Lots of Options, just One Choice.

- Temperature, Humidity Pressure Controllers
- Refrigeration Controllers
- Timers
- Compressor Pack Controller
- Monitoring, Data Logging Teleservicing
- Probes

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LOTS OF OPTIONS, JUST ONE CHOICE.

TEMPERATURE, HUMIDITY PRESSURE CONTROLLERS

LTR5
SINGLE OUTPUT ON/OFF OR PID
THERMOSTAT OR HUMIDISTAT

AC1-5
TWO CHANNEL UNIVERSAL CONTROLLER,
ON/OFF OR PID

AC1-27
TWO CHANNEL UNIVERSAL CONTROLLER,
ON/OFF OR PID

AC1-2W
TWO CHANNEL UNIVERSAL CONTROLLER,
ON/OFF OR PID

lae® ELECTRONIC

LTR-5

77x35x77mm

Single output ON/OFF or PID thermostat or humidistat

Runs on mains power supply ● PID with autotuning or ON/OFF control ● Output on relay (16A) or SSR piloting ● Input for PTC, NTC10K or 0÷1V ● 0.1 / 1°C or 1°F resolution ● Refrigerating (dehumidifying) or heating (humidifying) control mode selection ● Stand-by button on the front ● Load start limitation and safety function in the event of breakage of the sensor ● Quick setup through ZOT-LTR device ● Connection to LAE supervisory systems TAB.

Applications:

Temperature: Control of small cold stores, refrigerated cabinets and tables, heating systems, heated cupboards, bains-marie, ovens, laboratory equipment.

Humidity: Control of greenhouses, seasoning cells, cold rooms, air-conditioned rooms.

LTR-5 Series

Functions	LTR-5T..	LTR-5C..	LTR-5A..
Input type	PTC	NTC10K	0÷1V
Range	-50÷150°C -60÷300°F	-40÷125°C -40÷260°F	0÷99.9% r.H.
Accuracy	±0.3°C[a]; ±1.0°C[c]	±0.3°C[b]; ±1°C[c]	±0.7% r.H.
Resolution	0.1/1°C; °F		0.1/1 % r.H.
Front protection	IP55		
Panel cut-out	71x29 mm		

(a) -50÷140°C; (b) -40÷110°C; (c) remaining range.

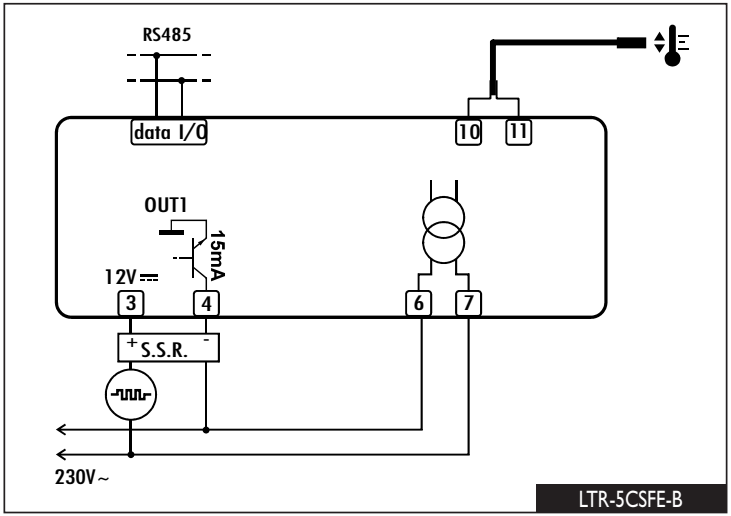
How to order examples:
LTR-5CSRE-A (NTC10K input, 1 relay, screw terminals, 230Vac supply, TTL port)
LTR-5ASRU (0÷1V input, 1 relay, screw terminals, 115Vac supply, no serial port)

On request, the LTR-5 is also available with gasket for a better protection between bezel and panel.

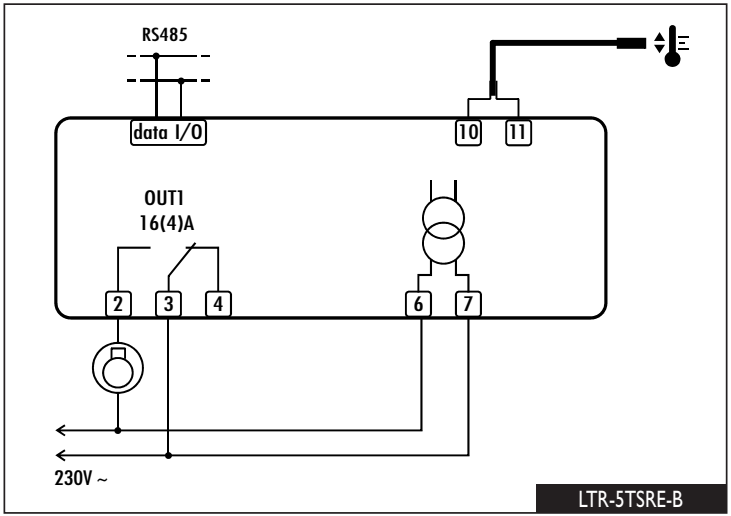
LTR-5	T	S	R	E	-B
	1	2	3	4	5

POS.	FUNCTION	DESCRIPTION
1	Input	**T**= PTC; **C**= NTC10K; **A**= 0÷1V
2	Connectors	**S**= screw terminals; **Q**= male+female terminals
3	Output type	**R** = relay; **F** = SSR drive
4	Supply	**D** =12Vac/dc; **E** =230Vac; **U** =115Vac, 2W
5	Serial comm.	**-** = no serial port; **-A** = TTL; **-B** = RS485

Wiring diagrams | Applications | Instruction



LTR-5CSFE-B



LTR-5TSRE-B

Temperature: *Control of small cold stores, refrigerated cabinets and tables, heating systems, heated cupboards, bains-marie, ovens, laboratory equipment.*

Humidity*: Control of greenhouses, seasoning cells, cold rooms, air-conditioned rooms.*

LTR-5 INSTRUCTIONS FOR USE

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

DESCRIPTION

Fig.1 — Front panel

[▲▼] Setpoint button.

[▼] Decrease button.

[▲] Increase button.

[×⏻] Exit / Stand-by button.

INDICATIONS

OUT1 Thermostat output

INSTALLATION

- Insert the controller through a hole measuring 71x29 mm.
- Make sure that electrical connections comply with the paragraph "wiring diagrams". To reduce the effects of electromagnetic disturbance, keep the sensor and signal cables well separate from the power wires.
- Fix the controller to the panel by means of the suitable clips, by pressingly 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.
- Place the probe T1 inside the room in a point that truly represents the temperature of the stored product.

OPERATION

DISPLAY

During normal operation, the display shows either the temperature measured or one of the following indications:

OFF	Controller in stand-by	**E1**	In tuning: timeout1 error
OR	Probe T1 overrange or failure	**E2**	In tuning: timeout2 error
TUN / 5.4	Controller in autotuning	**E3**	In tuning: overrange error

SETPOINT (display and modification of desired temperature value)

- press button [▲▼] for at least half second, to display the setpoint value.
- By keeping button [▲▼] pressed, use button [▼] or [▲] to set the desired value (adjustment is within the minimum **SPL** and the maximum **SPH** limit).
- When button [▲▼] is released, the new value is stored.

STAND-BY

Button [⏻], when pressed for 3 seconds, allows the controller to be put on a standby or output control to be resumed (with **SB**=YES only).

CONTROLLER AUTOTUNING IN PID MODE

Before starting

- Adjust the setpoint **1SP** to the desired value.
- Set **1Y**=PID.
- Make sure that the **1PB** value matches the desired control mode (**1PB**<0 for heating; **1PB**>0 for refrigeration).

Start autotuning

- Keep buttons [▼] + [▲] pressed for 3 seconds. **1CT** blinks on the display.
- With [▲▼] + [▼] or [▲] set the cycle time in order to define the dynamic of the process to be controlled.
- To start autotuning press [▼] + [▲] or wait for 30 seconds. To abort the autotuning function, press [×].

During autotuning

- During the entire autotuning phase, the display alternates [tun] with the actual temperature measured.
- In case of power failure, when power is resumed, after the initial autotest phase, the controller resumes the autotuning function.
- To abort the autotuning, without modifying the previous control parameters, keep button [×] pressed for 3 seconds.
- After the autotuning has taken place successfully, the controller updates the control parameters and start to control.

Errors

- If the autotuning function failed, the display shows an error code:
- E1 timeout1 error: the controller could not bring the temperature within the proportional band. Increase **1SP** in case of heating control, vice versa, decrease **1SP** in case of refrigerating control and re-start the process.
- E2 timeout2 error: the autotuning has not ended within the maximum time allowed (1000 cycle times). Re-start the autotuning process and set a longer cycle time **1CT**.
- E3 temperature overrange: check that the error was not caused by a probe malfunction, then decrease **1SP** in case of heating control, vice versa increase **1SP** in case of refrigerating control and then re-start the process.
- To eliminate the error indication and return to the normal mode, press button [×].

Control improvement

- To reduce overshoot, reduce the integral action reset **1AR**.
- To increase the response speed of the system, reduce 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 it may be a source of instability.

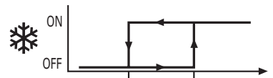
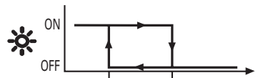
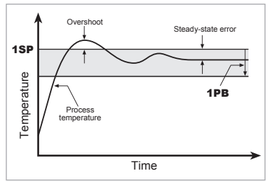
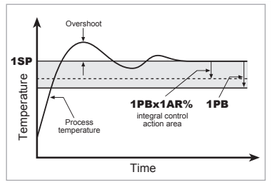
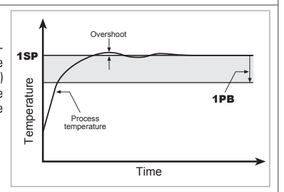
RECALIBRATION

- Have a precision reference thermometer or a calibrator to hand.
- Ensure that **OS1**=0 and **SIM**=0.
- Switch the controller off then on again.
- During the auto-test phase, press buttons [×] + [▼], and keep them pressed till the controller shows **0AD**.
- With buttons [▼] and [▲] select **0AD** or **SAD**: **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.

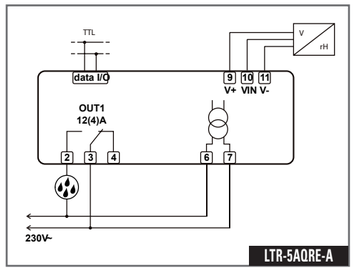
- Press [▲▼] to display the value and then use [▲▼] + [▼] or [▲] to make the read value coincide with the value measured by the reference instrument.
- Exit from calibration by pressing button [×].

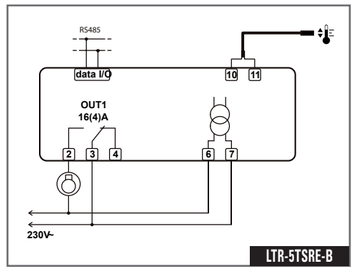
CONFIGURATION PARAMETERS

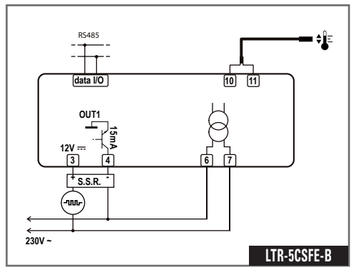
- Setup menu is accessed by pressing buttons [▲▼] + [×] for 5 seconds.
- With button [▼] or [▲] select the parameter to be modified.
- Press button [▲▼] to display the value.
- By keeping button [▲▼] pressed, use button [▼] or [▲] to set the desired value.
- When button [▲▼] is released, the newly programmed value is stored and the following parameter is displayed.
- To exit from the setup, press button [×] or wait for 30 seconds.

PAR	RANGE	DESCRIPTION
SCL	1°C; 2°C; °F	Readout scale. 1°C : measuring range -50/-19.9 … 99.9/150°C for LTR-5T -40/-19.9 … 99.9/125°C for LTR-5C 0.0 … 99.9 %r.H. for LTR-5A 2°C : measuring range -50 … 150°C for LTR-5T -40 … 125°C for LTR-5C 00 … 99 %r.H. for LTR-5A °F : measuring range -60 … 300°F for LTR-5T -40 … 250°F for LTR-5C Caution: upon changing the SCL value, it is then absolutely necessary to re-configure the parameters relevant to the absolute and relative temperatures (**SPL**, **SPH**, **1SP**, **1HY**, etc..).
SPL	-50..SPH	Minimum limit for **1SP** setting
SPH	SPL.150°	Maximum limit for **1SP** setting
1SP	SPL... SPH	Setpoint (value to be maintained in the room).
1Y	HY / PID	Control mode. With **1Y**=HY you select control with hysteresis: parameters **1HY** and **1CT** are used. With **1Y**=PID you select a Proportional-Integral-Derivative control mode: parameters **1PB, 1IT, 1DT, 1AR, 1CT** will be used.
1HY	-19.9…19.9°C	Thermostat differential [control with hysteresis]. Set **1HY** on a value greater than zero to make the output work in refrigerating mode, vice versa set on a value lower than zero to make the output work in heating mode. With **1HY**=0 the output is always off.  Fig. 1a. ON/OFF refrigerating control (**1Y**=HY, **1HY**>0)  Fig. 1b. ON/OFF heating control (**1Y**=HY, **1HY**<0)
1PB	-19.9…19.9°C	Proportional band [PID control]. Set **1PB** on a value greater than zero to make the output work in refrigerating mode, vice versa set on a value lower than zero to make the output work in heating mode. With **1PB**=0 the output is always off. With a proportional controller, the temperature is controlled by varying the time of activation of the output. 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. 
1IT	0…999s	Integral action time [PID control]. The steady-state error is cancelled by inserting an integral action into the control system. The integral action time, determines the speed with which the steady-state temperature is achieved, but a high speed (**1IT** low) may be the cause of overshoot and instability in the response. With **1IT**=0 the integral control is disabled. 
1DT	0…999s	Derivative action time [PID control]. Response overshoot in a system controlled by a Proportional-Derivative controller may be reduced by inserting a derivative action in the control. A high derivative action (1**DT** high) makes the system very sensitive to small temperature variations and causes instability. With **1DT**=0 the derivative control is disabled. 
1AR	0…100%	Reset of integral action time referred to **1PB** [PID control]. Decreasing the parameter **1AR** reduces the integral control action zone, and consequently the overshoot (see figure on paragraph **1IT**).
1CT	0…255s	Cycle time. In the ON/OFF control (**1Y**=HY), after the output has switched on or off, it will remain in the new state for a minimum time of **1CT** seconds, regardless of the temperature value. In the PID control (**1Y**=PID), the cycle time is the period of time in which the output completes a cycle (Time ON + Time OFF). The faster the system to be controlled reacts to temperature changes, the smaller the cycle time should be, in order to obtain a greater temperature stability and less sensitivity to load variations.
1PF	ON / OFF	Output state in case of probe failure.
BAU	NON / SBY	With **BAU**=SBY, the stand-by button is enabled.
SIM	0...100	Display slowdown.
OS1	-12.5..12.5°C	Probe T1 offset.
ADR	1...255	LTR-5 address for PC communication.

WIRING DIAGRAMS







TECHNICAL DATA

Power supply

LTR-5…D 12Vac/dc±10%, 2W
LTR-5…E 230Vac±10%, 50/60Hz, 2W
LTR-5…U 115Vac±10%, 50/60Hz, 2W

Relay outputs (LTR-5..R..)

LTR-5.**SR**.. OUT1 16(4)A
LTR-5.**QR**.. OUT1 12(4)A

SSR drive (LTR-5..F..)

OUT1 15mA 12Vdc

Inputs

LTR-5A…: 0-1V
LTR-5C…: NTC 10KΩ@25°C, part No. LAE SN4...
LTR-5T…: PTC 1000Ω@25°C, part No. LAE ST1...

Measuring Range

LTR-5A…: 0…99%r.H.
LTR-5C…: -40…125°C
LTR-5T…: -50…150°C

Measuring accuracy

LTR-5A…: <±0.7%r.H. in the measuring range
LTR-5C…: <±0.3°C -40…100°C; ±1°C out of that range
LTR-5T…: <±0.3°C -50…140°C; ±1°C out of that range

Operating conditions

-10 … +50°C; 15…80% r.H.

CE (Reference Norms)

EN60730-1; EN60730-2-9;
EN55022 (Class B);
EN50082-1

Front protection

IP55

lae ELECTRONIC

VIA PADOVA, 25
31046 ODERZO /TV /ITALY
TEL. +39 - 0422 815320
FAX +39 - 0422 814073
www.lae-electronic.com
E-mail: sales@lae-electronic.com

AC1-5

77x35x77 MM

Two channel universal Controller, ON/OFF or PID

Runs on mains power supply ● PID with autotuning or ON/OFF control ● Main output on 12A relay or for SSR-piloting and auxiliary output on 5A relay ● Input for 0÷1V, 0/4÷20mA, PTC/NTC10K, TC J/K or Pt100 ● 0.1 / 1°C or 1°F resolution ● Selectable Refrigerating/Heating (Dehumidifying/Humidifying) control ● Absolute or relative temperature alarms ● ON/OFF button on front ● Load start limitation and safety operation in case of probe failure ● Quick programming through ZOT-AC1 key ● Connection to LAE TAB supervisory systems

Applications:

Temperature: *Control of small cold stores, refrigerated cabinets and tables, heating systems, heated cupboards, bains-marie, ovens, laboratory equipment.*

Humidity: *Control of greenhouses, seasoning cells, cold rooms, air-conditioned rooms.*

AC1-5 Series

Functions	AC1-5T..		AC1-5P..	AC1-5J..		AC1-5A..	AC1-5I..
Input type	PTC	NTC10K	Pt100	TC "J"	TC "K"	0÷1V	0/4÷20mA
Range	-50÷150°C -60÷300°F	-40÷125°C -40÷260°F	-100÷850°C -150÷999°F	-50÷750°C -60÷999°F	-50÷999°C -60÷999°F	Configurable in setup	
Accuracy	±0.3°C	±0.3°C	±0.3°C[a]; ±1°C[b]	±3°C		±3mV	±0.2mA
Resolution	0.1 / 1 °C / 1 °F			1 °C / °F		0.1/1	

(a) -50÷150°C; (b) remaining range.

How to order:
AC1-5TS2RW-A (PTC/NTC10K input, screw terminals, 2 relays, 115÷230Vac supply voltage, TTL port)
AC1-5AS2MD-B (0÷1V input, screw terminals, output 1 on SSR drive, output 2 on relay, 12Vac/dc supply voltage, RS485 port)

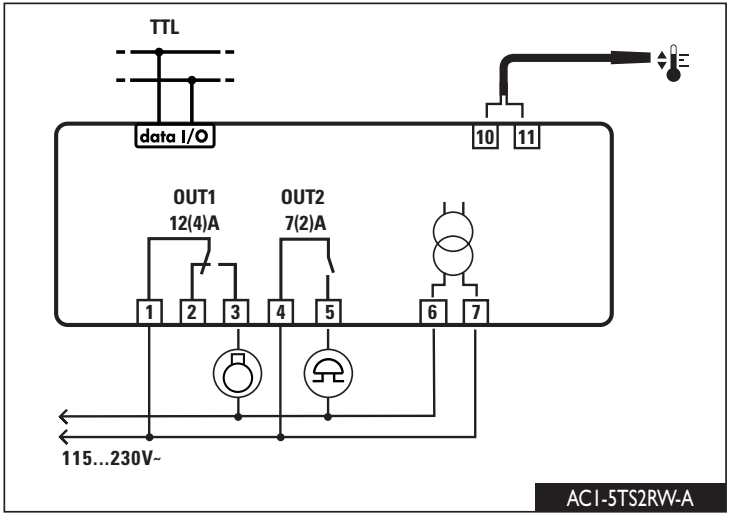
On request, the AC1-5 is also available with gasket for a better protection between bezel and panel.

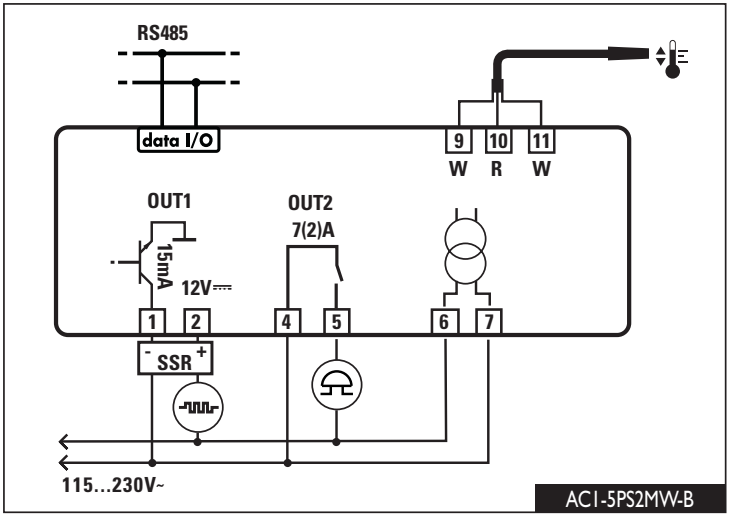
AC1-5	T	S	1	R	W	-B
	1	2	3	4	5	6

POS.	FUNCTION	DESCRIPTION
1	Input	**A** = 0÷1V; **I** = 0/4÷20mA; **J** = TC 'J' / 'K'; **P** = Pt100; **T** = PTC/ NTC10K
2	Connections	**S** = built-in screw terminals
3	Output No.	**1** = one; **2** = two
4	Output type	**R** = relay; **M** = Out1 on SSR, Out2 on relay
5	Supply	**D*** = 12Vac/dc; **W** = 115…230Vac 50/60Hz; 3 W
6	Serial comm.	**Nil** = no; -A = **TTL**; -B = RS485

* = in the version with 12Vac/dc power supply, the maximum voltage on the outputs is 50Vac/dc, in order to ensure safety insulations.

Wiring diagrams | Applications | Instruction


TTL
data I/O
10
11
OUT1
12(4)A
OUT2
7(2)A
1
2
3
4
5
6
7
115...230V~
AC1-5TS2RW-A


RS485
data I/O
9
10
11
W
R
W
OUT1
15mA
12V
OUT2
7(2)A
1
2
4
5
6
7
- SSR +
115...230V~
AC1-5PS2MW-B

Temperature: *Control of small cold stores, refrigerated cabinets and tables, heating systems, heated cupboards, bains-marie, ovens, laboratory equipment.*

Humidity: *Control of greenhouses, seasoning cells, cold rooms, air-conditioned rooms.*

AC1-5 INSTRUCTION FOR USE

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

DESCRIPTION

Fig.1 - Front panel

Info / Enter button

Modify Setpoint 1 / Decrease button

INDICATION

OUT1 Channel 1 output

OUT2 Channel 2 output

L1 Channel 1 setpoint modification

L2 Channel 2 setpoint modification

Alarm

Increase / Modify Setpoint 2 button

Exit / Stand-by button.

INSTALLATION

- Insert the controller through a hole measuring 71x29 mm;
- Make sure that electrical connections comply with the paragraph “wiring diagrams”. To reduce the effects of electromagnetic disturbance, keep the sensor and signal cables well separate from the power wires.
- Fix the controller to the panel by means of the suitable clips, by pressingly 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.
- ATTENTION: during the setup of the controller, please make sure that the parameter INP matches the sensor used, as indicated in the table “input specifications”.
- Place the probe T1 inside the room in a point that truly represents the temperature of the stored product.

OPERATION

DISPLAY

During normal operation, the display shows either the temperature measured or one of the following indications:

OFF	Controller in stand-by	**TUN/xx.x**	Controller in autotuning
OR	Probe T1 overrange or failure	**E1**	In tuning: timeout1 error
HI	Room high temperature alarm	**E2**	In tuning: timeout2 error
LO	Room low temperature alarm	**E3**	In tuning: overrange error

MENU INFO

The information available in this menu is:

THI	Maximum temperature recorded	**LOC**	Keypad state lock
TLO	Minimum temperature recorded		

Access to menu and information displayed.
- Press and immediately release button (i).
- With button (▼) or (▲) select the data to be displayed.
- Press button (i) to display value.
- To exit from the menu, press button (✕) or wait for 10 seconds.

Reset of THI, TLO recordings
- With button (▼) or (▲) select the data to be reset.
- Display the value with button (i).
- While keeping button (i) pressed, use button (✕).

CHANNEL 1 SETPOINT (display and modification of desired temperature value)

- Press and release button (L1) : the LED L1 blinks, the display shows 1SP for 1 second and then the setpoint associated value.
- Press buttons (▼) or (▲) to set the desired value (adjustment is within the minimum **SPL** and maximum **SPH** limit).
- To store the new value press button (↵), or wait for 10 seconds.
- To go back to normal mode without saving the new value, press (✕).

CHANNEL 2 SETPOINT

- With the auxiliary output set as thermostat control (**OAU**=THR), it’s possible to modify setpoint 2 during the normal operation of the controller.
- Press and release button (L2); the LED L2 blinks, the display shows 2SP for 1 second if setpoint 2 is an absolute threshold (**2SM**=ABS), alternatively the display shows 2DF, if setpoint 2 is a threshold relative to setpoint 1 (**2SM**=REL), then the value associated to the parameter appears.
- Press buttons (▲) or (▼) to set the desired value.
- To store the new value press button (↵) or wait for 10 seconds.
- To go back to normal mode without saving the new value, press (✕).

STAND-BY

Button (⏻), when pressed for 3 seconds, allows the controller to be put on a standby or output control to be resumed (with **SB**=YES only).

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 menu, set parameter **LOC**=YES to inhibit all functions of the buttons. To resume normal operation of keypad, adjust setting so that **LOC**=NO.

CONTROLLER AUTOTUNING IN PID MODE

Before starting

In the setup mode (see configuration parameters): set **1CM**=PID; make sure that **1CH** matches the desired operation mode (**1CH**=REF for refrigerating control, **1CH**=HEA for heating control); then adjust setpoint **1SP** at the desired value.

Start autotuning

During normal operation, keep buttons (i) + (▼) pressed for 3 seconds. 1CT blinks on the display. With (i) + (▼) or (▲) set the cycle time in order to define the dynamic of the process to be controlled. To abort the autotuning function, press (✕); to start autotuning press (▼) + (▲) or wait for 30 seconds.

During autotuning

During the entire autotuning phase, the display alternates TUN with the actual temperature measured. In case of power failure, when power is resumed, after the initial autotest phase, the controller resumes the autotuning function. To abort the autotuning, without modifying the previous control parameters, keep button (✕) pressed for 3 seconds. After the autotuning has taken place successfully, the controller updates the control parameters and start to control.

Errors

If the autotuning function failed, the display shows an error code:
- E1 timeout1 error: the controller could not bring the temperature within the proportional band. Increase **1SP** in case of heating control, vice versa, decrease **1SP** in case of refrigerating control and re-start the process.
- E2 timeout2 error: the autotuning has not ended within the maximum time allowed (1000 cycle times). Re-start the autotuning process and set a longer cycle time **1CT**.
- E3 temperature overrange: check that the error was not caused by a probe malfunction, then decrease **1SP** in case of heating control, vice versa increase **1SP** in case of refrigerating control and then re-start the process.
- To eliminate the error indication and return to the normal mode, press button (✕).

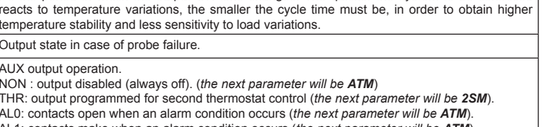
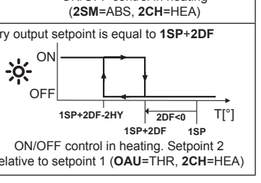
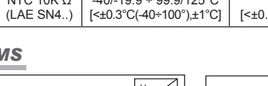
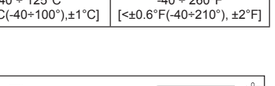
Control improvement
- To reduce overshoot, reduce the integral action reset **1AR**
- To increase the response speed of the system, reduce the proportional band **1PB**. Caution: doing this makes the system less stable.
- To reduce swings in steady-state temperature, increase the integral action time **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 it may be a source of instability.

RECALIBRATION

- Have a precision reference thermometer or a calibrator to hand. Ensure that **OS1**=0 and **SIM**=0.
- Switch the controller off then on again.
- During the auto-test phase, press buttons (i) + (▲) and keep them pressed till the controller shows **0AD**.
- With buttons (▼) and (▲) select **0AD** or **SAD**: **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.
- Press (i) to display the value and then use (i) + (▲) or (▼) to make the read value coincide with the value measured by the reference instrument.
- Exit from calibration by pressing button (✕).

CONFIGURATION PARAMETERS

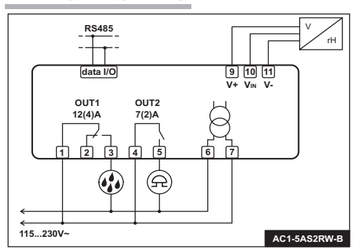
- To get access to the parameter configuration menu, press button (✕) + (i) for 5 seconds.
- With button (▼) or (▲) select the parameter to be modified.
- Press button (i) to display the value.
- By keeping button (i) pressed, use button (▼) or (▲) to set the desired value.
- When button (i) is released, the newly programmed value is stored and the following parameter is displayed.
- To exit from the setup, press button (✕) or wait for 30 seconds.

PAR	RANGE	DESCRIPTION
SCL	1°C; 2°C; °F	Readout scale (see table of input specifications) *Caution: upon changing the **SCL** value, it is then absolutely necessary to reconfigure the parameters relevant to the absolute and relative temperatures (**SPL**, **SPH**, **1SP**, **1HY** etc..)*
SPL	-50°...SPH	Minimum limit for **1SP** setting
SPH	SPL...150°	Maximum limit for **1SP** setting.
1SP	SPL... SPH	Setpoint (value to be maintained in the room).
1CM	HY; PID	Control mode. With **1CM**=HY you select control with hysteresis: parameters **1HY**, **1T0** and **1T1** are used. With **1CM**=PID you select a Proportional-Integral-Derivative control mode: parameters **1PB**, **1IT**, **1DT**, **1AR**, **1CT** will be used
1CH	REF; HEA	Refrigerating (REF) or Heating (HEA) control mode.
1HY (1CM=HY)	0...19.9°	OFF/ON thermostat differential. With **1HY**=0 the output is always off.  ON/OFF refrigerating control (**1CM**=HY, **1CH**=REF) ON/OFF heating control (**1CM**=HY, **1CH**=HEA)
1T0 (1CM=HY)	0...30min	Minimum off time. After output 1 has been turned off, it remains inactive for **1T0** minutes regardless of the temperature value measured.
1T1 (1CM=HY)	0...30min	Minimum on time. (*the following parameter will be **1PF***). After output 1 has been turned on, it remains active for **1T1** minutes regardless of the temperature value measured.
1PB (1CM=PID)	0...19.9°	Proportional bandwidth. Temperature control takes place by changing the ON time of the output: the closer the temperature to the setpoint, 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 setpoint. With **1PB**=0 the output is always off. 
1IT (1CM=PID)	0...999s	Integral action time. The steady-state error is cancelled by inserting an integral action. The integral action time, determines the speed with which the steady-state temperature is achieved, but a high speed (**1IT** low) may be the cause of overshoot and instability in the response. With **1IT**=0 the integral control is disabled.
1DT (1CM=PID)	0...999s	Derivative action time. Response overshoot may be reduced by inserting a derivative Action. A high derivative action (**1DT** high) makes the system very sensitive to small temperature variations and causes instability. With **1DT**=0 the derivative control is disabled.
1AR (1CM=PID)	0...100%	Reset of integral action time referred to **1PB** Decreasing the parameter **1AR** reduces the integral control action zone, and consequently the overshoot (see figure on paragraph **1IT**).
1CT (1CM=PID)	1...255s	Cycle time. It’s the period in which the output ON time changes. The quicker the system to be controlled reacts to temperature variations, the smaller the cycle time must be, in order to obtain higher temperature stability and less sensitivity to load variations.
1PF	ON/OFF	Output state in case of probe failure.
OAU	NON; THR; AL0; AL1	AUX output operation. NON : output disabled (always off). (*the next parameter will be **ATM***) THR: output programmed for second thermostat control (*the next parameter will be **2SM***). AL0: contacts open when an alarm condition occurs (*the next parameter will be **ATM***). AL1: contacts make when an alarm condition occurs (*the next parameter will be **ATM***).
2SM (OAU=THR)	ABS; REL	Setpoint 2 mode. Channel 2 setpoint may be absolute (**2SM**=ABS), or a differential relative to setpoint 1 (**2SM**=REL)
2SP (2SM=ABS)	SPL...SPH	Auxiliary output switchover temperature (*the next parameter will be **2CH***) ON/OFF control in refrigeration (**2SM**=ABS, **2CH**=REF) ON/OFF control in heating (**2SM**=ABS, **2CH**=HEA)
2DF (2SM=REL)	-19.9...19.9°	Temperature differential relative to **1SP**. The auxiliary output setpoint is equal to **1SP**+**2DF** ON/OFF control in refrigeration. Setpoint 2 relative to setpoint 1 (**OAU**=THR, **2CH**=REF) ON/OFF control in heating. Setpoint 2 relative to setpoint 1 (**OAU**=THR, **2CH**=HEA)
2CH (OAU=THR)	REF; HEA	Refrigerating control (REF) or heating control mode (HEA) for the auxiliary output.
2HY (OAU=THR)	0...19.9°	Differential of thermostat 2. With **2HY**=0 the auxiliary output always remains off.
2T0 (OAU=THR)	0...30min	Minimum off time. After output 2 has been turned off, it remains inactive for **2T0** minutes regardless of the temperature value measured.
2T1 (OAU=THR)	0...30min	Minimum on time. After output 2 has been turned on, it remains active for **2T1** minutes regardless of the temperature value measured.
2PF (OAU=THR)	ON/OFF	Auxiliary output state in case of probe failure.
ATM	NON; ABS; REL	Alarm threshold management. NON: all temperature alarms are inhibited (*the following parameter will be **SB***). ABS: the values programmed in **ALA** and **AHA** represent the real alarm thresholds. REL: the values programmed in **ALR** and **AHR** are alarm differentials referred to **1SP** and **1SP**+**1HY**.  Temperature alarm with relative thresholds, refrigerating control (**ATM**=REL, **1CH**=REF)  Temperature alarm with relative thresholds, heating control (**ATM**=REL, **1CH**=HEA).
ALA (ATM=ABS)	-50°...AHA	Low temperature alarm threshold.
AHA (ATM=ABS)	ALA...150°	High temperature alarm threshold.
ALR (ATM=REL)	-12.0...0°	Low temperature alarm differential. With **ALR**=0 the low temperature alarm is excluded
AHR (ATM=REL)	0...12.0°	High temperature alarm differential. With **AHR**=0 the high temperature alarm is excluded
ATD	0...120min	Delay before alarm temperature warning.
SB	NO/YES	Stand-by button enabling.
INP	0mA/4mA, T1/T2 ST1/SN4	Sensor input selection (see table of input specifications). *In the models AC1-5A..., AC1-5J..., AC1-5T... only.*
RLO	-19.9...RHI	Minimum range value (*in the models AC1-5A…, AC1-5I… only*) **RLO** takes the minimum value measured by the transmitter (i.e. the value matching 0V, 0/4mA).
RHI	RLO...99.9	Maximum range value (*in the models AC1-5A…, AC1-5I… only*) **RHI** takes the maximum value measured by the transmitter (i.e. the value matching 1V, 20mA)
OS1	-12.5...12.5°	Probe T1 offset.
TLD	1...30min	Delay for minimum temperature (TLO) and maximum temperature (THI) logging.
SIM	0...100	Display slowdown
ADR	1...255	AC1-5 address for PC communication

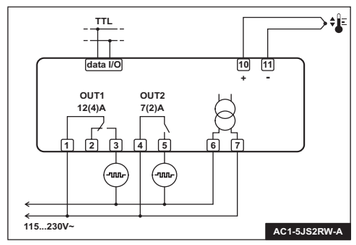
INPUT SPECIFICATIONS

MODEL	INPUT		RANGE [MEASUREMENT ACCURACY]		
			SCL=1°C	SCL=2°C	SCL=°F
AC1-5A...	0÷1V		RLO÷RHI [< ± 3mV]		---
AC1-5I...	INP = 0mA	0÷20mA	RLO÷RHI [< ± 0.2mA]		---
	INP = 4mA	4÷20mA			
AC1-5J...	INP=T1	TC “J”	---	-50÷750°C [< ±3°C]	-60÷999°F [< ±5°F]
	INP=T2	TC “K”	---	-50÷999°C [< ±3°C]	
AC1-5P...	PT100		-50/-19.9÷99.9/150°C [< ±0.3°C]	-100÷850°C [<±1°C(-50÷850°), ±2°C]	-150÷999°F [<±2°F(-60÷999°), ±4°F]
AC1-5T...	INP=ST1	PTC 1000 Ω (LAE ST1..)	-50/-19.9 ÷ 99.9/150°C [<±0.3°C(-30÷130°),±1°C]	-50 ÷ 150°C [<±0.3°C(-30÷130°), ±1°C]	-60 ÷ 300°F [< ±0.6°F(-20÷260°),±2°F]
	INP=SN4	NTC 10K Ω (LAE SN4..)	-40/-19.9 ÷ 99.9/125°C [<±0.3°C(-40÷100°),±1°C]	-40 ÷ 125°C [<±0.3°C(-40÷100°),±1°C]	-40 ÷ 260°F [<±0.6°F(-40÷210°), ±2°F]

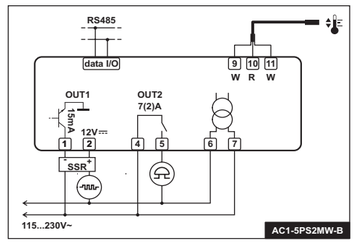
WIRING DIAGRAMS



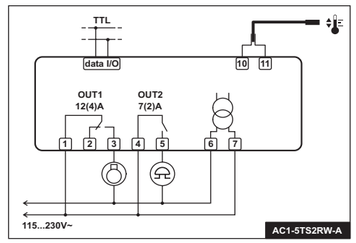
AC1-5AS2RW-B



AC1-5JS2RW-A



AC1-5PS2MW-B



AC1-5TS2RW-A

TECHNICAL DATA

Power supply
AC1-5…D 12Vac/dc ±10%, 2W
AC1-5...W 110 - 230Vac±10%, 50/60Hz, 2W

Relay outputs (AC1-5..R..)
OUT1 12(4)A
OUT2 7(2)A

SSR drive (AC1-5..M..)
OUT1 15mA 12Vdc

Inputs
see table of input specifications

Measurement range
see table of input specifications

Measurement accuracy
see table of input specifications

Operating conditions
-10 … +50°C; 15%...80% U.R.

