

LCR2251

Level Controller

Installation and Maintenance Instructions



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1. Safety information

The equipment may only be installed, electrically connected and commissioned by suitable persons with the relevant instruction/training.

Maintenance and modification may only be performed by authorised staff who have undergone specific instruction/training.



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.

Directives and standards

VdTÜV Bulletin "Wasserstand 100" (Water Level 100)

The LCR2251 level controller, in combination with the LP20/LP21 capacitance probe and PA420 level transmitter, is type approved to the VdTÜV Bulletin "Water Level 100".

The VdTÜV "Wasserstand (=Water Level) 100" describes the requirements for water level control and limiting equipment for boilers.

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

The equipment conforms to the requirements of the Low Voltage Directive 2014/35/EU and the EMC Directive 2014/30/EU.

ATEX (Atmosphère Explosible)

The equipment must not be used in potentially explosive atmospheres, in accordance with European Directive 2014/34/EU.

2. General product information

2.1 Intended use

The LCR2251 level controller is used in combination with the LP20/LP21 capacitance probe and PA420 level transmitter as a limit switch and water level controller, e.g. in steam and water boiler systems, or in condensate and feedwater tanks. The level controller indicates when a MIN and MAX water level has been reached, and controls a control valve or pump.

2.2 Function

The LCR2251 level controller processes the level-dependent current signal from the LP20/LP21 capacitance probe and PA420 level transmitter. This input signal is recognised by the controller as 0 and 100 % of the boiler measuring range, and shown as an actual value on the 7-segment LED display. The controller is suitable for use with liquids having an electrical conductivity of 5 $\mu\text{S}/\text{cm}$ or 5 ppm, when used with LP20/LP21 capacitance probe and PA420 level transmitter.

The level controller works with an electro-pneumatically actuated control valve as a continuous controller with proportional-plus-integral control (PI controller). In the event of deviations from the setpoint, it outputs a current of 4-20 mA as manipulated variable Y.

Alternatively the controller can be configured to control a pump (on/off control) and transmit a 4 - 20 mA signal to provide an external level indication (actual value output).

The controller can be configured for fill or discharge control.

If the MIN or MAX water level is reached, after the de-energizing delay the MIN or MAX output contact switches over in the level controller, and the MIN or MAX LED lights up.

Faults in the level transmitter, the electrical connection or the settings are indicated as error codes on the 7-segment LED display. In the event of a malfunction, the MIN and MAX alarm is triggered.

If faults occur only in the LCR2251 level controller, the MIN and MAX alarm is triggered and the system is restarted.

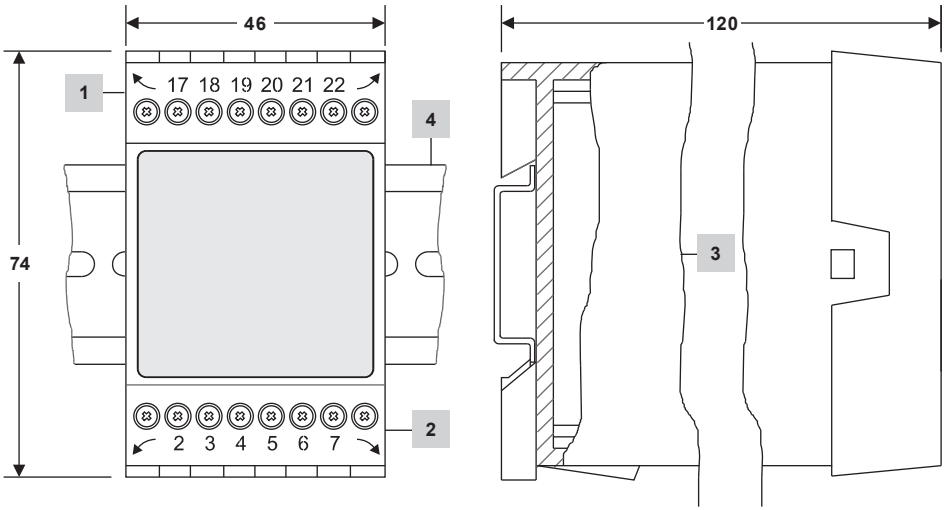
Parameters can be changed or the MIN/MAX alarm simulated by operating the push buttons.



