

LCS3050

Low Water Level Switch for one probe

Installation and Maintenance Instructions



1. Safety information
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3. Mechanical installation
4. Electrical installation
5. Commissioning
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1. Safety information

Water level limiters are safety devices and must only be installed, wired and commissioned by qualified and competent staff. Incorrect installation, wiring or commissioning can impact the safe operation of the device.

Retrofitting and maintenance work must only be performed by qualified staff who – through adequate training – have achieved a recognised level of competence.



Danger

The terminal strips of the equipment are live during operation! There is a risk of serious injury due to electric shock!

Always cut off the power supply to the equipment before installing, removing or connecting terminal strips!



Important

The name plate specifies the features of the equipment. Do not commission or operate any item of equipment that does not have its own specific name plate.

1.1 Directives and Standards

Pressure Equipment Directive (PED) 2014/68/EU

Water level limiters are safety accessories as defined in the Pressure Equipment Directive (PED). The level switch LCS3050 in conjunction with level probe LP40 are EU type approved according to EN 12952/EN 12953. These Directives state, among other things, the requirements made on limiting systems and equipment for steam boiler plants and (pressurised) hot-water installations.

Functional Safety acc. to IEC 61508

The level switch LCS3050 is certified acc. to IEC 61508 only if used in combination with level probe LP40. This standard describes the functional safety of safety-related electrical/electronic/programmable electronic systems.

The equipment combination LP40 + LCS3050 corresponds to a type B subsystem with Safety Integrity Level (SIL) 3.

VdTÜV Bulletin “Wasserstand 100” (Water Level 100)

The level switch LCS3050 in conjunction with the level probe LP40 is type approved according to the VdTÜV Bulletin “Water Level 100”.

The VdTÜV Bulletin “Wasserstand (Water Level) 100” specifies the requirements made on water level control and limiting equipment for boilers.

LV (Low Voltage) Directive and EMC (Electromagnetic Compatibility)

The level switch LCS3050 meets the requirements of the Low Voltage Directive 2014/35/EU and the EMC Directive 2014/30/EU.

ATEX (Atmosphère Explosible)

According to the European Directive 2014/34/EU the level switch LCS3050 must not be used in potentially explosive areas.



Note

The level probe LP40 is a simple item of electrical equipment as specified in EN 60079-11 section 5.7. According to the European Directive 2014/34/EU the equipment must be equipped with approved Zener barriers if used in potentially explosive areas. Applicable in Ex-zones 1, 2 (1999/92/EC).

The equipment does not bear an Ex marking.

Note: The requirements of the IEC 61508 are not met if the LP40 + Zener barriers + LCS3050 are interconnected!

1.2 Functional Safety according to IEC 61508

Safety characteristics of the subsystem LP40/LCS3050

The level switch LCS3050 is certified acc. to IEC 61508 if used in combination with level probe LP40.

The combination LP40/LCS3050 corresponds to a type B subsystem with Safety Integrity Level (SIL) 3. Type B means that the behaviour under fault conditions of the used components cannot be completely determined. The functional safety of the equipment combination refers to the detection and evaluation of the water level and, as a consequence, the contact position of the output relays.

The design of the equipment combination LP40/LCS3050 corresponds to the architecture 1oo2. This architecture consists of two channels that detect and diagnose faults in each other. If a fault is detected, the equipment combination LP40/LCS3050 will go to the safe state, which means that the contacts of both output relays will open the safety circuit.

Table 1

Safety characteristics	SIL	Architecture	Lifetime (a)	Proof Test Interval (a)
General	3	1oo2	20	20
	SFF	PFDav	PFHav	λ DU
Level switch LCS3050 in conjunction with one level probe LP40	>90%	$<5 \times 10^{-4}$	$<5 \times 10^{-8}$	$<10 \times 10^{-8}$

1.3 Terms and abbreviations

Table 2

Terms/Abbreviations	Description
Safety Integrity Level/SIL	Classification of the Safety Integrity Level acc. to IEC 61508
Lifetime (a)	Functional safety: Lifetime in years
Safe Failure Fraction/SFF	Percentage of failures without the potential to put the safety-related system into a dangerous state
Probability Failure per Demand (Low Demand)/PFDav	Average probability of failure on demand for low demand mode (once a year)
Probability Failure per Hour/PFHav	Probability of failure per hour
λ_{DU}	Failure rate for all dangerous undetected failures (per hour) of a channel of a subsystem

Determination of the Safety Integrity Level (SIL) for safety-related systems

Level probe, level switch and actuators (auxiliary contactor in safety circuit) are subsystems and together constitute a safety-related system that executes a safety function.

