Hardware description for the AQ 300 series

Document ID: AN00006

Version: 1.0

Author: TI

Document class: Public

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15 September 2023

2

Contents

Document ID: AN00006
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Hardware description for the AQ 300 series   3

15 September 2023

Arcteq Relays Ltd.
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1 SYSTEM DESIGN

Arcteq's AQ 300 series protection device family is a scalable hardware platform to adapt to different applications. Data exchange is performed via a 16-bit high-speed digital non-multiplexed parallel bus with the help of a backplane module.

Each module is identified by its location and there is no difference between module slots in terms of functionality. The only restriction is the position of the CPU module because it is limited to the "CPU" position. The built-in self-supervisory function minimizes the risk of device malfunctions.

Figure 1-1. CPU block diagram.
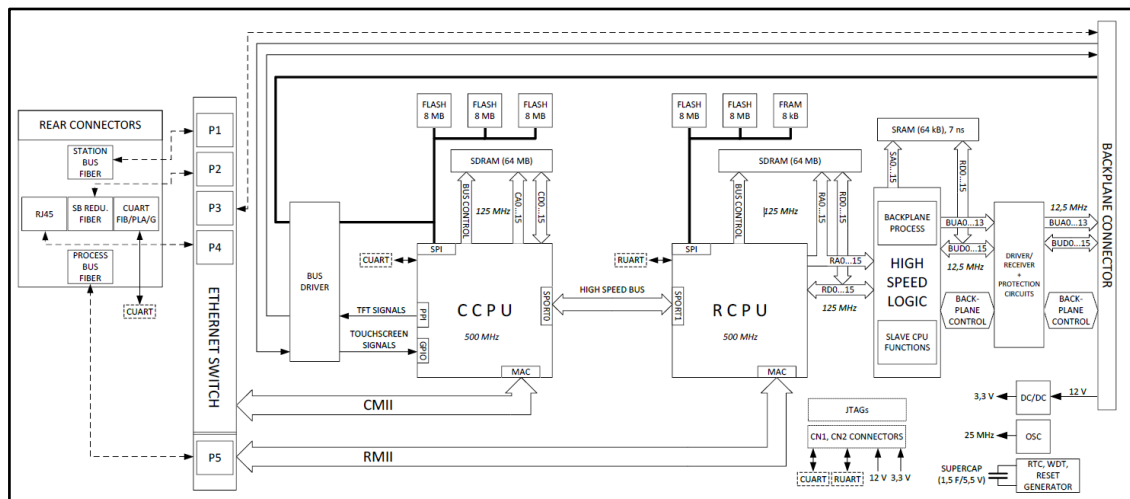
The backplane board itself is a passive board but it provides a 16-bit bus, power supply distribution, a two-wire interface (TWI) supporting module inventory management and module identification. It is designed to meet the requirements for high-speed digital buses and to comply with electromagnetic emission standards.

2 CPU AND COM MODULE

2.1 CPU+ MODULE

The CPU module contains all the protection, control, and communication functions of the AQ 300 series device. Dual 500 MHz high-performance Analog Devices Blackfin processors separate relay functions (RDSP) from communication and HMI functions (CDSP). Reliable communication between processors is performed via high-speed synchronous serial internal bus (SPORT).

Each processor has its own operative memory such as SDRAM and flash memories for configuration, parameter, and firmware storage. Both firmware are stored in a dedicated flash memory independent from the disturbance recorder and event storage.

The CDSP's operating system (uClinux) utilizes a robust JFFS flash file system, which enables fail-safe operation and the storage of disturbance record files, configuration, and parameters.

The RDSP core runs at 500 MHz and its external bus speed is 125 MHz. The backplane data speed is limited to approx. 20 MHz, which is more than enough for module data throughput. An additional logic element (CPLD and SRAM) is used as a bridge between the RDSP and the backplane. The CPLD collects analogue samples from CT/VT modules, and controls signaling outputs and inputs.

2.1.1 Fast start-up

After power-up the RDSP processor starts up with the previously saved configuration and parameters. Generally, the power-up procedure for the RDSP and relay functions takes only a few seconds. That is to say, it is ready to trip within this time. CDSP's start-up procedure is longer because its operating system needs time to build its file system, initializing user applications such as HMI functions and the IEC 61850 software stack.

2.1.2   HMI and communication tasks

- Embedded web interface
    - o   Firmware upgrade possibility
    - o   Modification of user parameters
    - o   Events list and disturbance records
    - o   Password management
    - o   Online data measurement
    - o   Commands
    - o   Administrative tasks
- Front panel TFT display handling: the interactive menu set is available through the TFT and the touchscreen interface
- User keys: capacitive touch keys on the front panel
- The built-in five-port Ethernet switch allows AQ 300 devices to connect to IP/Ethernet-based networks:
    - o   Station bus (100Base-FX Ethernet) SBW
    - o   Redundant station bus (100Base-FX Ethernet) SBR
    - o   Process bus (100Base-FX Ethernet)
    - o   EOB2 (Ethernet Over Board) **or** RJ-45 Ethernet user interface on the front panel
    - o   Optional 10/100Base-T port via an RJ-45 connector
- PRP/HSR seamless redundancy for Ethernet networking (100Base-FX Ethernet)
- Other communication:
    - o   RS422/RS485 interfaces (galvanic interface to support legacy or other serial protocols, ASIF)
    - o   Plastic or glass fiber interfaces to support legacy protocols, ASIF
    - o   Proprietary process bus communication controller on COM+ modules
    - o   Telecommunication interfaces: G.703, IEEE C37.94

Table 2-1. *Available CPU modules for AQ 300 devices.*

CPU module	Primary station bus	Secondary (redundant) station bus	Legacy port/ protocol	Process bus (fiber)	Service port on front panel EOB/RJ-45
CPU+/0007	—	—	—	—	+
CPU+/0091	—	—	—	SM/FC SH	+
* CPU+/0201	—	RJ-45	—	—	+
* CPU+/0281	—	RJ-45	—	SM/FC LH	+
* CPU+/0291	—	RJ-45	—	SM/FC SH	+
CPU+/0301	—	—	POF	—	+
CPU+/0401	—	—	GS	—	+
* CPU+/0501	—	—	RS485/422	—	+
CPU+/1001	MM/ST	—	—	—	+
CPU+/1091	MM/ST	—	—	SM/FC SH	+
* CPU+/1101	MM/ST	MM/ST	—	—	+
CPU+/1181	MM/ST	—	—	SM/FC LH	+
CPU+/1191	MM/ST	—	—	SM/FC SH	+
* CPU+/1201	MM/ST	RJ-45	—	—	+
CPU+/1281	MM/ST	RJ-45	—	SM/FC LH	+
* CPU+/1291	MM/ST	RJ-45	—	SM/FC SH	+
CPU+/1301	MM/ST	—	POF	—	+
CPU+/1331	MM/ST	—	Double POF	—	+
CPU+/1381	MM/ST	—	—	SM/FC LH	+
CPU+/1391	MM/ST	—	—	SM/FC SH	+
CPU+/1401	MM/ST	—	GS	—	+
CPU+/1481	MM/ST	—	GS	SM/FC LH	+
CPU+/1491	MM/ST	—	GS	SM/FC SH	+
CPU+/1501	MM/ST	—	Galv. RS485/422	—	+

CPU module	Primary station bus	Secondary (redundant) station bus	Legacy port/ protocol	Process bus (fiber)	Service port on front panel EOB/RJ-45
CPU+/1581	MM/ST	—	Galv. RS485/422	SM/FC LH	+
CPU+/6001	MM/LC	—	—	—	+
CPU+/6093	MM/LC	—	—	SM/FC SH	+
* CPU+/6601	MM/LC	MM/LC	—	—	+
CPU+/9201	SM/FC SH	RJ-45	—	—	+
CPU+/9291	SM/FC SH	RJ-45	—	SM/FC SH	+
CPU+/9501	SM/FC SH	—	Galv. RS485/422	—	+
CPU+/9901	SM/FC SH	SM/FC SH	—	—	+
* CPU+/A001	MM/LC PRP/HSR	—	—	—	+
CPU+/A081	MM/LC PRP/HSR	—	—	SM/FC LH	+
CPU+/A091	MM/LC PRP/HSR	—	—	SM/FC SH	+

These modules can be equipped with a different handle (narrower, made of aluminum instead of plastic as is standard), if other modules of the device are equipped with top-screw terminals. In these cases, the letter "T" appears on the module's label (e.g. CPU+/1201T). All other properties remain the same.

- MM/ST = multimode with an ST connector
- MM/LC = multimode with an LC connector
- SM/FC = single mode with an FC/PC connector
- LH = long haul with an FC/PC connector
- SH = short haul with an FC/PC connector
- POF = plastic optical fiber with 1 mm fiber connector
- GS = glass fiber with an ST connector

All CPU cards can be ordered with PRP/HSR communication as a software option!

Interface types:

- 100Base-FX Ethernet:
    o MM/ST 1300 nm, 50/62.5/125 μm connector, up to 2 km fiber

- o SM/FC 1550 nm, 9/125 µm connector, up to 50 km (SH) or 120 km (LH)
- o MM/LC 1300 nm, 50/62.5/125 µm connector, up to 2 km fiber
- 10/100 Base-TX Ethernet: RJ-45-8/8
- Service port on HMI:
  - o 10/100 Base-T Ethernet: RJ-45-8/8
  - o EOB2 interface: attachable to the front panel by a proprietary magnetic connector; the connector box ends in an RJ-45 8/8 plug. It Is a 10Base-T full duplex interface, and it enables 10/100Base Tx communication with service computers.
- ASIF: Asynchronous Serial Interface:
  - o Plastic optical fiber (ASIF-POF)
  - o Glass with an ST connector (ASIF-GS)
  - o Galvanic RS485/422 (ASIF-G)

2.2 COM MODULES

The COM+ modules are responsible for special communication tasks, such as:

- binary signal transmission,
- line differential protection communication via Ethernet or telecommunication networks,
- busbar differential protection communication, and
- multi-port Ethernet switch using the Modbus/TCP protocol for Remote I/O (RIO) servers.

2.2.1 COM modules for binary signal transmission

Table 2-2. *Available COM modules for binary signal transmission.*

COM module	Interface type	No. of interfaces	Unit width	Application
* COM+/1801	MM/ST 1300 nm, 50/62.5/125 µm and SM/FC 1550 nm, 9/125 µm connectors, 100Base-Fx Ethernet	2	4 HP	Line differential protection, binary signal transmission up to 2 km and up to 120 km

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Hardware description for the AQ 300 series

10

15 September 2023

COM module	Interface type	No. of interfaces	Unit width	Application
* COM+/1901	MM/ST 1300 nm, 50/62.5/125 µm and SM/FC 1550 nm, 9/125 µm connectors, 100Base-Fx Ethernet	2	4 HP	Line differential protection, binary signal transmission up to 2 km and up to 50 km
COM+/8882	SM/FC 1550 nm, 9/125 µm connector, 100Base-Fx Ethernet	3	4 HP	3-direction binary signal transmission up to 120 km
COM+/9902	SM/FC 1550 nm, 9/125 µm connector, 100Base-Fx Ethernet	2	4 HP	2-direction binary signal transmission up to 50 km
COM+/9992	SM/FC 1550 nm, 9/125 µm connector, 100Base-Fx Ethernet	3	4 HP	3-direction binary signal transmission up to 50 km

* These modules can be equipped with a different handle (narrower, made of aluminum instead of plastic as is standard), if other modules of the device are equipped with top-screw terminals. In these cases, the letter "T" appears on the module's label (e.g. CPU+/1801T). All other properties remain the same.

2.2.2   COM modules for line differential communication

Table 2-3. Available COM modules for line differential communication.

COM module	Interface type	No. of interfaces	Unit width	Application
COM+/0091	G703.1 (64 kbit/s)	1	4 HP	Line differential protection via a telecom network
COM+/8801	SM/FC 1550 nm, 9/125 µm connector, 100Base-FX Ethernet	2	4 HP	3 terminals, or redundant line differential protection, up to 120 km
COM+/9901	SM/FC 1550 nm, 9/125 µm connector, 100Base-FX Ethernet	2	4 HP	3 terminals, or redundant line differential protection, up to 50 km

2.3   COMMUNICATION INTERFACE CHARACTERISTICS

2.3.1   Ethernet multi-mode transmitter and receiver

2.3.1.1   MM/ST connector

Up to approximately 2 km.

Table 2-4. Technical data for the transmitter in the MM/ST connector.

TRANSMITTER					
Parameter	Symbol	Min.	Typical	Max.	Unit
Optical output power 62.5/125 µm, NA = 0.275 fiber	P_0	* BOL: –19 ** EOL: –20	—	–14	dBm avg.
Optical output power 50/125 µm, NA = 0.2 fiber	P_0	* BOL: –22.5 ** EOL: –23.5	—	–14	dBm avg.
Optical extinction ratio	ER	—	—	10 -10	% dB
Center wavelength	λ_C	1270	1308	1380	nm

* BOL = Beginning of life.

** EOL = End of life.

Please note that according to field experiences, the 62.5/125 µm cabling is recommended for applications where the center wavelength is 1300/1310 nm!

Receiver sensitivity is measured with $2^{33}-1$ PRBS pattern within BER = 2.5×10^{-10}.

Table 2-5. Technical data for the receiver in the MM/ST connector.

RECEIVER					
Parameter	Symbol	Min.	Typical	Max.	Unit
Signal detected - Asserted	P_A	P_0 + 1.5 dB	—	–33	dBm avg.
Signal detected - Deasserted	P_0	–45	—	—	dBm avg.
Signal detected - Hysteresis	$P_A - P_0$	1.5	—	—	dB
Signal detected – Assert time (OFF to ON)	AS_Max	0	2	100	µs

RECEIVER					
Parameter	Symbol	Min.	Typical	Max.	Unit
Signal detected – Deassert time (ON to OFF)	ANS_Max	0	8	350	µs

2.3.1.2 MM/LC connector

Up to approximately 2 km.

Table 2-6. Technical data for the transmitter in the MM/LC connector.

TRANSMITTER					
Parameter	Symbol	Min.	Typical	Max.	Unit
Optical output power 62.5/125 µm, NA = 0.275 fiber	P_0	* BOL: –19 ** EOL: –20	–15.7	–14	dBm avg.
Optical output power 50/125 µm, NA = 0.2 fiber	P_0	* BOL: –22.5 ** EOL: –23.5	—	–14	dBm avg.
Optical extinction ratio	ER	—	0.002 –47	0.2 –27	% dB
Center wavelength	λ_C	1270	1308	1380	nm

* BOL = Beginning of life.

** EOL = End of life.

Please note that according to field experiences, the 62.5/125 µm cabling is recommended for applications where the center wavelength is 1300/1310 nm!

Receiver sensitivity is measured with $2^{33}-1$ PRBS pattern within BER = 2.5 × 10^{-10}.

Table 2-7. Technical data for the receiver in the MM/LC connector.

RECEIVER					
Parameter	Symbol	Min.	Typical	Max.	Unit
Signal detected - Asserted	P_A	P_0 + 1.5 dB	—	–33	dBm avg.
Signal detected - Deasserted	P_D	–45	—	—	dBm avg.
Signal detected - Hysteresis	$P_A - P_D$	1.5	—	—	dB

RECEIVER					
Parameter	Symbol	Min.	Typical	Max.	Unit
Signal detected – Assert time (OFF to ON)	AS_Max	0	2	100	µs
Signal detected – Deassert time (ON to OFF)	ANS_Max	0	5	100	µs

2.3.2 Ethernet single mode transmitter and receiver

2.3.2.1 Long haul single mode transceiver

Up to approximately 120 km, with a maximum of 32 dB link attentuation.

Table 2-8. Technical data for the transmitter in the Ethernet SM/FC long haul mode transceiver.

TRANSMITTER					
Parameter	Symbol	Min.	Typical	Max.	Unit
Optical output power	P_0	–6	—	–14	dBm avg.
Optical extinction ratio	ER	8.3	—	—	dB
Center wavelength	λ_C	1490	1550	1380	nm

Receiver sensitivity is measured with $2^{33}-1$ PRBS pattern within BER = 2.5×10^{-10}.

Table 2-9. Technical data for the receiver in the Ethernet SM/FC long haul mode transceiver.

RECEIVER					
Parameter	Symbol	Min.	Typical	Max.	Unit
Optical input sensitivity	P_{IN}	—	–38	–35	dBm avg.
Saturation	P_{SAT}	–3	0	—	dBm
Center wavelength	λ_C	1100	—	1600	nm
Signal detected – Asserted	P_A	—	—	–35	dB avg.
Signal detected – Deasserted	P_D	–45	—	—	dB avg.
Hysteresis	P_{HYS}	—	3	—	dB

2.3.2.2 Short haul single mode transceiver

Up to approximately 50 km, with a maximum of 27 dB link attentuation.

Table 2-10. Technical data for the transmitter in the Ethernet SM/FC short haul mode transceiver.

TRANSMITTER					
Parameter	Symbol	Min.	Typical	Max.	Unit
Optical output power	P_0	–12	—	–6	dBm avg.
Optical extinction ratio	ER	8.3	—	—	dB
Center wavelength	λ_C	1490	1550	1610	nm

Receiver sensitivity is measured with $2^{33}-1$ PRBS pattern within BER = 2.5×10^{-10}.

Table 2-11. Technical data for the receiver in the Ethernet SM/FC short haul mode transceiver.

RECEIVER					
Parameter	Symbol	Min.	Typical	Max.	Unit
Optical input sensitivity	P_{IN}	—	–38	–35	dBm avg.
Saturation	P_{SAT}	–3	0	—	dBm
Center wavelength	λ_C	1100	—	1600	nm
Signal detected – Asserted	P_A	—	—	–35	dB avg.
Signal detected – Deasserted	P_D	–45	—	—	dB avg.
Hysteresis	P_{HYS}	—	3	—	dB

2.3.3 ASIF-O transmitter and receiver

2.3.3.1 ASIF-O POF

Table 2-12. Technical data for the transmitter in the ASIF-O POF.

TRANSMITTER						
Parameter	Symbol	Min.	Typical	Max.	Unit	Jumper settings
Optical output power	P_T	–15.3	—	–9	dBm	JP1 2-3
		–23.3	—	–17		JP1 1-2
Peak emission wavelength	λ_{PK}	—	660	—	nm	—
Effective diameter	D	—	1	—	Nm	—
Numerical aperture	NA	—	0.5	—	—	—

Table 2-13. Technical data for the receiver in the ASIF-O POF.

RECEIVER					
Parameter	Symbol	Min.	Typical	Max.	Unit
Input optical power, level logic 0	$P_{R(L)}$	–39	—	–13.7	dBm avg.
Input optical power, level logic 1	$P_{R(H)}$	—	—	–53	dBm
Effective diameter	D	—	1	—	nm
Numerical aperture	NA	—	0.5	—	—

These characteristics are valid for both POF interfaces in the CPU+/1331 module!

2.3.3.2 ASIF-O GLASS

Table 2-14. Technical data for the transmitter in the ASIF-O glass.

TRANSMITTER						
Parameter	Symbol	Min.	Typical	Max.	Unit	Jumper settings
* 50/125 µm fiber cable, NA = 0.2	P_O	−19.4	−16.4	−14.4	dBm peak	JP1 2-3
		−28.9	−25.9	−23.9		JP1 1-2
* 62.5/125 µm fiber cable, NA = 0.275	P_O	−15.6	−12.6	−10.6	dBm peak	JP1 2-3
		−22.9	−19.9	−17.9		JP1 1-2

* Output measured out of one (1) meter of cable.

Table 2-15. Technical data for the receiver in the ASIF-O glass.

RECEIVER					
Parameter	Symbol	Min.	Typical	Max.	Unit
Peak optical input power, logic level HIGH (λP= 820 nm)	P_{RH}	−25.4	—	—	dBm peak
Peak optical input power, logic level LOW	P_{RL}	—	—	—	dBm peak

2.3.4   ASIF-G transmitter and receiver

The RS422/RS485 interfaces of our CPU+/1501, CPU+/1581, CPU+/9501 modules provide galvanic interface to support legacy or other serial protocols.

Table 2-16. Technical data for the transmitter in the ASIF-G.

