LD1-15

Thank you for having chosen an LAE electronic product. Before installing the instrument, please read this instruction booklet carefully in order to ensure safe installation and optimum performance.

1. INSTALLATION

1.1 The LD1-15, size 77x35x77 mm (WxHxD), is inserted into the panel through a hole measuring 71x29 mm and is fixed by means of the suitable clips, by pressing gently. If fitted, check that the rubber gasket adheres to the panel perfectly, in order to prevent debris and moisture infiltration to the back of the instrument.
1.2 The instrument should work with room temperatures between -10°.. +50°C and relative humidity between 15%.. 80% inclusive. Supply voltage, switched powers and connection set-up should scrupulously comply with the indications given on the container. To reduce the effects of electromagnetic disturbance, keep the sensor and signal cables well separate from the power wires.
1.3 The sensor T1 measures the air temperature and activates in the thermostat control cycle; it should be placed inside the appliance in a point that truly represents the temperature of the stored product. If fitted, the sensor T2 can either be used for defrost termination or, alternatively, for condenser temperature monitoring. In the first case, the probe should be placed where there is the maximum formation of frost. If T2 is used for condenser monitoring, it should be located between the condenser fins, half way between the condenser inlet and the outlet.
***CAUTION**: should the relays have to switch a heavy load frequently, it is advisable to contact the manufacturer for indications on the lifetime of the contacts.*
Whenever products must be kept within very severe specifications or the products have considerable value, the use of a second instrument is recommended, which activates upon or warns of any malfunction.

2. OPERATING MODES

Upon switching on, just the central line (autotest) appears on the display for approximately three seconds and the subsequent indications depend on the operating status of the controller. TABLE 1 gives the indications associated with the various states, whereas the symbols appearing below are explained in TABLE 2.

STANDBY	NORMAL	INFO MENU	INFO DATA	SETUP MENU	PARAMETER VALUE
OFF Not Operating	2.4 Product Temper. (sim.)	T1 Air temperature	3.0	SCL Display scale	1°C
	DEF Defrost	T2 Evaporator temperature	-1.2	SPL Minimum setpoint	1.0
	REC Recovery after defrost	THI Max. stored temperature	3.4	SPH Maximum setpoint	10.0
	HI High temperature alarm	TLO Min. stored temperature	1.9	- - -	- - -
	- - -	CND Condenser clean cycle	15	- - -	- - -
	E1 Faulty T1 probe	LOC Locked keypad	NO	- - -	- - -

TABLE 1

2.1 STANDBY. If button 0/I is pressed for 3 seconds, it allows the LD1 to be put on a standby, or to resume output control (with parameter **SB**=YES only). An OFF indication on the display shows that the outputs are off permanently.
2.2 NORMAL. During normal operation, the display shows the temperature measured by probe T1, presented in the most appropriate manner. Parameter **SCL** may be adjusted in °C with auto-range (SCL=1°C), in °C with 1° fixed resolution (SCL=2°C) or in Fahrenheit (SCL=°F). The measured temperature may be corrected with a fixed offset by assigning a value other than 0 to the parameter OS1.

Additionally, prior to display, the temperature is treated by an algorithm that allows the simulation of a thermal mass directly proportional to the **SIM** value. The result is a reduction in the fluctuation of the displayed value.

2.3 INFO MENU. Pressing the button i.set and releasing it immediately activates the information selection menu. From this menu you can display the instantaneous temperatures T1 and T2; the maximum (THI) and minimum (TLO) stored temperature; the total operating time of the condenser since its last cleaning (CND) and the keypad status (LOC). The information to be displayed can be selected sequencially, by pressing i.set repeatedly or quickly via the buttons ◄ and ► to scroll through the menu. Exit from the info menu is by pressing button 0/I or automatic after 6 seconds of not using the keypad.

In the INFO operating mode it's also possibile to reset the recordings THI and TLO and the hour counter CND by pressing buttons i.set +0/I simultaneously while the value is displayed.

