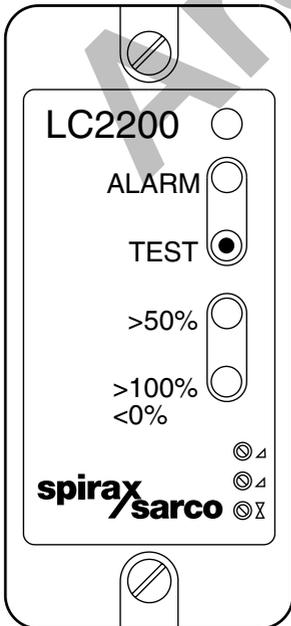


## LC2200 Level Controller Installation and Maintenance Instructions



1. *Safety information*
2. *General product information*
3. *Installation*
4. *Setting up the controller*
5. *Wiring diagrams*
6. *Commissioning*
7. *Maintenance*
8. *Fault finding*

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# 1. Safety information

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Safe operation of the product can only be guaranteed if it is properly installed, commissioned, used and maintained by qualified personnel (see Section 1.11) in compliance with the operating instructions and any National or local regulations which may be in existence. General installation and safety instructions for pipeline and plant construction, as well as the proper use of tools and safety equipment must also be complied with.

The product is designed and constructed to withstand the forces encountered during normal use. Use of the product for any other purpose, or failure to install the product in accordance with these Installation and Maintenance Instructions, could cause damage to the product, will invalidate the **CE** marking, and may cause injury or fatality to personnel.

## **Additional Safety Notes:**

### **Level control and level limiting/alarm products in steam boilers**

Products/systems must be selected, installed, operated, and tested in accordance with:

- Local or National standards and regulations.
- Guidance Notes, (Health and Safety Executive PM5 in the UK).
- The requirements of Approvals Authorities.
- Boiler inspection bodies.
- Boiler manufacturer's specifications.

Two independent low water limiting / alarm systems must be installed on steam boilers. Level probes must be installed in separate protection tubes / chambers, with sufficient clearance between the tips, and earth.

Each probe must be connected to an independent controller. The alarm relays must isolate the boiler heat supply at low alarm status.

A high water alarm may be part of the water level control, or a separate system. An independent high water alarm system must be fitted if it is considered a safety requirement. In this case, the relays must simultaneously isolate the feedwater supply and the boiler heat supply at high alarm status. All boiler water limiters / alarms require regular functional testing.

A suitable water treatment regime must be used to ensure continuous safe and correct operation of the control and limiter / alarm systems. Consult the above authorities and a competent water treatment company.

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## Warning

Isolate the mains supply before unplugging the controller since hazardous voltages will be exposed on the controller base. This product complies with the requirements of Electromagnetic Compatibility Directive 89/336/EEC by meeting the standards of: Emissions EN 61326: 1997 A1 + A2 Class B equipment Table 4. Immunity EN 61326: 1997 A1 + A2 Industrial Locations.

The following conditions should be avoided as they may create interference above the limits specified in EN 61326 (Immunity):

- The product or its wiring is located near a radio transmitter.
- Excessive electrical noise occurs on the mains supply. Power line protectors (ac) should be installed if mains supply noise is likely. Protectors can combine filtering, suppression, surge and spike arrestors.
- Cellular telephones and mobile radios may cause interference if used within approximately 1 metre (39") of the product or its wiring. The actual separation distance necessary will vary according to the surroundings of the installation and the power of the transmitter.

If this product is not used in the manner specified by this IMI, then the protection provided may be impaired.

### 1.1 Intended use

- i) Check that the product is suitable for use with the intended fluid.
- ii) Check material suitability, pressure and temperature and their maximum and minimum values. If the maximum operating limits of the product are lower than those of the system in which it is being fitted, or if malfunction of the product could result in a dangerous overpressure or overtemperature occurrence, ensure a safety device is included in the system to prevent such over-limit situations.
- iii) Determine the correct installation situation and direction of fluid flow.
- iv) Spirax Sarco products are not intended to withstand external stresses that may be induced by any system to which they are fitted. It is the responsibility of the installer to consider these stresses and take adequate precautions to minimise them.
- v) Remove protection covers from all connections and protective film from all name-plates, where appropriate, before installation on steam or other high temperature applications.