The specification of the safety-related characteristics Table 1 refers to the level probe and the level switch including the output contacts. The actuator (e. g. an auxiliary contactor in the safety circuit) is installation specific and, according to IEC 61508, must be considered separately for the whole safety-related system.

Table 3 shows the dependence of the Safety Integrity Level (SIL) on the average probability of failure on demand of a safety function for the whole safety-related system (PFDsys). The “Low demand mode” is here considered for a water level limiter, which means that the frequency of demands for operation of the safety-related system is no greater than one per year.

Table 3

Low demand mode PFDsys	Safety Integrity Level (SIL)
$\geq 10^{-5} \dots < 10^{-4}$	4
$\geq 10^{-4} \dots < 10^{-3}$	3
$\geq 10^{-3} \dots < 10^{-2}$	2
$\geq 10^{-2} \dots < 10^{-1}$	1

Table 4 indicates the attainable Safety Integrity Level (SIL) as a function of the Safe Failure Fraction (SFF) and the Hardware Fault Tolerance (HFT) for safety-related systems.

Table 4

Hardware Fault Tolerance (HFT) for type B			Safe Failure Fraction (SFF)
0	1	2	
	SIL 1	SIL 2	< 60 %
SIL 1	SIL 2	SIL 3	60 % - < 90 %
SIL 2	SIL 3	SIL 4	90 % - < 99 %
SIL 3	SIL 4	SIL 4	≥ 99 %

2. General product information

2.1 Intended use

The level switch LCS3050 is used in conjunction with level probe LP40 to limit the water level in steam boilers and (pressurised) hot-water plants.

Water level limiters switch off the heating when the water level falls below the set minimum level (low water).

2.2 Function

The level switch LCS3050 is designed for connecting one level probe. See section Schematic representations of arrangements on page 10.

When the water level falls below the low level the level probe is exposed and a low level alarm is triggered in the level switch. This switchpoint is determined by the length of the probe rod (level probe LP40).

After the de-energizing delay has elapsed, the two output contacts of the level switch will open the safety circuit for the heating. The switching-off of the heating is interlocked in the external safety circuit and can only be deactivated when the level probe enters the water again.

In addition, a signal output for an external signaling device closes instantaneously.

An alarm will also be raised if a malfunction occurs in the level probe and/or the electrical connection.

An automatic self-testing routine monitors the safety functions in the level switch and the level probes. In the event of a malfunction the safety circuit opens instantaneously and switches the heating off.

Alarm and error messages are indicated by LEDs and a signal output is energized without delay.

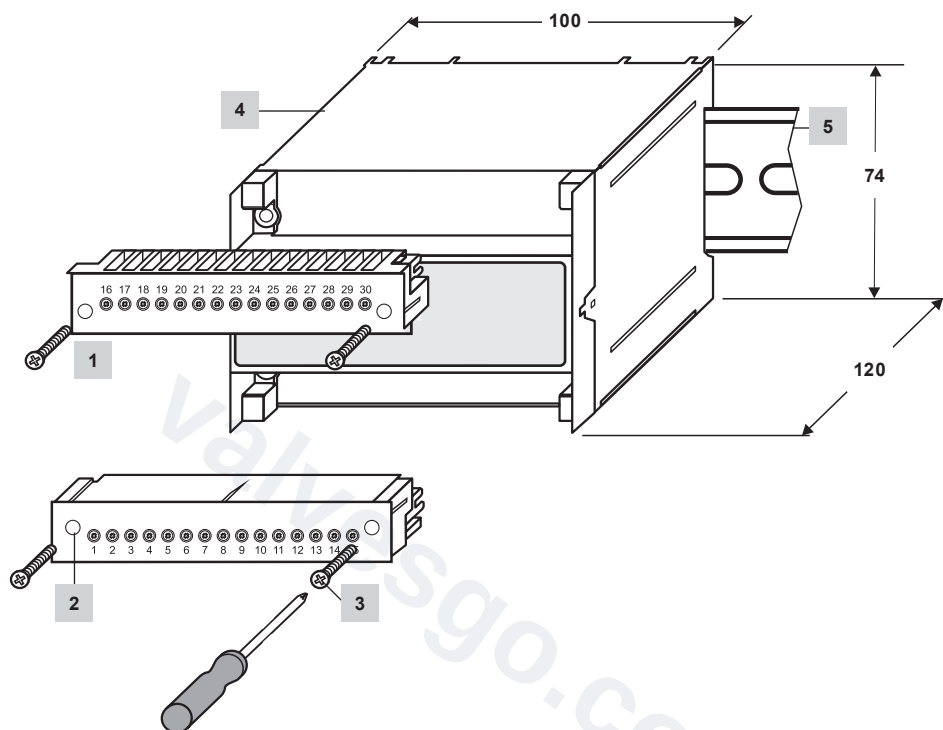
An alarm can be simulated by pressing the test button.