TRANSMITTER					
Parameter	Symbol	Min.	Typical	Max.	Unit
Differential output voltage (loaded, R_L = 100 Ω, RS422)	V_{OD2}	2	—	3.6	V

TRANSMITTER					
Parameter	Symbol	Min.	Typical	Max.	Unit
Differential output voltage (loaded, R_L = 54 Ω, RS485)	V_{OD2}	1.5	—	3.6	V

Table 2-17. *Technical data for the receiver in the ASIF-G.*

RECEIVER					
Parameter	Symbol	Min.	Typical	Max.	Unit
Differential input threshold voltage	V_{TH}	–200	–125	–30	mV
Input voltage hysteresis	V_{HYS}	—	15	—	mV
Line input resistance	R_{IN}	96	—	—	kΩ

2.3.5   G.703 64 kbit/s co-directional interface (E0)

All AQ 300 devices also support line differential communication via telecom networks using the G.703.1 64 kbit/s co-directional interface type through the COM+/0091 module. This type of communication is performed via a 2×2 wire isolated galvanic type interface. The protection device is connected to a multiplexer or a gateway which is responsible for protocol/speed conversion.

- Connector type: Weidmüller
    - receptacle: S2L 3.50/12/90 F
    - plug: B2L 3.50/12/180 F
- Impedance: 120 Ω
- Cable length: 50 m
- Interface type: G.703.1 64 kbit/s (E0) co-directional, selectable earthing, with optional external clock input

Table 2-18. *Technical data for the transmitter in the ASIF-G.*

Parameter	Value
Pair for each direction	± 1.5 dB difference between alarm ON and alarm OFF
Test load impedance	10 dB maximum cable loss range
Nominal peak voltage of a "mark" (pulse)	One (1) symmetric pair
Peak voltage of a "space" (no pulse)	120 Ω resistive
Nominal pulse width	1.0 V
Amplitude ratio of positive and negative	0 V ± 0.10 V
Pulses at the center of the pulse interval	3.9 ms
Width ratio of positive and negative pulses	0.95 to 1.05
At the nominal half amplitude	0.95 to 1.05
Maximum peak-to-peak jitter at the output port	Refer to clause 2/G.823

Table 2-19. *Technical data for the receiver in the ASIF-G.*

Parameter	Value
Loss of signal alarm level	± 1.5 dB difference between alarm ON and alarm OFF
Dynamic range	10 dB maximum cable loss range

2.3.6   PRP/HSR redundant Ethernet communication interface

The PRP/HSR redundant Ethernet communication interface (the CPU+/A001 CPU module) supports the two new IEC 62439-3 protocols which provide seamless redundancy for Ethernet networking in substations with zero-time recovery in case of a single failure without frame loss:

- PRP – Parallel Redundancy Protocol (IEC 62439-3, Clause 4)
- HSR – High-availability Seamless Redundancy (IEC 62439-3, Clause 5)

This interface uses two MM/LC connectors for double connection to networks as these protocols are based on the duplication of the sent frames.

2.3.6.1 Parallel Redundancy Protocol (PRP)

This redundancy protocol implements redundancy in the nodes as they are connected to two independent networks (LAN_A and LAN_B) sending a copy of each frame to both directions. The destination node receives and processes the first copy and discards the other copy of the sent frame.

Figure 2-1. *Example of a PRP redundant network.*
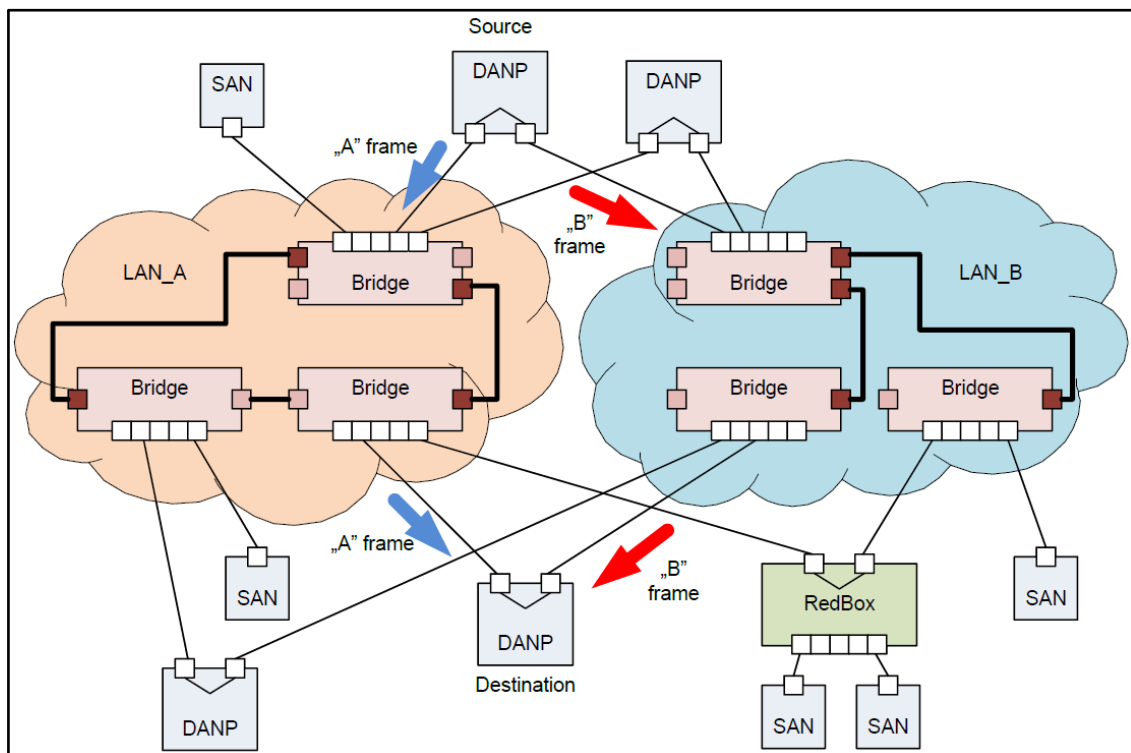
- Single attached node (SAN): Network device that connects to a network with only one port.
- Double attached node implementing PRP (DANP): Network device which connects to a network with two ports implementing PRP redundancy.

2.3.6.2 High-availability Seamless Redundancy (HSR)

An HSR network provides redundancy with the same safety as PRP does with a lower cost. The principle of this protocol is also based on the duplication of the sent frames but in this solution the nodes are connected to a closed ring. A source node sends two copies

of a frame to both directions, and the destination node accepts the first received copy and discards the other one. If a frame returns to its source the node does not let it through itself prevent the possibility of an overload of the ring.

Figure 2-2. Example of a HSR redundant network.
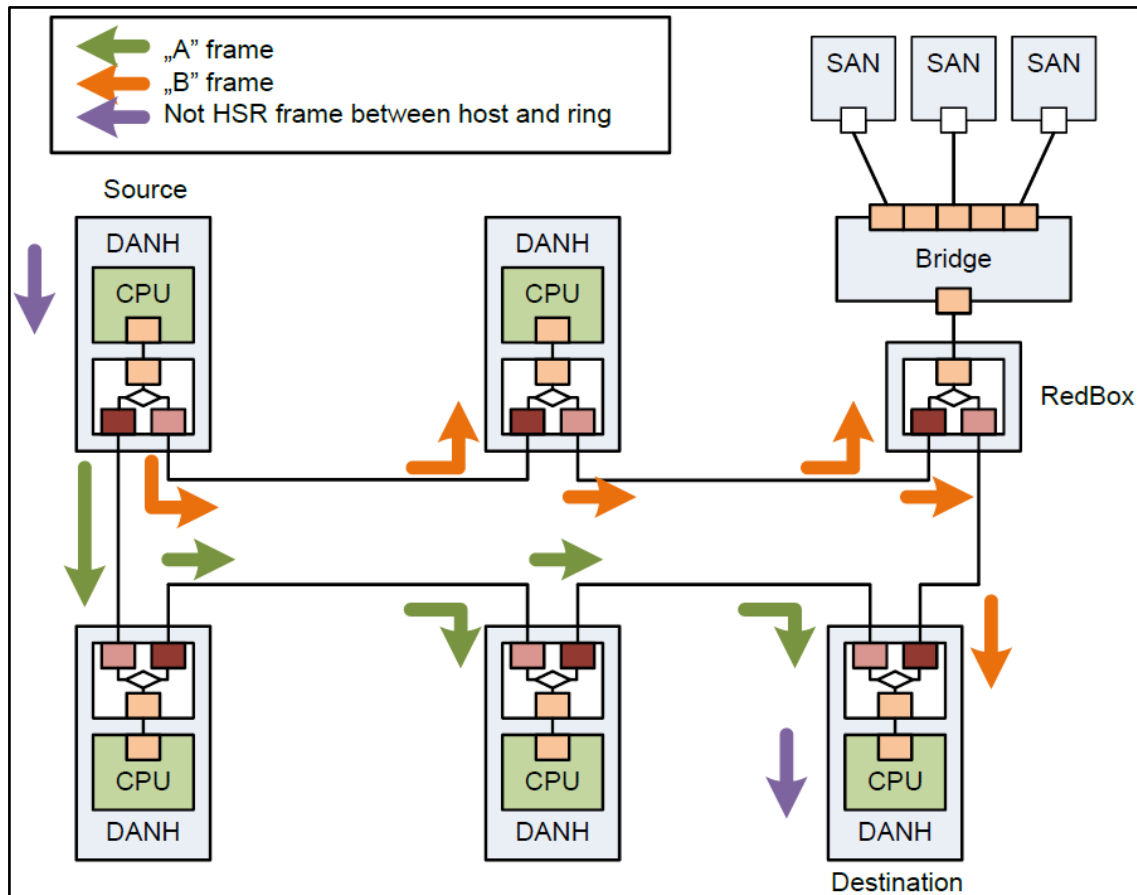
- Single attached node (SAN): Network device that connects to a network with only one port.
- Double attached node implementing HSR (DANH): Network device which connects to a network with two ports implementing HSR redundancy.

3   Device housings

There are three versions available for the device housing: 84 HP wide with 21 module slots, 42 HP wide with 10 module slots, and 24 HP with 6 module slots.

Depending on the installed modules of the configuration, the top and bottom panels of the 84 HP and 42 HP racks can be either solid (default) or perforated by 2 mm holes to prevent overheating. 24 HP housings do not have this feature: for AQ-F310 and AQ-L310 devices the system is less flexible, and their range of the optional modules are narrower.

Table 3-1. Available device housings for AQ 300 devices.

Rack configuration	* Free module slots	Bottom and top panels	Display options
84 HP, single rack (3U)	20	Solid Perforated	3.5 in TFT, 5.7 in TFT
42 HP, single rack (3U)	9	Solid Perforated	3.5 in TFT, 5.7 in TFT
24 HP, panel instrument case	5	Solid	B/W alphanumeric 3.5 in TFT

** The CPU module is mandatory and uses one (1) fixed position.*

Previously, a new rack type has been introduced to the 42HP devices. As of April 2021. this type is introduced to the 84HP devices as well. The depth of the box has been reduced from 242 mm to 223 mm. By default, this reduced-depth housing shall be used for newly manufactured devices. For more information about the previous and new size, see Chapter 19.5 ("Previous 42 HP and 84 HP device housings") of this document.

The following images showcase examples of the different types of available device housings with different kinds of front panel HMI. The available front panels are listed in Chapter 4 ("Human-machine interface (HMI) module") of this document.
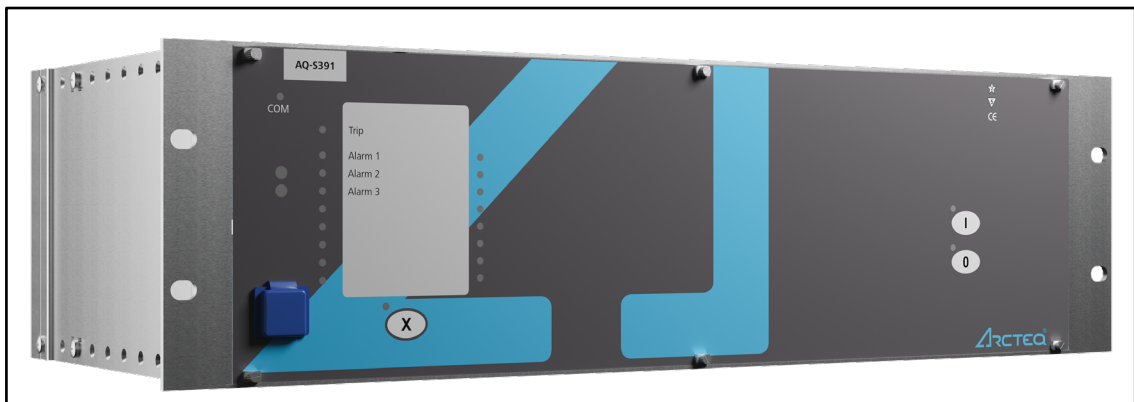
Figure 3-1. *84 HP single rack (3U) with a 5.7 in TFT display and perforated housing.*
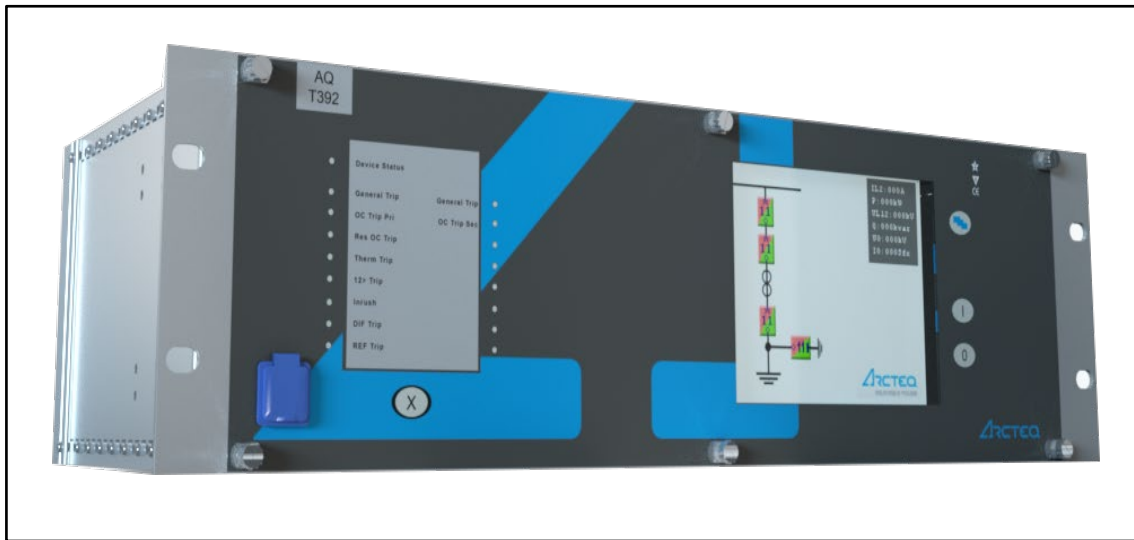
Figure 3-2. *84 HP single rack (3U) with solid housing (no display).*

Figure 3-3. *42 HP single rack (3U) with a 3.5 in TFT display and solid housing.*

Figure 3-4. *24 HP panel instrument case with a B/W display.*

Figure 3-5. *24 HP panel instrument case with a TFT display.*

4 HUMAN-MACHINE INTERFACE (HMI) MODULE

The HMI of an AQ 300 device consists of the following two main parts:

- Hardware: the HMI module, which is the front panel of the device, is described in this chapter.
- Software:
  o The menu system which is accessible through the HMI module.
  o The web interface which is accessible via station bus, EOB interface, or an RJ-45 Ethernet connector (described in detail in the device manuals).

4.1 LOCAL HMI MODULES

Table 4-1. *Available local HMI modules for AQ 300 devices.*

Module type	Display	Service port	Rack size	Rack depth
HMI+/3505 *HMI+/3405	3.5 in TFT	EOB	42 HP 84 HP	Reduced
HMI+/3506 *HMI+/3404	3.5 in TFT	RJ-45	84 HP 42 HP	Reduced
HMI+/5005	5.7 in TFT	EOB	42 HP	Reduced
HMI+/5006 *HMI+/5004	5.7 in TFT	RJ-45	42 HP	Reduced
HMI+/5704 *HMI+/5704	5.7 in TFT	RJ-45	84 HP	Reduced

* The new display hardware requires a CDSP firmware version 1560-H5 or higher!

The following modules were made for the previous (now obsolete) racks (see Chapter 19.5, "Previous 42 HP and 84 HP device housings"), which means they can be found in numerous devices. These became obsolete as well, and **they are not recommended for new designs!**

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Table 4-2. The local HMI modules in previous AQ 300 devices.

Module type	Display	Service port	Rack size	Rack depth
HMI+/3501	3.5 in TFT	EOB	42 HP	Normal
			84 HP	
HMI+/3502	3.5 in TFT	RJ-45	42 HP	Normal
			84 HP	
HMI+/5001	5.7 in TFT	EOB	42 HP	Normal
HMI+/5002	5.7 in TFT	RJ-45	42 HP	Normal
HMI+/5701	5.7 in TFT	EOB	84 HP	Normal
HMI+/5702	5.7 in TFT	RJ-45	84 HP	Normal

4.2   HMI in AQ-F310 and AQ-F310

The AQ-F310 and AQ-L310 devices have a different HMI from other AQ 300 series devices.

Table 4-3. The S24 HMI module for AQ-F310 and AQ-L310.

Module type	Display	Service port	Rack size	Rack depth
HMI+/2404 *HMI+/2304	3.5 in TFT	RJ-45	24 HP	Normal
HMI+/2406 *HMI+/2306	3.5 in TFT	RJ-45	24 HP	DIN rail
HMI+/2401	3.5 in TFT	EOB	24 HP	Normal
HMI+/2504	B/W LCD	RJ-45	24 HP	Normal
*HMI+/2706 HMI+/2506	B/W LCD	RJ-45	24 HP	DIN rail

* The new display hardware requires a CDSP firmware version 1560-H5 or higher!

Please note that the HMI module HMI+/2401 (in orange in the table above) is obsolete, and it is not recommended for new designs!