Fig. 1

3. Mechanical installation

3.1 Dimensions (approximate) in mm



Item	
1	Upper terminal strip
2	Lower terminal strip
3	Housing
4	Support rail TH 35, EN 60715

Fig. 2

3.2 Installation in control cabinet

The LCR2251 level controller is clipped onto a type TH 35, EN 60715 support rail in the control cabinet. Fig. 2, item 4

3.2 Installation in a control cabinet door

The BHC Panel Adaptor Small (SXS Part Number 441549) is available which enables the controller to be installed in a control cabinet door.



Fig. 3

3.3 Name plates

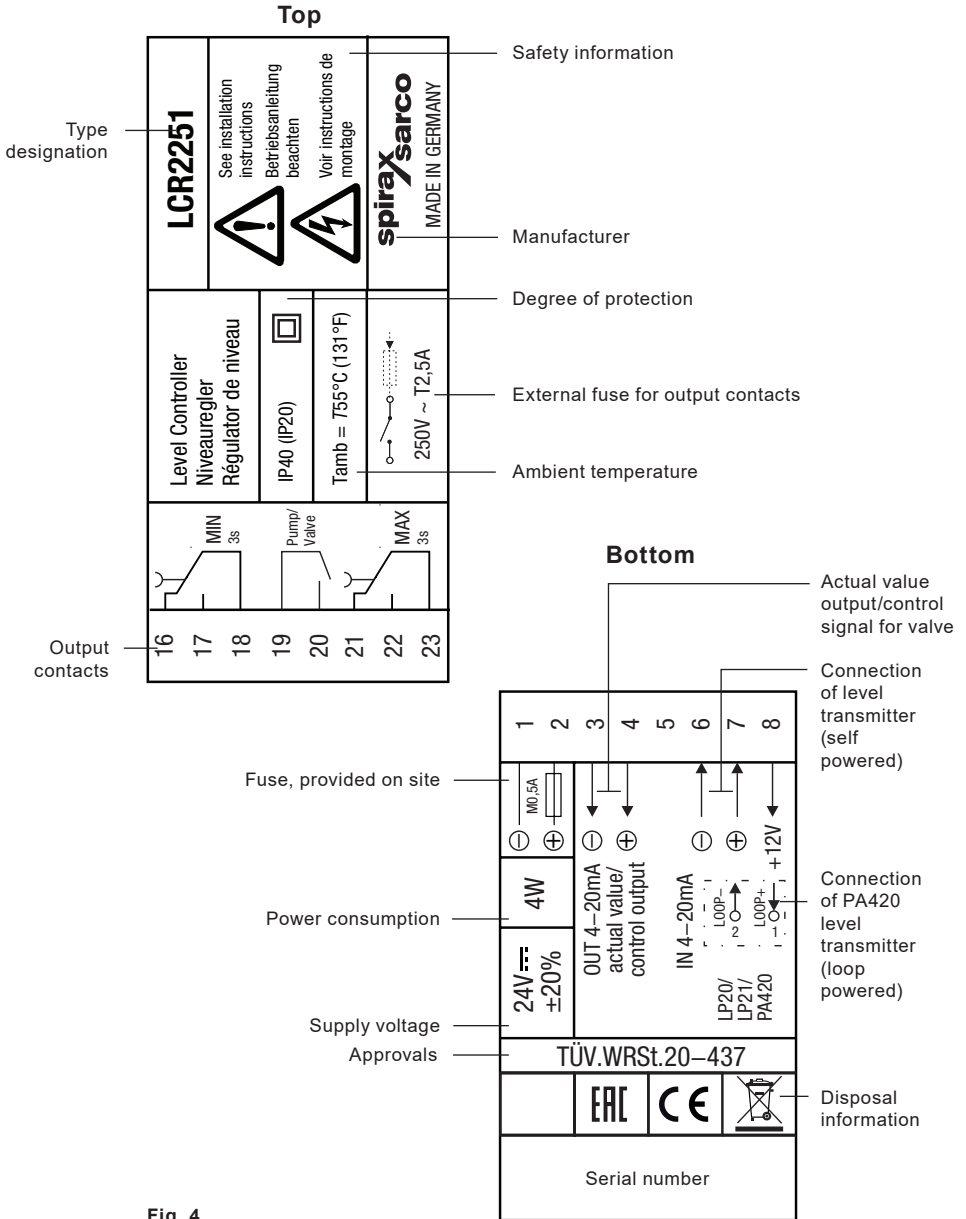
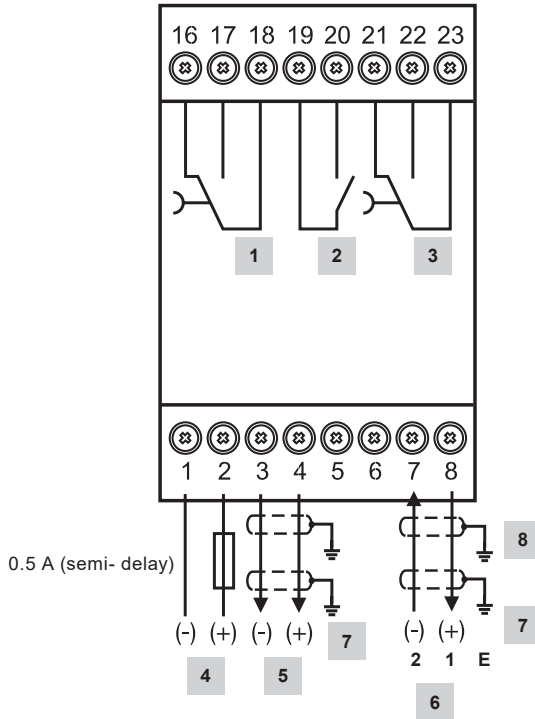


