

LCS3051

High Water Level Switch

Installation and Maintenance Instructions



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1. Safety information

High water level alarms 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 LCS3051 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!



Important

The name plate specifies the technical features of the equipment. Note that any piece of equipment without its specific name plate must neither be commissioned nor operated.

1.1 Directives and Standards

Pressure Equipment Directive (PED) 2014/68/EU

The level switch LCS3051 in conjunction with level probe LP41 is 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 according to IEC 61508

The level switch LCS3051 is certified according to IEC 61508 only if used in combination with level probe LP41. This standard describes the functional safety of safety-related electrical/electronic/programmable electronic systems.

The equipment combination LP41 + LCS3051 corresponds to a type B subsystem with Safety Integrity Level (SIL) 2.

VdTÜV Bulletin “Wasserstand 100” (Water Level 100)

The level switch LCS3051 in conjunction with the level probe LP41 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 LCS3051 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 LCS3051 must not be used in potentially explosive areas.



Note

The level probe LP41 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 LP41 + Zener barriers + LCS3051 are interconnected!

1.2 Functional Safety according to IEC 61508

Safety characteristics of the subsystem LP41/LCS3051

The level switch LCS3051 is certified acc. to IEC 61508 only if used in combination with level probe LP41.

The equipment combination LP41/LCS3051 corresponds to a type B subsystem with Safety Integrity Level (SIL) 2. 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 LP41/LCS3051 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 LP41/LCS3051 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	2	1oo2	20	20
	SFF	PFD _{av}	PFH _{av}	λ DU
Level switch LCS3051 in conjunction with one level probe LP41	>90%	<5 x 10 ⁻³	<5 x 10 ⁻⁷	<5 x 10 ⁻⁷ /h

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 contactors 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 (PFD_{sys}). 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 PFD _{sys}	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 LCS3051 is used in conjunction with level probe LP41 as high level alarm in steam boilers and (pressurised) hot-water plants.

A high level alarm prevents the water level from exceeding the preset max. water level (HW) and for this purpose switches off e. g. the feedwater supply.

2.2 Function

The level switch LCS3051 is designed for connecting one level probe. See section Schematic representations of arrangements on page 10.

When the water level exceeds the MAX limit, the level probe enters the liquid and an alarm is triggered in the level switch. This switchpoint is determined by the length of the probe rod (level probe LP41).

After the de-energizing delay has elapsed, both output contacts of the level switch will open the safety circuit, e. g. for the feedwater supply. If the deactivation of the feedwater supply is interlocked in the external safety circuit, the lockout can only be deactivated when the level probe is exposed again.

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 of the level switch. In the event of a malfunction the safety circuit opens instantaneously and switches off e. g. the feedwater supply.

Alarm and malfunction messages are indicated by LEDs, and the signal output is instantaneously energized. An alarm can be simulated by pressing the test button.



