INSTRUCTIONS FOR INSTALLATION AND USE.

0LLTC001EN

LTC15

Thank you for having chosen a LAE electronic product. Before installing the instrument, please read these instructions carefully to ensure maximum performance and safety.

1. INSTALLATION

1.1. LTC15 is sized 77x35x77 mm (WxHxD). It is inserted into the panel through a hole 71x29 mm and secured by pressing gently into the relative clamps. The rubber gasket should be placed between the instrument frame and the panel, checking its seal to avoid infiltration.

1.2 The instrument should operate at an ambient temperature between -10°…+50°C and relative humidity between 15%...80%. To reduce the effects of electromagnetic disturbance, ensure that the sensor and signal cables are well separated from the power conductors.

1.3. The supply voltage, switched powers and arrangement of connections must be in compliance with the indications given on the container.

CAUTION: *: if the relays must frequently change over a heavy load, it is advisable to contact the manufacturer to obtain indications regarding the lifetime of the contacts.*

Whenever products are to be stored within very rigid specifications or they are very valuable, it is advisable to use a second instrument that can activate or warn in the event of any malfunction.

2. CONTROL PARAMETERS

The regulator is adapted to the controlled system by suitably programming its configuration parameters from the setup menu.

The instrument comes with a general setup and cannot therefore be used without having first checked that the parameters are correct.

Setup is accessed by keeping the buttons ⏎ + 0/I pressed for 5 seconds. The available parameters appear in TABLE 1 shown below. The LTC15 features an easier parameter programming procedure: just the parameters specific to the control mode selected are displayed, in this way programming of the controller will be easier and quickier. Use the keys ▶ /◀ to pass from one parameter to the next/previous one. To display the correlated value press key ⏎, to change it press ⏎ + ◀ or ▶ simultaneously. Press the key 0/I to exit from setup; if the keypad is not touched for 30 seconds, exit is automatic.

The setpoint **1SP** and setpoint/differential **2SP/2DF** may also be displayed and programmed during normal regulator operation.

To modify setpoint of channel 1 press and release key L1: the LED L1 starts to blink, the display will show 1SP for 1 second then the value associated to the setpoint; to change this value press ◀ or ▶, the setpoint in any case remain within the limits **SPL** and **SPH**. To save the new value and switch back to the normal operation, press ⏎ or do not touch the keypad for 10 seconds; to revert back to normal operation without saving the newly programmed value, just press 0/I.

To change the setpoint/differential of channel 2 press and release key L2: the LED L2 starts to blink, the display shows 2SP for 1 second, if the setpoint2 is an absolute value, alternatively the display shows 2DF if the sepoint2 is a relative value referred to 1SP. The display will then show the associated value; to modify the displayed value press ◀ or ▶; to save the newly programmed value and switch over to normal operation press key ⏎ or do not touch the keypad for 10 seconds; to switch over to the normal operation without saving the newly programmed value, just press key 0/I.

INP	PTC / NTC	Input selection	**1CT**	1…255 [s]	Cycle time channel 1
SCL	1°C / 2°C / °F	Reading scale	**1PF**	ON / OFF	Channel 1 status with faulty sensor
RLO	-199…RHI[°]	Minimum range value	**2CH**	NO / THR / ALR	Control mode channel 2
RHI	RLO…999[°]	Maximum range value	**2FN**	H / C	Function of channel 2 (heating / cooling)
SPL	-199…SPH[°]	Minimum temperature setpoint	**2MD**	ABS / REL	Mode setpoint 2 (Absolute/Differential)
SPH	SPL…999[°]	Maximum temperature setpoint	**2SP**	SPL…SPH [°]	Effective temperature set channel 2
1CH	HY / PID	Control type channel 1	**2DF**	-199…199[°]	Temp. differential set2 to set1
1FN	H / C	Function of channel 1 (heating / cooling)	**2HY**	-199…199 [°]	Hysteresis channel 2
1SP	SPL…SPH [°]	Effective temperature set of channel 1	**2CT**	1…255 [s]	Cycle time channel 2
1HY	-199…199 [°]	Hysteresis channel 1	**2PF**	ON / OFF	Channel 2 status with faulty sensor
1PB	-199…199 [°]	Proportional band channel 1	**SB**	YES / NO	Button standby enabling
1IT	0…999 [s]	Integral action time channel 1	**OS1**	-120…120[°]	Probe offset
1DT	0…999 [s]	Derivative action time channel 1	**SIM**	0…100	Display slowdown
1AR	0…100%	Reset of integral action referred to Pb1	**ADR**	1…255	Peripheral address

