aquasant

Operating manual

Safety Liquid Switch
AS 2.0 (2.1) D24 Control Device, 1-channel
for connecting electro-optic overfill protection systems,
conductivity detectors and Namur sensors
in 2- and 3-wire configurations

Im Visier

Change index

Version	Date	Description
1.00	04/2021	First version for firmware 1.00
1.10	09.2021	FW 1.3.3: p. 18 Scheme supplement, p. 21 compatibility note to LW9
1.20	01.2023	FW 1.4.0: p. 14 4.1 Assembly conditions, p. 22 address DIL6 new function, p. 23 «Test»-function relay OUT 1-3 after >10s, p. 28 DIL setting, p.30 Sensor monitoring

Document information

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Production:	**Aquasant Messtechnik AG** CH-4416 Bubendorf

Manual No.:	VEB-Device_AS20D24G [Manual]
Version:	230310/3 V1.20
Firmware:	AS 2.0 D24: V1.3.5|1.3.4
Pages:	41
Changes:	Subject to change without notice

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List of figures and tables

1 Information about this document

This manual provides the information you need to install, connect and commission the device, as well as important instructions for maintenance, troubleshooting, replacing parts and user safety. You must therefore read the manual before commissioning and keep it accessible at all times as part of the product in the immediate vicinity of the device.

1.1 Target group

This operating manual is intended for trained specialists. The contents of this manual must be made accessible to each specialist and must be applied.

1.2 Symbols

A yellow triangle indicates a warning. Each warning sign is provided.

1.2.1 Warnings

Explosion protection symbol
  ➲ Observe the warnings to ensure explosion protection.

Electrical symbol
  ➲ Observe the warnings for hazards with electrical voltage.

Attention symbol
  ➲ Pay special attention to the instructions.

Operating symbol
  ➲ Follow the instructions for operating the control device

Maintenance symbol
  ➲ Information regarding maintenance

Manual symbol
  ➲ Follow the instructions and information.

1.3 Supplementary documentation

1.3.1 Standard documents

ATEX test certificate
EMC certificate of conformity
QA documentation
Swiss Association for Technical Inspections (SVTI) test report (equipment for water-polluting liquids)

1.3.2 Device-specific additional documentation

Technical data: VDT-aquasant_AS2.0-D24
Quick start guide (included with the delivery)

Aquasant Messtechnik AG

2 Safety instructions

2.1 General safety instructions

This device is built and tested in accordance with the safety requirements for electronic instrumentation. It is only possible to guarantee that the device will function correctly and that it can be operated safely if the generally applicable safety precautions and the device-specific safety instructions in this operating manual are observed during use.

2.2 Authorised personnel

All the operations described in this documentation may only be carried out by trained specialists who are authorised by the plant operator. Always wear the required personal protective equipment when working on and with the device. The device is a piece of electronic equipment for use in closed electrical operating areas to which only qualified electricians or persons trained in electrical engineering have right of entry or access.

The personnel must meet the following requirements for their activities, such as commissioning or maintenance:

▸ Trained specialists have qualifications appropriate to the role and activity
▸ Authorised by the plant operator
▸ Familiar with national regulations
▸ Instructions in the manual and additional documentation have been read and understood
▸ Follow instructions and conditions

2.3 Intended use

- AS2.*-D24 with intrinsically safe Ex output on aquasant® liquid sensors, conductivity detectors and NAMUR devices (ATEX Directive 2014/34/EU)
- Only connect suitable transducers
- The device may cause hazards if it is used improperly
- Only use insulated tools
- Only use original parts

2.3.1 Warning against misuse

The manufacturer is not liable for damage resulting from improper use or use that is not in accordance with the intended purpose. Any other conditions of use negatively affect the protection. It is not possible to guarantee that the device will function correctly.

2.4 Product safety

This device is built and tested to be operationally safe, according to the current state of the art and good engineering practice. The device has left the factory in perfect condition in terms of safety.

2.4.1 EU conformity

The device complies with the legal requirements of the applicable EU directives. The directives are listed with the applied standards in the applicable EU declaration of conformity. By affixing the CE mark, aquasant® confirms that the device has been successfully tested.

2.4.2 RoHS conformity

This product complies with the provisions of Directive 2011/65/EU of the European Parliament and of the European Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) and its amendments.

2.4.3 NAMUR Recommendations

NAMUR is the User Association of Automation Technology in Process Industries in Germany. The recommendations issued by NAMUR are considered to be standards in field instrumentation. The device meets the requirements of the following NAMUR recommendations:
• NE 21 – Electromagnetic Compatibility of Equipment
• NE 53 – Compatibility of field devices and display/adjustment components
  For more information, go to: www.namur.de.

2.5 Functional approvals

2.5.1 Switzerland; Swiss Association for Technical Inspections (SVTI)/Swiss Conference of Heads of Environmental Protection Services (KVU)

Approved for plant components for water-polluting liquids in Switzerland according to KVU (Conference of the Heads of Environmental Protection Services in Switzerland).

Filling protection: KVU No.: 301.001
Special overspill protection: KVU No.: 302.004
Leakage monitoring: KVU No.: 321.003

2.5.2 Ex according to ATEX

Control devices with intrinsically safe output, approved for the connection of defined liquid sensors, sensors and detectors in the Ex zone according to SEV ATEX21.

The EU type examination certificate must be observed. It is particularly important to comply with the "Special conditions" contained in the certificate. Ex certification according to Directive 2014/34/EU

Scan; PDF download: ATEX documentation

3 Product information

3.1 Basic functions

Level monitoring is an important safety function to prevent overfilling of liquids in storage tanks. Electro-optical overfill protection with the AS* control devices is proven technology that is now moving to the next generation. The multi-functional control and monitoring device can be universally parametrised with a wide range of sensors and is operated with 2- or 3-wire sensors. The single-channel basic device allows you to add further basic devices via the loop power supply. Further expansion sensor modules can also be connected to a basic device.

The AS 2.2 D24 sensor modules expand the AS 2.0 D24 basic device with additional intrinsically safe sensor outputs.
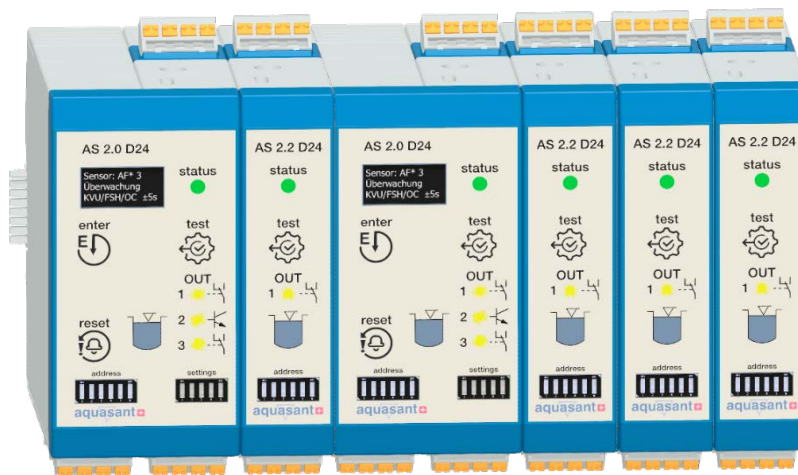
Figure 1 Row of control devices with TBUS connector

The AS2.0 basic module is monitored up to the sensor in accordance with the Namur EN107 standard. For the 3-wire electro-optical systems, the current sensor reading is monitored and provides early warning of sensor failure, thereby assisting in the maintenance and servicing of equipment. The basic device offers a wide range of alarm outputs.

Switch contact	*ISB	*ESB	Description	LED indicator on front
HL alarm OUT 1 relay	0.5s	2s	Relay output; redundant, monitored (SIL) with two independent switch-over contacts	Yellow continuous
HL alarm OUT 2 Opto coupler	Δt	Δt	NPN open collector output; 0-60s time delay ON-delay or OFF-delay: if the delay is active:	Yellow flashing quickly for delay time, then Yellow continuous
HL alarm OUT 3 relay	1s	1s	Relay output; can be acknowledged via external button or "Reset" button on front of device, potential-free switch-over contact for an external alarm (horn)	Yellow continuous, flashing after acknowledgement
Fault message K4 relay	1s		Relay switch contact (Display with error message)	4-colour LED according to Namur

*ISB=Immersion switching behaviour / *ESB=Exchange switching behaviour

The "Test" button is used to check that the control device is working. All relay outputs de-energise, OC is blocked, LEDs and acoustic buzzer are activated.

The basic functions via fail-safe high (FSH)/fail-safe low (FSL), time delays, acknowledgement reset time and internal alarm buzzer can be parameterized via the Quick DIL switches. and To deactivate the sensor monitoring slide address-DIL switch Nr. 6 up [=on].

3.2 Special functions

A potentiometer can be connected externally for the time delay of the OC alarm output. The sensor sensitivity can also be adjusted using an external potentiometer. This option applies, for example, when measuring in glass containers with strong reflections or when there is a bubbling effect on the glass. The alarm acknowledgement can be confirmed directly on the device or via an external button.