### 1.2 Access

Ensure safe access and if necessary a safe working platform (suitably guarded) before attempting to work on the product. Arrange suitable lifting gear if required.

### 1.3 Lighting

Ensure adequate lighting, particularly where detailed or intricate work is required.

### 1.4 Hazardous liquids or gases in the pipeline

Consider what is in the pipeline or what may have been in the pipeline at some previous time. Consider: flammable materials, substances hazardous to health, extremes of temperature.

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## 1.5 Hazardous environment around the product

Consider: explosion risk areas, lack of oxygen (e.g. tanks, pits), dangerous gases, extremes of temperature, hot surfaces, fire hazard (e.g. during welding), excessive noise, moving machinery.

## 1.6 The system

Consider the effect on the complete system of the work proposed. Will any proposed action (e.g. closing isolation valves, electrical isolation) put any other part of the system or any personnel at risk?

Dangers might include isolation of vents or protective devices or the rendering ineffective of controls or alarms. Ensure isolation valves are turned on and off in a gradual way to avoid system shocks.

## 1.7 Pressure systems

Ensure that any pressure is isolated and safely vented to atmospheric pressure. Consider double isolation (double block and bleed) and the locking or labelling of closed valves. Do not assume that the system has depressurised even when the pressure gauge indicates zero.

## 1.8 Temperature

Allow time for temperature to normalise after isolation to avoid danger of burns.

## 1.9 Tools and consumables

Before starting work ensure that you have suitable tools and/or consumables available. Use only genuine Spirax Sarco replacement parts.

## 1.10 Protective clothing

Consider whether you and/or others in the vicinity require any protective clothing to protect against the hazards of, for example, chemicals, high/low temperature, radiation, noise, falling objects, and dangers to eyes and face.

## 1.11 Permits to work

All work must be carried out or be supervised by a suitably competent person. Installation and operating personnel should be trained in the correct use of the product according to the Installation and Maintenance Instructions.

Where a formal 'permit to work' system is in force it must be complied with. Where there is no such system, it is recommended that a responsible person should know what work is going on and, where necessary, arrange to have an assistant whose primary responsibility is safety.

Post 'warning notices' if necessary.

## 1.12 Handling

Manual handling of large and/or heavy products may present a risk of injury. Lifting, pushing, pulling, carrying or supporting a load by bodily force can cause injury particularly to the back. You are advised to assess the risks taking into account the task, the individual, the load and the working environment and use the appropriate handling method depending on the circumstances of the work being done.

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### **1.13 Residual hazards**

In normal use the external surface of the product may be very hot.

Many products are not self-draining. Take due care when dismantling or removing the product from an installation.

### **1.14 Freezing**

Provision must be made to protect products which are not self-draining against frost damage in environments where they may be exposed to temperatures below freezing point.

### **1.15 Disposal**

Unless otherwise stated in the Installation and Maintenance Instructions, this product is recyclable and no ecological hazard is anticipated with its disposal providing due care is taken.

### **1.16 Returning products**

Customers and stockists are reminded that under EC Health, Safety and Environment Law, when returning products to Spirax Sarco they must provide information on any hazards and the precautions to be taken due to contamination residues or mechanical damage which may present a health, safety or environmental risk. This information must be provided in writing including Health and Safety data sheets relating to any substances identified as hazardous or potentially hazardous.

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## 2. General product information

The Spirax Sarco LC2200 is used to control an electrically actuated valve in response to a signal from a capacitance probe, providing proportional modulating control of liquid levels. It can be used for level control of boilers, deaerators, and tanks. The controller can also be used with any two-wire 4 - 20 mA transmitter, for example for pressure, temperature, or level control using a pressure or differential pressure transmitter. A dc power supply for a two-wire transmitter is included.

The LC2200 may also be connected to an LC2400 to provide 2 or 3 element control. These systems use the additional signal from a steam flowmeter (plus a water flowmeter for 3 element) to compensate for fluctuations in steam demand and feedwater pressure. The LC2400 IMI gives full details.

The LC2200 has a three stage wave filter (input signal damping). This switch-selectable feature gives an averaged output, maintaining a stable signal under the very different turbulence conditions found in tanks and high output boilers.