Fig. 1

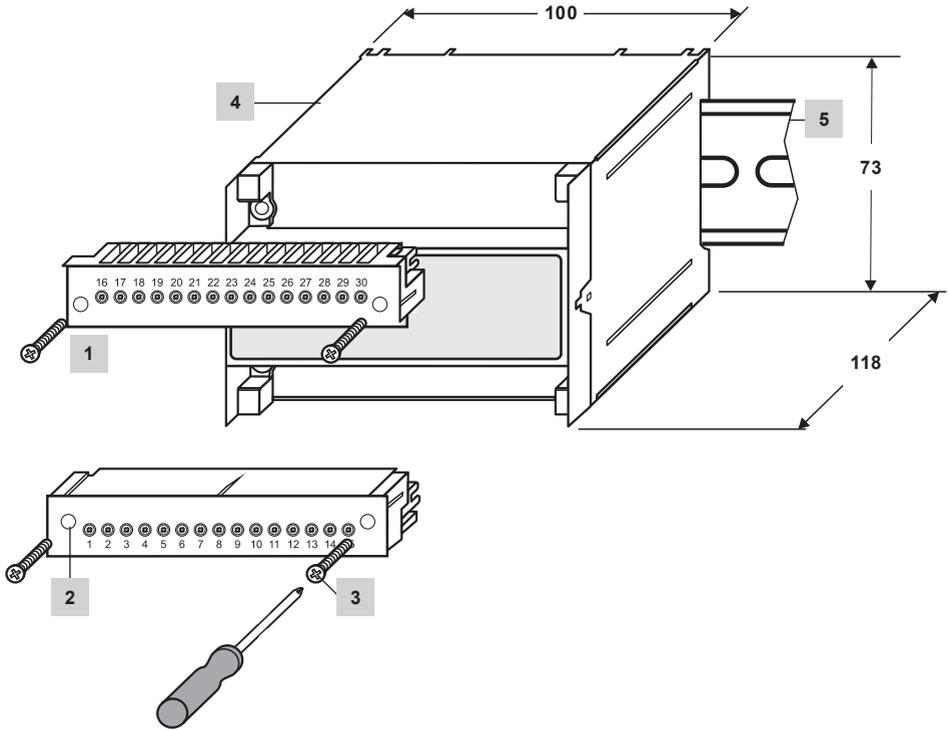


Note

A high level alarm prevents the water level from exceeding the preset max. liquid level (HW). For this purpose it can, for instance, interrupt the feedwater supply. If the interruption of the feedwater supply endangers the heating surfaces in the feedwater preheater (economizer), the heating must be switched off, too.

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

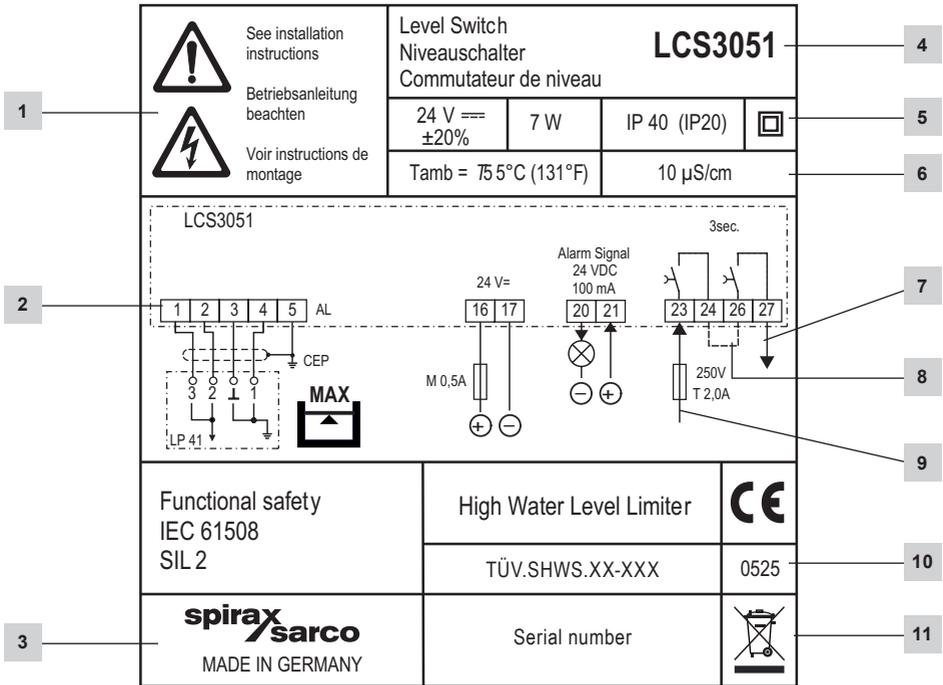
Fig. 2

The code switches are accessible after removing the lower terminal strip. The terminal strips can be unplugged after undoing the right and the left fixing screws.

3.2 Installation in control cabinet

The level switch LCS3051 is clipped onto the support rail 7 type TH 35, EN 60715 in the control cabinet.