Fig. 4

4. Electrical installation

4.1 Wiring diagram



Item	
1	MIN output contact, de-energizing delay 3 seconds
2	Pump output contact. Not used in continuous controller
3	MAX output contact, de-energizing delay 3 seconds
4	Supply voltage connection 24 Vdc with semi-delay fuse 0.5 A provided on site
5	Valve control output 4-20 mA, manipulated variable Y for continuous controller or actual value output for ON/ OFF controller (pump control)
6	Level transmitter input 4-20 mA (PA420 + LP20/LP21)
7	Earthing point at auxilliary equipment (e.g.PA420/LP20/LP21)
8	Central earthing point (CEP) in control cabinet

Fig. 5

On/off control

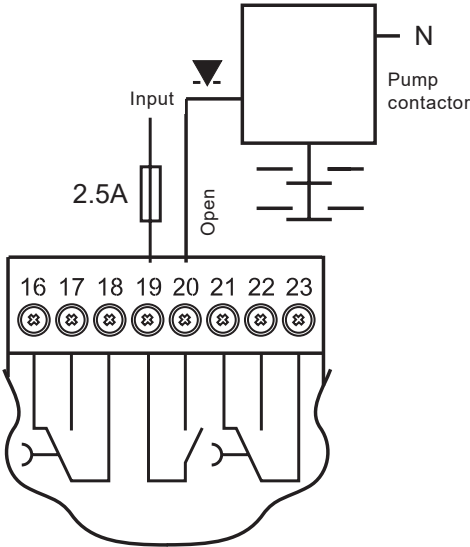


Fig. 6a
Example of Valve On/Off control

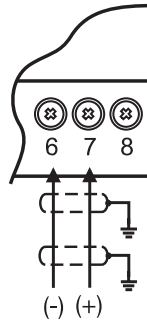


Fig. 6b
Connection of 4-20 mA level transmitter
(self powered)

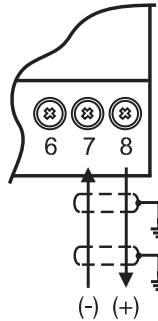


Fig. 6c
Connection of PA420 level transmitter
(loop powered)

4.2 Supply voltage connection

The equipment must be supplied with 24 Vdc from a SELV (Safety Extra Low Voltage) power supply. An external 0.5A semi-delay fuse must also be fitted.

This power supply unit must be electrically isolated from dangerous live voltages and meet the requirements for double or reinforced insulation in accordance with one of the following standards:

EN 50178, EN 61010-1, EN 60730-1, EN 60950-1 or EN 62368-1.