Fig. 1

3. Mechanical installation

3.1 Dimensions (approximate) in mm



Item	
1	Upper terminal strip
2	Lower terminal strip
3	Fixing screws (cross recess head screws M3)
4	Enclosure
5	Supporting rail type TH 35, EN 60715

Fig. 2

3.2 Installation in control cabinet

The level switch LCS3050 is clipped onto the support rail 7 type TH 35, EN 60715 in the control cabinet.

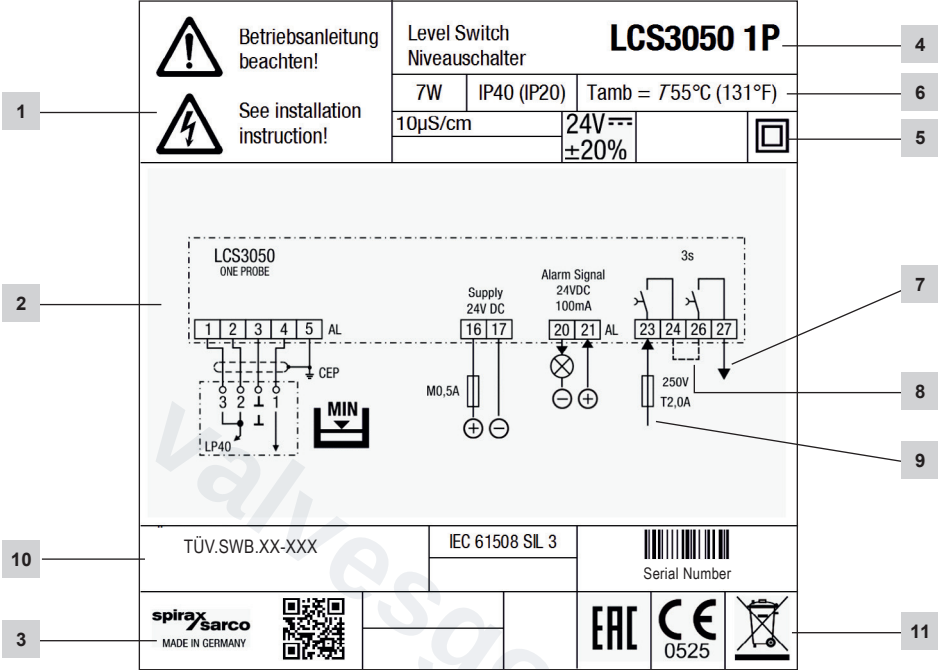
3.3 Installation in a control cabinet door

The BHC Panel Adaptor Large is available which enables the controller to be installed in a control cabinet door.