The AS2.1 device version performs the following two functions when unloading via road tanker, in combination for filling protection:

If the 3-pole connector from the road tanker is connected to the filling protection, the signal is received from the road tanker and enabled as a relay contact. This means that the enable signal can be transmitted to the PLC or directly to the slider so that it is closed. This ensures that the surface water is monitored.

If there is an alternative system for instrumentation at the tank farm as overfill prevention, which is also designed to function as filling protection, the AS2.1 control device provides an enable signal for the road tanker, which is interrupted as soon as the overfill protection in the tank responds.

3.3 Applications

The AS2.2 D24 is used for the described sensors at tank farm/filling stations to monitor limit levels.

The safety liquid switch forms an intrinsically safe sensor circuit with the sensor, which can be used in explosion-risk areas. It can be used to monitor liquid limit levels for petrol, mineral oils, acids, alkalis, solvents and other chemicals, as well as all types of liquids.

The control device with associated sensor meets the requirements for use with water-polluting materials according to KVU (CH).

3.3.1 Use according to KVU (CH)

Special overspill protection   KVU No.: 302.004
Liquid sensor types: AF1S*, -21, -23, -33, -42, -26, -

Leakage detection system with sensor   KVU No.: 321.003
Conductivity detector types: LS11, -12, -13, -21
Liquid sensor types: AF1S*, -21, -23, -33, -42, -26

3.3.2 Special overspill protection

Possible applications: Monitoring containers, tanks, tankers, drainage shafts, waste water treatment plants, sewage treatment plants, basins, weighing tanks, pipelines, filling devices, water supply systems, water overflows, oil separators, leakage monitoring of catch basins, room monitoring, dry-running protection for pumps, etc.
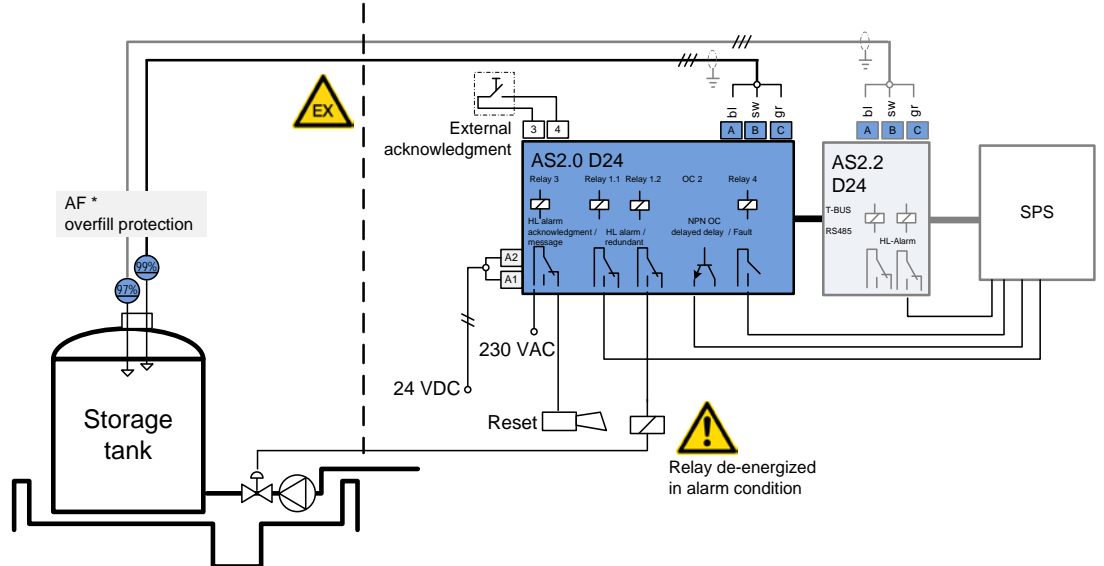
Figure 2 Using special overspill protection with AS2.0 and AS2.2 - schematic
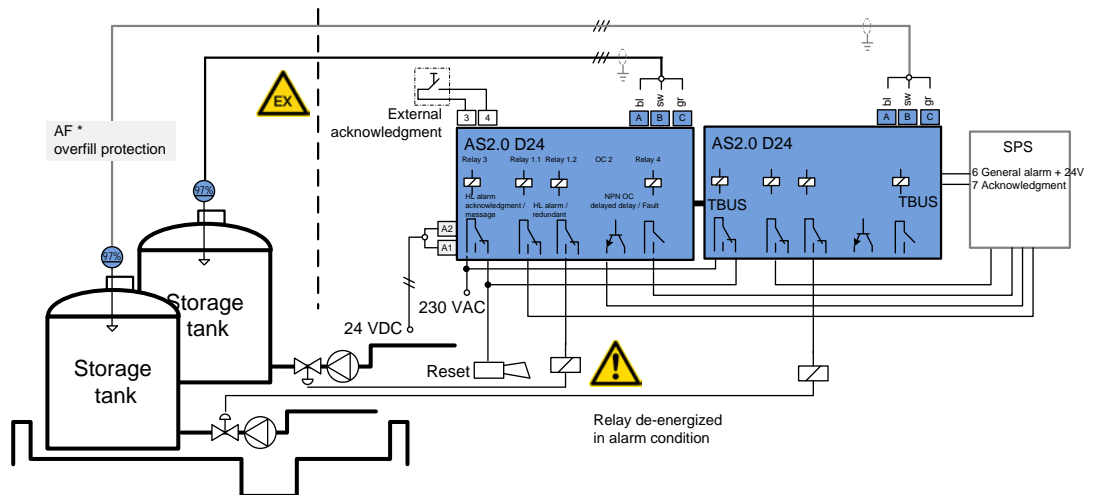
Figure 3 Using special overspill protection with two AS2.0 devices - schematic

3.3.3 Leakage monitoring

Possible applications: Monitoring dome shafts, retention basins, and troughs
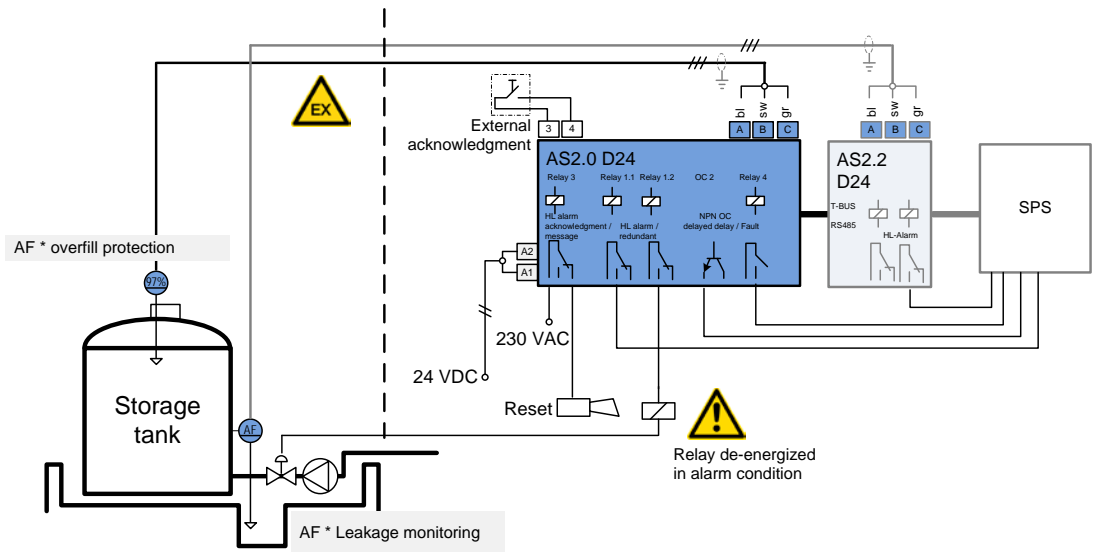
Figure 4 Using leakage monitoring - schematic

3.3.4 Oil detection monitoring

Possible applications: Monitoring rainwater in a basin for heavy or light oil leaks
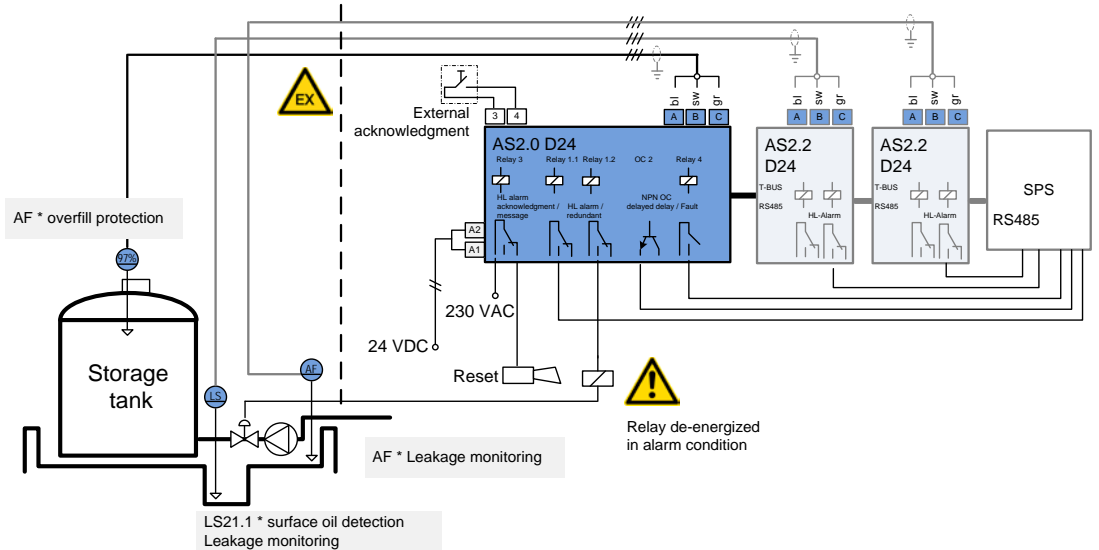
Figure 5 Using oil detection with LS - schematic