4.3   PARTS OF THE HMI MODULES

Table 4-4. *All parts in HMI modules.*

Function	Description
User LEDs	Sixteen (16) three-color, Ø3 mm circular LEDs
COM LED	Yellow, Ø 3 mm circular LED indicating EOB/RJ-45 (on the front panel) communication link and activity
Capacitive touch key LEDs	Four (4) yellow, Ø 3 mm circular LEDs indicating touch key actions
Device status LED	One (1) three-color, Ø3 mm circular LED: • green = normal device operation • yellow = the device is in Warning state • red = the device is in Error state
Device keys ("I", "O", "X", "Page")	Capacitive touch keys Tactile push buttons
Buzzer	Audible touch key pressure feedback
Changeable LED description panel	Label to describe user LED functionality
Display	320×420 px TFT color display with a resistive touchscreen interface (3.5 in by default, or 5.7 in optionally) 128×64 px LCD black and white display **(only AQ-F310 and AQ-L310!)**
Optical interface for factory usage	For debugging and software development purposes **Please note that this is available only for 42 HP and 84 HP devices!**
EOB connector	Ethernet Over Board: a communication interface creates an isolated, non-galvanic Ethernet connection with the help of a magnetically attached EOB device. The EOB device has an RJ-45 type connector supporting the Ethernet connection to the user computer. • EOB1: Supports 10Base-T Ethernet connections. A passive device with one (1) RJ-45 type connector. Obsolete. • EOB2: Supports 10/100Base-Tx Ethernet connections. An

Function	Description
	active device that has a USB port in addition to the one (1) RJ-45 type connector for powering up.
Ethernet service port	IP56 rated Ethernet 10/100Base-T interface with an RJ-45 type connector. **Please note that the IP56 rating is only valid when the cap of the service port is closed!**

Figure 4-1. HMI signals and controls.
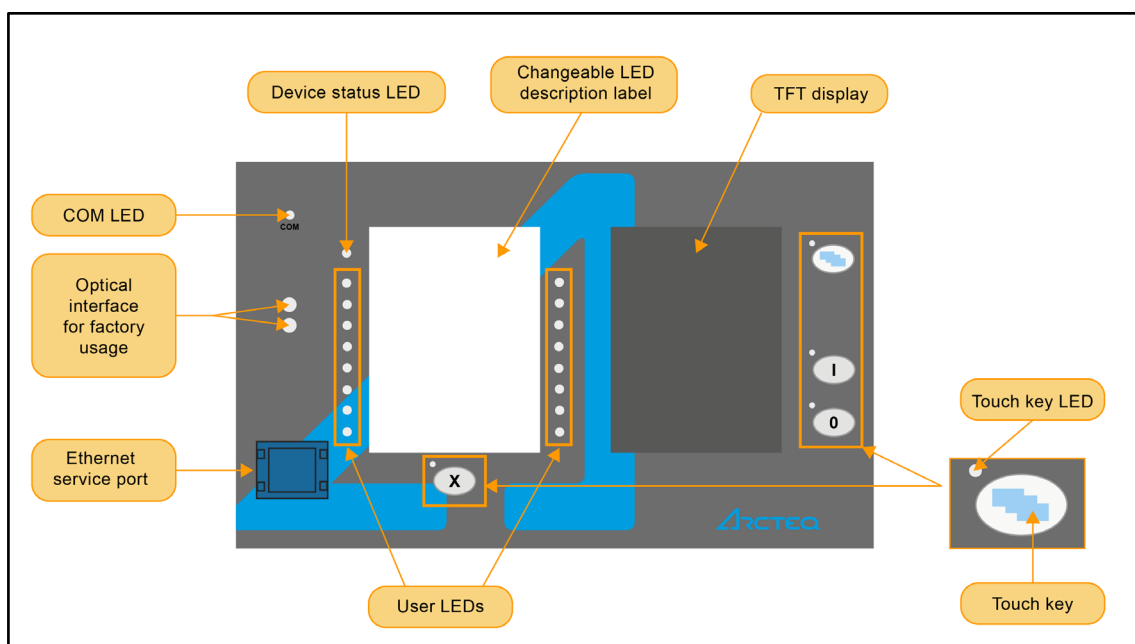
LCD displays include the dot-defect handling policy. The definitions of dot-defect are as below:

- The defect area of the dot must be bigger than half of a dot.
- For bright dot-defect (sparkle mode), showing black pattern, the dot's brightness must be over 30 % brighter than others at black raster.
- For dark dot-defect (black mode), showing white pattern, the dot's brightness must be under 70 % darker than others at R.G.B. raster.

Table 4-5. LCD dot-detect.

Dot-defect type		Maximum number acceptable	
		3.5 in	5.7 in
Sparkle mode	1 dot	4	4
	2 dots	2 (sets)	1
	In total	4	5
Black mode	1 dot	4	5
	2 dots	2 (sets)	2
	In total	4	5
Sparkle mode and black mode	2 dots	2 (sets)	—
In total		6	10

5 CURRENT INPUT MODULE

This is an input module with intermediate current transformers to input the phase currents and the zero-sequence current. The rated current for the phase current and for the zero-sequence current can be selectable by parameter.

The main features are the rated frequency of both 50 Hz and 60 Hz, as well as electronic iron core flux compensation.

The default and optionally available connector types are indicated for each current input module in the table below. For additional information about the various connector types, please refer to Chapter 17.2 ("Connectors").

Table 5-1. *Available current input modules for AQ 300 devices.*

Module type	CT+/5151		CT+/5153				
Number of channels	1—4		1—3		4		
Selectable rated current (I_N) [A]	1	5	1	5	5	1	0.2
Max. measured current (± 10 %)	$50 \times I_N$		$50 \times I_N$				$10 \times I_N$
Power consumption at rated current [VA]	0.01	0.25	0.06	1.3	0.6	0.004	0.0004

Thermal withstand:
    Continuously
    10 s
    1 s
    10 ms
	20 A
	175 A
	500 A
	1200 A
			20 A
			175 A
			500 A
			1200 A
					7 A
					50 A
					150 A
					330 A		

Connector type	STVS (default) R (optional)		STVS (default) R, * T (optional)				
Recommended application	General protection applications		General protection applications, extremely sensitive transient earth fault protections				

* The connector type T is functionally the same as the connector type STVS, its handle just becomes narrower and will be made out of aluminum instead of plastic.

6   VOLTAGE INPUT MODULE

If the device performs voltage and/or frequency related functions and measurements (voltage protections, directional protections, frequency protections, etc.), this module is needed.

The default and optionally available connector types are indicated for each voltage input module in the table below. For additional information about the various connector types, please refer to Chapter 17.2 ("Connectors").

Table 6-1. *Available voltage input modules for AQ 300 devices.*

Module type	VT+/2211	* VT+/2215	
Number of channels	4	4	
Selectable voltage range Type 100 Type 200	(100/√3) V, 100 V (200/√3) V, 200 V	(100/√3) V, 100 V (200/√3) V, 200 V	
Continuous voltage withstand	200 V	200 V	
Short time overload (1 s)	275 V (10 s)	275 V	
Voltage measuring range (± 10 %)	0.05—1.3 × U_N	0.05—1.3 × U_N	
Power consumption of voltage input	0.61 VA at 200 V 0.2 VA at 100 V	**Ch. 1—3:** 0.61 VA at 200 V 0.2 VA at 100 V	**Ch. 4:** 50 mVA at 100 V
Connector type	BLA (default) F, T, R (optional)	BLA (default) — (optional)	
Recommended application	General protection applications	Special protection applications with voltage transformers that require low power consumption on the 4th channel.	

* *Special module.*

7 BINARY INPUT MODULE

The inputs are galvanic isolated, and the module converts high-voltage signals to the voltage level and format of the internal circuits. The inputs of this module can also be programmed to serve as a PPM input for time synchronization.

The default and optionally available connector types are indicated for each binary input module in the table below. For additional information about the various connector types, please refer to Chapter 17.2 ("Connectors").

The thermal withstand voltage is defined as continuous when 60 % of the input channels are energized. Clamp voltages, on the other hand, are guaranteed values. The actual values may differ from the ones provided in the tables below: falling and rising around $0.66 \times U_N$ and $0.77 \times U_N$, respectively.

Please note that O16 modules (the third table) are not recommended for new designs! If you need over 12 digital inputs, please consult your Arcteq sales representative!

Table 7-1. *Available binary input modules with 8 digital inputs for AQ 300 devices.*

Module type	08+/2401	08+/4801	08+/1101	08+/2201
Number of channels	8	8	8	8
Time synchronization	Configured by AQtivate 300	Configured by AQtivate 300	Configured by AQtivate 300	Configured by AQtivate 300
Rated voltage	24 V	48 V	110 V	220 V
Thermal withstand voltage	72 V	100 V	250 V	320 V
Clamp voltage	Falling: $0.64 \times U_N$ Rising: $0.8 \times U_N$	Falling: $0.64 \times U_N$ Rising: $0.8 \times U_N$	Falling: $0.64 \times U_N$ Rising: $0.8 \times U_N$	Falling: $0.64 \times U_N$ Rising: $0.8 \times U_N$
Common groups	Independent	Independent	Independent	Independent
Connector type	BLA (default) T (optional)	BLA (default) T (optional)	BLA (default) T (optional)	BLA (default) T (optional)

Table 7-2. Available binary input modules with 12 digital inputs for AQ 300 devices.

Module type	012+/2401	012+/4801	012+/1101	012+/2201
Number of channels	12	12	12	12
Time synchronization	Configured by AQtivate 300	Configured by AQtivate 300	Configured by AQtivate 300	Configured by AQtivate 300
Rated voltage	24 V	48 V	110 V	220 V
Thermal withstand voltage	72 V	100 V	250 V	320 V
Clamp voltage	Falling: $0.64 \times U_N$ Rising: $0.8 \times U_N$	Falling: $0.64 \times U_N$ Rising: $0.8 \times U_N$	Falling: $0.64 \times U_N$ Rising: $0.8 \times U_N$	Falling: $0.64 \times U_N$ Rising: $0.8 \times U_N$
Common groups	4×3 common	4×3 common	4×3 common	4×3 common
Connector type	BLA (default) T (optional)	BLA (default) F, T (optional)	BLA (default) F, T (optional)	BLA (default) T (optional)

Table 7-3. Previously available binary input modules with 16 digital inputs for AQ 300 devices.

Module type	016+/2401	016+/4801	016+/1101	016+/2201
Number of channels	16	16	16	16
Time synchronization	—	—	—	—
Rated voltage	24 V	48 V	110 V	220 V
Thermal withstand voltage	72 V	100 V	250 V	320 V
Clamp voltage	Falling: $0.64 \times U_N$ Rising: $0.8 \times U_N$	Falling: $0.64 \times U_N$ Rising: $0.8 \times U_N$	Falling: $0.64 \times U_N$ Rising: $0.8 \times U_N$	Falling: $0.64 \times U_N$ Rising: $0.8 \times U_N$
Common groups	2×8 common	2×8 common	2×8 common	2×8 common
Connector type	BL 3.5 (default) — (optional)	BL 3.5 (default) — (optional)	BL 3.5 (default) — (optional)	BL 3.5 (default) — (optional)

Document ID: AN00006
Version: 1.0
Author: TI
Document class: Public

Hardware description for the AQ 300 series

33

15 September 2023

Main features of the binary input modules:

- Digitally filtered per channel
- Current drain:
    - max. 1.6 mA per channel at 220 V DC
    - max. 1.8 mA per channel at 110 V DC
    - max. 2 mA per channel at 48 V DC
    - max. 3 mA per channel at 24 V DC
- In applications where the input voltage is 60 V, the modules with a rated voltage of 48 V can be used.
- The input voltage type can be either DC or AC voltage. If AC voltage is used, make sure that the type and the parameters of the binary inputs are configured properly in the AQtivate 300 configuration and setting software! The software's manual is available for download on our website (www.arcteq.com/downloads-and-software → *Software* → *Instruction manuals* → "AQtivate 300 software instruction manual").

Document ID: AN00006
Version: 1.0
Author: TI
Document class: Public

Hardware description for the AQ 300 series

34

15 September 2023

8 SIGNALING MODULE

The signaling module has 4, 8, 12, or 16 relay outputs with dry contacts. The default and optionally available connector types are indicated for each signaling module in the tables below. For additional information about the various connector types, please refer to Chapter 17.2 ("Connectors").

Table 8-1. Available signaling modules with 4 contacts for AQ 300 devices.

Module type	R4+/01
Number of contacts	4
Rated voltage	250 V AC/DC
Continuous carry	8 A
Contact versions	4 CO
Group isolation	4 independent
Connector type	BLA (default) F (optional)

Table 8-2. Available signaling modules with 8 contacts for AQ 300 devices.

Module type	R8+/00	R8+/80	R8+/C0
Number of contacts	8	8	8
Rated voltage	250 V AC/DC	250 V AC/DC	250 V AC/DC
Continuous carry	8 A	8 A	8 A
Contact versions	8 NO	7 NO 1 NC (ch. 8)	6 NO 2 NC (ch. 7 and 8)
Group isolation	8 independent	8 independent	8 independent
Connector type	BLA (default) F, T (optional)	BLA (default) T (optional)	BLA (default) T (optional)

Table 8-3. *Available signaling modules with 12 contacts for AQ 300 devices.*

Module type	R12+/0000	R12+/4000	R12+/4400
Number of contacts	12	12	12
Rated voltage	250 V AC/DC	250 V AC/DC	250 V AC/DC
Continuous carry	8 A	8 A	8 A
Contact versions	12 NO	11 NO 1 NC (ch. 12)	2×3 NO + 2 NO, 1 NC + 2 NO, 1 NC
Group isolation	4×3 common	4×3 common	2×3 + 2 common, 1 + 2 common, 1 independent
Connector type	BLA (default) F, T (optional)	BLA (default) F, T (optional)	BLA (default) — (optional)

Table 8-4. *Available signaling modules with 16 contacts for AQ 300 devices.*

Module type	R16+/0000	R16+/8000	R16+/8080
Number of contacts	16	16	16
Rated voltage	250 V AC/DC	250 V AC/DC	250 V AC/DC
Continuous carry	8 A	8 A	8 A
Contact versions	16 NO	15 NO 1 NC (ch. 16)	14 NO 2 NC (ch. 16 and 8)
Group isolation	2×8 common	2×8 common	2×8 common
Connector type	BLA (default) — (optional)	BLA (default) — (optional)	BLA (default) — (optional)

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The main features of the signaling modules (according to IEC 60255-1):

- Maximum switching voltage: 400 V AC
- Breaking capacity (L/R=40 ms):
  - at 220 V DC: 0.2 A
  - at 110 V DC: 0.3 A
- Maximum breaking capacity: 2000 VA
- Short time carrying capacity: 1 s, 35 A
- Limiting making current (maximum of 4 s): 15 A (df = 10 %)
- Dielectric strength between open contacts (1 min): 1000 V_{RMS}
- Mechanical endurance: 10 × 106 cycles
- Circuit closing capability: 10 ms (typical), 22 ms (maximal), 0.5 ms (only for modules with solid state relays)
- Bounce time: 6.5 ms (typical), 10 ms (maximal), 0.5 ms (only for modules with solid state relays)
- Minimal switching requirement: 5 V

9   TRIPPING MODULE

The tripping module is a proprietary and patented solution that facilitates direct control of a circuit breaker. The default and optionally available connector types are indicated for each tripping module in the table below. For additional information about the various connector types, please refer to Chapter 17.2 ("Connectors").

Table 9-1. *Available (and one obsolete) tripping modules for AQ 300 devices.*

Module type	TRIP+/4201	TRIP+/1101	TRIP+/2101	TRIP+/2201
Number of channels	4	4	4	4
Rated voltage	24 V DC, 48 V DC	110 V	110 V	220 V
Thermal withstand voltage	72 V DC	242 V DC	150 V DC	242 V DC
Continuous carry	8 A	8 A	8 A	8 A
Making capacity	0.5 s, 30 A	0.5 s, 30 A	0.5 s, 30 A	0.5 s, 30 A
Breaking capacity	L/R = 40 ms: 4 A DC	L/R = 40 ms: 4 A DC	L/R = 40 ms: 4 A DC	L/R = 40 ms: 4 A DC
Connector type	BLA (default) F, T (optional)	BLA (default) — (optional)	BLA (default) F, T (optional)	BLA (default) T (optional)

Please note that the TRIP+/1101 module (in orange in the table above) is obsolete and not recommended for new designs!

The main features of the tripping modules:

- High-speed operation: with pre-trip 0.5 ms, without pre-trip typically 10 ms, maximally 22 ms.
- Trip circuit supervision for each trip contact.
- With 2-wire wiring the tripping output can also be a <u>dry</u> contact type.

9.1 TRIPPING MODULE WIRING

Each tripping module includes the tripping circuit supervision function (TCS). The wiring of these modules can be 2-wire or 3-wire; the TCS function is active for both wiring methods.

The voltage of the NO (normally open) contact is maximized at 15 V by a Zener-diode. Please make sure that the combined voltage caused by the CB's resistance and the tripping module's injected current **does not** reach 10 V!

Our tripping modules are improved to switch DC circuits. However, using reversed polarity or AC voltage can cause damage to the internal circuits. Additionally, improper wiring might cause improper operation!

9.1.1 3-wire wiring methods for tripping modules

The figure below presents a regular 3-wire wiring method:

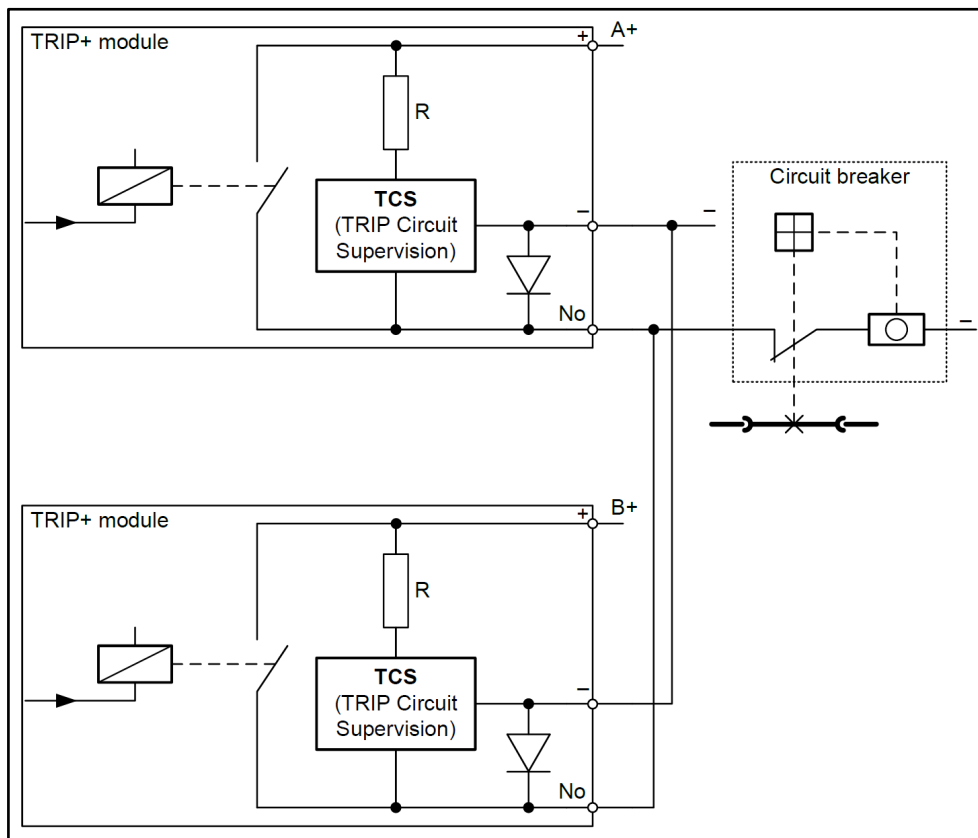**Figure 9-1.** *3-wire wiring method.*
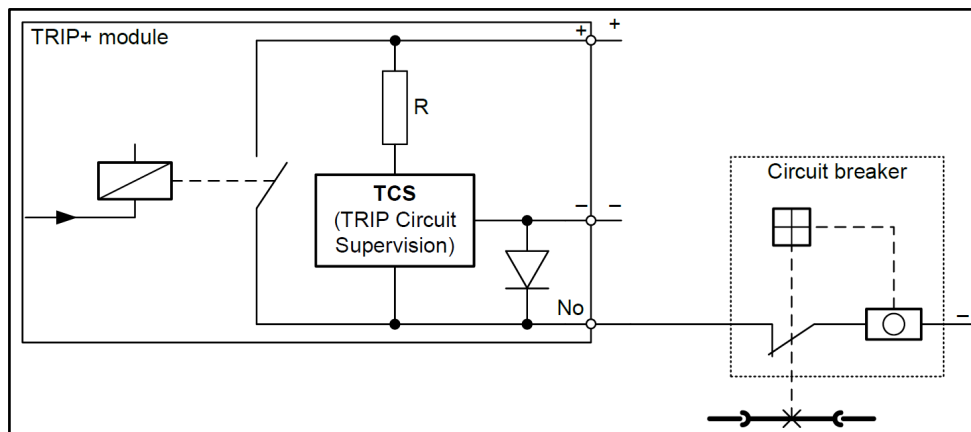
It is also possible to connect tripping modules in parallel with the 3-wire wiring method. In this case the negative terminals must be common!
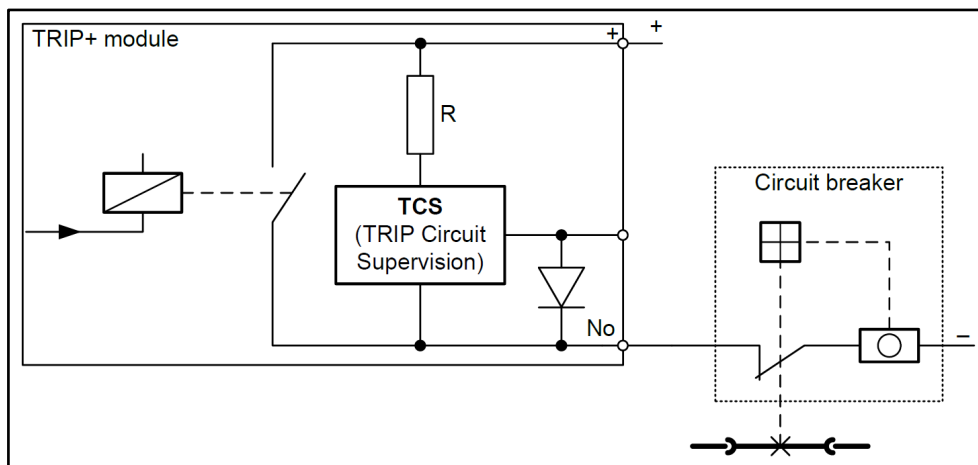
Figure 9-2. 3-wire wiring method where the tripping modules are connected in parallel.