TABLE 1

3. INPUT SELECTION

In some models it's possible to select the type of sensor used:
LTC15T: with INP=PTC the sensor to be fitted is the PTC1000, with INP=NTC it's the NTC10K.
LTC15J: with INP=T1 the thermocouple to be fitted is of type J, with INP=T2 it's of type K.
LTC15I: with INP=0mA the current input is of type 0÷20mA, with INP=4mA it's of type 4÷20mA.

In the models LTC15A and LTC15I, it's possible to adapt the range to the transmitter used, through the parameters RLO and RHI: to RLO you assign the minimum value measured by the transmitter (corresponding to 0V, 0/4mA); to RHI the maximum value (corresponding to 1V, 20mA).

4. DISPLAYS

For approx. three seconds upon switching on, the instrument displays --- (internal self-test phase). Subsequent indications depend on the operating status of the regulator. TABLE 2 gives the indications associated with the various states.
The temperature measured by the sensor is processed by the microprocessor to display it in the most representative way. For this purpose it may be corrected with a fixed offset, assigning the parameter **OS1** a value other than zero, and displayed in the desired scale by setting the parameter **SCL**: with **SCL=1°C** the temperature is displayed in °C with autorange 0.1/1°; with **SCL=2°C** or **°F** the temperature is displayed with a resolution of a degree in the Celsius or Fahrenheit scale respectively.
Prior to display, the temperature is processed by a special algorithm, which allows the simulation of a thermal mass directly proportional to the **SIM** value; the resulting effect is a reduction in the oscillation of the displayed value.
The status of the outputs is shown through the respective luminous points on the display.
CAUTION*: when changing the display scale SCL, the parameters related to the absolute (SPL, SPH, 1SP...) and differential (1HY, 1PB, OS1 ...) temperatures MUST be reconfigured.*

---	Internal self-test (3 seconds)	E1	In tuning: timeout 1error
5.4	Sensor T1 temperature	E2	In tuning: timeout 2 error
or	Over range or breakage T1	E3	In tuning: over range error
Tun/5.4	Instrument in auto-tuning	OFF	Controller standby

TABLE 2

5. STAND-BY OF CONTROLLER

With **SB=YES**, pressing the key 0/I for about 2 seconds puts the LTC15 on stand-by, or, if it's already on a stand-by, resumes the control of the outputs. On stand-by the controller displays OFF and the outputs are off. With **SB=NO** the key 0/I is disabled.

6. CHANNEL 1 OPERATION

6.1. TYPE OF CONTROL. Channel 1 may operate in the ON/OFF (**1CH=HY**) or PID mode (**1CH=PID**), and can operate in heating (**1FN=H**) or cooling mode (**1FN=C**). In heating mode the hysteresis 1HY, or the proportional band 1PB can take negative values only, viceversa, in cooling mode, the hysteresis and proportional band can take positive values only. With 1HY=0 or 1PB=0 the output is always off.
Caution*: when changing the mode of operation 1FN, the hysteresis 1HY (or the proportional band 1PB) MUST then be re-configured accordingly.*
6.2. ON/OFF CONTROL. In the ON/OFF mode the output is either ON or OFF in relation to the input temperature, setpoint (**1SP**) and hysteresis value (**1HY**). The hysteresis indicates the amplitude of deviation of the temperature from the setpoint in order to reactivate the output. Increasing the hysteresis value decreases the switchovers of the output, while decreasing the hysteresis value gives finer control. After a switchover the output remains in the new state for a minimum time of **1CT** seconds irrespective of the temperature value.