4.3 Connection of output contacts

Wire the upper terminal strip 1 (terminals 16-23), shown in Figure 2, according to the desired switching functions after (see Fig. 5 and Fig. 6a). Provide an external slow-blow 2.5 A fuse for the output contacts.

When inductive loads are switched off, voltage spikes are produced that may have a major adverse effect on the operation of control and measuring systems. Connected inductive loads must therefore have interference suppression (RC combination) as per the manufacturer's specifications.

4.4 Connecting the level transmitter

For connecting the equipment, please use a screened, multi-core control cable with a minimum conductor size of 0.5 mm², e.g. LiYCY 2 x 0.5 mm², maximum length 100 m.

Wire the terminal strip as shown in the wiring diagram (see Fig. 5 and Fig. 6b/6c).

Connect the screen as shown in the wiring diagram.

Route the connecting cable between items of equipment separately from power lines.

4.5 Output of manipulated variable Y or connection of actual value output

For connection, please use a screened, multi-core control cable with a minimum conductor size of 0.5 mm², e.g. LiYCY 2 x 0.5 mm², maximum length 100 m. Please note the load of max. 500 ohms.

Wire the terminal strip as shown in the wiring diagram (Fig. 5).

Connect the screen as shown in the wiring diagram (Fig. 5). Route the connecting cable between items of equipment separately from power lines.

Any item of equipment that you wish to connect to the terminals for the output of manipulated variable Y or actual value output 4-20 mA must be certified to have at least double or reinforced insulation to EN 50178, EN 61010-1, EN 60730-1, EN 60950-1 or EN 62368-1. between the current loop and live parts of the equipment that are not supplied with safety extra-low voltage (SELV).



Important

Do not use unused terminals as support point terminals.

4.6 Tools

Screwdriver size 3.5 x 100 mm, fully insulated to VDE 0680-1.

4.7 Connection of level transmitter

The LCR2251 level controller can be combined with the LP20/LP21 capacitance probe and PA420 level transmitter.

For connecting the equipment, please use a screened, multi-core control cable with a minimum conductor size of 0.5 mm², e.g. LiYCY 2 x 0.5 mm², maximum length 100 m.

Connect the screen as shown in the wiring diagram (Fig. 5).



Important

- Please commission the equipment as described in the LP20/LP21/PA420 installation and operating manuals.
- Route the connecting cable between items of equipment separately from power lines.

5. Commissioning

5.1 Factory settings

- De-energizing delay: 3 sec. (factory set)
- Current input for the connection of LP20/LP21 capacitance probe and PA420 level transmitter
- MAX switchpoint AL.Hi = 80 %
- MIN switchpoint AL.Lo = 20 %
- Setpoint SP = 50 % (continuous controller) or SP.Hi = 60% and SP.Lo = 40% (ON/OFF controller)
- Proportional band Pb = 20 % of setpoint (continuous controller only)
- Integral action time ti = 0 s (continuous controller only)
- Dead band = +/- 5 % of setpoint (factory set)
- Filter = 2 s
- Fill control function

Code switch **C**: S1 = OFF, S2 = OFF, S3 = ON, S4 = ON

See Figure 9

5.2 Changing factory settings



Danger

The upper terminal strip of the equipment is 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 the terminal strip!

5.3 Changing the function and input of the level transmitter

The input and function are determined by the setting of code switch **C**. To make changes, you can access the code switch as follows:

- Switch off the supply voltage.
- Remove the lower terminal strip (Fig. 9).
- Insert a screwdriver between the terminal strip and the front frame, to the right and left of the arrow markings.
- Release the terminal strip on the right and left sides, by turning the screwdriver in the direction of the arrow.
- Remove the terminal strip.

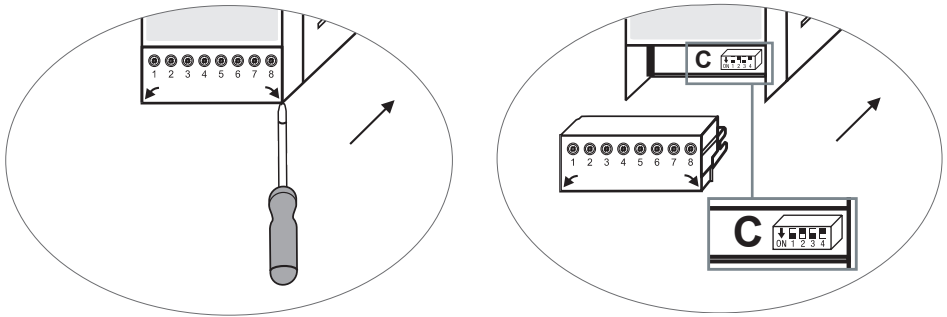



Fig. 9

When your changes are complete:


- Refit the lower terminal strip.
- Switch the supply voltage back on. The equipment restarts.