2.4 KEYPAD LOCK. The keypad lock avoids undesired, potentially dangerous operations, which might be attempted when the controllers is operating in a public place. In the INFO mode, through the buttons ◄ and ► it's possibile to assign YES or NO to the parameter LOC. With LOC=YES all keypad commands are inhibited. To resume normal operation of keypad, adjust setting so that LOC=NO.

2.5 DEFROSTING. By assigning a value grater than 0 to the parameter **DDY**, during defrost the indication DEF is displayed instead of the temperature. In this case, after defrost and for the time programmed in DDY, the display indication REC shows that the normal thermostatic cycle is being resumed.

2.6 ALARM. An anomaly in the operation is displayed through the lighting up of an abbreviation showing its cause: HI/LO high/low alarm temperature in the cabinet, DO door open, HP condenser high temperature, CL periodic condenser cleaning, E1/E2 fault of probe T1 / T2.

2.7 SETUP. The setup is accessed by pressing the buttons 0/I+i.set in succession and keeping them pressed simultaneously for 5 seconds. The available parameters appear in TABLE 2 as shown below.

3. CONFIGURATION

The controller is configured for the system to be controlled by programming the operating parameters, that is, through the setup (see par. 2.7). The instrument is dispatched with a general setup and the suitability of the parameters must therefore be checked before use. In SETUP, press button ► to pass from one parameter to the next, and press button ◄ to go back. To display the value of a parameter press i.set, to modify it press buttons i.set + ◄ or ► simultaneously. Exit from the setup is by pressing button 0/I or automatic after 30 seconds of not using the keypad. The setpoint **SP** can be displayed and programmed even during normal operation of the controller, by pressing button i.set + ◄ or ►. The range will always remain within the limits **SPL** and **SPH**.

SCL	1°C/2°C/°F	Readout scale	**ATD**	0.. 120 [min]	Alarm temperature delay
SPL	-40.. SPH [°]	Minimum temperature set point	**3)AHT**	0.. 75 [°]	Condenser alarm temperature
SPH	SPL.. +40 [°]	Maximum temperature set point	**3)AHM**	NON/ALR/STP	Condenser high temperature alarm operation
SP	SPL.. SPH [°]	Effective temperature set point	**ACC**	0.. 52 [weeks]	Periodic condenser cleaning
HYS	+0.1.. +10.0 [°]	Thermostat hysteresis	**SB**	YES/NO	Button 0/I enabling
CRT	0.. 30 [min]	Compressor rest time	**DS**	YES/NO	Door switch enabling
CDC	0.. 10	Compressor regulation with sensor T1 failure	**4)CSD**	0.. 30 [min]	Compressor stop delay from door opening
FPC	0.. 4	Evaporator fan timed control	**4)ADO**	0.. 30 [min]	Door alarm delay
DFR	0.. 24	Defrosting frequency /24h	**BAU**	YES/NO	Manual control enabling
1)DLI	-40.. +40 [°]	Defrost end temperature	**OAU**	NON/0-1/MAN	Auxiliary output control mode
DTO	1.. 120 [min]	Maximum defrosting duration		FAN/DEF/ALR	
2)DTY	OFF/ELE/GAS	Defrost type	**OS1**	-12.. +12 [°]	Probe T1 offset
2)DRN	0.. 30 [min]	Drain down time	**T2**	NON/DEF/CND	Function probe T2
DDY	0.. 60 [min]	Defrosting display control	**OS2**	-12.. +12 [°]	Probe T2 offset
ATL	-12.. 0 [°]	Low alarm differential	**TLD**	1.. 30 [min]	Delay for min./max. temperature storage
ATH	0.. +12 [°]	High alarm differential	**SIM**	0.. 100	Display slowdown
			ADR	1.. 255	Peripheral address

TABLE 2

1) Only with T2=DEF; 2) Only with OAU=DEF; 3) Only with T2=CND; 4) Only with DS=YES.