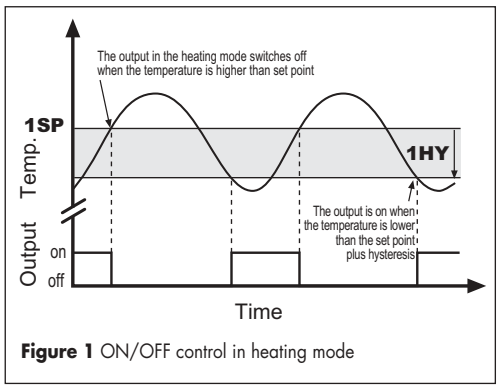


Figure 1 ON/OFF control in heating mode

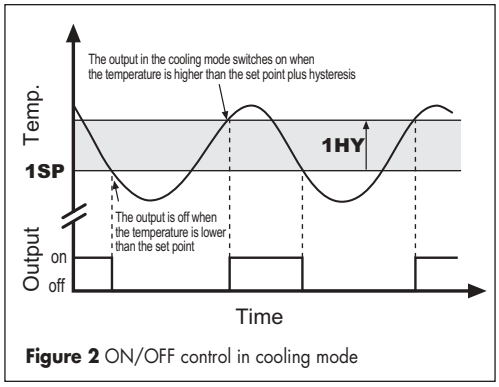


Figure 2 ON/OFF control in cooling mode

6.3. PID CONTROL. In the PID mode the output is ON for a fraction of the cycle time **1CT**. The cycle time characterises the dynamics of the system to be controlled and influences the accuracy of the control: the higher the system speed of response the shorter the cycle time to obtain greater temperature stability and less sensitivity to variations in load.

6.3.1. Proportional control. The temperature is controlled by varying the time of activation of channel 1 when the temperature is inside the proportional band (**1PB**). The nearer the temperature to set point, the less time of activation. A small proportional band increases the promptness of response of the system to temperature variations, but tends to make it less stable. A purely proportional control stabilises the temperature within the proportional band but does not cancel the deviation from the set point.

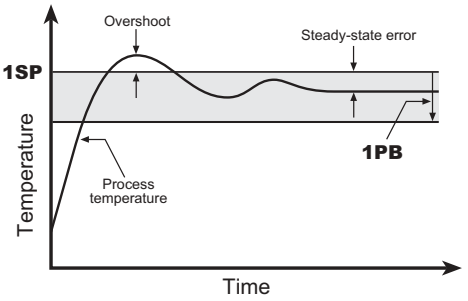


Figure 3 Proportional Control (P) in heating mode

6.3.2. PROPORTIONAL-INTEGRAL CONTROL. The steady-state error is cancelled by inserting an integral action into the control system. The integral action time, **1IT**, determines the speed of cancellation of the error, but a high speed (**1IT** low) may be the cause of overshoot and instability in the response. The integral part normally acts within the proportional band, but this area of action may be reduced in terms of percentage by lowering the integral action reset **1AR**. The response overshoot is thus decreased. With **1IT=0** the integral control is disabled.

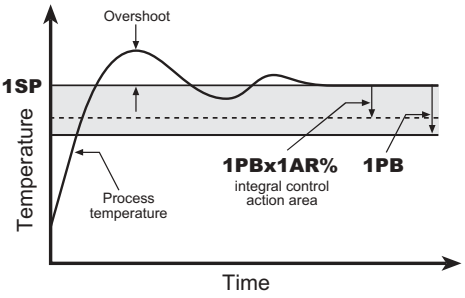


Figure 4 Proportional-Integral Control (PI) in heating mode

6.3.3. PROPORTIONAL-INTEGRAL-DERIVATIVE CONTROL. Response overshoot in a system controlled by a PI controller may be reduced by inserting a derivative action in the control. The derivative action is greater the faster the temperature variation within the time unit. A controller with a high derivative action (**1DT** high) is extremely sensitive to small temperature variations and can make the system instable. With **1DT=0** the derivative control is disabled.