If you wish to change the input or the function, set code switch C S1 to S4 in accordance with Table 1 below.

Table 1

Code switch C	 Toggle switch, white			
	S 1	S 2	S 3	S 4
Level controller LCR2251				
Not used	OFF			
	ON			
Not used			OFF	
Input for connection of level transmitter LP20/LP21/PA420 *			ON	
Fill control		OFF		
Discharge control		ON		
Continuous PI controller				OFF
On/Off level controller				ON

grey = factory setting


	<p>Important</p> <p>* Set the upper and lower ends of the measuring range only in the transmitter.</p> <p>Here, please pay attention to the LP20/LP21/PA420 installation and operating manual.</p> <p>Do not change the code switch C settings of S4!</p>
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5.4 Meaning of codes on the 7-segment display



Fig. 10

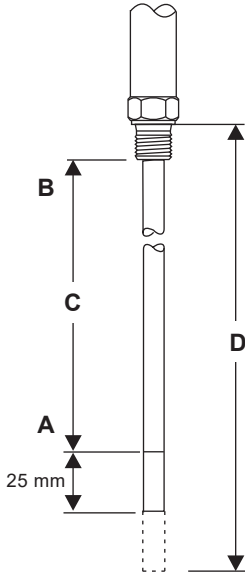
Code	Meaning	
Indicated when up and down are pressed:		
ON/OFF Level Controller (S4 = ON)		
AL.Hi	Alarm High	MAX switchpoint
AL.Lo	Alarm Low	MIN switchpoint
SP.Hi	Setpoint High	Pump OFF**
SP.Lo	Setpoint Low	Pump ON**
tEst	Test	Tests output relays
FiLt	Filter	Used to dampen the effects of turbulent water level
Continuous PI controller (S4 = OFF)		
AL.Hi	Alarm High	MAX switchpoint
AL.Lo	Alarm Low	MIN switchpoint
SP	Setpoint	Setpoint
Pb	Proportional band	adjustable between 0 and 100 %
ti	Time integral	Integral action time, adjustable between 0 and 120 seconds
tEst	Test	Tests output relays
FiLt	Filter	Used to dampen the effects of turbulent water level

	<p>Note</p> <p>** Pump status with fill control selected (S2 = OFF). If discharge control is selected (S2=ON), pump switches on when the level reaches/exceeds SP.Hi and the switches off when the level falls below SP.Lo.</p>
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5.4 Meaning of codes on the 7-segment display (continued)

Code	Meaning	
Indicated when up and down are pressed:		
Indicated in parameterization mode		
quit	Confirm	Input is not confirmed
done	Done	Input is confirmed
Indicated if malfunctions occur		
E.005	Error	Faulty level transmitter, measuring current too low
E.006	Error	Faulty level transmitter, measuring current too high
E.013	Error	MIN switchpoint higher than MAX switchpoint

5.5 Setting the measuring range



A	Lower end of measuring range, adjustable
B	Upper end of measuring range, adjustable
C	Measuring range [mm] = xxx %
D	Maximum installed length at 238 °C

Set the lower and upper ends of the measuring range for your fill level measurement. The result is the measuring range C.

Please calculate this measuring range in percent.

Fig. 11 LP20/21 with a PA420 level transmitter.



Important

Set the upper and lower end of the measuring range only in the transmitter.