4 Installation

4.1 Conditions for assembly

Do not assemble damaged or dirty equipment. Avoid direct sunlight when operating outdoors and in warmer climatic regions. The device is designed with protection class IP20 according to IEC/EN 60529. The device is designed to be assembled on a 35mm DIN rail according to EN 60715. Only use the device when stationary. The device may only be installed and operated in an environment that ensures pollution degree 2 (or better) according to IEC/EN 60664-1. Only power supply units that match the parameters for supplying the device may be connected as power supply modules. All circuits connected to the device must comply with over-voltage category II (or better) according to IEC/EN 60664-1. Observe the installation instructions according to IEC/EN 60079-14. The device may only be installed and operated if the device is installed in an enclosure that meets the requirements for enclosures according to IEC/EN 60079-0, which is designed with IP54 protection according to IEC/EN 60529.

- Install outside the hazardous area in a control cabinet
- Install horizontally protected from weather (vertical installation leads to heat accumulation)
- Do not block ventilation slots
- Avoid direct sunlight when operating outdoors and in warmer climatic regions.
- Do not assemble the control device near a heat source. The device should be well ventilated; avoid accumulation of heat
- Install the device in a safe place so that no one can accidentally touch the device and be injured by it.

4.2 Control device assembly on DIN rail

4.2.1 Installing Ex devices
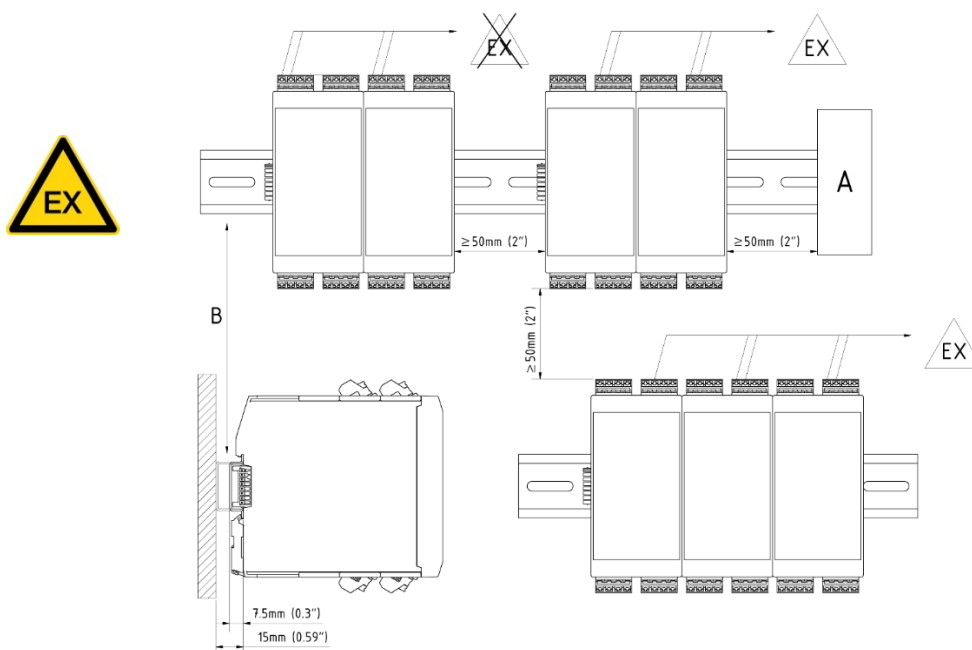
Figure 6 Arrangement for installing the AS2.*

Connecting another device type
B   DIN rail according to EN 60715 TH35-7.5/15

Compliance with the required flashover clearance of ≥ 50 mm

The horizontal installation position provides better heat dissipation than the vertical installation position.

If several AS2.* devices are used, the T-bus connector should be used. The T-bus is snapped into the DIN rail and is pushed in and connected with further connectors. The T-bus connector stays in the DIN rail when the device is removed.

Place the control device on the standard rail and press downwards/backwards until the DIN rail engages.
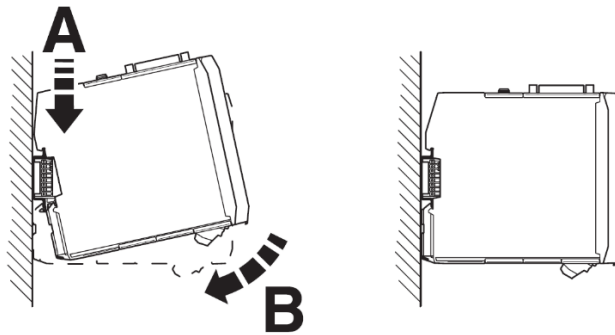
Figure 7 Installing on DIN rail according to NS35 DIN EN 60715

4.2.2 Enclosure dimensions
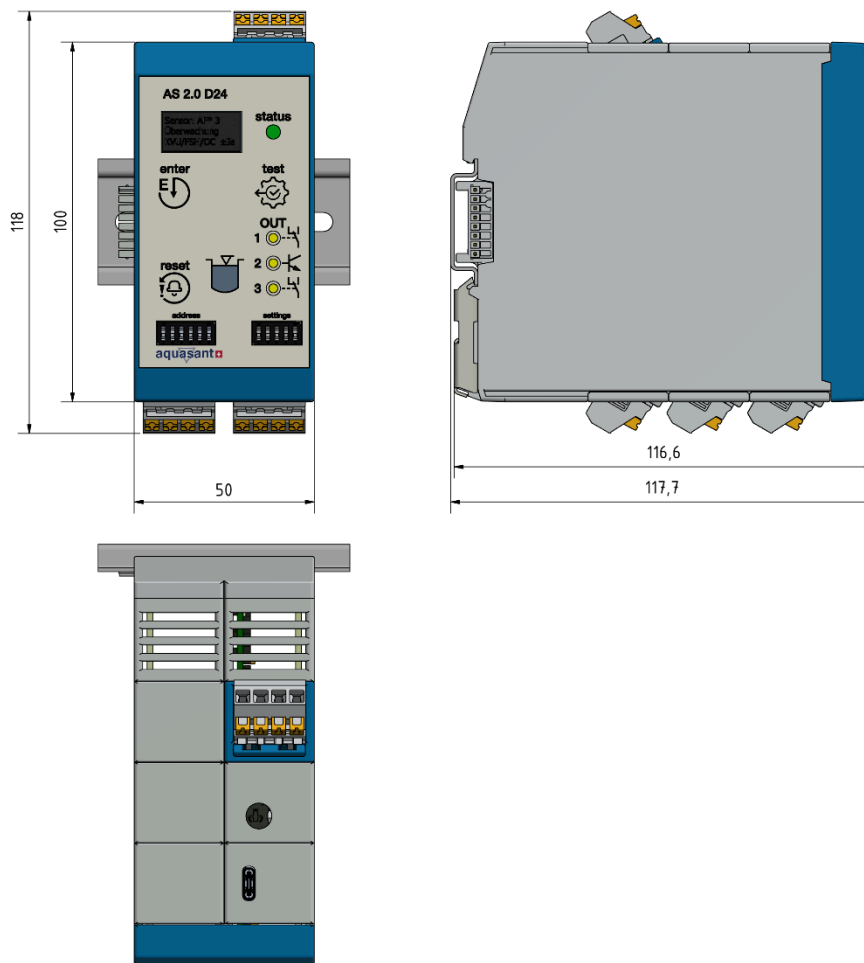
Figure 8 Device dimensions; top view, side view

4.3 Electrical connections

The AS2.* D24 is a DIN rail control device that is operated at 24 V DC. The removable terminals make connection and the control cabinet build easier. For servicing, they allow the device to be replaced quickly and without errors. The convenient plug-in connections have a $1.5mm^2$ push-in length, so the stranded wire is inserted directly without a wire end ferrule. The intrinsically safe Ex connection has blue connectors.

The T-bus loop power supply provides the 24VDC supply voltage, the RS485 bus, the error signalling contact and the level alarm acknowledgement, when several devices are connected together. The T-bus connector is not required for single devices.

Never touch live parts! Live parts can cause an electric shock, which can lead to serious injury or even death. Whenever possible, use power cables with an upstream residual-current circuit breaker (RCCB) (rated tripping current: max. 30 mA).