Fig. 3

3.4 Name plate

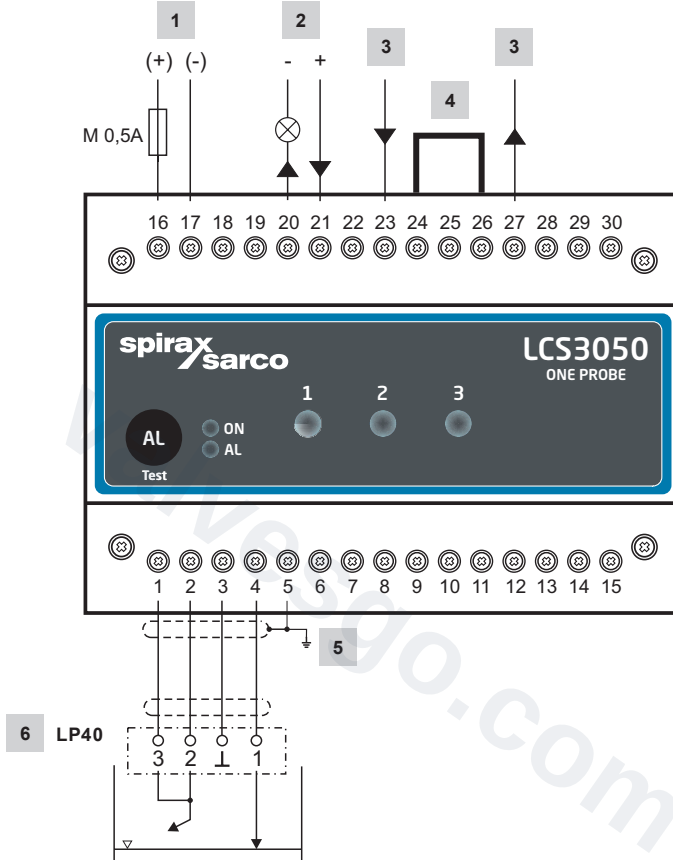


1	Safety note
2	Wiring diagram
3	Manufacturer
4	Type designation
5	Supply voltage/sensitivity
6	Ambient temperature/Protection/Power consumption
7	Safety circuit
8	Wire link,provided on site
9	Fuse, provided on site
10	Type approval no.
11	Disposal note

Fig. 4

4. Electrical installation

4.1 Wiring diagram



Item	
1	Supply voltage
2	Signal output for external alarm 24 Vdc, 100 mA (semiconductor output)
3	Safety circuit, input and output
4	Wire link, on site, when used as water level limiter according to EN 12952 / EN 12953
5	CEP Central earthing point in control cabinet
6	Level probe LP40.

Fig. 5

4.2 Schematic representations of arrangements

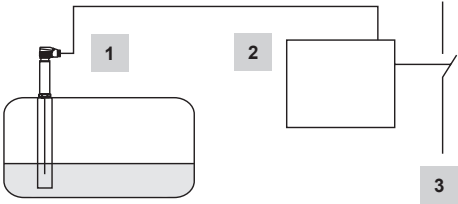


Fig. 6

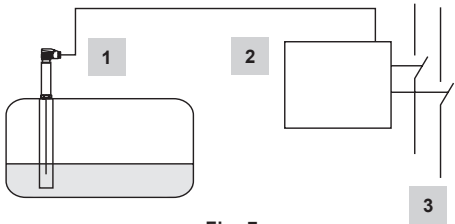


Fig. 7

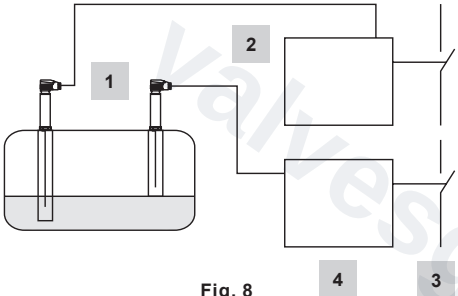


Fig. 8

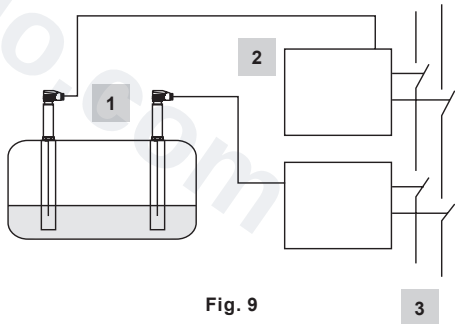


Fig. 9

Item	
1	Level probe(s) LP40
2	Level switch LCS3050
3	Safety circuit
4	Level switch LCS3050 for low-level pre-alarm

4.3 Explanatory notes to schematic representations

- Fig. 6

(Pressurised) hot-water plants and electrically heated steam boilers according to EN 12953-06. Steam boiler plants with high availability according to EN 12952-07 / EN 12953-06, 72h operation. Combination consisting of 1 level probe LP40 and 1 level switch LCS3050 as water level limiter. Functional safety IEC 61508, SIL 3. Hot water installations require two independent and separate water level limiters. For this purpose one equipment combination LP40/LCS3050 shall be installed in the hot-water boiler and the second one in the pressure maintaining vessel, the expansion tank or the like (depending on the type of pressurisation). For electrically heated steam boilers one water level limiter is sufficient. To meet the plant operator's demand for a higher level of availability of the steam boiler plant, two (or three) independent equipment combinations LP40/LCS3050 can be installed in the steam boiler.
- Fig. 7