Name-plates

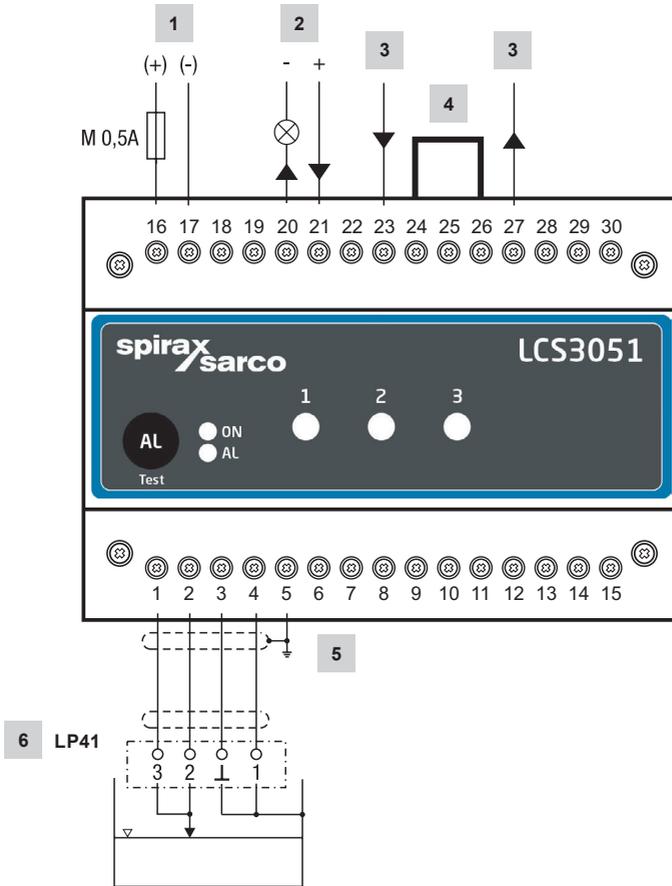


1	Safety note
2	Wiring diagram
3	Manufacturer
4	Type designation
5	Supply voltage/Protection
6	Ambient temperature/sensitivity
7	Safety circuit
8	Wire link, provided on site
9	Fuse, provided on site
10	Type-approval no.
11	Disposal note

Fig. 3

4. Electrical installation

4.1 Wiring diagram



Item	
1	Power supply
2	Signal output 1 for external alarm 24 Vdc, 100mA (semiconductor output)
3	Safety circuit, input and output
4	Wire link, fitted on site, when used as high water level alarm acc. to EN 12952/EN 12953
5	CEP Central earthing point in control cabinet
6	Level probe LP41.

Fig. 4

LCS3051 High Water Level Switch

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4.2 Schematic representations of arrangements

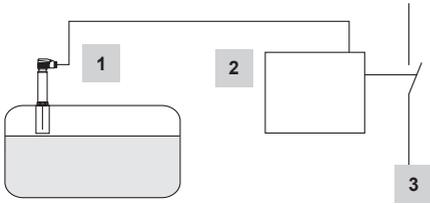


Fig. 5

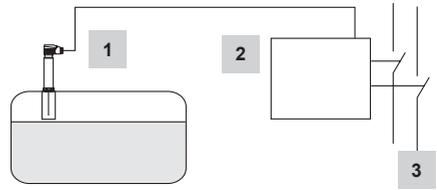


Fig. 6

Item	
1	Level probe LP41
2	Level switch LCS3051
3	Safety circuit

Steam boiler plants according to EN 12952-07/EN 12953-06, 72 h operation

Fig. 5 Combination consisting of 1 level probe LP41 and 1 level switch LCS3051 as high water level alarm. Functional safety IEC 61508, SIL 2.

Further applications in accordance with national sets of regulations

Fig. 6 Combination consisting of 1 level probe LP41 and 1 level switch LCS3051 as high water level alarm. The level switch opens two separate safety circuits. Functional safety IEC 61508, SIL 2.

4.3 Connection of supply voltage

Provide the level switch LCS3051 with an external semi-delay fuse 0.5 A.

	<p>Danger</p> <p>For the supply of the level switch LCS3051 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 electrical isolation).</p>
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4.4 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. Fig. 4. Connect screens to terminal 5 and to the central earthing point (CEP) in the control cabinet.

4.5 Connection for signal output

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

4.6 Connection of safety circuit

Connect the safety circuit for the feedwater supply/heating to terminals 23, 24 and 26, 27. When used as high water level alarm to EN 12952/EN 12953 connect the output contacts of both monitoring channels by fitting a wire link between the terminals 24 and 26.

Fuse the output contacts with a 2 A or 1 A slow-blow fuse.