The connection values for the power supply must be observed, as stated in the technical data or on the connection diagram. If the mains is heavily contaminated, a mains filter or mains stabiliser is recommended.

The cross-section of the sensor connection cable should be at least $0.75mm^2$. The sensor connection cables must be laid separately and at a distance from high-voltage and high-frequency cables. In areas with potentially explosive atmospheres, the installation regulations must be observed (EN 60079-x/ATEX Directive 2014/35/EU).

Sensor connection cables must, whenever possible, be routed via a suitable, sealed connection box with screw fitting (max. 5m from sensor). It must be possible to check the sensor. When stripping the sheathing, care must be taken not to damage the insulation of the individual wires or strands.

If the cables are routed via junction boxes, a wiring diagram must then be drawn up.

4.3.1 EMC protection

Input, output and power supply cables must not be routed in areas that have sources of electromagnetic interference!

Sources of interference may include, but are not limited to, relays, contactors, motors and their controls, including thyristor controls and the cables connecting those units. Blue Ex cables must not be routed together with cables of the same type in the same duct. The locally applicable regulations for the installation of electrical systems must be observed.

The sensor connection cables must be neatly separated and laid at a distance from high-voltage and high-frequency cables. In intrinsically safe systems, the sensor cables must be sheathed in blue (marking).

The type of sensor and device must match and correspond to the application (product-related use, Ex zone, lightning protection, etc.). The system must be checked to ensure its function with original fluid (or non-hazardous replacement fluid, e.g. water) for commissioning and service checks.

The intrinsically safe circuits of the devices (light blue marking on the device) may be routed into the potentially explosive area (observe the zones). The intrinsically safe circuits must be installed in accordance with the applicable erection regulations and with EN 60079-14.
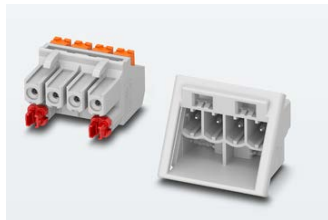
4.3.2 Connector coding

All connectors are coded by Aquasant.

The labelled, coded connectors are equipped with push-in terminals for quick wiring with stranded wires.

4.3.3 Eight-pole mounting rail bus connector

Increases the flexibility Simply connecting enclosures to each other connectors with serial amount of work for The bus connector is the top hat rail. The bus when the control device is detached. The T-bus connector is used

Item No.: 21.01.32.187

when using the enclosure: individual control device using 8-pole mounting rail bus and parallel contacts reduces the wiring.

plugged together and clicked onto connector stays in the DIN rail to interconnect several AS2* DIN rail

devices. The 24 V DC power supply (for max. 10 devices), RS485 bus, fault signal contact and acknowledgement are looped through.

The connector for the T-bus with a nominal cross-section of 0.5 mm², nominal current of 6A and rated voltage (III/2) of 160V, is used to connect to the second DIN rail row or to the PLC.

Item No.: 21.01.32.187-1 connector
Item No.: 21.01.32.187-2 socket

A maximum of 10 basic modules may be supplied with 24 V DC via the T-bus connectors.
For more than that, the supply voltage must be connected again via terminals A1/A2. If the product's connectors are not coded, there is not enough protection against mixing up the connectors.

4.3.4 Electrical connection diagram
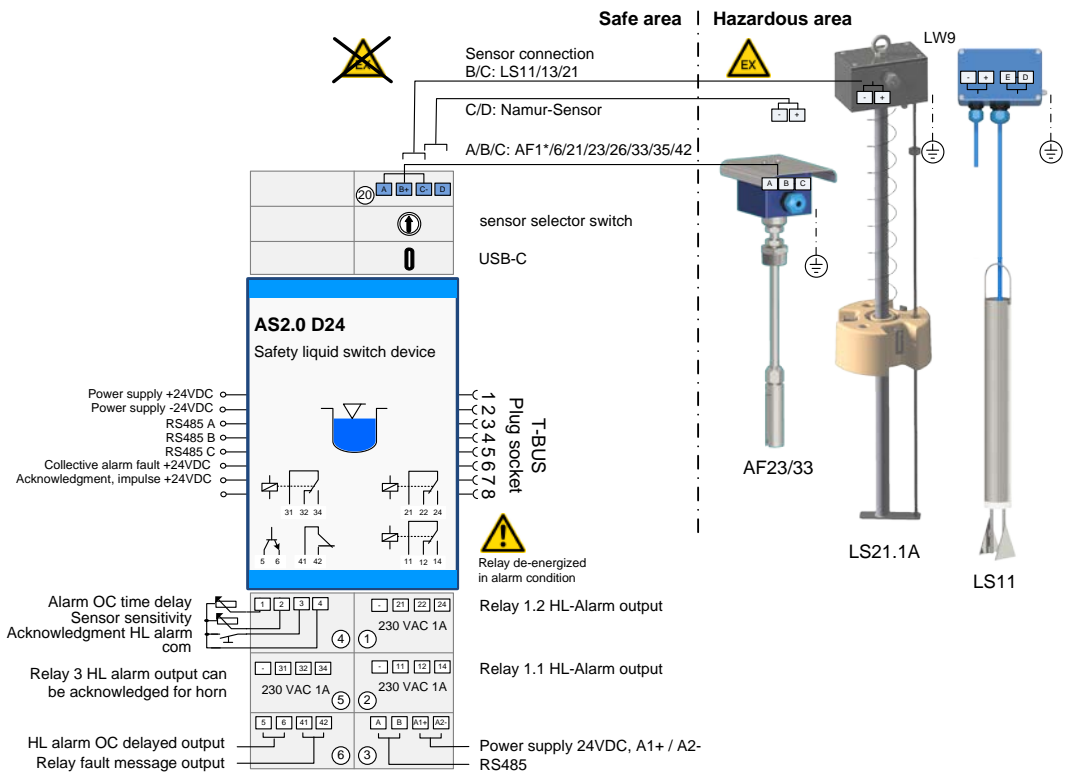
Figure 9 Connection diagram for the AS2.0 D24 G

The control device relay outputs are galvanically isolated and shown in de-energized condition. The relays is de-energised when the device switched off or in alarm state.

5 Operation and parametrisation

5.1 Description of the device

1. rey push-in connector terminals
   Relay 1.2 output, high alarm

2. rey push-in connector terminals
   Relay 1.1 output, high alarm

3. rey push-in connector terminals
   Power supply, 24 V DC/RS485

4. ot used in this version
   [Grey push-in plug terminals, potentiometer/external acknowledgement]

5. rey push-in connector terminals
   Relay 3 output

6. rey push-in connector terminals
   OC/relay 4 output

7. evice status and power indicator, RGB LED

8. est button

9. iquid level alarm relay, yellow LED

10. C output time-delayed, yellow LED

11. iquid level alarm relay (can be acknowledged), yellow LED

12. IL switch device functions, quick (settings)

13. Enclosure PA (polyamide)
14. Function display 2.9"
15. Enter button
16. T-bus connector in DIN rail
17. Reset button
18. DIL switch for bus addressing (address)
19. DIN rail snap lock

20. Push-in connector terminals [Ex ia], connections on blue header
21. Sensor selector
22. USB-C socket

AS 2.0 D24

5.1.1 Nameplate

Left side   Right side
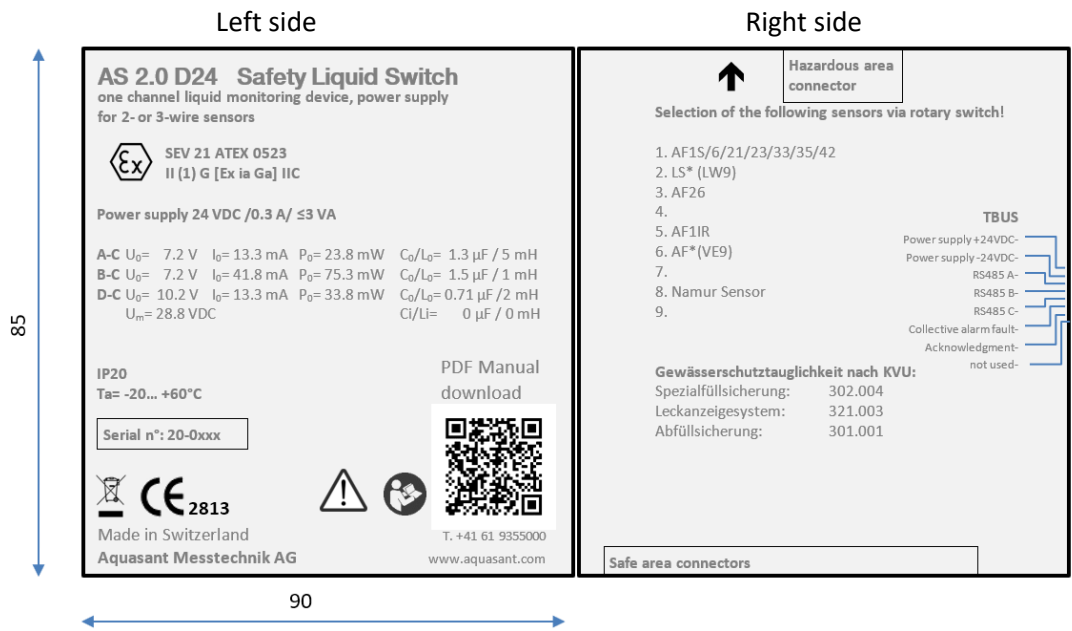
Figure 10 Nameplate for the AS 2.0 D24

