

# LC3050

## Level Controller

### Installation and Maintenance Instructions

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2. User instructions and delivery information
3. System overview
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# 1. Safety information

Safe operation of this 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. 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.

Your attention is drawn to IEE Regulations (BS 7671, EN 12953, EN 12952 and EN 50156). Elsewhere, other regulations will normally apply.

All wiring materials and methods shall comply with relevant EN and IEC standards where applicable.

## Warning

This product is designed and constructed to withstand the forces encountered during normal use. Use of the product other than as a level limiter, or failure to install the product in accordance with these Instructions or to make product modifications or repair could:

- Cause injury or fatality to personnel.
- Cause damage to the product/property.
- Invalidate the  marking.

These instructions must be stored in a safe place near the product installation at all times.

## Warning - LP30 or LP31 level probe and LC3050 level controller

The above products comply with the requirements of the Pressure Equipment Directive (PED) and carry the  mark.

They are classed as Safety Accessories and therefore fall within Category 4 of the Directive.

An assessment upon the LP3050/LP30 Low Level Alarm System concluded it meets the requirements of IEC 61508-2:2010, to Safety Integrity Level of SIL2 when used in a 1oo1 architecture and SIL3 when used in 1oo2 architecture.

This product complies with Electromagnetic Compatibility Directive 2014/30/EU and all its requirements.

This product meets all the Requirements of the Directive and is suitable for Class A Environments (i.e. Industrial). The LC3050 meets the requirements of the Directive by meeting the Controlling standard:

- EN 61326-1: 2006 - Electrical equipment for measurement control and laboratory use - EMC requirements Part 1: General requirements.

The product may be exposed to interference above the limits of Heavy Industrial Immunity if:

- 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.

This product complies with Low Voltage Directive 2014/35/EU by meeting the standards of:

- EN 61010-1: 2010 Safety requirements for electrical equipment for measurement, control, and laboratory use.

This product has been type-tested, and the documentation validated, as a Special Design Water Level Limiter by meeting the Standard:

- VdTÜV requirements for water level control and limiting devices, water level 100 (07.2006).

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

## **Static precautions (ESD)**

Static precautions must be observed at all times to avoid damage to the product.

## **Level control and level limiting 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.

## **Functional Safety to IEC 61508**

The LC3050 is certified to IEC 61508 if used in conjunction with the LP30 Low Level Probe. This standard describes the Functional Safety of safety-related electrical/electronic/programmable electronic systems. The Safety Function of the LC3050 corresponds to a Safety Integrity (SIL) 2 when used in a 1oo1 architecture and SIL 3 when used in a 1oo2 architecture.

In most countries two independent low water limiting 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 require regular functional testing.

The level probe and controller is only part of the safety system. To complete the system, additional circuitry (wiring, relays, alarm bell/lamp etc.) is required.

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

## Failed product

In the unlikely event of a fault condition to trigger the alarm with the LC3050/LP30 low level system the standard Maintenance and Fault finding procedures listed in this instruction manual must be followed - Please refer to Section 9.

In the event the condition cannot be resolved, the standard device repair and return procedures listed in Section 10.2 of this manual must be followed.

The end user shall retain failed components and return them to Spirax-Sarco Limited along with details of failure mode and time in service (operational).

This will allow the 'actual' failure rates to be calculated and compared with those estimated in the Failure, Modes, Effects Diagnostics Analysis (FMEDA). A FMEDA is one of the steps to be taken to achieve functional safety certification per IEC 61508 of a device. From the FMEDA, failure rates are determined and consequently the Safe Failure Fraction (SFF) is calculated for the device. For full safety certification purposes all requirements of IEC 61508 will be considered.

Leading to product improvement and hence maintaining/reassuring its SIL rating.

We wish to encourage end-users to collect failure rate data and to provide feedback on design integrity.

## Product lifetime/replacement limits

According to section 7.4.9.5 of IEC 61508-2, a useful lifetime, for the LC3050, based on experience, has been assumed. Although a constant failure rate is assumed by probabilistic estimation method, this only applies provided that the useful lifetime of components is not exceeded. Beyond their useful lifetime the result of the probabilistic calculation method is therefore meaningless, as the probability of failure significantly increases with time. The useful lifetime is highly dependent on the subsystem itself and its operating conditions.

The product has gained its SIL2 rating on the assumption that electrolytic capacitors are to be replaced every 8 years.

It is the responsibility of the user to maintain and operate the LC3050/LP30 low level alarm system per the manufacturer's instructions. Furthermore, regular inspection should indicate that all components are free of damage.

Note: For further product data see the following Technical Information Sheet TI-P402-135.



# PRfsS Ltd

## Functional Safety Services

### Declaration of Conformity

This Declaration of Conformity is with regards to the  
*Electronic Hardware and associated LP30 conductivity probe* of the  
**LC 3050/LP30 Low Level Alarm System**

manufactured by

### **Spirax Sarco Ltd**

Charlton House,  
Cheltenham,  
Gloucestershire  
GL53 8ER,  
UK

PRfsS Ltd have performed an assessment of the LC3050/LP30 with reference to the CASS methodologies and found it to meet the requirements of

### **IEC61508-2:2010** route 1<sub>H</sub>

Performing the safety functions stated in the associated report in both demand and continuous mode to a Safety Integrity Level of **SIL2** when used in a **1oo1 architecture** and **SIL3** when used in a **1oo2 architecture**.

This declaration is made subject to the conditions on Page 4 of this document

Assessment performed by: **P R Smith, BA CEng FInstMC FIET**

Signed



The LC3050 is a single channel level alarm capable of measuring conductivity at a fixed point determined by the position of a Spirax-Sarco Ltd LP30 High integrity low level alarm probe and is intended for low water level detection in steam and hot water boilers.

The safety integrity relies on correct installation of the probe in accordance with the manufacturer's installation and maintenance manuals and frequent proof testing, and connection of the appropriate safety actuator(s) using both LC3050 safety relays configured in series to ensure that the safety function will be carried out by either LC3050 relay being de-energised.

*Note: That the normal recommended application of the LC3050 is in a 1oo2 architecture with two separate LC3050's and two separate LP30 level probes. The output relays are now connected so that any one of four output relays will implement the safety function on demand.*

### Safety functions

The safety function covered by this declaration of conformity is that of low water level.

### Product identification and configuration

The LC3050 version covered by this declaration is defined in the Manufacturer's drawings listed below:

Document number	Rev	Date	Document description
4025518	3	26/06/2013	Circuit Diagram for LC3050 (Safety Related Circuits)
4025518	F*	20/08/2009	Circuit Diagram for LC3050 (Non-Safety Related Circuits)
4025528	4	-	Silk Screen component layout for LC3050
4025528	F*	-	Silk Screen component layout for LC3050
4025518	4	03/10/2018	Component List (-Safety Related Circuits)
4025518	F*	-	Component List (-Non Safety Related Circuits)

\*Not reviewed for this latest D of C update

The assessment has been carried out with reference to the Conformity Assessment of Safety-related Systems (CASS) guidance. This includes an assessment of the techniques and measures used to avoid systematic failures introduced during the lifecycle and the control of failures during operation.