CE (Reference Norms)
EN60730-1; EN60730-2-9;
EN55022 (Class B); EN50082-1

Front protection
IP55

lae ELECTRONIC
VIA PADOVA, 25
31046 ODERZO /TV /ITALY
TEL. +39 - 0422 815320
FAX +39 - 0422 814073
www.lae-electronic.com
E-mail: sales@lae-electronic.com

AC1-27

71x97x61mm DIN rail

Two channel universal Controller, ON/OFF or PID

Runs on mains power supply ● PID with autotuning or ON/OFF control ● Main output on 12A relay or for SSR-piloting and auxiliary output on 5A relay ● Input for 0÷1V, 0/4÷20mA, PTC/NTC10K, TC J/K or Pt100 ● 0.1 / 1°C or 1°F resolution ● Selectable Refrigerating/Heating (Dehumidifying/Humidifying) control ● Absolute or relative temperature alarms ● ON/OFF button on front ● Load start limitation and safety operation in case of probe failure ● Quick programming through ZOT-AC1 key ● Connection to LAE TAB supervisory systems

Applications:

Temperature: *on control panels for small cold stores, heating systems, heated cupboards, bains-marie, ovens, laboratory equipment.*

Humidity: *control panels for greenhouses, seasoning cells, cold rooms, air-conditioned rooms.*

AC1-27 Series

Functions	AC1-27T..		AC1-27P..	AC1-27J..		AC1-27A..	AC1-27I..
Input type	PTC	NTC10K	Pt100	TC "J"	TC "K"	0÷1V	0/4÷20mA
Range	-50÷150°C -60÷300°F	-40÷125°C -40÷260°F	-100÷850°C -150÷999°F	-50÷750°C -60÷999°F	-50÷999°C -60÷999°F	Configurable in setup	
Accuracy	±0.3°C	±0.3°C	±0.3°C(a); ±1°C(b)	±3°C		±3mV	±0.2mA
Resolution	0.1 / 1 °C / 1 °F			1 °C / °F		0.1/1	

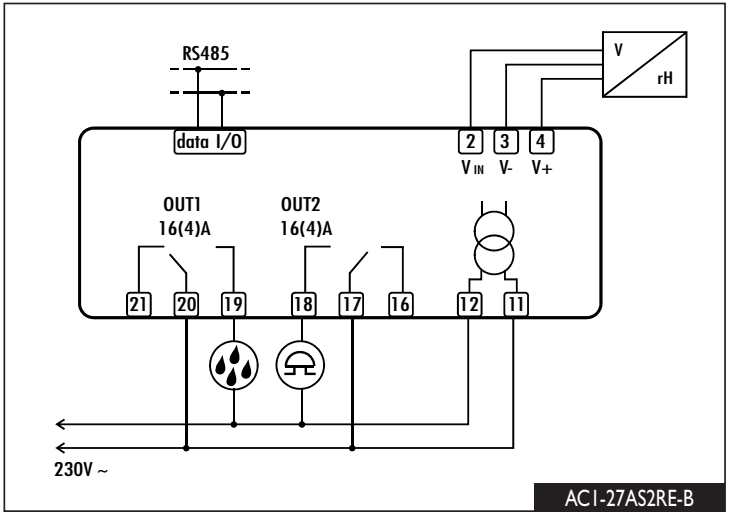
(a) -50÷150°C; (b) remaining range.

AC1-27	T	S	1	R	E	-B
	1	2	3	4	5	6

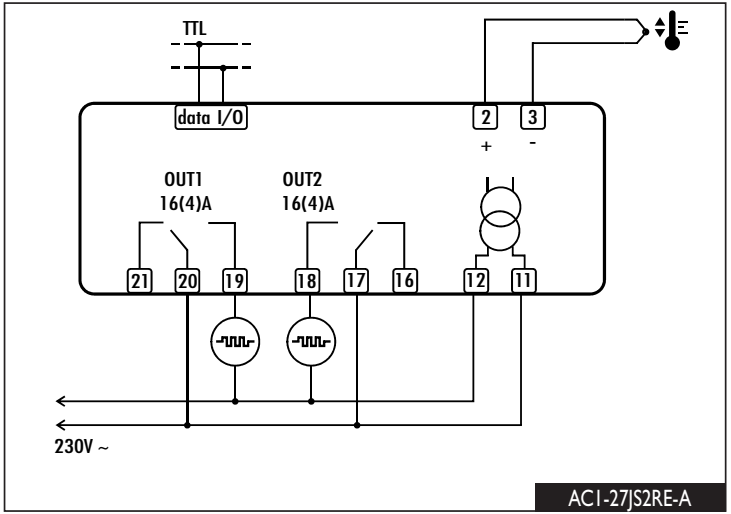
POS.	FUNCTION	DESCRIPTION
1	Input	**A** = 0÷1V; **I** = 0/4÷20mA; **J** = TC 'J' / 'K'; **P** = Pt100; **T** = PTC/ NTC10K
2	Connections	**S** = built-in screw terminals
3	Output No.	**1** = one; **2** = two
4	Output type	**R** = relay; **M** = Out1 on SSR, Out2 on relay
5	Supply	**D** = 12Vac/dc; **E** = 230Vac 50/60Hz; **U**= 115Vac 50/60Hz 3 W
6	Serial comm.	**Nil** = no; **-A** = **TTL**; -B = RS485

How to order:
AC1-27JS1RE-B (TC J/K input, screw terminals, 1 relay output, 230Vac supply voltage, RS485 port).
AC1-27IS2MD-A (0/4÷20mA input, screw terminals, output 1 on SSR drive, output 2 on relay, 12Vac/dc supply voltage, TTL port)

Wiring diagrams | Applications | Instruction



AC1-27AS2RE-B



AC1-27JS2RE-A

***Temperature**: on control panels for small cold stores, heating systems, heated cupboards, bains-marie, ovens, laboratory equipment.*

***Humidity**: control panels for greenhouses, seasoning cells, cold rooms, air-conditioned rooms.*

AC1-27 INSTRUCTION FOR USE

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

DESCRIPTION

Fig.1 - Front panel

INDICATION

- **OUT1** Channel 1 output
- **OUT2** Channel 2 output
- **L1** Channel 1 setpoint modification
- **L2** Channel 2 setpoint modification
- Alarm
- Info / Enter button
- Modify Setpoint 1 / Decrease button
- Increase / Modify Setpoint 2 button
- Exit / Stand-by button

INSTALLATION

- The AC1-27 controller, size 72x94x47 mm (WxHxD), is to be secured to a DIN rail in such a position as to ensure that no liquid infiltrates causing serious damage and compromising safety;
- Make sure that electrical connections comply with the paragraph “wiring diagrams”. To reduce the effects of electromagnetic disturbance, keep the sensor and signal cables well separate from the power wires.
- Place the probe T1 inside the room in a point that truly represents the temperature of the stored product.

OPERATION

DISPLAY

During normal operation, the display shows either the temperature measured or one of the following indications:

oFF	Controller in stand-by	tun	Controller in autotuning
or	Probe T1 overrange or failure	E1	In tuning: timeout1 error
hi	Room high temperature alarm	E2	In tuning: timeout2 error
Lo	Room low temperature alarm	E3	In tuning: overrange error

MENU INFO

The information available in this menu is:

tHi	Maximum temperature recorded	Loc	Keypad state lock
tLo	Minimum temperature recorded		

Access to menu and information displayed.

- Press and immediately release button i.
- With button ▼ or ▲ select the data to be displayed.
- Press button i to display value.
- To exit from the menu, press button ⏻ or wait for 10 seconds.

Reset of THI, TLO recordings

- With button ▼ or ▲ select the data to be reset.
- Display the value with button i.
- While keeping button i pressed, use button ⏻ .

CHANNEL 1 SETPOINT (display and modification of desired temperature value)

- Press and release button L1 : the LED L1 blinks, the display shows 1SP for 1 second and then the setpoint associated value.
- Press buttons ▼ or ▲ to set the desired value (adjustment is within the minimum **SPL** and maximum **SPH** limit).
- To store the new value press button ↵, or wait for 10 seconds.
- To go back to normal mode without saving the new value, press ⏻.

CHANNEL 2 SETPOINT

- With the auxiliary output set as thermostat control (**OAU**=THR), it’s possible to modify setpoint 2 during the normal operation of the controller.
- Press and release button L2: the LED L2 blinks, the display shows 2SP for 1 second if setpoint 2 is an absolute threshold (**2SM**=ABS), alternatively the display shows 2DF, if setpoint 2 is a threshold relative to setpoint 1 (**2SM**=REL), then the value associated to the parameter appears.
- Press buttons ▲ or ▼ to set the desired value.
- To store the new value press button ↵ or wait for 10 seconds.
- To go back to normal mode without saving the new value, press ⏻.

STAND-BY

Button ⏻, when pressed for 3 seconds, allows the controller to be put on a standby or output control to be resumed (with **SB**=YES only).

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 menu, set parameter **LOC**=YES to inhibit all functions of the buttons. To resume normal operation of keypad, adjust setting so that **LOC**=NO.

CONTROLLER AUTOTUNING IN PID MODE

Before starting

In the setup mode (see configuration parameters): set **1CM**=PID; make sure that **1CH** matches the desired operation mode (**1CH**=REF for refrigerating control, **1CH**=HEA for heating control); then adjust setpoint **1SP** at the desired value.

Start autotuning

During normal operation, keep buttons i + ▼ pressed for 3 seconds. 1CT blinks on the display. With i + ▼ or ▲ set the cycle time in order to define the dynamic of the process to be controlled. To abort the autotuning function, press ⏻; to start autotuning press ▼ + ▲ or wait for 30 seconds.

During autotuning

During the entire autotuning phase, the display alternates TUN with the actual temperature measured. In case of power failure, when power is resumed, after the initial autotest phase, the controller resumes the autotuning function. To abort the autotuning, without modifying the previous control parameters, keep button ⏻ pressed for 3 seconds. After the autotuning has taken place successfully, the controller updates the control parameters and start to control.

Errors

If the autotuning function failed, the display shows an error code:

- E1 timeout1 error: the controller could not bring the temperature within the proportional band. Increase **1SP** in case of heating control, vice versa, decrease **1SP** in case of refrigerating control and re-start the process.
- E2 timeout2 error: the autotuning has not ended within the maximum time allowed (1000 cycle times). Re-start the autotuning process and set a longer cycle time **1CT**.
- E3 temperature overrange: check that the error was not caused by a probe malfunction, then decrease **1SP** in case of heating control, vice versa increase **1SP** in case of refrigerating control and then re-start the process.
- To eliminate the error indication and return to the normal mode, press button ⏻.

Control improvement

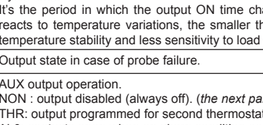
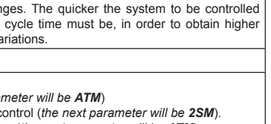
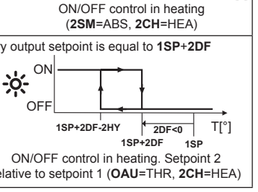
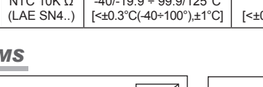
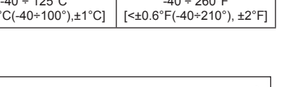
- To reduce overshoot, reduce the integral action reset **1AR**
- To increase the response speed of the system, reduce the proportional band **1PB**. Caution: doing this makes the system less stable.
- To reduce swings in steady-state temperature, increase the integral action time **1IT**; system stability 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 it may be a source of instability.

RECALIBRATION

- Have a precision reference thermometer or a calibrator to hand. Ensure that **OS1**=0 and **SIM**=0.
- Switch the controller off then on again.
- During the auto-test phase, press buttons i + ▲ and keep them pressed till the controller shows **0AD**.
- With buttons ▼ and ▲ select **0AD** or **SAD**: **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.
- Press i to display the value and then use i + ▲ or ▼ to make the read value coincide with the value measured by the reference instrument.
- Exit from calibration by pressing button ⏻.

CONFIGURATION PARAMETERS

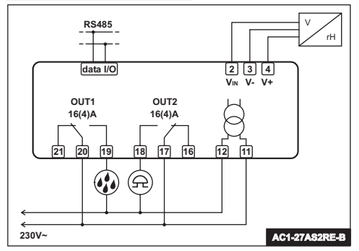
- To get access to the parameter configuration menu, press button ⏻ + i for 5 seconds.
- With button ▼ or ▲ select the parameter to be modified.
- Press button i to display the value.
- By keeping button i pressed, use button ▼ or ▲ to set the desired value.
- When button i is released, the newly programmed value is stored and the following parameter is displayed.
- To exit from the setup, press button ⏻ or wait for 30 seconds.

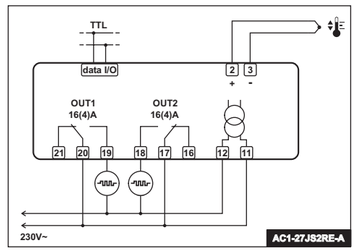
	PAR	RANGE	DESCRIPTION
	SCL	1°C; 2°C; °F	Readout scale (see table of input specifications) *Caution: upon changing the **SCL** value, it is then absolutely necessary to reconfigure the parameters relevant to the absolute and relative temperatures (**SPL**, **SPH**, **1SP**, **1HY** etc..)*
	SPL	-50°...SPH	Minimum limit for **1SP** setting
	SPH	SPL...150°	Maximum limit for **1SP** setting.
	1SP	SPL... SPH	Setpoint (value to be maintained in the room).
	1CM	HY; PID	Control mode. With **1CM**=HY you select control with hysteresis: parameters **1HY**, **1T0** and **1T1** are used. With **1CM**=PID you select a Proportional-Integral-Derivative control mode: parameters **1PB**, **1IT**, **1DT**, **1AR**, **1CT** will be used
	1CH	REF; HEA	Refrigerating (REF) or Heating (HEA) control mode.
1CM=HY	**1HY**	0...19.9°	OFF/ON thermostat differential. With **1HY**=0 the output is always off.  ON/OFF refrigerating control (**1CM**=HY, **1CH**=REF)  ON/OFF heating control (**1CM**=HY, **1CH**=HEA)
	1T0	0...30min	Minimum off time. After output 1 has been turned off, it remains inactive for **1T0** minutes regardless of the temperature value measured.
	1T1	0...30min	Minimum on time. (*the following parameter will be **1PF***). After output 1 has been turned on, it remains active for **1T1** minutes regardless of the temperature value measured.
1CM=PID	**1PB**	0...19.9°	Proportional bandwidth. Temperature control takes place by changing the ON time of the output: the closer the temperature to the setpoint, 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 setpoint. With **1PB**=0 the output is always off. 
	1IT	0...999s	Integral action time. The steady-state error is cancelled by inserting an integral action. The integral action time, determines the speed with which the steady-state temperature is achieved, but a high speed (**1IT** low) may be the cause of overshoot and instability in the response. With **1IT**=0 the integral control is disabled.
	1DT	0...999s	Derivative action time. Response overshoot may be reduced by inserting a derivative Action. A high derivative action (**1DT** high) makes the system very sensitive to small temperature variations and causes instability. With **1DT**=0 the derivative control is disabled.
	1AR	0...100%	Reset of integral action time referred to **1PB** Decreasing the parameter **1AR** reduces the integral control action zone, and consequently the overshoot (see figure on paragraph **1IT**).
	1CT	1...255s	Cycle time. It’s the period in which the output ON time changes. The quicker the system to be controlled reacts to temperature variations, the smaller the cycle time must be, in order to obtain higher temperature stability and less sensitivity to load variations.
	1PF	ON/OFF	Output state in case of probe failure.
	OAU	NON; THR; AL0; AL1	AUX output operation. NON : output disabled (always off). (*the next parameter will be **ATM***) THR: output programmed for second thermostat control (*the next parameter will be **2SM***). AL0: contacts open when an alarm condition occurs (*the next parameter will be **ATM***). AL1: contacts make when an alarm condition occurs (*the next parameter will be **ATM***).
	2SM	ABS; REL	Setpoint 2 mode. Channel 2 setpoint may be absolute (**2SM**=ABS), or a differential relative to setpoint 1 (**2SM**=REL)
OAU=THR 2SM=ABS	**2SP**	SPL...SPH	Auxiliary output switchover temperature (*the next parameter will be **2CH***) ON/OFF control in refrigeration (**2SM**=ABS, **2CH**=REF) ON/OFF control in heating (**2SM**=ABS, **2CH**=HEA)
OAU=THR 2SM=REL	**2DF**	-19.9...19.9°	Temperature differential relative to **1SP**. The auxiliary output setpoint is equal to **1SP**+**2DF** ON/OFF control in refrigeration. Setpoint 2 relative to setpoint 1 (**OAU**=THR, **2CH**=REF) ON/OFF control in heating. Setpoint 2 relative to setpoint 1 (**OAU**=THR, **2CH**=HEA)
OAU=THR	**2CH**	REF; HEA	Refrigerating control (REF) or heating control mode (HEA) for the auxiliary output.
	2HY	0...19.9°	Differential of thermostat 2. With **2HY**=0 the auxiliary output always remains off.
	2T0	0...30min	Minimum off time. After output 2 has been turned off, it remains inactive for **2T0** minutes regardless of the temperature value measured.
	2T1	0...30min	Minimum on time. After output 2 has been turned on, it remains active for **2T1** minutes regardless of the temperature value measured.
	2PF	ON/OFF	Auxiliary output state in case of probe failure.
	ATM	NON; ABS; REL	Alarm threshold management. NON: all temperature alarms are inhibited (*the following parameter will be **SB***). ABS: the values programmed in **ALA** and **AHA** represent the real alarm thresholds. REL: the values programmed in **ALR** and **AHR** are alarm differentials referred to **1SP** and **1SP**+**1HY**.  Temperature alarm with relative thresholds, refrigerating control (**ATM**=REL, **1CH**=REF)  Temperature alarm with relative thresholds, heating control (**ATM**=REL, **1CH**=HEA).
ATM=ABS	**ALA**	-50°...AHA	Low temperature alarm threshold.
	AHA	ALA...150°	High temperature alarm threshold.
ATM=REL	**ALR**	-12.0...0°	Low temperature alarm differential. With **ALR**=0 the low temperature alarm is excluded
	AHR	0...12.0°	High temperature alarm differential. With **AHR**=0 the high temperature alarm is excluded
	ATD	0...120min	Delay before alarm temperature warning.
	SB	NO/YES	Stand-by button enabling.
	INP	0mA/4mA, T1/T2 ST1/SN4	Sensor input selection (see table of input specifications). *In the models AC1-27A..., AC1-27J..., AC1-27T... only.*
	RLO	-19.9...RHI	Minimum range value (*in the models AC1-27A..., AC1-27I... only*) **RLO** takes the minimum value measured by the transmitter (i.e. the value matching 0V, 0/4mA).
	RHI	RLO...99.9	Maximum range value (*in the models AC1-27A..., AC1-27I... only*) **RHI** takes the maximum value measured by the transmitter (i.e. the value matching 1V, 20mA)
	OS1	-12.5...12.5°	Probe T1 offset.
	TLD	1...30min	Delay for minimum temperature (TLO) and maximum temperature (THI) logging.
	SIM	0...100	Display slowdown
	ADR	1...255	AC1-27 address for PC communication

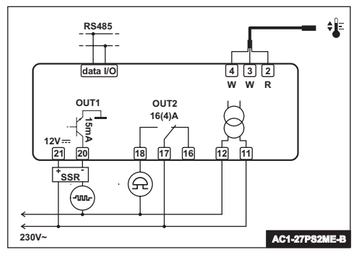
INPUT SPECIFICATIONS

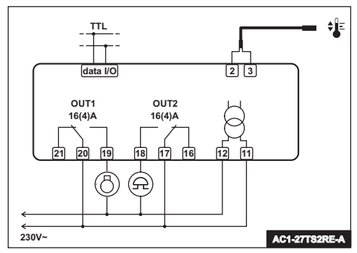
MODEL	INPUT		RANGE [MEASUREMENT ACCURACY]		
			SCL=1°C	SCL=2°C	SCL=°F
AC1-27A...	0÷1V		RLO÷RHI [< ± 3mV]		---
AC1-27I...	INP = 0mA	0÷20mA	RLO÷RHI [< ± 0.2mA]		---
	INP = 4mA	4÷20mA			
AC1-27J...	INP=T1	TC “J”	---	-50÷750°C [< ±3°C]	-60÷999°F [< ±5°F]
	INP=T2	TC “K”	---	-50÷999°C [< ±3°C]	
AC1-27P...	PT100		-50/-19.9÷99.9/150°C [< ±0.3°C]	-100÷850°C [<±1°C(-50÷850°), ±2°C]	-150÷999°F [<±2°F(-60÷999°), ±4°F]
AC1-27T...	INP=ST1	PTC 1000 Ω (LAE ST1..)	-50/-19.9 ÷ 99.9/150°C [<±0.3°C(-30÷130°),±1°C]	-50 ÷ 150°C [<±0.3°C(-30÷130°), ±1°C]	-60 ÷ 300°F [< ±0.6°F(-20÷260°),±2°F]
	INP=SN4	NTC 10K Ω (LAE SN4..)	-40/-19.9 ÷ 99.9/125°C [<±0.3°C(-40÷100°),±1°C]	-40 ÷ 125°C [<±0.3°C(-40÷100°),±1°C]	-40 ÷ 260°F [<±0.6°F(-40÷210°), ±2°F]

WIRING DIAGRAMS









TECHNICAL DATA

Power supply
AC1-27…D 12Vac/dc ±10%, 2W
AC1-27…E 230Vac±10%, 50/60Hz, 2W
AC1-27...U 110Vac±10%, 50/60Hz, 2W

Relay outputs (AC1-27..R..)
OUT1 16(4)A
OUT2 16(4)A

SSR drive (AC1-27..M..)
OUT1 15mA 12Vdc

Inputs
see table of input specifications

Measurement range
see table of input specifications

Measurement accuracy
see table of input specifications

Operating conditions
-10 … +50°C; 15%...80% r.H.

CE (Reference Norms)
EN60730-1; EN60730-2-9;
EN55022 (Class B); EN50082-1

Front protection
IP55

lae ELECTRONIC
VIA PADOVA, 25
31046 ODERZO /TV /ITALY
TEL. +39 - 0422 815320
FAX +39 - 0422 814073
www.lae-electronic.com
E-mail: sales@lae-electronic.com

AC1-2W 110x53x75mm

Two channel universal Controller, ON/OFF or PID

Wall-mount controller ● Runs on mains power supply ● PID with autotuning or ON/OFF control ● Outputs on relay or for SSR-piloting ● Input for 0÷1V, PTC/NTC10K ● 0.1 / 1°C or 1°F resolution ● Selectable Refrigerating/Heating (Dehumidifying/Humidifying) control ● Absolute or relative temperature alarms ● ON/OFF button on front ● Load start limitation and safety operation in case of probe failure ● Quick programming through ZOT-AC1 key ● Connection to LAE TAB supervisory systems

Applications:

Temperature: *control of small cold stores, swimming pools, heating systems, bains-marie, ovens, laboratory equipment.*

Humidity: *control of greenhouses, seasoning cells, cold rooms, air-conditioned rooms.*

AC1-2W Series

Functions	AC1-2WT..		AC1-2WA..
Input type	PTC	NTC10K	0÷1V
Range	-50÷150°C -60÷300°F	-40÷125°C -40÷260°F	Configurable in setup
Accuracy	±0.3°C	±0.3°C	±3mV
Resolution	0.1 / 1 °C / 1 °F		0.1/1

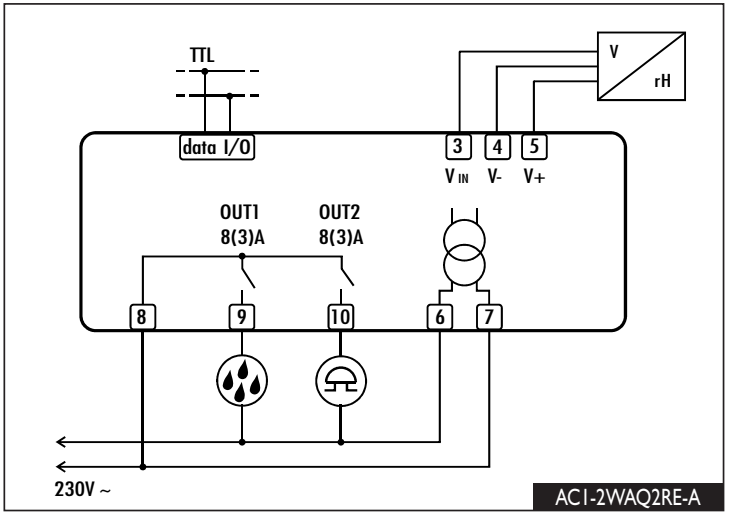
AC1-2W	T	Q	1	R	E	-B
	1	2	3	4	5	6

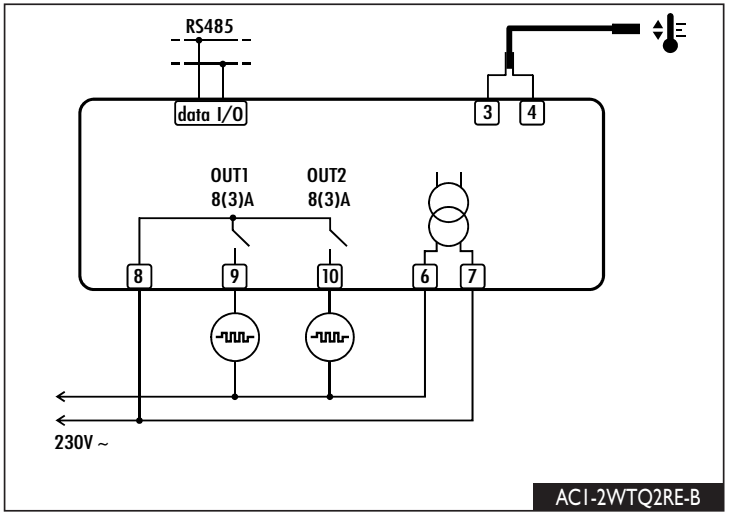
POS.	FUNCTION	DESCRIPTION
1	Input	**A** = 0÷1V; **T** = PTC/ NTC10K
2	Connections	**Q** = detachable screw terminals
3	Output No.	**1** = one; **2** = two
4	Output type	**R** = relay; **F** = SSR drives
5	Supply	**D** = 12Vac/dc; **E** = 230Vac 50/60Hz; **U**= 115Vac 50/60Hz 3 W
6	Serial comm.	**Nil** = no; **-A** = **TTL**; -B = RS485

How to order:
AC1-2WTQ2RE-B (PTC/NTC10K input, detachable screw terminals, 2 relays, 230Vac supply voltage, RS485 port)
AC1-2WAQ2RD-A (0÷1V input, detachable screw terminals, 2 relays, 12Vac/dc supply voltage, TTL port)

Wiring diagrams

Instruction


TTL
data I/O
V
rH
3
4
5
V IN
V-
V+
OUT1
8(3)A
OUT2
8(3)A
8
9
10
6
7
230V ~
AC1-2WAQ2RE-A


RS485
data I/O
3
4
OUT1
8(3)A
OUT2
8(3)A
8
9
10
6
7
230V ~
AC1-2WTQ2RE-B

AC1-2W INSTRUCTION FOR USE

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

DESCRIPTION

Fig.1 - Front panel

INDICATION

- **OUT1** Channel 1 output
- **OUT2** Channel 2 output
- **L1** Channel 1 setpoint modification
- **L2** Channel 2 setpoint modification
- Alarm
- Info / Enter button
- L1 Modify Setpoint 1 / Decrease button
- L2 Increase / Modify Setpoint 2 button
- Exit / Stand-by button

INSTALLATION

- The AC1-2W sizes 110x75x55 mm (WxHxD). Fix the plate to the panel using 2 cheese-headed screws with 4 or 5 mm diameter and then apply the instrument casing to the plate. This should be done for vertical panels and for correct positioning of the instrument with the outlets at the bottom.
- Make sure that electrical connections comply with the paragraph “wiring diagrams”. To reduce the effects of electromagnetic disturbance, keep the sensor and signal cables well separate from the power wires.
- Place the probe T1 inside the room in a point that truly represents the temperature of the stored product.

OPERATION

DISPLAY

During normal operation, the display shows either the temperature measured or one of the following indications:

oFF	Controller in stand-by	tun	Controller in autotuning
or	Probe T1 overrange or failure	E1	In tuning: timeout1 error
hi	Room high temperature alarm	E2	In tuning: timeout2 error
Lo	Room low temperature alarm	E3	In tuning: overrange error

MENU INFO

The information available in this menu is:

th1	Maximum temperature recorded	Loc	Keypad state lock
tLo	Minimum temperature recorded		

Access to menu and information displayed.

- Press and immediately release button i.
- With button ▼ or ▲ select the data to be displayed.
- Press button i to display value.
- To exit from the menu, press button ⏻ or wait for 10 seconds.

Reset of THI, TLO recordings

- With button ▼ or ▲ select the data to be reset.
- Display the value with button i.
- While keeping button i pressed, use button ⏻ .

CHANNEL 1 SETPOINT (display and modification of desired temperature value)

- Press and release button L1 : the LED L1 blinks, the display shows 1SP for 1 second and then the setpoint associated value.
- Press buttons ▼ or ▲ to set the desired value (adjustment is within the minimum **SPL** and maximum **SPH** limit).
- To store the new value press button ↵, or wait for 10 seconds.
- To go back to normal mode without saving the new value, press ⏻.

CHANNEL 2 SETPOINT

- With the auxiliary output set as thermostat control (**OAU**=THR), it’s possible to modify setpoint 2 during the normal operation of the controller.
- Press and release button L2; the LED L2 blinks, the display shows 2SP for 1 second if setpoint 2 is an absolute threshold (**2SM**=ABS), alternatively the display shows 2DF, if setpoint 2 is a threshold relative to setpoint 1 (**2SM**=REL), then the value associated to the parameter appears.
- Press buttons ▲ or ▼ to set the desired value.
- To store the new value press button ↵ or wait for 10 seconds.
- To go back to normal mode without saving the new value, press ⏻.

STAND-BY

Button ⏻, when pressed for 3 seconds, allows the controller to be put on a standby or output control to be resumed (with **SB**=YES only).

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 menu, set parameter **LOC**=YES to inhibit all functions of the buttons. To resume normal operation of keypad, adjust setting so that **LOC**=NO.

CONTROLLER AUTOTUNING IN PID MODE

Before starting

In the setup mode (see configuration parameters): set **1CM**=PID; make sure that **1CH** matches the desired operation mode (**1CH**=REF for refrigerating control, **1CH**=HEA for heating control); then adjust setpoint **1SP** at the desired value.

Start autotuning

During normal operation, keep buttons i + ▼ pressed for 3 seconds. 1CT blinks on the display. With i + ▼ or ▲ set the cycle time in order to define the dynamic of the process to be controlled. To abort the autotuning function, press ⏻; to start autotuning press ▼ + ▲ or wait for 30 seconds.

During autotuning

During the entire autotuning phase, the display alternates TUN with the actual temperature measured. In case of power failure, when power is resumed, after the initial autotest phase, the controller resumes the autotuning function. To abort the autotuning, without modifying the previous control parameters, keep button ⏻ pressed for 3 seconds. After the autotuning has taken place successfully, the controller updates the control parameters and start to control.

Errors

If the autotuning function failed, the display shows an error code:

- E1 timeout1 error: the controller could not bring the temperature within the proportional band. Increase **1SP** in case of heating control, vice versa, decrease **1SP** in case of refrigerating control and re-start the process.
- E2 timeout2 error: the autotuning has not ended within the maximum time allowed (1000 cycle times). Re-start the autotuning process and set a longer cycle time **1CT**.
- E3 temperature overrange: check that the error was not caused by a probe malfunction, then decrease **1SP** in case of heating control, vice versa increase **1SP** in case of refrigerating control and then re-start the process.
- To eliminate the error indication and return to the normal mode, press button ⏻.

Control improvement

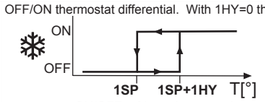
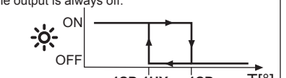
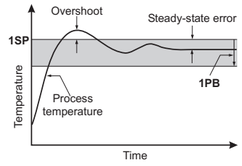
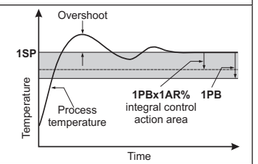
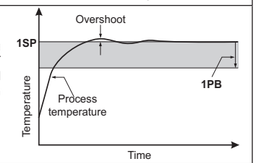
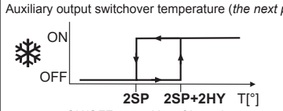
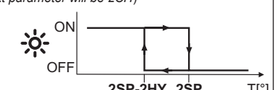
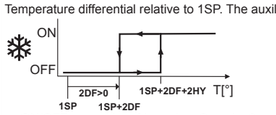
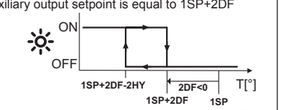
- To reduce overshoot, reduce the integral action reset **1AR**
- To increase the response speed of the system, reduce the proportional band **1PB**. Caution: doing this makes the system less stable.
- To reduce swings in steady-state temperature, increase the integral action time **1IT**; system stability 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 it may be a source of instability.

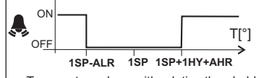
RECALIBRATION

- Have a precision reference thermometer or a calibrator to hand. Ensure that **OS1**=0 and **SIM**=0.
- Switch the controller off then on again.
- During the auto-test phase, press buttons i + ▲ and keep them pressed till the controller shows **0AD**.
- With buttons ▼ and ▲ select **0AD** or **SAD**: **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.
- Press i to display the value and then use i + ▲ or ▼ to make the read value coincide with the value measured by the reference instrument.
- Exit from calibration by pressing button ⏻.

CONFIGURATION PARAMETERS

- To get access to the parameter configuration menu, press button ⏻ + i for 5 seconds.
- With button ▼ or ▲ select the parameter to be modified.
- Press button i to display the value.
- By keeping button i pressed, use button ▼ or ▲ to set the desired value.
- When button i is released, the newly programmed value is stored and the following parameter is displayed.
- To exit from the setup, press button ⏻ or wait for 30 seconds.

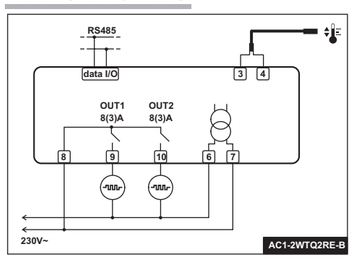
	PAR	RANGE	DESCRIPTION
	SCL	1°C; 2°C; °F	Readout scale (see table of input specifications) *Caution: upon changing the SCL value, it is then absolutely necessary to reconfigure the parameters relevant to the absolute and relative temperatures (SPL, SPH, 1SP, 1HY etc..)*
	SPL	-50°...SPH	Minimum limit for 1SP setting
	SPH	SPL...150°	Maximum limit for 1SP setting.
	1SP	SPL... SPH	Setpoint (value to be maintained in the room).
	1CM	HY; PID	Control mode. With 1CM=HY you select control with hysteresis: parameters 1HY, 1T0 and 1T1 are used. With 1CM=PID you select a Proportional-Integral-Derivative control mode: parameters 1PB, 1IT, 1DT, 1AR, 1CT will be used.
	1CH	REF; HEA	Refrigerating (REF) or Heating (HEA) control mode.
1CM=HY	**1HY**	0...19.9°	OFF/ON thermostat differential. With 1HY=0 the output is always off.  ON/OFF refrigerating control (**1CM**=HY, **1CH**=REF)  ON/OFF heating control (**1CM**=HY, **1CH**=HEA)
	1T0	0...30min	Minimum off time. After output 1 has been turned off, it remains inactive for 1T0 minutes regardless of the temperature value measured.
	1T1	0...30min	Minimum on time. (*the following parameter will be 1PF*). After output 1 has been turned on, it remains active for 1T1 minutes regardless of the temperature value measured.
1CM=PID	**1PB**	0...19.9°	Proportional bandwidth. Temperature control takes place by changing the ON time of the output: the closer the temperature to the setpoint, 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 setpoint. With 1PB=0 the output is always off. 
	1IT	0...999s	Integral action time. The steady-state error is cancelled by inserting an integral action. The integral action time, determines the speed with which the steady-state temperature is achieved, but a high speed (1IT low) may be the cause of overshoot and instability in the response. With 1IT=0 the integral control is disabled. 
	1DT	0...999s	Derivative action time. Response overshoot may be reduced by inserting a derivative Action. A high derivative action (1DT high) makes the system very sensitive to small temperature variations and causes instability. With 1DT=0 the derivative control is disabled. 
	1AR	0...100%	Reset of integral action time referred to 1PB Decreasing the parameter 1AR reduces the integral control action zone, and consequently the overshoot (see figure on paragraph 1IT).
	1CT	1...255s	Cycle time. It’s the period in which the output ON time changes. The quicker the system to be controlled reacts to temperature variations, the smaller the cycle time must be, in order to obtain higher temperature stability and less sensitivity to load variations.
	1PF	ON/OFF	Output state in case of probe failure.
	OAU	NON; THR; AL0; AL1	AUX output operation. **NON** : output disabled (always off). (*the next parameter will be ATM*) **THR** : output programmed for second thermostat control (*the next parameter will be 2SM*). **AL0** : contacts open when an alarm condition occurs (*the next parameter will be ATM*). **AL1** : contacts make when an alarm condition occurs (*the next parameter will be ATM*).
OAU=THR	**2SM**	ABS; REL	Setpoint 2 mode. Channel 2 setpoint may be absolute (2SM=ABS), or a differential relative to setpoint 1 (2SM=REL)
2SM=ABS	**2SP**	SPL...SPH	Auxiliary output switchover temperature (*the next parameter will be 2CH*)  ON/OFF control in refrigeration (2SM=ABS, 2CH=REF)  ON/OFF control in heating (2SM=ABS, 2CH=HEA)
2SM=REL	**2DF**	-19.9...19.9°	Temperature differential relative to 1SP. The auxiliary output setpoint is equal to 1SP+2DF  ON/OFF control in refrigeration. Setpoint 2 relative to setpoint 1 (OAU=THR, 2CH=REF)  ON/OFF control in heating. Setpoint 2 relative to setpoint 1 (OAU=THR, 2CH=HEA)

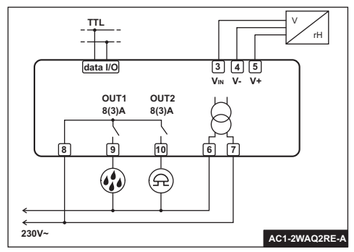
OAU=THR	**2CH**	REF; HEA	Refrigerating control (REF) or heating control mode (HEA) for the auxiliary output.
	2HY	0...19.9°	Differential of thermostat 2. With 2HY=0 the auxiliary output always remains off.
	2T0	0...30min	Minimum off time. After output 2 has been turned off, it remains inactive for 2T0 minutes regardless of the temperature value measured.
	2T1	0...30min	Minimum on time. After output 2 has been turned on, it remains active for 2T1 minutes regardless of the temperature value measured.
	2PF	ON/OFF	Auxiliary output state in case of probe failure.
	ATM	NON; ABS; REL	Alarm threshold management. **NON** : all temperature alarms are inhibited (*the following parameter will be SB*). **ABS** : the values programmed in ALA and AHA represent the real alarm thresholds. **REL** : the values programmed in ALR and AHR are alarm differentials referred to 1SP and 1SP+1HY.  Temperature alarm with relative thresholds, refrigerating control (ATM=REL, 1CH=REF)  Temperature alarm with relative thresholds, heating control (ATM=REL, 1CH=HEA).
ATM=ABS	**ALA**	-50°...AHA	Low temperature alarm threshold.
	AHA	ALA...150°	High temperature alarm threshold.
ATM=REL	**ALR**	-12.0...0°	Low temperature alarm differential. With ALR=0 the low temperature alarm is excluded.
	AHR	0...12.0°	High temperature alarm differential. With AHR=0 the high temperature alarm is excluded.
	ATD	0...120min	Delay before alarm temperature warning.
	SB	NO/YES	Stand-by button enabling.
	INP	ST1/SN4	Sensor input selection (see table of input specifications). *In the models AC1-2WT... only.*
	RLO	-19.9...RHI	Minimum range value (*in the models AC1-2WA… only*) RLO takes the minimum value measured by the transmitter (i.e. the value matching 0V).
	RHI	RLO...99.9	Maximum range value (*in the models AC1-2WA… only*) RHI takes the maximum value measured by the transmitter (i.e. the value matching 1V)
	OS1	-12.5...12.5°	Probe T1 offset.
	TLD	1...30min	Delay for minimum temperature (TLO) and maximum temperature (THI) logging.
	SIM	0...100	Display slowdown
	ADR	1...255	AC1-2W address for PC communication

INPUT SPECIFICATIONS

MODEL	INPUT		RANGE [MEASUREMENT ACCURACY]		
			SCL=1°C	SCL=2°C	SCL=°F
AC1-2WA..	0÷1V		RLO÷RHI [< ± 3mV]		---
AC1-2WT...	INP=ST1	PTC 1000 Ω (LAE ST1..)	-50/-19.9 ÷ 99.9/150°C [<±0.3°C(-30÷130°),±1°C]	-50 ÷ 150°C [<±0.3°C(-30÷130°), ±1°C]	-60 ÷ 300°F [< ±0.6°F(-20÷260°),±2°F]
	INP=SN4	NTC 10K Ω (LAE SN4..)	-40/-19.9 ÷ 99.9/125°C [<±0.3°C(-40÷100°),±1°C]	-40 ÷ 125°C [<±0.3°C(-40÷100°),±1°C]	-40 ÷ 260°F [<±0.6°F(-40÷210°), ±2°F]

WIRING DIAGRAMS





TECHNICAL DATA

Power supply

AC1-2W…D	12Vac/dc ±10%, 2W
AC1-2W...E	230Vac±10%, 50/60Hz, 2W
AC1-2W...U	115Vac±10%, 50/60Hz, 2W

Relay outputs (AC1-2W..R..)