9.1.2 2-wire wiring methods for tripping modules
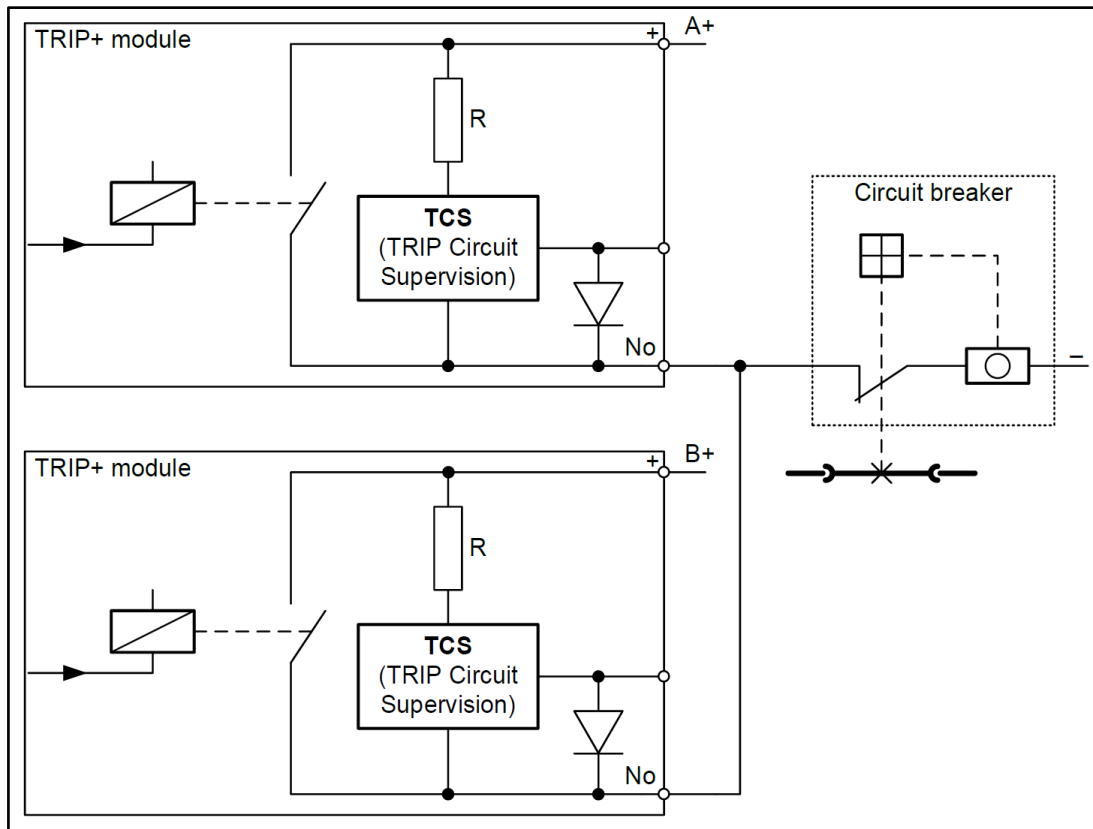
If necessary, tripping modules can be wiring using only the "+" and NO contacts.

Figure 9-3. 2-wire wiring method.

It is also possible to connect tripping modules in parallel with the 2-wire wiring method.

Figure 9-4. *2-wire wiring method where the tripping modules are connected in parallel.*
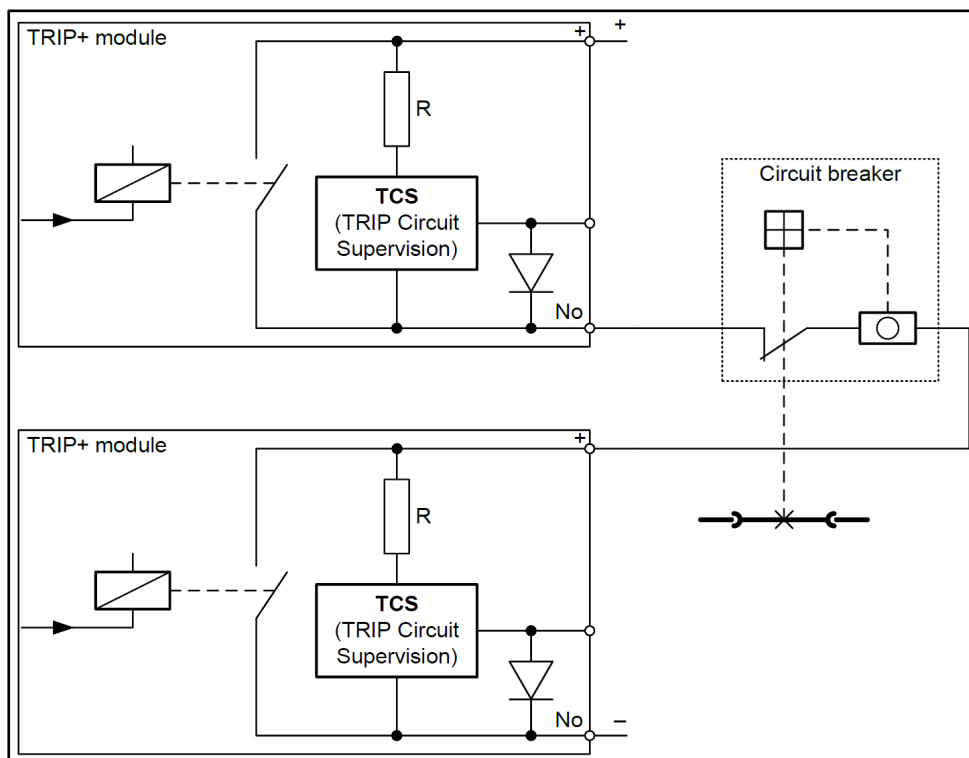

If the circuit breaker requires two-pole switching, the tripping modules can also be connected in series.

Figure 9-5. *2-wire wiring method where the tripping modules are connected in series.*

9.2 TRIP CIRCUIT SUPERVISION (TCS)

The trip circuit supervision function is used for checking the integrity of the circuit between the trip coil and the tripping output of the protection device. This is done by injecting a small DC current (around 1…5 mA) into the trip circuit. If the circuit is intact, the current flows, causing an active signal to the coupler input of the trip contact.

For more information about the TCS function, please refer to the Trip Circuit Supervision document available on our website (www.arcteq.com/downloads-and-software → *AQ 300 series → Application notes and white papers →* "Application note: AQ 300 series trip circuit supervision").s

Table 9-2. *The technical data of the TCS function.*

Module type	TRIP+/4201		TRIP+/2101		TRIP+/2201
Resistor (R) value (± 10 %)	10 kΩ		73 kΩ		130 kΩ
Injected current at NO contact	2.4 mA (at 24 V DC)	4.8 mA (at 48 V DC)	1.5 mA (at 110 V DC)		1.7 mA (at 220 V DC)
Maximum resistance of the trip coil — 3-wire wiring (max. 10 V)	11.8 kΩ (at 24 V DC)	3.7 kΩ (at 48 V DC)	9.7 kΩ (at 110 V DC)	8.4 kΩ (at 125 V DC)	8.1 kΩ (at 220 V DC)
Maximum resistance of the trip coil — 3-wire wiring with in parallel (max. 10 V)	5.9 kΩ (at 24 V DC)	1.8 kΩ (at 48 V DC)	4.8 kΩ (at 110 V DC)	4.2 kΩ (at 125 V DC)	4 kΩ (at 220 V DC)
Maximum resistance of the trip coil — 2-wire wiring (min. current of 1 mA)	14 kΩ (at 24 V DC)	38 kΩ (at 48 V DC)	37 kΩ (at 110 V DC)	52 kΩ (at 125 V DC)	90 kΩ (at 220 V DC)

10   RTD INPUT MODULE

The basic RTD input module (RTD+/1100) is used to measure temperature through the resistance variation in the temperature detectors. However, the two special modules (RTD+/0200 and RTD+/1200) are designed for Petersen coil controllers (DRL), and they measure the resistance of the potentiometer.

The default and optionally available connector types are indicated for each RTD input module in the table below. For additional information about the various connector types, please refer to Chapter 17.2 ("Connectors").

Table 10-1. Available RTD input modules for AQ 300 devices.

| Module type	* RTD+/0200	RTD+/1100	* RTD+/1200
Number of channels	1	4	1
Measurement method	3-wire configuration	2-, 3-, or 4-wire configuration	3-wire configuration
Accuracy	± 0.5 %, ± 1 digit	± 0.5 %, ± 1 digit	± 0.5 %, ± 1 digit
Sensor type	Service-Ohm	Pt100/Ni100 Ni120/Ni120US Pt250/Ni250 Pt1000/Ni1000 Cu10 Service-Ohm (60 Ω … 1.6 kΩ)	Service-Ohm
Measurement ranges	2 … 200 Ω	–50 … + 150 ºC	10 … 1000 Ω
Connector type	BLA (default) — (optional)	BLA (default) T (optional)	BLA (default) — (optional)
Recommended application	Arc suppression coil controller	General resistance-based temperature measurement	Arc suppression coil controller

* Special module.

The RTD input module can be wired in four different ways: using the 2-wire wiring method, using the 3-wire wiring method, using the 4-wire wiring method, or using the 4-wire wiring method with a potentiometer.

Please note that if the 2-wire wiring method is used, you have to make sure that the value of the resistors (R_A and R_D) are set correctly in the parameters menu in the device's web interface!

Figure 10-1. 2-wire wiring method for the RTD input module.
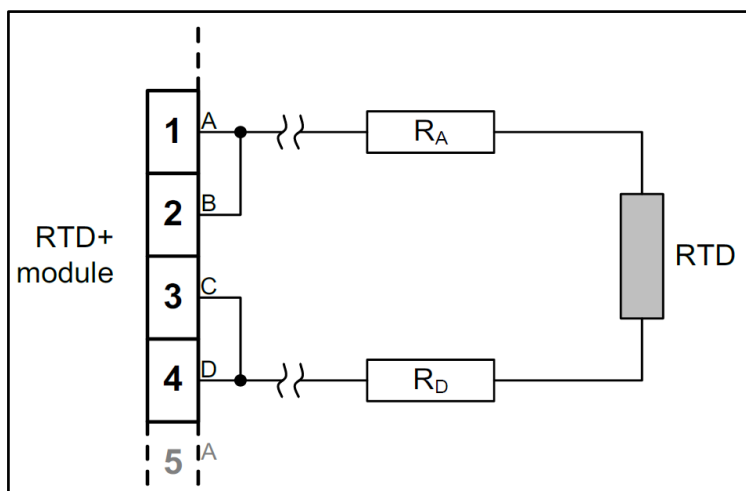
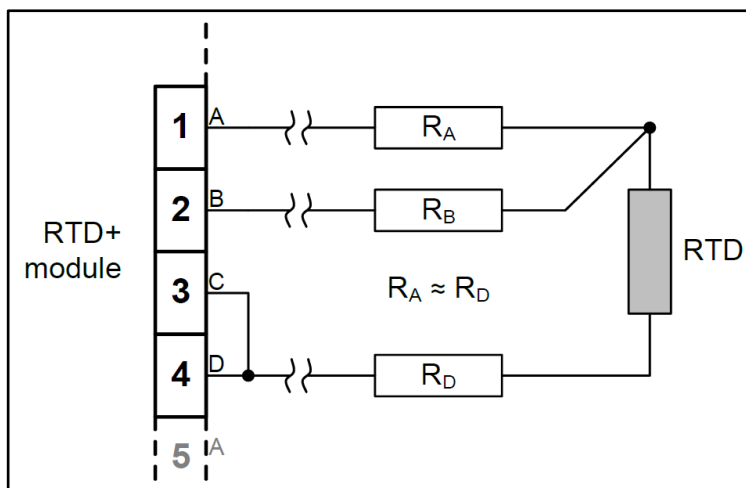*Figure 10-2.* 3-wire wiring method for the RTD input module.

Figure 10-3. *4-wire wiring method for the RTD input module.*
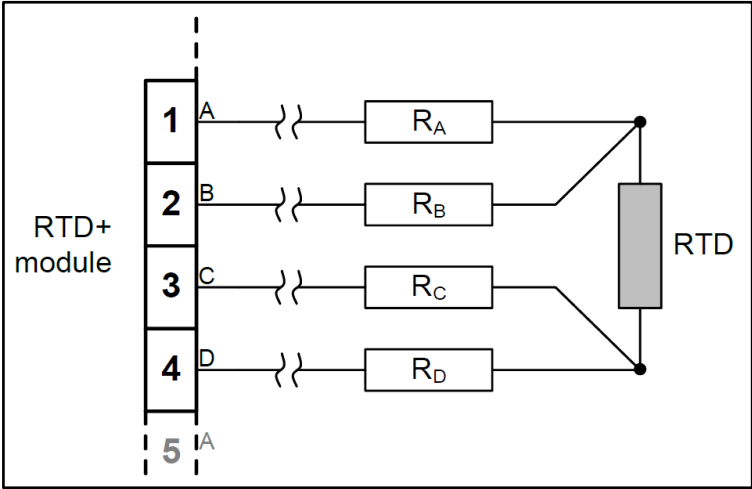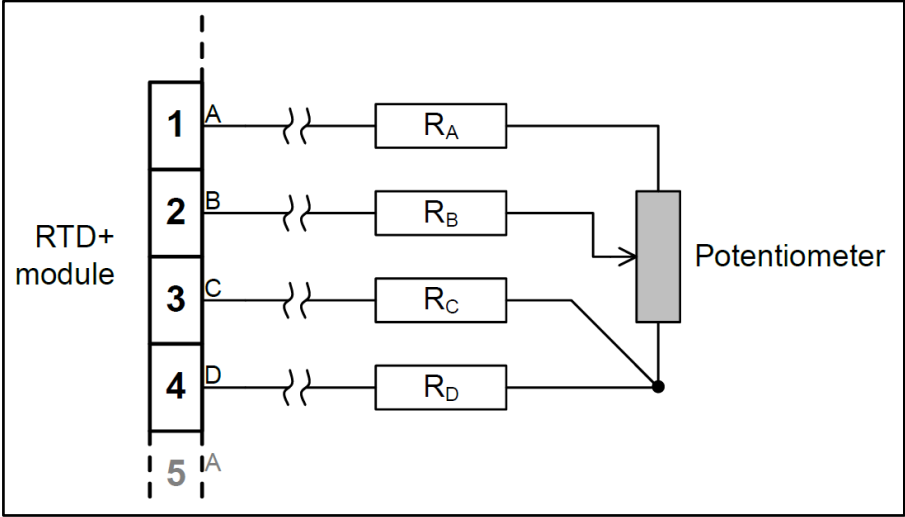

Figure 10-4. *4-wire wiring method with a potentiometer.*

11   ANALOG INPUT MODULE (AIC)

The analog input module accepts analog current outputs from transducers. The AIC module can measure both unipolar and bipolar current values in wide ranges.

The default and optionally available connector types are indicated for each analog input module in the table below. For additional information about the various connector types, please refer to Chapter 17.2 ("Connectors").

Table 11-1. *Available and obsolete analog input modules for AQ 300 devices.*

| Module type	AIC+/0200	AIC+/0201	AIC+/0202
Number of channels	4	4	4
Measurement method	2 wire inputs	2 wire inputs with optional 12 V excitation	2 wire inputs
Relative accuracy	± 0.5 %, ± 1 digit	± 0.5 %, ± 1 digit	± 0.5 %, ± 1 digit
Measurement ranges	± 20 mA (0…20 mA, 4…20 mA) $R_{LOAD} = 56\,\Omega$	± 20 mA (0…20 mA, 4…20 mA) $R_{LOAD} = 56\,\Omega$	± 20 mA (0…20 mA, 4…20 mA) $R_{LOAD} = 56\,\Omega$
Connector type	BLA (default) — (optional)	BLA (default) — (optional)	BLA (default) F, T (optional)

Please note that the module AIC+/0200 and AIC+/0201 (in orange in the table above) are obsolete and not recommended for new designs!

The following wiring method can be applied to the AIC module:

Figure 11-1. *Wiring method for the AIC module.*
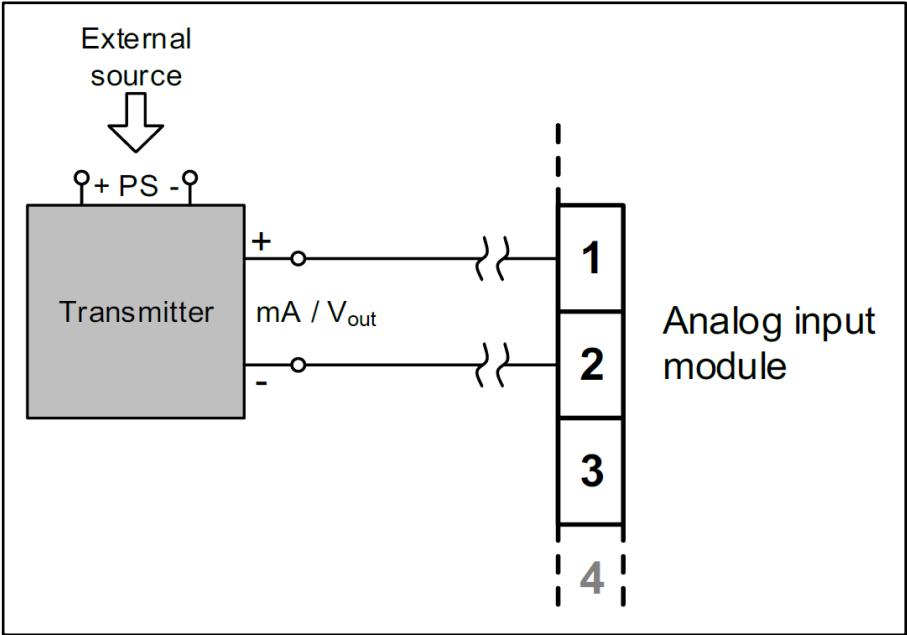
12 ANALOG OUTPUT MODULE (ATO)

The analog output module transmits current or voltage signals. The ATO module can be used in wide ranges in unipolar and bipolar mode.

The default and optionally available connector types are indicated for each analog output module in the table below. For additional information about the various connector types, please refer to Chapter 17.2 ("Connectors").

Table 12-1. *Available analog output modules for AQ 300 devices.*

Module type	ATO+/0002	ATO+/0004
Number of channels	2	4
Output mode	2 wire output	2 wire output
Maximum load ($R_{CABLE} + R_{RECEIVER}$)	500 Ω	500 Ω
Output ranges	± 20 mA 0…20 mA 4…20 mA	± 20 mA 0…20 mA 4…20 mA
Connector type	BLA (default) T (optional)	BLA (default) — (optional)

The ATO module should be connected according to the following wiring diagram:

Figure 12-1. *Wiring diagram for an ATO module.*
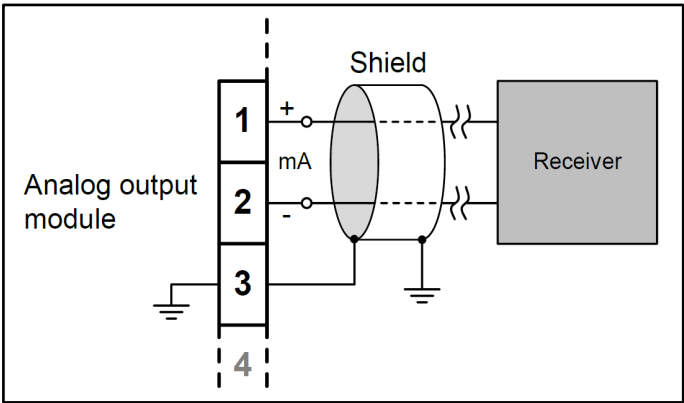
13 POWER SUPPLY MODULE

The power supply module converts primary AC and/or DC voltage to required system voltages. In most applications, one power supply module is sufficient to provide the required power to the system. Redundant power supply modules extend system availability in case of the outage of any power source.