A Failure Mode Effects and Diagnostics Analysis (FMEDA) has been carried out as part of this assessment and has established worst case failure modes and random failure rates for the LC3050 according to available failure rate data.

The 'Geometric Mean' results are summarised below in Tables 1 and 2:

**Table 1 – Low Demand Mode, 1oo1 architecture**

Safety function	$\lambda_{DU}$ $\times 10^{-9}$ /hr	$\lambda_{DD}$ $\times 10^{-9}$ /hr	$\lambda_{SU}$ $\times 10^{-9}$ /hr	$\lambda_{SD}$ $\times 10^{-9}$ /hr	No effect $\times 10^{-9}$ /hr	$\lambda_{TOTAL}$ $\times 10^{-9}$ /hr	t <sub>CE</sub>	SFF	PFD <sub>AVG</sub>
Low water level detection	39.4	334	12.6	4140	312	4838	470	99.1%	0.0002

**Table 2 – High Demand Continuous Mode, 1oo1 architecture**

Safety function	$\lambda_{DU}$ $\times 10^{-6}$ /hr	$\lambda_{DD}$ $\times 10^{-6}$ /hr	$\lambda_{SU}$ $\times 10^{-6}$ /hr	$\lambda_{SD}$ $\times 10^{-6}$ /hr	No effect $\times 10^{-6}$ /hr	$\lambda_{TOTAL}$ $\times 10^{-6}$ /hr	SFF	PFH <sub>G</sub>
Low water level detection	39.4	334	12.6	4140	312	4838	99.1%	3.94e-8

The failure data given in Tables 1 above was derived using the following:

- Proof Test interval = 1 year
- Mean Time to Repair = 8 hours
- The LC3050/LP30 system is considered to be a Type A equipment with reference to IEC61508-2, paragraph 7.4.3.1.2.
- The highest systematic SIL was found to be SIL3
- Fault Tolerance was found to be '0'.



- Environment / stress criteria – FMEDA carried out using a quality factor and environmental factor of 1.
- Environmental Limits – 0°C to +55°C
- Lifetime/ replacement limits – electrolytic capacitors to be replaced every 8 years

### **Management of Functional Safety**

The assessment did not cover the Manufacturer’s functional safety management system, however, Spirax-Sarco Ltd do have a Functional Safety Management System, in accordance with IEC61508-1:2010, certified by Sira Certification of CSA. No CASS 00020/01 renewal date August 2020.

### **Conditions of Safe Use**

To maintain functional safety the following conditions of safe use must be observed:

1. The Product shall be installed, operated and maintained by competent personnel in accordance with the instructions in the Manufacturer’s Installation and Maintenance manual;
2. The product shall be subject to proof tests as specified in the Manufacturer’s Installation and Maintenance Manual at intervals not exceeding those given on Page 3 above;
3. Only the Manufacturer’s recommended replacement parts shall be used;
4. Strict adherence to The Manufacturer’s specified applications for The Product and the environmental and lifetime limitations as shown on Page 3 above;
5. The achievement of functional safety relies not only on the satisfactory operation of the LC3050/LP30 system in response to a deviation in conductivity as measured by the sensor probe but also on the ability of a trained operator to take action in the event of a hazard or from failures revealed by calibration, proof testing or system failure;
6. Proof testing may require the system to be fully or partially taken off-line. The  $PFD_{avg}$  will vary from that calculated in proportion to the time taken off line and must be calculated for a particular application taking this into account along with the failure rates of the other loop components which aren’t in the scope of this Declaration of Conformity but are necessary to complete the required safety function.
7. The Manufacturer’s Restrictions in Use recommendations must be followed in their entirety.

# Symbols used within these Installation and Maintenance Instructions or on the product rating label

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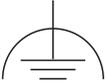
Equipment protected throughout by double insulation or reinforced insulation.

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Functional earth (ground) terminal, to enable the product to function correctly. Not used to provide electrical safety.

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Clean earth/ground.

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Safety earth.

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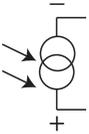
Caution, risk of electric shock.

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Caution, risk of danger, refer to accompanying documentation.

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Optically isolated current source or sink.

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Caution, Electrostatic Discharge (ESD) sensitive circuit. Do not touch or handle without proper electrostatic discharge precautions.

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ac, alternating current.

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## 1.1 Intended use

- i) This product is primarily intended for use in steam and hot water boilers. It may be used for other applications if the conductivity of the liquid is of at least 30  $\mu\text{S}/\text{cm}$ .
- 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 over-pressure or over-temperature 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.

## 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 labeling 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, dust, 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 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 all 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.

N.B: Electronics products:- Electrostatic discharge - Appropriate ESD precautions, (e.g grounded wrist strap, static dissipative work area) must be taken when handling to avoid damage to the product.

## 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 that are not self-draining against frost damage in environments where they may be exposed to temperatures below freezing point.

## 1.15 Disposal

On disposal of the unit or component, appropriate precautions should be taken in accordance with local/National regulations.

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.

## 2. User instructions and delivery information

Certain computer programs contained in this product were developed by Spirax-Sarco Limited ("the Work(s)").

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### All rights reserved

Spirax-Sarco Limited grants the legal user of this product (or device) the right to use the Work(s) solely within the scope of the legitimate operation of the product (or device). No other right is granted under this licence. In particular and without prejudice to the generality of the foregoing, the Work(s) may not be used, sold, licensed, transferred, copied or reproduced in whole or in part or in any manner or form other than as expressly granted here without the prior written consent of Spirax-Sarco Limited.

### 2.1 General description

The Spirax Sarco LC3050 is a high/low level limiting monitor and alarm suitable for use in conductive liquids.

The LC3050 is defined as a special design electronic water level limiter in the context of EN 12952.

It is designed for use with Spirax Sarco high or low level, self-monitoring, high integrity level probes, types LP31 and LP30.

The LC3050 is available as just one version to suit supply voltage ranges 110- 120 Vac and 220-240Vac. See Section 5.

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**Green** Normal Level

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**Red** Level alarm - Boiler water low/high (depending on application)

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## WARNING

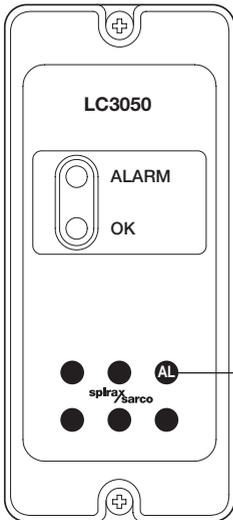
In most countries, steam boilers operating with limited supervision require two self-monitoring level probes and controllers to provide two independent low level alarms. A high level alarm is also advised, and is compulsory in some countries.

## WARNING

The minimum conductivity is 30  $\mu\text{S}/\text{cm}$  or 30 ppm.

The product can be panel, DIN rail or chassis mounted.

The front panel has two LEDs, indicating normal and alarm conditions, and a test button (AL).



**Press and hold this button to test the alarm.** This provides a full test of the probe, controller, and associated circuits.