5.6 Additional information on control parameters

Parameter		Control deviation	Control valve
Proportional band Pb	Larger	Large remaining deviation	Responds slowly
	Smaller	Small remaining deviation	Responds quickly and may continually open/ close
	Example	Measuring range 100% = 200 mm of sightglass Setpoint SP = 80 % of measuring range = 160 mm Proportional band Pb = +/- 20% of setpoint = +/- 16% = +/- 32 mm If the measuring range is 100% (200 mm) and the setpoint is 80% (160 mm), the proportional range will be +/- 16% (+/- 32 mm) or in the range of 128 to 192 mm	
Integral action time ti	Larger	Slow correction of deviations	Responds slowly
	Smaller	Fast correction of deviations, control loop may tend to overshoot	Responds quickly

5.7 Password entry



Fig. 12

Start

The ability to change parameters of the controller is password protected from software version S-18 onwards.
The default password is 7452

Password Entry

Action	Display	Function
Press the up or down button until desired parameter is shown.	Display toggles between parameter and saved value.	Selecting the parameter.
Press and hold the ok button.	P A S S is displayed.	Password protection is active.
Press and hold the ok button.	First digit (000 0) flashes.	Password entry mode active. You can change the first digit.
Press the up or down button.	A new value is displayed.	Pressing the up button increases the value, pressing the down button reduces the value.
Briefly press ok button.	2nd, 3rd or 4th digit flashes (from right to left).	2nd, 3rd or 4th digits can now be changed using the up and down buttons. Pressing the up button increases the value, pressing the down button reduces the value.
When your entries are complete: Press and hold the ok button for 3 sec.	d o n e is briefly displayed. Next, the display toggles between the parameter and value.	Correct password entered. System switches back to the parameter. Now all parameters can be changed.
	F A I L is briefly displayed After this, the display toggles between the parameter and value.	Wrong password entered. System switches back to the parameter.
If you do not make any further entries for 10 sec.	q u i t is briefly displayed After this, the display toggles between the parameter and value.	Password entry has timed out. System switches back to the parameter.
After 30 minutes of inactivity (no button pressed) the password has to be entered again. After power cycling the device always starts password protected.		

5.8 Setting parameters



Fig. 13

Start		
Action	Display	Function
Switch on supply voltage. Water level between MIN and MAX.	7-segment display shows software version and the type of equipment.	System test, takes approx. 3 sec.
	7-segment display shows actual value.	System switches to operating mode.

Setting parameters		
Action	7-segment display	Function
Press the up or down button until desired parameter is shown.	Display toggles between parameter and saved value.	Selecting the parameter.
Press and hold the ok button.	P A S S is displayed.	Password Entry, follow section 5.7
Press and hold the ok.	First digit (000 0) flashes.	Parameterization mode active. You can change the first digit.
Press the up or down button.	A new value is displayed.	Pressing the up button increases the value, pressing the down button reduces the value.
Briefly press ok button.	2nd, 3rd or 4th digit flashes (from right to left).	2nd, 3rd or 4th digit can now be changed using the up and down buttons. Pressing the up button increases the value, pressing the down button reduces the value.
When your entries are complete: press and hold the ok button within 3 sec.	donE is displayed. Next, the display toggles between the parameter and the new value.	Input is confirmed. System switches back to the parameter.
If you do not confirm your entry within 3 sec. or you do not make any further entries.	quit is briefly displayed. After this, the display toggles between the parameter and the old value.	If you do not confirm, your entries will not be applied. Please repeat the procedure. If you do not confirm, the system switches back to the parameter.
Press the up or down button until the next parameter is shown. Or press the up or down button until the actual value is displayed. Or after 30 s, the actual value is displayed automatically.		

5.9 Setting switchpoints and control parameters



Fig. 14

Setting the MIN/MAX switchpoints	
Select parameter AL.Lo , enter and save the desired percentage.	MIN switchpoint setting between 0-100 %
Select parameter AL.Hi , enter and save the desired percentage.	MAX switchpoint setting between 0-100 %
Setting the setpoint(s)	
Select parameter SP or SP.Hi/SP.Lo , enter and save the desired percentage.	Setpoint (s) setting between 0-100 % Please take the settings for MIN/MAX switchpoints into consideration.
Setting the proportional band (continuous control only)	
Select parameter Pb , enter and save the desired percentage.	Proportional band setting between 10-100 %
Setting the integral action time (continuous control only)	
Select parameter ti , enter and save the desired time.	Integral action time settings between 0-120 s.
Setting the filter time	
Select parameter FiLt , enter and save the desired time.	Filter time. Select either 2, 4, 8 or 16 s.



Note

- The actual value is shown on the 7-segment display.