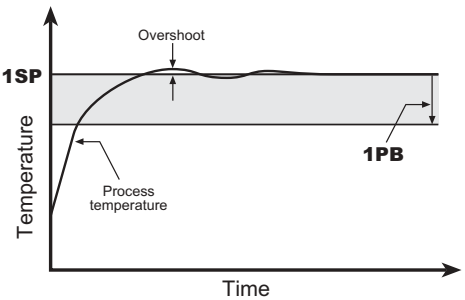


Figure 5 Proportional-Integral-Derivative Control (PID) in heating mode

6.4. MALFUNCTIONING. Following a sensor malfunction, or appears on the display and the output is controlled according to the value of the parameter **1PF**.

***CAUTION**: when programming the hysteresis 1HY or the proportional band 1PB, it is advisable to consider the number of switchovers that the relay will carry out and, if necessary, adapt the cycle time in order to limit the frequency of switchover.*

7. CHANNEL 2 OPERATION

7.1. MODE OF OPERATION. The parameter **2CH** assigns one of the following functions to channel 2: second thermostat (THR), alarm warning (ALR) or not used (NO). Setpoint 2 may be fixed in an absolute way (**2MD=ABS**), or a relative way in relation to setpoint1 (**2MD=REL**). If **2MD=ABS** setpoint 2 is expressed with the parameter **2SP**, and it's independent of 1SP (see Figure 6, Figure 8). If **2MD=REL** setpoint 2 is expressed with the parameter **2DF**, which is a differential in relation to 1SP: in this case, changing the setpoint 1, also changes the setpoint 2 by the same amount of degrees (see Figure 7, Figure 9).

7.2. OUTPUT 2 AS THERMOSTAT. With **2CH=THR**, channel 2 will operate as a second ON/OFF thermostat: the output is ON or OFF in relation to the input temperature, the setpoint/differential (**2SP/2DF**) and hysteresis value (**2HY**). The hysteresis indicates the amplitude of deviation of temperature from the setpoint to switch on the output again. By increasing the hysteresis value, as a result the

number of switchings will decrease, by reducing the hysteresis value you get a finer control. With channel 2 in heating mode (2FN=H) **2HY** can take negative values only; if in cooling mode (2FN=C) **2HY** can take positive values only. With **2HY=0** the output will always be Off. After the output has switched off, the output will remain in the new status for a minimum **2CT** time in seconds regardless of the temperature value.

***CAUTION**: upon changing the mode of operation 2FN it is then **ESSENTIAL** to re-configure parameter 2HY.*

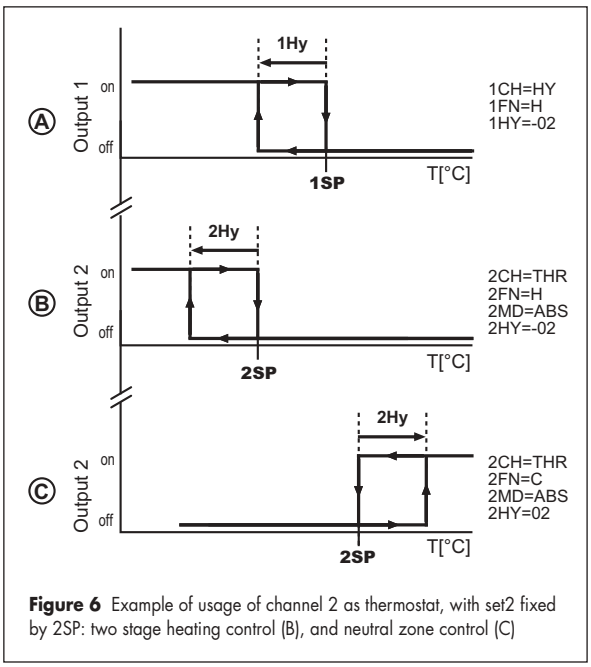


Figure 6 Example of usage of channel 2 as thermostat, with set2 fixed by 2SP: two stage heating control (B), and neutral zone control (C)