Refer to Section 6 'Commissioning' for details.

The other buttons on the keypad are non-functional.

**Fig. 1 Keypad button identification**

## 2.2 The LC3050 cyclic self-testing function

An automatic cyclic test of the probe, probe cable and controller integrity is carried out every few seconds by internally simulating a fault in the probe. If a fault should occur it will activate the alarm and shut down the burner. The system will detect both open circuit and short circuit conditions in the probe cable. This self-test is used to provide failure detection without interrupting normal operation.

With the water at a normal level in the boiler, the Green LED will be lit. The Green LED briefly extinguishes every few seconds indicating the automatic cyclic test is being carried out. If at any time the Red LED is lit, either a low water level or system fault has been detected. If boiler water level is normal the user should consult section 9 Fault finding for system diagnostics.

A full, manual test of the probe, cable, controller and associated circuits can be carried out using a front panel test button marked ALM. See Section 6 Commissioning. If two LC3050 controllers are present in the system, this manual test should be carried out on both.

Provision is made for the wiring of a remote test button if required (See Figures 6 and 7, Section 5.4).

## 2.3 Equipment delivery, handling and storage

### Factory shipment

The product is tested, calibrated and inspected prior to shipment, to ensure reliable operation.

### Receipt of shipment

At the time of delivery each carton should be inspected for possible external damage. Any visible damage should be recorded immediately on the carrier's copy of the delivery slip.

Quantity	Description
1x	LC3050 level controller
1x	IMI ( this document)
1x	Front bezel
1x	Foam gasket
2x	Fibre washers
2x	M4 x 20 panel head (configuration)
1x	Front panel configuration label
1x	ENC2 DIN rail clip

Each carton should be unpacked carefully and its contents checked for damage. If it is found that some items have been damaged or are missing, notify Spirax Sarco immediately and provide full details. In addition, damage must be reported to the carrier with a request for their on-site inspection of the damaged item and its shipping carton.

### Storage

If the product is to be stored for a period prior to installation, the environmental storage conditions should be at a temperature between 0 °C and 65 °C (32 °F and 149 °F), and between 10% and 90% relative humidity (non-condensing).



Ensure there is no condensation within the unit before installing and connecting the power.

## 3. System overview

The system consists of the LC3050 controller and the LP30 Low Level Probe. Alternatively, the system can be configured to detect a high level using the LP31 High Level Probe. If either a low water level or a system failure is detected, then the red LED (ALARM) is lit, the dual alarm relays are de-energised, an alarm is sounded and the boiler burner turned off.

The alarm condition will be enabled even if two independent random electronic failures have occurred. The ability of the self-test circuit to shut down the boiler is not tested during the self-test. Therefore this circuit is duplicated and is verified during manual test. The frequency of manual testing must be in line with local regulations and should usually be performed weekly.

The LC3050 unit is assembled from two PCB's: the LC3 – 4025518 and the MB3 – 4025519. The LC3 – 4025518 contains all the safety electronics and there is no embedded software on this PCB. The MB3 – 4025519 contains the communications and monitoring electronics and plays no role in the safety functions.

### Inputs

The product accepts inputs from the LP30 low level probe or the LP31 high level probe.

### Function

The LC3050 compares the resistance to earth from the probe, through the water, to the boiler or vessel shell. If a change in water level causes this resistance to change beyond a set limit, a timer is engaged which alters the state of an internal relay after a pre-set delay. This signal is used to trigger an alarm.

A compensation tip on the probe compensates for any leakage to earth caused by scale, dirt, or internal moisture, ensuring an alarm signal even under adverse conditions.

The product can communicate via an infrared link with adjacent boiler house controllers **only** if installed into the same enclosure ! See Section 4. (Spirax Sarco products only). The LC3050 is designated as a slave unit only – see Section 7, Communications.

# 4. Mechanical installation

**Note:** Read the 'Safety information' in Section 1 before installing the product.

At all times during installation, normal use or maintenance, the rear of the LC3050 in particular must be protected from environmental pollutants entering into the product. Therefore the product must be installed in a suitable industrial control panel or fireproof enclosure to provide impact and environmental protection. A minimum of IP54 (EN 60529) or Type 3, 3S, 4, 4X, 6, 6P and 13 (UL50/NEMA250) is required. If installed in a harsh environment (conductive dust and/or wet conditions), a higher degree of protection is required.

- **Caution 1:** The product must only be installed in the vertical orientation.
- **Caution 2:** Do not cover or obstruct the infrared beam between the products.
- **Caution 3:** Ensure that the red and green LED status indicators can be easily seen by the operator.
- **Caution 4:** During use the boiler control panel or enclosure doors must be kept closed at all times unless installation or maintenance work is being carried out.

## 4.1 Environmental conditions

Install the product in an environment that minimises the effects of heat, vibration, shock and electrical interference (see Section 1 – 'Safety information').

**Do not install the product outdoors without additional weather protection.**

**Do not attempt to open the product – it is sealed and has no replaceable parts or internal switches.**

## 4.2 Installation on a DIN rail

The product is provided with a clip and a set of self-tapping screws to secure it to a 35 mm DIN rail. On the rear of the enclosure, two sets of holes and an adjustable clip are provided to give alternative mounting height positions. Locate the clip onto one set of holes and secure it using the two screws provided. Ensure the spring clip is fully engaged with the rail.