5.1.2 Scope of delivery

The scope of delivery of the AS2.x control device consists of:

- Control device type: AS 2.x D24 for DIN rail mounting
- x7 connectors (AS2.0), coded
- Quick guide and Ex documentation (optional), printed

The following are accessories:

- USB interface cable
- T-bus connector, Item No.: 21.01.32.187
- T-bus connector, Item No.: 21.01.32.187-1
- T-bus socket, Item No.: 21.01.32.187-2

5.1.3 Parametrising the sensors

The control device can be operated with various sensors. They are defined using the sensor rotary selector switch on the top of the enclosure. The selector switched can be rotated 360°. If the sensor is incorrectly connected or parametrised, the device reports the fault via an error message. The following sensors can be connected and parametrised at the intrinsically safe output in a 3- or 2-wire configuration:

- ⮑ Aquasant - all AF* liquid sensors including the AF1IR filling protection devices
- ⮑ Aquasant LS* conductivity probes for water limit and surface oil detection
- ⮑ Namur sensors

The display shows the parametrised sensor. Standard parametrisation when purchasing the device without sensor: AF* liquid sensor with 3-wire connection. As-delivered parametrisation: when the system is purchased, the control device is parametrised for the sensor/detector that is supplied with it.

⚠️ *The connected sensor or detector must be defined and selected before "Mains on". Use a size 1 screwdriver for this purpose!*

No.	Sensor types	Standard
1	AF1S, AF6, AF21/23/33/35, AF42	X
2	LS11/13/21 (LW9)	
3	AF26	
4		
5		
6	AF*(VE9)	
7		
8	Namur 4-20 mA	as of V2.0
9		
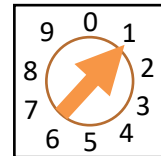
Sensor rotary selector switch

Table 1 Sensor selector switch

⚠️ *AS2* devices are not compatible with the old (prior 2016) on-site electronics type LW9/VE9 and may not be used.*

⚠️ *The control device is only intended to be operated with the described liquid and other sensors.*

5.1.4 Communication (address)

The RS485 communication interface via USB-C connector or T-bus connector can be passed to the PLC. This means that the alarms, error messages and states can be transmitted directly (from firmware version 1.20 and above).

The control device communicates with the extended sensor modules via the RS485 interface, which is how the device has to be addressed. The device is set via the binary switch combination using the 6-way DIL switch. If several devices are connected with the bus to the PLC (with long cable), a 120 Ω terminating resistor must be set across terminals A/B, at the first and last nodes of the bus. (from firmware version 1.10 and above)

⚠️ *If the bus is used or if AS2.2 devices have to communicate with the AS2.0 basic device, each device must be assigned its own address.*
Below is an example of possible address assignment for six control devices.

(Table: DIL switch parameters for the selector switch)

Control device	Binary (MSB)		Dec
Device 1	0b000001	>>	1
Device 2	0b000010	>>	2
Device 3	0b000011	>>	3
Device 4	0b000100	>>	4
Device 5	0b000101	>>	5
Device 6	0b000110	>>	6

	1	2	3	4	5	6
On	■					
Off						

Table 2 6-way DIL switch (address) – Device 1

	1	2	3	4	5	6
On		■				
Off						

Table 3 6-way DIL switch (address) – Device 2

	1	2	3	4	5	6
On	■	■				
Off						

Table 4 6-way DIL switch (address) – Device 3

5.1.4.1 Function measurement monitoring

The liquid sensor is permanently monitored during the process. Condensation, drop formation and/or contamination affect the measurement monitoring.
To deactivate the sensor monitoring slide address-DIL switch Nr. 6 up [=on].
More information in chapter 6.2.3

	1	2	3	4	5	6
On						■
Off						

Table 5 6-way DIL switch (address) – Function 6

5.2 Operation

5.2.1 Buttons

Button	Description	Function
	Test press <9s	Performs internal device test while the button is pressed and held. Display shows: current AF * sensor reading, system check, serial number, firmware version
	press >10s	Tests relays, OpenCollector and yellow LEDs, status: switches to red LED
	Enter	Saves a value in the parametrisation, increments a parameter
	Reset	Acknowledges relay K3 in event of HL alarm Acknowledges a fault on the display

Table 6 Description of button functions

5.2.2 Button functions

Function	Press and hold	(Test)	(Enter)	(Reset)
Tests the relays and LEDs	>10s	Press/hold		
Acknowledges OUT3 relay internal buzzer	<2s			Press
Acknowledges the error message	<2s			Press
Commissioning procedure	<2s		Press	
Save value	<2s		Press	
Back from menu	<2s	Press		
Next/confirm selection	<2s			Press

Table 7 Button combinations

5.3 Display and operating module

The basic module has a functional OLED 0.96" display with bright white font. The display shows the selected sensor type, the device status and the relay/OC information *(for font reasons, umlauts and special characters are not used on the display).*

5.3.1 Display menu structure

*COM = Commissioning

1st level 1st COM display*	2nd level Menu	3rd level Parametrisation	Description
deutsch francais italiano espanol english	(Select) (Save)		1st putting into operation with voltage on. After 10 minutes without activity, the display switches to the operating display.
SENS: AF* SYS: CHECK S/N: 200001 FW: 1.3.5|1.3.4	(No input)	Start display with power on	Vertical scrolling text After 4 seconds, the display continues to next screen
Operating display			
SENS: AF* -|S|**F**H|Q|H|-|-|			Operating display Monitoring active
F105! AF* sensor critical	(bell icon)		After acknowledgement Error message on operating display
SENSr: AF* SYS: ! F105! -|S|FH|Q|H|-|-|			Operating display Monitoring active
F106! AF* sensor defective Below minimum value	(bell icon)		Vertical scrolling text => Horn is acknowledged Error message on operating display
F210! Service maintenance	(bell icon)		Maintenance is due, alarm can be acknowledged
SENS: AF* SYS: Service maintenance K3|S|FH|Q|H|-|-|			Once the maintenance is complete, this can be reset
(test icon)	SENS: AF* mv: 7.2k/6.9k SYS: CHECK S/N: 200001 FW: 1.3.5|1.3.4		Device "Test" button Vertical scrolling text Display on AF* mv **m**easured **v**alue active / øt
(test icon) or	SENS: LS* SYS: CHECK S/N: 200001 FW: 1.3.5|1.3.4		Device "Test" button Scrolling text Display on LS*

Menu

	Menu	Status LED Comes on green

1 Language

	Deutsch Francais Italiano Espanol English	Select and save language (Scrolling display)

2 OC settings

	Delay time synchronous on-delay off-delay	NPN Open Collector Definition of time delay Display: |-|A|F|, LED flashing slowly
	Delay time	Re-dialing
	Delay time 1.0s	Define the time delay

3 Maintenance

	Inactive Year 1 Year 2 Year 3 Reset	Time interval for the KVU plant inspection (Scrolling display) Display: K3

4 Alarm reactivation

	Alarm reactivation 03 week	Range: 1-10 weeks DIL setting 3/4

5 Function mode

	standard mode mobile Mode	Display: M

6 Initialisation

	Parameter reset no yes	

1 Language

SENS: AF*		Operating display Monitoring active
K3|S|FH|Q|H		

Table 8 Order of parameters - Description of functions

5.3.2 Start display with mains on:

Powering up the control device for the first time or after initialisation triggers start-up mode. The display continues to the next screen if there is no input after 10 minutes. The last stored value remains active.

```
Francais
  Deutsch
Italiano
```
Language selection: DE/EN, selection is indented, selection is scrolling.

The display continues to the operating indicator if there is no input after 10 minutes.

```
SENS: AF*
SYS: CHECK
S/N: 200001
FW: 1.3.5|1.3.4
```
Checks sensor selector switch and connected sensor.
Checks device status; control device serial no. and firmware version
Displayed for 4s, then the display continues to next screen.

```
SENS: AF*

K3|S|FH|Q|H|-|-|
```
Displays sensor type: AF sensor in 3-wire configuration

Settings that are parametrised via DIL and menu - see key (Section 5.3.5)

After 5 seconds, the display switches to operating mode.

5.3.3 Test display

Pressing the test button displays the current and average sensor reading or conductivity detector status of the connected sensor on the display. After 8 seconds the OUT1-3 (relay, OC) drop out in test mode, the yellow LEDs light up, the status LED lights up red.

```
SENS: AF* mv: 7.2k/6.9
SYS: CHECK
S/N: 200001
FW: 1.3.5|1.3.4
```
Sensor type with current and average sensor reading
Displays the device status:
Control device serial no.
firmware version (main unit | frontend unit)

⇨ Press the test button ⚙

```
SENS: LS* mv: low
SYS: CHECK
S/N: 20001
FW: 1.3.5|1.3.4
```
Shows current status of the conductivity sensor
Displays the device status:
Control device serial no. and firmware version

⇨ Press the test button ⚙

5.3.4 Display operating mode

The display switches to sleep mode after 10 minutes. Pressing any button activates the display. If there is an error message, the display wakes up, until the message is acknowledged or the error is corrected.