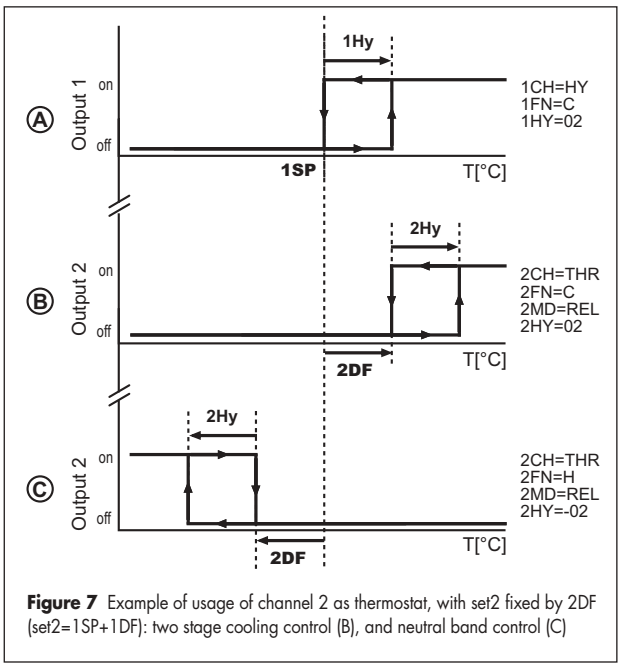


Figure 7 Example of usage of channel 2 as thermostat, with set2 fixed by 2DF (set2=1SP+1DF): two stage cooling control (B), and neutral band control (C)

7.3. Output 2 in alarm mode. With **2CH=ALR** channel 2 operates as alarm output. To set a high temperature alarm set 2FN=C and program the alarm threshold in 2SP or 2DF (see 7.1.). The hysteresis 2HY indicates the amplitude of the deviation of temperature from the setpoint to disactivate the alarm, and this can take negative values only.

To program a low temperature alarm set 2FN=H and program the alarm threshold (see 7.1.). The hysteresis 2HY can take positive values only.

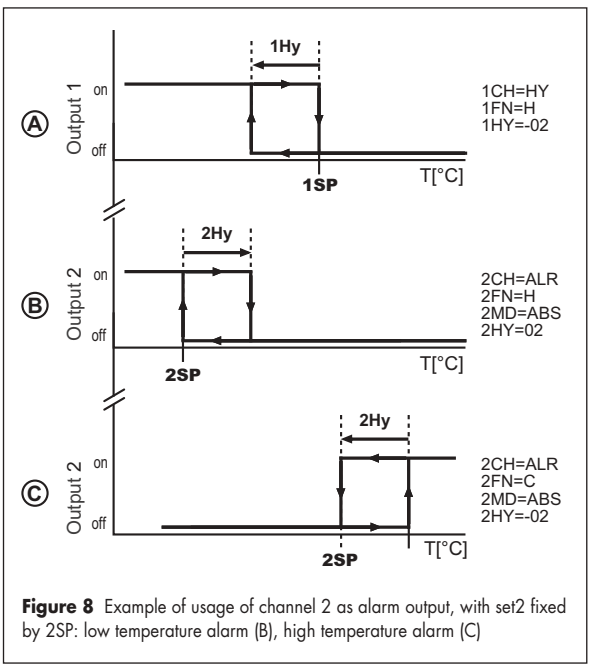


Figure 8 Example of usage of channel 2 as alarm output, with set2 fixed by 2SP: low temperature alarm (B), high temperature alarm (C)