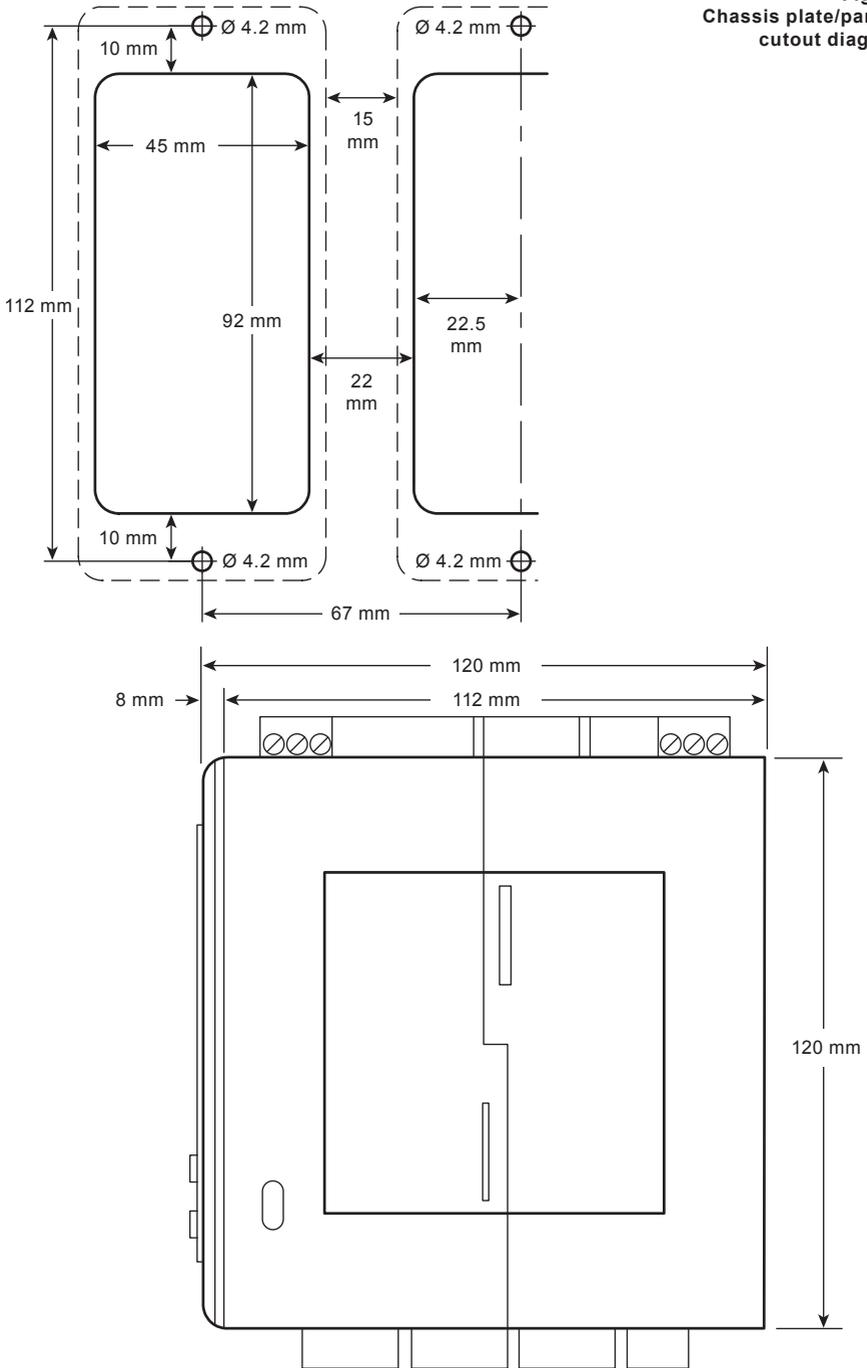
**Warning:** Only use the screws provided with the product.

## 4.3 Installation on a chassis plate:

- Drill holes in chassis plate as shown in Figure 2a.
- Fit unit to chassis plate and secure with 2 screws, nuts and washers, using the slots provided at the top and bottom of the case.

**Warning:** Do not drill the product case or use self-tapping screws.

**Fig. 2a**  
**Chassis plate/panel -**  
**cutout diagram**



## 4.4 Installation in a panel cutout:

(Minimum panel thickness 1 mm if the bezel is used).

- The product has integral threaded inserts (M4 x 0.7) at the top and bottom of the front panel.
- Two M4 x 25 mm screws are provided, together with fibre washers and a bezel.



### **Warning:**

**Do not use screws over 25 mm in length - danger of electric shock.**

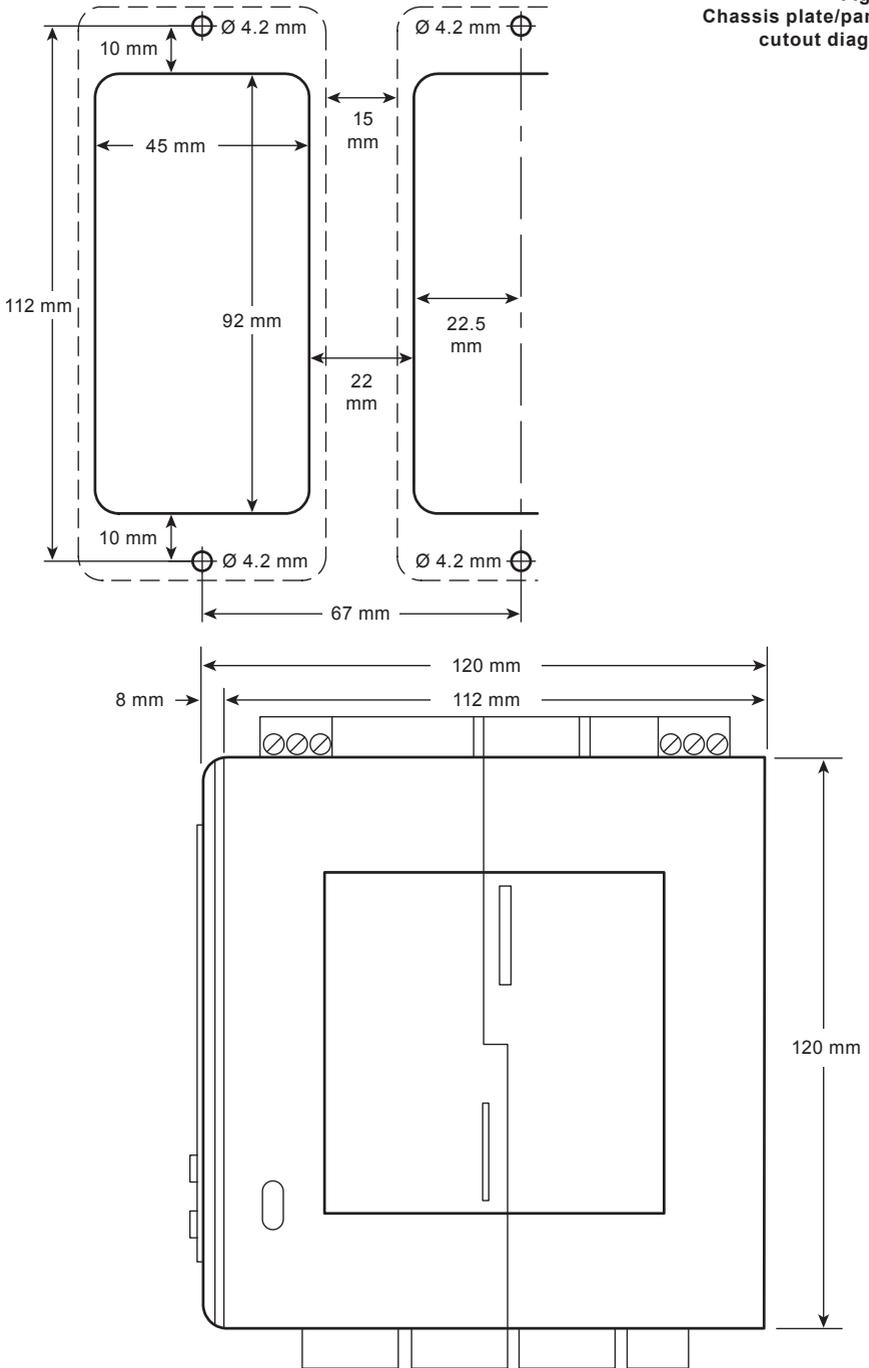
- Cut the panel to the dimensions given in Figure 2b. Drill the screw holes in the panel in the positions indicated.
- Remove the backing from the gasket supplied and apply to front face of the product.
- The bezel can be used to enhance the appearance of the panel cutout. If required, fit this to the outside of the panel.
- Fit the unit from the rear of the panel, and secure using the screws, washers (and bezel) provided.
- Tighten the M4 screws to 1.0 - 1.2 Nm.

