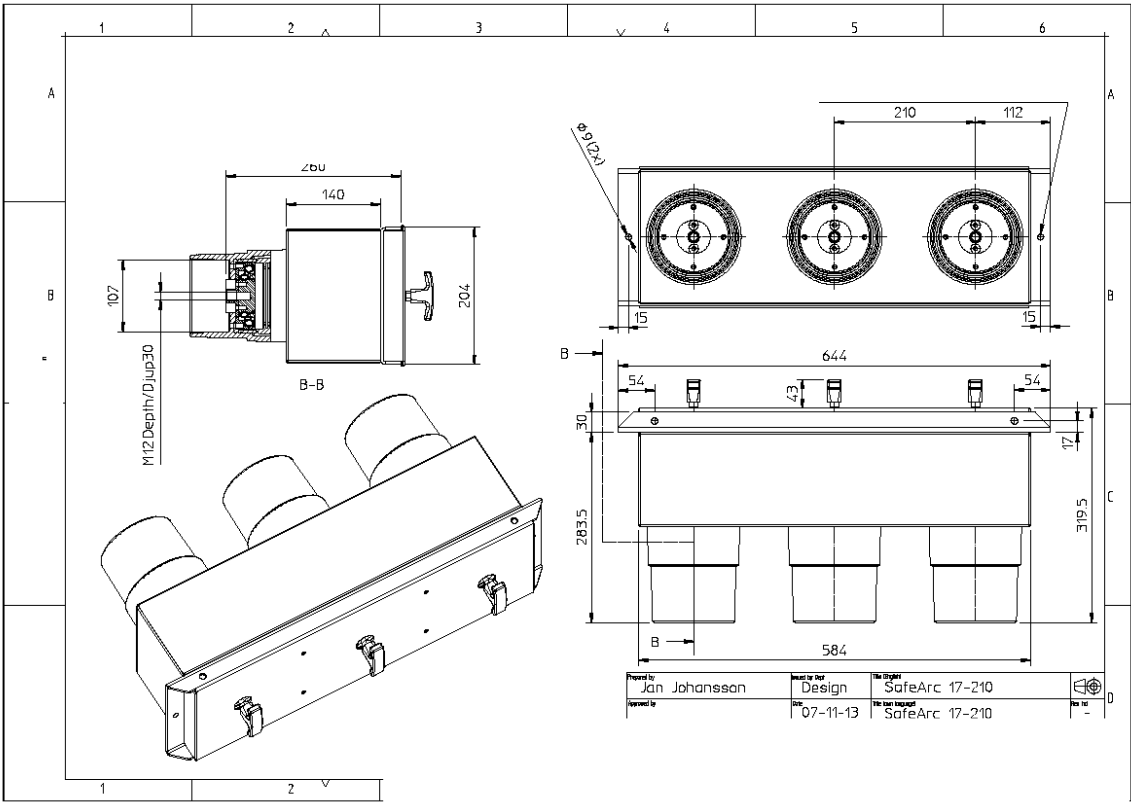


Figure 9-1: AQ 2000-Q dimensions

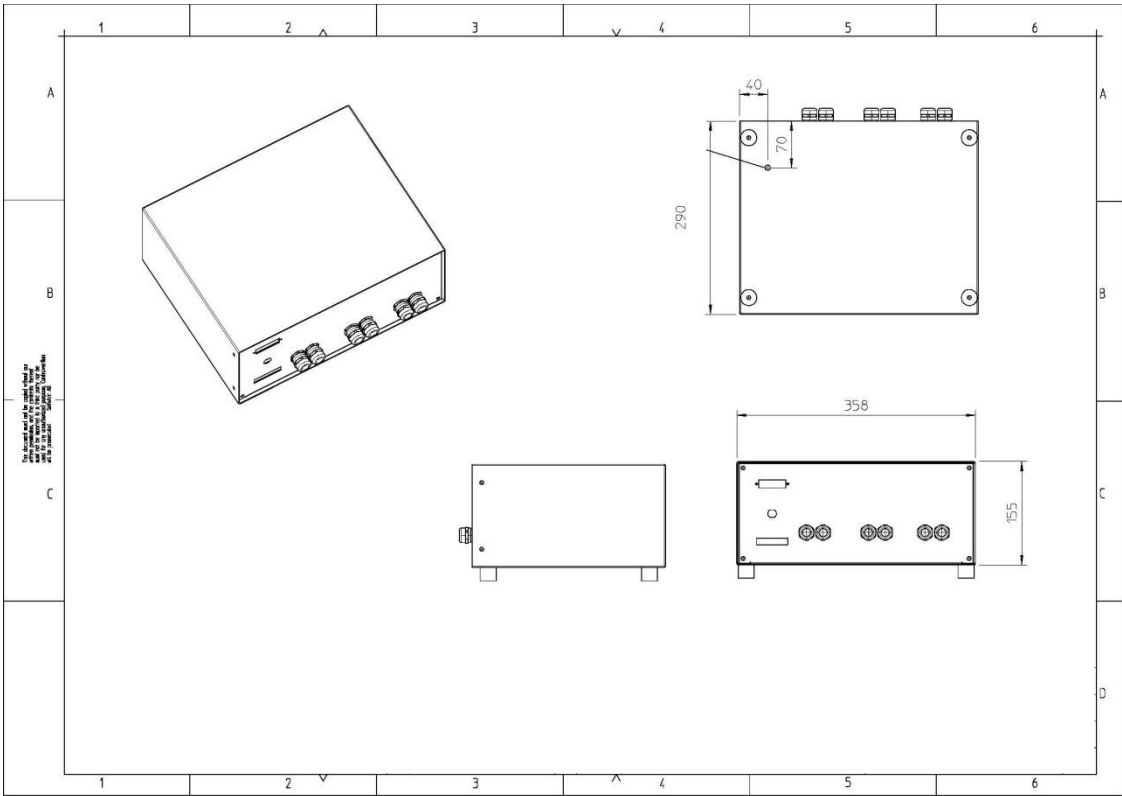


Figure 9-2: AQ 2000-T dimensions

10 TESTING

It is recommended that both the arc protection system (AQ 100) and arc quenching system is tested prior to substation energizing. For information on AQ 100 system testing refer to AQ 100 instruction manual.

While testing the AQ 2000 it is important to note the mechanical life of the AQ 2000-Q Quencher device which is limited to maximum 12 operations. As an example, this implies that typically one shot is tested at the switchgear factory and one at site prior to energizing. Routine testing can be performed every two years considering equipment life time of 20 years.

- 1) Check that the dipswitch setting positions are in accordance to your application.
Note. Must switch SW2/5 (S5: Fiber Loop / Quencher) to OFF.
- 2) Prepare wire S3 of AQ110P with an AQ01 point sensor.
- 3) Insert AQ 06/07/08 optic fiber sensor into Tx terminal of S5, check that the light pulse.
- 4) Insert another fiber end to the AQ2000T “TRIP” terminal.
- 5) After completing the charging AQ2000Q, activate the camera flash within 20cm (12 inches) of the AQ01 sensor unit with overcurrent condition simultaneously.
- 6) Verify that the corresponding indications LED status on AQ110P are changed to ON.
- 7) 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.
- 8) Verify that the ALARMN LED indication status is changed to ON.
- 9) If it doesn't activate, repeat from step 5). Charging the capacitor bank requires 20 minutes.