Combination consisting of 1 level probe LP40 and 1 level switch LCS3050 as water level limiter. The level switch opens two separate safety circuits. Functional safety IEC 61508, SIL 3. Further applications in accordance with national sets of regulations
- Fig. 8

Combination consisting of 1 level probe LP40 and 1 level switch LCS3050 as water level limiter and 1 level probe LP40/1 level switch LCS3050 as first low-level alarm. Functional safety IEC 61508, SIL 3. Further applications in accordance with national sets of regulations
- Fig. 9

Combination consisting of 2 level probes LP40 and 2 level switches LCS3050 as water level limiter. The level switch opens two separate safety circuits. Functional safety IEC 61508, SIL 3. Further applications in accordance with national sets of regulations



Note

Please observe the safety-related characteristics for the equipment combination 1 level probe LP40/level switch LCS3050 on Table 1.

4.4 Supply voltage

Provide the level switch LCS3050 with an external semi-delay fuse 0.5 A.



Danger

For the supply of the level switch LCS3050 with 24 Vdc use a safety extra-low voltage (SELV) power supply unit that must be electrically isolated from dangerous contact voltages and must meet at least the requirements on double or reinforced isolation acc. to EN 50178, EN 61010-1, EN 60730-1, EN 60950-1 or EN 62368-1 (safe isolation).

4.5 Connection of level probe

To connect the level probe please use screened multi-core control cable, min conductor size 0.5 mm², e.g. LiYCY 4 x 0.5 mm², max. length 100 m.

Wire terminal strip in accordance with the wiring diagram Figure 5. Connect screen to terminal 5 and to the central earthing point (CEP) in the control cabinet.

4.6 Connection for signal output

A signal output for the connection of further external signalling equipment is allocated to each monitoring channel in the level switch, max. load 100 mA. For connecting the level switch with the signal output unit use a control cable, 2 x 0.5 mm². In the event of an alarm or error message the signal output (terminals 20, and 21) close instantaneously.

4.7 Connection of safety circuit

Connect the safety circuit for the heating to terminals 23, 24 and 26, 27. When used as water level limiter according to EN 12952 / EN 12953, connect the output contacts of the two monitoring channels by adding a wire link between the terminals 24 and 26.

Provide the output contacts with a 2 A or 1 A (for 72 hours operation) slow-blow fuse.



Note

In the event of an alarm the level switch LCS3050 does not interlock automatically. If a lock function is required by the installation it must be provided in the follow-up circuitry (safety circuit). The circuitry must meet the requirements of the EN 50156.



Important

- Provide the level switch LCS3050 with an external semi-delay fuse 0.5 A.
- Connect screen to terminal 5 and to the central earthing point (CEP) in the control cabinet.
- To protect the switching contacts provide the safety circuit with a slow-blow fuse 2 A or 1.0 A (for 72 hrs. operation acc. to TRD 604).
- When switching off inductive loads, voltage spikes are produced that may impair the operation of control and measuring systems. Connected inductive loads must be provided with suppressors such as RC combinations as specified by the manufacturer.
- When used as water level limiter according to EN 12952 / EN 12953 connect terminals 24 and 26 by adding a wire link.
- Install connecting lines to level probes and logic unit separated from power cables.
- Do not use unused terminals as support point terminals.

4.8 Tools

Screwdriver for slotted screws, size 3.5 x 100 mm, completely insulated according to VDE 0680-1.

5. Commissioning

5.1 Factory setting

- De-energizing delay: 3 sec (factory set).



Danger

The terminal strips of the LCS3050 are live during operation. This presents the danger of electric shock!

Always cut off power supply to the equipment before mounting, removing or connecting the terminal strips!

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5.2 Checking switchpoint and function