5.10 Displays

Operation (Continuous PI Controller)		
Action	Display	Function
Control valve has changed.	Pump LED flashes amber.	4 - 20 mA manipulated variable Y has changed.
Control valve fully open or closed.	Pump LED lights up amber.	4 - 20 mA manipulated variable Y has reached 4 mA or 20 mA.

Operation (Pump on/off Controller)		
Action	Display	Function
Water level reached or exceeded the pump on switchpoint.	Pump LED lights up amber.	Pump output contacts 19/20 closed.
Water level reached or exceeded the pump off switchpoint.	Pump LED do not light up amber.	Pump output contacts 19/20 open.

MIN alarm		
Switchpoint for MIN water level reached or exceeded.	MIN LED flashes red.	De-energizing delay in progress.
	MIN LED lights up red.	Delay time elapsed, MIN output contacts 16/18 closed, 17/18 open.

MAX alarm		
Switchpoint for MAX water level reached or exceeded.	MAX LED flashes red.	De-energizing delay in progress.
	MAX LED lights up red.	Delay time elapsed, MAX output contacts 21/23 closed, 22/23 open.

5.11 Check function of MIN/MAX output contacts

Test of MIN alarm and MAX alarm		
Action	Display	Function
In operating mode: Water level between MIN and MAX Select parameter test . Press and hold ok button.	MAX LED flashes red.	De-energizing delay in progress.
	MAX LED lights up red for 3 seconds.	MAX output contact 21/23 closed, 22/23 open.
	The MIN and MAX LED do not light up for 1 second.	MIN output contact 16/18 open, 17/18 closed. MAX output contact 21/23 open, 22/23 closed.
	MIN LED flashes red.	De-energizing delay in progress.
	MIN LED lights up red for 3 seconds.	MIN output contact 16/18 closed, 17/18 open.
Test complete, release ok button. Device switches to operating mode.	Note: If you continue holding the ok button, the test sequence will start again. You can interrupt the test sequence at any time by releasing the ok button.	
Press the up or down buttons until the actual value is displayed. Or after 30s, the actual value is displayed automatically.		



Note

The actual value is shown on the 7-segment display.




Note

The test feature is protected by the requirement for PASSWORD entry see section 5.7

6. Fault finding


6.1 Display, diagnosis and troubleshooting


	Important
	<p>Please check the following before fault diagnosis:</p> <p>Supply voltage: Is the level switch supplied with the voltage specified on the name plate?</p> <p>Wiring: Does the wiring conform to the wiring diagram?</p>

Faults indicated by the 7-segment display

Fault code	Fault	Remedy
E.005	Faulty level transmitter, measuring current < 4 mA.	Check level transmitter and replace if necessary. Check electrical connection.
E.006	Faulty level transmitter, measuring current > 20 mA.	Check level transmitter and replace if necessary. Check electrical connection.
E.013	MIN switchpoint higher than MAX switch- point.	Re-adjust switchpoints.
E.097	Walkthrough application error.	Internal error. If persists replace the equipment.
E.098	Walkthrough test error.	Internal error. If persists replace the equipment.
E.099	Internal test error.	Internal error. If persists replace the equipment.

In the event of a malfunction, the MIN and MAX alarm is triggered.

	Important
	<p>For further diagnosis, please refer to the LP20, LP21, and PA420 installation and operating manual.</p>

	Note
	<p>In the event of a level controller malfunction, the MIN or MAX alarm is triggered and the equipment restarts. In the case of some internal errors (E.097) and when the cyclic self-test reports OK again, the device restarts. If the process is continually repeated, the equipment must be replaced.</p>

6.2 Action against high-frequency interference

High-frequency interference can be caused by out-of-phase switching operations. If such interference occurs and results in sporadic failure, we recommend taking the following action to suppress interference:

- Provide inductive loads with RC combinations as per manufacturer's specifications.
- Route the connecting cable to the level transmitter separately from power lines.
- Increase the distance from sources of interference.
- Check the connection of the screen to the central earthing point (CEP) in the control cabinet and auxiliary equipment.
- Suppress HF interference using hinged-shell ferrite rings.