OUT1	8(3)A
OUT2	8(3)A

SSR drive (AC1-2W..F..)

OUT1	15mA	12Vdc
OUT2	15mA	12Vdc

Inputs
see table of input specifications

Measurement range
see table of input specifications

Measurement accuracy
see table of input specifications

Operating conditions
-10 … +50°C; 15%...80% r.H.

CE (Reference Norms)
EN60730-1; EN60730-2-9;
EN55022 (Class B); EN50082-1

Front protection
IP55

lae ELECTRONIC
VIA PADOVA, 25
31046 ODERZO /TV /ITALY
TEL. +39 - 0422 815320
FAX +39 - 0422 814073
www.lae-electronic.com
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LOTS OF OPTIONS, JUST ONE CHOICE.

AT1-5
Universal Defrost Controller for High Temperature

AT2-5
Universal Defrost Controller for High and Low Temperature

AD2-5
Defrost Controller for Display Cases and Cold Stores

AR2-5
Defrost Controller with RTC for display cases and cold stores

AR2-27
Universal Defrost Controller with RTC

AD-32
Universal Powerful Defrost Controller

AH1-5
Defrost Controller for refrigerated transports

BIT25
Split Defrost Controller

BD1-28
Clever Split Defrost Controller

BR1-28
Clever Split Defrost Controller with RTC

LCD Display

Refrigeration Controllers

lae® ELECTRONIC

AT1-5

77x35x77 mm

Universal Defrost Controller for High Temperature

Selectable Refrigerating or Heating control ● Runs on mains power supply ● Direct compressor control through high power 16(4)A, 16(5)A or 16(8)A relay ● Selectable NTC10K or PTC probe input ● Integrated defrost functions ● Auxiliary output configurable in four different operation modes ● Absolute or relative temperature alarms ● Door open alarm ● Automatic condenser maintenance warning ● On/Off button ● Optional light control button ● Quick programming through ZOT-AT1 key ● Connection to LAE supervisory systems

Applications:

Freestanding upright cabinets and counters, cold stores, plug-in display cases, control panels, heated cabinets.

AT1-5 Series

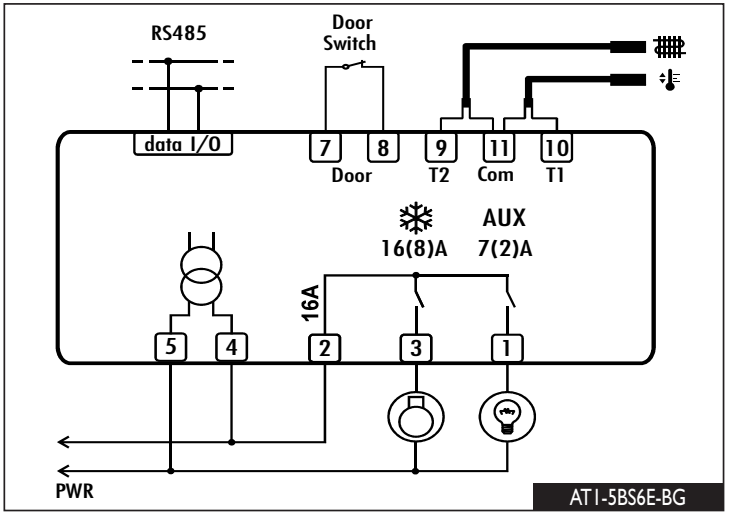
Functions		AS1E-G	BS2E-BG	BS6E-AL
Inputs	thermostat	✓	✓	✓
	evaporator		✓	✓
	door switch		✓	✓
Outputs	thermostat 16(4)A	✓	✓	
	thermostat 16(8)A			✓
	auxiliary 7(2)A		✓	✓
Power supply	230Vac	✓	✓	✓
Serial port	TTL			✓
	RS485		✓	
Kaypad	generic	✓	✓	
	with light button			✓

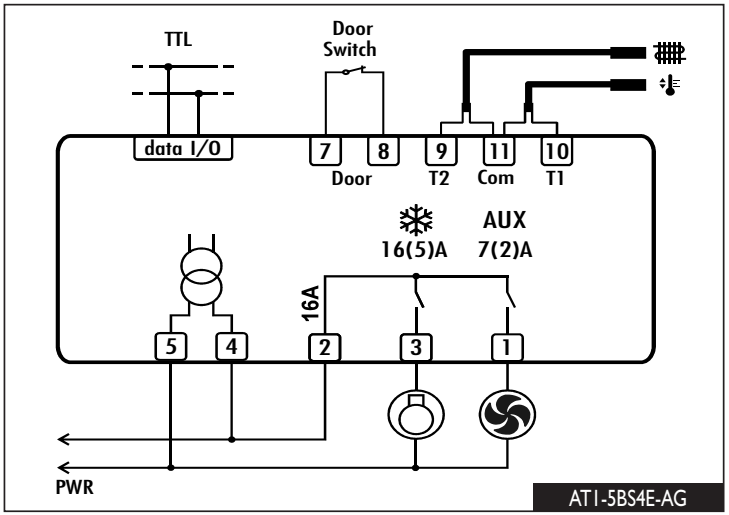
Models with removable screw terminal blocks are available. In this case, the letter "S" of code changes in "Q", ex. AT1-5BQ2E-BG.
All models come with an alarm buzzer. Versions with 110V power supply are available.
On request, the AT1-5 is also available with gasket for a better protection between bezel and metal panel.

Technical Data

Control Range:		-50÷120°C, -55÷240°F
Resolution:		0.1 / 1 °C, °F
Accuracy:	NTC10K:	<±0.3°C (-40.0÷70.0°C)
	PTC1000:	<±0.5°C (-50÷120°C)
Sensor type:		selectable NTC10K or PTC1000
Power supply:		230V~ ±10% 50÷60Hz 3W
Front protection:		IP55
Panel cut-out:		71x29 mm

Wiring diagrams | Applications | Instruction


RS485
Door Switch
data I/O
7
8
9
11
10
Door
T2
Com
T1
AUX
16(8)A
7(2)A
16A
5
4
2
3
1
PWR
AT1-5BS6E-BG


TTL
Door Switch
data I/O
7
8
9
11
10
Door
T2
Com
T1
AUX
16(5)A
7(2)A
16A
5
4
2
3
1
PWR
AT1-5BS4E-AG

Freestanding upright cabinets and counters, cold stores, plug-in display cases, control panels, heated cabinets.

AT1-5 INSTRUCTIONS FOR USE

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

DESCRIPTION

Fig.1 — Front panel

Info / Setpoint button.

Manual defrost / Decrease button.

Increase / manual activation button.

Exit / Stand-by button.

INDICATIONS

Thermostat output

Auxiliary output

Alarm

INSTALLATION

- Insert the controller through a hole measuring 71x29 mm.
- Make sure that electrical connections comply with the paragraph "wiring diagrams". To reduce the effects of electromagnetic disturbance, keep the sensor and signal cables well separate from the power wires.
- Fix the controller to the panel by means of the suitable clips, by pressingly 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.
- Place the probe T1 inside the room in a point that truly represents the temperature of the stored product.
- Place the probe T2 where there is the maximum formation of frost.

OPERATION

DISPLAY

During normal operation, the display shows either the temperature measured or one of the following indications:

DEF	Defrost in progress	**HI**	Room high temperature alarm
REC	Recovery after defrost	**LO**	Room low temperature alarm
OFF	Controller in stand-by	**E1**	Probe T1 failure
CL	Condenser clean warning	**E2**	Probe T2 failure
DO	Door open alarm		

INFO MENU

The information available in this menu is:

T1	Instant probe 1 temperature	**TLO**	Minimum probe 1 temperature recorded
T2	Instant probe 2 temperature	**CND**	Compressor working weeks
THI	Maximum probe 1 temperature recorded	**LOC**	Keypad state lock

Access to menu and information displayed.

- Press and immediately release button [i].
- With button [▼] or [▲] select the data to be displayed.
- Press button [i] to display value.
- To exit from the menu, press button [X] or wait for 10 seconds.

Reset of THI, TLO, CND recordings

- With button [▼] or [▲] select the data to be reset.
- Display the value with button [i].
- While keeping button [i] pressed, use button [X] .

SETPOINT (display and modification of desired temperature value)

- Press button [▲▼] for at least half second, to display the setpoint value.
- By keeping button [▲▼] pressed, use button [▼] or [▲] to set the desired value (adjustment is within the minimum **SPL** and the maximum **SPH** limit).
- When button [▲▼] is released, the new value is stored.

STAND-BY

Button [⏻], when pressed for 3 seconds, allows the controller to be put on a standby or output control to be resumed (with **SB**=YES only).

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 menu, set parameter **LOC**=YES to inhibit all functions of the buttons. To resume normal operation of keypad, adjust setting so that **LOC**=NO.

DEFROST

Timed defrost. 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. 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).

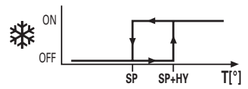
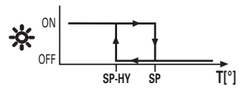
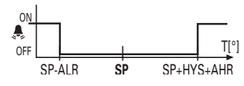
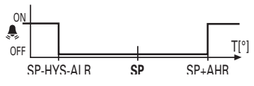
Manual defrost. Defrosting may also be induced manually by keeping the button [❄] pressed for 2 seconds.

Defrost type. Once defrost has started, Compressor and Defrost outputs are controlled according to the parameters **DTY** and **OAU**. The AUX output is associated to defrost function with **OAU**=DEF exclusively.

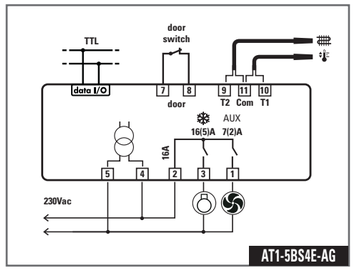
Defrost termination. Defrost lasts as long as time **DTO** but, if the evaporator probe has been enabled (**T2**=YES) and temperature **DLI** is achieved before this time elapses, defrost will be terminated in advance.
Caution: if **C-H***=HEA all defrost functions are inhibited; if* ***DFR****=0 the timed defrost function is excluded; during defrost, the high temperature alarm is inhibited.*

CONFIGURATION PARAMETERS

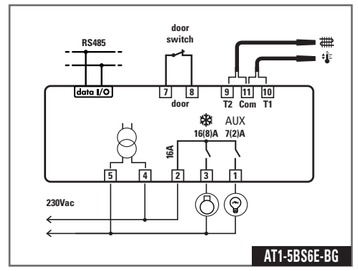
- The setup menu is accessed by pressing button [X]+[i] for 5 seconds.
- With button [▼] or [▲] select the parameter to be modified.
- Press button [i] to display the value.
- By keeping button [i] pressed, use button [▼] or [▲] to set the desired value.
- When button [i] is released, the newly programmed value is stored and the following parameter is displayed.
- To exit from the setup, press button [X] or wait for 30 seconds.

PAR	RANGE	DESCRIPTION
SCL	1°C; 2°C; °F	Readout scale. 1°C (only with **INP**=SN4): measuring range -50/-9.9 … 19.9/80°C 2°C : measuring range -50 … 120°C °F : measuring range -55 … 240°F Caution: upon changing the **SCL** value, it is then absolutely necessary to reconfigure the parameters relevant to the absolute and relative temperatures (**SPL**, **SPH**, **SP**, **ALA**, **AHA**, etc..)
SPL	-50..SPH	Minimum limit for **SP** setting
SPH	SPL..120°	Maximum limit for **SP** setting
SP	SPL... SPH	Setpoint (value to be maintained in the room).
C-H	REF; HEA	Refrigerating (REF) or Heating (HEA) control mode
HYS	1...10°	OFF/ON thermostat differential  Refrigerating control (**C-H**=REF)  Heating control (**C-H**=HEA)
CRT	0...30min	Compressor rest time. The output is switched on again after **CRT** minutes have elapsed since the previous switchover. We recommend to set **CRT**=03 with **HYS**<2.0°.
CT1	0...30min	Thermostat output run when probe T1 is faulty. With **CT1**=0 the output will always remain OFF.
CT2	0...30min	Thermostat output stop when probe T1 is faulty. With **CT2**=0 and **CT1**>0 the output will always be ON. Example: **CT1**=4, **CT2**= 6: In case of probe T1 failure, the compressor will cycle 4 minutes ON and 6 minutes OFF.
CSD	0..30min	Compressor stop delay after the door has been opened (active only if **DS**=YES).
DFR	0... 24(1/24h)	Defrost frequency expressed in cycles/24 hours.
DLI	-50...120°	Defrost end temperature.
DTO	1...120min	Maximum defrost duration.
DTY	OFF; ELE; GAS	Defrost type OFF: off cycle defrost (Compressor and Heater OFF). ELE: electric defrost* (Compressor OFF and Heater ON). GAS: hot gas defrost* (Compressor and Heater ON). * The defrost output is active if only **OAU**=DEF.
DDY	0...60min	Display during defrost. If **DDY**=0 during defrost the temperature continues to be displayed. If **DDY** > 0, during defrost the display shows DEF, when defrost is over REC is displayed during DDY minutes.
ATM	NON; ABS; REL	Alarm threshold management. NON: all temperature alarms are inhibited (the following parameter will be **ADO**). ABS: the values programmed in **ALA** and **AHA** represent the real alarm thresholds. REL: the values programmed in **ALR** and **AHR** are alarm differentials referred to **SP** and **SP+HY**.  Temperature alarm with relative thresholds, refrigerating control (**ATM**=REL, **C-H**=REF).  Temperature alarm with relative thresholds, heating control (**ATM**=REL, **C-H**=HEA).
ALA	-50... 120°	Low temperature alarm threshold.
AHA	-50... 120°	High temperature alarm threshold.
ALR	-12... 0°	Low temperature alarm differential. With **ALR**=0 the low temperature alarm is excluded.
AHR	0... 12°	High temperature alarm differential. With **AHR**=0 the high temperature alarm is excluded.
ATD	0... 120min	Delay before alarm temperature warning.
ADO	0... 30min	Delay before door open alarm warning.
ACC	0...52 weeks	Condenser periodic cleaning. When the compressor operation time, expressed in weeks, matches the **ACC** value programmed, "CL" flashes in the display. With **ACC**=0 the condenser cleaning warning is disabled.
SB	NO/YES	Stand-by button enabling [⏻].
DS	NO/YES	Door switch input enabling (closed when door is closed).
OAU	NON; 0-1; DEF; LGT; ALR;	AUX output operation NON : output disabled (always off). 0-1 : the relay contacts follow the on/standby state of controller. DEF: output programmed for defrost control. LGT : output enabled for light control. ALR : contacts make when an alarm condition occurs.
INP	SN4; ST1	Temperature sensor selection. With **INP** = SN4, the probes must be the LAE models SN4..; with **INP** = ST1, the probes must be the LAE models ST1...
OS1	-12.5..12.5°C	Probe T1 offset.
T2	NO/YES	Probe T2 enabling (evaporator).
OS2	-12.5..12.5°C	Probe T2 offset.
TLD	1...30 min	Delay for minimum temperature (TLO) and maximum temperature (THI) logging.
SIM	0...100	Display slowdown.
ADR	1...255	AT1-5 address for PC communication.

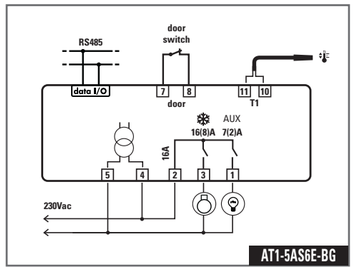
WIRING DIAGRAM



AT1-5BS4E-AG



AT1-5BS6E-BG



AT1-5AS6E-BG

TECHNICAL DATA

Power supply

AT1-5…E	230Vac±10%, 50/60Hz, 3W
AT1-5…U	115Vac±10%, 50/60Hz, 3W
AT1-5…D	12Vac±10%, 50/60Hz, 3W

Relay outputs

AT1-5.**Q1**(2)… compressor 12(4)A
AT1-5.**S1**(2)… compressor 16(4)A
AT1-5.**Q3**(4)… compressor 12(5)A
AT1-5.**S3**(4)… compressor 16(5)A
AT1-5.**Q5**(6)… compressor 12(8)A
AT1-5.**S5**(6)… compressor 16(8)A
Auxiliary loads 7(2)A 240vac

AT1-5.**Q**… maximum total current 12A
AT1-5.**S**… maximum total current 16A

Inputs

NTC 10KΩ@25°C, LAE part No. SN4...
PTC 1000Ω@25°C, LAE part No. ST1…

Measuring Range

-50…120°C, -55…240°F
-50 / -9.9 … 19.9 / 80°C (with NTC10K only)

Measuring accuracy

<0.5°C within the measurement range

Operating conditions

-10 … +50°C; 15%...80% r.H.

CE – UL (Approvals and Reference Norms)

EN60730-1; EN60730-2-9;
EN55022 (Class B);
EN50082-1
UL 60730-1A

Front protection

IP55

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VIA PADOVA, 25
31046 ODERZO /TV /ITALY
TEL. +39 - 0422 815320
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AT2-5

77x35x77 mm

Universal Defrost Controller for High and Low Temperature

Selectable Refrigerating or Heating control ● Runs on mains power supply ● Direct compressor control through high power 16(5)A ● Excellent evaporator fan control ● Auxiliary output configurable in six different operating modes ● Selectable NTC10K or PTC input ● Electrical, off cycle or hot gas defrost ● Absolute or relative temperature alarms ● Door open alarm ● Automatic condenser maintenance warning ● On/Off button ● Optional light control button ● Quick programming through ZOT-AT2 key

Applications:

High or Low Temperature upright cabinets and counters, cold stores, plug-in display cases, control panels, heated cabinets.

AT2-5 Series

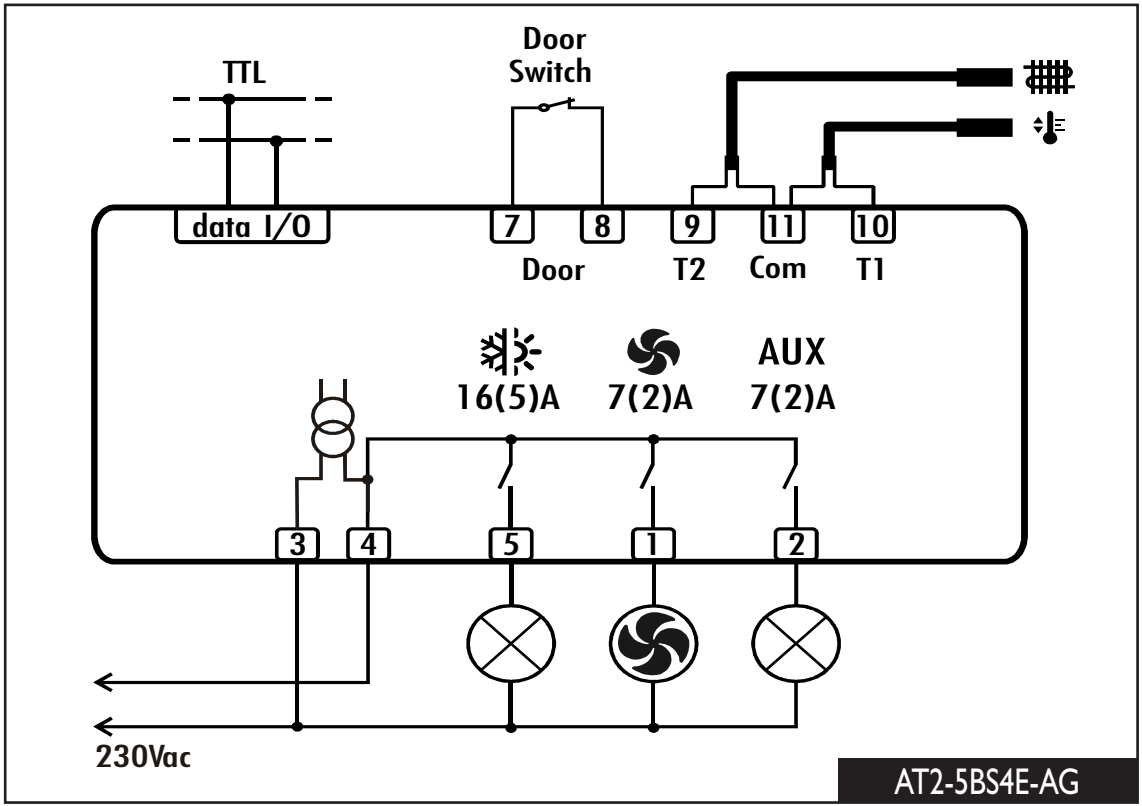
Functions		BS4E-G	BS4E-AG	BS4E-AL
Inputs	thermostat	✓	✓	✓
	evaporator	✓	✓	✓
	door switch	✓	✓	✓
Outputs	thermostat	✓	✓	✓
	evaporator fans	✓	✓	✓
	auxiliary	✓	✓	✓
Power supply	230Vac	✓	✓	✓
Serial port	serial port TTL		✓	✓
Keypad	generic	✓	✓	
	with light button			✓

Models with removable screw terminal blocks are available. In this case, the letter "S" of code changes in "Q", ex. AT2-5BQ4E-AL.
All models come with an alarm buzzer. Versions with 110V power supply are available.
Upon request, against large batches, the AT2-5 is also available with RS485 serial port
On request, the AT2-5 is also available with gasket for a better protection between bezel and metal panel.

Technical Data

Control Range:		-50÷120°C , -55÷240°F
Resolution:		0.1 / 1 °C; °F
Accuracy:	NTC10K:	<±0.3°C (-40.0÷70.0°C)
	PTC1000:	<±0.5°C (-50÷120°C)
Sensor type:		selectable NTC10K or PTC1000
Power supply:		230V~ ±10% 50÷60Hz 3W
Front protection:		IP55
Panel cut-out:		71x29 mm

Wiring diagrams | Applications | Instruction


TTL
Door
Switch
data I/O
7
8
9
11
10
Door
T2
Com
T1
16(5)A
7(2)A
AUX
7(2)A
3
4
5
1
2
230Vac
AT2-5BS4E-AG

High or Low Temperature upright cabinets and counters, cold stores, plug-in display cases, control panels, heated cabinets.

AT2-5 INSTRUCTIONS FOR USE

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

DESCRIPTION

Fig.1 — Front panel

- Info / Setpoint button.
- Manual defrost / Decrease button.
- Increase / manual activation button.
- Exit / Stand-by button.

INDICATIONS

- Thermostat output
- Fan output
- RL3 Auxiliary output
- II° Activation of 2nd parameter set
- Alarm

INSTALLATION

- Insert the controller through a hole measuring 71x29 mm.
- Make sure that electrical connections comply with the paragraph "wiring diagrams". To reduce the effects of electromagnetic disturbance, keep the sensor and signal cables well separate from the power wires.
- Fix the controller to the panel by means of the suitable clips, by pressingly 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.
- Place the probe T1 inside the room in a point that truly represents the temperature of the stored product.
- Place the probe T2 on the evaporator where there is the maximum formation of frost.

OPERATION

DISPLAY

During normal operation, the display shows either the temperature measured or one of the following indications:

DEF	Defrost in progress	**HI**	Room high temperature alarm
REC	Recovery after defrost	**LO**	Room low temperature alarm
OFF	Controller in stand-by	**E1**	Probe T1 failure
CL	Condenser clean warning	**E2**	Probe T2 failure
DO	Door open alarm		

INFO MENU

The information available in this menu is:

T1	Instant probe 1 temperature	**TLO**	Minimum probe 1 temperature recorded
T2	Instant probe 2 temperature	**CND**	Compressor working weeks
THI	Maximum probe 1 temperature recorded	**LOC**	Keypad state lock

Access to menu and information displayed.

- Press and immediately release button i.
- With button ▼ or ▲ select the data to be displayed.
- Press button i to display value.
- To exit from the menu, press button X or wait for 10 seconds.

Reset of THI, TLO, CND recordings

- With button ▼ or ▲ select the data to be reset.
- Display the value with button i.
- While keeping button i pressed, use button X .

SETPOINT (display and modification of desired temperature value)

- Press button ↕ for at least half second, to display the setpoint value.
- By keeping button ↕ pressed, use button ▼ or ▲ to set the desired value (adjustment is within the minimum **SPL** and the maximum **SPH** limit).
- When button ↕ is released, the new value is stored.

STAND-BY

Button ⏻, when pressed for 3 seconds, allows the controller to be put on a standby or output control to be resumed (with **SB**=YES only).

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 menu, set parameter **LOC**=YES to inhibit all functions of the buttons. To resume normal operation of keypad, adjust setting so that **LOC**=NO.

SELECTION OF SECOND PARAMETER GROUP

It's possible to select control parameters between two different pre-programmed groups, in order for the fundamental control parameters to be adapted quickly to changing needs. With **IISM**=MAN, changeover from Group I to Group II takes place manually by pressing button ▼ for 2 seconds. The activation of Group II is signalled by the lighting up of the relevant LED on the controller display. If **IISM**=NON, switchover to group II is inhibited.

DEFROST

Timed defrost. Defrosting starts automatically when necessary time has elapsed to obtain the defrosting frequency set with **DFR (IIDF)**. For example, with **DFR**=4 defrosting occurs once every 6 hours. 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).

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

Defrost type. Once defrost has started, Compressor and Defrost outputs are controlled according to the parameters **DTY** and **OAU**. The AUX output is associated to defrost function with **OAU**=DEF exclusively.
If **FID**=YES the evaporator fans are active all through defrost.

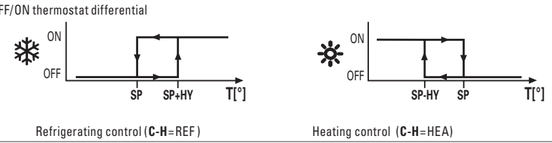
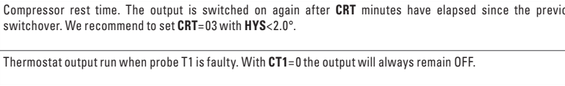
Defrost termination. Defrost lasts as long as time **DTO** but, if the evaporator probe has been enabled (**T2**=YES) and temperature **DLI** is achieved before this time elapses, defrost will be terminated in advance.

Resuming thermostatic cycle. When defrost is over, if **DRN** is greater than 0, all outputs will remain off for **DRN** minutes, in order for the ice to melt completely and the resulting water to drain. Moreover, if probe T2 is active (**T2**=YES), the fans will re-start when the evaporator gets to a temperature lower than **FDD**; Vice versa, if such condition does not occur after 4 minutes following defrost termination, the fans will be switched on anyway.

*Caution: if **C-H**=HEA all defrost functions are inhibited; if **DFR**=0 the timed defrost function is excluded; during defrost, the high temperature alarm is inhibited.*

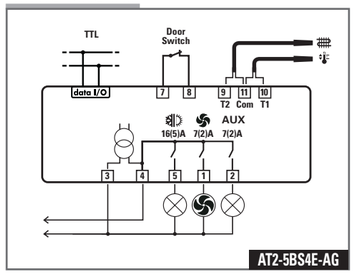
CONFIGURATION PARAMETERS

- The setup menu is accessed by pressing button X+i for 5 seconds.
- With button ▼ or ▲ select the parameter to be modified.
- Press button i to display the value.
- By keeping button i pressed, use button ▼ or ▲ to set the desired value.
- When button i is released, the newly programmed value is stored and the following parameter is displayed.
- To exit from the setup, press button X or wait for 30 seconds.

PAR	RANGE	DESCRIPTION
SCL	1°C; 2°C; °F	Readout scale. 1°C (only with **INP**=SN4): measuring range -50/-9.9 … 19.9/80°C 2°C : measuring range -50 … 120°C °F : measuring range -55 … 240°F Caution: upon changing the **SCL** value, it is then absolutely necessary to reconfigure the parameters relevant to the absolute and relative temperatures (**SPL**, **SPH**, **SP**, **ALA**, **AHA**, etc..)
SPL	-50..SPH	Minimum limit for **SP** setting
SPH	SPL.120°	Maximum limit for **SP** setting
SP	SPL... SPH	Setpoint (value to be maintained in the room).
C-H	REF; HEA	Refrigerating (REF) or Heating (HEA) control mode
HYS	1...10°	OFF/ON thermostat differential  Refrigerating control (**C-H**=REF) Heating control (**C-H**=HEA)
CRT	0...30min	Compressor rest time. The output is switched on again after **CRT** minutes have elapsed since the previous switchover. We recommend to set **CRT**=03 with **HYS**<2.0°.
CT1	0...30min	Thermostat output run when probe T1 is faulty. With **CT1**=0 the output will always remain OFF.
CT2	0...30min	Thermostat output stop when probe T1 is faulty. With **CT2**=0 and **CT1**>0 the output will always be ON. Example: **CT1**=4, **CT2**= 6: In case of probe T1 failure, the compressor will cycle 4 minutes ON and 6 minutes OFF.
CSD	0..30min	Compressor stop delay after the door has been opened (active only if **DS**=YES).
DFR	0... 24(1/24h)	Defrost frequency expressed in cycles/24 hours.
DLI	-50...120°	Defrost end temperature.
DTO	1...120min	Maximum defrost duration.
DTY	OFF; ELE; GAS	Defrost type OFF: off cycle defrost (Compressor and Heater OFF). ELE: electric defrost* (Compressor OFF and Heater ON). GAS: hot gas defrost* (Compressor and Heater ON). * The defrost output is active if only **OAU**=DEF.
DRN	0...30min	Pause after defrost (evaporator drain down time).
DDY	0...60min	Display during defrost. If **DDY**=0 during defrost the temperature continues to be displayed. If **DDY** > 0, during defrost the display shows DEF, and at the end of defrost it shows REC for **DDY** minutes.
FID	NO/YES	Fans active during defrost.
FDD	-50...120°	Evaporator fan re-start temperature after defrost.
FTC	NO/YES	Optimised fan control enabling. With **FTC** = NO the fans remain on all the time  Fig. 2 Optimised fan control (**FTC**=YES)
FT1	0...180sec	Fan stop delay after compressor stop. See Fig. 2.
FT2	0...30min	Timed fan stop. With **FT2**=0 the fans remain on all the time.
FT3	0...30min	Timed fan run. With **FT3**=0, and **FT2** > 0, the fans remain off all the time.
ATM	NON; ABS; REL	Alarm threshold management. NON: all temperature alarms are inhibited (the following parameter will be **ADO**). ABS: the values programmed in **ALA** and **AHA** represent the real alarm thresholds. REL: the values programmed in **ALR** and **AHR** are alarm differentials referred to **SP** and **SP+HY**.  Temperature alarm with relative thresholds, refrigerating control (**ATM**=REL, **C-H**=REF). Temperature alarm with relative thresholds, heating control (**ATM**=REL, **C-H**=HEA).

ALA	-50... 120°	Low temperature alarm threshold.
AHA	-50... 120°	High temperature alarm threshold.
ALR	-12... 0°	Low temperature alarm differential. With **ALR**=0 the low temperature alarm is excluded.
AHR	0... 12°	High temperature alarm differential. With **AHR**=0 the high temperature alarm is excluded.
ATD	0... 120min	Delay before alarm temperature warning.
ADO	0... 30min	Delay before door open alarm warning.
ACC	0...52 weeks	Condenser periodic cleaning. When the compressor operation time, expressed in weeks, matches the **ACC** value programmed, "CL" flashes in the display. With **ACC**=0 the condenser cleaning warning is disabled.
IISM	NON; MAN;	Switchover mode to second parameter set NON: inhibition to use the second parameter group (the following parameter will be **SB**). MAN: button M switches the two parameter groups over.
IISL	-50...IISH	Minimum limit for **IISP** setting.
IISH	IISL...120°C	Maximum limit for **IISP** setting.
IISP	IISL... IISH	Setpoint in mode 2
IIHY	1...10°	OFF/ON differential in mode 2.
IIFT	NO/YES	Optimised fan control enabling in mode 2.
IIDF	0...99hours	Defrost timer set to start a defrost in mode 2.
SB	NO/YES	Stand-by button enabling ⏻.
DS	NO/YES	Door switch input enabling (closed when door is closed).
LSM	NON; MAN; DOR	Light control mode NON : light output not controlled. MAN : light ouput controlled through button M (if **OAU**=LGT). DOR : light ouput switched on when door is opened (if **OAU**=LGT).
OAU	NON; 0-1; DEF; LGT; AL0; AL1	AUX output operation. NON : output disabled (always off). 0-1 : the relay contacts follow the on/standby state of controller. DEF : output programmed for defrost control. LGT : output enabled for light control. AL0 : contacts open when an alarm condition occurs. AL1 : contacts make when an alarm condition occurs.
INP	SN4; ST1	Temperature sensor selection. With **INP** = SN4, the probes must be the LAE models SN4..; with **INP** = ST1, the probes must be the LAE models ST1...
OS1	-12.5..12.5°C	Probe T1 offset.
T2	NO/YES	Probe T2 enabling (evaporator).
OS2	-12.5..12.5°C	Probe T2 offset.
TLD	1...30 min	Delay for minimum temperature (TLO) and maximum temperature (THI) logging.
SIM	0...100	Display slowdown.
ADR	1...255	AT2-5 address for PC communication.

WIRING DIAGRAM



TECHNICAL DATA

Power supply

AT2-5…E	230Vac±10%, 50/60Hz, 3W
AT2-5…U	115Vac±10%, 50/60Hz, 3W
AT2-5…D	12Vac/dc±10%, 3W

Relay outputs

AT2-5.**Q**…	Compressor	12(5)A 240vac
AT2-5.**S**…	Compressor	16(5)A 240vac
Evaporator fans		7(2)A 240vac
Auxiliary loads		7(2)A 240vac

AT2-5.**Q**… maximum total current 12A
AT2-5.**S**… maximum total current 16A

Inputs

NTC 10KΩ@25°C, LAE part No. SN4...
PTC 1000Ω@25°C, LAE part No. ST1…

Measurement Range

-50…120°C, -55…240°F
-50 / -9.9 … 19.9 / 80°C (NTC10K only)

Measurement accuracy

<0.5°C within the measurement range

Operating conditions

-10 … +50°C; 15%...80% r.H.

CE – UL (Approvals and Reference Norms)

EN60730-1; EN60730-2-9;
EN55022 (Class B);
EN50082-1
UL 60730-1A

Front protection

IP55

lae ELECTRONIC

VIA PADOVA, 25
31046 ODERZO /TV /ITALY
TEL. +39 - 0422 815320
FAX +39 - 0422 814073
www.lae-electronic.com
E-mail: sales@lae-electronic.com

PARTNER VENEZIA • 041 5460713

AD2-5

77x35x90 mm

Defrost Controller for Display Cases and Cold Stores

Cyclic defrosts ● Synchronized defrost start and termination with master-slave connection ● Selectable NTC10K or PTC input ● FLEXICOLD function for energy saving or alternative setpoint ● Direct compressor control through high power 12(5)A relay ● Optional control of a second compressor or evaporator ● Excellent evaporator fan control ● Absolute or relative temperature alarms, door open alarm, condenser high temperature/pressure alarm ● Light and standby control (On/Off) ● Quick programming through ZOT-AD2 ● Connection to LAE supervisory systems

Applications:

Plug-in cabinets, supermarket display cases, cold stores, control panels, upright fridges and freezers, refrigerated tables.