**Warning:** Do not drill the product case or use self-tapping screws.

### **Fixing template cutout notes:**

- Solid line indicates cutout required for panel mounting.
- Broken line indicates product outline.
- A minimum gap of 15 mm between units must be provided for product cooling.
- Mounting hole dimensions are the same for both panel and wall mounting.

**Fig. 2b**  
**Chassis plate/panel -**  
**cutout diagram**



# 5. Electrical installation

**Note:** Before installing read the 'Safety Information' in Section 1.



**Warning:**

Isolate the mains supply before touching any of the wiring terminals as these may be wired to hazardous voltages.

Use only the connectors supplied with the product, or spares obtained from Spirax Sarco Limited. Use of different connectors may compromise product safety and approvals. Ensure there is no condensation within the unit before installing and connecting the power.

Connecting the mains supply incorrectly can cause damage and may compromise safety.

## 5.1 General wiring notes

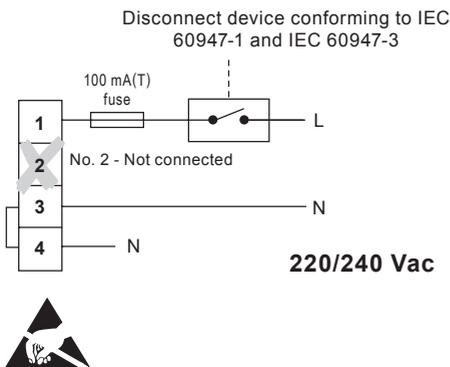
Every effort has been made during the design of the product to ensure the safety of the user but the following precautions must be observed:

1. Maintenance personnel must be suitably qualified to work with equipment having hazardous live voltages.
2. Ensure correct installation. Safety may be compromised if the installation of the product is not carried out as specified in this IMI.
3. The design of the product relies on the building electrical installation for overcurrent protection and primary isolation - See Note 12.
4. Overcurrent protection devices rated at 100 mA must be included in all phase conductors of the installation wiring. If overcurrent protection is included in both supply wires then the operation of one must also cause the operation of the other. Refer to IEC 60364 (Electrical Installations of Buildings) or National or Local standards for full details of requirements for overcurrent protection.
5. A 3 A quick-blow overcurrent protection device must be fitted to the relay in the burner circuit(s) - See Figure 5.
6. Relay contacts must be supplied on the same phase as the mains supply.
7. The product is designed as an installation category III product.
8. Install wiring in accordance with:
  - IEC 60364 - Low-voltage electrical installations.
  - EN 50156 Electrical Equipment for furnaces and ancillary equipment.
  - BS 6739 - Instrumentation in Process Control Systems: Installation design and practice or local equivalent.
  - National and Local Electrical Code (NEC) or Canadian code (CEC) for the US and Canadian markets. Note; use NEC Class 1 wire with a temperature rating greater than 75 °C. If the cable is to be exposed to a higher temperature, then a higher temperature rating needs to be selected
9. It is important that the cable screens (Figures 6 and 7) are connected as shown in order to comply with the electromagnetic compatibility requirements.
10. All external circuits must meet and maintain the requirements of double/reinforced installation as stated in IEC 60364 or equivalent.

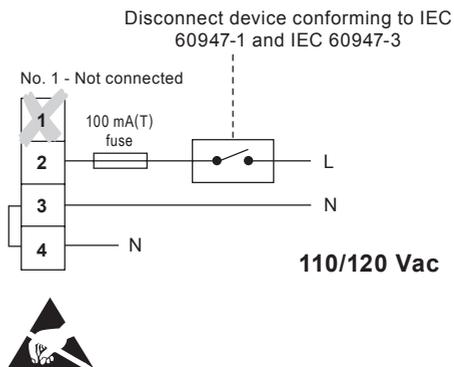
11. Additional protection must be provided to prevent accessible parts (e.g. signal circuits) from becoming Hazardous Live if a wire or screw is accidentally loosened or freed. Ensure all wires are secured mechanically to at least one other wire from the same circuit. The attachment must be as close to the terminal block as possible but must not apply undue stress on the connection. Example: Use a cable tie to secure the live and neutral wire together. If one wire becomes loose the other wire will prevent it from touching accessible parts.
12. A disconnecting device (switch or circuit breaker) must be included in the building installation. It must:
  - Have a rating with sufficient breaking capacity.
  - Be in close proximity to the equipment, within easy reach of the operator, but not fitted in a position that makes it difficult to operate.
  - Disconnect all phase conductors.
  - Be marked as the disconnecting device for the product.
  - Not interrupt a protective earth conductor.
  - Not be incorporated into a mains supply cord.
  - Comply with the requirements for a disconnecting device specified in IEC 60947-1 (Specification for low-voltage switchgear and control gear General rules) and IEC 60947-3 (Switches, disconnectors, switch-disconnectors and fuse-combination units).
13. See Section 10 'Technical information' for terminal and cable specification.

## 5.2 Mains wiring notes:

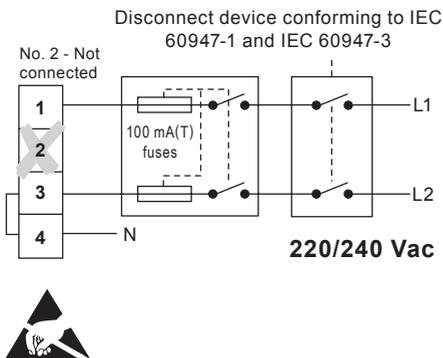
1. Read Section 5.1, General Wiring notes, before attempting to wire the supply to the product.
2. Fuses must be fitted in all live conductors.



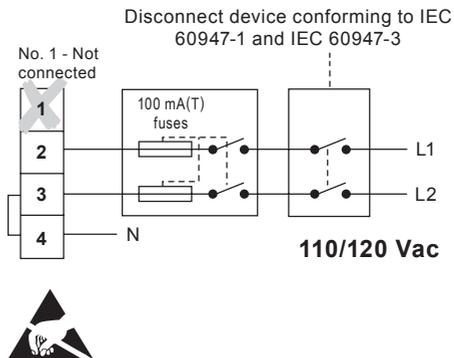
**Note:** Remove mains warning label completely (including any residue) before connecting the mains wiring.



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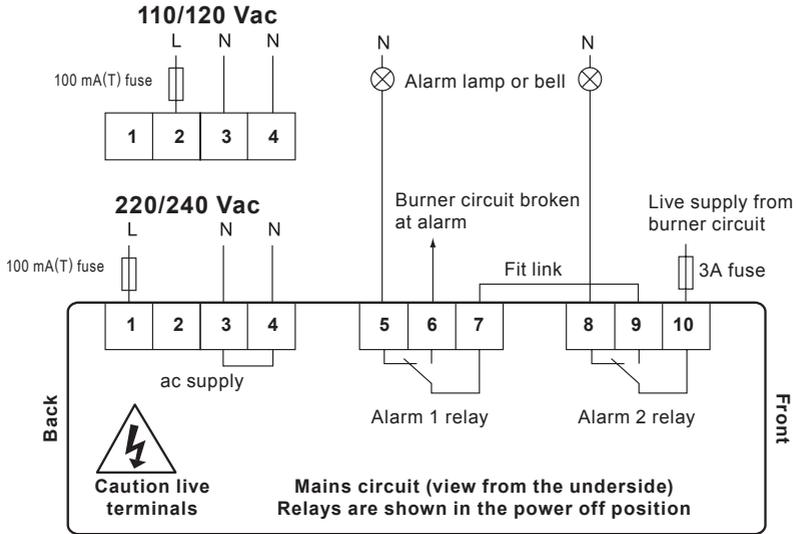
**Note:** Remove mains warning label completely (including any residue) before connecting the mains wiring.