The LC2200 has an alarm output, which can be set high or low, and has a filter which allows accurate alarm signalling under varying turbulence conditions. The controller also has an 'out of range' alarm which releases the alarm relay if the probe or wiring is damaged or has been incorrectly wired, enabling prompt action to be taken to rectify any potentially dangerous situation.

A green LED at the top of the front panel indicates power on. A test button is provided below the red alarm LED to check the alarm output. The green (> 50%) LED indicates that the level is higher than 50%. i.e. above the set point. The amber (> 100% / < 0%) LED indicates that the level is outside the proportional band.

The LC2200 is set up before installation to suit the mains supply voltage and to provide the required functions, using internal switches. Calibration of set point and proportional band is carried out using the potentiometers on the front panel, so calibration can be altered if required without removing or dismantling the unit.

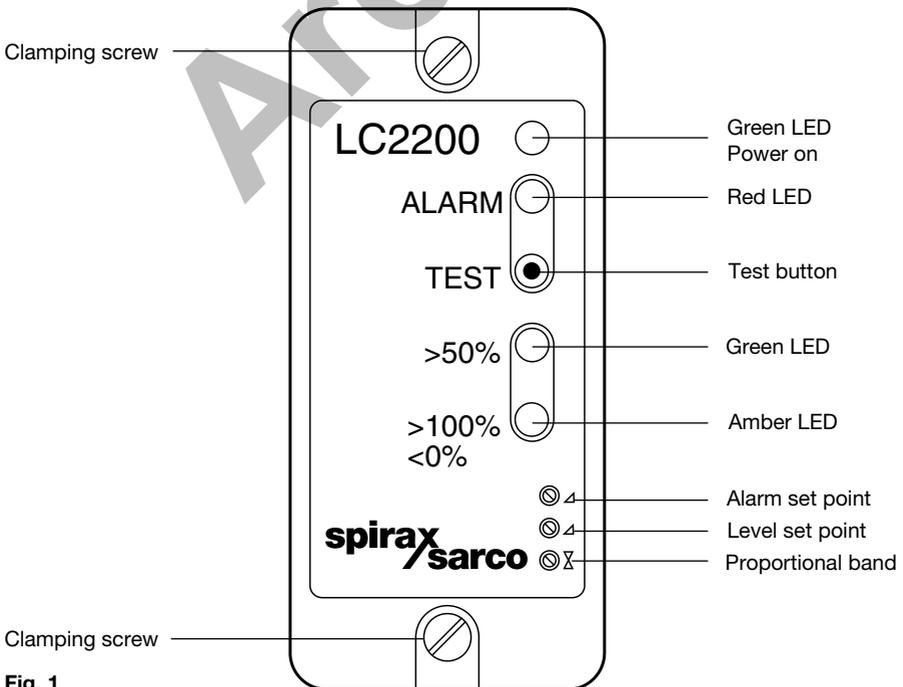


Fig. 1

## Technical data

<b>Maximum ambient temperature</b>	55°C	(131°F)
<b>Minimum ambient temperature</b>	0°C	(32°F)
<b>Pollution degree</b>	2	
<b>Overvoltage category</b>	II	
<b>Indoor use only</b>		
<b>Altitude up to</b>	2 000 m	(6 561.5 ft)
<b>Humidity</b>	Maximum relative humidity 80% for temperatures up to 31°C (87.8°F) decreasing linearly to 50% relative humidity at 40°C (104°F).	
<b>Protection rating</b>	IP40	
<b>Maximum cable length (controller to probe)</b>	100 m	(328 ft)
<b>Mains supply voltage</b>	<b>230 V setting</b>	198 V - 264 V
	<b>115 V setting</b>	99 V - 132 V
<b>Frequency</b>	50 - 60 Hz	
<b>Fuse type</b>	20 mm cartridge, 100 mA anti-surge (T).	
<b>Maximum power consumption</b>	3 VA	
<b>Input 1</b> (Selectable)	0 - 6 V	(27 kΩ)
	0 - 2 V	(9 kΩ)
	4 - 20 mA	(110 Ω)
	0 - 20 mA	(110 Ω)
<b>Input 2</b> Potentiometer input	1 kΩ Potentiometer	
<b>Input 3</b> (Opposite sense to input 1)	0 - 20 mA	(110 Ω)
	<b>or</b> 4 - 20 mA	(110 Ω)
<b>Relay outputs</b>	3 A maximum	
<b>Alarm output</b> to be protected by a 3 A fast-acting fuse		
<b>Level wave filter</b> (Approximate response time 63%) (Designed for slowly varying signals)	<b>Filter 1 position</b> (Minimum damping)	6 seconds
	<b>Filter 2 position</b> (Medium damping)	15 seconds
	<b>Filter 3 position</b> (Maximum damping)	45 seconds
<b>Alarm wave filter</b> (Approximate response time 63%)	<b>Filter switch OFF</b>	5 seconds
	<b>Filter switch ON</b>	27 seconds
<b>Set point range</b>	0% - 100% of input	
<b>Proportional band range</b>	2% - 100% of input	
<b>Transducer supply</b>	17 - 31 Vdc 20 mA maximum	