10.1 TEST PLAN EXAMPLE

Date:	
Substation	
Switchgear:	
AQ 110P serial number:	
AQ 2000T serial number:	
AQ 2000Q serial number:	

Preconditions		Light + current			Remark
Sensor channel 3 setting					
Sensor channel 4 setting					
Object activated		LED indication	T1,T2,T3,T4 active	AQ2000T ALARM LED indication	
Sensor channel 3	Sensor 1				
	Sensor 2				
	Sensor 3				
Sensor channel 4	Sensor 1				
	Sensor 2				
	Sensor 3				

Tested by :	
Approved by:	

11 TECHNICAL DATA

11.1 AQ 2000-Q RATINGS AND SPECIFICATIONS

Total quenching time*	6ms
Short circuit current	40kA for 1second
Maximum number of operations without load	12
Maximum number of operations with 40kA load	1 (above 100ms duration) 2 (below 100 ms duration)
BIL	38/95kV
Maximum rated voltage	17.5kV

*from arc detection to closing

11.2 AQ 2000-T AUXILIARY POWER SUPPLY

Auxiliary power supply Us	24Vdc
Power consumption	< 15W
Max. wire cross-section	2.5mm ² (13-14 AWG)

11.3 AQ 2000-T RATINGS AND SPECIFICATIONS

Output voltage	400Vdc
Output current	4000A peak

11.4 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, class III) - 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 8 kV Contact discharge 6 kV 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

11.5 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

11.6 CASING AND PACKAGE

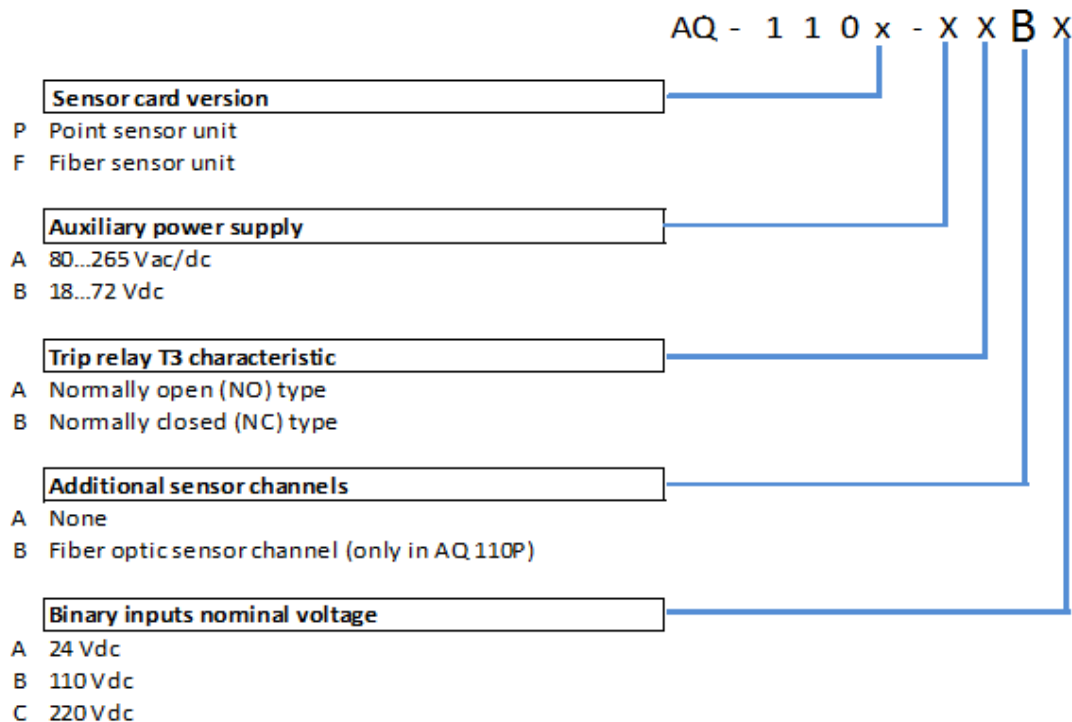
Protection degree (front)	IP 20 (AQ 2000T & AQ 2000Q)
Dimensions (W x H x D mm)	644 x 204 x 320 mm (AQ2000Q) 358 x 175x 290 mm (AQ 2000T)
Weight	27 kg (AQ2000Q) 10.5 kg (AQ2000T)