AD2-5 Series

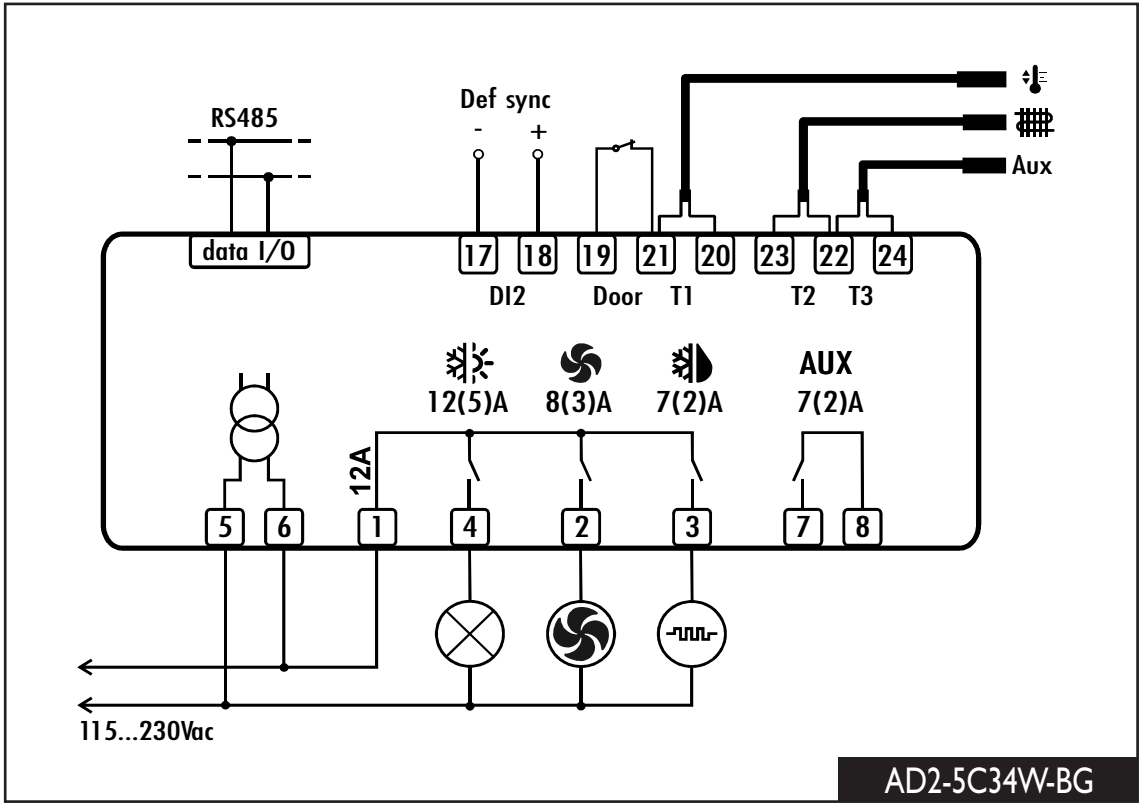
Functions		B14D-AL	B23W-AG	C34W-BG
Temperature Inputs	thermostat	✓	✓	✓
	evaporator	✓	✓	✓
	auxiliary			✓
Door switch input	Voltage free contact	✓	✓	✓
Digital inputs	Voltage free contact	✓		
	12÷24Vac voltage		✓	
	Defrost synchronisation			✓
Outputs	thermostat	✓	✓	✓
	evaporator fans	✓	✓	✓
	defrost	✓	✓	✓
	auxiliary	✓		✓
Power supply	115-230Vac		✓	✓
	12Vac/dc	✓		
Serial port	TTL serial port	✓	✓	
	RS485 serial port			✓
Kaypad	generic		✓	✓
	with light button	✓		

All models come with an alarm buzzer. All models are fitted with detachable screw terminals.
On request, the AD2-5 is also available with gasket for a better protection between bezel and metal panel.

Technical Data

Control Range:		-50÷120°C , -55÷240°F
Resolution:		0.1 / 1 °C; °F
Accuracy:	NTC10K:	<±0.3°C (-40.0÷70.0°C)
	PTC1000:	<±0.5°C (-50÷120°C)
Sensor type:		selectable NTC10K or PTC1000
Power supply:		115÷230V~ ±10% 50÷60Hz 3W
Front protection:		IP55
Panel cut-out:		71x29 mm

Wiring diagrams | Applications | Instruction


RS485
Def sync
-
+
Aux
data I/O
17
18
19
21
20
23
22
24
DI2
Door
T1
T2
T3
12(5)A
8(3)A
7(2)A
AUX
7(2)A
12A
5
6
1
4
2
3
7
8
115...230Vac
AD2-5C34W-BG

Plug-in cabinets, supermarket display cases, cold stores, control panels, upright fridges and freezers, refrigerated tables.

AD2-5 INSTRUCTIONS FOR USE

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.

DESCRIPTION

Fig.1 - Front panel

Info / Setpoint button.

Manual defrost / Decrease button.

INDICATIONS

Thermostat output

Fan output

Defrost output

Activation of 2nd parameter set

Alarm

Manual activation / Increase button.

Exit / Stand-by button.

INSTALLATION

- Insert the controller through a hole measuring 71x29 mm.
- Make sure that electrical connections comply with the paragraph “wiring diagrams”. To reduce the effects of electromagnetic disturbance, keep the sensor and signal cables well separate from the power wires.
- Fix the controller to the panel by means of the suitable clips, by pressingly 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.
- Place the probe T1 inside the room in a point that truly represents the temperature of the stored product.
- Place the probe T2 on the evaporator where there is the maximum formation of frost.
- The function of probe T3 is determined by the parameter T3. With **T3**=DSP the probe measures the temperature to be displayed. With **T3**=CND the probe measures the condenser temperature, it must therefore be placed between the fins of the condensing unit. With **T3**=2EU the probe measures the temperature of the second evaporator and it must therefore be placed where there is the maximum formation of frost. With **T3**=NON, the third probe is disabled.

OPERATION

DISPLAY

During normal operation, the display shows either the temperature measured or one of the following indications:

dEF	Defrost in progress	hP	Condenser high pressure alarm
oFF	Controller in stand-by	h1	Room high temperature alarm
cL	Condenser clean warning	Lo	Room low temperature alarm
do	Door open alarm	E1	Probe T1 failure
hc	Condenser high temperature alarm	E2	Probe T2 failure
		E3	Probe T3 failure

INFO MENU

The information available in this menu is:

t1	Instant probe 1 temperature	tH1	Maximum probe 1 temperature recorded
t2	* Instant probe 2 temperature	tL1	Minimum probe 1 temperature recorded
t3	* Instant probe 3 temperature	cnd	** Compressor working weeks
		Loc	Keypad state lock

: displayed only if enabled (see §Configuration Parameters) **: displayed only if* **ACC > 0

Access to menu and information displayed.

- Press and immediately release button (i) .
- With button (▼) or (▲) select the data to be displayed.
- Press button (i) to display value.
- To exit from the menu, press button (✕) or wait for 10 seconds.

Reset of THI, TLO, CND recordings

- With button (▼) or (▲) select the data to be reset.
- Display the value with button (i).
- While keeping button (i) pressed, use button (✕).

SETPOINT : display and modification

- Press button (i) for at least half second, to display the setpoint value.
- By keeping button (i) pressed, use button (▼) or (▲) to set the desired value (adjustment is within the minimum **SPL** and the maximum **SPH** limit).
- When button (i) is released, the new value is stored.

STAND-BY

Button (⏻), when pressed for 3 seconds, allows the controller to be put on a standby or output control to be resumed (with **SB**=YES only).

KEYPAD LOCK

The keypad lock avoids undesired, potentially dangerous operations, which might be attempted when the controller is operating in a public place. In the INFO menu, set parameter **LOC**=YES to inhibit all functions of the buttons. To resume normal operation of keypad, adjust setting so that **LOC**=NO.

SELECTION OF SECOND PARAMETER GROUP

It’s possible to select control parameters between two different pre-programmed groups, in order for the fundamental control parameters to be adapted quickly to changing needs. Changeover from Group **I** to Group **II** (and vice versa) may take place MANUALLY by pressing button (M) for 2 seconds (with **IISM**=MAN), or AUTOMATICALLY when heavy duty conditions are detected (with **IISM**=HDD), or when **IISM**=DI2 and the AUXILIARY INPUT DI2 is activated (the activation of DI2 selects Group **II**). If **IISM**=NON, switchover to Group **II** is inhibited. The activation of Group **II** is signalled by the lighting up of the relevant LED on the controller display.

DEFROST

Automatic defrost. Defrost starts automatically as soon as the time set with parameter **DFT** has elapsed.

- Timed defrost. With **DFM**=TIM defrosts take place at regular intervals when the timer reaches the value of **DFT**. For example, with **DFM**=TIM and **DFT**=06, a defrost will take place every 6 hours.
- Optimized defrost. With **DFM**=FRO the timer is only increased when the conditions occur for frost to form on the evaporator, until the time set with parameter **DFT** is matched. If the evaporator works at 0°C, defrost frequency depends on the thermal load and climatic conditions. With setpoints much lower than 0°C, defrost frequency mainly depends on the refrigerator operating time.
- Synchronised defrost. With **DI2** = DSY and when more units (models AD2-5x3xxx only) are linked to each other as per Fig. 3, synchronised defrosts of all linked controllers will take place. The first controller which will start defrost, will also get all other controllers synchronised.
- Defrost time count backup. At the power-up, if **DFB** = YES, the defrost timer resumes the time count from where it was left off before the power interruption. Vice versa, with **DFB**=NO, the time count re-starts from 0. In stand-by, the accumulated time count is frozen.

Manual or remote defrost start. It’s possible to manually start a defrost, by pressing button (❄) for 2 seconds, or defrost may be started remotely, if **DI2**=RDS, through the making of the auxiliary contact DI2.

Defrost type. Once defrost has started, Compressor and Defrost outputs are controlled according to parameter **DTY**. If **FID**=YES, the evaporator fans are active during defrost.

Defrost termination. The actual defrost duration is influenced by a series of parameters.

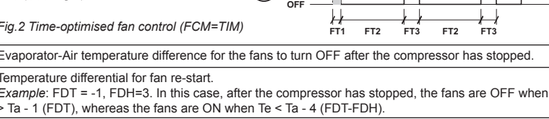
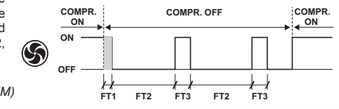
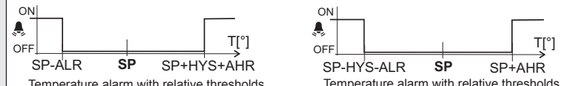
- Time termination: **T2** = NO and **T3** different from 2EU: the evaporator temperature is not monitored and defrost will last as long as time **DTO**.
- Temperature monitoring of one evaporator: **T2** = YES and **T3** different from 2EU. In this case, if the sensor T2 measures the temperature **DLI** before the time **DTO** elapses, defrost will be terminated in advance.
- Temperature monitoring of two evaporators: **T2** = YES, **T3** = 2EU, **OA1** = 2EU. This function is for the control of two independent evaporators and it switches off the individual heating of the evaporator which gets to temperature **DLI** first, waiting for the second evaporator to get to that temperature before the time **DTO** elapses.

Resuming thermostatic cycle. When defrost is over, if **DRN** is greater than 0, all outputs will remain off for **DRN** minutes, in order for the ice to melt completely and the resulting water to drain. Moreover, if probe T2 is active (**T2**=YES), the fans will re-start when the evaporator gets to a temperature lower than **FDD**; Vice versa, if probe T2 is not active (**T2**=NO) or after defrost has come to an end, such condition does not occur by end of the time **FTO**, after **FTO** minutes have elapsed the fans will be switched on anyway.

Caution: if ***DFM*** *= NON or* ***C-H*** *= HEA all defrost functions are inhibited; if* ***DFT*** *= 0, automatic defrost functions are excluded. During a high pressure alarm, defrost is suspended. During defrost, high temperature alarm is bypassed.*

CONFIGURATION PARAMETERS

- To get access to the parameter configuration menu, press button (⏻) + (i) for 5 seconds.
- With button (▼) or (▲) select the parameter to be modified.
- Press button (i) to display the value.
- By keeping button (i) pressed, use button (▼) or (▲) to set the desired value.
- When button (i) is released, the newly programmed value is stored and the following parameter is displayed.
- To exit from the setup, press button (✕) or wait for 30 seconds.

PAR	RANGE	DESCRIPTION
SCL	1°C; 2°C; °F	Readout scale. **1°C** (with **INP**=SN4 only): measuring range -50/-9.9 … 19.9/80°C **2°C** : measuring range -50 … 120°C **°F** : measuring range -55 … 240°F *Caution: upon changing the SCL value, it is then absolutely necessary to re-configure the parameters relevant to the absolute and relative temperatures (SPL, SPH, SP, ALA, AHA, etc..).*
SPL	-50..SPH	Minimum limit for SP setting.
SPH	SPL...120°	Maximum limit for SP setting.
SP	SPL... SPH	Setpoint (value to be maintained in the room).
C-H	REF; HEA	Refrigerating (REF) or Heating (HEA) control mode.
HYS	1...10°	OFF/ON thermostat differential.  Refrigerating control (C-H=REF) Heating control (C-H=HEA)
CRT	0...30min	Compressor rest time. The output is switched on again after CRT minutes have elapsed since the previous switchover. We recommend to set CRT=03 with HYS<2.0°.
CT1	0...30min	Thermostat output run when probe T1 is faulty. With CT1=0 the output will always remain OFF.
CT2	0...30min	Thermostat output stop when probe T1 is faulty. With CT2=0 and CT1>0 the output will always be ON. *Example:* CT1=4, CT2= 6: In case of probe T1 failure, the compressor will cycle 4 minutes ON and 6 minutes OFF.
CSD	0..30min	Compressor stop delay after the door has been opened (active only if DS=YES).
DFM	NON; TIM; FRO	Defrost start mode **NON** : defrost function is disabled *(the following parameter will be* FID*).* **TIM** : regular time defrost. **FRO** : the defrost time count is only increased when the conditions occur for frost to form on the evaporator (optimised time increase).
DFT	0...99 hours	Time interval among defrosts. When this time has elapsed since the last defrost, a new defrost cycle is started.
DFB	NO/YES	Defrost timer backup. With DFB=YES, after a power interruption, the timer resumes the count from where it was left off with ±30 min. approximation. With DFB=NO, after a power interruption, the defrost timer will re-start to count from zero.
DLI	-50...120°	Defrost end temperature.
DTO	1...120min	Maximum defrost duration.
DTY	OFF; ELE; GAS	Defrost type **OFF**: off cycle defrost (Compressor and Heater OFF). **ELE**: electric defrost (Compressor OFF and Heater ON). **GAS**: hot gas defrost (Compressor and Heater ON).
DPD	0...240sec	Evaporator pump down. At the beginning of defrost, defrost outputs (determined by DTY) are OFF for DPD seconds.
DRN	0...30min	Pause after defrost (evaporator drain down time).
DDM	RT; LT; SP; DEF	Defrost display mode. During defrost the display will show: **RT**: the real temperature; **LT** : the last temperature before defrost; **SP** : the current setpoint value; **DEF** : “dEF”.
DDY	0...60min	Display delay. The display shows the information selected with parameter DDM during defrost and for DDY minutes after defrost termination.
FID	NO/YES	Fans active during defrost.
FDD	-50...120°	Evaporator fan re-start temperature after defrost.
FTO	0...120min	Maximum evaporator fan stop after defrost.
FCM	NON; TMP; TIM	Fan mode during thermostatic control. **NON** : The fans remain ON all the time; **TMP** : Temperature-based control. The fans are ON when the compressor is ON. When the compressor is turned OFF, the fans remain ON as long as the temperature difference Te-Ta is greater than FDT. The fans are turned ON again with FDH differential. (Te = Evaporator temperature, Ta = Air temperature); **TIM** : Timed-based control. The fans are ON when the compressor is ON. When the compressor is OFF, the fans switch ON and OFF according to parameteres FT1, FT2, FT3 (See Fig.2).  *Fig.2 Time-optimised fan control (FCM=TIM)*
FDT	-120...0°	Evaporator-Air temperature difference for the fans to turn OFF after the compressor has stopped.
FDH	1...120°	Temperature differential for fan re-start. *Example:* FDT = -1, FDH=3. In this case, after the compressor has stopped, the fans are OFF when Te > Ta - 1 (FDT), whereas the fans are ON when Te < Ta - 4 (FDT-FDH).
FT1	0...180sec	Fan stop delay after compressor stop. See Fig. 2
FT2	0...30min	Timed fan stop. With FT2=0 the fans remain on all the time.
FT3	0...30min	Timed fan run. With FT3=0, and FT2 > 0, the fans remain off all the time.
ATM	NON; ABS; REL	Alarm threshold management. **NON** : all temperature alarms are inhibited (*the following parameter will be* ADO*).* **ABS** : the values programmed in ALA and AHA represent the real alarm thresholds. **REL** : the values programmed in ALR and AHR are alarm differentials referred to SP and SP+HYS.  Temperature alarm with relative thresholds, refrigerating control (ATM=REL, C-H=REF). Temperature alarm with relative thresholds, heating control (ATM=REL, C-H=HEA).
ALA	-50... 120°	Low temperature alarm threshold.
AHA	-50... 120°	High temperature alarm threshold.
ALR	-12... 0°	Low temperature alarm differential. With ALR=0 the low temperature alarm is excluded.
AHR	0... 12°	High temperature alarm differential. With AHR=0 the high temperature alarm is excluded.
ATI	T1; T2; T3	Probe used for temperature alarm detection.
ATD	0... 120min	Delay before alarm temperature warning.
ADO	0... 30min	Delay before door open alarm warning.
AHM	NON; ALR; STP;	Operation in case of high condenser alarm **NON** : high condenser alarm inhibited. **ALR** : in case of alarm, “HC” flashes in the display and the buzzer is switched on. **STP** : in addition to the alarm symbols displayed, the compressor is stopped and defrosts are suspended.
AHT	-50...120°	Condensation temperature alarm (referred to T3 probe).
ACC	0...52 weeks	Condenser periodic cleaning. When the compressor operation time, expressed in weeks, matches the **ACC** value programmed, “CL” flashes in the display. With ACC=0 the condenser cleaning warning is disabled and CND disappears from Info Menu.
IISM	NON; MAN; HDD; DI2	Switchover mode to second parameter set **NON** : inhibition to use the second parameter group (*the following parameter will be* SB*).* **MAN** : button (M) switches the two parameter groups over. **HDD** : automatic switchover to the second parameter group, when heavy duty conditions are detected. **DI2** : switchover to the second parameter group when the auxiliary DI2 input makes.
IISL	-50... IISH	Minimum limit for IISP setting.
IISH	IISL... 120°	Maximum limit for IISP setting.
IISP	IISL... IISH	Setpoint in mode 2.
IIHY	1... 10°	OFF/ON differential in mode 2.
IIFC	NON;TMP; TIM	Fan control in mode 2. See FCM.
HDS	1...5	Controller sensitivity for the automatic switchover from Group **I** to Group **II** (1=minimum, 5=maximum).
IIDF	0...99 hours	Time interval among defrosts in mode 2.
SB	NO/YES	Stand-by button (⏻) enabling.
DS	NO/YES	Door switch input enabling (closed when door is closed).
DI2	NON; HPS; IISM; RDS; DSY	DI2 digital input operation **NON** : digital input 2 not active. **HPS** : when contact opens a condensing unit high pressure alarm occurs. **IISM** : when contact makes the controller will use group 2 parameters. **RDS** : when contact makes a defrost is started (remote control). **DSY** : defrost synchronisation. The controllers, linked as per Fig. 3, will all start and end defrost together. The first controller in defrost will get defrost of all the others started. The last controller ending defrost will get defrost of all the others stopped.
LSM	NON; MAN; DOR	Light control mode **NON** : light output not controlled. **MAN** : light ouput controlled through button (M) (if OA1 = LGT). **DOR** : light ouput switched on when door is opened (if OA1 = LGT).
OA1	NON; 0-1; LGT; 2CU; 2EU; AL0; AL1	AUX output operation **NON** : output disabled (always off). **0-1** : the relay contacts follow the on/standby state of controller. **LGT** : output enabled for light control. **2CU** : output programmed for the control of an auxiliary compressor. **2EU** : output enabled for the control of the electrical defrost of a second evaporator. **AL0** : contacts open when an alarm condition occurs. **AL1** : contacts make when an alarm condition occurs.
2CD	0...120 sec	Auxiliary compressor start delay. If OA1 = 2CU the auxiliary output is switched on with a delay of 2CD seconds after the main compressor has cut-in. Both compressors are turned off at the same time.
INP	SN4; ST1	Temperature sensor selection. With INP=SN4, the probes must be the LAE models SN4..; with INP = ST1, the probes must be the LAE models ST1...
OS1	-12.5..12.5°C	Probe T1 offset.
T2	NO/YES	Probe T2 enabling (evaporator).
OS2	-12.5..12.5°C	Probe T2 offset.
T3	NON; DSP; CND; 2EU	Auxiliary probe T3 operation **NON** : probe T3 not fitted. **DSP** : temperature T3 to be displayed. **CND** : condenser temperature measurement. **2EU** : second evaporator temperature measurement.
OS3	-12.5..12.5°C	Probe 3 offset.
TLD	1...30 min	Delay for minimum temperature (TLO) and maximum temperature (THI) logging.
SIM	0...100	Display slowdown.
ADR	1...255	AD2-5 address for PC communication.

WIRING DIAGRAMS

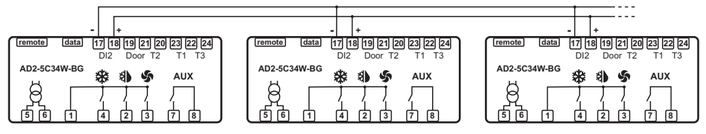
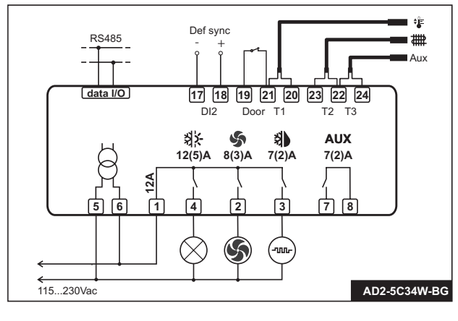


Fig.3 Connection for synchronising defrost start and termination



TECHNICAL DATA

Power supply

AD2-5….D	12Vac/dc ±10%, 3W
AD2-5….W	110 - 230Vac±10%, 50/60Hz, 3W

Relay output

Compressor	12(5)A 240Vac
Evap. Fan	8(3)A 240Vac
Defrost	7(2)A 240Vac
Auxiliary loads	7(2)A 240Vac

Input

NTC 10KΩ@25°C	LAE Part No. SN4...
PTC 1000Ω@25°C	LAE Part No. ST1...

Measurement Range

-50…120°C, -55…240°F
-50 / -9.9 … 19.9 / 80°C (NTC10K only)

Measurement accuracy

<0.5°C within the measurement range

Operating conditions

-10 … +50°C; 15%...80% r.H.

CE (Reference norms)

EN60730-1; EN60730-2-9;
EN55022 (Class B);
EN50082-1

lae ELECTRONIC

VIA PADOVA, 25
31046 ODERZO /TV /ITALY
TEL. +39 - 0422 815320
FAX +39 - 0422 814073
www.lae-electronic.com
E-mail: sales@lae-electronic.com

AR2-5

77x35x90 mm

Defrost Controller with RTC for display cases and cold stores

Up to 6 real time defrosts ● Synchronized defrost start and termination with master-slave connection ● Selectable NTC10K or PTC input ● FLEXICOLD function for energy saving or alternative setpoint ● Direct compressor control through high power 12(5)A relay ● Optional control of a second compressor or evaporator ● Excellent evaporator fan control ● Absolute or relative temperature alarms, door open alarm, condenser high temperature/ pressure alarm ● Light and standby control (On/Off) ● Quick programming through ZOT-AR2 ● Connection to LAE supervisory systems

Applications:

Plug-in cabinets, supermarket display cases, cold stores, control panels, upright fridges and freezers, refrigerated tables and all those plants where real time defrost starts are needed.

AR2-5 Series

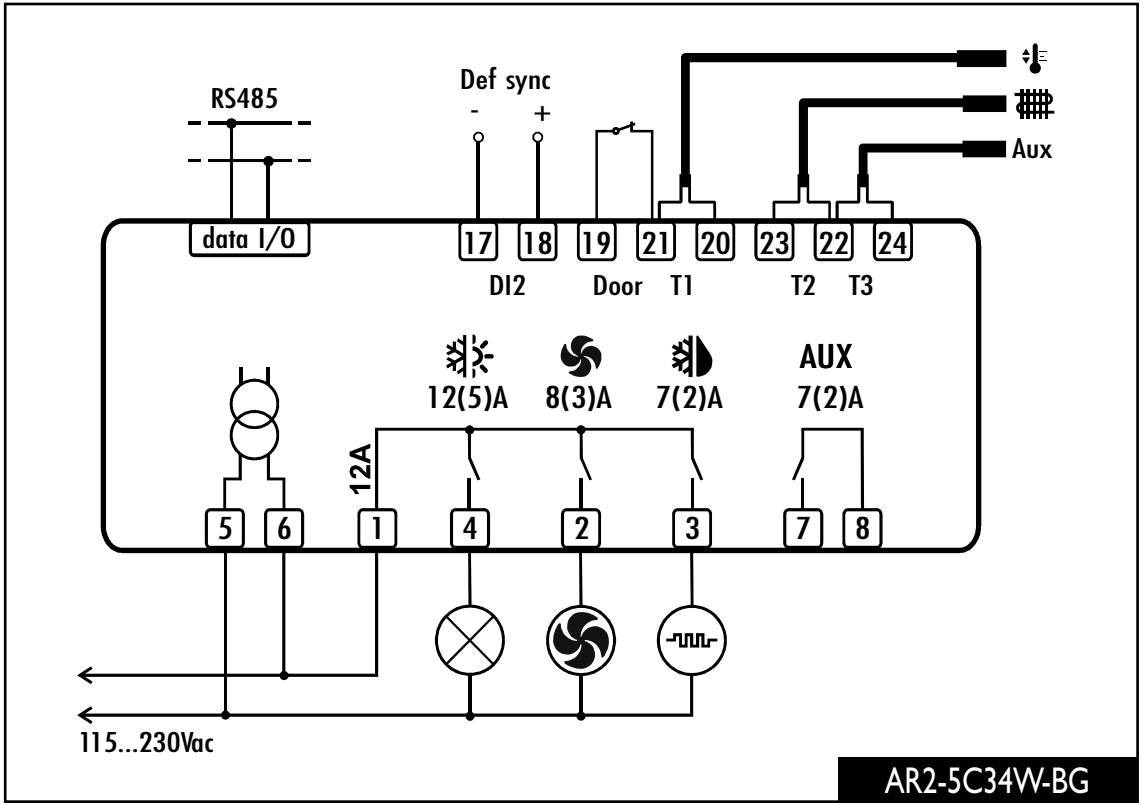
Functions		B14D-AL	B23W-AG	C34W-BG
Temperature Inputs	Thermostat	✓	✓	✓
	Evaporator	✓	✓	✓
	Auxiliary			✓
Door switch input	Voltage free contact	✓	✓	✓
Digital inputs	Voltage free contact	✓		
	12÷24Vac voltage		✓	
	Defrost synchronisation			✓
Outputs	Thermostat	✓	✓	✓
	Evaporator fans	✓	✓	✓
	Defrost	✓	✓	✓
	Auxiliary	✓		✓
Power supply	115-230Vac		✓	✓
	12Vac/dc	✓		
Serial port	Serial port TTL	✓	✓	
	Serial port RS485			✓
Keypad	Generic		✓	✓
	With light button	✓		

All models come with an alarm buzzer; All models are fitted with detachable screw terminals.
On request, the AR2-5 is also available with gasket for a better protection between bezel and metal panel.

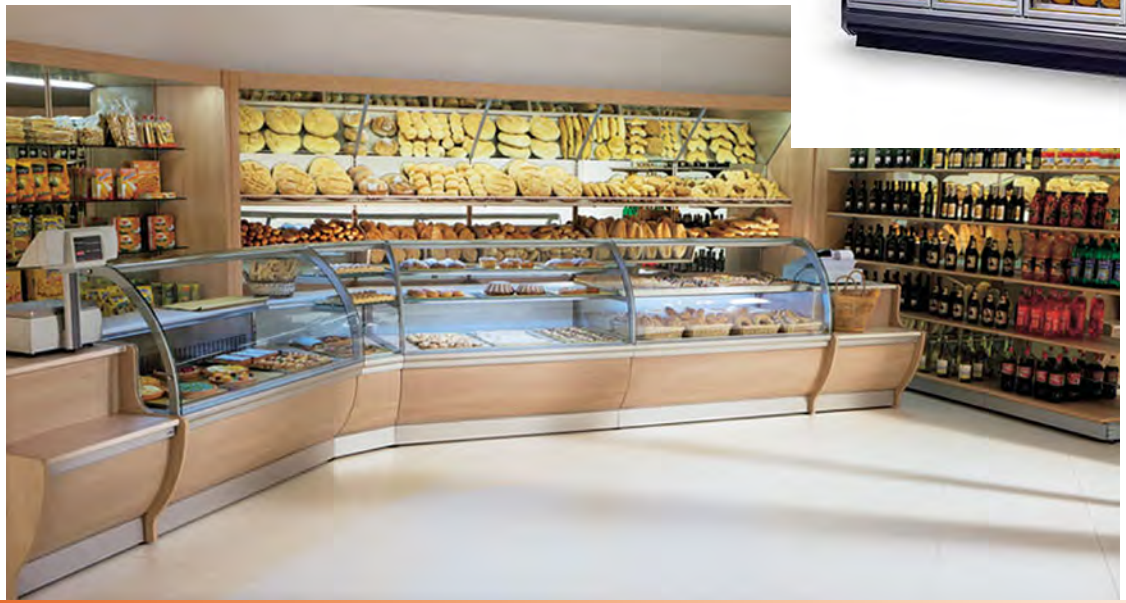
Technical Data

Control Range:		-50÷120°C , -55÷240°F
Resolution:		0.1 1 1 °C; °F
Accuracy:	NTC10K:	<±0.3°C (-40.0÷70.0°C)
	PTC1000:	<±0.5°C (-50÷120°C)
Sensor type:		selectable NTC10K or PTC1000
Power supply:		115÷230V~ ±10% 50÷60Hz 3W
Rechargeable battery:		>150 hours
Front protection:		IP55
Panel cut-out:		71x29 mm

Wiring diagrams | Applications | Instruction


RS485
Def sync
-
+
Aux
data I/O
17
18
19
21
20
23
22
24
DI2
Door
T1
T2
T3
12(5)A
8(3)A
7(2)A
AUX
7(2)A
12A
5
6
1
4
2
3
7
8
115...230Vac
AR2-5C34W-BG

Plug-in cabinets, supermarket display cases, cold stores, control panels, upright fridges and freezers, refrigerated tables and all those plants where real time defrost starts are needed.



AR2-5 INSTRUCTIONS FOR USE

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.

DESCRIPTION

Fig.1 - Front panel

Info / Setpoint button.

Manual defrost / Decrease button.

INDICATIONS

Thermostat output

Fan output

Defrost output

Activation of 2nd parameter set

Alarm

Manual activation / Increase button.

Exit / Stand-by button.

INSTALLATION

- Insert the controller through a hole measuring 71x29 mm.
- Make sure that electrical connections comply with the paragraph “wiring diagrams”. To reduce the effects of electromagnetic disturbance, keep the sensor and signal cables well separate from the power wires.
- Fix the controller to the panel by means of the suitable clips, by pressingly 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.
- Place the probe T1 inside the room in a point that truly represents the temperature of the stored product.
- Place the probe T2 on the evaporator where there is the maximum formation of frost.
- The function of probe T3 is determined by the parameter T3. With **T3**=DSP the probe measures the temperature to be displayed. With **T3**=CND the probe measures the condenser temperature, it must therefore be placed between the fins of the condensing unit. With **T3**=2EU the probe measures the temperature of the second evaporator and it must therefore be placed where there is the maximum formation of frost. With **T3**=NON, the third probe is disabled.

OPERATION

DISPLAY

During normal operation, the display shows either the temperature measured or one of the following indications:

dEF	Defrost in progress	hP	Condenser high pressure alarm
oFF	Controller in stand-by	h1	Room high temperature alarm
cL	Condenser clean warning	Lo	Room low temperature alarm
do	Door open alarm	E1	Probe T1 failure
hc	Condenser high temperature alarm	E2	Probe T2 failure
		E3	Probe T3 failure

INFO MENU

The information available in this menu is:

t1	Instant probe 1 temperature	th1	Maximum probe 1 temperature recorded
t2 *	Instant probe 2 temperature	tLo	Minimum probe 1 temperature recorded
t3 *	Instant probe 3 temperature	cnd **	Compressor working weeks
min	Minutes of the Real Time Clock	Loc	Keypad state lock
hrS	Hours of the Real Time Clock		

: displayed only if enabled (see §Configuration Parameters) **: displayed only if* **ACC > 0

Access to menu and information displayed.
- Press and immediately release button (i).
- With button (▼) or (▲) select the data to be displayed.
- Press button (i) to display value.
- To exit from the menu, press button (✕) or wait for 10 seconds.

Reset of THI, TLO, CND recordings
- With button (▼) or (▲) select the data to be reset.
- Display the value with button (i).
- While keeping button (i) pressed, use button (✕).

SETPOINT : display and modification
- Press button (i) for at least half second, to display the setpoint value.
- By keeping button (i) pressed, use button (▼) or (▲) to set the desired value (adjustment is within the minimum **SPL** and the maximum **SPH** limit).
- When button (i) is released, the new value is stored.

STAND-BY

Button (⏻), when pressed for 3 seconds, allows the controller to be put on a standby or output control to be resumed (with **SB**=YES only).

KEYPAD LOCK

The keypad lock avoids undesired, potentially dangerous operations, which might be attempted when the controller is operating in a public place. In the INFO menu, set parameter **LOC**=YES to inhibit all functions of the buttons. To resume normal operation of keypad, adjust setting so that **LOC**=NO.

SELECTION OF SECOND PARAMETER GROUP

It’s possible to select control parameters between two different pre-programmed groups, in order for the fundamental control parameters to be adapted quickly to changing needs. Changeover from Group **I** to Group **II** (and vice versa) may take place MANUALLY by pressing button (M) for 2 seconds (with **IISM**=MAN), or AUTOMATICALLY when heavy duty conditions are detected (with **IISM**=HDD), or when **IISM**=DI2 and the AUXILIARY INPUT DI2 is activated (the activation of DI2 selects Group **II**). If **IISM**=NON, switchover to Group **II** is inhibited. The activation of Group **II** is signalled by the lighting up of the relevant LED on the controller display.

REAL TIME CLOCK SETTING

The Real Time Clock (RTC) can be adjusted directly from the Info Menu (see Setpoint modification procedure). Tens of minutes MIN range from 0 to 59 and Hours HRS range from 0 to 23. If RTC is adjusted just before an upcoming change of hour, verify the correctness of the setting again. The RTC does not automatically change upon Daylight Saving Time.

DEFROST

Automatic defrost. Defrost starts automatically at fixed time-intervals or at programmed scheduled (up to six per 24 hours).
- Timed defrost. With **DFM**=TIM defrosts take place at regular intervals when the timer reaches the value of **DFT**. For example, with **DFM**=TIM and **DFT**=06, a defrost will take place every 6 hours.
- Scheduled defrost. With **DFM**=RTC defrost takes place at time specified by **DH1**...**DH6**. The format of time is “HH.M”, where HH are hours and M are tens of minutes. To disable one or more of the 6 scheduled defrosts, assign the value “---” (it is the value after “23.5”). Parameters **DH1**...**DH6** are accessible both in the setup (see §Configuration Parameters) and by keeping button (❄) pressed for 4 seconds during normal operation.
- Synchronised defrost. With **DI2**=DSY and when more units (models AR2-5x3xxx only) are linked to each other as per Fig. 3, synchronised defrosts of all linked controllers will take place. The first controller which will start defrost, will also get all other controllers synchronised.
- **Manual or remote defrost start**. If **DFM**=TIM it’s possible to manually start a defrost, by pressing button (❄) for 4 seconds. If **DFM**=RTC hold button (❄) down for 4 seconds to display **DH1**, then press button (❄) again for 4 seconds to manually start a defrost. Defrost may be also started remotely, if **DI2**=RDS, through the making of the auxiliary contact DI2.

Defrost type. Once defrost has started, Compressor and Defrost outputs are controlled according to parameter **DTY**. If **FID**=YES, the evaporator fans are active during defrost.

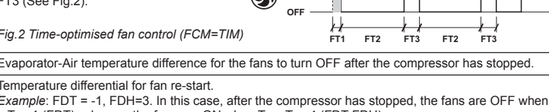
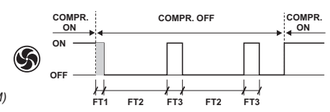
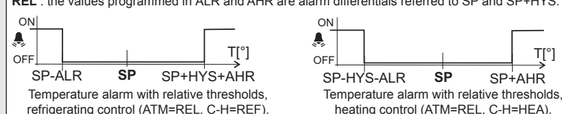
Defrost termination. The actual defrost duration is influenced by a series of parameters.
- Time termination: **T2**=NO and **T3** different from 2EU: the evaporator temperature is not monitored and defrost will last as long as time **DTO**.
- Temperature monitoring of one evaporator: **T2**=YES and **T3** different from 2EU. In this case, if the sensor T2 measures the temperature **DLI** before the time **DTO** elapses, defrost will be terminated in advance.
- Temperature monitoring of two evaporators: **T2**=YES, **T3**=2EU, **OAU**=2EU. This function is for the control of two independent evaporators and it switches off the individual heating of the evaporator which gets to temperature **DLI** first, waiting for the second evaporator to get to that temperature before the time **DTO** elapses.

Resuming thermostatic cycle. When defrost is over, if **DRN** is greater than 0, all outputs will remain off for **DRN** minutes, in order for the ice to melt completely and the resulting water to drain. Moreover, if probe T2 is active (**T2**=YES), the fans will re-start when the evaporator gets to a temperature lower than **FDD**; Vice versa, if probe T2 is not active (**T2**=NO) or after defrost has come to an end, such condition does not occur by end of the time **FTO**, after **FTO** minutes have elapsed the fans will be switched on anyway.

Caution: if ***DFM****=NON or* ***C-H****=HEA all defrost functions are inhibited; if* ***DFT****=0, automatic defrost functions are excluded. During a high pressure alarm, defrost is suspended. During defrost, high temperature alarm is bypassed.*

CONFIGURATION PARAMETERS

- To get access to the parameter configuration menu, press button (⏻) + (i) for 5 seconds.
- With button (▼) or (▲) select the parameter to be modified.
- Press button (i) to display the value.
- By keeping button (i) pressed, use button (▼) or (▲) to set the desired value.
- When button (i) is released, the newly programmed value is stored and the following parameter is displayed.
- To exit from the setup, press button (✕) or wait for 30 seconds.