5.3.5 Key - parametrisation status

Maintenance= K1/K2/K3 | M=Mobil modus| FH=FSH or FL=FSL *(fail safe high/low)*| R=Controller or Q=Acknowledgement of OUT3 relay | H=Horn/buzzer | A= OC on-delay or F=OC off-delay | != Sensor measurement monitoring deactivated

```
SENS: AF*

K3|-|FH|Q|H|-|-|
```
Displays sensor type: AF sensor in 3-wire configuration

Settings that are parametrised via DIL and menu - see key

```
SENS: VE/AF

-|-|FH|Q|H|-|-|
```
Displays sensor type: AF sensor in 2-wire configuration without reading check

Settings that are parametrised via DIL and menu - see key

```
SENS: LS* LW9

-|-|FH|Q|H|-|-|
```
Displays sensor type: LS conductivity sensor in 2-wire configuration without reading check
Settings that are parametrised via DIL and menu - see key

```
F108!
AF* sensor
defective, below
minimum value
```
Error no. (see the manual, Section 6.4.2)

Error message in plain text (scrolling)

5.3.6 Menu access for parametrisation

All parameters can be adjusted, even after commissioning, in the menu. Double-pressing the buttons opens the menu structure screen. The following table shows the default values on initialisation.

⇨ Access the menu by pressing the "Test" and "Enter" buttons ⚙ & 🕐

1 Language 2 OC settings 3 Maintenance	Menu selection 2nd level Only shows as much text as can be displayed, selection is indented, selection is scrolling.
Francais Deutsch Italiano	1. Language selection deutsch/français/italiano/español/english If there is no input after 1 min, the display switches to sensor scan
Delay time on-delay off-delay	2. Select delay If the delay is active, the yellow LED flashes slowly
Delay time: 00.5 s	2-liner with full text Select delay Setting range: 0/0.5/1-60 seconds (loop with increments in 1s steps)
Inactive Year 1 Year 2	3. Maintenance service according Selection: Inactive | 1 year | 2 years | 3 years |reset

Additional setting for DIL switch no. 3

Alarm reactivation 03 week	4. Auto-reset time after acknowledgement of the horn (OUT3 relay) and fault messages on the display and fault signalling relay. Setting range: 0-10 weeks
default mode: mobile mode	5. Function mode Fault message is acknowledged on the display directly when in mobile mode (e.g. truck tanker with plug connection
Parameter reset? no yes	6. Initialisation with standard operating parameters Restore the default factory parameters. Language English and restart the device.

From the menu back to operating mode:

⇨ Press the "Reset" button <2 seconds ⚙

5.3.7 Functions and parametrising quick settings

The control device has various functions that are controlled via the DIL switch. The DIL switch definition is in addition to the software visualisation. Apply the definition on the front before mains on. A status indicator for the DIL setting is shown in the menu.

DIL
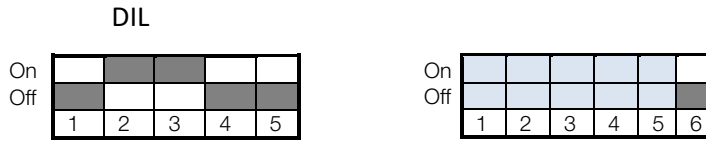
No.	Function		Standard	Display
1	OUT3 relay: Controller activation/acknowledgement – Off		Off	|R/Q|
2	Internal alarm buzzer activation – On		On	|-/H|
3	Error relay K4 reactivation after (x week(s)) after acknowledgement – Activation (minor fault)		On	
4	HL alarm reactivation OUT3 relay (horn) – (only buzzer and external horn)		Off	
5	Sensor function high/low alarm activation – On		Off	|FH/FL|
6	Deactivation of sensor reading monitoring		Off	|-/!|

Table 9 Selector switch parameters (settings)

No.	Function	Description
1	OUT3 relay controller/acknowledgement	The OUT3 relay can be operated as a high-level alarm that can be acknowledged or as a controller with two further sensor modules
2	Internal alarm buzzer On	The internal alarm buzzer can be activated/deactivated
3	Error reactivation (x week(s))	If a fault is displayed and is only acknowledged without being corrected, it is reactivated after x weeks.
4	OUT3 alarm reactivation	If a high alarm is triggered and acknowledged, but not corrected, OUT3 horn is activated again after x weeks.
5	High/low alarm sensor function	If the sensor is used as a full or empty detector, the relay function from OUT2/3 and yellow Led 1-3 is inverted (FSV/FSL)
6	Deactivation of AF-sensor reading monitoring	Active sensor measurement monitoring (pre-alarm <3.0 kΩ, alarm <1.5kΩ) deactivated

Table 10 Selector switch parameters – Description of functions

5.3.8 Menu parameters

Step	Function	Press and hold		⚙️	🔔	E↓	Status LED
							Buttons
1	Commissioning procedure menu	<2s				Press	Comes on green
2	Select menu parameters	<2s			Press		
3	Select menu item	<2s				Press	
4	Select variants	<2s			Press		
5	Save, continue to menu	<2s				Press	
6	Back to main menu	<2s		Press			
7	Back to operating mode	<2s		Press			

Table 11 Menu parameters - Description of functions

When entering data in the menu, the monitoring of liquids in the control device is active.

6 Initial commissioning

Before the control device is connected to the sensor and voltage, the sensor parameters must be checked and set using the rotary selector switch. Once the control device is connected and powered up, setup starts on the display. Language selection starts and the selected sensor is checked and displayed. If the IR liquid sensor in 3-wire configuration is used, the current reading of the liquid sensor is saved when the device is switched on. The sensor reading is constantly monitored and an alarm is output at the <3kΩ threshold as a pre-alarm for planned service. The sensor/detector does not require any further commissioning parameters after connection and is immediately ready for operation.

6.1 Checking installation

1. Before switching on the mains voltage, check:
   - ➲ the wiring of the sensors and power supply;
   - ➲ the adjustment of the rotary selector switch to define the sensor;
   - ➲ that the connected sensor/liquid sensor is clean, dry and is not exposed to daylight;
   - ➲ that, if several modules are connected to each other, the bus DIL switch for addressing the devices is set and the terminating resistor has been inserted (see Section 5.1.4);
   - ➲ the max. current/voltage of the relays and the Open Collector output
   - ➲ compliance with the Ex and safety directives.

2. Parameterization functions
   Select the desired functions using the quick DIL switch (see Section 5.3.7)
   Further parameters can be found in the menu

3. Switch on mains voltage
   The AS2.2 D24 liquid control device starts up and runs an internal test. On soft start, the LEDs come on for 5 seconds, then the relays energise. The display starts with the choice of languages for selection. Follow the instructions on the display. The connected liquid sensor is checked and the current reading is displayed.

4. Trigger a test alarm with liquid
   Immerse the liquid sensor in water or the liquid to be monitored.
   Check the display and LEDs of the AS2.0 control device; acknowledge relay 3 via the button. Remove sensor from liquid; check the device again.

5. The control device is now ready for operation and measurement is active!

6.2 Servicing and troubleshooting

6.2.1 Maintenance

With the exception of the relays and the buttons, devices from the AS2.0 series work without mechanical wearing parts. Their components are almost all over-dimensioned for a long service life. We only use high-quality parts. If properly operated and the installation instructions are followed, constant maintenance is not required. See the "Technical data" for the service life of our relays.

The system must be checked/serviced in accordance with the regulations of KVU, TTV, SEV, etc. Special overspill protection systems every 3 years/leakage monitoring every 2 years by Aquasant Messtechnik AG or a licensed company.

6.2.2 Function test

The general function test via the measuring system is based on the country-specific requirements that must be observed. In Switzerland, the SVTI/KVU technical rules apply. These state that, depending on the application, annual tests must be carried out when monitoring water-polluting liquids. The AS2.x control device can check all internal LEDs, alarms and fault alarms by using the "Test" button. This simulates checking the connected external components. If the «test» button is pressed for <9s, the sensor reading, system check, serial no. and firmware shown on the display. If the button is pressed longer >9s, the relays drop out, the status LED changes to red and the yellow OUT-LEDs light up. The sensor or detector readings are checked with a tester and additionally via a wet test.

6.2.3 Sensor measurement monitoring

When the AF* liquid sensor is connected to the [A/B/C] terminals the sensor resistance is continuously monitored. The first analysis result is available 36 hours after commissioning of the measurement. For the analysis 8 measurements are randomly taken during 36 hours and continuously monitored. If all 8 values are weak or out of spec. (see chap. 6.2.4) a pre-alarm or alarm is given. If no or faulty impulse packages are transmitted, the device goes into alarm status immediately.