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## 3. Installation

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### **WARNING:**

**Isolate the mains supply before unplugging the controller since hazardous voltages will be exposed on the controller base.**

To unplug the controller from its base, undo the two retaining screws and pull the controller straight forwards. Rocking the controller in the vertical plane will ease removal.

The controller must be installed in a suitable industrial control panel or enclosure to provide impact and environmental protection (pollution degree 2). Spirax Sarco can provide suitable enclosures. The controller may be mounted on a 'top hat' DIN rail using the clip provided or the clip can be removed and the controller base screwed directly to a chassis plate.

**Caution: Allow 15 mm (5/8") spacing between multiple units for air circulation.**

The controller is for installation category II (Overvoltage category) and must be installed in accordance with IEC 60364 or equivalent. The controller and all connected circuits must have a common isolation system which meets the relevant requirements of IEC 60947-1 and IEC 60947-3 or equivalent. This must be positioned close to the controller and clearly identified as the disconnect device.

A quick blow 3 amp external fuse must be fitted in all phases of the controller and relay supply. The relays are rated at 250 Vac and must be on the same phase as the controller supply. Cabling should be installed in accordance with BS 6739 - Instrumentation in Process Control Systems: Installation design and practice or local equivalent.

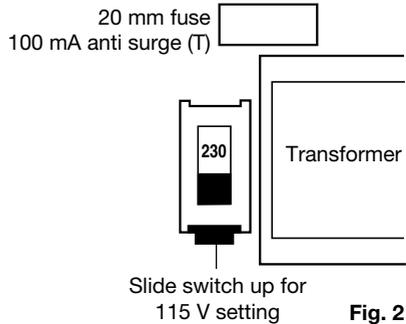
**Note:-** The wiring diagrams (Section 5) show all relays in the power off position.

Screened high temperature, 3 core, 1 mm<sup>2</sup> (18 - 16 AWG) copper cable is required for the probe wiring. The maximum permitted length is 100 metres (328 ft). Use cable with a suitable temperature rating for the installation. Pirelli FP200 or Delta Crompton Firetuf OHLS are suitable cables.

Connect the screens as shown in the wiring diagrams (Section 5).

**If the product is not used in the manner specified in this IMI, then the protection provided may be impaired.**

## 4. Setting up the controller



### 4.1 Setting up the controller

The controller is supplied set up as follows:

- 230 V mains supply.
- Capacitance probe input (voltage).
- Input out of range ON.
- High alarm.
- Alarm filter OFF.
- Level filter position 1 (minimum damping).

### 4.2 To change the mains supply voltage:

- Unplug the transmitter from its base.
- Remove the rear cover panel.
- Slide out the printed circuit board.
- Slide the voltage selector switch to the 115 V setting.
- Replace the printed circuit board.
- Ensure that the LED's engage with the holes in the front panel.
- Replace the rear cover panel.

### 4.3 To change the function settings:

- Unplug the transmitter from its base.
- Remove the rear cover panel.
- Slide out the printed circuit board.
- An 8-way switch on the printed circuit board determines the transmitter functions.
- Set the switches to the positions shown in Figure 3 for the chosen functions.
- Replace the printed circuit board.
- Ensure that the LED's engage with the holes in the front panel.
- Replace the rear cover panel.
- Plug the controller into its base.