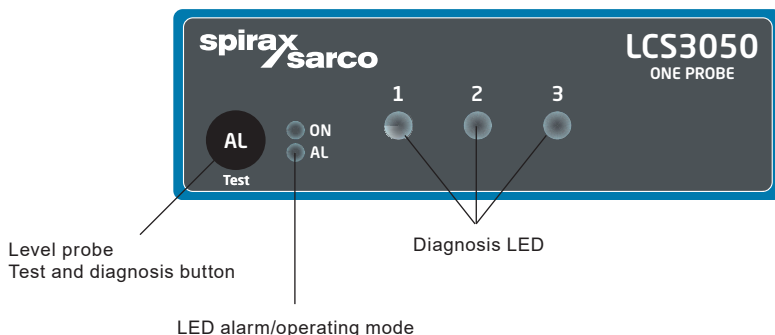


Fig. 10

Start		
Activity	Indication	Function
Apply supply voltage.	All LEDs are illuminated.	System is being started and tested, this takes approx. 10 sec. Output contacts are open. Signal output is closed.
	All LEDs are illuminated for more than 10 sec.	System malfunction. Possible causes: Faulty power supply, level switch defective.
Raise water in boiler until the switchpoint "low water level (LW)" is exceeded. Level probe(s) make(s) contact with the water.	Green LED for level probe is illuminated.	Output contacts are closed. Signal output is open
Checking switchpoint and function		
Lower water level until it is below the switchpoint "low water level (LW)". Level probe is exposed.	Red LED for level probe is flashing.	De-energizing delay is running. Signal output is closed instantaneously.
	Red LEDs for level probe is illuminated.	Delay time has elapsed, output contacts open. Signal output is closed.
Possible installation faults		
Status and indication	Fault	Remedy
Sightglass indicates level below switchpoint "low water (LW)", red LED for level probe is not illuminated. Safety circuit closed.	Probe rod is too long.	Cut probe rod to the length dictated by the switchpoint LW.
	If installed inside the boiler: Upper vent hole in protection tube does not exist or is obstructed.	Check installation of level probe. Make sure that the level in the protection tube corresponds to the actual water level.
Water level sufficient. Red LED for level probe is illuminated! Safety circuit open.	Probe rod is too short.	Replace probe rod and cut new rod to the length dictated by the switchpoint LW.
	The earth connection to the vessel is interrupted.	Clean probe threads and ensure excessive PTFE tape has not been applied.
	Electrical conductivity of the boiler water too low.	Correct water conductivity.
	Upper vent hole flooded.	Check installation of level probe. Make sure that the level in the protection tube corresponds to the actual water level.

5.3 Operation

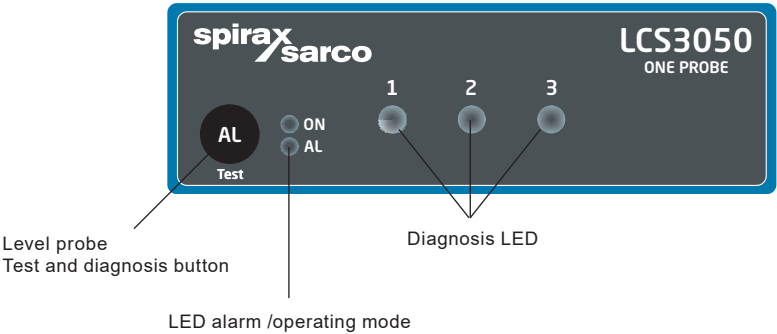


Fig. 11

Operation		
Activity	Indication	Function
Level probe submerged.	Green LED for level probe is illuminated.	Output contacts are closed. Signal output is open.
Alarm		
Level probe exposed, level below low water level (LW).	Red LED for level probe is flashing.	De-energizing delay is running. Signal output is closed instantaneously.
	Red LED for level probe is illuminated.	Delay time has elapsed, output contacts open. Signal output is closed.
Test		
During operation: Press key AL and hold it down until the end of the test, level switch must react as if there was an alarm.	Red LED for level probe is flashing.	Alarm simulated. De-energizing delay is running. Signal output is closed instantaneously.
	Red LED for level probe is illuminated.	Delay time has elapsed, output contacts open. Signal output is closed. Test finished.

6. Fault finding

6.1 Display, diagnosis and troubleshooting

	Important Before carrying out the fault diagnosis please check:
	Supply voltage Is the level switch supplied with the voltage specified on the name plate?
	Wiring Is the wiring in accordance with the wiring diagram and the relevant schematic representation of arrangement?
	Configuration Are the code switch settings 4 and 5 correct for the number of level probes used?

Fault indication			
Status	Diagnosis	Function	Next activity
Faulty evaluation of level probe	Diagnosis LED 1 and LED alarm are illuminated.	Output contacts are opened instantaneously. Signal output closes instantaneously.	next: Press key AL.
Malfunction in level switch detected.	Diagnosis LED 3 and LED alarm are illuminated.	Output contacts are opened instantaneously. Signal output is closed instantaneously.	next: Press key AL.