The measuring value declines when the sensor is contaminated or in case condensation, drops or viscous products stick to the sensor. The sensor resistance monitoring can be deactivated if any of these conditions are permanent and lead to malfunction.

To deactivate slide address-DIL switch Nr. 6 up [=on]. The liquid sensor is permanently monitored during the process.

6.2.4 Sensor measured values

The electro-optical liquid sensors are subject to an resistance value monitoring. With age this value declines. Hereafter you will find a chart with an interpretation of the sensor values:

Sensor	MV new	Critical	malfunction	
AF1S / 6	ab 6.0 kΩ	< 3.0 kΩ	< 1.5 kΩ	
AF21/23/33	ab 7.0 kΩ	< 3.0 kΩ	< 1.5 kΩ	
AF26	ab 3.0 kΩ		< 0.8 kΩ	

6.2.5 Cleaning

Before cleaning, the control device must be switched off and disconnected from the mains. The device must not be penetrated with any object and the enclosure must not be opened. The enclosure can be cleaned with a dusting brush or a damp cloth. If the device is very dusty, it can be cleaned with gentle compressed air.

Caution: Pressing the "Test" button switches off all the valves and pumps that are controlled downstream.

Do not immerse the device in water or pour water over it and do not clean it with solvent. When repairs are done, Aquasant carries out the cleaning. However, this work is not covered by the manufacturer's warranty. If the device is not used for a longer period of time, it must be protected from dust and dirt.

6.3 Procedure for repair

You must not operate a damaged device. If the connector or the enclosure is defective or the control device has been dropped or damaged in any other way, please return it immediately to the Aquasant® point of sale for repair or a follow-up check.

Electrical repairs may only be carried out by an electronics specialist from Aquasant Messtechnik AG. No liability is accepted for any damage caused by incorrect repairs. Incorrect repairs also void the warranty.

6.4 Device malfunction

6.4.1 Device status indicator

The AS2.* control device according to the NAMUR specification has an LED status indicator and fault message shown as full text on the display. The K4 relay contact (41/42) and / or TBUS 6 sends the fault message to the PLC.

Config DIL 5	State RGB Led	K1 / OUT1	K1 / OUT1 LED	OC / OUT2	OC / OUT2 LED	K3/OUT3
H	-	energized	deactivated	deactivated	deactivated	energized c
FL	-	energized	activated	activated	activated	disenergized a
H	-	disenergized	activated	activated	activated	disenergized c
FL	-	disenergized	deactivated	deactivated	deactivated	energized c
H	-	energized	deactivated	deactivated	deactivated	energized a
FL	-	energized	activated	activated	activated	disenergized c
H	-	disenergized	activated	activated	activated	disenergized a
FL	-	disenergized	deactivated	deactivated	deactivated	energized c
H	-	disenergized	deactivated	deactivated	deactivated	disenergized c
FL	-	energized	deactivated	deactivated	deactivated	energized c
H	-	energized	activated	activated	activated	disenergized c
FL	-	energized	deactivated	deactivated	deactivated	energized a
H	-	disenergized	activated	activated	activated	disenergized c
FL	-	disenergized	deactivated	deactivated	deactivated	energized c
H	-	energized	activated	activated	activated	disenergized a
FL	-	energized	deactivated	deactivated	deactivated	energized c
FL	-	disenergized	deactivated	deactivated	deactivated	disenergized a
FL		disenergized	activated	activated	flashes activated	disenergized a

Config RGB Led	OUT1	OUT1 LED	OC / OUT2	OC / OUT2 LED	K3/OUT3
red / no change	disenergized	activated	-	-	disenergized
green flashes	-	deactivated	-	-	energized
green shines	-	deactivated	-	-	energized
DIL6 on					
yellow	-	deactivated	deactivated	deactivated	disenergized
blue	-	deactivated	deactivated	deactivated	disenergized
orange	-	activated	energized	activated	energized
orange	-				

Table 12 Status error messages

Relay OFF = de-energised/Relay ON = energised
Attention when setting DIL 5 to on FSL, relays OUT2 / 3 are inverted

Devices operated in connection with potentially explosive atmospheres must not be modified. Such devices must also not be repaired.

6.4.2 Troubleshooting

All devices go through several stages of quality control during production. For some initial help in identifying faults, see the overview of the possible causes of faults below. System error messages that occur during the self-test or during operation are immediately indicated by LED and shown on the display. If the fault that has occurred is corrected, the LCD error message is still shown and the fault signal relay is de-energised. This can be acknowledged using the "Reset" button. The status LED resets itself.

Fault no.	Message	Troubleshooting
F100	No sensor	⮑
F101	No sensor	⮑ Connect a sensor to the A/B/C (D) Ex terminals
		⮑ Check the connection cable for correct polarity
F102	Wire break	⮑ Check the connection cable for wire break or short circuit
F103	Sensor incorrectly assigned	⮑ Check the sensor selector switch on the top right of the device. It must match the connected sensor type
F104	External light	⮑ Measurement is disturbed by external light (sun); use daylight

			protection for the sensor
F105	Critical reading	➲	Pre-alarm: the threshold value of the sensor is reached; measurement still works reliably for a certain time. Report this for the next maintenance.
F107	Excessive temperature	➲	Make sure that the cabinet temperature is lowered
F109	Com. Time out	➲	Restart the device (power cut) or menu 6, initialization (Attention: parameters have to be set again)
F208	Sensor defective	➲	Sensor must be replaced by a specialist company
F113	Sensor short circuit	➲	check the supply line to the sensor
F210	Maintenance due	➲	Order Aquasant service to carry out KVU maintenance
F211	Software error	➲	Switch off the device and restart it after 1 minute
		➲	If the error message is displayed again, send the device for repair
F212	OUT1 relay defective	➲	The device has to be sent for repair to replace the SMD relay.

Table 13 Error messages - Troubleshooting

6.5 Removal

6.5.1 Steps for removal

The coded connectors are pulled out with a screwdriver (by levering). First, the blue Ex connector to the sensor is disconnected (all relays de-energise, alarm is triggered, which is acknowledged). Then the mains and relay plugs connectors are disconnected. The DIN rail device is disconnected from the DIN rail (see Figure). The T-bus connector stays connected to the upstream and downstream devices on the DIN rail.
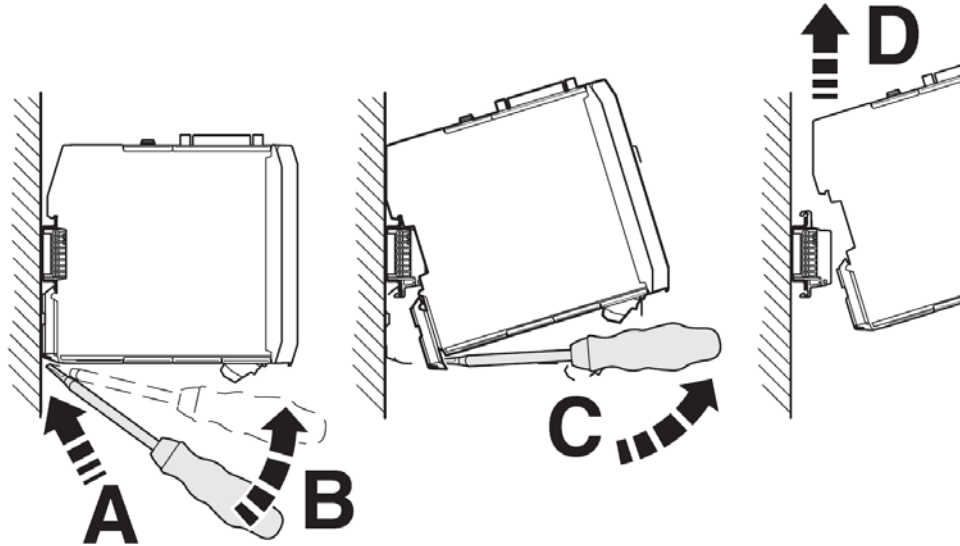
Figure 11 DIN rail disassembly

6.5.2 Disposal under WEEE Directive

The Waste Electrical and Electronic Equipment (WEEE) Directive, which came into force on 13 February 2003, has brought about a major change in the way we handle electrical and electronic equipment that is no longer used. The WEEE logo (see on left), either on the product itself or on the packaging, indicates that this product must not be disposed of with normal household waste. For more information regarding the disposal of waste electrical and electronic equipment and for recycling and collection points, please contact your relevant local authority or the business where you purchased the device.