**Note: that Switch 8 is not used.**

### 4.4 Current / voltage input - Switches 1 and 2

The controller is supplied set for use with a capacitance probe, (voltage input), with Switches 1 and 2 OFF. If a current input is required, for use with a 4 - 20 mA transmitter for example, set Switch 1 and 2 to ON.

### 4.5 Input out of range - Switch 3

The controller is supplied with the alarm disabled. If an alarm is required in the event of a wiring or probe fault, set Switch 3 to ON.

## 4.6 High/low alarm - Switch 4

The controller is supplied set to give an alarm output at high liquid level. To select low alarm, set Switch 4 to ON.

## 4.7 Alarm filter - Switch 5

The controller is supplied with this facility OFF. For conditions where turbulence may cause over-frequent signalling of an alarm, a delayed response may be selected by setting Switch 5 to ON.

## 4.8 Level filter - Switches 6 and 7

This feature averages the level input signal over a longer period for conditions where waves and high turbulence may otherwise cause continuous oscillation, giving over-frequent valve movement.

The unit is supplied set to Filter 1 position, the least damped response, with Switch 6 and 7 OFF. This position is generally suitable for tanks and small to medium output boilers with a reasonably steady steam demand.

For filter position, medium damped response, set Switch 6 to OFF and Switch 7 to ON.

This position should be selected if turbulence is causing the output signal to oscillate, causing over-frequent valve actuation.

For very turbulent conditions (high output boilers subject to wide variations in steam demand), set Switches 6 and 7 to ON.