***CAUTION**: upon changing the display scale SCL, it is **ESSENTIAL** to reconfigure the parameters related to the absolute (SPL, SPH, SP, etc.) and differential (HYS, ATL, ATH, etc.) temperatures.*

4. THERMOSTAT CONTROL

4.1 Thermostat control is based on comparing the temperature T1, the set point **SP** and the hysteresis **HYS**.

Example: SP= 2.0; HYS= 1.5, compressor Off with T1= +2.0° and On with T1= +3.5° (2.0+1.5).

The compressor only switches On again if the Off time period determined by **CRT** since the previous switchover has elapsed. Whenever a very small hysteresis HYS must be maintained, it is advised that a suitable value for CRT is selected in order to reduce the number of starts per hour.

4.2 If sensor T1 fails, the output is controlled by parameter **CDC** as a proportion of a 10 minute operating cycle.

Example: CDC=06, 6 minutes On, 4 minutes Off.

4.3 If door switch input control has been enabled (DS=YES), parameter **CSD** determines the delay between when the door is opened and the compressor stopping.

5. DEFROSTING

5.1 Defrosting starts automatically when necessary time has elapsed to obtain the defrosting frequency set with **DFR**. For example, with DFR=4 defrosting occurs once every 6 hours. With DFR=0 the timed defrosting function is removed.

The internal timer is set to zero when power is applied to the controller and at each subsequent defrost start. When the controller is put on a standby, the accumulated time count is "frozen" (is not incremented).

Defrosting may also be induced manually by keeping the button pressed for 2 seconds.

During a High Pressure alarm (see par. 6.3), defrost is suspended.

5.2 Once defrost has started, the outputs are controlled according to parameter **OAU** and **DTY**. If OAU is different from DEF, defrost takes place through simple compressor stop, alternatively, if OAU=DEF, defrost takes place as per the following table:

DTY	DEFROST	COMPRESSOR
OFF	Off	Off
ELE	On	Off
GAS	On	On

TABLE 3

5.3 Defrost lasts for the time **DTO** but, if the evaporator probe has been enabled (T2=DEF) and temperature **DLI** is achieved before this time elapses, defrost will be terminated in advance.

If OUA=DEF and **DRN** is greater than 0, before cooling starts all outputs will remain off for the time assigned to DRN. This phase, called drain down, will allow a complete ice melting and the drain of the resulting water.

6. ALARMS

With LD1, correct operation of the refrigerator and thermostat may be monitored by a wide range of functional and diagnostics alarms, individually selectable by means of the relevant parameters. The alarm warnings are given on the display through explicit indications (see following par.) and intermittent buzzer sounding. During an alarm, by pressing any button, the buzzer is muted. Then, if the alarm persists, the buzzer will be periodically switched on for 20 seconds every 60 minutes, until the alarm ends (the display indications remain on all the time). The repeated acoustic warning applies to all alarms with the exception of the condenser cleaning alarm. Operation of the various elements is given in detail below.

6.1 The parameters ATL and ATH define two differential temperatures that, referred to the set point, determine the temperature alarm thresholds. ATL establishes the alarm differential for temperatures below set point, ATH the alarm differential for temperatures above set point + hysteresis. Putting one or both differentials to 0 cuts out the corresponding alarm.

Example: SP= 2.0, HYS= 1.5, ATL= -5.0, ATH= 5.0; the alarm thresholds are set at -3.0° (2.0-5.0) and +8.5° (2.0+1.5+5.0).

The alarm warning may be immediate or delayed by the time ATD whenever this is greater than 0. The indication HI for high temperature and LO for low temperature alarm blinks on the display. The alarm indication remains stored in the display, even when the alarm is over, until you acknowledge the alarm manually by pressing any button.

The high temperature alarm is bypassed during defrosting.