PAR	RANGE	DESCRIPTION
SCL	1°C; 2°C; °F	Readout scale. **1°C** (with **INP**=SN4 only): measuring range -50/-9.9 … 19.9/80°C **2°C** : measuring range -50 … 120°C **°F** : measuring range -55 … 240°F *Caution: upon changing the SCL value, it is then absolutely necessary to re-configure the parameters relevant to the absolute and relative temperatures (SPL, SPH, SP, ALA, AHA, etc..).*
SPL	-50..SPH	Minimum limit for SP setting.
SPH	SPL.120°	Maximum limit for SP setting.
SP	SPL... SPH	Setpoint (value to be maintained in the room).
C-H	REF; HEA	Refrigerating (REF) or Heating (HEA) control mode.
HYS	1...10°	OFF/ON thermostat differential.  Refrigerating control (C-H=REF) Heating control (C-H=HEA)
CRT	0...30min	Compressor rest time. The output is switched on again after CRT minutes have elapsed since the previous switchover. We recommend to set CRT=03 with HYS<2.0°.
CT1	0...30min	Thermostat output run when probe T1 is faulty. With CT1=0 the output will always remain OFF.
CT2	0...30min	Thermostat output stop when probe T1 is faulty. With CT2=0 and CT1>0 the output will always be ON. *Example:* CT1=4, CT2= 6: In case of probe T1 failure, the compressor will cycle 4 minutes ON and 6 minutes OFF.
CSD	0..30min	Compressor stop delay after the door has been opened (active only if DS=YES).
DFM	NON; TIM; RTC	Defrost start mode **NON** : defrost function is disabled *(the following parameter will be* FID*)*. **TIM** : regular time defrost. **RTC** : the defrost time is scheduled by parameters DH1, DH2...DH6.
DFT	0...99 hours	Time interval among defrosts. When this time has elapsed since the last defrost, a new defrost cycle is started.
DH1 ... DH6	HH.M	Scheduled time for defrost 1 to 6. HH hours from midnight, M tens of minutes. Accepted values go from 00.0 to 23.5. After “23.5” the value is “---” that means “skipped defrost”. *Example*: DH1=8.3 means 8.30 AM.
DLI	-50...120°	Defrost end temperature.
DTO	1...120min	Maximum defrost duration.
DTY	OFF; ELE; GAS	Defrost type **OFF**: off cycle defrost (Compressor and Heater OFF). **ELE**: electric defrost (Compressor OFF and Heater ON). **GAS**: hot gas defrost (Compressor and Heater ON).
DPD	0...240sec	Evaporator pump down. At the beginning of defrost, defrost outputs (determined by DTY) are OFF for DPD seconds.
DRN	0...30min	Pause after defrost (evaporator drain down time).
DDM	RT; LT; SP; DEF	Defrost display mode. During defrost the display will show: **RT**: the real temperature; **LT** : the last temperature before defrost; **SP** : the current setpoint value; **DEF** : “dEF”.
DDY	0...60min	Display delay. The display shows the information selected with parameter DDM during defrost and for DDY minutes after defrost termination.
FID	NO/YES	Fans active during defrost.
FDD	-50...120°	Evaporator fan re-start temperature after defrost.
FTO	0...120min	Maximum evaporator fan stop after defrost.
FCM	NON; TMP; TIM	Fan mode during thermostatic control. **NON** : The fans remain ON all the time; **TMP** : Temperature-based control. The fans are ON when the compressor is ON. When the compressor is turned OFF, the fans remain ON as long as the temperature difference Te-Ta is greater than FDT. The fans are turned ON again with FDH differential. (Te = Evaporator temperature, Ta = Air temperature); **TIM** : Timed-based control. The fans are ON when the compressor is ON. When the compressor is OFF, the fans switch ON and OFF according to parameteres FT1, FT2, FT3 (See Fig.2).  *Fig.2 Time-optimised fan control (FCM=TIM)*
FDT	-120...0°	Evaporator-Air temperature difference for the fans to turn OFF after the compressor has stopped.
FDH	1...120°	Temperature differential for fan re-start. *Example*: FDT = -1, FDH=3. In this case, after the compressor has stopped, the fans are OFF when Te > Ta - 1 (FDT), whereas the fans are ON when Te < Ta - 4 (FDT-FDH).
FT1	0...180sec	Fan stop delay after compressor stop. See Fig. 2
FT2	0...30min	Timed fan stop. With FT2=0 the fans remain on all the time.
FT3	0...30min	Timed fan run. With FT3=0, and FT2 > 0, the fans remain off all the time.
ATM	NON; ABS; REL	Alarm threshold management. **NON** : all temperature alarms are inhibited (*the following parameter will be* ADO*).* **ABS** : the values programmed in ALA and AHA represent the real alarm thresholds. **REL** : the values programmed in ALR and AHR are alarm differentials referred to SP and SP+HYS.  Temperature alarm with relative thresholds, refrigerating control (ATM=REL, C-H=REF). Temperature alarm with relative thresholds, heating control (ATM=REL, C-H=HEA).
ALA	-50... 120°	Low temperature alarm threshold.
AHA	-50... 120°	High temperature alarm threshold.
ALR	-12... 0°	Low temperature alarm differential. With ALR=0 the low temperature alarm is excluded.
AHR	0... 12°	High temperature alarm differential. With AHR=0 the high temperature alarm is excluded.
ATI	T1; T2; T3	Probe used for temperature alarm detection.
ATD	0... 120min	Delay before alarm temperature warning.
ADO	0... 30min	Delay before door open alarm warning.
AHM	NON; ALR; STP;	Operation in case of high condenser alarm **NON** : high condenser alarm inhibited. **ALR** : in case of alarm, “HC” flashes in the display and the buzzer is switched on. **STP** : in addition to the alarm symbols displayed, the compressor is stopped and defrosts are suspended.
AHT	-50...120°	Condensation temperature alarm (referred to T3 probe).
ACC	0...52 weeks	Condenser periodic cleaning. When the compressor operation time, expressed in weeks, matches the **ACC** value programmed, “CL” flashes in the display. With ACC=0 the condenser cleaning warning is disabled and CND disappears from Info Menu.
IISM	NON; MAN; HDD; DI2	Switchover mode to second parameter set **NON** : inhibition to use the second parameter group (*the following parameter will be* SB*).* **MAN** : button (M) switches the two parameter groups over. **HDD** : automatic switchover to the second parameter group, when heavy duty conditions are detected. **DI2** : switchover to the second parameter group when the auxiliary DI2 input makes.
IISL	-50... IISH	Minimum limit for IISP setting.
IISH	IISL... 120°	Maximum limit for IISP setting.
IISP	IISL... IISH	Setpoint in mode 2.
IIHY	1... 10°	OFF/ON differential in mode 2.
IIFC	NON;TMP; TIM	Fan control in mode 2. See FCM.
HDS	1...5	Controller sensitivity for the automatic switchover from Group **I** to Group **II** (1=minimum, 5=maximum).
IIDF	0...99 hours	Time interval among defrosts in mode 2.
SB	NO/YES	Stand-by button (⏻) enabling.
DS	NO/YES	Door switch input enabling (closed when door is closed).
DI2	NON; HPS; IISM; RDS; DSY	DI2 digital input operation **NON** : digital input 2 not active. **HPS** : when contact opens a condensing unit high pressure alarm occurs. **IISM** : when contact makes the controller will use group 2 parameters. **RDS** : when contact makes a defrost is started (remote control). **DSY** : defrost synchronisation. The controllers, linked as per Fig. 3, will all start and end defrost together. The first controller in defrost will get defrost of all the others started. The last controller ending defrost will get defrost of all the others stopped.
LSM	NON; MAN; DOR	Light control mode **NON** : light output not controlled. **MAN** : light ouput controlled through button (M) (if OA1=LGT). **DOR** : light ouput switched on when door is opened (if OA1=LGT).
OA1	NON; 0-1; LGT; 2CU; 2EU; AL0; AL1	AUX output operation **NON** : output disabled (always off). **0-1** : the relay contacts follow the on/standby state of controller. **LGT** : output enabled for light control. **2CU** : output programmed for the control of an auxiliary compressor. **2EU** : output enabled for the control of the electrical defrost of a second evaporator. **AL0** : contacts open when an alarm condition occurs. **AL1** : contacts make when an alarm condition occurs.
2CD	0...120 sec	Auxiliary compressor start delay. If OA1=2CU the auxiliary output is switched on with a delay of 2CD seconds after the main compressor has cut-in. Both compressors are turned off at the same time.
INP	SN4; ST1	Temperature sensor selection. With INP=SN4, the probes must be the LAE models SN4..; with INP = ST1, the probes must be the LAE models ST1...
OS1	-12.5..12.5°C	Probe T1 offset.
T2	NO/YES	Probe T2 enabling (evaporator).
OS2	-12.5..12.5°C	Probe T2 offset.
T3	NON; DSP; CND; 2EU	Auxiliary probe T3 operation **NON** : probe T3 not fitted. **DSP** : temperature T3 to be displayed. **CND** : condenser temperature measurement. **2EU** : second evaporator temperature measurement.
OS3	-12.5..12.5°C	Probe 3 offset.
TLD	1...30 min	Delay for minimum temperature (TLO) and maximum temperature (THI) logging.
SIM	0...100	Display slowdown.
ADR	1...255	AR2-5 address for PC communication.

WIRING DIAGRAMS

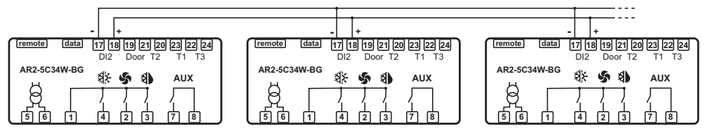
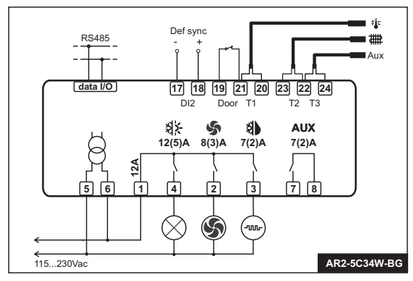


Fig.3 Connection for synchronising defrost start and termination



TECHNICAL DATA

Power supply

AR2-5….D	12Vac/dc ±10%, 3W
AR2-5....W	110 - 230Vac±10%, 50/60Hz, 3W

Relay output

Compressor	12(5)A 240Vac
Defrost	7(2)A 240Vac
Evap. Fan	8(3)A 240Vac
Auxiliary loads	7(2)A 240Vac

Input

NTC 10KΩ@25°C	LAE Part No. SN4...
PTC 1000Ω@25°C	LAE Part No. ST1...

Measurement Range

-50…120°C, -55…240°F
-50 / -9.9 … 19.9 / 80°C (NTC10K only)

Measurement accuracy

<0.5°C within the measurement range

Real Time Clock battery

>150 hours; self-rechargeable

Operating conditions

-10 … +50°C; 15%...80% r.H.

CE (Reference norms)

EN60730-1; EN60730-2-9;
EN55022 (Class B);
EN50082-1

lae ELECTRONIC

VIA PADOVA, 25
31046 ODERZO /TV /ITALY
TEL. +39 - 0422 815320
FAX +39 - 0422 814073
www.lae-electronic.com
E-mail: sales@lae-electronic.com

AR2-27 71x97x61 mm DIN Rail

Universal Defrost Controller with RTC

Selectable Refrigerating or Heating control ● Selectable NTC10K or PTC input ● FLEXICOLD function for energy saving or alternative setpoint ● Cyclic defrosts or scheduled real time starts ● Synchronized defrost start and termination with master-slave connection ● Optional control of a second compressor or evaporator ● Excellent evaporator fan control ● Absolute or relative temperature alarms and door open alarm ● Temperature and pressure monitoring and condensing unit maintenance ● Light and standby control (On/Off) ● Quick programming through ZOT-AR2 ● Connection to LAE supervisory systems

Applications:

On control panels for cold stores, plug-in and supermarket display cases.

AR2-27 Series

Functions		B13E-AG	C24E-AG	C35E-BG
Temperature Inputs	Thermostat	✓	✓	✓
	Evaporator	✓	✓	✓
	Auxiliary		✓	✓
Door switch input	Voltage free contact	✓	✓	✓
Digital inputs	Voltage free contact	✓		
	12÷24Vac voltage		✓	
	Defrost synchronisation			✓
Outputs	Thermostat	✓	✓	✓
	Evaporator fans	✓	✓	✓
	Defrost	✓	✓	✓
	Auxiliary 1		✓	✓
	Auxiliary 2			✓
Power supply	230Vac	✓	✓	✓
Serial port	Serial port TTL	✓	✓	
	Serial port RS485			✓
Keypad	Generic	✓	✓	✓

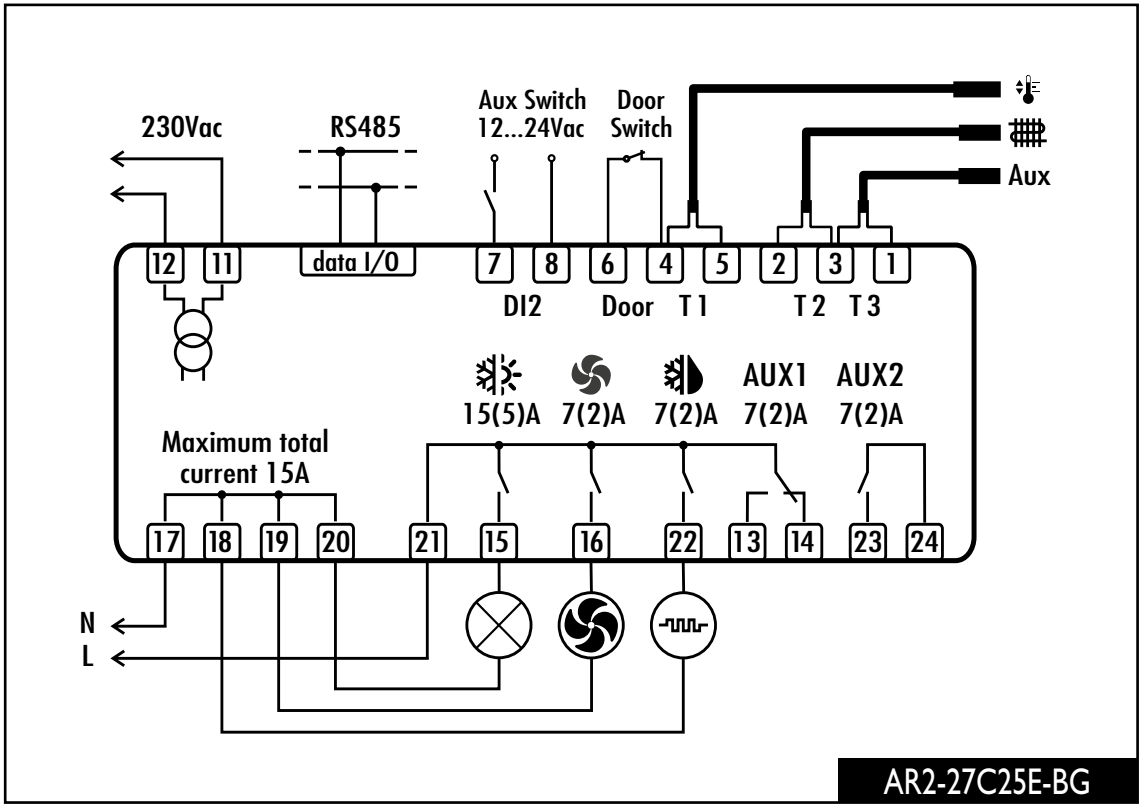
All models come with an alarm buzzer.
Versions with power supply 12Vac/dc and 115Vac are also available.

Technical Data

Control Range:		-50÷120°C, -55…240°F
Resolution:		0.1 / 1 °C; °F
Accuracy:	NTC10K:	<±0.3°C (-40.0÷70.0°C)
	PTC1000:	<±0.5°C (-50÷120°C)
Sensor type:		selectable NTC10K or PTC1000
Power supply:		230Vac ±10% 50÷60Hz 3W
Rechargeable battery:		>150 hours
Front protection:		IP55

Wiring diagrams

Instruction


230Vac
RS485
Aux Switch
12...24Vac
Door
Switch
Aux
12
11
data I/O
7
8
6
4
5
2
3
1
DI2
Door
T1
T2
T3
15(5)A
7(2)A
7(2)A
AUX1
7(2)A
AUX2
7(2)A
Maximum total
current 15A
17
18
19
20
21
15
16
22
13
14
23
24
N
L
AR2-27C25E-BG

AR2-27 INSTRUCTIONS FOR USE

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.

DESCRIPTION

Fig.1 - Front panel

info Info / Setpoint button.

Manual defrost / Decrease button.

M Manual activation / Increase button.

Stand-by button.

INDICATIONS

Thermostat output

Fan output

Defrost output

II° Activation of 2nd parameter set

Alarm

INSTALLATION

■ The AR2-27 controller, size 71x97x61 mm (WxHxD), is to be secured to a DIN rail in such a position as to ensure that no liquid infiltrates causing serious damage and compromising safety.
■ Make sure that electrical connections comply with the paragraph “wiring diagrams”. To reduce the effects of electromagnetic disturbance, keep the sensor and signal cables well separate from the power wires.
■ Place the probe T1 inside the room in a point that truly represents the temperature of the stored product.
■ Place the probe T2 on the evaporator where there is the maximum formation of frost.
■ The function of probe T3 is determined by the parameter T3. With **T3**=DSP the probe measures the temperature to be displayed. With **T3**=CND the probe measures the condenser temperature, it must therefore be placed between the fins of the condensing unit. With **T3**=2EU the probe measures the temperature of the second evaporator and it must therefore be placed where there is the maximum formation of frost. With **T3**=NON, the third probe is disabled.

OPERATION

DISPLAY

During normal operation, the display shows either the temperature measured or one of the following indications:

dEF	Defrost in progress	hP	Condenser high pressure alarm
rEc	Recovery after defrost	h1	Room high temperature alarm
oFF	Controller in stand-by	Lo	Room low temperature alarm
cL	Condenser clean warning	E1	Probe T1 failure
do	Door open alarm	E2	Probe T2 failure
hc	Condenser high temperature alarm	E3	Probe T3 failure

INFO MENU

The information available in this menu is:

t1	Instant probe 1 temperature	th1	Maximum probe 1 temperature recorded
t2	* Instant probe 2 temperature	tLo	Minimum probe 1 temperature recorded
t3	* Instant probe 3 temperature	cnd	**Compressor working weeks
min	Minutes of the Real Time Clock	Loc	Keypad state lock
hrS	Hours of the Real Time Clock		

: displayed only if enabled (see §Configuration Parameters) **: displayed only if* **ACC > 0

Access to menu and information displayed.
■ Press and immediately release button info .
■ With button ▼ or ▲ select the data to be displayed.
■ Press button info to display value.
■ To exit from the menu, press button ⏻ or wait for 10 seconds.
Reset of THI, TLO, CND recordings
■ With button ▼ or ▲ select the data to be reset.
■ Display the value with button info.
■ While keeping button info pressed, use button ⏻.

SETPOINT (display and modification of desired temperature value)
■ Press button for at least half second, to display the setpoint value.
■ By keeping button pressed, use button ▼ or ▲ to set the desired value (adjustment is within the minimum **SPL** and the maximum **SPH** limit).
■ When button is released, the new value is stored.

STAND-BY

Button ⏻, when pressed for 3 seconds, allows the controller to be put on a standby or output control to be resumed (with **SB**=YES only).

KEYPAD LOCK

The keypad lock avoids undesired, potentially dangerous operations, which might be attempted when the controller is operating in a public place. In the INFO menu, set parameter **LOC**=YES to inhibit all functions of the buttons. To resume normal operation of keypad, adjust setting so that **LOC**=NO.

SELECTION OF SECOND PARAMETER GROUP

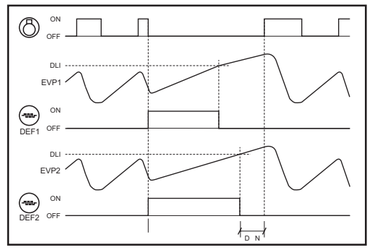
It’s possible to select control parameters between two different pre-programmed groups, in order for the fundamental control parameters to be adapted quickly to changing needs. Changeover from Group **I** to Group **II** (and vice versa) may take place MANUALLY by pressing button M for 2 seconds (with **IISM**=MAN), or AUTOMATICALLY when heavy duty conditions are detected (with **IISM**=HDD), or when **IISM**=DI2 and the AUXILIARY INPUT DI2 is activated (the activation of DI2 selects Group **II**). If **IISM**=NON, switchover to Group **II** is inhibited. The activation of Group **II** is signalled by the lighting up of the relevant LED on the controller display.

REAL TIME CLOCK SETTING

The Real Time Clock (RTC) can be adjusted directly from the Info Menu (see Setpoint modification procedure). Tens of minutes MIN range from 0 to 59 and Hours HRS range from 0 to 23. If RTC is adjusted just before an upcoming change of hour, verify the correctness of the setting again. The RTC does not automatically change upon Daylight Saving Time.

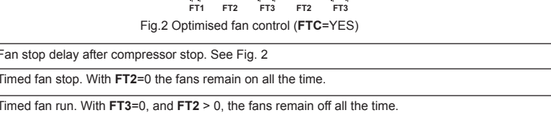
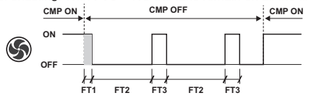
DEFROST

Automatic defrost. Defrost starts automatically at fixed time-intervals or at programmed scheduled (up to six per 24 hours).
■ Timed defrost. With **DFM**=TIM defrosts take place at regular intervals when the timer reaches the value of **DFT**. For example, with **DFM**=TIM and **DFT**=06, a defrost will take place every 6 hours.
■ Scheduled defrost. With **DFM**=RTC defrost takes place at time specified by **DH1**...**DH6**. The format of time is “HH.M”, where HH are hours and M are tens of minutes. To disable one or more of the 6 scheduled defrosts, assign the value “---” (it is the value after “23.5”). Parameters **DH1**...**DH6** are accessible both in the setup (see §Configuration Parameters) and by keeping button pressed for 4 seconds during normal operation.
■ Synchronised defrost. With **DI2**=DSY and when more units AR2-27 are linked to each other as per Fig. 3 (see parameter table), synchronised defrosts of all linked controllers will take place. The first controller which will start defrost, will also get all other controllers synchronised.
■ **Manual or remote defrost start**. If **DFM**=TIM it’s possible to manually start a defrost, by pressing button for 4 seconds. If **DFM**=RTC hold button down for 4 seconds to display **DH1**, then press button again for 4 seconds to manually start a defrost. Defrost may be also started remotely, if **DI2**=RDS, through the making of the auxiliary contact DI2.
Defrost type. Once defrost has started, Compressor and Defrost outputs are controlled according to parameter **DTY**. If **FID**=YES, the evaporator fans are active during defrost.
Defrost termination. The actual defrost duration is influenced by a series of parameters.
■ Time termination: **T2**=NO and **T3** different from 2EU: the evaporator temperature is not monitored and defrost will last as long as time **DTO**.
■ Temperature monitoring of one evaporator: **T2**=YES and **T3** different from 2EU. In this case, if the sensor T2 measures the temperature **DLI** before the time **DTO** elapses, defrost will be terminated in advance.
■ Temperature monitoring of two evaporators: **T2**=YES, **T3**=2EU, **OAU**=2EU. This function is for the control of two independent evaporators and it switches off the individual heating of the evaporator which gets to temperature **DLI** first, waiting for the second evaporator to get to that temperature before the time **DTO** elapses (see figure).
Resuming thermostatic cycle. When defrost is over, if **DRN** is greater than 0, all outputs will remain off for **DRN** minutes, in order for the ice to melt completely and the resulting water to drain. Moreover, if probe T2 is active (**T2**=YES), the fans will re-start when the evaporator gets to a temperature lower than **FDD**; Vice versa, if probe T2 is not active (**T2**=NO) or after defrost has come to an end, such condition does not occur by end of the time **FTO**, after **FTO** minutes have elapsed the fans will be switched on anyway.
Caution: if ***DFM****=NON or* ***C-H****=HEA all defrost functions are inhibited; if* ***DFT****=0, automatic defrost functions are excluded. During a high pressure alarm, defrost is suspended. During defrost, high temperature alarm is bypassed.*

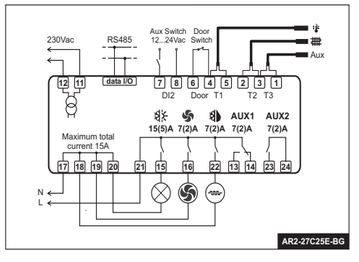


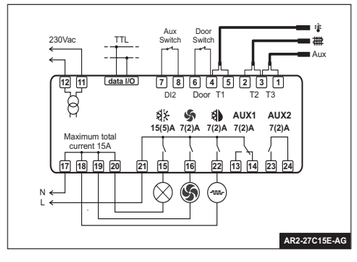
CONFIGURATION PARAMETERS

■ To get access to the parameter configuration menu, press button ⏻ + info for 5 seconds.
■ With button ▼ or ▲ select the parameter to be modified.
■ Press button info to display the value.
■ By keeping button info pressed, use button ▼ or ▲ to set the desired value.
■ When button info is released, the newly programmed value is stored and the following parameter is displayed.
■ To exit from the setup, press button ⏻ or wait for 30 seconds.

PAR	RANGE	DESCRIPTION
SCL	1°C; 2°C; °F	Readout scale. 1°C (with **INP**=SN4 only): measuring range -50/-9.9 … 19.9/80°C 2°C : measuring range -50 … 120°C °F : measuring range -55 … 240°F *Caution: upon changing the* **SCL** *value, it is then absolutely necessary to re-configure the parameters relevant to the absolute and relative temperatures (****SPL****, ****SPH****, ****SP****, ****ALA****, ****AHA****, etc..).*
SPL	-50..SPH	Minimum limit for **SP** setting.
SPH	SPL..120°	Maximum limit for **SP** setting.
SP	SPL... SPH	Setpoint (value to be maintained in the room).
C-H	REF; HEA	Refrigerating (REF) or Heating (HEA) control mode.
HYS	1...10°	OFF/ON thermostat differential.  Refrigerating control (**C-H**=REF) Heating control (**C-H**=HEA)
CRT	0...30min	Compressor rest time. The output is switched on again after CRT minutes have elapsed since the previous switchover. We recommend to set **CRT**=03 with **HYS**<2.0°.
CT1	0...30min	Thermostat output run when probe T1 is faulty. With **CT1**=0 the output will always remain OFF.
CT2	0...30min	Thermostat output stop when probe T1 is faulty. With **CT2**=0 and **CT1**>0 the output will always be ON. *Example:* **CT1**=4, **CT2**= 6: In case of probe T1 failure, the compressor will cycle 4 minutes ON and 6 minutes OFF.
CSD	0..30min	Compressor stop delay after the door has been opened (active only if **DS**=YES).
2CD	0...120sec	Auxiliary compressor start delay. If **OAU**=2CU the auxiliary output is switched on with a delay of **2CD** seconds after the main compressor has cut-in. Both compressors are turned off at the same time.
DFM	NON; TIM; RTC	Defrost start mode NON : defrost function is disabled *(the following parameter will be* **FID***).* TIM : regular time defrost. RTC : the defrost time is scheduled by parameters **DH1**, **DH2**...**DH6**.
DFT	0...99 ore	Time interval among defrosts. When this time has elapsed since the last defrost, a new defrost cycle is started.
DH1	HH.M	Scheduled time for defrost 1. HH hours from midnight, M tens of minutes. Accepted values go from 00.0 to 23.5. After “23.5” the value is “---” that means “skipped defrost”. *Example*: **DH1**=8.3 means 8.30 AM
DH2	HH.M	Scheduled time for defrost 2
DH3	HH.M	Scheduled time for defrost 3
DH4	HH.M	Scheduled time for defrost 4
DH5	HH.M	Scheduled time for defrost 5
DH6	HH.M	Scheduled time for defrost 6
DLI	-50...120°	Defrost end temperature.
DTO	1...120min	Maximum defrost duration.
DTY	OFF; ELE; GAS	Defrost type OFF: off cycle defrost (Compressor and Heater OFF). ELE: electric defrost (Compressor OFF and Heater ON). GAS: hot gas defrost (Compressor and Heater ON).
DRN	0...30min	Pause after defrost (evaporator drain down time).
DDY	0...60min	Display during defrost. If **DDY**=0 during defrost the temperature continues to be displayed. If **DDY**>0, during defrost the display shows DEF, when defrost is over REC is displayed during **DDY** minutes.
FID	NO/YES	Fans active during defrost.
FDD	-50...120°	Evaporator fan re-start temperature after defrost.
FTO	0...120min	Maximum evaporator fan stop after defrost.
FTC	NO/YES	Optimised fan control enabling. With **FTC** = NO the fans remain on all the time.  Fig.2 Optimised fan control (**FTC**=YES)
FT1	0...180sec	Fan stop delay after compressor stop. See Fig. 2
FT2	0...30min	Timed fan stop. With **FT2**=0 the fans remain on all the time.
FT3	0...30min	Timed fan run. With **FT3**=0, and **FT2** > 0, the fans remain off all the time.
ATM	NON; ABS; REL	Alarm threshold management. NON: all temperature alarms are inhibited (*the following parameter will be* **ADO***).* ABS: the values programmed in **ALA** and **AHA** represent the real alarm thresholds. REL: the values programmed in **ALR** and **AHR** are alarm differentials referred to **SP** and **SP**+**HYS**.  Temperature alarm with relative thresholds, refrigerating control (**ATM**=REL, **C-H**=REF).  Temperature alarm with relative thresholds, heating control (**ATM**=REL, **C-H**=HEA).
ALA	-50... 120°	Low temperature alarm threshold.
AHA	-50... 120°	High temperature alarm threshold.
ALR	-12... 0°	Low temperature alarm differential. With **ALR**=0 the low temperature alarm is excluded.
AHR	0... 12°	High temperature alarm differential. With **AHR**=0 the high temperature alarm is excluded.
ATI	T1; T2; T3	Probe used for temperature alarm detection.
ATD	0... 120min	Delay before alarm temperature warning.
ADO	0... 30min	Delay before door open alarm warning.
AHM	NON; ALR; STP;	Operation in case of high condenser alarm NON: high condenser alarm inhibited. ALR: in case of alarm, “HC” flashes in the display and the buzzer is switched on. STP: in addition to the alarm symbols displayed, the compressor is stopped and defrosts are suspended.
AHT	-50...120°	Condensation temperature alarm (referred to T3 probe).
ACC	0...52 weeks	Condenser periodic cleaning. When the compressor operation time, expressed in weeks, matches the **ACC** value programmed, “CL” flashes in the display. With **ACC**=0 the condenser cleaning warning is disabled and CND disappears from Info Menu.
HDS	1...5	Controller sensitivity for the automatic switchover from Group **I** to Group **II** (1=minimum, 5=maximum).
IISM	NON; MAN; HDD; DI2	Switchover mode to second parameter set NON: inhibition to use the second parameter group (*the following parameter will be* **SB***).* MAN: button M switches the two parameter groups over.. HDD: automatic switchover to the second parameter group, when heavy duty conditions are detected. DI2: switchover to the second parameter group when the auxiliary DI2 input makes.
IISL	-50... IISH	Minimum limit for **IISP** setting.
IISH	IISL... 120°	Maximum limit for **IISP** setting.
IISP	IISL... IISH	Setpoint in mode 2.
IIHY	1... 10°	OFF/ON differential in mode 2.
IIFT	NO/YES	Optimised fan control enabling in mode 2.
IIDF	0...99hours	Defrost timer set to start a defrost in mode 2.
SB	NO/YES	Stand-by button ⏻ enabling.
DS	NO/YES	Door switch input enabling (closed when door is closed).
DI2	NON; HPS; IISM; RDS; DSY	DI2 digital input operation NON : digital input 2 not active. HPS: when contact opens a condensing unit high pressure alarm occurs. IISM : when contact makes the controller will use group 2 parameters. RDS : when contact makes a defrost is started (remote control). DSY: defrost synchronisation. The controllers, linked as per Fig. 3, will all start and end defrost together. The first controller in defrost mode will get defrost of all the others started. The last controller ending defrost will get defrost of all the others stopped.
LSM	NON; MAN; DOR	Light control mode NON : light output not controlled. MAN : light ouput controlled through button M (if **OAU**=LGT). DOR : light ouput switched on when door is opened (if **OAU**=LGT).
OA1	NON; 0-1; LGT; 2CU; 2EU; AL0; AL1	AUX 1 output operation NON : output disabled (always off). 0-1 : the relay contacts follow the on/standby state of controller. LGT : output enabled for light control. 2CU : output programmed for the control of an auxiliary compressor. 2EU : output enabled for the control of the electrical defrost of a second evaporator. AL0 : contacts open when an alarm condition occurs. AL1 : contacts make when an alarm condition occurs.
OA2	See **OA1**	AUX2 output operation. See **OA1**.
INP	SN4; ST1	Temperature sensor selection. With **INP** = SN4, the probes must be the LAE models SN4..; with **INP** = ST1, the probes must be the LAE models ST1...
OS1	-12.5..12.5°C	Probe T1 probe.
T2	NO/YES	Probe T2 enabling (evaporator).
OS2	-12.5..12.5°C	Probe T2 offset.
T3	NON; DSP; CND; 2EU	Auxiliary probe T3 operation NON: probe T3 not fitted. DSP: temperature T3 to be displayed. CND: condenser temperature measurement. 2EU: second evaporator temperature measurement.
OS3	-12.5..12.5°C	Probe 3 offset.
TLD	1...30 min	Delay for minimum temperature (TLO) and maximum temperature (THI) logging.
SIM	0...100	Display slowdown.
ADR	1...255	AR2-27 address for PC communication.

WIRING DIAGRAMS





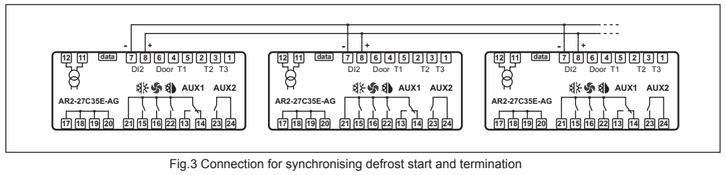


Fig.3 Connection for synchronising defrost start and termination

TECHNICAL DATA

Power supply

AR2-27…D	12Vac/dc ±10%, 3W
AR2-27…E	230Vac±10%, 50/60Hz, 3W
AR2-27...U	115Vac±10%, 50/60Hz, 3W

Relay output

Compressor	15(5)A 240Vac
Evap. Fan	7(2)A 240Vac
Defrost	7(2)A 240Vac
Auxiliary loads 1	7(2)A 240Vac
Auxiliary loads 2	7(2)A 240Vac

Input

NTC 10KΩ@25°C	LAE Part No. SN4...
PTC 1000Ω@25°C	LAE Part No. ST1…

Measurement Range

-50…120°C, -55…240°F
-50 / -9.9 … 19.9 / 80°C (NTC10K only)

Measurement accuracy

<0.5°C within the measurement range

Real Time Clock battery

>150 hours; self-rechargeable

Operating conditions

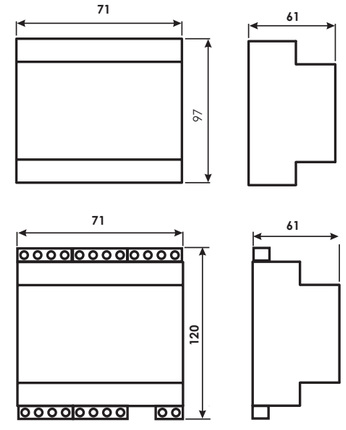
-10 … +50°C; 15%...80% r.H.

CE (Reference norms)

EN60730-1; EN60730-2-9;
EN55022 (Class B);
EN50082-1

Front protection

IP55



lae ELECTRONIC
VIA PADOVA, 25
31046 ODERZO /TV /ITALY
TEL. +39 - 0422 815320
FAX +39 - 0422 814073
www.lae-electronic.com
E-mail: sales@lae-electronic.com

AD-32

169x38x78 mm

Universal Powerful Defrost Controller

Selectable Refrigerating or Heating control ● Selectable NTC10K or PTC input ● FLEXICOLD function for energy saving or alternative setpoint ● Timed or optimised defrost control ● Synchronized defrost start and termination with master-slave connection ● Optional control of a second compressor or evaporator ● Excellent evaporator fan control ● Absolute or relative temperature alarms and door open alarm ● Temperature and pressure monitoring and condensing unit maintenance ● Light and standby control (On/Off) ● Quick programming through ZOT-AD key ● Connection to LAE supervisory systems

Applications:

Plug-in cabinets, supermarket display cases, cold stores, upright fridges and freezers, refrigerated tables.

AD-32 Series

Functions		Q13W-AG	S24W-AG	S35W-BG
Temperature Inputs	Thermostat	✓	✓	✓
	Evaporator	✓	✓	✓
	Auxiliary		✓	✓
Digital inputs	Voltage free contact	✓	✓	✓
Digital inputs	Voltage free contact	✓		
	12÷24Vac voltage		✓	
	Defrost synchronisation			✓
Outputs	Thermostat 15(5)A	✓	✓	✓
	Evaporator fans	✓	✓	✓
	Defrost	✓	✓	✓
	Auxiliary 1		✓	✓
	Auxiliary 2			✓
Connections	Screw terminals		✓	✓
	M/F terminals + fastons	✓		
Power supply	115÷230Vac	✓	✓	✓
Serial port	Serial port TTL	✓	✓	
	Serial port RS485			✓

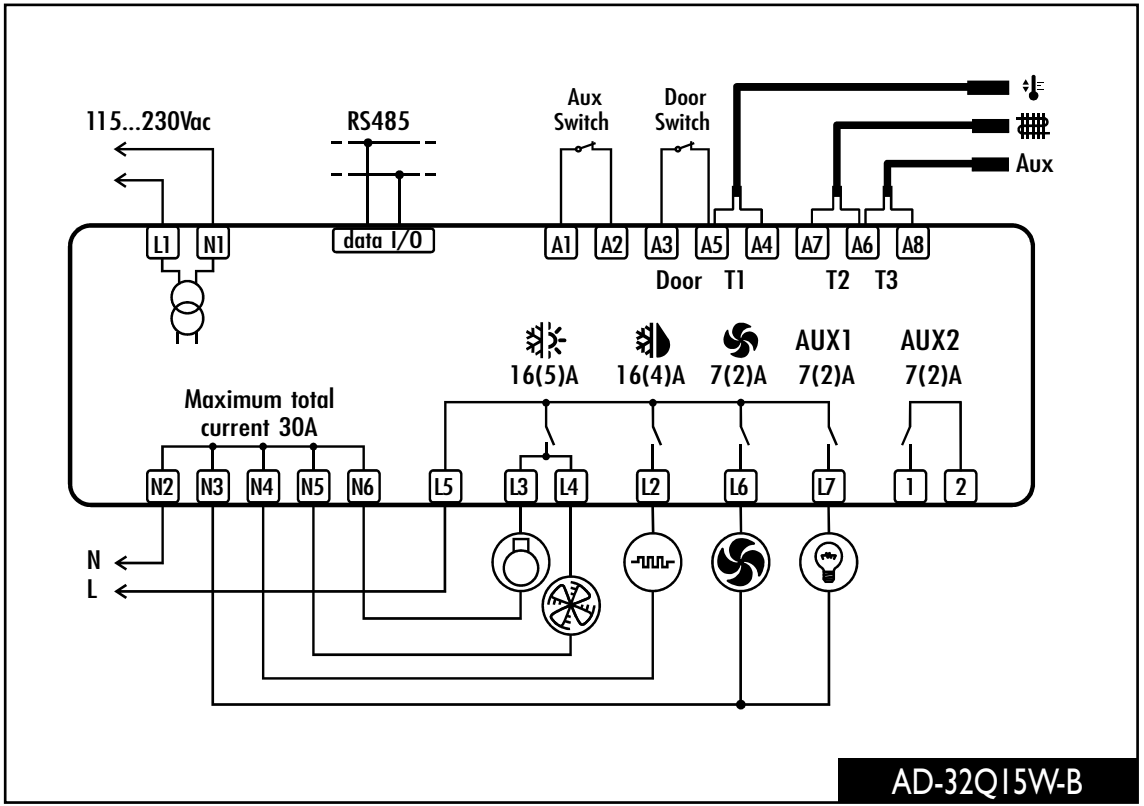
All models come with an alarm buzzer
On request, the AD-32 is also available with 7…30Vdc power supply.
On request, the AD2-32 is also available with gasket for a better protection between bezel and metal panel.