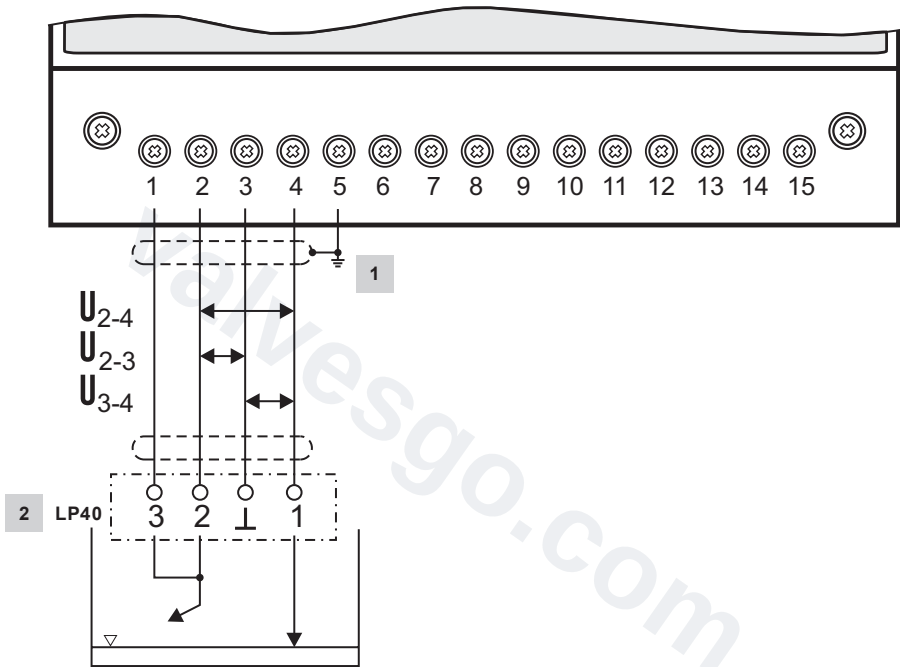
Diagnosis			
Display 1 and activity	Display 2	Fault	Remedy
LED alarm and diagnosis LED 1 illuminated. Press and hold down key AL.	Diagnosis LED 1 flashing.	Malfunction in level probe, malfunction in level switch, faulty wiring, faulty measuring voltage.	– check wiring, – measure probe voltages, clean and, if necessary, – exchange level probe, – exchange level switch.
	Diagnosis LED 2 flashing.	Malfunction in level probe, malfunction in level switch, faulty wiring.	
	Diagnosis LED 3 flashing.	Interference voltage causing malfunction, boiler earth without PE	Provide screen and earthing, connect boiler with PE.
LED alarm and Diagnosis LED 3 illuminated. Press and hold down key AL.	Diagnosis LED 1 flashing.	Malfunction in processor	Replace level switch.
	Diagnosis LED 2 flashing.	Internal voltage fault.	
	Diagnosis LED 3 flashing.	Malfunction in relay.	
Once the fault is eliminated, the level switch returns to normal operation. After elimination of the fault switch off the supply voltage and switch it on again after approx. 5 sec.			

If faults occur that are not listed above or cannot be corrected, please contact our service centre or authorized agency in your country.

6.2 Measuring voltage across level probe

Measure the probe voltage in order to check whether the level probe is immersed or if there is a malfunction. Please observe Figure 12.

U_{2-4}	U_{3-4}		U_{2-3}
	immersed	exposed	Malfuction (immersed/ alarm)
$\approx 0.7\text{ V}$ 85 Hz!	$< \frac{U_{2-4}}{2}$	$\geq \frac{U_{2-4}}{2}$	$\leq U_{3-4}$



Item	
1	CEP Central earthing point in control cabinet
2	Level probe LP40.

Fig. 12

Note

The self-checking routine of the level switch LCS3050 reduces U_{2-4} to 0 Volt, if executed cyclically.

6.3 Action against high frequency interference

Should sporadic failures occur in installations susceptible to faults (e. g. malfunctions due to out-of-phase switching operations) we recommend the following actions in order to suppress interferences:

- Provide inductive loads with RC combinations according to manufacturer's specification to ensure interference suppression.
- Make sure that connecting cables leading to the level probes are segregated and run separately from power cables.
- Increase the distance to sources of interference.
- Check the connection of the screen to the central earthing point (CEP) in the control cabinet.
- HF interference suppression by means of hinged-shell ferrite rings.