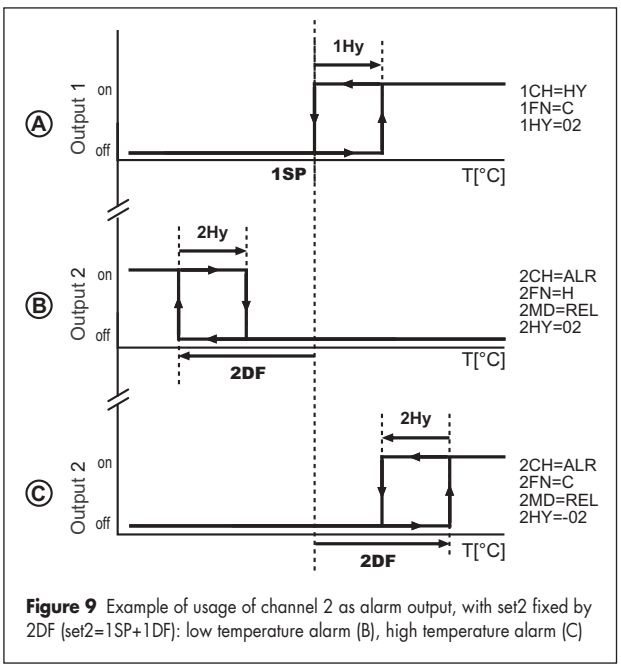


Figure 9 Example of usage of channel 2 as alarm output, with set2 fixed by 2DF (set2=1SP+1DF): low temperature alarm (B), high temperature alarm (C)

7.4. Malfunctioning. Following a sensor malfunction, or appears on the display and the output is controlled according to the value of the parameter **2PF**.

***CAUTION**: when programming the hysteresis 2HY, it is advisable to consider the number of switchovers that the relay will carry out and, if necessary, adapt the cycle time in order to limit the frequency of switchover.*

8. AUTOTUNING CHANNEL 1

8.1. Before starting. Before starting the auto-tuning procedure, ensure that the output has been set with PID control (1CH=PID), the required mode of operation has been set (heating/cooling) and that the set point has been fixed at the required value. The auto-tuning procedure is divided into two parts. In the first part, the operator has to characterise the process to be controlled by fixing the cycle time. In the second, the controller acquires the responses of the system to certain stresses for efficient adaptation of the control parameters.

8.2. Starting the function. To access the auto-tuning function, keep the keys ⏎ + ◀ pressed for 3 seconds. If the output 1 is in the PID mode (1CH=PID), 1CT starts to blink on the display. Press ⏎ to display the current parameter value. Using ⏎ + ◀ or ▶, change the cycle time to characterise the dynamics of the process to be controlled. In this first phase the auto-tuning function may be quit by pressing key 0/I. The acquisition phase starts upon pressing the keys ◀ + ▶ or after 30 seconds without touching the keyboard.

8.3. Acquisition of responses. Throughout the whole acquisition phase fun and the measured temperature value appear alternately on the display. If there is a power failure during this phase, the next time the instrument is switched on, after the initial internal self-test phase, it continues the auto-tuning function. To manually abort the auto-tuning function without modifying the control parameters, keep button 0/I pressed for 3 seconds.

Upon successful completion of auto-tuning, the controller updates the value of the control parameters and starts to control.

8.4. Errors. If the auto-tuning procedure is unsuccessful, an indication of the error that has caused the failure blinks on the display:

- E1 timeout error 1: the controller has not succeeded in bringing the system temperature within the proportional band. Temporarily increase the setpoint with control in the heating mode and vice versa in the cooling mode, then restart the procedure.
- E2 timeout error 2: the auto-tuning procedure has not finished within the maximum set time (1000 cycle times). Restart the auto-tuning procedure and set a higher cycle time.
- E3 temperature over range: after having checked that the error has not been caused by a sensor malfunction, temporarily decrease the set point with control in the heating mode and vice versa in the cooling mode and then restart the procedure.

To erase the error indication and return to the normal mode, press the key 0/I.