Technical Data

Control Range:		-50÷120°C , -55÷240°F
Resolution:		0.1 1 °C; °F
Accuracy:	NTC10K:	<±0.3°C (-40.0÷70.0°C)
	PTC1000:	<±0.5°C (-50÷120°C)
Sensor type:		selectable NTC10K or PTC1000
Power supply:		115÷230V~ ±10% 50÷60Hz 3W
Front protection:		IP55
Panel cut-out:		163x31.5 mm

Wiring diagrams

Instruction


115...230Vac
RS485
Aux Switch
Door Switch
Aux
L1
N1
data I/O
A1
A2
A3
A5
A4
A7
A6
A8
Door
T1
T2
T3
16(5)A
16(4)A
7(2)A
AUX1
7(2)A
AUX2
7(2)A
Maximum total current 30A
N2
N3
N4
N5
N6
L5
L3
L4
L2
L6
L7
1
2
N
L
AD-32Q15W-B

AD-32 INSTRUCTIONS FOR USE

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.

DESCRIPTION

Fig.1 - Front panel

Setpoint / Edit button. Manual defrost / Increase button. Mute alarm / Decrease button.

Info / exit button. 2nd parameter set button. Light button. Stand-by button.

INDICATIONS

Thermostat output. Defrost output. Alarm.

Fan output. Activation of 2nd parameter set. Light output activated.

INSTALLATION

- The AD-32 controller, size 169x38x78mm (WxHxD), is inserted into the panel through a hole measuring 163x31.5 mm and is fixed by means of the screws on the rear flange. If fitted, check that the rubber gasket adheres to the panel perfectly, in order to prevent infiltration to the back of the instrument.
- Make sure that electrical connections comply with the paragraph "wiring diagrams". To reduce the effects of electromagnetic disturbance, keep the sensor and signal cables well separate from the power wires.
- Place the probe T1 inside the room in a point that truly represents the temperature of the stored product.
- Place the probe T2 on the evaporator where there is the maximum formation of frost.
- The function of probe T3 is determined by the parameter T3. With **T3**=DSP the probe measures the temperature to be displayed. With **T3**=CND the probe measures the condenser temperature, it must therefore be placed between the fins of the condensing unit. With **T3**=2EU the probe measures the temperature of the second evaporator and it must therefore be placed where there is the maximum formation of frost. With **T3**=NON, the third probe is disabled.

OPERATION

DISPLAY

During normal operation, the display shows either the temperature measured or one of the following indications:

dEF	Defrost in progress	hP	Condenser high pressure alarm
oFF	Controller in stand-by	hi	Room high temperature alarm
cL	Condenser clean warning	Lo	Room low temperature alarm
do	Door open alarm	E1	Probe T1 failure
hc	Condenser high temperature alarm	E2	Probe T2 failure
		E3	Probe T3 failure

INFO MENU

The information available in this menu is:

t1	Instant probe 1 temperature	tH1	Maximum probe 1 temperature recorded
t2 *	Instant probe 2 temperature	tL0	Minimum probe 1 temperature recorded
t3 *	Instant probe 3 temperature	cnd	**Compressor working weeks
		Loc	Keypad state lock

: displayed only if enabled (see §Configuration Parameters) **: displayed only if* **ACC > 0

Access to menu and information displayed.
- Press and immediately release button (i).
- With button (▼) or (▲) select the data to be displayed.
- Press button (SET) to display value.
- To exit from the menu, press button (×) or wait for 10 seconds.

Reset of THI, TLO, CND recordings
- With button (▼) or (▲) select the data to be reset.
- Display the value with button (SET).
- While keeping button (SET) pressed, use button (×).

SETPOINT : display and modification
- Press button (SET) for at least half second, to display the setpoint value.
- By keeping button (SET) pressed, use button (▼) or (▲) to set the desired value (adjustment is within the minimum **SPL** and the maximum **SPH** limit).
- When button (SET) is released, the new value is stored.

STAND-BY

Button (⏻), when pressed for 3 seconds, allows the controller to be put on a standby or output control to be resumed (with **SB**=YES only).

KEYPAD LOCK

The keypad lock avoids undesired, potentially dangerous operations, which might be attempted when the controller is operating in a public place. In the INFO menu, set parameter **LOC**=YES to inhibit all functions of the buttons. To resume normal operation of keypad, adjust setting so that **LOC**=NO.

SELECTION OF SECOND PARAMETER GROUP

It's possible to select control parameters between two different pre-programmed groups, in order for the fundamental control parameters to be adapted quickly to changing needs. Changeover from Group **I** to Group **II** (and vice versa) may take place MANUALLY by pressing button (II°) for 2 seconds (with **IISM**=MAN), or AUTOMATICALLY when heavy duty conditions are detected (with **IISM**=HDD), or when **IISM**=DI2 and the AUXILIARY INPUT DI2 is activated (the activation of DI2 selects Group **II**). If **IISM**=NON, switchover to Group **II** is inhibited. The activation of Group **II** is signalled by the lighting up of the relevant LED on the controller display.

DEFROST

Automatic defrost. Defrost starts automatically as soon as the time set with parameter **DFT** has elapsed.
- Timed defrost. With **DFM**=TIM defrosts take place at regular intervals when the timer reaches the value of **DFT**. For example, with **DFM**=TIM and **DFT**=06, a defrost will take place every 6 hours.
- Optimized defrost. With **DFM**=FRO the timer is only increased when the conditions occur for frost to form on the evaporator, until the time set with parameter **DFT** is matched. If the evaporator works at 0°C, defrost frequency depends on the thermal load and climatic conditions. With setpoints much lower than 0°C, defrost frequency mainly depends on the refrigerator operating time.
- Synchronised defrost. With **DI2**=DSY and when more units (models AD-32x3xx-x only) are linked to each other as per Fig. 3, synchronised defrosts of all linked controllers will take place. The first controller which will start defrost, will also get all other controllers synchronised.
- Defrost time count backup. At the power-up, if **DFB**=YES, the defrost timer resumes the time count from where it was left off before the power interruption. Vice versa, with **DFB**=NO, the time count re-starts from 0. In stand-by, the accumulated time count is frozen.

Manual or remote defrost start. It's possible to manually start a defrost, by pressing button (❄) for 2 seconds, or defrost may be started remotely, if **DI2**=RDS, through the making of the auxiliary contact DI2.

Defrost type. Once defrost has started, Compressor and Defrost outputs are controlled according to parameter **DTY**. If **FID**=YES, the evaporator fans are active during defrost.

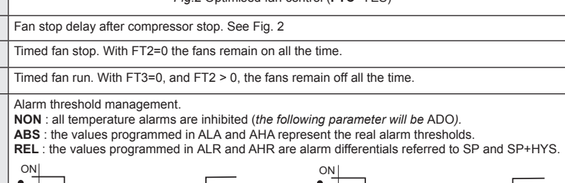
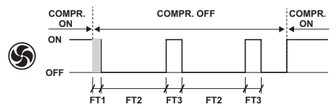
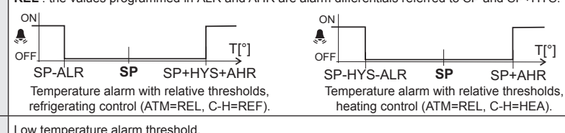
Defrost termination. The actual defrost duration is influenced by a series of parameters.
- Time termination: **T2**=NO and **T3** different from 2EU: the evaporator temperature is not monitored and defrost will last as long as time **DTO**.
- Temperature monitoring of one evaporator: **T2**=YES and **T3** different from 2EU. In this case, if the sensor T2 measures the temperature **DLI** before the time **DTO** elapses, defrost will be terminated in advance.
- Temperature monitoring of two evaporators: **T2**=YES, **T3**=2EU, **OAU**=2EU. This function is for the control of two independent evaporators and it switches off the individual heating of the evaporator which gets to temperature **DLI** first, waiting for the second evaporator to get to that temperature before the time **DTO** elapses.

Resuming thermostatic cycle. When defrost is over, if **DRN** is greater than 0, all outputs will remain off for **DRN** minutes, in order for the ice to melt completely and the resulting water to drain. Moreover, if probe T2 is active (**T2**=YES), the fans will re-start when the evaporator gets to a temperature lower than **FDD**; Vice versa, if probe T2 is not active (**T2**=NO) or after defrost has come to an end, such condition does not occur by end of the time **FTO**, after **FTO** minutes have elapsed the fans will be switched on anyway.

Caution: if ***DFM****=NON or* ***C-H****=HEA all defrost functions are inhibited; if* ***DFT****=0, automatic defrost functions are excluded. During a high pressure alarm, defrost is suspended. During defrost, high temperature alarm is bypassed.*

CONFIGURATION PARAMETERS

- To get access to the parameter configuration menu, press button (⏻) + (SET) for 5 seconds.
- With button (▼) or (▲) select the parameter to be modified.
- Press button (SET) to display the value.
- By keeping button (SET) pressed, use button (▼) or (▲) to set the desired value.
- When button (SET) is released, the newly programmed value is stored and the following parameter is displayed.
- To exit from the setup, press button (×) or wait for 30 seconds.

PAR	RANGE	DESCRIPTION
SCL	1°C; 2°C; °F	Readout scale. **1°C** (with **INP**=SN4 only): measuring range -50/-9.9 … 19.9/80°C **2°C** : measuring range -50 … 120°C **°F** : measuring range -55 … 240°F *Caution: upon changing the* SCL *value, it is then absolutely necessary to re-configure the parameters relevant to the absolute and relative temperatures (SPL, SPH, SP, ALA, AHA, etc..).*
SPL	-50..SPH	Minimum limit for SP setting.
SPH	SPL.120°	Maximum limit for SP setting.
SP	SPL... SPH	Setpoint (value to be maintained in the room).
C-H	REF; HEA	Refrigerating (REF) or Heating (HEA) control mode.
HYS	1...10°	OFF/ON thermostat differential.  Refrigerating control (C-H=REF) Heating control (C-H=HEA)
CRT	0...30min	Compressor rest time. The output is switched on again after CRT minutes have elapsed since the previous switchover. We recommend to set CRT=03 with HYS<2.0°.
CT1	0...30min	Thermostat output run when probe T1 is faulty. With CT1=0 the output will always remain OFF.
CT2	0...30min	Thermostat output stop when probe T1 is faulty. With CT2=0 and CT1>0 the output will always be ON. *Example:* CT1=4, CT2= 6: In case of probe T1 failure, the compressor will cycle 4 minutes ON and 6 minutes OFF.
CSD	0..30min	Compressor stop delay after the door has been opened (active only if DS=YES).
2CD	0...120sec	Auxiliary compressor start delay. If OAx=2CU the auxiliary output is switched on with a delay of 2CD seconds after the main compressor has cut-in. Both compressors are turned off at the same time.
DFM	NON; TIM; FRO	Defrost start mode **NON** : defrost function is disabled *(the following parameter will be* FID*).* **TIM** : regular time defrost. **FRO** : the defrost time count is only increased when the conditions occur for frost to form on the evaporator (optimised time increase).
DFT	0...99 hours	Time interval among defrosts. When this time has elapsed since the last defrost, a new defrost cycle is started.
DFB	NO/YES	Defrost timer backup. With DFB=YES, after a power interruption, the timer resumes the count from where it was left off with ±30 min. approximation. With DFB=NO, after a power interruption, the defrost timer will re-start to count from zero.
DLI	-50...120°	Defrost end temperature.
DTO	1...120min	Maximum defrost duration.
DTY	OFF; ELE; GAS	Defrost type **OFF**: off cycle defrost (Compressor and Heater OFF). **ELE**: electric defrost (Compressor OFF and Heater ON). **GAS**: hot gas defrost (Compressor and Heater ON).
DRN	0...30min	Pause after defrost (evaporator drain down time).
DDY	0...60min	Display during defrost. If DDY=0 during defrost the temperature continues to be displayed. If DDY>0, during defrost the display shows DEF, when defrost is over REC is displayed during DDY minutes.
FID	NO/YES	Fans active during defrost.
FDD	-50...120°	Evaporator fan re-start temperature after defrost.
FTO	0...120min	Maximum evaporator fan stop after defrost.
FTC	NO/YES	Optimised fan control enabling. With FTC = NO the fans remain on all the time.  *Fig.*2 Optimised fan control (**FTC**=YES)
FT1	0...180sec	Fan stop delay after compressor stop. See Fig. 2
FT2	0...30min	Timed fan stop. With FT2=0 the fans remain on all the time.
FT3	0...30min	Timed fan run. With FT3=0, and FT2 > 0, the fans remain off all the time.
ATM	NON; ABS; REL	Alarm threshold management. **NON** : all temperature alarms are inhibited (*the following parameter will be* ADO*).* **ABS** : the values programmed in ALA and AHA represent the real alarm thresholds. **REL** : the values programmed in ALR and AHR are alarm differentials referred to SP and SP+HYS.  Temperature alarm with relative thresholds, refrigerating control (ATM=REL, C-H=REF). Temperature alarm with relative thresholds, heating control (ATM=REL, C-H=HEA).
ALA	-50... 120°	Low temperature alarm threshold.
AHA	-50... 120°	High temperature alarm threshold.
ALR	-12... 0°	Low temperature alarm differential. With ALR=0 the low temperature alarm is excluded.
AHR	0... 12°	High temperature alarm differential. With AHR=0 the high temperature alarm is excluded.
ATI	T1; T2; T3	Probe used for temperature alarm detection.
ATD	0... 120min	Delay before alarm temperature warning.
ADO	0... 30min	Delay before door open alarm warning.
AHM	NON; ALR; STP;	Operation in case of high condenser alarm **NON** : high condenser alarm inhibited. **ALR** : in case of alarm, "HC" flashes in the display and the buzzer is switched on. **STP** : in addition to the alarm symbols displayed, the compressor is stopped and defrosts are suspended.
AHT	-50...120°	Condensation temperature alarm (referred to T3 probe).
ACC	0...52 weeks	Condenser periodic cleaning. When the compressor operation time, expressed in weeks, matches the **ACC** value programmed, "CL" flashes in the display. With ACC=0 the condenser cleaning warning is disabled and CND disappears from Info Menu.
HDS	1...5	Controller sensitivity for the automatic switchover from Group **I** to Group **II** (1=minimum, 5=maximum).
IISM	NON; MAN; HDD; DI2	Switchover mode to second parameter set **NON** : inhibition to use the second parameter group (*the following parameter will be* SB*).* **MAN** : button (II°) switches the two parameter groups over. **HDD** : automatic switchover to the second parameter group, when heavy duty conditions are detected. **DI2** : switchover to the second parameter group when the auxiliary DI2 input makes.
IISL	-50...IISH	Minimum limit for IISP setting.
IISH	IISL...120°	Maximum limit for IISP setting.
IISP	IISL...IISH	Setpoint in mode 2.
IIHY	1...10°	OFF/ON differential in mode 2.
IIFT	NO/YES	Fan control in mode 2. See FTC.
IIDF	0...99 hours	Time interval among defrosts in mode 2.
SB	NO/YES	Stand-by button (⏻) enabling.
DS	NO/YES	Door switch input enabling (closed when door is closed).
DI2	NON; HPS; IISM; RDS; DSY	DI2 digital input operation **NON** : digital input 2 not active. **HPS** : when contact opens a condensing unit high pressure alarm occurs. **IISM** : when contact makes the controller will use group 2 parameters. **RDS** : when contact makes a defrost is started (remote control). **DSY** : defrost synchronisation. The controllers, linked as per Fig. 3, will all start and end defrost together. The first controller in defrost will get defrost of all the others started. The last controller ending defrost will get defrost of all the others stopped.
LSM	NON; MAN; DOR	Light control mode **NON** : light output not controlled. **MAN** : light ouput controlled through button (💡) (if OAx=LGT). **DOR** : light ouput switched on when door is opened (if OAx=LGT).
OA1	NON; 0-1; LGT; 2CU; 2EU; AL0; AL1	AUX 1 output operation **NON** : output disabled (always off). **0-1** : the relay contacts follow the on/standby state of controller. **LGT** : output enabled for light control. **2CU** : output programmed for the control of an auxiliary compressor. **2EU** : output enabled for the control of the electrical defrost of a second evaporator. **AL0** : contacts open when an alarm condition occurs. **AL1** : contacts make when an alarm condition occurs.
OA2	See **OA1**	AUX2 output operation. See OA1.
INP	SN4; ST1	Temperature sensor selection. With INP=SN4, the probes must be the LAE models SN4..; with INP = ST1, the probes must be the LAE models ST1...
OS1	-12.5..12.5°C	Probe T1 offset.
T2	NO/YES	Probe T2 enabling (evaporator).
OS2	-12.5..12.5°C	Probe T2 offset.
T3	NON; DSP; CND; 2EU	Auxiliary probe T3 operation **NON** : probe T3 not fitted. **DSP** : temperature T3 to be displayed. **CND** : condenser temperature measurement. **2EU** : second evaporator temperature measurement.
OS3	-12.5..12.5°C	Probe 3 offset.
TLD	1...30 min	Delay for minimum temperature (TLO) and maximum temperature (THI) logging.
SIM	0...100	Display slowdown.
ADR	1...255	AD-32 address for PC communication.

WIRING DIAGRAMS

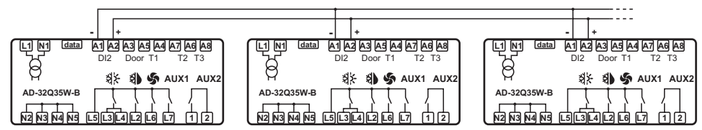
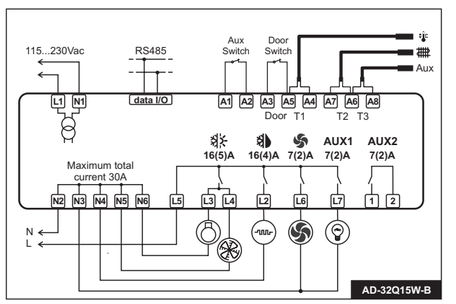


Fig.3 Connection for synchronising defrost start and termination



TECHNICAL DATA

Power supply

AD-32….L	7...30Vdc ±10%, 5W
AD-32....W	115...230Vac±10%, 50/60Hz, 5W

Relay output

Compressor	16(5)A 240Vac
Defrost	16(4)A 240Vac
Evap. Fan	7(2)A 240Vac
Auxiliary loads 1	7(2)A 240Vac
Auxiliary loads 2	7(2)A 240Vac

Input

NTC 10KΩ@25°C LAE Part No. SN4...
PTC 1000Ω@25°C LAE Part No. ST1…

Measurement Range

-50…120°C, -55…240°F
-50 / -9.9 … 19.9 / 80°C (NTC10K only)

Measurement accuracy

<0.5°C within the measurement range

Operating conditions

-10 … +50°C; 15%...80% r.H.

CE (Reference norms)

EN60730-1; EN60730-2-9;
EN55022 (Class B);
EN50082-1

lae ELECTRONIC
VIA PADOVA, 25
31046 ODERZO /TV /ITALY
TEL. +39 - 0422 815320
FAX +39 - 0422 814073
www.lae-electronic.com
E-mail: sales@lae-electronic.com

AH1-5

77x35x90 mm

Defrost Controller for refrigerated transports

Selectable Heating/Refrigerating control with Neutral Band ● Selectable NTC10K or PTC input ● FLEXICOLD function for energy saving or alternative setpoint ● Timed or optimised defrost start, or remote start option ● Defrost timer backup in case of power failure ● Direct compressor control through high power relay ● Optional control of a second compressor or evaporator ● Excellent evaporator fan control ● Absolute or relative temperature alarms and door open alarm ● Temperature and pressure monitoring and condensing unit maintenance ● Light and standby control (On/Off) ● Quick programming through ZOT-AH1 key ● Connection to LAE supervisory systems

Applications:

refrigerated transports, HT and LT cold storage rooms, plug-in cabinets, display cases, open counters.

AH1-5 series

Functions		B14L-AG	B13W-AG	C24W-BL
Temperature inputs	Thermostat	✓	✓	✓
	Evaporator	✓	✓	✓
	Auxiliary			✓
Door switch input	Voltage free contact	✓	✓	✓
Digital input DI2	Voltage free contact	✓	✓	
	Voltage 12÷24Vac			✓
Outputs	Thermostat	✓	✓	✓
	Evaporator fans	✓	✓	✓
	Defrost	✓	✓	✓
	Auxiliary	✓		✓
Power supply	115-230Vac		✓	✓
	7-30Vdc	✓		
Serial port	TTL	✓	✓	
	RS485			✓
Keypad	Generic	✓	✓	
	With light button			✓

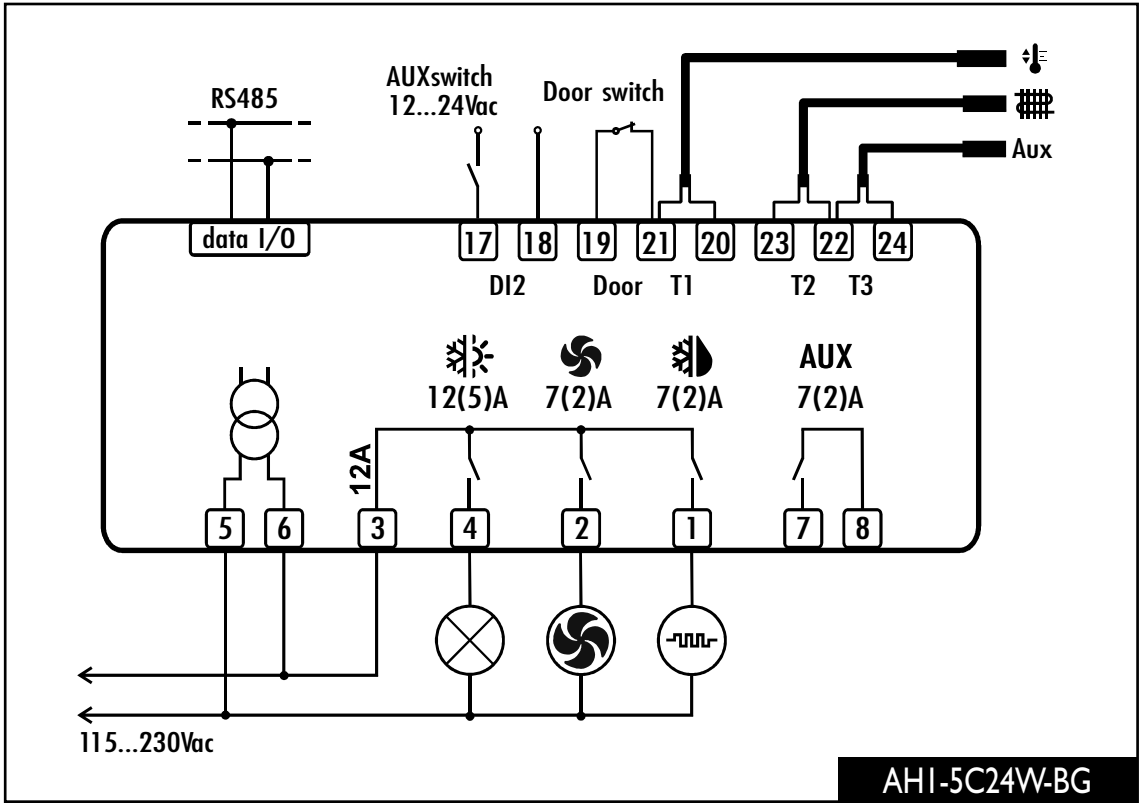
All models come with an alarm buzzer. All models are fitted with detachable screw terminals.
On request, the AH1-5 is also available with gasket for a better protection between bezel and metal panel.

Technical Data

Control Range:		-50÷120°C, -55÷240°F
Resolution:		0.1 / 1 °C; °F
Accuracy:	NTC10K:	<±0.3°C (-40.0÷70.0°C)
	PTC1000:	<±0.5°C (-50÷120°C)
Sensor type:		selectable NTC10K or PTC1000
Power supply:		115-230V~ ±10% 50÷60Hz 3W
Front protection:		IP55
Panel cut-out:		71x29 mm

Wiring diagrams

Instruction


RS485
AUXswitch
12...24Vac
Door switch
Aux
data I/O
17
18
19
21
20
23
22
24
DI2
Door
T1
T2
T3
12(5)A
7(2)A
7(2)A
AUX
7(2)A
12A
5
6
3
4
2
1
7
8
115...230Vac
AH1-5C24W-BG

AH1-5 INSTRUCTIONS FOR USE

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.

DESCRIPTION

Fig.1 - Front panel

- Info / Setpoint button.
- Manual defrost / Decrease button.
- Increase / manual activation button.
- Exit / Stand-by button.

INDICATIONS

- Thermostat output
- Fan output
- Defrost output
- Activation of 2nd parameter set
- Alarm

INSTALLATION

■ Insert the controller through a hole measuring 71x29 mm.
■ Make sure that electrical connections comply with the paragraph “wiring diagrams”. To reduce the effects of electromagnetic disturbance, keep the sensor and signal cables well separate from the power wires.
■ Fix the controller to the panel by means of the suitable clips, by pressingly 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.
■ Place the probe T1 inside the room in a point that truly represents the temperature of the stored product.
■ Place the probe T2 on the evaporator where there is the maximum formation of frost.
■ The function of probe T3 is determined by the parameter T3. With **T3**=DSP the probe measures the temperature to be displayed. With **T3**=CND the probe measures the condenser temperature, it must therefore be placed between the fins of the condensing unit. With **T3**=2EU the probe measures the temperature of the second evaporator and it must therefore be placed where there is the maximum formation of frost. With **T3**=NON, the third probe is disabled.

OPERATION

DISPLAY

During normal operation, the display shows either the temperature measured or one of the following indications:

dEF	Defrost in progress	hP	Condenser high pressure alarm
rEc	Recovery after defrost	h1	Room high temperature alarm
oFF	Controller in stand-by	Lo	Room low temperature alarm
cL	Condenser clean warning	E1	Probe T1 failure
do	Door open alarm	E2	Probe T2 failure
hc	Condenser high temperature alarm	E3	Probe T3 failure

INFO MENU

The information available in this menu is:

t1	Instant probe 1 temperature	tLo	Minimum probe 1 temperature recorded
t2	Instant probe 2 temperature	cnd	Compressor working weeks
t3	Instant probe 3 temperature	Loc	Keypad state lock
th1	Maximum probe 1 temperature recorded		

Access to menu and information displayed.
■ Press and immediately release button (i).
■ With button (▼) or (▲) select the data to be displayed.
■ Press button (i) to display value.
■ To exit from the menu, press button (✕) or wait for 10 seconds.
Reset of THI, TLO, CND recordings
■ With button (▼) or (▲) select the data to be reset.
■ Display the value with button (i).
■ While keeping button (i) pressed, use button (✕).
SETPOINT (display and modification of desired temperature value)
■ Press button (⇕) for at least half second, to display the setpoint value.
■ By keeping button (⇕) pressed, use button (▼) or (▲) to set the desired value (adjustment is within the minimum **SPL** and the maximum **SPH** limit).
■ When button (⇕) is released, the new value is stored.

STAND-BY

Button (⏻), when pressed for 3 seconds, allows the controller to be put on a standby or output control to be resumed (with **SB**=YES only).

KEYPAD LOCK

The keypad lock avoids undesired, potentially dangerous operations, which might be attempted when the controller is operating in a public place. In the INFO menu, set parameter **LOC**=YES to inhibit all functions of the buttons. To resume normal operation of keypad, adjust setting so that **LOC**=NO.

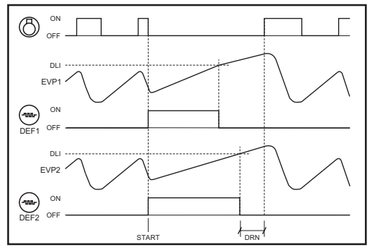
SELECTION OF SECOND PARAMETER GROUP

It’s possible to select control parameters between two different pre-programmed groups, in order for the fundamental control parameters to be adapted quickly to changing needs.
Changeover from Group **I** to Group **II** (and vice versa) may take place manually by pressing button (M) for 2 seconds (with **IISM**=MAN), or automatically when heavy duty conditions are detected (with **IISM**=HDD), or when **IISM**=DI2 and the auxiliary input DI2 is activated (the activation of DI2 selects Group **II**). If **IISM**=NON, switchover to Group **II** is inhibited. The activation of Group **II** is signalled by the lighting up of the relevant LED on the controller display.

DEFROST

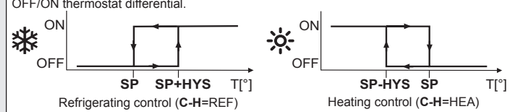
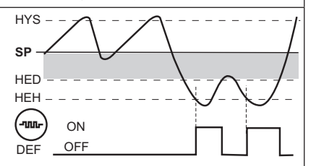
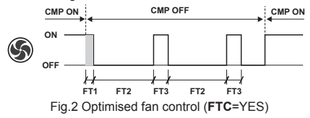
Automatic defrost. A defrost is started automatically as soon as the time set with parameter **DFT** has elapsed.
■ Timed defrost. With **DFM**=TIM the timer increment is continuous and defrosts take place at regular intervals. For example, with **DFM**=TIM and **DFT**=06, a defrost will take place every 6 hours.
■ Optimized defrost. With **DFM**=FRO the timer is only increased when the conditions occur for frost to form on the evaporator, until the time set with parameter DFT is matched. If the evaporator works at 0°C, defrost frequency depends on the thermal load and climatic conditions. With setpoints much lower than 0°C, defrost frequency mainly depends on the refrigerator operating time.
■ Defrost time count backup. At the power-up, if **DFB**=YES, the defrost timer resumes the time count from where it was left off before the power interruption. Vice versa, with **DFB**=NO, the time count re-starts from 0. In stand-by, the accumulated time count is frozen.
Manual or remote defrost start. It’s possible to manually start a defrost, by pressing button (❄) for 2 seconds, or defrost may be started remotely, if **DI2**=RDS, through the making of the auxiliary contact DI2.
Defrost type. Once defrost has started, Compressor and Defrost outputs are controlled according to parameter **DTY**. If **FID**=YES, the evaporator fans are active during defrost.
Defrost termination. The actual defrost duration is influenced by a series of parameters.
■ Time termination: **T2**=NO and **T3** different from 2EU: the evaporator temperature is not monitored and defrost will last as long as time **DTO**.
■ Temperature monitoring of one evaporator: **T2**=YES and **T3** different from 2EU. In this case, if the sensor T2 measures the temperature **DLI** before the time **DTO** elapses, defrost will be terminated in advance.
■ Temperature monitoring of two evaporators: **T2**=YES, **T3**=2EU, **OAU**=2EU. This function is for the control of two independent evaporators and it switches off the individual heating of the evaporator which gets to temperature **DLI** first, waiting for the second evaporator to get to that temperature before the time **DTO** elapses (see figure).
Resuming thermostatic cycle. When defrost is over, if **DRN** is greater than 0, all outputs will remain off for **DRN** minutes, in order for the ice to melt completely and the resulting water to drain. Moreover, if probe T2 is active (**T2**=YES), the fans will re-start when the evaporator gets to a temperature lower than **FDD**; Vice versa, if probe T2 is not active (**T2**=NO) or after defrost has come to an end, such condition does not occur by end of the time **FTO**, after **FTO** minutes have elapsed the fans will be switched on anyway.

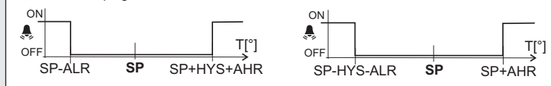
*Caution: if **DFM**=NON or **C-H**=HEA all defrost functions are inhibited; if **DFT**=0, automatic defrost functions are excluded. During a high pressure alarm, defrost is suspended. During defrost, high temperature alarm is bypassed.*
Defrost output as heater control. The defrost output can be used to drive a heater. This is achieved through parameters **HED** and **HEH**.



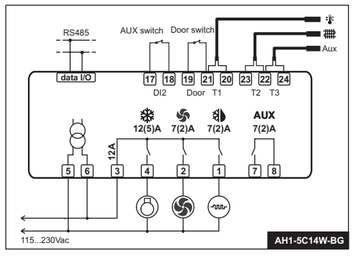
CONFIGURATION PARAMETERS

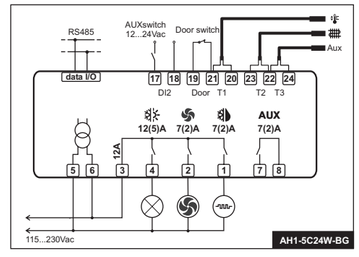
■ To get access to the parameter configuration menu, press button (✕) + (i) for 5 seconds.
■ With button (▼) or (▲) select the parameter to be modified.
■ Press button (i) to display the value.
■ By keeping button (i) pressed, use button (▼) or (▲) to set the desired value.
■ When button (i) is released, the newly programmed value is stored and the following parameter is displayed.
■ To exit from the setup, press button (✕) or wait for 30 seconds.

PAR	RANGE	DESCRIPTION
SCL	1°C; 2°C; °F	Readout scale. 1°C (with **INP**=SN4 only): measuring range -50/-9.9 … 19.9/80°C 2°C : measuring range -50 … 120°C °F : measuring range -55 … 240°F *Caution: upon changing the **SCL** value, it is then <u>absolutely</u> necessary to re-configure the parameters relevant to the absolute and relative temperatures (**SPL**, **SPH**, **SP**, **ALA, AHA,** etc..).*
SPL	-50..SPH	Minimum limit for **SP** setting.
SPH	SPL.120°	Maximum limit for **SP** setting.
SP	SPL... SPH	Setpoint (value to be maintained in the room).
C-H	REF; HEA	Refrigerating (REF) or Heating (HEA) control mode.
HYS	1...10°	OFF/ON thermostat differential.  Refrigerating control (**C-H**=REF) Heating control (**C-H**=HEA)
HED	0...10°	Heating neutral zone. When T1 < **SP-HED-HYS** , the defrost output is turned on, when T1 > **SP-HED** the defrost output is turned off. During this operation, the defrost timer is cleared. The fan output is switched according to the defrost output (heater), regardless of the **FID** parameter. 
HEH	0...10°	Heating hysteresis. If **HEH**=0 the heater function associated to the defrost output is inhibited.
CRT	0...30min	Compressor rest time. The output is switched on again after CRT minutes have elapsed since the previous switchover. We recommend to set **CRT**=03 with **HYS**<2.0°.
CT1	0...30min	Thermostat output run when probe T1 is faulty. With **CT1**=0 the output will always remain OFF.
CT2	0...30min	Thermostat output stop when probe T1 is faulty. With **CT2**=0 and **CT1**>0 the output will always be ON. *Example:* **CT1**=4, **CT2**= 6: In case of probe T1 failure, the compressor will cycle 4 minutes ON and 6 minutes OFF.
CSD	0..30min	Compressor stop delay after the door has been opened (active only if **DS**=YES).
2CD	0...120sec	Auxiliary compressor start delay. If **OAU** = 2CU the auxiliary output is switched on with a delay of **2CD** seconds after the main compressor has cut-in. Both compressors are turned off at the same time.
DFM	NON; TIM; FRO	Defrost start mode NON: defrost function is disabled *(the following parameter will be **FID**)*. TIM: regular time defrost. FRO: the defrost time count is only increased when the conditions occurs for frost to form on the evaporator (optimised time increase)
DFT	0...99 hours	Time interval among defrosts. When this time has elapsed since the last defrost, a new defrost cycle is started.
DFB	NO/YES	Defrost timer count backup. With **DFB**=YES, after a power interruption, the timer resumes the count from where it was left off with ±30 min. approximation. With **DFB**=NO, after a power interruption, the defrost timer will re-start to count from zero.
DLI	-50...120°	Defrost end temperature.
DTO	1...120min	Maximum defrost duration.
DTY	OFF; ELE; GAS	Defrost type OFF: off cycle defrost (Compressor and Heater OFF). ELE: electric defrost (Compressor OFF and Heater ON). GAS: hot gas defrost (Compressor and Heater ON).
DRN	0...30min	Pause after defrost (evaporator drain down time).
DDY	0...60min	Display during defrost. If **DDY**=0 during defrost the temperature continues to be displayed. If **DDY**>0, during defrost the display shows DEF, when defrost is over REC is displayed during **DDY** minutes.
FID	NO/YES	Fans active during defrost.
FDD	-50...120°	Evaporator fan re-start temperature after defrost.
FTO	0...120min	Maximum evaporator fan stop after defrost.
FTC	NO/YES	Optimised fan control enabling. With **FTC** = NO the fans remain on all the time.  Fig.2 Optimised fan control (**FTC**=YES)
FT1	0...180sec	Fan stop delay after compressor stop. See Fig. 2.
FT2	0...30min	Timed fan stop. With **FT2**=0 the fans remain on all the time.
FT3	0...30min	Timed fan run. With **FT3**=0, and **FT2** > 0, the fans remain off all the time.