6.4 Interlock and interlock deactivation

In the event of an alarm the level switch LCS3050 does not interlock automatically.

If a lock function is required by the installation it must be provided in the follow-up circuitry (safety circuit). The circuitry must meet the requirements of the EN 50156.

6.5 Checking the switchpoints

To check the switchpoint "Low water (LW)" you have to lower the water level. When the water level falls below the probe tip, the level switch must activate an alarm and the safety circuit must open as soon as the de-energizing time delay has elapsed. The switching-off of the heating is interlocked in the safety circuit and can only be deactivated when the level probe enters the water again. In this case the LED for alarm must be illuminated and no malfunction must be indicated (diagnosis LEDs are not illuminated). Always check the switchpoint when commissioning the equipment, after replacing the level probe and at regular intervals, e.g. every year.

6.6 Decommissioning/replacing level switch

- Switch off supply voltage and cut off power supply to the equipment.
- Unscrew the right and left fixing screws 3 and remove the upper and lower terminal strips 1, 2. See Figure 2.
- Release the white fixing slide at the bottom of the equipment and take the equipment off the supporting rail.

6.7 Disposal

For the disposal of the level switch observe the pertinent legal regulations concerning waste disposal.

7. Technical information

Supply voltage	24 Vdc +/- 20%
External fuse	0.5 A (semi-delay)
Power consumption	7 W
Response sensitivity (Electrical conductivity of water at 25 °C)	> 10 ... < 10000 µS/cm
Electrical connection of level probe	1 input for level probe LP40, 4 poles, with screen.
Safety circuit	2 volt-free make contacts, 6 A 250 Vac/30 Vdc cos φ = 1.
	Delay of response: 3 seconds.
	Provide inductive loads with RC combinations according to manufacturer's specification to ensure interference suppression.
Signal output	1 volt-free output for instantaneous external signalling, 24 Vdc, max. 100 mA (semiconductor output).
Indicators and adjustors	1 button for test and diagnosis,
	1 red, 1 green LED for indicating the operating mode and alarm.
	3 red LEDs for diagnosis,
Housing	Housing material: base: polycarbonate, black; front: polycarbonate, grey.
	Maximum Conductor size* Cross section of connection: 1 x 4.0 mm² solid per wire or 1 x 2.5 mm² per stranded wire with sleeve to DIN 46228 or 2 x 1.4 mm² per stranded wire with sleeve to DIN 46228. *Please see section 4.5 - 4.6 for recommended cable specifications
	Terminal strips can be detached separately
	Fixing of housing: Mounting clip on supporting rail TH 35, EN 60715
Electrical safety	Degree of contamination: 2, overvoltage category III to EN 61010-01.
Protection	Housing: IP 40 to EN 60529
	Terminal strip: IP 20 to EN 60529
Weight	approx. 0.5 kg

Further conditions:	
Ambient temperature	when system is switched on: 0 ° ... 55 °C during operation: -10 ... 55 °C
Transport temperature	-20 ... +80 °C (<100 hours), defrosting time of the de-energized equipment before it can be put into operation: 24 hours.
Storage temperature	-20 ... +70 °C, defrosting time of the de-energized equipment before it can be put into operation: 24 hours.
Relative humidity	max. 95%, no moisture condensation
Site altitude	max. 2000 m
Approvals:	PED Pressure Equipment Directive 2014/68/EU EU type approval EN 12952-11, EN 12953-09: Requirements made on limiting equipment for boilers.
	Functional safety IEC 61508 Functional safety of safety-related electrical/electronic/programmable electronic systems SIL 3
	TÜV type approval VdTÜV Bulletin "Wasserstand 100" (Water Level 100): Requirements made on water level limiting & control equipment. Type approval no. TÜV · SWB · XX -XXX (see name plate)

Content of package

1 x Level switch LCS3050 for one probe

1 x Installation manual

8. Technical assistance

Contact your local Spirax Sarco representative. Details can be found on accompanying order/delivery documentation or on our web site:

www.spiraxsarco.com

Returning faulty equipment

Return all items to your local Spirax Sarco representative. Ensure all items are suitably packed for transit (preferably in the original cartons).

Please provide the following information with any equipment being returned:

1. Your name, company name, address and telephone number, order number and invoice and return delivery address.
2. Description and serial number of equipment being returned.
3. Full description of the fault or repair required.
4. If the equipment is being returned under warranty, please indicate:
 - a. Date of purchase.
 - b. Original order number.

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