6.2 If a suitable door switch has been connected to detect the door status and door switch input control has been enabled (DS=YES), the door open alarm function is enabled. In this way, if the door remains open the controller will react after the time delay set with **ADO** by displaying the alarm source through the indication DO.

6.3 To monitor the condenser temperature to avoid gas pressure from getting too high, it's necessary to secure probe T2 to the condenser firmly (see 1.3) and enable condenser probe control (T2=CND). Parameter AHT determines the condenser temperature alarm threshold and parameter **AHM** determines the reaction following the temperature rising over **AHT**. With AHM=ALR the only reaction will be the buzzer sounding and HP being displayed. Alternatively, with AHM=STP, besides the alarm indication the compressor will be stopped immediately and defrosts suspended.

With AHM=NON, all functions related to the High Pressure alarm are inhibited.

6.4 Assigning a value greater than 0 to the parameter **ACC** enables the indication for periodic cleaning of the condenser. Subsequently, when the count of compressor hours of operation reaches the equivalent in weeks set with ACC, an indication for cleaning appears on the display.

Example: with ACC=16 there is a warning once every 16x7x24=2688 hours of ***compressor operation****, so, assuming for this an operation with 5 minutes On and 5 minutes Off - after approx. 32 weeks.*
In order to clear the time counter, follow the prescribed procedure in paragraph 2.3.
6.5 Upon failure of probe T1 or, if enabled, probe T2, probe failure is signalled with the blinking indication E1 or E2 respectively.

7. TEMPERATURE STORAGE

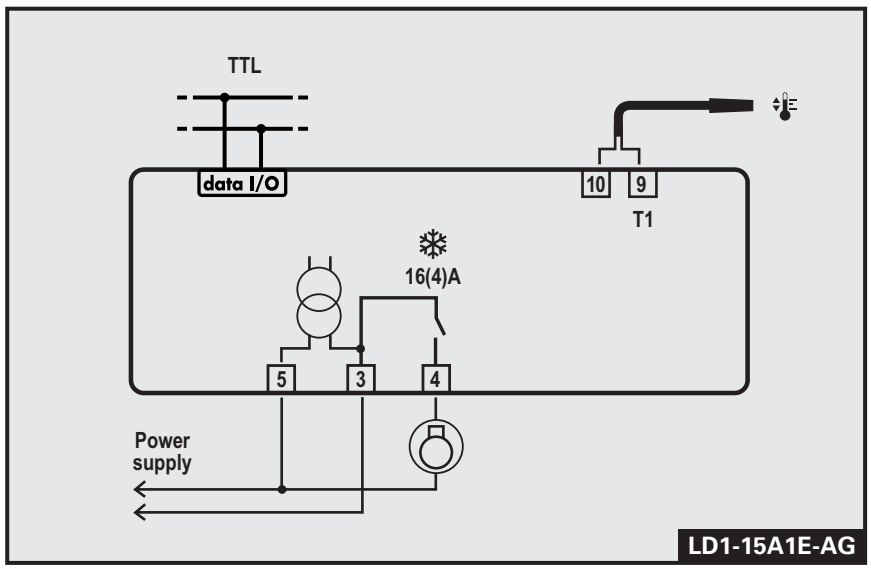
The LD1 features a system for permanent storage of the minimum and maximum temperature logged during operation. This system is a valid help to achieve compliance with the HACCP directive in its part relating to a correct preservation of foodstuffs. Temperature is measured by probe T1 which should therefore be placed in a point where the temperature of the preserved product may always be measured correctly. The logging is however subject to some simple rules that filter the data and give a rational interpretation. The logging is suspended during the periods in which the refrigerator is put on a standby and during defrostings and, during the normal operation (thermostatic control), it's "slowed down" through the parameter **TLD**. This parameter defines the time during which the measured temperature must permanently exceed the current value before the logging is performed. In this way, it will be possible to avoid idle loggings that don't reflect the actual product temperature, for example, the door being left open, the temperature recovery after a defrost or other temporary short term temperature huntings.
It is suggested that a reasonably long TLD time is programmed, for instance 5-15 minutes, you then put the product into the refrigerator and start a new logging cycle by clearing previous values (see par. 2.3). It will now suffice that at regular intervals, in the INFO menu you check the minimum and maximum logged values in order to know if the product has been kept within the required temperature limits.