> **NOTE!**   The power consumption of a device depends on the hardware configuration. We reserve the right to make the decision about which power supply module is used based on the power consumption! Most applications where the power consumption does not reach 20 W, a power supply module that is 4 HP wide shall be installed.

The default and optionally available connector types are indicated for each power supply module in the tables below. For additional information about the various connector types, please refer to Chapter 17.2 ("Connectors").

Table 13-1. *Available power supply modules (4 HP wide).*

Module type	PS+/4201	PS+/2101
Rated voltage	24 V DC 48 V DC 60 V DC	110 V DC 220 V DC
Operative range of the input voltage	19.2...72 V DC	88...264 V DC 80...250 V AC
Nominal power	20 W	20 W
Voltage dip withstand at 80 % × U_N → 0 % input voltage change (IEC 60255-26)	50 ms	100 ms
Internal fuse	3.15 A / 250 V	3.15 A / 250 V
Connector type	BLA (default) T (optional)	BLA (default) F, T (optional)

> **NOTE!** Devices with a power consumption of 20 W or higher shall be equipped with a power supply module of 8 HP wide!

Table 13-2. Available power supply modules (8 HP wide), modules 1…4 out of 16.

Module type		PS+/1301	* PS+/1303	PS+/2301	* PS+/2303
Rated voltage		110 V DC	110 V DC	220 V DC	220 V DC
Operative range of the input voltage		88…132 V DC 85…130 V AC	88…150 V DC 85…130 V AC	176…264 V DC 160…250 V AC	176…264 V DC 160…250 V AC
Maximum continuous power output		30 W	30 W	30 W	30 W
Voltage dip withstand at input voltage changes (IEC 60255-26)	at 80%U_N → 0 %	50 ms	50 ms	50 ms	50 ms
	at 100%U_N → 0 %	100 ms	100 ms	100 ms	100 ms
Internal fuse		2.5 A / 250 V	2.5 A / 250 V	2.5 A / 250 V	2.5 A / 250 V
Connector type		BLA (default) — (optional)	BLA (default) — (optional)	BLA (default) — (optional)	BLA (default) — (optional)

* These modules can be connected in parallel.

Table 13-3. Available power supply modules (8 HP wide), modules 5…8 out of 16.

Module type	* PS+/1030	* PS+/1060	PS+/1601	* PS+/1602
Rated voltage	110 V DC 220 V DC	110 V DC 220 V DC	110 V DC	110 V DC
Operative range of the input voltage	88…264 V DC 85…250 V AC	88…264 V DC	88…132 V DC 95…130 V AC	88…132 V DC 95…130 V AC
Maximum continuous power output	25 W	60 W	60 W	60 W

Module type		* PS+/1030	* PS+/1060	PS+/1601	* PS+/1602
Voltage dip withstand at input voltage changes (IEC 60255-26)	at 80%U_N → 0 %	20 ms	20 ms	50 ms	50 ms
	at 100%U_N → 0 %	100 ms	100 ms	100 ms	100 ms
Internal fuse		2.5 A / 250 V	3.15 A / 250 V	2.5 A / 250 V	2.5 A / 250 V
Connector type		BLA (default) F, T (optional)	BLA (default) F, T (optional)	BLA (default) — (optional)	BLA (default) F (optional)

These are special modules, and are only available in custom configurations.

The power supply module PS+/1602 supports auxiliary voltage measurement. The module is also calibrated to DC voltage measurement.

Table 13-4. *Available power supply modules (8 HP wide), modules 9…12 out of 16.*

Module type		PS+/2601	PS+/4301	* PS+/2161	** PS+/2164
Rated voltage		220 V DC	48 V DC	110 V DC 220 V DC	110 V DC 220 V DC
Operative range of the input voltage		176…264 V DC 160…250 V AC	38.4…57.6 V DC	88…264 V DC	88…264 V DC
Maximum continuous power output		60 W	25 W	60 W	60 W
Voltage dip withstand at input voltage changes (IEC 60255-26)	at 80%U_N → 0 %	50 ms	20 ms	40 ms	40 ms
	at 100%U_N → 0 %	100 ms	30 ms	—	—

Document ID: AN00006
Version: 1.0
Author: TI
Document class: Public

Hardware description for the AQ 300 series   52

15 September 2023

Module type	PS+/2601	PS+/4301	* PS+/2161	** PS+/2164
Internal fuse	2.5 A / 250 V	3.15 A / 250 V	3.15 A / 250 V	3.15 A / 250 V
Connector type	BLA (default) T (optional)	BLA (default) — (optional)	BLA (default) — (optional)	BLA (default) — (optional)

* This module can be connected in parallel.

** This module can be connected in parallel, and it supports auxiliary voltage measurement.

Please note that the module PS+/4301 (in orange in the table above) is obsolete and not recommended for new designs!

Table 13-5. *Available power supply modules (8 HP wide), modules 13…16 out of 16.*

Module type		* PS+/4261	** PS+/4264	* PS+/4401	*** PS3F+/1001
Rated voltage		24 V DC 48 V DC 60 V DC	24 V DC 48 V DC 60 V DC	48 V DC 60 V DC	3 × 100 V AC (line voltage)
Operative range of the input voltage		19.2…72 V DC	19.2…72 V DC	38.4…72 V DC	80…120 V DC
Maximum continuous power output		60 W	60 W	30 W	20 W
Voltage dip withstand at input voltage changes (IEC 60255-26)	at 80%U_N $\rightarrow$ 0 %	40 ms	40 ms	20 ms	50 ms
	at 100%U_N $\rightarrow$ 0 %	—	—	30 ms	100 ms
Internal fuse		8 A / 250 V	8 A / 250 V	3.15 A / 250 V	2.5 A / 250 V
Connector type		BLA (default) — (optional)	BLA (default) — (optional)	BLA (default) F, T (optional)	BLA (default) — (optional)

* This module can be connected in parallel.

** This module can be connected in parallel, and it supports auxiliary voltage measurement.

*** This is a special module.

The PS3F+/1001 power supply module is a special module, and it requires at least two (2) healthy phase voltages for its operation. The LEDs on the module's front indicate the presence of healthy phase voltages. In order to get the correct internal signals, please connect the common point of the three-phase voltage supplying the power to the module's 4th connector ("N").

The main features of the power supply modules:

- Fault relay contacts (NC and NO): Device fault contact and also assignable to user functions. All the relay contact points are accessible to users.
- Redundant applications: nominal power and reliability can be increased by using parallel power supplies.
- On-board self-supervisory circuits: temperature and voltage monitors.
- Short-circuit-protected outputs.
- Efficiency: > 70 %, power consumption = nominal power/efficiency.
- A passive heatsink.
- Early power failure indication signals into the CPU for the possibility of power outage, thus the CPU has enough time to save the necessary data to non-volatile memory.
- Inrush current (until 0.1 s): < 10 A for all types, except the PS+4401 module which has an inrush current of < 21 A.
- Common features for internal fuses:
  - 5 mm x 20 mm (0.20" x 0.79"),
  - TT characteristics (very inverse time-lag), and
  - Rated breaking capacity of 35 A at 250 V AC.
- Recommended external protection: miniature circuit breaker, 6 A (C char.).

14   MIXED FUNCTION MODULES

14.1   PSTP+ MODULE (POWER SUPPLY + TRIPPING)

> **NOTE!**   The PSTP+ modules can only be used when the power consumption is under 20 W **AND** the application does not need more than two (2) tripping contacts. Unless the application meets both criteria, it is not allowed to use these modules. Instead, the application needs separate modules for power supply and tripping.

The default and optionally available connector types are indicated for each mixed function module in the tables below. For additional information about the various connector types, please refer to Chapter 17.2 ("Connectors").

Please also note that thermal withstand voltage is defined as continuous when 60 % of the input channels are energized!

Table 14-1. *Available PSTP modules for AQ 300 devices.*

Module type	PSTP+/2101	* PSTP+/2102	** PSTP+/2131	PSTP+/4201	* PSTP+/4202
POWER SUPPLY CHARACTERISTICS					
Rated voltage	110 V 220 V	110 V 220 V	110 V 220 V	24 V 48 V 60 V	24 V 48 V 60 V
Operative range of the input voltage	88...264 V DC 80...250 V AC	88...264 V DC 80...250 V AC	88...264 V DC 80...250 V AC	19.2...72 V DC	19.2...72 V DC
Maximum continuous power output	20 W	20 W	20 W	20 W	20 W

Module type	PSTP+/2101	* PSTP+/2102	** PSTP+/2131	PSTP+/4201	* PSTP+/4202
Voltage dip duration at 0 % residual voltage (IEC 60255-26)	**Min. 100 ms** (in the specified input voltage range)	**Min. 100 ms** (in the specified input voltage range)	**Min. 100 ms** (in the specified input voltage range)	**50 ms** (at nominal input voltages) **Min. 40 ms** (in the specified input voltage range)	**50 ms** (at nominal input voltages) **Min. 40 ms** (in the specified input voltage range)
Internal fuse	3.15 A / 250 V	3.15 A / 250 V	3.15 A / 250 V	3.15 A / 250 V	3.15 A / 250 V
Connector type	BLA (default) F, T (optional)	BLA (default) F, T (optional)	BLA (default) T (optional)	BLA (default) T (optional)	BLA (default) T (optional)
TRIPPING CHARACTERISTICS					
Number of channels	2	2	2	2	2
Rated voltage	110 V DC and 220 V DC **or** dry contacts	110 V DC and 220 V DC **or** dry contacts	110 V DC and 220 V DC **or** dry contacts	24 V DC and 48 V DC **or** dry contacts	24 V DC and 48 V DC **or** dry contacts
Thermal withstand voltage	242 V DC	242 V DC	242 V DC	72 V DC	72 V DC
Continuous carry	8 A	8 A	8 A	8 A	8 A
Making capacity	0.5 s, 30 A	0.5 s, 30 A	0.5 s, 30 A	0.5 s, 30 A	0.5 s, 30 A
Breaking capacity	L/R = 40 ms: 4 A DC	L/R = 40 ms: 4 A DC	L/R = 40 ms: 4 A DC	L/R = 40 ms: 4 A DC	L/R = 40 ms: 4 A DC
Connector type	BLA (default) F, T (optional)	BLA (default) F, T (optional)	BLA (default) T (optional)	BLA (default) T (optional)	BLA (default) T (optional)

This is a special module which supports auxiliary voltage measurement. The module is calibrated to DC voltage measurement..

*** This module DOES NOT HAVE the trip circuit supervision function!*

The main features of the PSTP+ module:

- High-speed operation: with pre-trip 0.5 ms, without pre-trip typically 10 ms, maximally 22 ms.
- Trip circuit supervision for each trip contact.
- Modules are 1-unit wide (= 4 HP).
- Inrush current (until 0.1 s): < 10 A.
- Common features for internal fuses:
  - 5 mm x 20 mm (0.20" x 0.79").
  - TT characteristics (very inverse time-lag), and
  - Rated breaking capacity of 35 A at 250 V AC.
- Recommended external protection: miniature circuit breaker, 6 A (C char.).

Apart from the PSTP+/2131 module, all PSTP modules include the trip circuit supervision (TCS) function.

Table 14-2. The technical data of the TCS function in PSTP modules.

	Module type	PSTP+/4201 PSTP+/4202	PSTP+/2101 PSTP+/2102
	Injected current at NO contact	1.5 mA	1.5 mA
Maximum resistance of the trip coil	3-wire wiring (1 mA current)	**8 kΩ** (max. 8 V)	**13 kΩ** (max. 13 V)
	3-wire wiring in parallel	**4 kΩ** (max. 8 V)	**6.5 kΩ** (max. 13 V)
	2-wire wiring (min. current of 1 mA)	**24 kΩ** (at 24 V DC) **48 kΩ** (at 48 V DC) **60 kΩ** (at 60 V DC)	**110 kΩ** (at 110 V DC) **220 kΩ** (at 220 V DC)

14.2 O6R5+ MODULE (BINARY INPUTS + SIGNALING OUTPUTS)

The O6R5+ module contains six (6) binary input channels in one grounding group, and five (5) relay outputs with 2×2 NO contacts and one (1) CO contact.

The default and optionally available connector types are indicated for each O6R5+ module in the table below. For additional information about the various connector types, please refer to Chapter 17.2 ("Connectors").

The thermal withstand voltage is defined as continuous when 60 % of the input channels are energized. Clamp voltages, on the other hand, are guaranteed values. The actual values may differ from the ones provided in the tables below: falling and rising around $0.66 \times U_N$ and $0.77 \times U_N$, respectively.

Table 14-3. Available PSTP modules for AQ 300 devices.

Module type	O6R5+/2101	O6R5+/4201
BINARY INPUT CHARACTERISTICS		
Number of channels	6	6
Rated voltage *	110 V 220 V	24 V 48 V
Time synchronization	Configured with AQtivate 300	Configured with AQtivate 300
Thermal withstand voltage	320 V	72 V
Clamp voltage	$0.64 \times U_N$ (falling) $0.8 \times U_N$ (rising)	$0.64 \times U_N$ (falling) $0.8 \times U_N$ (rising)
Common groups	1 × 6 common	1 × 6 common
TRIPPING CHARACTERISTICS		
Rated voltage	250 V AC/DC	250 V AC/DC
Continuous carry	8 A	8 A

Document ID: AN00006
Version: 1.0
Author: TI
Document class: Public

Hardware description for the AQ 300 series

58

15 September 2023

Module type	O6R5+/2101	O6R5+/4201
Contact versions	4 NO, 1 CO	4 NO, 1 CO
Group isolation	2 × 2 common, 1 independent	2 × 2 common, 1 independent
Connector type for both binary inputs and relay outputs	BLA (default) T (optional)	BLA (default) T (optional)

* User can select the rated voltage on a channel basis by using jumpers.

The main features for the binary inputs in the O6R5+ module:

- Digitally filtered per channel.
- Current drain:
    - max. 1.6 mA per channel at 220 V DC,
    - max. 1.8 mA per channel at 110 V DC,
    - max. 2 mA per channel at 48 V DC, and
    - max. 3 mA per channel at 24 V DC.
- Applications with an input voltage of 60 V can use the modules with a rated voltage of 48 V.
- The input voltage type can be either DC or AC voltage. If AC voltage is used, make sure that the type and the parameters of the binary inputs are configured properly in the AQtivate 300 configuration and setting software.

The main features for the signaling outputs in the O6R5+ module:

- Maximum switching voltage: 400 V AC
- Breaking capacity (L/R = 40 ms)
    - at 220 V DC: 0.1 A
    - at 110 V DC: 0.2 A
- Maximum breaking capacity: 2000 VA
- Short time carrying capacity: 1 s, 35 A
- Limiting making current (max. 4 s): 15 A (df = 10 %)
- Initial dielectric strength between open contacts (1 min): 1000 V_{RMS}

- Circuit closing capability: 10 ms (typical), 22 ms (maximal)
- Bounce time: 6.5 ms (typical), maximally 10 ms (maximal)
- Mechanical endurance: 10 × 106 cycles
- Circuit closing capability

14.3   O9S+ MODULE (BINARY INPUTS WITH TIME SYNCHRONIZATION)

Binary input modules with time synchronization (O9S+) have galvanically isolated inputs. The module converts high-voltage signals to the voltage level and format of the internal circuits. This module is also used as an external IRIG-B synchronization (IRIG-B000, unmodulated), PPM, or PPS input. The dedicated synchronization input is used for this purpose.

The default and optionally available connector types are indicated for each O9S+ module in the table below. For additional information about the various connector types, please refer to Chapter 17.2 ("Connectors").

The thermal withstand voltage is defined as continuous when 60 % of the input channels are energized. Clamp voltages, on the other hand, are guaranteed values. The actual values may differ from the ones provided in the tables below: falling and rising around 0.66 × U_N and 0.77 × U_N, respectively.

Table 14-4. *Available O9S+ modules for AQ 300 devices.*

Module type	O9S+/2111	O9S+/2121
Number of channels	9	9
Type and number of synchronization channels	1 isolated BNC connector	1 850 nm multimode fiber with an ST connector
Rated voltage *	110 V DC 220 V DC	110 V DC 220 V DC
Thermal withstand voltage	320 V	320 V
Withstand voltage for the synchronization input	35 V$_{PEAK}$	—

Document ID: AN00006
Version: 1.0
Author: TI
Document class: Public

Hardware description for the AQ 300 series   60

15 September 2023

Module type	09S+/2111	09S+/2121
Clamp voltage	$0.64 \times U_N$ (falling) $0.8 \times U_N$ (rising)	$0.64 \times U_N$ (falling) $0.8 \times U_N$ (rising)
Common groups	9 (3 × 3 common)	9 (3 × 3 common)
Connector type	BLA (default) T (optional)	BLA (default) F, T (optional)

15 GENERAL DATA

- Storage temperature: –40 ºC ... +70 ºC
- Operation temperature: –20 ºC ... +55 ºC
- Humidity: 10 % ... 93 %
- Altitude: up to 2,000 m
- Atmospheric pressure: 86 ... 106 kPa

16   STANDARD CONFORMANCE

Table 16-1. *Standard conformances for AQ 300 devices.*

Standard	Test	Test specification
IEC-EN 60255-26:2013, Level 4	Electrostatic discharge immunity (ESD)	Test voltages: 15 kV (air discharge) 8 kV (contact discharge)
IEC-EN 60255-26:2013, Level 3	Radiated, radio-frequency, electromagnetic field immunity	Test field strength: 10 V/m
IEC-EN 60255-26:2013, Level 4	Electrical fast transient/burst immunity (EFT/B)	Test voltage: 4 kV
IEC-EN 60255-26:2013	Surge immunity test	Test voltages: 4 kV (line-to-earth) 2 kV (line-to-line)
IEC-EN 60255-26:2013, Level 3	Immunity to conducted disturbances, induced by radio-frequency fields	Test voltage: 10 V
IEC-EN 60255-26:2013	Damped oscillatory wave immunity test	Test frequency: 1 MHz Test voltages: 2.5 kV (in common mode) 1 kV (in differential mode)
IEC-EN 60255-26:2013	Voltage dips, short interruptions, and voltage variations immunity	Voltage dips: 40 % (200 ms) 70 % (500 ms) 80 % (5000 ms)
IEC-EN 60255-26:2013, Level 4	Immunity for ripple on d.c. input power port	15 % of the rated d.c. value
IEC-EN 60255-26:2013, Level 5	Power frequency magnetic field immunity test	Test field strength: 100 A/m (continuous) 1,000 A/m (for 3 s)
IEC-EN 60255-26:2013	Power frequency immunity test on the binary inputs	Test voltages: 300 V (in common mode) 150 V (in differential mode)

Standard	Test	Test specification

IEC-EN 60255-27:2013	Insulation test: Impulse voltage	Test levels:
		    5 kV
		    1 kV for transducer and
		        temperature measuring inputs

	Insulation test: Dielectric test	Test levels:
		     2 kV AC 50 Hz
		      0.705 kV DC for transducer inputs

	Insulation test: Insulation resistance	Test level: > 15 GΩ

IEC-EN 60255-26:2013	Radiated emission:
	    30...230 MHz
	    230...1,000 MHz
	    1...3 GHz
	    3...6 GHz
		
		50 dB (µV/m) quasi peak, 3 m
		57 dB (µV/m) quasi peak, 3 m
		76 dB (µV/m) peak, 3 m
		80 dB (µV/m) peak, 3 m

IEC-EN 60255-26:2013	Conducted emission:
	    0.15...0.50 MHz
	
	    0.5...30 MHz
		
		79 dB (µV) quasi peak,
		66 dB (µV) average
		73 dB (µV) quasi peak,
		60 dB (µV) average

IEC-EN 60255-21-1:1988	Vibration tests (sinusoidal), Class I	—
IEC-EN 60255-21-2:1988	Shock and bump test, Class I	—
IEC-EN 60255-21-3:1993	Seismic tests, Class I	—

Document ID: AN00006   **Hardware description for the AQ 300 series**   64
Version: 1.0
Author: TI
Document class: Public   15 September 2023

17 MECHANICAL DATA

17.1 GENERAL MECHANICAL DATA

Table 17-1. General mechanical data for AQ 300 devices.