Note

- A high level alarm prevents the water level from exceeding the preset max. liquid level (HW). For this purpose it can, for instance, interrupt the feedwater supply. If the interruption of the feedwater supply endangers the heating surfaces in the feedwater preheater (economizer), the heating must be switched off, too.
- In the event of an alarm the level switch LCS3051 does not interlock automatically. If a lockout 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

- Fuse the level switch LCS3051 with an external semi-delay fuse 0.5 A.
- Connect screens to terminal 5 and to the central earthing point (CEP) in the control cabinet.
- To protect the switching contacts fuse the safety circuit with a slow-blow fuse 2 A or 1 A.
- 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 high water level alarm according to EN 12952/EN 12953 connect terminals 24 and 26 by fitting a wire link.
- Install connecting lines to level probes separated from power cables.
- Do not use unused terminals as support point terminals.

4.7 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).

	<p>Danger</p> <p>The terminal strips of the LCS3051 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!</p>
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5.2 Checking switchpoint and function

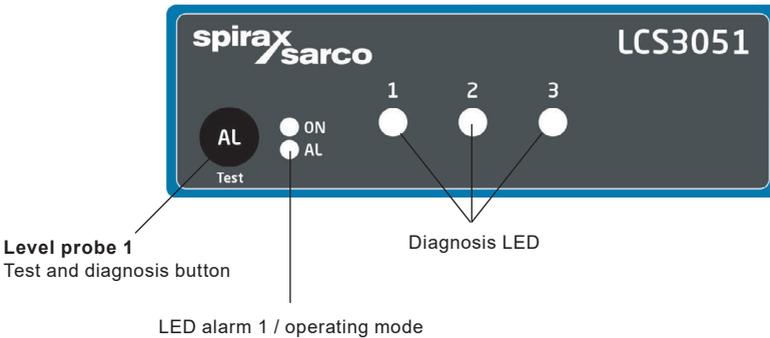


Fig. 7

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 1 closed.
	All LEDs are illuminated for more than 10 sec.	System malfunction. Possible causes: Faulty power supply, level switch defective.
Lower water level in boiler until the level falls below the switchpoint high water level (HW). Level probe is exposed.	Green LED for level probe 1 is illuminated	Output contacts are closed. Signal output 1 is open.
Checking switchpoint and function		
Raise level in boiler until the switchpoint "high water level (HW)" is exceeded. Level probe enters the water.	Red LED for level probe 1 is flashing	De-energizing delay is running. Signal output 1 is closed instantaneously.
	Red LED for level probe 1 is illuminated	Delay time has elapsed, output contacts open. Signal output 1 is closed.

Possible installation faults		
Status and indication	Fault	Remedy
Sightglass indicates high water level (HW) exceeded, red LED for level probe 1 is not illuminated. Safety circuit closed.	The probe rod is too short.	Replace probe rod and cut new rod to the length dictated by the switchpoint HW.
	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.
	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 1 is illuminated. Safety circuit is open.	Probe rod is too long.	Cut probe rod to the length dictated by the switchpoint HW.
	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, Alarm and Test

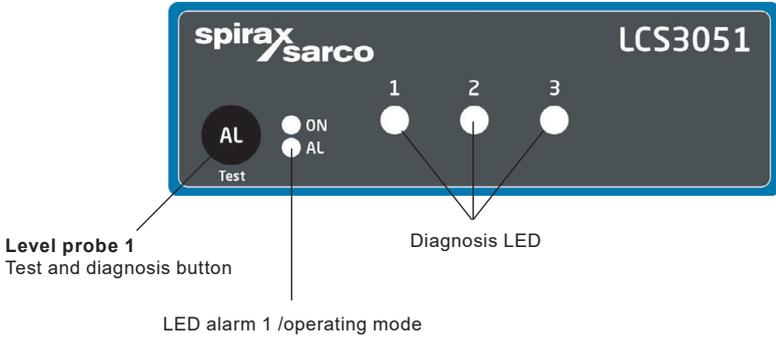


Fig. 8

Operation		
Activity	Indication	Function
Level probe exposed	Green LED for level probe 1 is illuminated	Output contacts are closed. Signal output 1 is open.
Alarm		
Level probe submerged, high water level (HW) exceeded.	Red LED for level probe 1 is flashing	De-energizing delay is running. Signal output 1 is closed instantaneously.
	Red LED for level probe 1 is illuminated	Delay time has elapsed, output contacts open. Signal output 1 is closed.
Test channel 1		
During operation:		
Press and hold down key 1 until the end of the test, level switch must function as if there were an alarm.	Red LED for level probe 1 is flashing	Alarm simulated in channel 1. De-energizing delay is running. Signal output 1 is closed instantaneously.
	Red LED for level probe 1 is illuminated	Delay time has elapsed, output contacts open. Signal output 1 is closed. Test finished.
Replace level switch if the test was not finished successfully.		