8. AUXILIARY FUNCTIONS

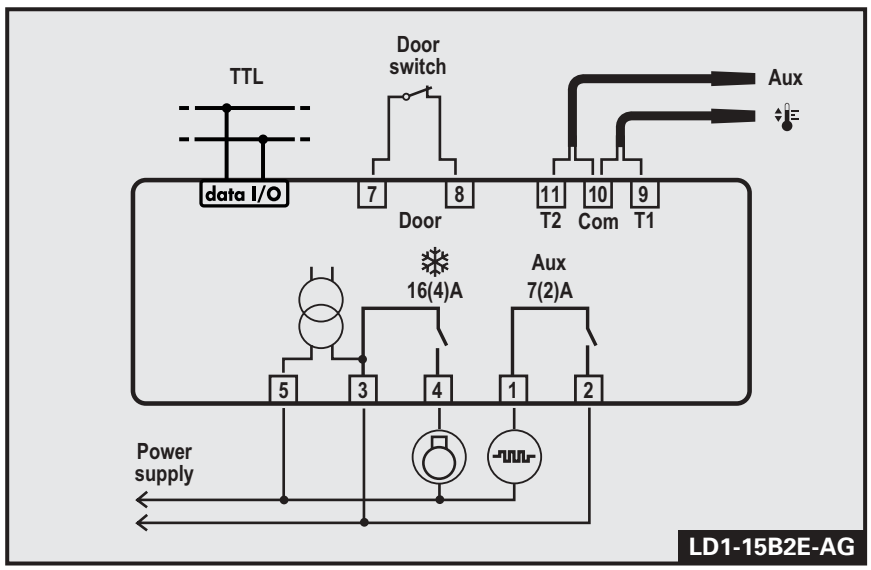
8.1 The operation of the auxiliary output, if fitted, is controlled by parameter **OAU**. With OAU=0-1 the relay contacts follow the on/off status of the controller (standby=OFF); with OAU=MAN, the status is determined manually by means of the suitable button (control of lights, BAU=YES); with OAU=FAN, the output will control the evaporator fans (see 8.2); with OAU=DEF, defrost heater is controlled (see 5.2); with OAU=ALR, the output reverses the alarm signal, the output is therefore closed during correct operation and opened in case of an alarm condition (even in case of power failure). With OAU=NON the contacts remain constantly open.
8.2 If OAU=FAN, the auxiliary output will control the evaporator fans in the following way: always ON during defrost; during thermostatic control, the fans are ON and OFF according to the door switch status, to the compressor run and parameter **FPC**; alternatively, always OFF on a standby. During thermostatic control the fans follow the compressor cycle: they will operate in conjunction with the compressor (i.e. when the compressor runs they will run) and, dependant upon the FPC value set, they will ON/OFF cycle after the compressor has stopped. With FPC set to 1, 2 and 3, you will obtain On/Off ratios of respectively, 20%, 33% or 50%. Whereas with FPC=4, the fans will always be ON, and with FPC=0 the fans will follow the compressor cycle only.
Example: FPC=1; after the compressor stops, the fans will continue to run for 30 seconds, they will then stay off for 120 seconds and so on.
This fan control function aims at recovering the maximum cooling effect available at the evaporator as well as greatly reducing unwanted heat generated by the evaporator fan motors, so increasing the energy efficiency. Cycling the fans also avoids air stratification, and allowing the temperature measured by probe "T1" to be updated, and thus accurate. If the temperature to be maintained is above freezing then the maximum humidity is maintained in the chilled environment.
8.3 The controller is provided with a serial port for connection to a PC or a programmer. In the first case it is important to assign to the parameter **ADR** a different value for each linked unit (peripheral address); with automatic programming, ADR should remain on 1.