**Fig. 3 220/240 Vac supply**

**Fig. 4 110/120 Vac supply**

3. Double or reinforced insulation must be maintained between:
  - Hazardous live conductors (mains and relay circuits) and
  - Safety extra low voltages (All other components/connectors/conductors).

4. The wiring diagrams show relays and switches in the **Power off** position.



220/240 Vac mains input – Live T1 – Neutral T3 or T4

110/120 Vac mains input – Live T2 – Neutral T3 or T4

Connections 3 and 4 are internally linked.

**Fig. 5 Selecting the operating voltage**

## 5.3 Probe wiring

The maximum cable length for both LP30 and LP31 probes is 50 m (164 ft).

### LP30 and LP31 UL probes only

The LP30 and LP31 UL probes are supplied with four 18 AWG, 12" long colour coded flying leads. These are to be cut to length and connected to a suitable metal terminal box. A length of flexible metal conduit is required between the probe and the terminal box to provide environmental protection and easy electrical connection. The cable socket is provided with a ½" NPT conduit adaptor for this purpose. See the LP30 and LP31 Installation and Maintenance Instructions for further details.

## 5.4 Signal wiring notes

An earth current loop is created if a wire or screen is connected between two earth points that are at different potential (voltage). If the wiring diagram is followed correctly, the screen will only be connected to the earth at one end.

The 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 is used as a sink or drain for any electrical interference. The earth terminal must be connected to a local earth in order to conform to the EMC directive.

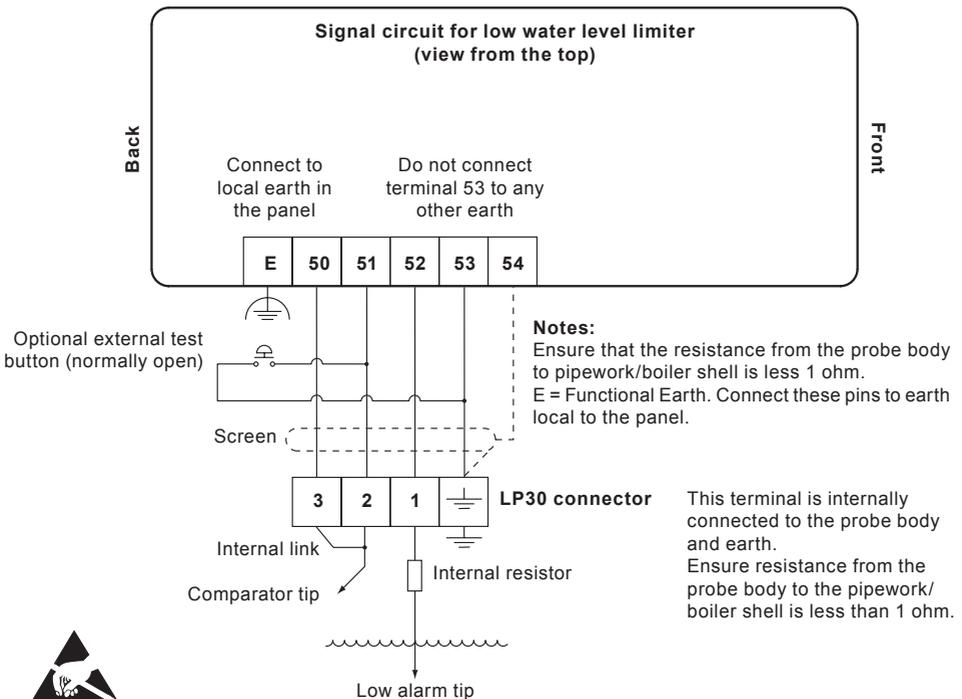
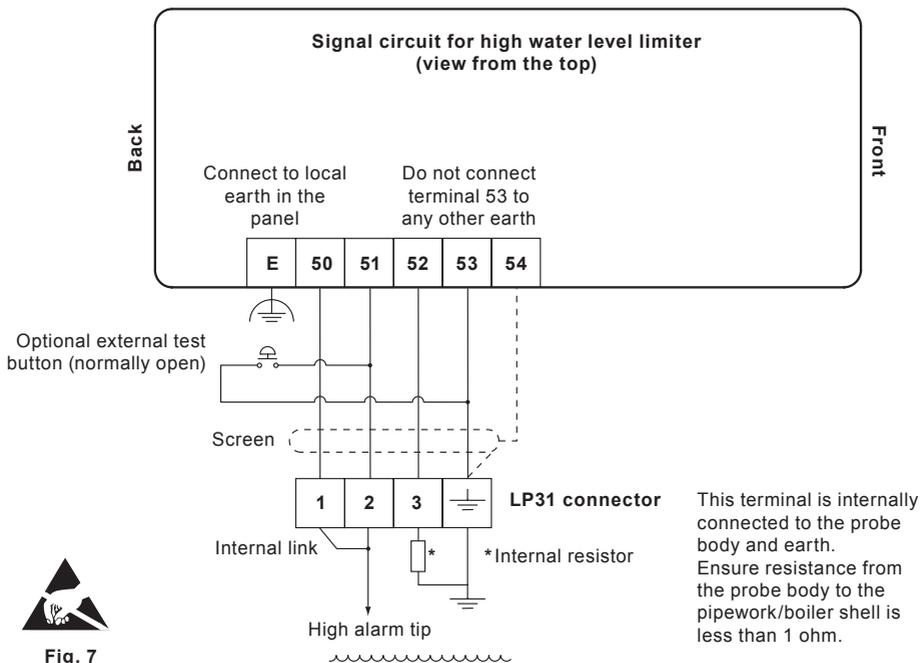