Data point	Mechanical data	Additional information
Construction	Chromate aluminum surface with built-in EMC accessories	If the power consumption of the device does not exceed the limits, the construction will be built with solid top and bottom cover panels: 30 W (84 HP) 14 W (42 HP) If the power consumption exceeds these limits, the construction will be built with perforated top and bottom cover panels.
EMC rack protection	—	Protects against electromagnetic environmental influences and protects the environment from radiation from the device interior.
IP protection	24 HP panel instrument case: IP4x, optionally IP54 (front)	—
	84 HP and 42 HP: IP4x (side), IP2x (rear), optionally IP54 (front)	
Size	19 in, 3 U, single rack (84 HP)	—
	9.5 in, 3 U, single rack (42 HP)	
	Panel instrument case (24 HP)	
Weight	Max. 8 kg (84 HP)	—
	Max. 4.5 kg (42 HP)	
	Max. 3 kg (24 HP)	

17.2 CONNECTORS

Certain modules can be equipped with different terminals for different connectors. The available choices are listed among each module's technical data with their short ID. Please see the first column of the table below where the short ID has been mentioned in brackets after the connector name (if the connector does not have a short ID, the brackets will show a hyphen instead).

The type of the used terminal is indicated on the module's label with its short ID (see the following example). The actual type of the connector is chosen according to the number of the available pins of the module.

Let's look at the VT+/2211 module as an example. From its description table (see Chapter 6, "Voltage input module") we can see that it can have four types of connectors: BLA, F, T, and R:

- The default terminal is indicated with nothing attached (VT+/2211), only its name (BLA) is mentioned. Since it has 8 pins, the type is BLA 8/180.
- The flanged terminal's short ID is F, so the module's label will be "VT+/2211F", if it is equipped with this terminal (BLA 8B/180).
- With the top-screw terminal ("T") the label becomes "VT+/2211T" (BLT 5.08HC/08/180F). With the ring-lug terminal ("R"), on the other hand, the module's label shall be "VT+/2211R".

Table 17-2. All connector types available for AQ 300 devices.

Connector name (short ID)	Connector types	Strip length [mm]	Conductor area [mm²]	Conductor diameter [mm]	Tightening torque [Nm]	Minimum bend radius *
BLA (—)	Wiedmüller BLA 2/180 BLA 3/180 BLA 4/180 BLA 6/180 BLA 8/180	7	0.2…1.5 0.2…2.5 (solid)	0.5…1.4 0.5…1.8 (solid)	0.4…0.5	3 × OD **

Connector name (short ID)	Connector types	Strip length [mm]	Conductor area [mm²]	Conductor diameter [mm]	Tightening torque [Nm]	Minimum bend radius *
BLA 3.5 (—)	BLA 10/180 BLA 12/180 BLA 13/180 BLA 16/180 Wiedmüller BLA 3.5/05/180 BLA 3.5/09/180	6	0.2…1.5	0.5…1.4	0.2…0.25	3 × OD **
Flanged (F)	Wiedmüller BLA 2B/180 BLA 3B/180 BLA 4B/180 BLA 6B/180 BLA 8B/180 BLA 10B/180 BLA 12B/180 BLA 16B/180	7	0.2…1.5 0.2…2.5 (solid)	0.5…1.4 0.5…1.8 (solid)	0.4…0.5	3 × OD **
Top-screw (T)	Wiedmüller BLT 5.08HC/06/180F BLT 5.08HC/08/180F BLT 5.08HC/12/180F BLT 5.08HC/16/180	13	0.2…1.5 0.2…2.5 (solid)	0.5…1.4 0.5…1.8 (solid)	0.4…0.5	3 × OD **
Ring-lug (R)	TE Connectivityr BC6-Q308-08	—	0.33…3.31	0.65…2.05	0.79	3 × OD **
STVS (—)	Weidmüller STVS 6 SB STVS 8 SB	9	0.5…4.0	0.8…2.3	0.5…0.6	3 × OD **
B2L 3.5 (—)	Weidmüller B2L 3.5	7	0.2…1.0	0.5…1.1	Tension clamp connection	3 × OD **
ST/FC/LC (—)	Bayonet/Screw/Snap Fiber optic	—	—	—	—	30 mm

Connector name (short ID)	Connector types	Strip length [mm]	Conductor area [mm²]	Conductor diameter [mm]	Tightening torque [Nm]	Minimum bend radius *
PE Faston terminal (—)	TE Connectivityr 6.3 × 0.8	7	Min. 4	Min. 2.3	—	3 × OD **

* The bend radius is measured along the inside curve of the wire or wire bundles.

** OD is the outer diameter of the wire or cable, including isolation.

Minimum tightening torques:

- The tightening torque of the screw for protective earth connection and the wall mounting must be approx. 5 Nm.
- The tightening torque of the screw for fastening the STVS connector must be approx. 1 Nm.

Minimum distances:

- The minimum distance between an AQ 300 device and its wire channel must be at least 3 cm.
- The minimum distance between two AQ 300 devices must be at least 10 cm.

During installation, please make sure that the shortest possible length for the PE (protective earth) cable routing is applied!

18 MOUNTING METHODS

Table 18-1. *Availability of the various mounting methods for AQ 300 devices.*

Mounting method	84 HP single rack	42 HP single rack	24 HP panel instrument case
Flush mounting	X	X	X
Rack mounting	X	X	
Semi-flush mounting	X	X	X
Wall mounting (no terminals)	X	X	
DIN rail mounting			X
IP54-rated mounting	X	X	X*
Fold-down mounting (no terminals)	X	X	
No mounting	X	X	

* The additional gasket is inserted into the original front panel frame.

NOTE! We recommend that you leave some free space (at least 80 mm) for wiring behind the device, when the mounting method is flush mounting, rack mounting, or semi-flush mounting!

18.1 FLUSH MOUNTING

Flush mounting can be used for racks of all sizes: 84 HP and 42 HP as well as the 24 HP panel instrument case. When flush mounting is used, the 24 HP devices have a mounting frame fit fastened on the front panel, while the others (84 HP and 42 HP) have a cover profile fit fastened on the front panel.

Figure 18-1. *Dimensions for flush mounting 84 HP and 42 HP single rack devices.*
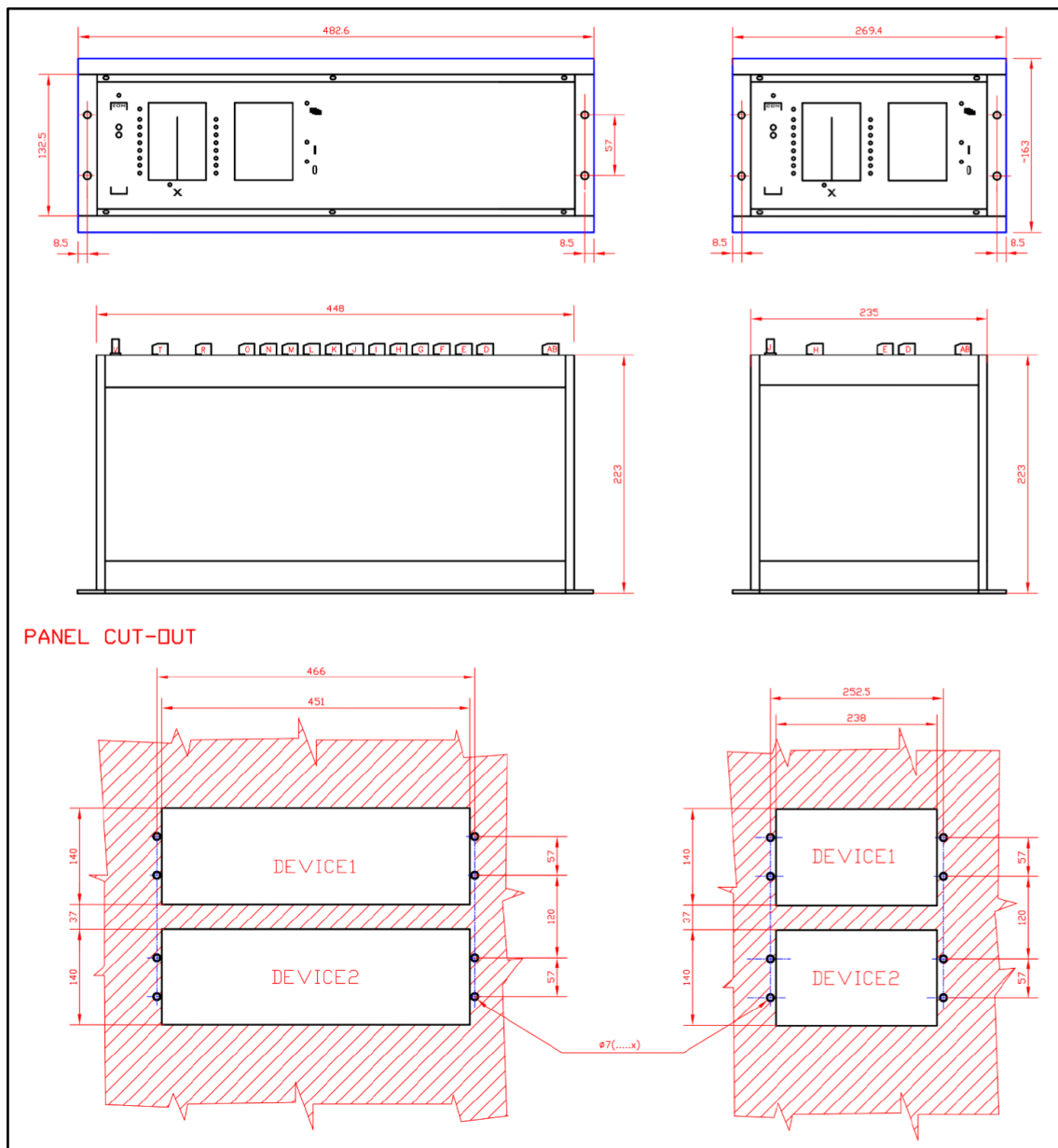
Figure 18-2. Dimensions for flush mounting 24 HP panel instrument cases.
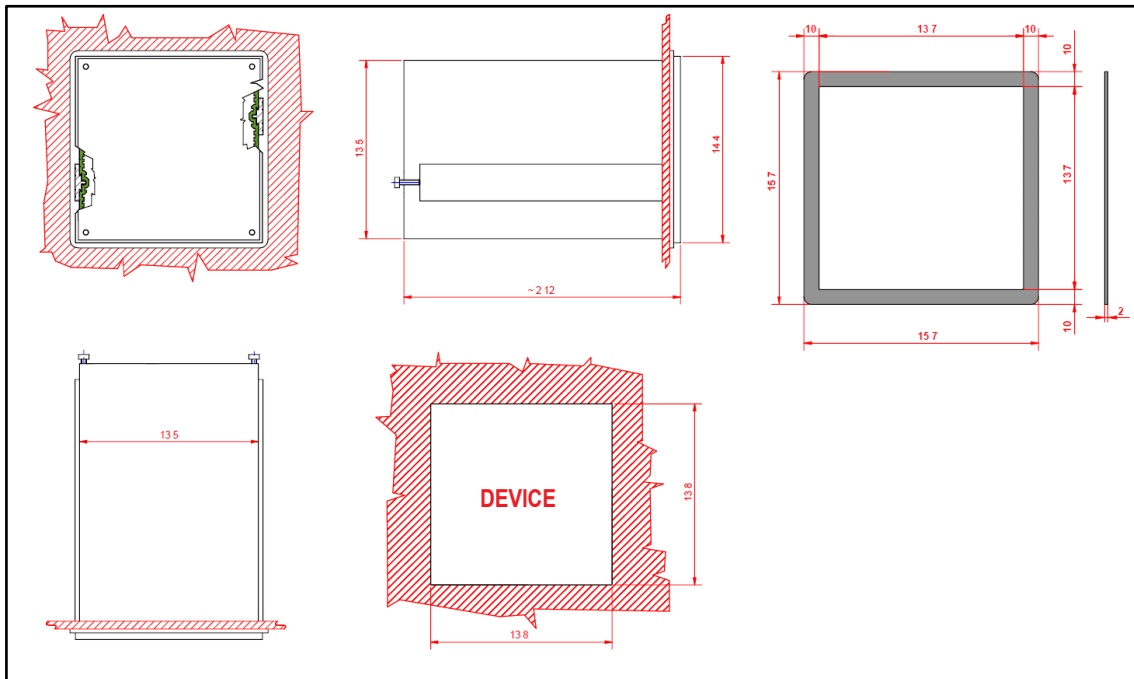
18.2 RACK MOUNTING

When rack mounting is used, the devices do not have a cover profile fit on, which makes it possible to mount them in a 19" rack. Rack mounting devices can also be mounted in a cut-out, for example, on a switchgear door. The devices can be mounted from the front or from the back of the cut-out. The dimensions for rack mounting cut-outs are in Figure 18-4 on the following page. Please note that the dimensions placed in brackets are applicable when mounting from the back!

Figure 18-3. *Dimensions for rack mounting 84 and 42 HP single rack devices.*
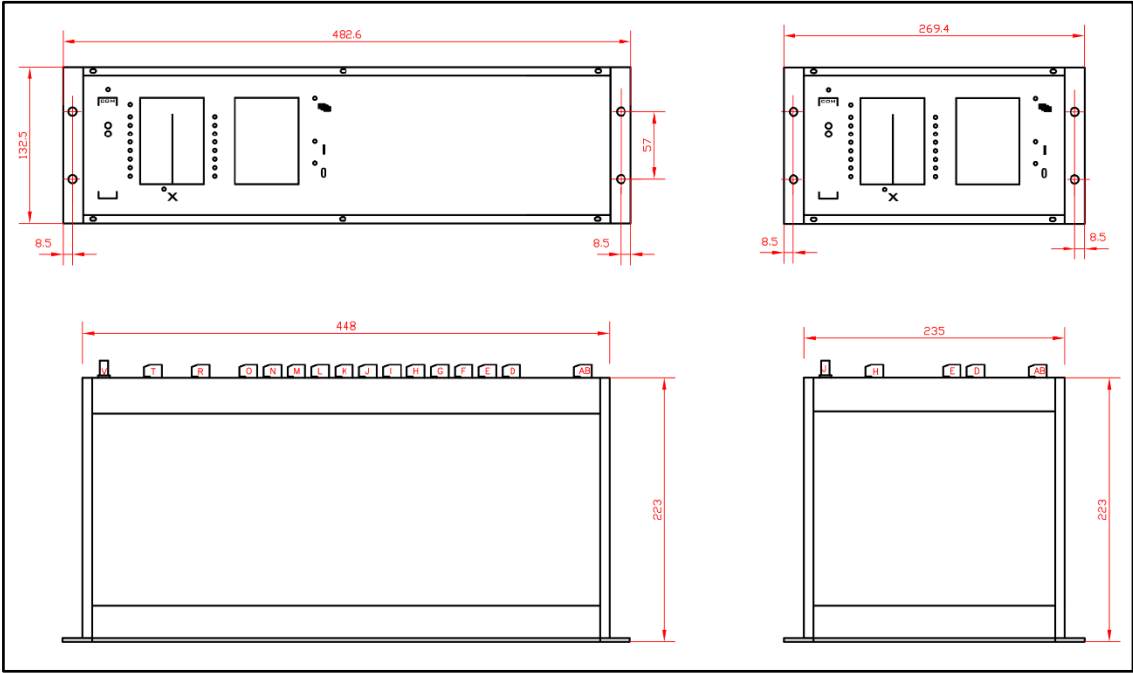
Figure 18-4. *Dimensions for rack mounting cut-outs.*
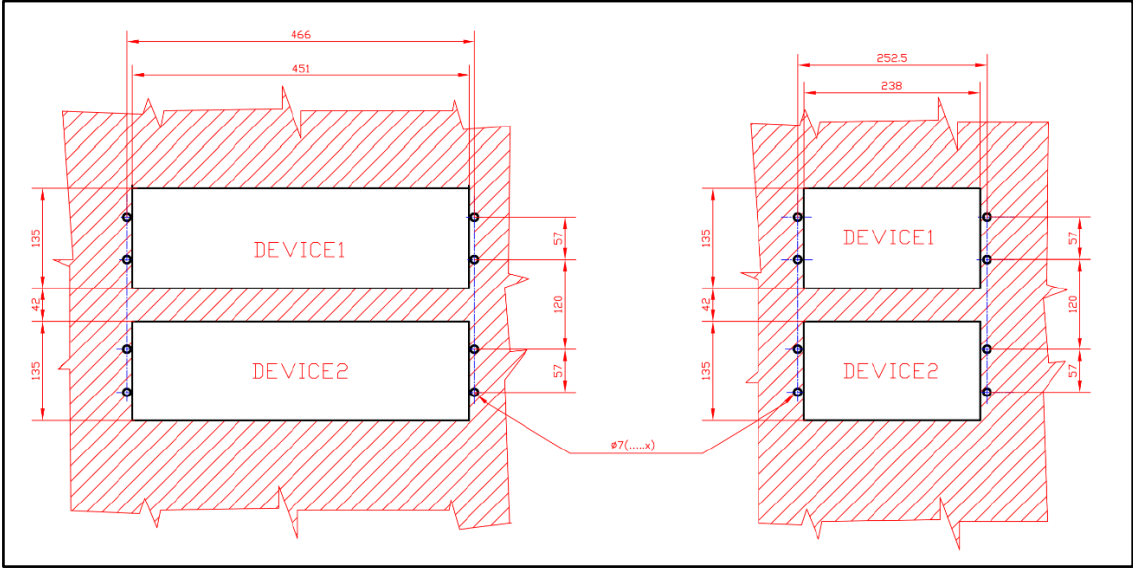
18.3   SEMI-FLUSH MOUNTING

Semi-flush mounting can be used for 84 HP and 42 HP single racks as well as for 24 HP panel instrument cases. The purpose of this type of mounting alternative is to reduce the depth of the devices in the switchgear/rack if there is not enough space in that direction. To achieve this, a special mounting collar must be fitted on devices of rack mounting type. The default color of the mounting collar is grey (RAL 7035).

The dimensions of the panel cut-out for this type of mounting method are the same as the cut-out dimensions for flush mounting, that is 138 mm × 138 mm. For semi-flush mounting, it is enough to cut the fixing elements in two and to make the assembly as shown in the figure below.

Please note that the IP54 front panel option <u>cannot</u> be utilized with this type of mounting!