WARRANTY

WIRING DIAGRAM



LD1-15A1E-AG



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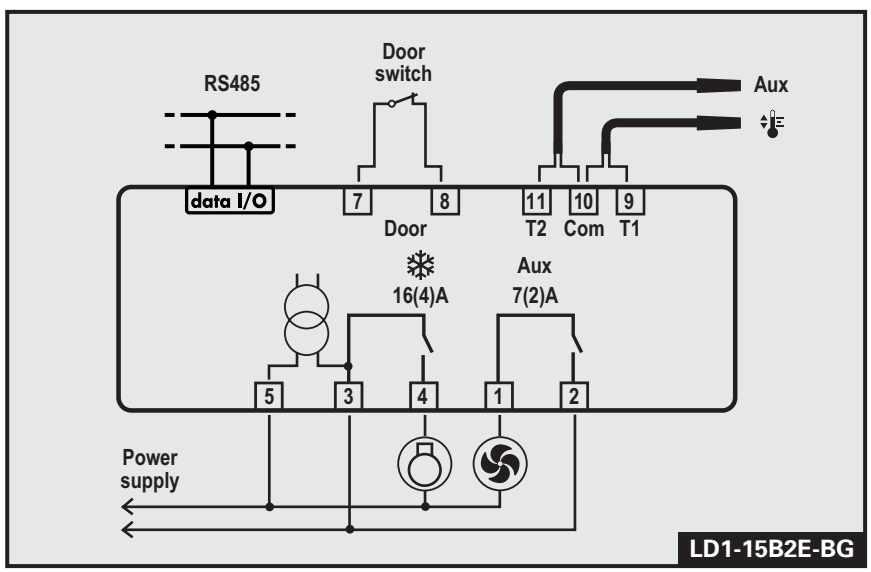

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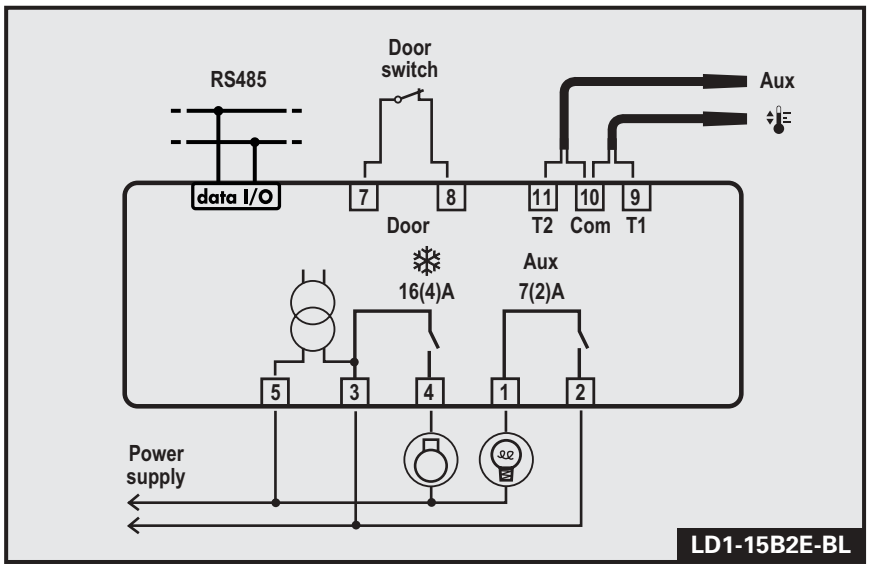

VIA PADOVA, 25
31046 ODERZO /TV /ITALY
TEL. 0422 815320 - 815303
TELEFAX 0422 814073
www.lae-electronic.com
E-mail: info@lae-electronic.com