11.7 ENVIRONMENTAL CONDITIONS

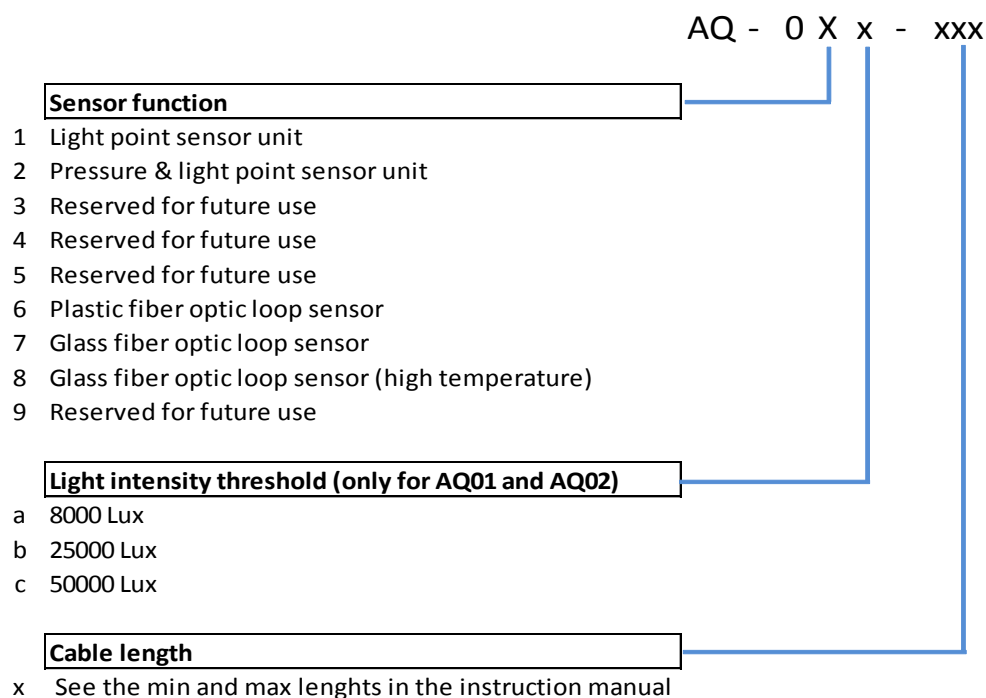
Specified ambient service temp. range	-35...+70°C
Transport and storage temp. range	-40...+70°C

12 ORDERING CODES

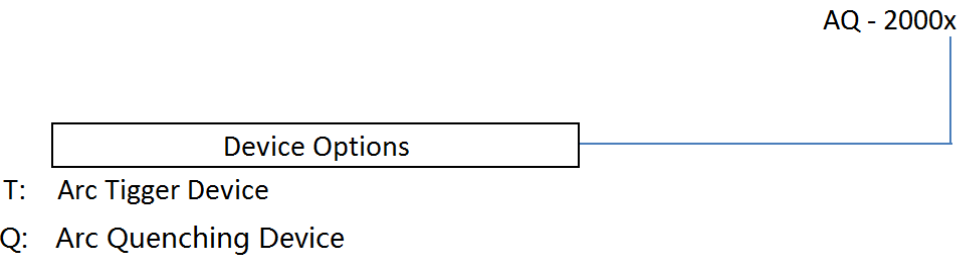
12.1 AQ 110 POINT SENSOR UNIT



12.2 AQ 0X ARC SENSORS



12.3 AQ 2000 ARC QUENCHING DEVICES



13 REFERENCE INFORMATION

Manufacturer information:

Arcteq Relays Ltd. Finland

Visiting and postal address:

Wolffintie 36 F 11

65200 Vaasa, Finland

Contacts:

Phone: +358 10 3221 370

Fax: +358 10 3221 389

url: www.arcteq.fi

email sales: sales@arcteq.fi

email technical support: support@arcteq.fi