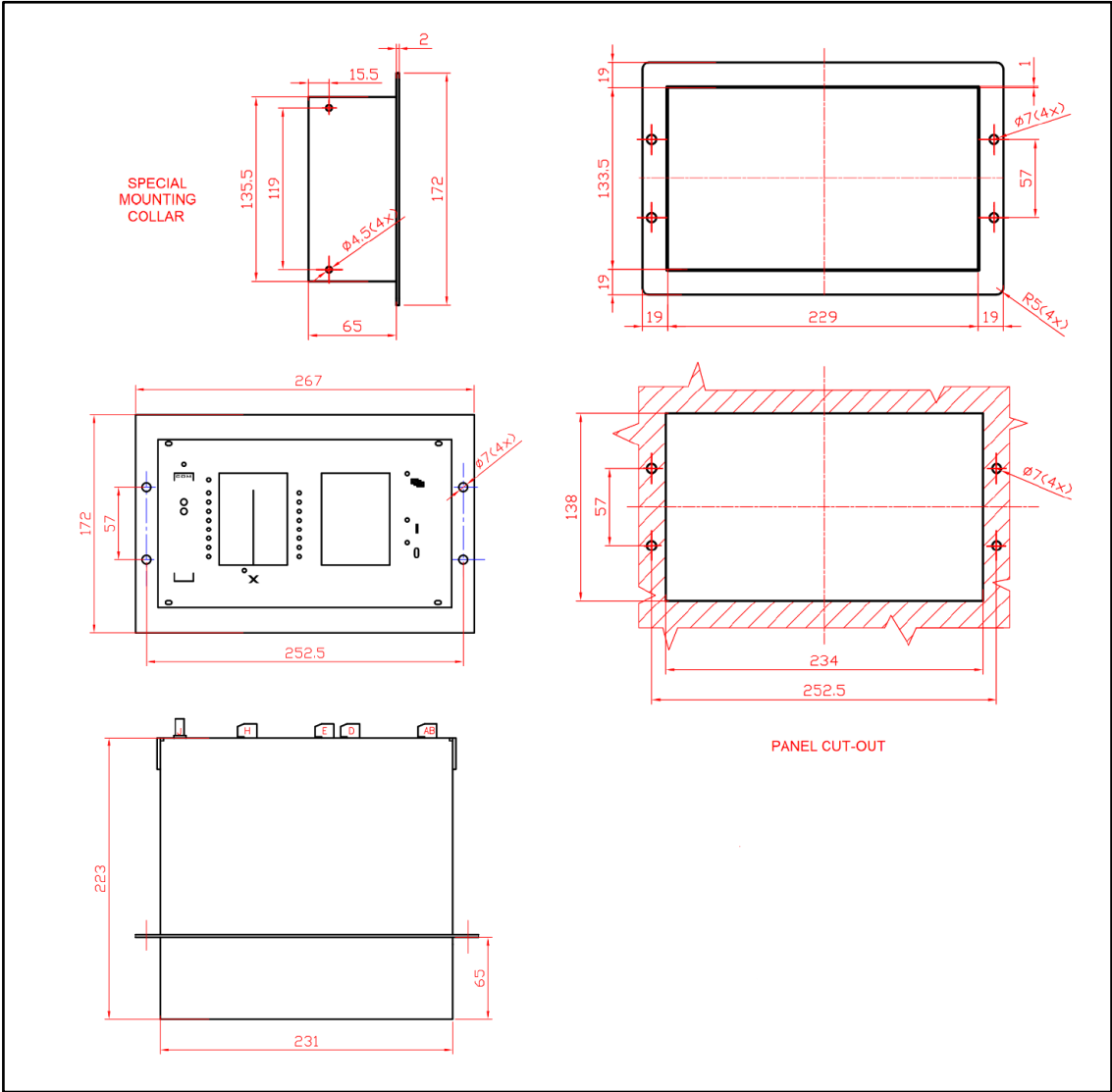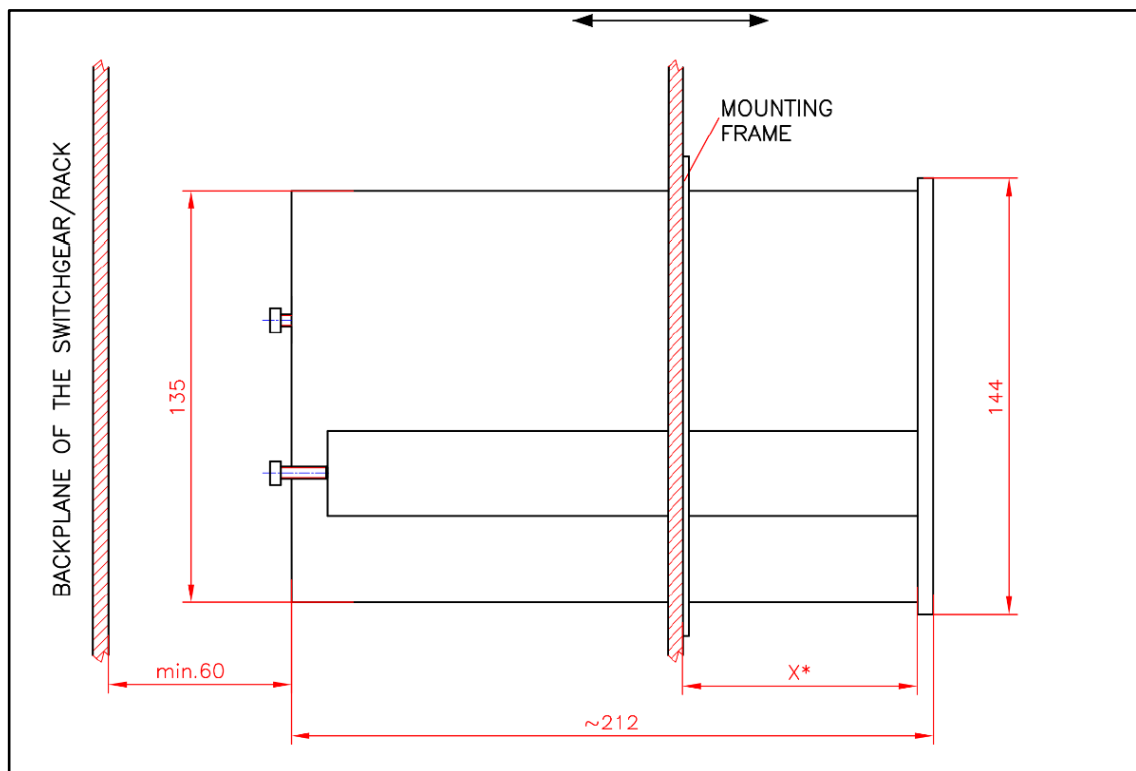**Figure 18-5.** *Dimensions for semi-flush mounting 84 HP single rack devices.*
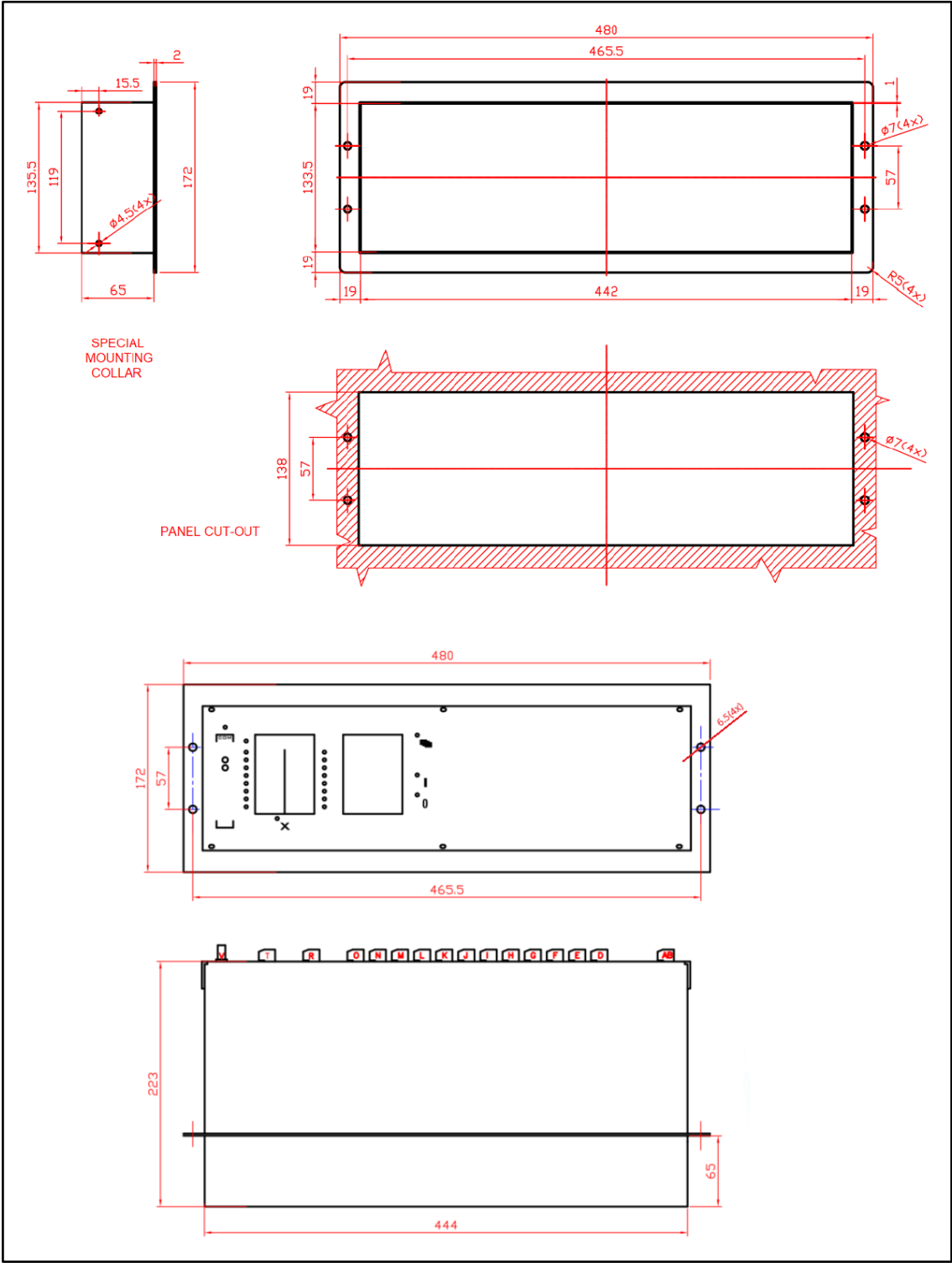
Figure 18-6. *Dimensions for semi-flush mounting 42 HP single rack devices.*

Figure 18-7. *Dimensions for semi-flush mounting 24 HP panel instrument cases.*

* Depending on the position of the cutting, the frame can be placed freely.

18.4   WALL MOUNTING (NO TERMINALS)

Wall mounting uses corner braces for supporting the device on the wall. AQ 300 devices cannot be mounted on a wall while allowing for terminal contacts, neither above the device ("upper terminals") nor below the device ("lower terminals").

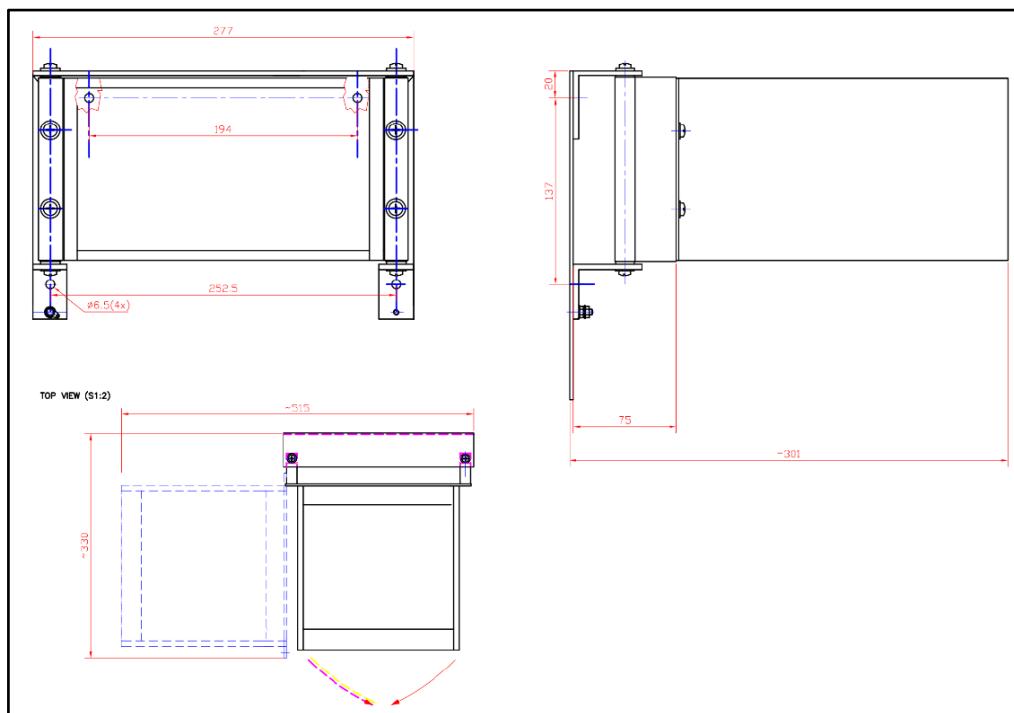With wall mounting you can open the rack from the left or to the right.

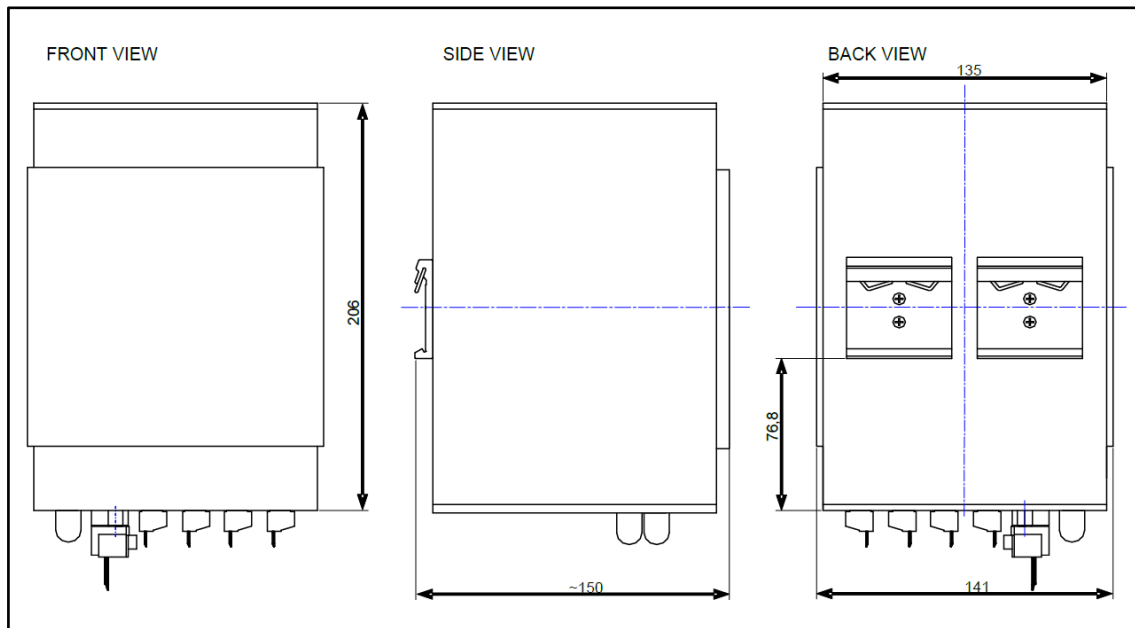*Figure 18-8.* Dimensions for wall mounting 84 HP single rack devices.
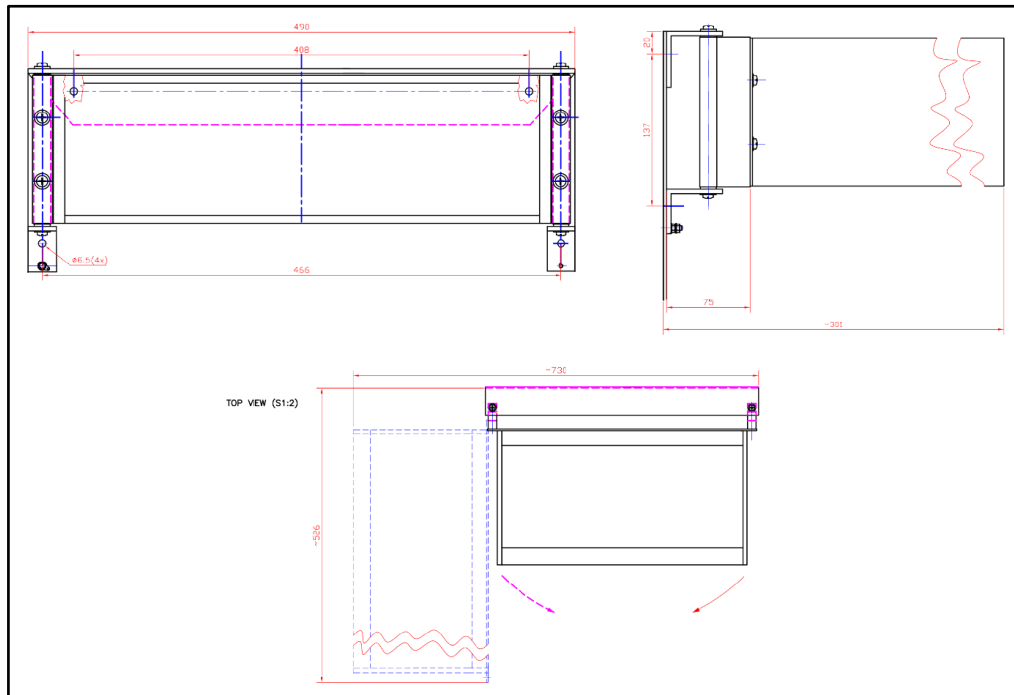
Figure 18-9. Dimensions for wall mounting 42 HP single rack devices.

18.5 DIN RAIL MOUNTING

When rack mounting is used, the devices do not have a cover profile fit on, which makes it possible to mount them in a 19" rack.

Figure 18-10. Dimensions for DIN rail mounting 24 HP panel instrument cases.

18.6 IP54-RATED MOUNTING

The IP frame provides IP54 protection from the front for 84 HP and 42 HP devices.

Please note that devices ordered with the IP54-rated mounting can only be mounted by the flush mounting method! Using any other mounting type (such as semi-flush mounting) means we cannot guarantee that the protection remains at IP54 level!

Please note that AQ-F310 and AQ-L310 devices already come with an IP54 gasket applied to them within the device frame!