6.3 Replacing/taking the equipment out of service

- Switch off the power supply and cut off power to the equipment.
- Remove the upper and lower terminal strips (Fig. 15).
- Insert a screwdriver between the terminal strip and the front frame, to the right and left of the arrow markings.
- Release the terminal strip on the right and left sides, by turning the screwdriver in the direction of the arrow.
- Remove the terminal strips.
- Release the white sliding fixture at the bottom of the housing and take the device off the support rail.

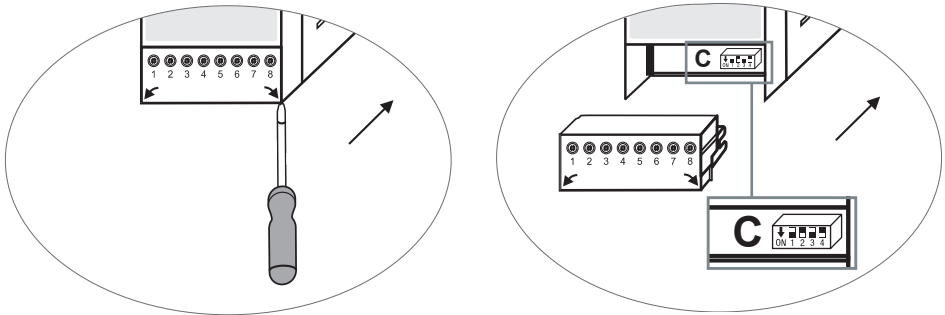


Fig. 15

6.4 Disposal

The equipment must be disposed of in accordance with statutory waste disposal provisions.

In the event of faults that cannot be remedied with the aid of this manual, please contact our Technical Customer Service.

7. Technical information

Supply voltage	24 Vdc +/- 20%
Fuse	External 0.5 A (semi-delay)
Power consumption	4 W
Connection of level transmitter	1 analogue input 4-20 mA, e.g. for LP20/LP21 capacitance probe and PA420 level transmitter, 2 poles and screen
Supply voltage to level transmitter	12 Vdc/max. 20 mA
Outputs:	<p>2 floating changeover contacts, 8 A 250 Vac/30 Vdc cos ϕ = 1. De-energizing delay 3 seconds (MIN/MAX alarm)</p> <p>1 floating open/close contact, 8 A 250 Vac/30 Vdc cos ϕ = 1 (pump on/off control)</p> <p>1 analogue output 4-20 mA, max. load 500 ohms (manipulated variable Y or actual value)</p> <p>Inductive loads must have interference suppression (RC combination) as per the manufacturer's specification</p>
Displays and controls	<p>3 push buttons for MIN/MAX alarm test and parameter setting,</p> <p>1 green 4 digit 7-segment LED display</p> <p>2 red LEDs for MIN/MAX alarm,</p> <p>1 amber LED for pump active or manipulated variable Y,</p> <p>1 4-pole code switch for configuration</p>
Housing	<p>Housing material, base: black polycarbonate; front: grey polycarbonate</p> <p>Maximum Conductor size*: 1 x 4.0 mm² solid, per wire, or</p> <p>1 x 2.5 mm² per lead with sleeve to DIN 46228, or</p> <p>2 x 1.5 mm² per lead with sleeve to DIN 46228 (min. \varnothing 0.1 mm)</p> <p>*Please see section 4.2 to 4.7 for recommended cable specifications</p> <p>Terminal strips can be removed separately</p> <p>Housing attachment: Mounting clip on support rail TH 35, EN 60715</p>
Electrical safety	Degree of contamination 2 for installation in control cabinet with degree of protection IP 54, fully insulated
Degree of protection	Housing: IP 40 to EN 60529 Terminal strip: IP 20 to EN 60529
Weight	approx. 0.2 kg
Ambient temperature	At moment of switch-on 0 ° ... 55 °C In operation -10 ... 55 °C
Transport temperature	-20 ... +80 °C (<100 hours), only switch on after a defrosting period of 24 hours
Storage temperature	-20 ... +70 °C, only switch on after a defrosting period of 24 hours
Relative humidity	max. 95%, no moisture condensation

Contents of package

1 x Level controller LCR2251
1 x Installation and Maintenance Instructions

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.

Spirax Sarco Ltd
Runnings Road
Cheltenham
GL51 9NQ
United Kingdom

www.spiraxsarco.com