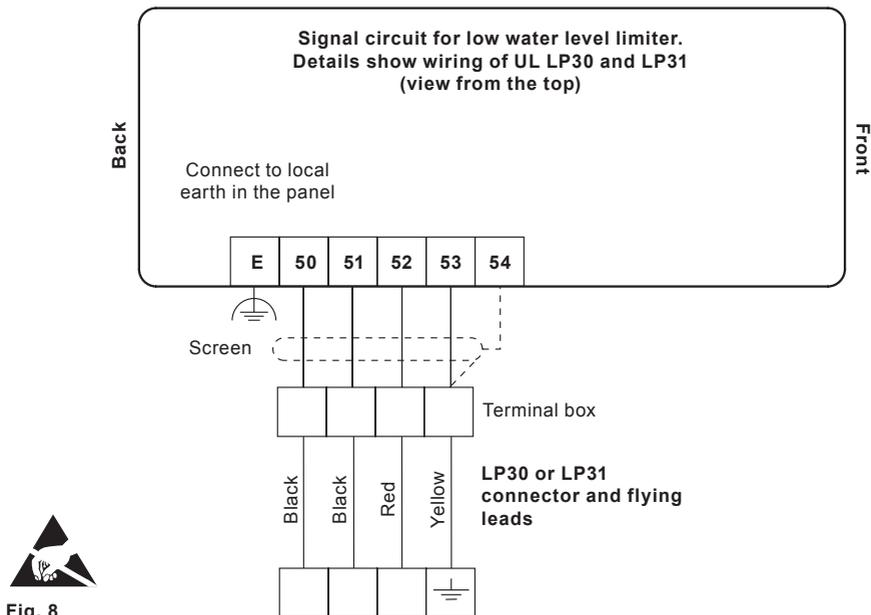
Fig. 6



**Fig. 7**

**Notes:**

Ensure that the resistance from the probe body to pipework/boiler shell is less than 1 ohm.



**Fig. 8**

# 6. Commissioning

## 6.1 General information

In normal boiler operation with the water level normal, the LC3050 green LED will be lit and the status indicators on the boiler control panel will indicate a normal water level. The green LED briefly extinguishes every few seconds showing that the automatic cyclic test is being carried out.

### To carry out a manual test:

1. With the boiler water level normal, press and hold the LC3050 AL button (~5-6 seconds) until the green (normal) LED extinguishes and the red (alarm) LED lights. This is simulating an alarm condition and so the boiler panel indicators should now signal an alarm and bells/buzzers should sound.
2. Release the test button – After a short delay, the green LED will light and the red LED will extinguish, showing that the internal checking circuits have been verified. The boiler panel indicators will return to normal and any bells/buzzers will be silenced. If there is an external lockout circuit in the boiler panel this will need to be reset.
3. If the optional external test button has been connected, press and hold it until the same test sequence occurs, (approximately 5 - 6 seconds).
4. Use the boiler controls to lower the boiler water level to below the low alarm level (low alarm), or raise the water level to above the high alarm level (high alarm). The green LED will extinguish and the red LED will light. The boiler panel indicators will go to alarm.
5. Restore the water level to normal — The controller relays will re-energise, alarms will be disabled and allow the burner to fire (after resetting any lockout).

**For specific testing instructions for Spirax Sarco systems please see separate literature.**

Press and hold this button to test the alarm. This provides a full test of the probe, controller, and associated circuits.

The other buttons on this product are non-functional.

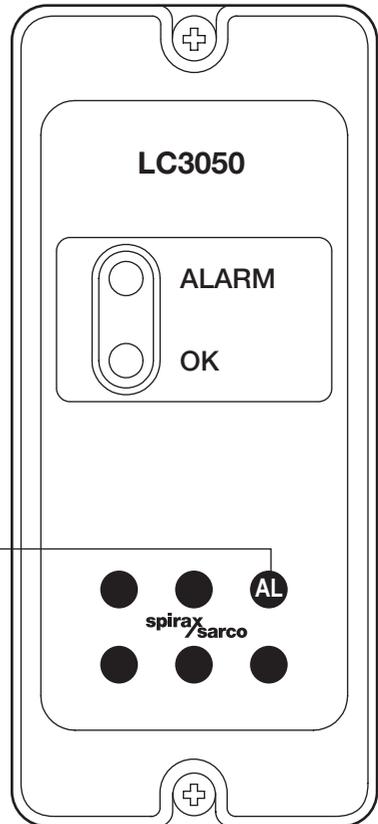


Fig. 8 Keypad and definitions

# 7. Communications

## Infrared (IR)

All products in the range can communicate via an infrared link between adjacent controllers. It enables the parameters of this product (OEM) to be passed to a product fitted with RS485 (USER).

USER products are fitted with a graphics display and OEM products either have LED's, or three digit displays.

LC3050 unit is always an IR slave – no set-up or adjustment is needed.

For further information on Infrared and RS485 communication, see User Installation and Maintenance Instructions.

**Important: Do not cover or obstruct the infrared beam between products.**

See appendix for further details.

# 8. Maintenance

**Note: Read the 'Safety information' in Section 1 before starting any maintenance.**

## 8.1 System maintenance

However, boiler water level controls and level alarms do require regular testing and inspection. General guidance is given in Health and Safety Executive Guidance Note PM5. For specific instructions for the Spirax Sarco system please see separate literature.

During such system maintenance, the rear of the product must be protected from environmental pollutants entering the product. Alternatively, maintenance tasks can be performed in a dry clean environment.

## 8.2 Checking the low level alarm points/proof test procedure

To perform this functional check, use the boiler controls to lower the water level. When this level falls below the probe tip, the Green LED will extinguish, the Red LED will be lit and the alarm circuit will sound and the burner will be turned off. The heating function can only resume when the power circuit is re-activated by increasing the water level to the point when the level probe enters the water again. At this time, the Red LED will extinguish, the Green LED will be lit and the internal cyclic testing will re-start. The Low Level Alarm point must be checked when commissioning the system, after replacing the level probe and at regular intervals based on local legislation, usually every year.

## 8.3 Probe clearance test

To ensure safe, correct operation of the system, it is essential that the probe tip does not touch any part of the boiler or protection tube. Standards require that the probe tip has at least 14 mm (9/16") clearance.

If, as a result of the cyclic self-test or a full manual test, the system detects a probe tip short to earth then the Probe Clearance Test Procedure (Section 5) in the LP30 IMI should be followed. All specialised testing accessories are supplied with the LC3050.

### LP30

Clean and inspect the LP30 annually, particularly the threaded contact surfaces between the tip and extension and the probe central electrode.

More regular cleaning is advised where the quality of the boiler water might cause a build-up of insulative scale or oxide on the probe.

# 9. Fault finding

## WARNING:

Before fault finding read the Safety information in Section 1 and the General wiring notes in Section 5.1.

Please note that there are hazardous voltages present and only suitably qualified personnel should carry out fault finding.

The product must be isolated from the mains supply before touching any of the wiring terminals.

Safety may be compromised if the fault finding procedures are not carried out in line with this manual.

Relay fuses to be replaced by manufacturer or accredited service department.

During installation or maintenance, the rear of the product **MUST** be protected from environmental pollutants entering the product. Alternatively, the tasks can be performed in a dry clean environment.

## 9.1 Introduction

If for any reason a fault occurs on the product, the instructions in this section will allow the fault to be isolated and corrected. The most likely time for faults to occur is during installation and commissioning. The most common type of fault is wiring.