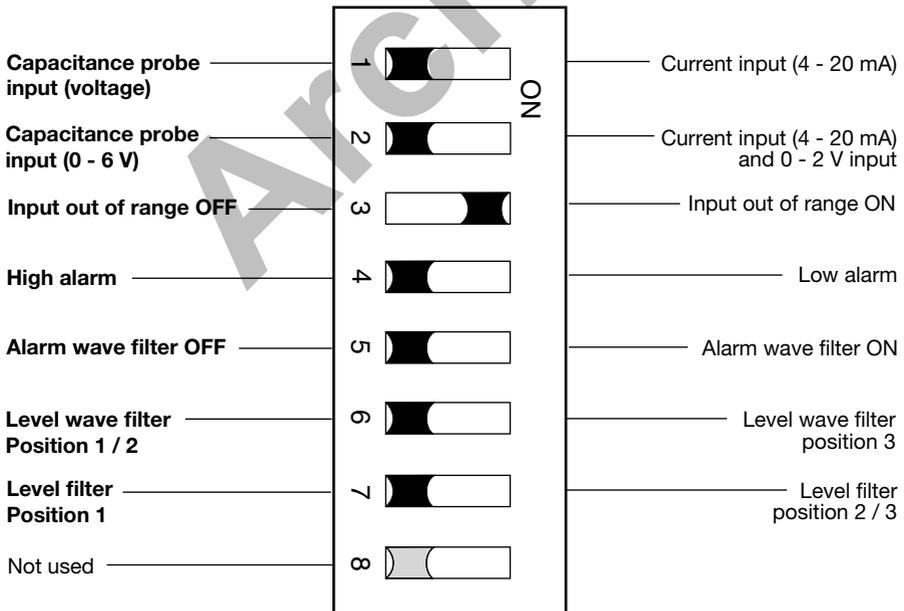


Fig. 3 Ex-works setting in bold

# 5. Wiring diagram

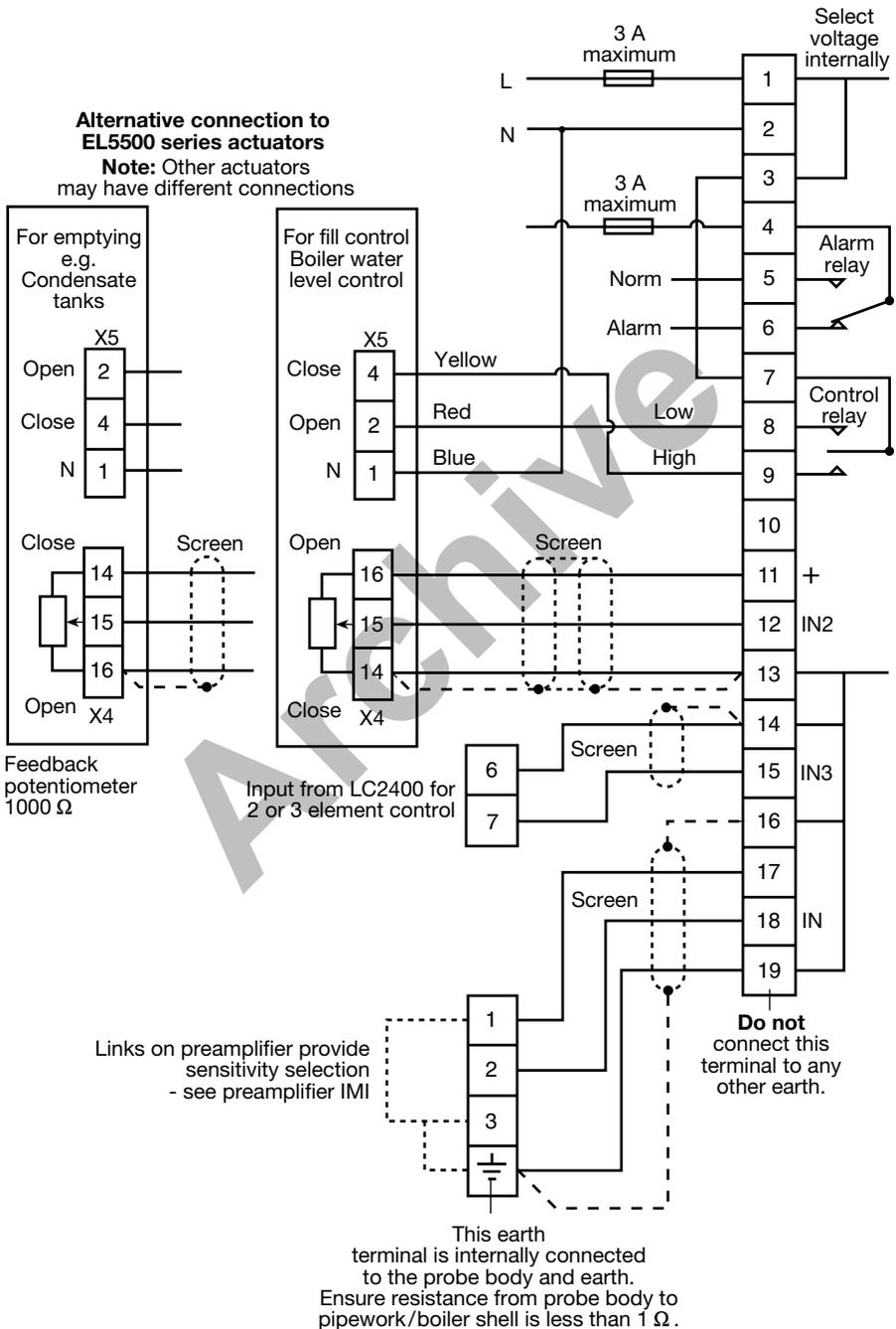


Fig. 4

See **CAUTION** in Section 5.1

## 5.1 Screen connection

To avoid damage to the product, screens must be installed as follows:

- An earth current loop is created if a wire or screen is connected between two earth points, which are at different potential (voltage).
- The preamplifier and controller screen are only connected to earth at one end, i.e. at the PA20 earth terminal.

**Note: The PA20 earth terminal is a functional earth rather than a protective earth.**

- A protective earth provides protection from electric shock under a single fault condition.
- This product has double insulation and therefore does not require a protective earth.
- A functional earth is used in order for the product to operate.
- In this application, the earth (tank/boiler shell) is used as the common of the probe/preamplifier.
- It also provides a sink/drain for any electrical interference.
- Ensure that the screen is connected to the common of the controller (Terminal 16) and to the Earth Terminal of the PA20.
- The LC2200 common terminal is internally isolated from earth.
- The common terminal must only be earthed via the PA20.