7 Appendix

7.1 Technical data

Power supply		
	Connection	Terminals A1(+)/A2(-) & TBUS 1(+)/2(-) (max. 20 units)
	Operating voltage	12-28 V DC (typically: 24 V DC)
	Max. operating current	0.3 A
	Power consumption	≤ 3 VA

Communication		
RS485	Connection	Terminals A/B & TBUS 3(A)/4(B)/5(COM)
	Cable	Min. 24AWG shielded, length (l): 3m < l <30 m
	Protocol	MODBUS

Display & signals		
Display	Type	OLED 0.96 inch, 128*64 pixel, 21.7 x 10.9 mm
	Function	Status & device menu display
LEDs	Type/function	Status LED, RGB/device status indicator
	Type/function	OUT LED 1, yellow/sensor alarm indicator
	Type/function	OUT LED 2, yellow/Open Collector indicator
	Type/function	OUT LED 3, yellow/HL alarm 3 indicator
Buzzer	Type	65-75 dB buzzer
	Function	Acoustic sensor alarm (resettable)

Status & configuration		
Button	Name	Test button
	Function	Device test function
	Name	Input button
	Function	Button to confirm input
	Name	Reset button
	Function	Button to confirm alarm (Reset acoustic alarm and relay HL alarm 3)
DIL switch	Name	"Address"
	Type	6-pole DIL switch
	Function	Basic bus communication configuration
	Name	"Settings"
	Type	5-pole DIL switch
	Function	Basic configuration of the device function mode
Sensor selector switch	Name	Sensor selector switch
	Type	Rotary switch, 10 positions
	Function	Select the sensor type
External peripherals	Name	OC time delay
	Function	Evaluate external potentiometer (0-10 kΩ potentiometer)
	Connection	Terminals 1/4
	Name	Sensor sensitivity
	Function	Evaluate external potentiometer (0-10 kΩ potentiometer)
	Connection	Terminals 2/4
	Name	Acknowledge HLalarm
	Function	Evaluate external reset button
	Connection	Terminals 3/4

Sensor

AF1S/21/23/33/42	Connection	Terminals/(AF* wire colours): A (Blue)/B (Black)/C (Green)
	Cable type	Min. 3x0.75 mm^2, length l: l <1000 m
	Cable resistance	Max. 300 Ω
	Sensor rotary selector switch	Position 1
	Fault monitoring	Sensor misconfiguration
		Connection error
		Cable break
		Sensor reading
	Fail-safe	Yes
AF 26	Connection	Terminals/(AF* wire colours): A (Blue)/B (Black)/C (Green)
	Cable type	Min. 3x0.75 mm^2, length l: l <1000 m
	Cable resistance	Max. 300 Ω
	Rotary switch	Position 3
	Fault monitoring	Sensor misconfiguration
		Connection error
		Cable break
		Sensor reading
	Fail-safe	Yes
AF1IR	Connection	Terminals/(AF* wire colours): A (Blue)/B (Black)/C (Green)
	Cable type	Min. 3x0.75 mm^2
	Cable resistance	Max. 300 Ω
	Rotary switch	Position 5
	Fault monitoring	Sensor misconfiguration
		Connection error
		Cable break
		Sensor reading
	Fail-safe	Yes
AF* with VE9	Connection	Terminals/(VE terminals): B (+)/C (-)
	Cable type	Min. 2x0.75 mm^2, length l: l <1000 m
	Cable resistance	Max. 300 Ω
	Rotary switch	Position 6
	Fault monitoring	Sensor misconfiguration
		Connection error
		Cable break
	Fail-safe	Yes
LS* with LW9	Connection	Terminals/(LW terminals): B (7.2V)/C (GND)
	Cable type	Min. 2x0.75 mm^2, length l: l <1000 m
	Cable resistance	Max. 300 Ω
	Rotary switch	Position 2
	Fault monitoring	Sensor misconfiguration
		Connection error
		Cable break
	Fail-safe	Yes
Namur	Connection	Terminals/(level): D (+)/C (-)
	Cable type	Min. 2x0.75 mm^2, length l: l <1000 m
	Cable resistance	Max. 300 Ω
	Rotary switch	Position 8
	Fault monitoring	Sensor misconfiguration
		Connection error
		Cable break
		Sensor reading

Outputs

Relay	Name/	HL Alarm 1/switch-over contact/terminals [11 - 12 - 14] L<30 m	
	Type/	HL Alarm 2/switch-over contact/terminals [21 – 22 - 24] L<30 m	
	Connection	HL Alarm 3/switch-over contact/terminals [21 – 22 - 24] - (resettable)	
		Fault signal/NC contact/terminals [41-42] - (closed on fault signal)	
	Max. switching voltage	250 V AC/220 V DC	
	Continuous current	3 A	
	Max. switching current	2 A Resistive load	1 A Inductive load $\cos\phi = 0.4$
	Max. switching power	60 VA	
	Switching delay	≤ 100 ms	
	ON delay (HL Alarm 1 & 2)	< 10 sek. (Sensor type dependent)	
	Mechanical service life	10^7 switching cycles	
Open Collector	Name	OC HL alarm	
	Type	Open Collector	
	Connection	Terminals [5 (Collector) - 6 (Emitter)]	
	Switching voltage	5-30 V DC	
	Max. continuous current	50 mA	
	Internal resistance	≤ 122 Ω	
	Response delay	0-60 seconds, adjustable	
Collective alarm	Name	Collective alarm	
	Type	Digital IO	
	Connection	TBUS 6	
	Output voltage	0 - operating voltage V DC	
	Input voltage	8.5 - operating voltage V DC (high logic) 0-3 V DC (low logic)	
	Output current	22 mA @ 12 V DC operating voltage 54 mA @ 28 V DC operating voltage	
	Internal resistance	Output resistance: ~ 500 Ω Output resistance: ≥ 1.3 MΩ	
	Switching delay	≤ 20ms	
acknowledgement	Name	Collective alarm	
	Type	Digital IO	
	Connection	TBUS 7	
	Output voltage	0 - operating voltage V DC	
	Input voltage	8.5 - operating voltage V DC (high logic) 0-3 V DC (low logic)	
	Output current	13.5 mA @ 12 V DC operating voltage 5.5 mA @ 28 V DC operating voltage	
	Internal resistance	Output resistance: ~ 2 kΩ Output resistance: ≥ 1.3 MΩ	
	Switching delay	≤20 ms	

Conformity with directives

Electromagnetic compatibility	Directive 2014/30/EU	EN 61326-1:2018
Low voltage	Directive 2014/35/EU	EN 61010-1:2010
RoHS	Directive 2011/65/EU	EN 63000:2018
Ex	Directive 2014/34/EU	EN 60079-0:2018 EN 60079-11:2012

Conformity

Environmental conditions

Storage temperature	–20 to +60 °C, ideally +20 °C
Ambient temperature	–20 to +60 °C
Relative humidity	80%, non-condensing
Shock resistance	300 g/s2

Mechanical data

Protection class	IP 20
Connection	Plug-in connector
Weight	Approx. 260 g
Dimensions	117x51x118 [mm] (L x W x H)
Attachment	35mm DIN rail

Parameters for potentially explosive area

EU type examination certificate		SEV 21 ATEX 0523
Identification		Ex II (1) G [Ex ia Ga] IIC
Protection class		Intrinsically safe
U_m		28.8 VDC
U_0	A-C	7.2 V
	B-C	7.2 V
	D-C	10.2 V
I_0	A-C	13.3 mA
	B-C	41.8 mA
	D-C	13.3 mA
P_0 (linear characteristic)	A-C	23.8 mW
	B-C	75.3 mW
	D-C	33.8 mW
C_i/L_i	A/B/C/D	0 µF/0 nH
C_0/L_0 (IIC)	A-C	1.3 uF/5 mH
	B-C	1.5 uF/1 mH
	D-C	0.71 uF/2 mH
C_0/L_0 (IIB)	A-C	5.1 uF/20 mH
	B-C	3.7 uF/20 mH
	D-C	2.4 uF/20 mH

International approvals

National approvals

CH	SVTI/KVU	Filling protection:	
			KVU No.: 301.001
		Special overspill protection:	
			KVU No.: 302.004
		Leakage monitoring:	
			KVU No.: 321.003
EU	ATEX		SEV 21 ATEX 0523

7.2 Declaration of conformity

we create solutions

aquasant ▪

EU- DECLARATION OF CONFORMITY

CE

Manufacturer:	Aquasant Messtechnik AG, Hauptstrasse 22, 4416 Bubendorf, Switzerland
Brand:	aquasant®
Notified body:	N° 2813, CSA Group Testing UK Ltd
Description:	AS-Control units for electro-optical AF liquid sensors for limit values, overfill protection and leakage monitoring, according to ATEX 16 type code.

We hereby declare under our sole responsibility that the products:

Product:	Safety liquid switch, Sensor control unit
Model:	AS2.* D24
EU-Type Examination Certificate Number:	SEV 21 ATEX 0523
	Eurofins Electrosuisse Produkt Testing AG n°.: 1258

comply with the following European guidelines under the harmonised standards or normative documents:

ATEX RL 2014/34/EU	EN IEC 60079-0:2018
	EN 60079-11:2012
EMC RL 2014/30/EU	EN IEC 61000-6-2:2019
	EN IEC 61000-6-4:2019
	EN 61000-6-2:2005
	EN 6100-6-4:2007+A1:2011
RoHS RL 2011/65/EU	EN IEC 63000:2018
SVTI Special fill safety device SM 312836 Water protection suitability according to KVU	KVU 301.001
	KVU 302.004
	KVU 321.003

Bubendorf,   01.06.2021

Roger Inauen
Head Manufacturing

VEZ-EU-KONFORMITÄT-CONFORMITY_AS2-D24-21.docx   21322/1

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