## 9.2 System faults

Symptom	Action
<b>1</b> No LEDs lit	<ol style="list-style-type: none"><li>1. Switch off the mains supply to the product.</li><li>2. Check all wiring is correct.</li><li>3. Ensure the mains live wire is connected to terminal 1 for 220/240 Vac or terminal 2 for 110/120 Vac.</li><li>4. Check external fuse(s) are intact. Replace if necessary.</li><li>5. Check the mains supply is within specification.</li><li>6. Switch on the mains supply.</li></ol> <p>If the symptoms are still present return the product for examination (See Section 10). Consider the likelihood that the product has been damaged from mains borne surges/spikes. Consider installing an additional ac power line protector between the product and the mains supply. The protector needs to be positioned close to the product to gain full protection.</p>

<b>Symptom</b>	<b>Action</b>
<p style="text-align: center;"><b>2</b></p> <p><b>Red LED stays on (LP30 low alarm)</b></p>	<ol style="list-style-type: none"> <li>1. Probe cable to 'low alarm tip' connection is open circuit.</li> <li>2. Comparator tip shorted to earth.</li> <li>3. Earth open circuit.</li> <li>4. Probe wires crossed.</li> <li>5. Low alarm tip shorted to comparator tip.</li> </ol>
<p style="text-align: center;"><b>3</b></p> <p><b>Red LED stays on (LP31 high alarm)</b></p>	<ol style="list-style-type: none"> <li>1. Probe cable to 'high alarm tip' shorted to earth.</li> <li>2. Probe cable to probe terminal 3 is open circuit.</li> <li>3. Earth open circuit.</li> <li>4. Probe wires crossed.</li> </ol>
<p style="text-align: center;"><b>4</b></p> <p><b>Red and green LEDs stay on (LP30 low alarm)</b></p>	<ol style="list-style-type: none"> <li>1. Probe cable to 'low alarm tip' is shorted to earth.</li> <li>2. Probe wires crossed.</li> <li>3. Comparator tip open circuit.</li> </ol>
<p style="text-align: center;"><b>5</b></p> <p><b>Red and green LEDs stay on (LP31 high alarm)</b></p>	<ol style="list-style-type: none"> <li>1. Probe cable to 'high alarm tip' is open circuit (probe terminals 1 or 2).</li> <li>2. Probe wires crossed.</li> </ol>

<b>Symptom</b>	<b>Action</b>
<p><b>6</b>  <b>Green LED flashes quickly on start-up, then red LED lights for about 12 seconds. Green LED then flashes approximately every 4 seconds</b></p>	<p>1. No fault present – Controller self-checking circuitry has simulated a fault at the moment it was switched on, but is working normally.</p>
<p><b>7</b>  <b>A high or low water alarm has occurred</b></p>	<p>1. Check the actual level in the boiler immediately. If the level is in the alarm area, then take action to normalise the level.  2. If an alarm has occurred and the level is normal, switch off the boiler and investigate the fault immediately.</p>
<p><b>8</b>  <b>Controller internal thermal fuse blown</b></p>	<p>1. Check the mains supply voltage is lower than 264 Vac or 132 Vac, 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.  2. Ensure the probe supply voltage is approximately 2 - 2.5 Vac between terminals 52 and 53 of the controller, or terminal 1 and earth of the probe.</p>

# 10. Technical information

## 10.1 For technical assistance

Contact your local Spirax Sarco representative. Details can be found on order/delivery documentation or on our web site: [www.spiraxsarco.com](http://www.spiraxsarco.com)

## 10.2 Returning faulty equipment

Please return all items to your local Spirax Sarco representative, if this is not known, please contact Spirax Sarco via the website. Please 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:
  - Date of purchase.
  - Original order number.

## 10.3 Power supply

Mains voltage range	220/240 Vac setting (198 V to 264 V)
	110/120 Vac setting (99 V to 132 V)
Frequency	50 - 60 Hz
Power consumption	230 V/30 mA or 115 V/60 mA

## 10.4 Environmental

General	Indoor use only	
Maximum altitude	2 000 m (6 562 ft) above sea level	
Ambient temperature limits	0 - 55 °C (32 - 131 °F)	
Maximum relative humidity	80% up to 31 °C (88 °F) decreasing linearly to 50% at 40 °C (104 °F)	
Overvoltage category	III 2 (as supplied)	
Pollution degree	3 (when installed in an enclosure) - Minimum of IP54 or UL50/NEMA Type 3, 3S, 4, 4X, 6, 6P or 13. See Section 4, Mechanical installation.	
Enclosure rating (front panel only)	NEMA type 4 hose down only (UL approval), and IP65 (verified by TRAC Global)	
Torque rating for panel screws	1 - 1.2 Nm	
LVD (safety)	Electrical Safety EN 61010-1 UL61010-1, 3rd Edition, 2012-05 CAN/CSA-C22.2 No. 61010-1, 3rd Edition, 2012-05	
EMC	Immunity/ Emissions	Suitable for heavy industrial locations
Enclosure	Colour	Light grey (similar to RAL7035)
	Material	ABS polycarbonate plastic
Front panel	Colour	Pantone 294 (blue)
	Material	Silicone rubber, 60 shore.
Solder		Tin/lead (60/40%)

## 10.5 Cable/wire and connector data

### Mains and signal connector

Termination	Rising clamp plug-in terminal blocks with screwed connectors
Cable size	0.2 mm <sup>2</sup> (24 AWG) to 2.5 mm <sup>2</sup> (14 AWG).
Stripping length	5 - 6 mm

**Caution:- Use only the connectors supplied by Spirax Sarco Ltd. Safety and Approvals may be compromised otherwise.**

### Level probe cable/wires

Type	High temperature
Shield type	Screened
Number of cores	4
Gauge	1 - 1.5 mm <sup>2</sup> (18 - 16 AWG)
Maximum length	50 m (164 ft)
Recommended type	Prysmian (Pirelli) FP200, Delta Crompton Firetuf OHLS

## 10.6 Input technical data

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### Level

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Minimum conductivity	30 $\mu$ S/cm or 30 ppm
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## 10.7 Output technical data

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### Relay(s)

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Contacts	2 x single pole changeover relays (SPCO)
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Voltage ratings (maximum)	250 Vac
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Resistive load	3 amp @ 250 Vac
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Inductive load	1 amp @ 250 Vac
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ac motor load	$\frac{1}{4}$ HP (2.9 amp) @ 250 Vac
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$\frac{1}{16}$ HP (3 amp) @ 120 Vac
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Pilot duty load	C300 (2.5 amp) - control circuit/coils
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Electrical life (operations)	3 x 10 <sup>5</sup> or greater depending on load
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Mechanical life (operations)	30 x 10 <sup>6</sup>
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### Infrared

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Physical layer	IrDA
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Baud	38400
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Range	10 cm
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Working angle	15°
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Eye safety information	Exempt from EN 60825-12: 2007 Safety of laser products- does not exceed the accessible emission limits (AEL) of class 1
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# 11. Appendix - Data registers

## Parameters and register data

Register	Parameters
0	7 - Identity <b>Note:</b> When the device is an IR slave and there is a temporary error in the IR Master-Slave comms, an offset of +32768 is added to the identification value of that particular slave stored in the master's database.
1	Alarm status ~ 01 = normal or 00 = alarm
2	-
3	-
4	-
5	-
6	-
7	-
8	-
9	-

The format of the register data is 16 bit integer, with the most significant byte transmitted first.