### CAUTION:

**Do not connect the common terminals (13, 14, 16 and 19) to an earth local to the controller. To do so may induce an earth current loop, which may reduce the performance or damage the product.**

## 5.2 Connecting to a 4 - 20 mA level transducer

The controller can be connected to a self-powered or loop-powered 4 - 20 mA level transducer instead of a capacitance probe. Connect wiring as shown in Figures 5 and 6.

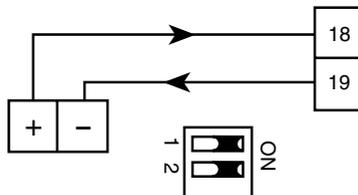


Fig. 5 Self-powered 4 - 20 mA input

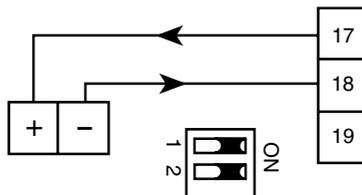
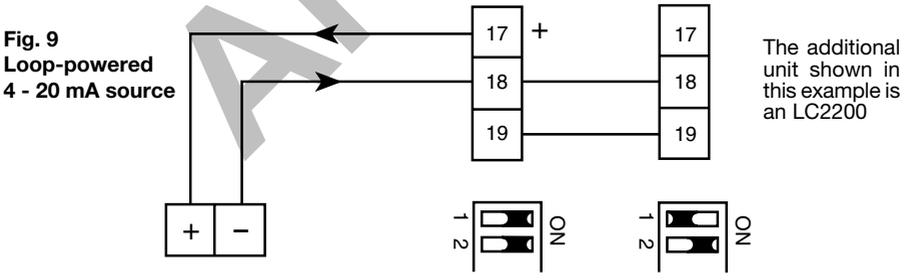
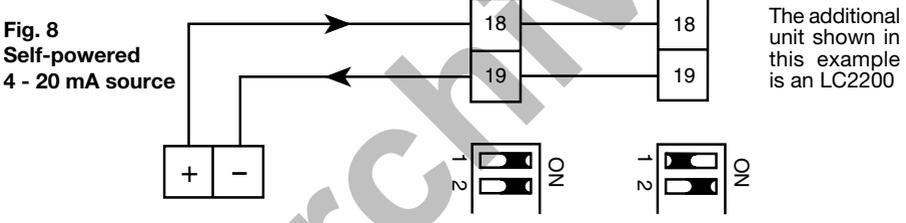
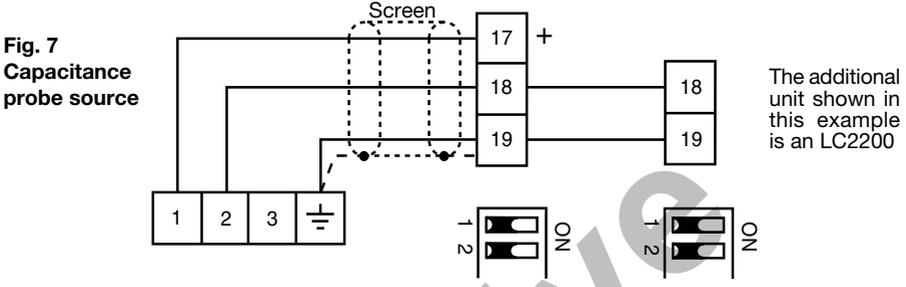


Fig. 6 Loop-powered 4 - 20 mA input

### 5.3 Multiple controllers

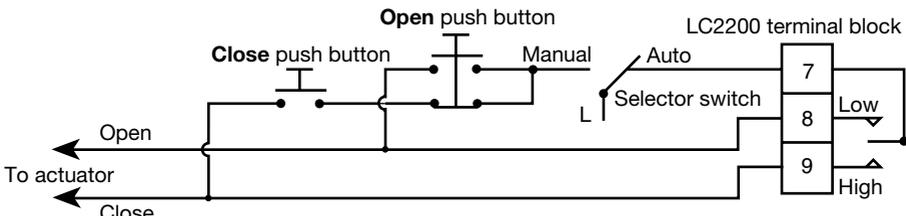
Several controllers can be connected to a single capacitance probe or a 4 - 20 mA (self-powered or loop-powered) source. Connect wiring as shown in Figures 7, 8 and 9.