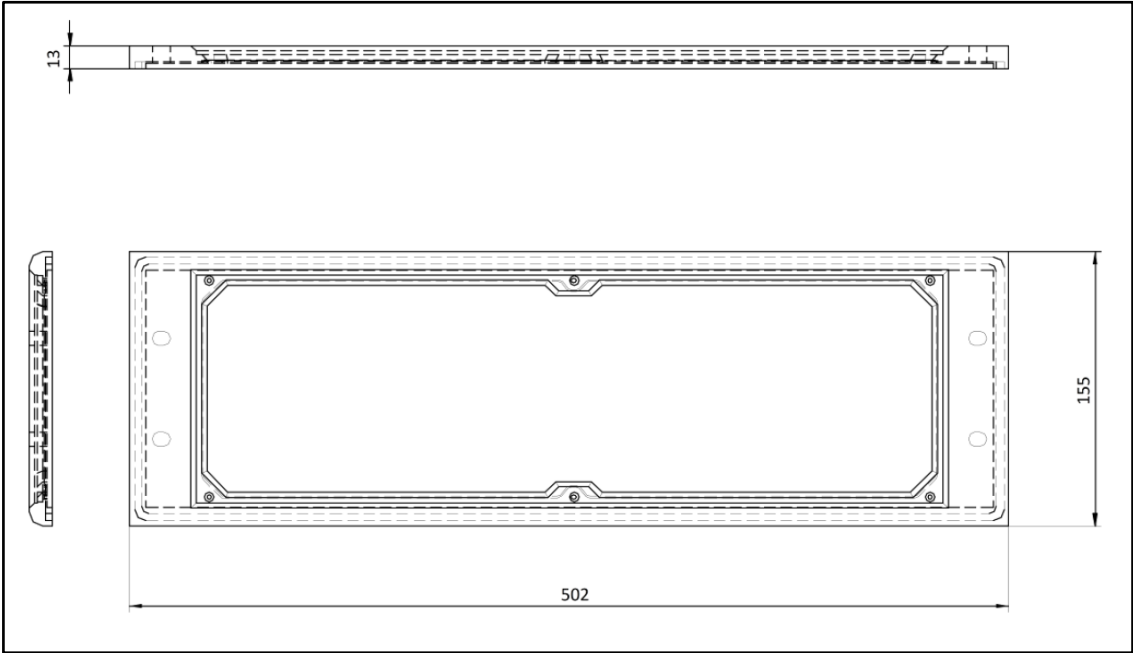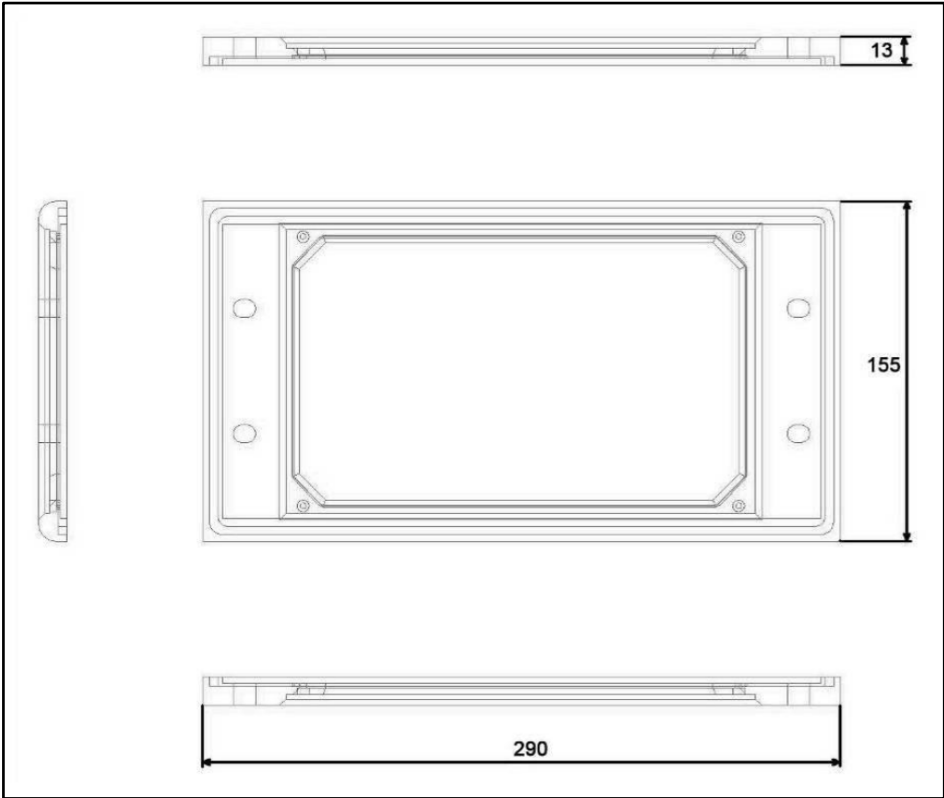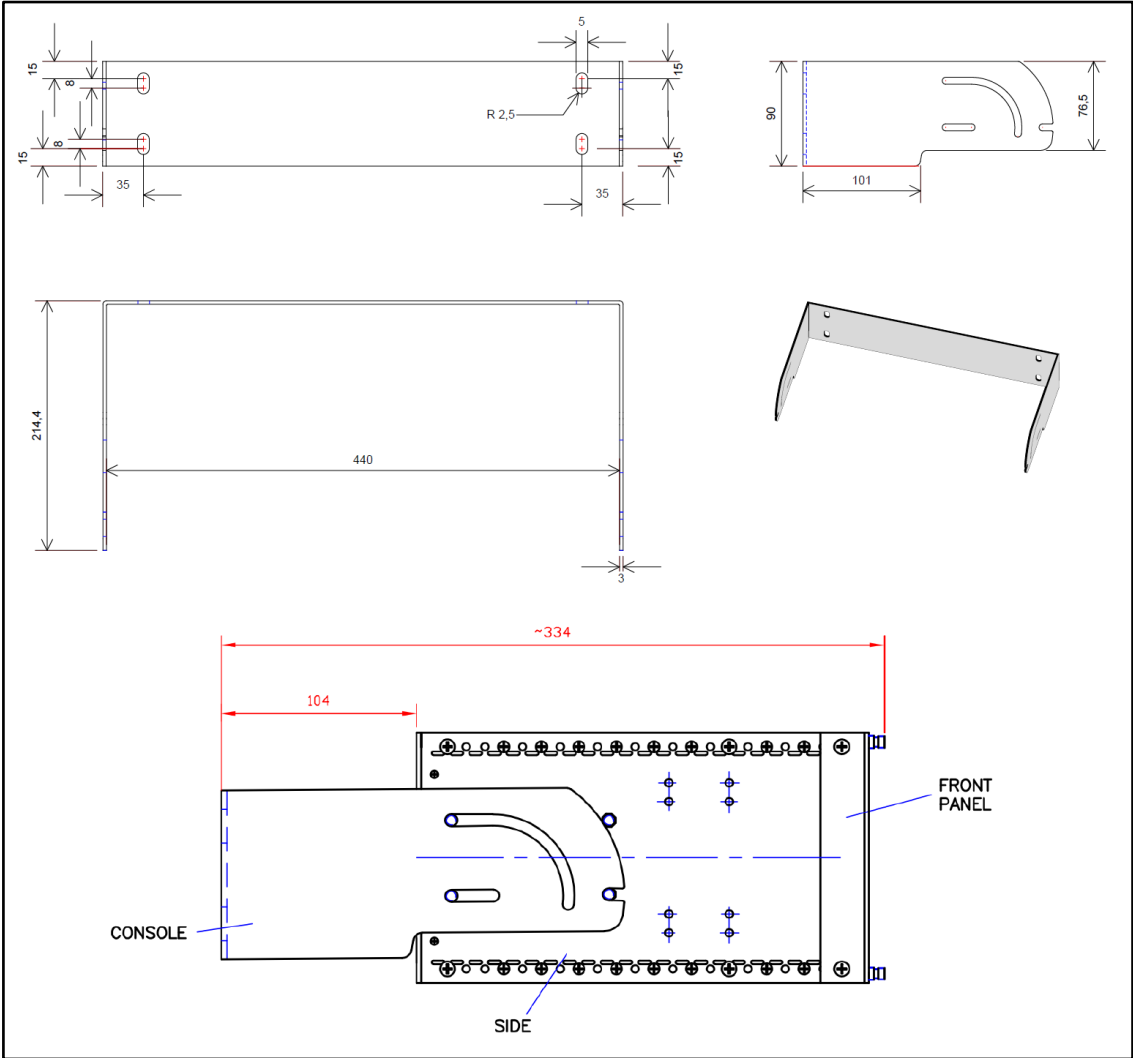*Figure 18-11.* Dimensions of the IP frame for 84 HP single rack devices.

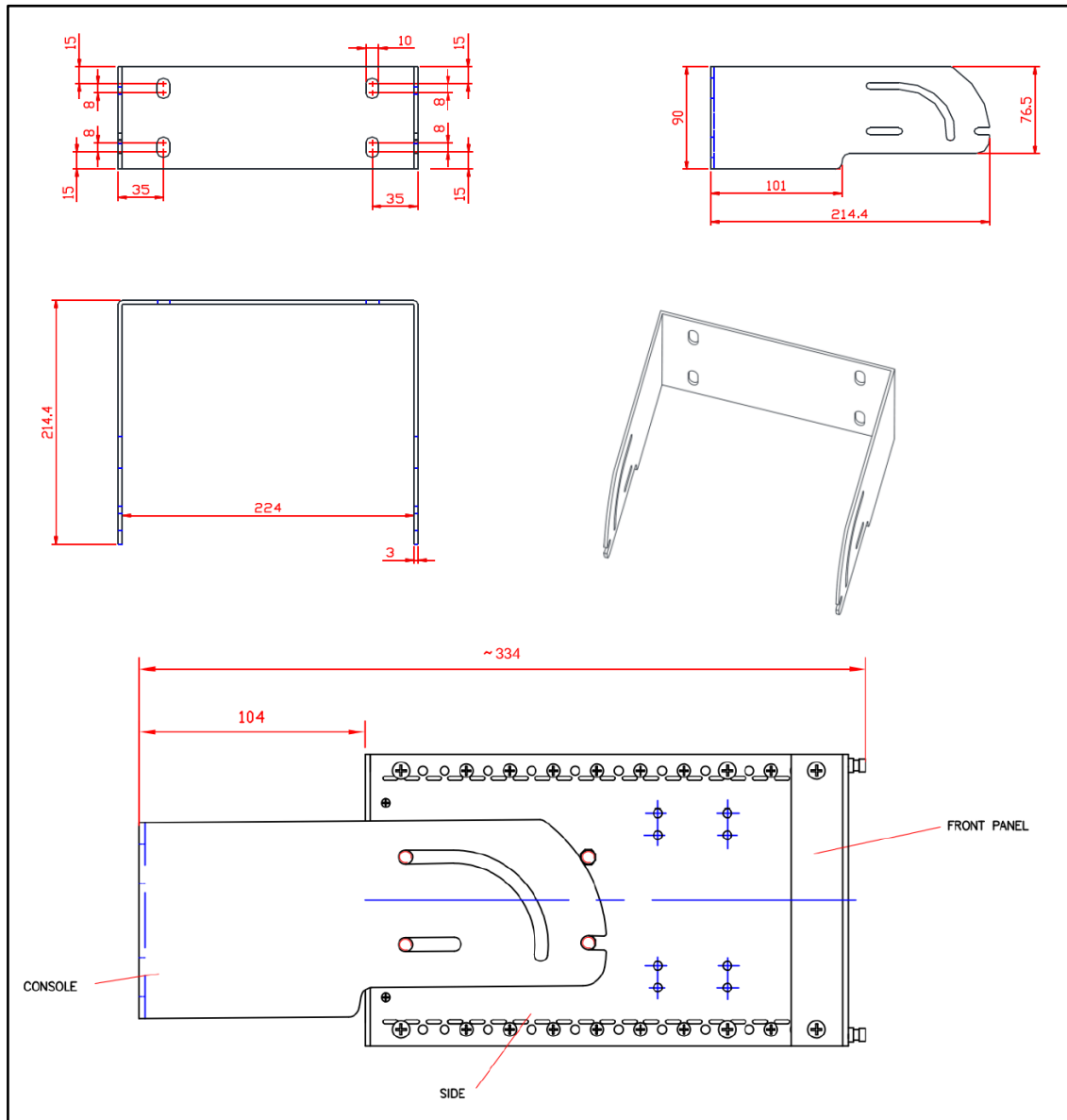*Figure 18-11.* Dimensions of the IP frame for 42 HP single rack devices.

18.7   FOLD-DOWN MOUNTING (NO TERMINALS)

Figure 18-12. *Dimensions for fold-down mounting 84 HP single rack devices.*

Figure 18-13. *Dimensions for fold-down mounting 42 HP single rack devices.*

18.8   NO MOUNTING

The mounting option "No mounting" means that an 84 HP or 42 HP device does not have any accessories on it. Please note that this mounting method is only applicable if the device is for a demonstration application! For more information about this topic, please contact our Support team (see Chapter 20, "Contact information").

19   PRODUCT AVAILABILITY: SPECIAL, LEGACY, AND OBSOLETE PRODUCTS

In this chapter you can read a list of the modules that have not regular availability for one or more reasons (being obsolete, being used only in special configurations, etc.).

19.1   SPECIAL MODULES

These modules can be ordered for special applications. These special applications are indicated for each module in its description in the previous chapters.

For more information about these devices please contact our Support team (see Chapter 20, "Contact information").

Table 18-1. *Availability of the various mounting methods for AQ 300 devices.*

Module type	Comment	Date
CT+/1155	Available only for special configurations.	12 Jun 2013
CT+/5152	Available only for OGYD bay unit configurations.	12 Jun 2013
VT+/2215	Available only for special configurations.	12 Jun 2013
O12+/2101	Available only for demonstration applications.	12 Jun 2013
O12+/4201	Available only for demonstration applications.	12 Jun 2013
R4S+/01	Available only for special configurations.	12 Jun 2013
R4S+/16	Available only for special configurations.	12 Jun 2013
PS+/1602	Available only for special configurations.	12 Jun 2013
HMI+/2404	Available only for special configurations.	6 Oct 2014
HMI+/2504	Available only for special configurations.	6 Oct 2014
COM+/8882	Available only for special configurations.	6 Oct 2014

Document ID: AN00006
Version: 1.0
Author: TI
Document class: Public

Hardware description for the AQ 300 series

82

15 September 2023

Module type	Comment	Date
CT+/1111	Available only for special configurations.	6 Oct 2014
CT+/2500	Available only for special configurations.	6 Oct 2014
CT+/5153	Available only for special configurations.	6 Oct 2014
VT+/2212	Available only for special configurations.	6 Oct 2014
R8+/01	Available only for special configurations.	6 Oct 2014
R8+/A1	Available only for special configurations.	6 Oct 2014
R8+/C0	Available only for special configurations.	6 Oct 2014
R8+/FF	Available only for special configurations.	6 Oct 2014
R12+/4400	Available only for special configurations.	6 Oct 2014
R16+/0101	Available only for special configurations.	6 Oct 2014
R16+/0001	Available only for special configurations.	6 Oct 2014
R16+/A001	Available only for special configurations.	6 Oct 2014
PS+/4401	Available only for special configurations.	6 Oct 2014
PSTP+/2102	Available only for special configurations.	23 Jun 2015
PSTP+/4202	Available only for special configurations.	23 Jun 2015
CT+/5111	Available only for special configurations.	8 Dec 2015
CT+/0101	Available only for special configurations. Only for DEFL earth fault protection!	19 Mar 2018
CT+/5155	Available only for special configurations.	26 Mar 2018
VT+/2246	Available only for special configurations.	26 Mar 2018
CT+/5253	Available only for special configurations.	5 Oct 2018
PS+/1030	Available only for special configurations.	7 May 2020

Module type	Comment	Date
PS+/1060	Available only for special configurations.	7 May 2020
CT+/1515	Available only for special configurations.	4 Jun 2020
CT+/5115	Available only for special configurations.	4 Jun 2020
CT+/5116	Available only for special configurations.	4 Jun 2020
CT+/5154	Available only for special configurations.	4 Jun 2020
RTD+/0200	Available only for special configurations.	4 Jun 2020
RTD+/1200	Available only for special configurations.	4 Jun 2020
R4MC+/01	Available only for special configurations.	4 Jun 2020

19.2 LEGACY MODULES

Table 19-2. List of all legacy cards of AQ 300 devices.

Module type	Comment	Date
CPU+/0003	Legacy CPU card, not recommended for new configurations. Please use the replacement module CPU+/1101!	12 Jun 2013
CPU+/0004	Legacy CPU card, not recommended for new configurations. Please use the replacement module CPU+/1201!	12 Jun 2013
CPU+/0005	Legacy CPU card, not recommended for new configurations. Please use the replacement module CPU+/1281!	12 Jun 2013
CPU+/0006	Legacy CPU card, not recommended for new configurations. Please use the replacement module CPU+/1381!	12 Jun 2013

19.3 OBSOLETE MODULES

Table 18-1. Availability of the various mounting methods for AQ 300 devices.

Module type	Comment	Date
TRIP+/1101	Obsolete module, not recommended for new designs.	12 Jun 2013

Module type	Comment	Date
HMI+/2401	Obsolete module, not recommended for new designs.	6 Oct 2014
CT+/2500	Obsolete module, not recommended for new designs. Please use the replacement module CT+/1500!	13 Feb 2015
AIC+/0201	Obsolete module, not recommended for new designs.	26 Mar 2018
CT+/5111	Obsolete module, not recommended for new designs.	27 Mar 2018
AIC+/0200	Obsolete module, not recommended for new designs.	8 Apr 2019
HMI+/5001	Obsolete module, not recommended for new designs.	4 Jun 2020
HMI+/5002	Obsolete module, not recommended for new designs.	4 Jun 2020
HMI+/3502	Obsolete module, not recommended for new designs.	4 Jun 2020
PS+/4301	Obsolete module, not recommended for new designs.	4 Jun 2020
HMI+/3501	Obsolete module, not recommended for new designs.	20 Apr 2021
HMI+/3502	Obsolete module, not recommended for new designs.	20 Apr 2021
HMI+/5701	Obsolete module, not recommended for new designs.	20 Apr 2021
HMI+/5702	Obsolete module, not recommended for new designs.	20 Apr 2021
COM+/1202	Obsolete module, not recommended for new designs.	20 Apr 2021
COM+/1324	Obsolete module, not recommended for new designs.	29 Apr 2021
VT+/2212	Obsolete module, not recommended for new designs.	6 May 2021
CT+/5154	Obsolete module, not recommended for new designs.	6 May 2021
O16+/2401	Obsolete module, not recommended for new designs.	22 Mar 2022
O16+/4801	Obsolete module, not recommended for new designs.	22 Mar 2022
O16+/1101	Obsolete module, not recommended for new designs.	22 Mar 2022
O16+/2201	Obsolete module, not recommended for new designs.	22 Mar 2022

19.4   OPTIONAL CONNECTORS

The optional connectors are indicated in each module's description in the previous chapters. If a module is to be shipped with an optional connector, the issue must be discussed during ordering.

19.5   PREVIOUS 42 HP AND 84 HP DEVICE HOUSINGS

Table 18-1. *Availability of the various mounting methods for AQ 300 devices.*

| Module type	Comment	Date
42 HP housing	The length of the 42 HP box has been reduced from 242 mm to 223 mm. For more information about the previous size, please refer to Chapter 19.5 ("Previous 42 HP and 84 HP device housings").	18 Dec 2018
84 HP housing	The depth of the 84 HP box has been reduced from 242 mm to 223 mm. For more information about the previous size, please refer to Chapter 19.5 ("Previous 42 HP and 84 HP device housings").	1 Apr 2021

As of the 2nd quarter of 2021 both 42 HP and 84 HP devices are shipped with shorter racks than previously. Please note that this is the only difference between the new and old device housings! The new racks are shorter by 19 mm from the front; thus, their depth is 223 mm, instead of 242 mm.

The mounting methods described in Chapter 18 ("Mounting methods") are valid for the previous racks as well, you just have to keep in mind that the depth of the device is 19 mm more than the depth stated in the drawings. For example, in Figure 18-1 (p. 69) of the flush mounting for 42 HP and 84 HP devices, you can see that the depth 223 mm. If you used this figure as the basis for flush mounting a 42 HP device with an old device housing, you would need to remember that the actual depth for that device is 242 mm.

The figure below shows both the old housing dimensions as well as the new, shorter rack dimensions (drawn in light blue).

Figure 19-1. *Dimensions for both old and new device housings (84 HP and 42 HP).*
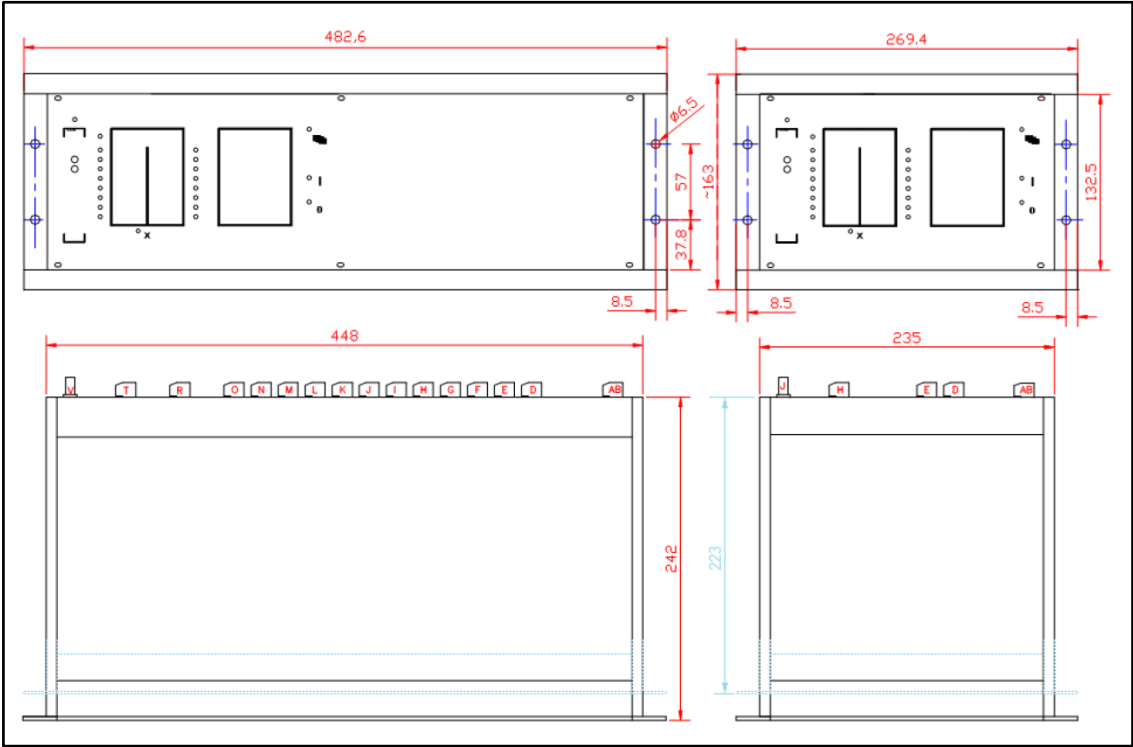
20   Contact information

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