8.5. Control improvement. If the resulting control is unsatisfactory, proceed as follows:

- to reduce overshoot, decrease the integral action reset **1Ar**;
- to increase the response speed of the system, decrease the proportional band **1Pb**; caution: doing this makes the system less stable;
- to reduce swings in steady-state temperature, increase the integral action time **1It**; system stability is thus increased, although its response speed is decreased;
- to increase the speed of response to the variations in temperature, increase the derivative action time **1Dt**; caution: a high value makes the system sensitive to small variations and may be a source of instability.

***CAUTION**: during the auto-tuning procedure the temperature oscillates near the set point; it is therefore advisable to remove products to be controlled within severe specifications.*

9. RECALIBRATION

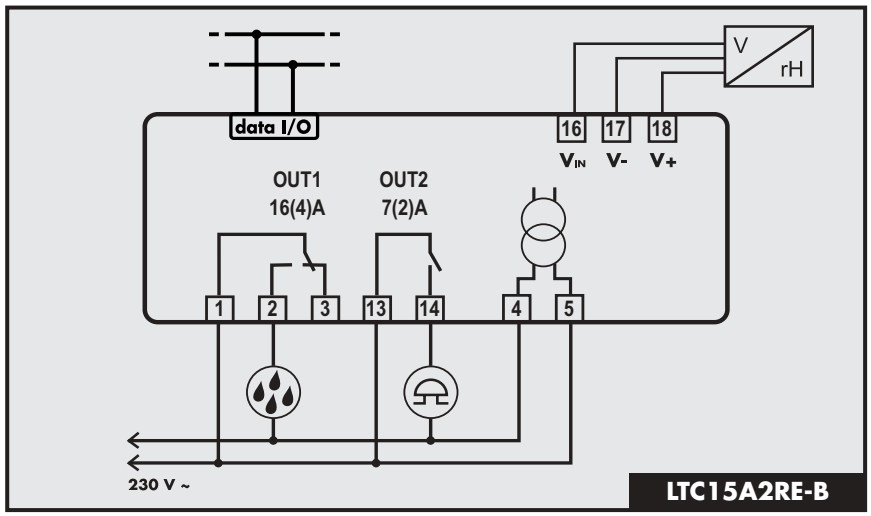
If it is necessary to recalibrate the instrument, for example following replacement of a sensor, proceed as follows: have a precision reference thermometer or a calibrator to hand; ensure that the offset **OS1** and the simulation **SIM** are set to 00. Switch the controller off then on again. During the internal self-test phase, press the keys ⏎ + ▶ and keep them pressed till the auto-test phase is over. With the recalibration function activated, select the value to be changed using ◀ or ▶: **0Ad** allows a calibration of 0, inserting a constant correction over the whole scale of measurement. **SAd** allows a calibration of the top part of the measurement scale with a proportional correction between the calibration point and 0. After having selected the required parameter, press ⏎ to display the value and use ⏎ + ◀ or ▶ to make the read value coincide with the value measured by the reference instrument (ensure that the temperature is stable). Exit from calibration by pressing the key 0/I.

10. SERIAL COMMUNICATION

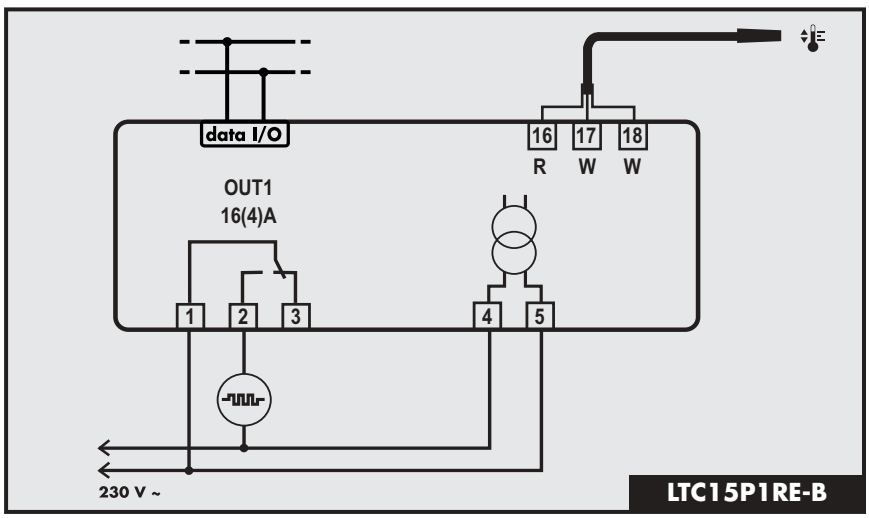
LTC15 is provided with a serial port for connection with a PC or a programmer. In the first case it is important to assign a different value to the **ADR** parameter for each linked unit (peripheral address); in the case of automatic programming, ADR should remain at 1.