Note:- As an example, terminal numbers and switch positions of a second LC2200 are shown. Wiring connections for other Spirax Sarco controllers / transmitters are different, and are given in the individual Installation and Maintenance Instructions.



### 5.4 Electrical override

The control valve normally used with the LC2200 has a manual control handwheel. It is also possible to wire an electrical override using an external switch and push buttons (see Figure 10):-



**Fig. 10** Wiring diagram shown for a fill control application

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## 6. Commissioning

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Control and alarm levels are set by adjusting the potentiometers on the front panel. To commission the controller proceed as follows:-

### 6.1 Level alarm

1. Ensure that the controller is set up for the correct mains supply voltage and functions, including the selection of high or low alarm on the internal 8-way switch.
2. Alter the water level to the desired alarm level.
3. Adjust the top (alarm set point) potentiometer until the red alarm LED just lights. Turning clockwise increases the level at which the alarm operates.

### 6.2 Level control

In order to simplify the description these instructions refer to boiler water level control applications (fill control).

The set point is in the middle of the control band of a proportional controller.

The modulating control valve will be approximately half open when the water level is at the set point, will be fully open when the level is at the bottom of the proportional band, and fully closed when the level is at the top of the band.

1. Ensure the controller is set up for the correct functions and mains supply voltage.
2. Alter the water level in the boiler to the desired set point.
3. Adjust the middle (level set point) potentiometer until the green > 50% LED just lights.
4. Alter the water level to either the top or the bottom of the desired proportional band. This can be the top (valve fully closed), or bottom (valve fully open) position, whichever is most convenient.
5. Adjust the bottom (proportional band) potentiometer until the amber > 100% /< 0% LED just lights.
6. The unit is now calibrated.  
Check that the valve is fully open/closed at the upper and lower limits of the proportional band.

#### Note - Spirax Sarco EL5500 actuators

Valves fitted with this actuator will be fully open/closed before the limits of the proportional band are reached.

#### CAUTION:

**The water level inside a boiler can be different to the level shown in the gauge glass under certain circumstances, so the settings may need minor adjustment when the boiler is running.**

Literature is available from Spirax Sarco which gives general information on boiler water level variations.

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## 7. Maintenance

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No special servicing or maintenance of the controller is necessary. Boiler water level controls and level alarms, however, do require regular testing and inspection. General safety guidance for the UK is given in Health and Executive Guidance Note PM5. For specific instructions for the Spirax Sarco system please see separate literature.

### Available spares

Spare fuses	Stock No. 4033380	Set of 3
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## 8. Fault finding

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Most faults which occur on commissioning are due to incorrect wiring or setting up. In the case of problems, the following checklist may be helpful:-

### Mains on LED not lit:

- No live supply.
- Neutral not connected.
- Controller internal fuse blown.
- Transformer internal fuse blown.

### Controller internal fuse blown:

- Check the mains supply voltage is lower than 264 V, and that the ambient temperature inside the control panel is less than 55°C (131°F). If either of these limits has been exceeded, it is possible that the controller internal thermal fuse has blown, and that the controller will need to be replaced.
- Ensure that the probe supply voltage is between 24 Vdc and 35 Vdc between terminals 10 and 12 of the controller, or terminals 1 and earth of the probe.
- The probe output voltage should be 1 Vdc to 6 Vdc between terminals 11 and 12 of the controller, or terminals 2 and earth of the probe, depending on the level. This voltage increases with the level, even when reverse acting output has been selected.

### Transformer internal fuse blown:

- The probe output voltage should be 1 Vdc to 6 Vdc between terminals 18 and 19 of the controller, or terminals 2 and earth of the probe, depending on the level. The voltage increases as the level rises.
- If the valve fails to modulate correctly, a possible reason might be that the feedback potentiometer is not working or has been wired incorrectly. The voltage between terminals 11 and 13 of the controller should be approximately 8 Vdc.
- For a Spirax Sarco EL5500 actuator wired for boiler water level applications, (fill control), this voltage can also be measured across terminals 14 and 16 of the potentiometer. The voltage between terminals 12 and 13 of the controller will rise from 1 or 2 volts to 6 or 7 volts as the valve opens. This voltage can also be measured between terminals 14 and 15 of the potentiometer.