ATM	NON; ABS; REL	Alarm threshold management. NON: all temperature alarms are inhibited (*the following parameter will be **ADO**).* ABS: the values programmed in **ALA** and **AHA** represent the real alarm thresholds. REL: the values programmed in **ALR** and **AHR** are alarm differentials referred to **SP** and **SP+HYS**.  Temperature alarm with relative thresholds, refrigerating control (**ATM**=REL, **C-H**=REF). Temperature alarm with relative thresholds, heating control (**ATM**=REL, **C-H**=HEA).
ALA	-50... 120°	Low temperature alarm threshold.
AHA	-50... 120°	High temperature alarm threshold.
ALR	-12... 0°	Low temperature alarm differential. With **ALR**=0 the low temperature alarm is excluded.
AHR	0... 12°	High temperature alarm differential. With **AHR**=0 the high temperature alarm is excluded.
ATI	T1; T2; T3	Probe used for temperature alarm detection.
ATD	0... 120min	Delay before alarm temperature warning.
ADO	0... 30min	Delay before door open alarm warning.
AHM	NON; ALR; STP;	Operation in case of high condenser alarm NON: high condenser alarm inhibited. ALR: in case of alarm, “HC” flashes in the display and the buzzer is switched on. STP: in addition to the alarm symbols displayed, the compressor is stopped and defrosts are suspended.
AHT	-50...120°	Condensation temperature alarm (referred to T3 probe).
ACC	0...52 weeks	Condenser periodic cleaning. When the compressor operation time, expressed in weeks, matches the **ACC** value programmed, “CL” flashes in the display. With **ACC**=0 the condenser cleaning warning is disabled and CND disappears from Info Menu.
HDS	1...5	Controller sensitivity for the automatic switchover from Group 1 to Group 2 (1=minimum, 5=maximum).
IISM	NON; MAN; HDD; DI2	Switchover mode to second parameter set NON: inhibition to use the second parameter group (*the following parameter will be **SB**).* MAN: button (M) switches the two parameter groups over. HDD: automatic switchover to the second parameter group, when heavy duty conditions are detected. DI2: switchover to the second parameter group when the auxiliary DI2 input makes.
IISL	-50... IISH	Minimum limit for **IISP** setting.
IISH	IISL... 120°	Maximum limit for **IISP** setting.
IISP	IISL... IISH	Setpoint in mode 2.
IIHY	1... 10°	OFF/ON differential in mode 2.
IIFT	NO/YES	Optimised fan control enabling in mode 2.
IIDF	0...99 hours	Defrost timer set to start a defrost in mode 2.
SB	NO/YES	Stand-by button (⏻) enabling.
DS	NO/YES	Door switch input enabling (closed when door is closed).
DI2	NON; HPS; IISM; RDS	DI2 digital input operation NON : digital input 2 not active. HPS: when contact opens a condensing unit high pressure alarm occurs. IISM : when contact makes the controller will use group 2 parameters. RDS : when contact makes a defrost is started (remote control).
LSM	NON; MAN; DOR	Light control mode NON : light output not controlled. MAN : light ouput controlled through button (M) (if **OAU**=LGT). DOR : light ouput switched on when door is opened (if **OAU**=LGT).
OAU	NON; 0-1; LGT; 2CU; 2EU; AL0; AL1	AUX output operation NON : output disabled (always off). 0-1 : the relay contacts follow the on/standby state of controller. LGT : output enabled for light control. 2CU : output programmed for the control of an auxiliary compressor. 2EU : output enabled for the control of the electrical defrost of a second evaporator. AL0 : contacts open when an alarm condition occurs. AL1 : contacts make when an alarm condition occurs.
INP	SN4; ST1	Temperature sensor selection. With **INP** = SN4, the probes must be the LAE models SN4..; with **INP** = ST1, the probes must be the LAE models ST1...
OS1	-12.5..12.5°C	Probe T1 offset.
T2	NO/YES	Probe T2 enabling (evaporator).
OS2	-12.5..12.5°C	Probe T2 offset.
T3	NON; DSP; CND; 2EU	Auxiliary probe T3 operation NON: probe T3 not fitted. DSP: temperature T3 to be displayed. CND: condenser temperature measurement. 2EU: second evaporator temperature measurement.
OS3	-12.5..12.5°C	Probe 3 offset.
TLD	1...30 min	Delay for minimum temperature (TLO) and maximum temperature (THI) logging.
SIM	0...100	Display slowdown.
ADR	1...255	AH1-5 address for PC communication.

WIRING DIAGRAMS





TECHNICAL DATA

Power supply
AH1-5...D 12Vdc ±10%, 3W
AH1-5...W 110 - 230Vac±10%, 50/60Hz, 3W
AH1-5...L 7-30Vdc, 3W

Relay outputs
Compressor 12(5)A 240Vac
Evap. fans 7(2)A 240Vac
Defrost 7(2)A 240Vac
Auxiliary loads 7(2)A 240Vac

Inputs
NTC 10KΩ@25°C LAE part No. SN4...
PTC 1000Ω@25°C LAE part No. ST1…

Measurement Range
-50…120°C, -55…240°F
-50 / -9.9 … 19.9 / 80°C (NTC10K only)

Measurement accuracy
<0.5°C within the measurement range

Real Time Clock battery
>150 hours; self-rechargeable

Operating conditions
-10 … +50°C; 15%...80% r.H.

CE (Reference Norms)
EN60730-1; EN60730-2-9;
EN55022 (Class B);
EN50082-1

Front protection
IP55

lae ELECTRONIC
VIA PADOVA, 25
31046 ODERZO /TV /ITALY
TEL. +39 - 0422 815320
FAX +39 - 0422 814073
www.lae-electronic.com
E-mail: sales@lae-electronic.com

BIT25

86x82x44 mm

Split Defrost Controller

● Three highly rated relay outputs ● Alternate set of parameters for energy saving ● Management of multiple alarms ● Option of setpoint adjustment via a potentiometer ● Standby button (On/Off) ● Option of universal power supply ECO ● Connection to LAE supervisory systems

Applications:

Upright refrigerators, bottle coolers, plug-in display cases for shops and supermarkets, cold stores, control panels.

BIT25 series

Functions		A0S2E-A	B1S3E-B
Temperature inputs	Thermostat	✓	✓
	Evaporator		✓
Digital inputs	DI1 digital input	✓	✓
	DI2 digital input		✓
Outputs	Thermostat	✓	✓
	Auxiliary 1	✓	✓
	Auxiliary 2		✓
Power supply	230Vac	✓	✓
Serial port	TTL	✓	
	RS485		✓

All models come with an alarm buzzer
On request, the AR2-5 is also available with gasket for a better protection between bezel and metal panel.

Technical Data: LCD-5S display unit

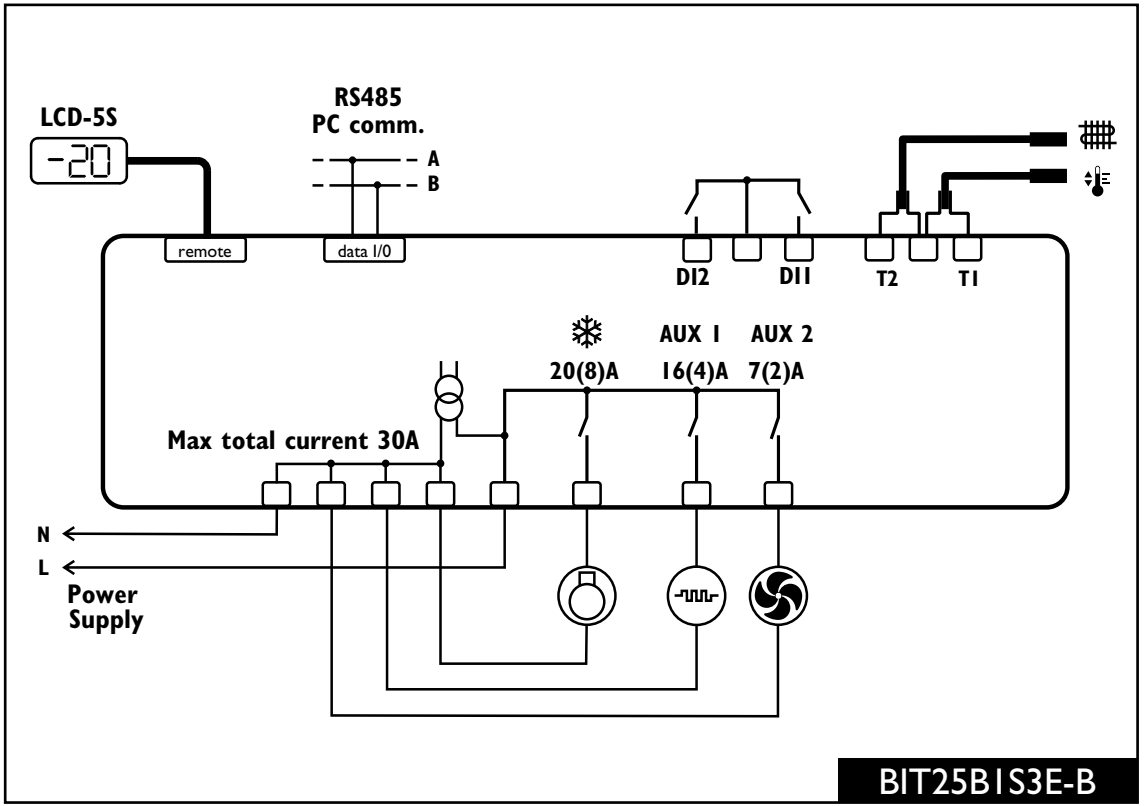
Dimensions :	77x35x20 mm (WxHxD)	**Panel cut-out:**	71x29mm
Front protection:			IP55

Technical Data

Range:	-50...110°C, -58...180°F
Resolution:	0.1 1 °C; °F
Precision:	<±0.5°C within the measurement range
Sensor type:	NTC10K
Power supply:	115Vac, 230Vac or universal 115..230Vac ±10% 50÷60Hz 3W

Wiring diagrams

Instruction


LCD-5S
-20
RS485
PC comm.
A
B
remote
data I/0
DI2
DI1
T2
T1
AUX I
AUX 2
20(8)A
16(4)A
7(2)A
Max total current 30A
N
L
Power
Supply
BIT25B1S3E-B

BIT25 INSTRUCTIONS FOR USE

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.

DESCRIPTION

Fig.1 - Front panel

- Info / Setpoint button.
- Manual defrost / Decrease button.

INDICATIONS

- Thermostat output
- Fan output
- Defrost output
- Activation of 2nd parameter set
- Alarm
- Increase button / Manual activation.
- Exit / Stand-by button.

INSTALLATION

- The BIT-25 controller has a size 86x82x44 mm (WxHxD).
- Make sure that electrical connections comply with the paragraph “wiring diagrams”. To reduce the effects of electromagnetic disturbance, keep the sensor and signal cables well separate from the power wires.
- Place the probe T1 inside the room in a point that truly represents the temperature of the stored product.
- If present, place the probe T2 on the evaporator where there is the maximum formation of frost.
- If probe T3 is connected to DI2, its function is determined by the parameter **T3M**. With **T3M**=DSP the probe measures the temperature to be displayed. With **T3M**=CND the probe measures the condenser temperature, it must therefore be placed between the fins of the condensing unit.

OPERATION

DISPLAY

During normal operation, the display shows either the temperature measured or one of the following indications:

dEF	Defrost in progress	h1	Room high temperature alarm
oFF	Controller in stand-by	Lo	Room low temperature alarm
cL	Condenser clean warning	E1	Probe T1 failure
do	Door open alarm	E2	Probe T2 failure
hc	Condenser high temperature alarm	E3	Probe T3 failure
AL	Generic Alarm		

INFO MENU

The information available in this menu is:

t1	Instant probe 1 temperature	tLo	Minimum probe 1 temperature recorded
t2 *	Instant probe 2 temperature	cnd **	Compressor working weeks
t3 *	Instant probe 3 temperature	Loc	Keypad state lock
th	Maximum probe 1 temperature recorded		

: displayed only if enabled (see §Configuration Parameters)* * : displayed only if **ACC** > 0*

Access to menu and information displayed.
- Press and immediately release button (i).
- With button (▼) or (▲) select the data to be displayed.
- Press button (i) to display value.
- To exit from the menu, press button (✕) or wait for 10 seconds.

Reset of THI, TLO, CND recordings
- With button (▼) or (▲) select the data to be reset.
- Display the value with button (i).
- While keeping button (i) pressed, use button (✕).

SETPOINT : display and modification
- Press button (i) for at least half second, to display the setpoint value.
- By keeping button (i) pressed, use button (▼) or (▲) to set the desired value (adjustment is within the minimum **SPL** and the maximum **SPH** limit).
- When button (i) is released, the new value is stored.

STAND-BY

Button (⏻), when pressed for 3 seconds, allows the controller to be put on a standby or output control to be resumed (with **SB**=YES only).

KEYPAD LOCK

The keypad lock avoids undesired, potentially dangerous operations, which might be attempted when the controller is operating in a public place. In the INFO menu, set parameter **LOC**=YES to inhibit all functions of the buttons. To resume normal operation of keypad, adjust setting so that **LOC**=NO.

SELECTION OF SECOND PARAMETER GROUP

It’s possible to select control parameters between two different pre-programmed groups, in order for the fundamental control parameters to be adapted quickly to changing needs. Changeover from Group **I** to Group **II** (and vice versa) may take place MANUALLY by pressing button (M) for 2 seconds (with **IISM**=MAN), or AUTOMATICALLY when **IISM**=DI2 and the AUXILIARY INPUT DI2 is activated (the activation of DI2 selects Group **II**). If **IISM**=NON, switchover to Group **II** is inhibited. The activation of Group **II** is signalled by the lighting up of the relevant LED on the controller display.

SETPOINT ADJUSTMENT VIA POTENTIOMETER

With **DI2**=PSP the setpoint is set via a 10KΩ linear potentiometer connected to DI2. The setpoint changes between **PSL** (10KΩ) and **PSL**+**PSR** (0Ω) proportionally. With **POF**=YES, if the potentiometer is turned to the minimum (0Ω), the controller will be put on standby. If the second parameter group is active, the setpoint used will be **IISP**.

DEFROST

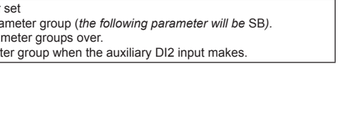
Automatic defrost. Defrost starts automatically when the defrost timer matches the time value set with **DFT**.
- Timed defrost. With **DFM**=TIM defrosts take place at regular intervals of **DFT** hours. For example, with **DFM**=TIM and **DFT**=06, a defrost will take place every 6 hours.
- Optimized defrost. With **DFM**=FRO the timer is increased only when the condition for frost to form in the evaporator occurs. Once the **DFT** value is reached, defrost takes place. If the evaporator works at 0°C, defrost frequency depends on the thermal load and climatic conditions. With setpoints much lower than 0°C, defrost frequency mainly depends on the refrigerator operating time.
- Defrost time count backup. At the power-up, if **DFB**=YES, the defrost timer resumes the time count from where it was left off before the power interruption. Vice versa, with **DFB**=NO, the time count re-starts from 0. In stand-by, the accumulated time count is frozen.

Manual or remote defrost start. It’s possible to manually start a defrost, by pressing button (❄) for 2 seconds, or defrost may be started remotely, if **DI1**=RDS (**DI2**=RDS), through the making of the auxiliary contact DI1 (DI2).
Defrost type. Once defrost has started, Compressor and Defrost outputs are controlled according to parameter **DTY**. If **FID**=YES, the evaporator fans are active during defrost.
Defrost termination. The actual defrost duration is influenced by a series of parameters.
- Time termination: **T2**=NO. the evaporator temperature is not monitored and defrost will last as long as time **DTO**.
- Temperature termination: **T2**=YES. In this case, if the sensor T2 measures the temperature **DLI** before the time **DTO** elapses, defrost will be terminated in advance.

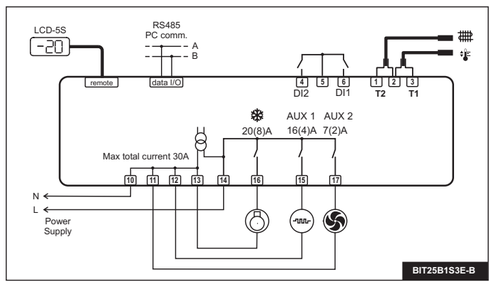
Resuming thermostatic cycle. When defrost is over, if **DRN** is greater than 0, all outputs will remain off for **DRN** minutes, in order for the ice to melt completely and the resulting water to drain. Moreover, the fans will re-start only when the evaporator temperature is lower than **FDD** (if **T2**=YES), or after **FTO** minutes have elapsed.
*Caution: if **DFM**=NON all defrost functions are inhibited; if **DFT**=0, automatic defrost functions are excluded; during a high pressure alarm or a DI1 (DI2) generic alarm, defrost is suspended; during defrost, high temperature alarm is bypassed.*

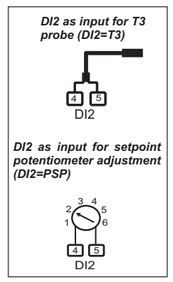
CONFIGURATION PARAMETERS

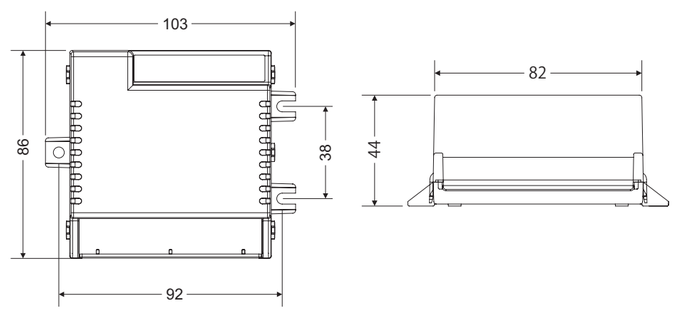
- To get access to the parameter configuration menu, press button (⏻) + (i) for 5 seconds.
- With button (▼) or (▲) select the parameter to be modified.
- Press button (i) to display the value.
- By keeping button (i) pressed, use button (▼) or (▲) to set the desired value.
- When button (i) is released, the newly programmed value is stored and the following parameter is displayed.
- To exit from the setup, press button (✕) or wait for 30 seconds.

PAR	RANGE	DESCRIPTION
SPL	-50..SPH	Minimum limit for SP setting.
SPH	SPL...110°C	Maximum limit for SP setting.
SP	SPL... SPH	Setpoint (value to be maintained in the room).
HYS	1.0...10.0°C	OFF/ON thermostat differential.
CRT	0...30min	Compressor rest time. The output is switched on again after CRT minutes have elapsed since the previous switchover. We recommend to set CRT=03 with HYS<2.0°.
CT1	0...30min	Thermostat output run when probe T1 is faulty. With CT1=0 the output will always remain OFF.
CT2	0...30min	Thermostat output stop when probe T1 is faulty. With CT2=0 and CT1>0 the output will always be ON. *Example:* CT1=4, CT2= 6: In case of probe T1 failure, the compressor will cycle 4 minutes ON and 6 minutes OFF.
CSD	0..30min	Compressor stop delay after the door has been opened (active only if D1=DOR or DI2=DOR).
DFM	NON; TIM; FRO	Defrost start mode **NON** : defrost function is disabled *(the following parameter will be* FCM*).* **TIM** : regular time defrost. **FRO** : the defrost time count is only increased when the conditions occur for frost to form on the evaporator (optimised time increase).
DFM = TIM or FRO	**DFT**	0...99 hours	Built-in timer value for an automatic defrost to take place.
	DFB	NO/YES	Defrost timer backup. With DFB=YES, after a power interruption, the timer resumes the count from where it was left off with ±30 min. approximation. With DFB=NO, after a power interruption, the defrost timer will re-start to count from zero.
	DLI	-50...110°C	Defrost end temperature.
	DTO	1...120min	Maximum defrost duration.
	DTY	OFF; ELE; GAS	Defrost type **OFF**: off cycle defrost (Compressor and Heater OFF). **ELE**: electric defrost (Compressor OFF and Heater ON). **GAS**: hot gas defrost (Compressor and Heater ON).
	DPD	0...240sec	Evaporator pump down. At the beginning of defrost, defrost outputs (determined by DTY) are OFF for DPD seconds.
	DRN	0...30min	Pause after defrost (evaporator drain down time).
	DDM	RT; LT; SP; DEF	Defrost display mode. During defrost the display will show: **RT**: the real temperature; **LT** : the last temperature before defrost; **SP** : the current setpoint value; **DEF** : “dEF”.
	DDY	0...60min	Display delay. The display shows the information selected with parameter DDM during defrost and for DDY minutes after defrost termination.
	FID	NO/YES	Fans active during defrost.
	FDD	-50...110°C	Evaporator fan re-start temperature after defrost (referred to T2 probe).
	FTO	0...120min	Maximum evaporator fan stop after defrost.
FCM	NON; TMP; TIM	Fan mode during thermostatic control. **NON** : The fans remain ON all the time; **TMP** : Temperature-based control. The fans are ON when the compressor is ON. When the compressor is turned OFF, the fans remain ON as long as the temperature difference T2-T1 is greater than FDT. The fans are turned ON again with FDH differential. (T1 = Air temperature, T2 = Evaporator temperature); **TIM** : Timed-based control. The fans are ON when the compressor is ON. When the compressor is OFF, the fans switch ON and OFF according to parameteres FT1, FT2, FT3. 
FDT	-12.0...0.0°C	Evaporator-Air temperature difference for the fans to turn OFF after the compressor has stopped.
FDH	1.0 ...12.0°C	Temperature differential for fan re-start. *Example*: FDT = -1.0, FDH=3.0. In this case, after the compressor has stopped, the fans are OFF when T2 > T1 - 1.0 (FDT), whereas the fans are ON when T2 < T1 - 4.0 (FDT-FDH).
FT1	0...180sec	Fan stop delay after compressor stop.
FT2	0 ... 30min	Timed fan stop. With FT2=0 the fans remain on all the time.
FT3	0 ... 30min	Timed fan run. With FT3=0, and FT2 > 0, the fans remain off all the time.
ATM	NON; ABS; REL	Alarm threshold management. **NON** : all temperature alarms are inhibited (*the following parameter will be* ADO*).* **ABS** : the values programmed in ALA and AHA represent the real alarm thresholds. **REL** : the values programmed in ALR and AHR are alarm differentials referred to SP and SP+HYS.  Temperature alarm with relative thresholds (ATM=REL).
ATM = ABS	**ALA**	-50 ... 110°C	Low temperature alarm threshold.
	AHA	-50 ... 110°C	High temperature alarm threshold.
ATM = REL	**ALR**	-12.0...0.0°C	Low temperature alarm differential. With ALR=0 the low temperature alarm is excluded.
	AHR	0.0 ...12.0°C	High temperature alarm differential. With AHR=0 the high temperature alarm is excluded.
ATM = ABS or REL	**ATI**	T1; T2; T3	Probe used for temperature alarm detection.
	ATD	0 ... 120min	Delay before alarm temperature warning.
ADO	0 ... 30min	Delay before door open alarm warning.
AHM	NON; ALR; STP;	Operation in case of high condenser alarm **NON** : high condenser alarm inhibited *(the following parameter will be* ACC*).* **ALR** : in case of alarm, “HC” flashes in the display and the buzzer is switched on. **STP** : in addition to the alarm symbols displayed, the compressor is stopped and defrosts are suspended.
AHT	-50...110°C	Condensation temperature alarm (referred to T3 probe). [only if AHM=ALR or AHM=STP]
ACC	0 ... 52 weeks	Condenser periodic cleaning. When the compressor operation time, expressed in weeks, matches the ACC value programmed, “CL” flashes in the display. With ACC=0 the condenser cleaning warning is disabled and CND disappears from Info Menu.
IISM	NON; MAN; DI2	Switchover mode to second parameter set **NON** : inhibition to use the second parameter group (*the following parameter will be* SB*).* **MAN** : button (M) switches the two parameter groups over. **DI2** : switchover to the second parameter group when the auxiliary DI2 input makes.
IISM = MAN or DI2	**IISL**	-50... IISH	Minimum limit for IISP setting.
	IISH	IISL... 110°C	Maximum limit for IISP setting.
	IISP	IISL... IISH	Setpoint in mode 2.
	IIHY	1.0... 10.0°C	OFF/ON differential in mode 2.
	IIFC	NON; TMP; TIM	Fan control in mode 2. See FCM.
	IIDF	0...99 hours	Built-in timer value for an automatic defrost to take place, in mode 2.
SB	NO/YES	Stand-by button (⏻) enabling.
DI1	NON; DOR; ALR; RDS.	DI1 digital input operation **NON** : digital input 1 not active. **DOR** : door input. **ALR** : when contact opens an alarm is generated (if AHM=STP, the compressor is stopped and defrosts are suspended). **RDS** : when contact makes a defrost is started (remote control).
DI2	NON; DOR; ALR; RDS; IISM; T3; PSP	DI2 digital input operation **NON** : digital input 2 not active. **DOR** : door input. **ALR** : when contact opens an alarm is generated (if AHM=STP, the compressor is stopped and defrosts are suspended). **RDS** : when contact makes a defrost is started (remote control). **IISM** : when contact makes the second parameter group is active. **T3** : probe T3 input. **PSP** : potentiometer setpoint input.
DI2 = T3	**T3M**	DSP; CND.	Auxiliary probe T3 operation **DSP** : temperature T3 to be displayed. **CND** : condenser temperature measurement.
	OS3	-12.5..12.5°C	Probe 3 offset.
DI2 = PSP	**PSL**	-50...70°C	Minimum setpoint adjusted via potentiometer.
	PSR	0.0...15.0 °C	Range of setpoint adusted via potentiometer Example: with PSL=2.0 and PSR=8.0, the setpoint changes between 2.0°C and 10.0°C (PSL+PSR).
	POF	NO/YES	Potentiometer standby enabling. With POF=YES, when the potentiometer is turned to the minimum, the controller will be put on standby.
LSM	NON; MAN; D1O; D2O; D2C.	Light control mode **NON** : light output not controlled. **MAN** : light ouput controlled through button (M) **D1O** : when DI1 is open, light output is on. **D2O** : when DI2 is open, light output is on. **D2C** : when DI2 is closed, light output is on.
OA1	NON; FAN; DEF; LGT; 0-1; ALO; ALC	AUX 1 output operation **NON** : output disabled (always off). **FAN** : output enabled for fan control. **DEF** : output enabled for defrost control. **LGT** : output enabled for light control. **0-1** : the relay contacts follow the on/standby state of controller. **ALO** : contacts open when an alarm condition occurs. **ALC** : contacts make when an alarm condition occurs.
OA2	See **OA1**	AUX2 output operation. See OA1.
OS1	-12.5..12.5°C	Probe T1 offset.
T2	NO/YES	Probe T2 enabling (evaporator).
OS2	-12.5..12.5°C	Probe T2 offset.
TLD	1...30 min	Delay for minimum temperature (TLO) and maximum temperature (THI) logging.
SCL	1°C; 2°C; °F	Readout scale. **1°C** : measuring range -50…110°C (0.1°C resolution within -9.9 ÷ 19.9°C interval, 1°C outside) **2°C** : measuring range -50…110°C **°F** : measuring range -58…180°F
SIM	0...100	Display slowdown.
ADR	1...255	BIT25 address for PC communication.

WIRING DIAGRAMS







TECHNICAL DATA

Power supply

BIT25...E	230Vac±10%, 50/60Hz, 3W
BIT25...U	115Vac±10%, 50/60Hz, 3W
BIT25…W	115…230Vac±10%, 50/60Hz, 3W

Relay output max loads

Compressor	20(8)A 240Vac
Auxiliary loads 1	16(4)A 240Vac
Auxiliary loads 2	7(2)A 240Vac

Input
NTC 10KΩ@25°C LAE Part No. SN4...

Measurement Range
-50 / -9.9 … 19.9 / 110°C
-50…110°C, -58…180°F

Measurement accuracy
<0.5°C within the measurement range

Operating conditions
-10 … +50°C; 15%...80% r.H.

CE (Approvals and Reference norms)
EN60730-1; EN60730-2-9; EN55022 (Class B); EN50082-1

lae ELECTRONIC
VIA PADOVA, 25
31046 ODERZO /TV /ITALY
TEL. +39 - 0422 815320
FAX +39 - 0422 814073
www.lae-electronic.com
E-mail: sales@lae-electronic.com

BD1-28

107x95x47 mm DIN rail

Clever Split Defrost Controller

Refrigeration controller with cyclic defrosts ● Enhanced ECO Energy Saving management ● Synchronised defrosts among more controllers ● Optional control of a second compressor or evaporator ● Up to 2 auxiliary outputs (Light, switched loads etc.) ● Excellent evaporator fan control ● Universal mains power supply ● Optional power supply for refrigerated transports ● Several alarm sources: temperature, door, condenser high temperature etc. ● Quick programming through ZOT-BD1 ● Connection to LAE supervisory systems, including wireless option ● Many display options: coloured LED's with DU5S or new high contrast LCD, fully customised

Applications:

Upright refrigerators, plug-in and supermarket display cases, cold stores, control panels.

BD1-28 series

Functions		B0Q3W-A	C1S4L-C	C1S5W-B
Temperature inputs	Thermostat	✓	✓	✓
	Evaporator	✓	✓	✓
	Auxiliary		✓	✓
DI1, DI2 digital inputs	Voltage free contact	✓		
DI3 aux. digital input	Voltage free contact/ defrost synchronization		✓	✓
Outputs	Thermostat	✓	✓	✓
	Evaporator fans	✓	✓	✓
	Defrost	✓	✓	✓
	Auxiliary 1		✓	✓
	Auxiliary 2			✓
Connections	Quick with M/F connectors	✓		
	Screw terminals		✓	✓
Power supply	100÷240Vac	✓		✓
	7÷30Vdc		✓	
Aux functions	TTL serial port	✓		
	RS485 serial port			✓
	RF module		✓	

All models come with an alarm buzzer.

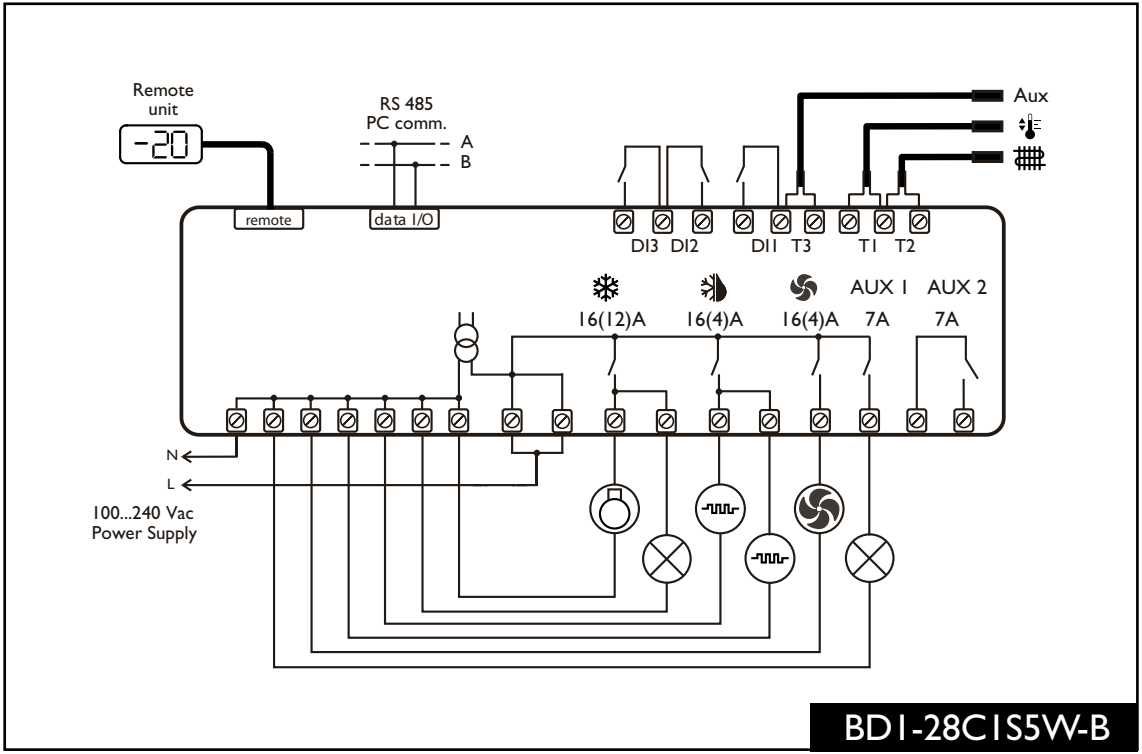
Technical Data DU5S: Red LED display unit

Dimensions :	77x35x20 mm (WxHxD)	**Panel cut-out:**	71x29mm
Front protection:			IP55

Technical Data

Range:	-50÷110°C, -58...180°F
Resolution:	0.1 1 °C; °F
Precision:	<±0.5°C within the measurement range
Sensor type:	NTC 10KΩ@25°C
Power supply:	100÷240Vac ±10% 50÷60Hz 3W

Wiring diagrams | Applications | Instruction


Remote unit
-20
remote
RS 485
PC comm.
A
B
data I/O
Aux
DI3 DI2
DI1 T3
T1 T2
16(12)A
16(4)A
16(4)A
AUX 1
7A
AUX 2
7A
N
L
100...240 Vac
Power Supply
BD1-28C1S5W-B

Upright refrigerators, plug-in and supermarket display cases, cold stores, control panels.

BD1-28 INSTRUCTIONS FOR USE

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.

DESCRIPTION

Fig.1 - Front panel

[i] Info / Setpoint button.

[▼] Manual defrost / Decrease button.

INDICATIONS

- Thermostat output
- Fan output
- Defrost output
- II° Activation of 2nd parameter set
- Alarm

[▲M] Manual activation / Increase button.

[✕⏻] Exit / Stand-by button.

INSTALLATION

- The BD1-28 controller, size 107x95x47 mm (WxHxD), is to be secured to a DIN rail in such a position as to ensure that no liquid infiltrates causing serious damage and compromising safety.
- Make sure that electrical connections comply with the paragraph "wiring diagrams". To reduce the effects of electromagnetic disturbance, keep the sensor and signal cables well separate from the power wires.
- Place the probe T1 inside the room in a point that truly represents the temperature of the stored product.
- Place the probe T2 on the evaporator where there is the maximum formation of frost.
- The function of probe T3 is determined by the parameter T3. With **T3**=DSP the probe measures the temperature to be displayed. With **T3**=CND the probe measures the condenser temperature, it must therefore be placed between the fins of the condensing unit. With **T3**=2EU the probe measures the temperature of the second evaporator and it must therefore be placed where there is the maximum formation of frost. With **T3**=NON, the third probe is disabled.

OPERATION

DISPLAY

During normal operation, the display shows either the temperature measured or one of the following indications:

dEF	Defrost in progress	hP	Condenser high pressure alarm
oFF	Controller in stand-by	h1	Room high temperature alarm
cL	Condenser clean warning	Lo	Room low temperature alarm
do	Door open alarm	E1	Probe T1 failure
hc	Condenser high temperature alarm	E2	Probe T2 failure
		E3	Probe T3 failure

INFO MENU

The information available in this menu is:

t1	Instant probe 1 temperature	th1	Maximum probe 1 temperature recorded
t2	* Instant probe 2 temperature	tLo	Minimum probe 1 temperature recorded
t3	* Instant probe 3 temperature	cnd	** Compressor working weeks
		Loc	Keypad state lock

: displayed only if enabled (see §Configuration Parameters) **: displayed only if* **ACC > 0

Access to menu and information displayed.
- Press and immediately release button [i] .
- With button [▼] or [▲] select the data to be displayed.
- Press button [i] to display value.
- To exit from the menu, press button [✕] or wait for 10 seconds.

Reset of THI, TLO, CND recordings
- With button [▼] or [▲] select the data to be reset.
- Display the value with button [i].
- While keeping button [i] pressed, use button [✕].

SETPOINT : display and modification
- Press button [i] for at least half second, to display the setpoint value.
- By keeping button [i] pressed, use button [▼] or [▲] to set the desired value (adjustment is within the minimum **SPL** and the maximum **SPH** limit).
- When button [i] is released, the new value is stored.

STAND-BY

Button [⏻], when pressed for 3 seconds, allows the controller to be put on a standby or output control to be resumed (with **SB**=YES only).

KEYPAD LOCK

The keypad lock avoids undesired, potentially dangerous operations, which might be attempted when the controller is operating in a public place. In the INFO menu, set parameter **LOC**=YES to inhibit all functions of the buttons. To resume normal operation of keypad, adjust setting so that **LOC**=NO.

SELECTION OF SECOND PARAMETER GROUP

It's possible to select control parameters between two different pre-programmed groups, in order for the fundamental control parameters to be adapted quickly to changing needs. Changeover from Group **I** to Group **II** (and vice versa) may take place MANUALLY by pressing button [M] for 2 seconds (with **IISM**=MAN), or AUTOMATICALLY when ECO conditions are detected (with **IISM**=ECO), or when **IISM**=DI, **DxO**=IISM and the digital input is activated (the activation of DIx selects Group **II**, x=1,2,3). If **IISM**=NON, switchover to Group **II** is inhibited. The activation of Group **II** is signalled by the lighting up of the relevant LED on the controller display.

DEFROST

Automatic defrost. Defrost starts automatically as soon as the time set with parameter **DFT** has elapsed.
- Timed defrost. With **DFM**=TIM defrosts take place at regular intervals when the timer reaches the value of **DFT**. For example, with **DFM**=TIM and **DFT**=06, a defrost will take place every 6 hours.
- Optimized defrost. With **DFM**=FRO the timer is only increased when the conditions occur for frost to form on the evaporator, until the time set with parameter **DFT** is matched. If the evaporator works at 0°C, defrost frequency depends on the thermal load and climatic conditions. With setpoints much lower than 0°C, defrost frequency mainly depends on the refrigerator operating time.
- Synchronised defrost. With **D3O**=DSY and when more units are linked to each other, synchronised defrosts of all linked controllers will take place. The first controller which will start defrost, will also get all other controllers synchronised.
- Defrost time count backup. At the power-up, if **DFB**=YES, the defrost timer resumes the time count from where it was left off before the power interruption. Vice versa, with **DFB**=NO, the time count re-starts from 0. In stand-by, the accumulated time count is frozen.

Manual or remote defrost start. It's possible to manually start a defrost, by pressing button [❄] for 2 seconds, or defrost may be started remotely, if **DxO**=RDS, through the activation of the auxiliary contact DIx.

Defrost type. Once defrost has started, Compressor and Defrost outputs are controlled according to parameter **DTY**. If **FID**=YES, the evaporator fans are active during defrost.

Defrost termination. The actual defrost duration is influenced by a series of parameters.
- Time termination: **T2**=NO and **T3** different from 2EU: the evaporator temperature is not monitored and defrost will last as long as time **DTO**.
- Temperature monitoring of one evaporator: **T2**=YES and **T3** different from 2EU. In this case, if the sensor T2 measures the temperature **DLI** before the time **DTO** elapses, defrost will be terminated in advance.
- Temperature monitoring of two evaporators: **T2**=YES, **T3**=2EU, **AOx**=2EU. This function is for the control of two independent evaporators and it switches off the individual heating of the evaporator which gets to temperature **DLI** first, waiting for the second evaporator to get to that temperature before the time **DTO** elapses.

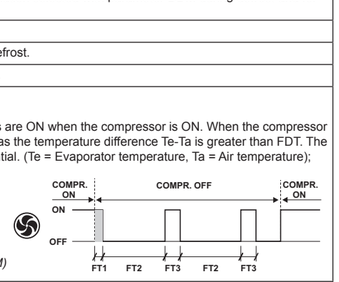
Resuming thermostatic cycle. When defrost is over, if **DRN** is greater than 0, all outputs will remain off for **DRN** minutes, in order for the ice to melt completely and the resulting water to drain. Moreover, if probe T2 is active (**T2**=YES), the fans will re-start when the evaporator gets to a temperature lower than **FDD**; Vice versa, if probe T2 is not active (**T2**=NO) or after defrost has come to an end, such condition does not occur by end of the time **FTO**, after **FTO** minutes have elapsed the fans will be switched on anyway.