WARRANTY

WIRING DIAGRAMS



LTC15A2RE-B



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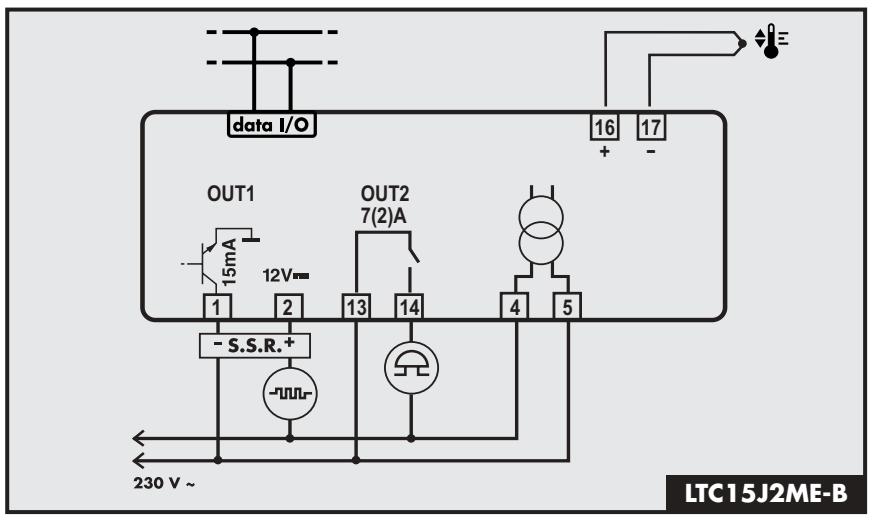

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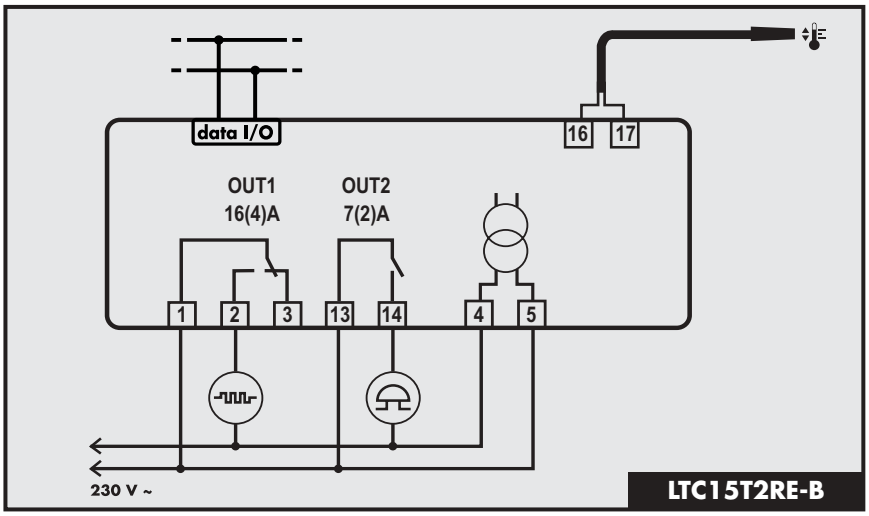

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