6. Fault finding

6.1 Display, diagnosis and troubleshooting

	<p>Important Before carrying out the fault diagnosis please check:</p>
	<p>Supply voltage Is the level switch supplied with the voltage specified on the name plate?</p>
	<p>Wiring Is the wiring in accordance with the wiring diagram and the relevant schematic representation of arrangement?</p>

Malfunction in level probe		
Status	Fault	Remedy
Water level sufficient. Red LED for level probe 1 is illuminated. Safety circuit is open.	The insulation of the level probe is dirty or faulty.	Clean or, if necessary, replace level probe.

Further fault indications			
Status	Diagnosis	Function	Next activity
Faulty evaluation of level probe 1, channel 1	Diagnosis LED 1 and LED alarm 1 illuminated.	Output contacts are opened instantaneously. Signal output 1 closes instantaneously.	next: Press key AL.
Malfunction in level switch detected.	Diagnosis LED 3 and LED alarm 1 or 2 illuminated.	Output contacts are opened instantaneously. Signal output 1 closes instantaneously.	next: Press key AL.

Diagnosis			
Display 1 and activity	Display 2	Fault	Remedy
LED alarm 1 and diagnosis LED 1 illuminated. Press and hold down key AL.	Diagnosis LED 1 flashing.	Malfunction in level probe 1, malfunction in level switch, faulty wiring, faulty measuring voltage.	Check wiring, replace level switch.
	Diagnosis LED 2 flashing.	Malfunction in level probe 1, 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 1 and Diagnosis LED 3 illuminated. Press and hold down key AL.	Diagnosis LED 1 flashing.	Malfunction in processor, stand-by fault.	Replace level switch.
	Diagnosis LED 2 flashing.	Internal voltage fault.	
	Diagnosis LED 3 flashing.	Malfunction in relay.	
<p>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.</p>			

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 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.

6.3 Interlock and interlock deactivation

In the event of an alarm the level switch LCS3051 does not interlock automatically.

If a lockout 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.

6.4 Checking the switchpoints

To check the switchpoint "High water level (HW) exceeded" you have to fill the boiler until the max. water level is reached. As soon as the high level is reached the level switch must trigger an alarm and open the safety circuit after the de-energizing delay has elapsed. The deactivation of the heating is interlocked in the safety circuit and the lockout can only be reset when the level probe is exposed again. Always check the switchpoint when commissioning the equipment, after replacing the level probe and at regular intervals, e. g. every year.

6.5 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, Fig. 2
- Undo the fixing slide in order to snap out the level switch and take it off the supporting rail.

6.6 Disposal

Remove the level switch and separate the waste materials in accordance with the material specification.

Electronic component parts such as the circuit board must be disposed of separately!

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 LP41, 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/green LED for indicating the operating mode and alarm
	3 red LEDs for diagnosis
Housing	Housing material: base: polycarbonate, black; front: polycarbonate, grey. Cross section of connection: 1 x 4.0 mm ² solid per wire or 1 x 2.5 mm ² per stranded wire with sleeve to DIN 46228 or 2 x 1.4 mm ² per stranded wire with sleeve to DIN 46228; terminal strips can be detached 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	EU type approval	Pressure Equipment Directive (PED) EN 12952-11, EN 12953-09: Requirements made on limiting equipment for boilers
	Functional safety SIL 2	IEC 61508 Functional safety of safety-related electrical/ electronic/ programmable electronic systems
	TÜV type approval	VdTÜV Bulletin "Wasserstand 100" (Water Level 100): Requirements made on water level limiting & control equipment. Type approval no. TÜV · SHWS · XX-XXX (see name plate)

Contents of package

1 x Level switch LCS3051

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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