Caution: if ***DFM****=NON or* ***C-H****=HEA all defrost functions are inhibited; if* ***DFT****=0, automatic defrost functions are excluded. During a high pressure alarm, defrost is suspended. During defrost, high temperature alarm is bypassed.*

CONFIGURATION PARAMETERS

- To get access to the parameter configuration menu, press button [⏻] + [i] for 5 seconds.
- With button [▼] or [▲] select the parameter to be modified.
- Press button [i] to display the value.
- By keeping button [i] pressed, use button [▼] or [▲] to set the desired value.
- When button [i] is released, the newly programmed value is stored and the following parameter is displayed.
- To exit from the setup, press button [✕] or wait for 30 seconds.

PAR	RANGE	DESCRIPTION
SPL	-50..SPH	Minimum limit for SP setting.
SPH	SPL...110°	Maximum limit for SP setting.
SP	SPL... SPH	Setpoint (value to be maintained in the room).
C-H	REF; HEA	Refrigerating (REF) or Heating (HEA) control mode.
HY0	1...10°	Thermostat OFF -> ON differential.
HY1	0...10°	Thermostat ON -> OFF differential.
CRT	0...30min	Compressor rest time. The output is switched on again after CRT minutes have elapsed since the previous switchover. We recommend to set CRT=03 with HY0<2.0°.
CT1	0...30min	Compressor/Heater output run when probe T1 is faulty. With CT1=0 the output will always remain OFF.
CT2	0...30min	Compressor/Heater output stop when probe T1 is faulty. With CT2=0 and CT1>0 the output will always be ON. *Example:* CT1=4, CT2= 6: In case of probe T1 failure, the compressor will cycle 4 minutes ON and 6 minutes OFF.
DFM	NON; TIM; FRO	Defrost start mode **NON** : defrost function is disabled *(the following parameter will be* FCM*).* **TIM** : regular time defrost. **FRO** : the defrost time count is only increased when the conditions occur for frost to form on the evaporator (optimised time increase).
DFT	0...99 hours	Time interval among defrosts. When this time has elapsed since the last defrost, a new defrost cycle is started.
DFB	NO/YES	Defrost timer backup. With DFB=YES, after a power interruption, the timer resumes the count from where it was left off with ±30 min. approximation. With DFB=NO, after a power interruption, the defrost timer will re-start to count from zero.
DLI	-50...110°	Defrost end temperature.
DTO	1...120min	Maximum defrost duration.
DTY	OFF; ELE; GAS	Defrost type **OFF**: off cycle defrost (Compressor and Heater OFF). **ELE**: electric defrost (Compressor OFF and Heater ON). **GAS**: hot gas defrost (Compressor and Heater ON).
DSO	OFF; LO; HI	Defrost start optimisation **OFF** : no optimisation. **LO** : defrost waits until the compressor cut-out. **HI** : defrost waits until the compressor cut-in.
SOD	0...30 min	Start optimisation delay.
DPD	0...240sec	Evaporator pump down. At the beginning of defrost, defrost outputs (determined by DTY) are OFF for DPD seconds.
DRN	0...30min	Pause after defrost (evaporator drain down time).
DDM	RT; LT; SP; DEF	Defrost display mode. During defrost the display will show: **RT**: the real temperature; **LT** : the last temperature before defrost; **SP** : the current setpoint value; **DEF** : "dEF".
DDY	0...60min	Display delay. The display shows the information selected with parameter DDM during defrost and for DDY minutes after defrost termination.
FID	NO/YES	Fans active during defrost.
FDD	-50...110°	Evaporator fan re-start temperature after defrost.
FTO	0...120min	Maximum evaporator fan stop after defrost.
FCM	NON; TMP; TIM	Fan mode during thermostatic control. **NON** : The fans remain ON all the time; **TMP** : Temperature-based control. The fans are ON when the compressor is ON. When the compressor is turned OFF, the fans remain ON as long as the temperature difference Te-Ta is greater than FDT. The fans are turned ON again with FDH differential. (Te = Evaporator temperature, Ta = Air temperature); **TIM** : Timed-based control. The fans are ON when the compressor is ON. When the compressor is OFF, the fans switch ON and OFF according to parameteres FT1, FT2, FT3 (See Fig.2). *Fig.2 Time-optimised fan control (FCM=TIM)*
FDT	-12...0°	Evaporator-Air temperature difference for the fans to turn OFF after the compressor has stopped.
FDH	1...12°	Temperature differential for fan re-start. *Example*: FDT = -1, FDH=3. In this case, after the compressor has stopped, the fans are OFF when Te > Ta - 1 (FDT), whereas the fans are ON when Te < Ta - 4 (FDT-FDH).
FT1	0...180sec	Fan stop delay after compressor/heater stop. See Fig. 2
FT2	0...30min	Timed fan stop. With FT2=0 the fans remain on all the time.
FT3	0...30min	Timed fan run. With FT3=0, and FT2 > 0, the fans remain off all the time.
ATM	NON; ABS; REL	Alarm threshold management. **NON** : all temperature alarms are inhibited (*the following parameter will be* ACC*).* **ABS** : the values programmed in ALA and AHA represent the real alarm thresholds. **REL** : the alarm threshold is obtained by the sum of setpoint, thermostat differential and ALR/AHR.
ALA	-50... 110°	Low temperature alarm threshold.
AHA	-50... 110°	High temperature alarm threshold.
ALR	-12... 0°	Low temperature alarm differential. With ALR=0 the low temperature alarm is excluded.
AHR	0... 12°	High temperature alarm differential. With AHR=0 the high temperature alarm is excluded.
ATI	T1; T2; T3	Probe used for temperature alarm detection.
ATD	0... 120min	Delay before alarm temperature warning.
ACC	0...52 weeks	Condenser periodic cleaning. When the compressor operation time, expressed in weeks, matches the **ACC** value programmed, "CL" flashes in the display. With ACC=0 the condenser cleaning warning is disabled and CND disappears from Info Menu.
IISM	NON; MAN; ECO; DI	Switchover mode to second parameter set **NON** : inhibition to use the second parameter group (*the following parameter will be* SB*).* **MAN** : button [M] switches the two parameter groups over. **ECO** : automatic switchover to the second parameter group, when ECO conditions are detected. **DI** : switchover to the second parameter group when DIx input is on.
IISL	-50... IISH	Minimum limit for IISP setting.
IISH	IISL... 110°	Maximum limit for IISP setting.
IISP	IISL... IISH	Setpoint in mode 2.
IIH0	1... 10°	Thermostat OFF->ON differential in mode 2.
IIH1	0... 10°	Thermostat ON->OFF differential in mode 2.
IIDF	0...99 hours	Time interval among defrosts in mode 2.
IIFC	NON;TMP; TIM	Fan control in mode 2. See FCM.
ECS	1...5	Controller sensitivity for the automatic switchover from Group **I** to Group **II** (1=minimum, 5=maximum).



PAR	RANGE	DESCRIPTION
EPT	0...240 min	Eco pull-down time. Only with IISM=ECO. Group I parameters are used in regulation for at least EPT minutes. See Fig.3
SB	NO/YES	Stand-by button [⏻] enabling.
DSM	NON; ALR; STP	Door switch input mode: **NON** : door switch inhibited **ALR** : when DIx=DOR and the digital input is on, an alarm is generated after ADO minutes **STP** : when DIx=DOR and the digital input is on, in addition to the alarm, the fans are immediately stopped and the compressor is stopped after CSD minutes.
DAD	0...30 min	Delay before door open alarm warning.
CSD	0...30 min	Compressor/heater stop delay after door has been opened.
D1O	NON; DOR; ALR; IISM; RDS	DI1 digital input operation **NON** : digital input 1 not active. **DOR** : door input. **ALR** : when the input is on, an alarm is generated (if AHM=STP, the compressor is stopped and the defrosts are suspended). **IISM** : when the input is on, the controller will use group 2 parameters. **RDS** : when the input is on, a defrost is started (remote control).
D1A	OPN; CLS.	DI1 digital input activation. **OPN** : on open **CLS** : on close
D2O	See D1O	DI2 digital input operation. See D1O.
D2A	OPN; CLS.	DI2 digital input activation. **OPN** : on open **CLS** : on close
D3O	NON; DOR; ALR; IISM; RDS; DSY.	DI3 digital input operation **NON** ... **RDS** : See D1O. **DSY** : defrost synchronization. The controllers will all start and end defrost together. The first controller in defrost will get defrost of all the others started. The last controller ending defrost will get defrost of all the others stopped.
D3A	OPN; CLS.	DI3 digital input activation. **OPN** : on open **CLS** : on close
LSM	NON; MAN; ECO; DI1; DI2; DI3.	Light control mode **NON** : light output not controlled. **MAN** : light ouput controlled through button [M] (if OAx=LGT). **ECO** : lights activated/deactivated following the ECO state. **DIx** : lights activated/deactivated following the DIx state.
LSA	OPN; CLS	Light activation (only with LSM=ECO or LSM=DIx). **OPN** : lights on with DIx open or ECO mode deactivated. **CLS** : lights on with DIx closed or ECO mode activated.
OA1	NON; LGT; 0-1; 2CU; 2EU; ALO; ALC	AUX 1 output operation **NON** : output disabled (always off). **LGT** : output enabled for light control. **0-1** : the relay contacts follow the on/standby state of controller. **2CU** : output programmed for the control of an auxiliary compressor. **2EU** : output enabled for the control of the electrical defrost of a second evaporator. **ALO** : contacts open when an alarm condition occurs. **ALC** : contacts make when an alarm condition occurs.
OA2	See **OA1**	AUX2 output operation. See OA1.
2CD	0...120 sec	Auxiliary compressor start delay. If OAx=2CU the auxiliary output is switched on with a delay of 2CD seconds after the main compressor has cut-in. Both compressors are turned off at the same time.
OS1	-12.5..12.5°	Probe T1 offset.
T2	NO/YES	Probe T2 enabling (evaporator).
OS2	-12.5..12.5°	Probe T2 offset.
T3	NON; DSP; CND; 2EU	Auxiliary probe T3 operation **NON** : probe T3 not fitted. **DSP** : temperature T3 to be displayed. **CND** : condenser temperature measurement. **2EU** : second evaporator temperature measurement.
OS3	-12.5..12.5°	Probe 3 offset.
AHM	NON; ALR; STP;	Operation in case of high condenser alarm **NON** : high condenser alarm inhibited. **ALR** : in case of alarm, "HC" flashes in the display and the buzzer is switched on. **STP** : in addition to the alarm symbols displayed, the compressor is stopped and defrosts are suspended.
AHT	-50...110°	Condensation temperature alarm (referred to T3 probe).
TLD	1...30 min	Delay for minimum temperature (TLO) and maximum temperature (THI) logging.
TDS	T1; 1-2; T3	Selects the temperature probe to be displayed. **T1** : probe T1 **1-2** : the AVG-weighted average between T1 and T2 **T3** : probe T3
AVG	0...100%	The relative weight of T2 on T1 (if TDS = 1-2) Example 1: T1 = -5°, T2 = -20°, AVG = 100%. The displayed temperature will be -20° (T1 has no effect) Example 2: T1 = -5°, T2 = -20°, AVG = 60%. The displayed temperature will be -14.
SCL	1°C; 2°C; °F	Readout scale. **1°C** : measuring range -50…110°C (0.1°C resolution within -9.9 ÷ 19.9°C interval, 1°C outside) **2°C** : measuring range -50 … 110°C **°F** : measuring range -55 … 180°F
SIM	0...100	Display slowdown.
ADR	1...255	BD1-28 address for PC communication.

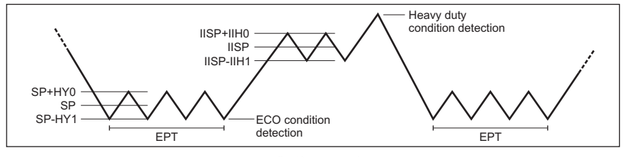


Fig.3 EPT parameter

TECHNICAL DATA

Power supply

BD1-28….W 100-240Vac ±10%, 50/60Hz, 3W

Relay output max loads (240Vac)

	BD1-28..S/T..-.	BD1-28..Q/R..-.
Compressor	16A resistive 12 FLA 48 RLA	12A resistive 12 FLA 48 RLA
Evap. Fan	16A resistive 4 FLA 12 RLA	8A resistive 4 FLA 12 RLA
Defrost	16A resistive 4 FLA 12 LRA	16A resistive 4 FLA 12 LRA
Auxiliary loads 1	7A resistive	7A resistive
Auxiliary loads 2	7A resistive	7A resistive

Input

NTC 10KΩ@25°C LAE Part No. SN4...

Measurement Range

-50…110°C, -58…180°F
-50 / -9.9 … 19.9 / 110°C

Measurement accuracy

<0.5°C within the measurement range

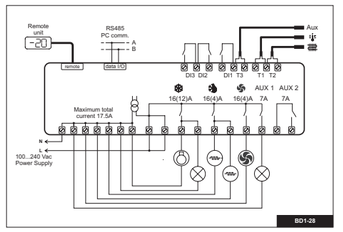
Operating conditions

-10 … +50°C; 15%...80% r.H.

CE (Approvals and Reference norms)

EN60730-1; EN60730-2-9; EN55022 (Class B); EN50082-1

WIRING DIAGRAMS



lae ELECTRONIC

VIA PADOVA, 25
31046 ODERZO /TV /ITALY
TEL. +39 - 0422 815320
FAX +39 - 0422 814073
www.lae-electronic.com
E-mail: sales@lae-electronic.com

BR1-28

107x95x47 mm DIN rail

Clever Split Defrost Controller with RTC

Up to 6 real time defrosts ● Enhanced ECO Energy Saving management ● Synchronised defrosts among more controllers ● Optional control of a second compressor or evaporator ● Up to 2 auxiliary outputs (Light, switched loads etc.) ● Excellent evaporator fan control ● Universal mains power supply ● Optional power supply for refrigerated transports ● Several alarm sources: temperature, door, condenser high temperature etc. ● Quick programming through ZOT-BR1 ● Connection to LAE supervisory systems, including wireless option ● Many display options: coloured LED's with DU5S or new high contrast LCD, fully customised

Applications

Cold stores, control panels, upright refrigerators, plug-in and supermarket display cases, and all those plants where real time defrost starts are needed.

BR1-28 series

Functions		B0Q3W-A	C1S4L-C	C1S5W-B
Temperature inputs	Thermostat	✓	✓	✓
	Evaporator	✓	✓	✓
	Auxiliary		✓	✓
DI1, DI2 digital inputs	Voltage free contact	✓		
DI3 aux. digital input	Voltage free contact/ defrost synchronization		✓	✓
Outputs	Thermostat	✓	✓	✓
	Evaporator fans	✓	✓	✓
	Defrost	✓	✓	✓
	Auxiliary 1		✓	✓
	Auxiliary 2			✓
Connections	Quick with M/F connectors	✓		
	Screw terminals		✓	✓
Power supply	100÷240Vac	✓		✓
	7÷30Vdc		✓	
Aux functions	TTL serial port	✓		
	RS485 serial port			✓
	RF module		✓	

All models come with an alarm buzzer.

Technical Data DU5S: Red LED display unit

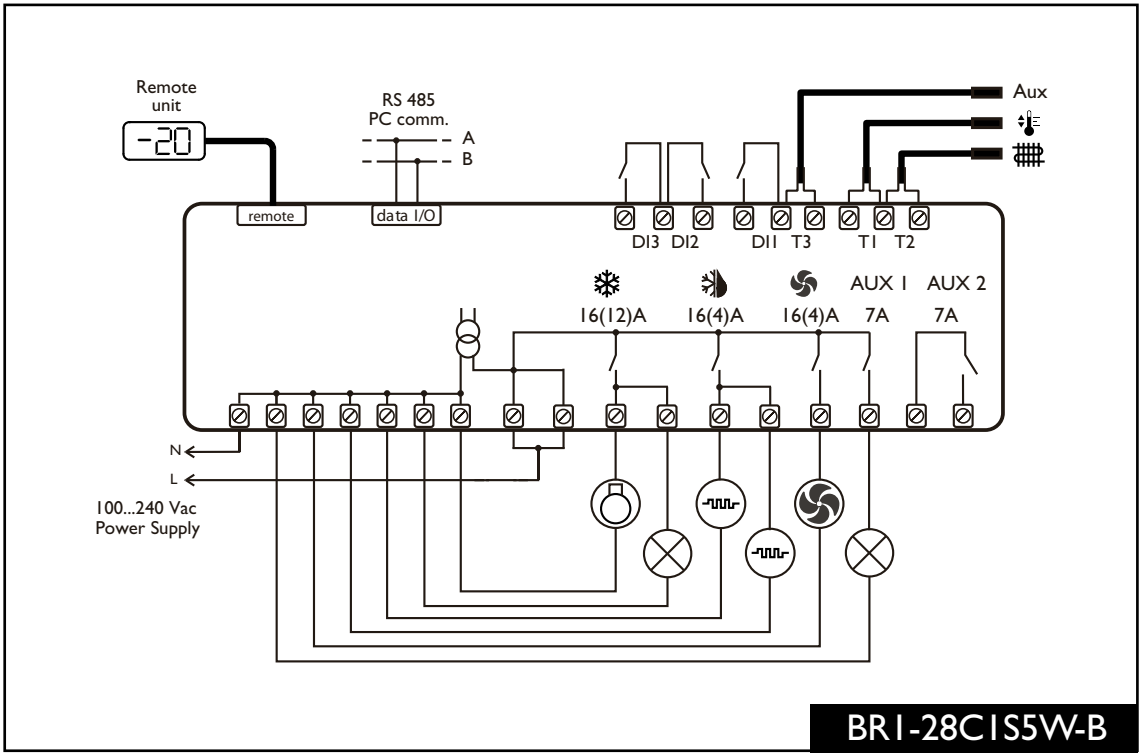
Dimensions :	77x35x20 mm (WxHxD)	**Panel cut-out:**	71x29mm
Front protection:			IP55

Technical Data

Range:	-50÷110°C, -58...180°F
Resolution:	0.1 1 °C; °F
Precision:	<±0.5°C within the measurement range
Sensor type:	NTC 10KΩ@25°C
Power supply:	100÷240Vac ±10% 50÷60Hz 3W

Wiring diagrams

Applications


Remote unit
-20
RS 485 PC comm.
A
B
Aux
remote
data I/O
DI3 DI2
DI1 T3
T1 T2
16(12)A
16(4)A
16(4)A
AUX 1 7A
AUX 2 7A
N
L
100...240 Vac Power Supply
BR1-28C1S5W-B

Cold stores, control panels, upright refrigerators, plug-in and supermarket display cases, and all those plants where real time defrost starts are needed.

LCD-DISPLAY

New High Contrast Technology

- May be matched to the latest generation LAE controllers
- May be customised to suit specific aesthetical customer's needs.

MS-27

71x97x61 mm DIN Rail

Multi-compressor or multi-fan controller

Four ON/OFF outputs for the control of single or multi-stage compressors or fans. ● Proportional output for speed control (inverters) ● Output with change-over contacts for alarm control ● Input for pressure transmitter (0/4…20mA) or for a temperature probe (NTC10K) ● Two digital inputs on voltage free contact for programmable function, up to three digital optocoupled voltage inputs for a complete system diagnostics ● Selection of the control algorithm: rotation of outputs, sequential activation, optimisation of the available power ● Pressure – Temperature conversion according to gas used ● Storage of the latest nine alarms ● Automatic maintenance management ● 115Vac or 230Vac power supply by means of built-in transformer ● Connections on screw terminals or quick connectors ● DIN-Rail mount ● Connection to supervisory PC.

Applications:

for cryogenerators in supermarkets, cold stores and all cryogenic systems with variable demand.

MS27 series

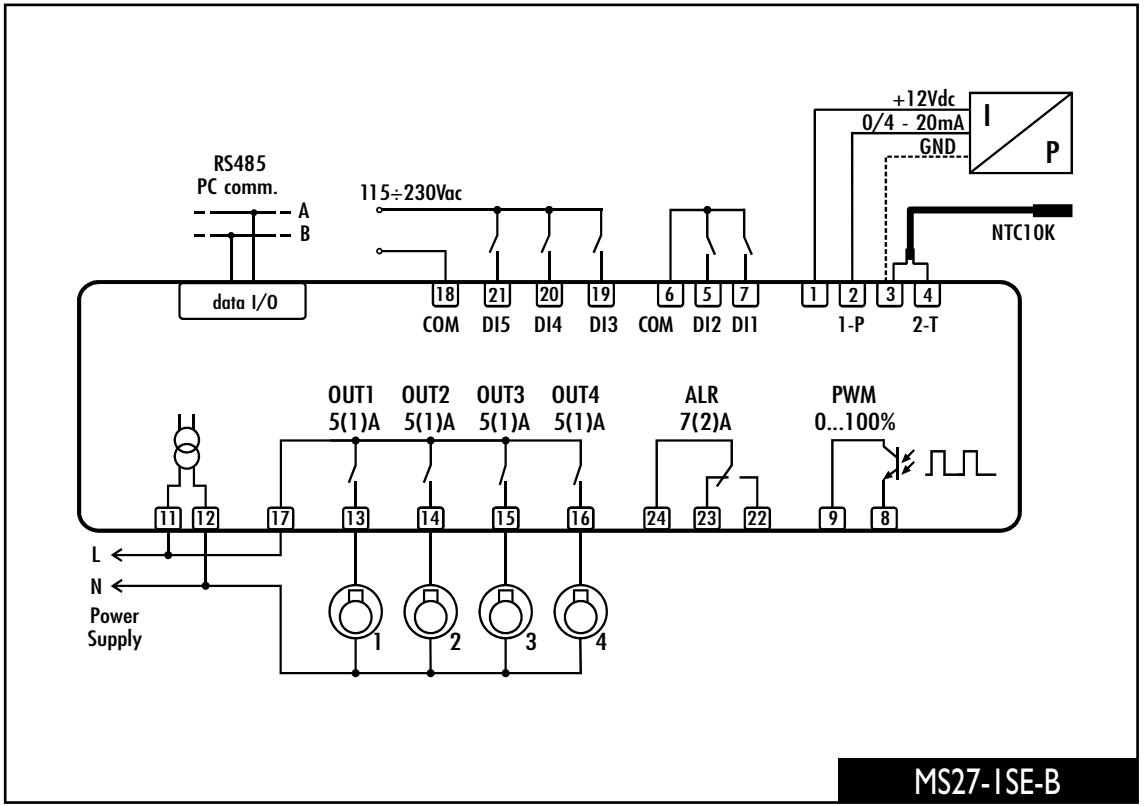
Functions		-1QE-B	-1SE-A	-1SU-B
Connections	Screw terminals		✓	✓
	Quick on M/F terminals	✓		
Power supply	230Vac	✓	✓	
	115Vac			✓
Serial port	TTL		✓	
	RS485	✓		✓

MS27: Technical Data

Pressure input	type:	0/4…20mA
	range:	-1.0…45.0bar
	resolution:	0.1bar
	accuracy:	±0.2bar
Temperature input	type:	NTC10K
	range:	-50.0…120.0°C
	resolution:	0.5°C
	accuracy:	±0.5°C
Power supply	MS27…E	230Vac±10%, 50/60Hz, 3W
	MS27…U	115Vac±10%, 50/60Hz, 3W
Relay outputs	OUT1…OUT4	5(1)A
	Alarm	7(2)A
Front protection		IP55

Wiring diagrams

Instruction


RS485
PC comm.
A
B
data I/O
115÷230Vac
18
21
20
19
COM
DI5
DI4
DI3
6
5
7
COM
DI2
DI1
+12Vdc
0/4 - 20mA
GND
I
P
NTC10K
1
2
3
4
1-P
2-T
OUT1
5(1)A
OUT2
5(1)A
OUT3
5(1)A
OUT4
5(1)A
ALR
7(2)A
PWM
0...100%
11
12
17
13
14
15
16
24
23
22
9
8
L
N
Power
Supply
1
2
3
4
MS27-1SE-B

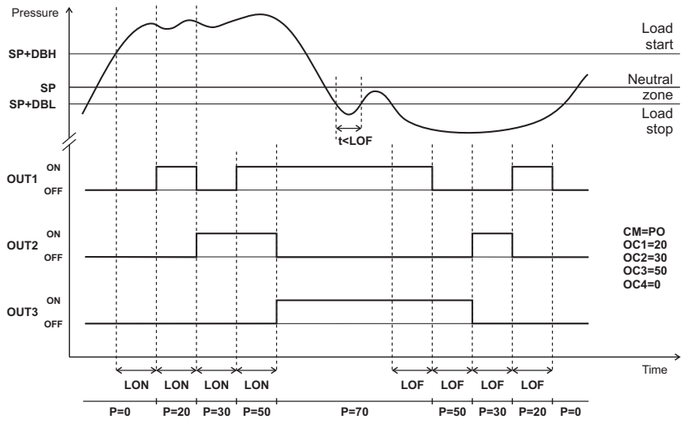


Fig.4 Control by optimisation of the available power

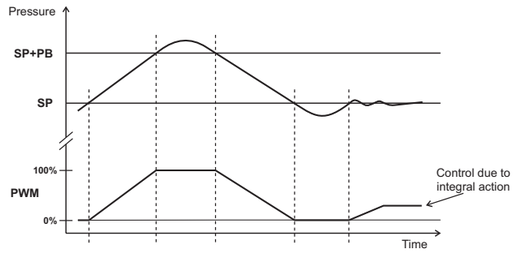
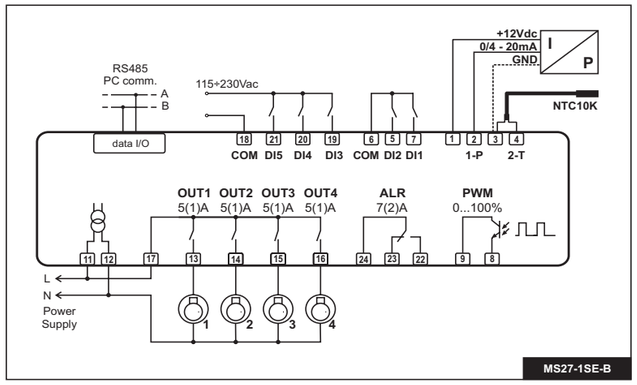


Fig.5 PWM output control

WIRING DIAGRAMS



TECHNICAL DATA

Power supply
MS27…E 230Vac±10%, 50/60Hz, 3W
MS27…U 115Vac±10%, 50/60Hz, 3W

Relay outputs
OUT1…OUT4 5(1)A
Alarm 7(2)A

Pressure input
type: 0/4…20mA
range: -1.0…45.0bar
resolution: 0.1bar

Temperature input
type: NTC10K (LAE SN4…)
range: -50.0…120.0°C
resolution: 0.5°C (-20.0…80.0); 1°C out of that range

Operating conditions
-10 … +50°C; 15…80% r.H.

CE (Reference norms)
EN60730-1; EN60730-2-9;
EN55022 (Class B);
EN50082-1

Front Protection
IP55

lae ELECTRONIC
VIA PADOVA, 25
31046 ODERZO /TV /ITALY
TEL. +39 - 0422 815320
FAX +39 - 0422 814073
www.lae-electronic.com
E-mail: sales@lae-electronic.com

MS27 INSTRUCTIONS FOR USE

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.

DESCRIPTION

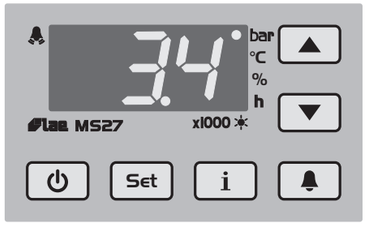


Fig.1 - Front Panel

INDICATIONS

bar	Pressure display in bar	⏻	Stand-by button
°C	Temperature display in °C	Set	Setpoint button
%	Percentage of use of available power	i	Info button
h	Hours of operation (LED lit)	🔔	Alarm display button
x1000	Thousands of hours of operation (LED blinking)	▲	Increase button
🔔	Alarm	▼	Decrease button

INSTALLATION

- The controller, size 71x97x61 mm (WxHxD), is to be secured to a DIN rail in such a position as to ensure that no liquid infiltrates causing serious damage and compromising safety.
- Make sure that electrical connections comply with the paragraph “wiring diagrams”. To reduce the effects of electromagnetic disturbance, keep the sensor and signal cables well separate from the power wires.
- Connect a pressure transmitter with output 0/4..20mA to input 1-P. Whenever control takes place through temperature, connect an NTC10K probe (part No. LAE SN4…) to input 2-T.

OPERATION

DISPLAY
Parameter **INP** selects the input used for control.
- **INP**=1-P: Input 1-P (0/4…20mA) is used to control pressure. In the setup the parameters relating to the variable to be controlled (**SPL**, **SPH**, **SP**,…) are expressed in bar. In normal mode, the display shows the pressure measured in bar, or the corresponding temperature in °C, calculated according to the refrigerant gas used (see REF). Input 2-T is disabled.
- **INP**=2-T: Input 2-T (NTC10K) is used for temperature control. In the setup the parameters relating to the variable to be controlled (**SPL**, **SPH**, **SP**,…) are espressed in °C. In normal mode the display shows the temperature measured in °C, or the corresponding pressure calculated in bar. Input 1-P is disabled.

In normal mode it’s also possible to display the percentage of available power used. To modify the type of display, press ▼ or ▲.
The following indications may also appear:

oFF	Controller in stand-by	LL	Low refrigerant level alarm
or	Over range or probe failure	ALr	Generic alarm
hP	High pressure alarm	hi	High measured value alarm
LP	Low pressure alarm	Lo	Low measured value alarm
oiL	Low compressor oil alarm	mtn	Periodic maintenance warning

INFO MENU
To have access to the info menu, press button i. The available info is:

out..4	Output 1..4 state / hours of operation	iLo	Min input value measured.
ihi	Max. input value measured.	Loc	Keypad state (lock)

Access to menu and information displayed.
- With button ▼ or ▲ select the data to be displayed;
- Press button i to display the value;
- To exit from the menu, press button ⏻ or wait for 10seconds

Reset of hours of operation of out1…out4 outputs and of IHI, ILO recordings
- With buttons ▼ or ▲ select the data to be reset;
- Press button i to display the value;
- While keeping button i pressed, use button 🔔.

Display of hours of operation of out1…out4 outputs
- With button ▼ or ▲ select the output;
- Display the ON/OFF state of output by pressing button i ;
- While holding down button i, press button ▲ to display the hours of operation (multiplied by 1000); the “h” LED blinks.
- While holding down button i, press button ▼ to display the hours of operation; the “h” LED is lit.
- Warning: the hours of operation of stages are not stored, ‘---‘ is displayed.

SETPOINT (display and modification of desired pressure/temperature value)
- Press button Set for at least half second, to display the setpoint value;
- If the second setpoint has been enabled (see **DI1**, **DI2**), before its value appears, the display shows “2SP”;
- By keeping button Set pressed, use button ▼ or ▲ to set the desired value (adjustment is within the minimum **SPL** and the maximum **SPH** limit).
- When button Set is released, the new value is stored.

ALARM MENU
The last nine alarms can be displayed in the alarm menu, from the most recent AL1, to the least recent AL9.

Access to menu and display of stored alarm.
- Press button 🔔;
- With button ▼ or ▲ select the data to be displayed;
- Press button 🔔 to display the alarm type;
- To exit from the menu, press button ⏻ or wait for 10 sec.

Reset of all stored alarm.
- Press button 🔔 to display the type of any alarm in the list;
- By keeping button 🔔 pressed, press button ⏻ for 1 second, until the inscription ‘non’ appears.

STAND-BY
Button ⏻ when pressed for 3 seconds, allows the controller to be put on a standby or output control to be resumed (with **SB**=YES only).

KEYPAD LOCK
The keypad lock avoids undesired, potentially dangerous operations, which might be attempted when the controller is operating in a public place. In the INFO menu, set parameter **LOC**=YES to inhibit all functions of the buttons. To resume normal operation of keypad, adjust setting so that **LOC**=NO.

CONTROL

OUTPUT CONFIGURATION

Outputs are configured with parameters **OC1**, **OC2**, **OC3**, **OC4**. Parameter **OCx** controls the operation of output OUTx: **OCx=**1…100 indicates the power in percentage over the total power, of the compressor connected to OUTx. With **OCx=** -1, output OUTx is associated to a stage, which is active when the relay is closed. With **OCx=** -2, output OUTx is associated to a stage, which is active when the relay is open. With **OCx=**0, output OUTx is not used for control.
Warning: the output associated to the compressor motor must always be wired in the terminals located before the terminals where the outputs controlling the stages are. Example: in a system with two compressors of different power (the first with 60% of total power, the second with 40%), each compressor having a stage, the configuration of outputs is as follows: ***OC1*** *= 60, OUT1 is connected to the motor of compressor 1 of power equal to 60% of total power.* ***OC2*** *= -1, OUT2 is connected to the stage of compressor 1, the stage is active when the relay is closed.* ***OC3*** *= 40, OUT3 is connected to the motor of compressor 2 of power equal to 40% of total power.* ***OC4*** *= -1, OUT4 is connected to the stage of compressor 2.*

CONTROL ALGORITHM

Parameter CM provides the control algorithm.

- **CM=**ROT: rotation of outputs of equal power. This algorithm minimises the number of starts/stops per hour of each load. When the system calls for more power, the output which has been off for longer will be activated. When demand for power decreases, the output which has been on for longer will be switched off. When an output remains active for more than LRT minutes, the controller looks for an inactive output fulfilling the requirements to be activated (less hours of operation, minimum off time elapsed,…) and the rotation of the two outputs will take place. In this way, an equal sharing of the total operation time among all loads will be achieved (see Fig. 2). *Note:the compressor rotation algorithm assumes that compressors have got an equal power. In this case, parameter* ***OCx*** *is used only to define if output OUTx either controls a compressor or a stage. So, if the value is positive, it will have no effect on* ***OCx****, regardless of what you program. Example: in a system consisting of four compressors, each will have a power equal to 25% of the total value, regardless of the value programmed to* ***OCx****.*
- **CM=**SEN: sequential activation of the enabled outputs. The outputs are switched on/off with fixed sequence, from output 1 to output 4 (see Fig. 3).
- **CM=**PO: optimisation of the available power. The controller combines the outputs in such a way as to obtain a fine control, both in case of calls for more power and less power. Example: **OC1=**10, **OC2=**20, **OC3=**30, **OC4=**50. If a capacity of 90 is required, outputs OUT1, OUT3, OUT4 (10+30+50) are switched on. If a capacity of 50 is required, outputs OUT2 and OUT3 (20+30) are switched on (see Fig. 4).

CONFIGURATION PARAMETERS

- To get access to the parameter configuration menu, press button Set + ⏻ for 5 seconds;
- with button ▼ or ▲ select the parameter to be modified;
- press button Set to display the value;
- by keeping button Set pressed, use button ▼ or ▲ to set the desired value;
- when button Set is released, the newly programmed value is stored and the following parameter is displayed;
- to exit from the setup, press button ⏻ or wait for 30 seconds.

Note: re-programming some parameters causes a complete re-configuration of the controller operation. So please put the controller on stand-by, if you have to modify the parameters relating to the output configuration or the selection of the control algorithm.
(In the parameter description, we refer to 'pressure control'. In case of temperature based control, please replace the word 'pressure' with 'temperature' and 'bar' with '°C').

PAR		RANGE	DESCRIPTION
INP		1-P, 2-T	Input selection for control **1-P**: input 1-P is used for pressure control; input 2-T is disabled. **2-T**: input 2-T is used for temperature control; input 1-P is disabled.
INP=1-P	**MPI**	0MA, 4MA	Min. current input range. **0MA**: input 0…20mA; **4mA**: input 4…20mA
INP=1-P	**RLO**	-1.0…RHI bar	Min. scale range. RLO takes the minimum value measured by the transmitter (corresponding to 0/4mA).
INP=1-P	**RHI**	RLO...45.0bar	Max. scale range. RHI takes the maximum value measured by the transmitter (corresponding to 20mA).
OS1		-12.0..12.0bar	Probe offset
REF		404,507,22,134	Refrigerant used. It allows Pressure - Temperature conversion. **404**=R404A, **507**=R507, **22**=R22, **134**=R134A
SPL		RLO…SPH	Minimum limit for SP and 2SP setting
SPH		SPL…RHI	Maximum limit for SP and 2SP setting
SP		SPL...SPH	Main setpoint, indicates the pressure to be maintained.
2SP		SPL...SPH	Alternate Setpoint. Pressure refence point is 2SP if DI1 (DI2) = 2SP and the corresponding input is active.
DBL		-10.0...0.0bar	Lower neutral zone. The state of outputs remains unchanged as long as pressure is within the band SP+DBL and SP+DBH.
DBH		0.0...10.0bar	Higher neutral zone.
LON		0...250s	Load start delay. Pressure must remain higher than SP+DBH for LON seconds before the next load is switched on.
LOF		0...250s	Load stop delay. Pressure must remain lower than SP+DBL for LOF seconds before the next load is switched off.
SON		0...250s	Stage start delay. Pressure must remain higher than SP+DBH for SON seconds before the next stage is switched on.
SOF		0...250s	Stage stop delay. Pressure must remain lower than SP+DBL for SOF seconds before the next stage is switched off.
PB		0...20.0bar	Proportional band (PWM output control, see Fig. 5). Zone above setpoint in which the PWM output is activated proportionally. *Example*: pressure < SP, PWM=0%; pressure=SP+PB/2, PWM=50%; pressure>SP+PB, PWM=100%.
IT		0...250s	Integral action time (control of PWM output, see Fig. 5). The greater the IT value, a more stable control takes place.
CM		ROT, SEN, PO	Selection of control algorithm. **ROT**: rotation of equal power outputs. **SEN**: sequential activation of outputs. **PO**: optimisation of available power.
OC1, OC2, OC3, OC4		-2...100	Control of output 1, 2, 3, 4. **1…100**: power (percentage of total) of the load connected to output OUTx (x=1, 2, 3, 4); **0**: output OUTx not used; **-1**: output OUTx connected to a stage, which is activated when the contact is closed. **-2**: output OUTx connected to a stage, which is activated when the contact is open.
MLS		0...30min	Minimum off time of loads. Minimum time which must elapse between when the load is switched off and when it's switched on again.
LRT		0...120min	Time of forced rotation of loads (only with CM=ROT). This parameter, if greater than 0, provides the operation time of a load after which the controller takes into account the possibility of rotation of two outputs.
DPU		0...120min	Start delay. Delay between the time when the controller is switched on when the outputs are activated, in order for the compressor crankcases to warm up.
SCD		0...100 %	Down Scaling. It indicates the maximum per cent power usable during an alarm with enabled down scaling action.
ALA		RLO...AHA	Low value measured alarm threshold.
AHA		ALA...RHI	High value measured alarm threshold.
AID		0...120min	High/Low alarm delay.
D1M D2M		NON, SBY, 2SP, ALR	Function of digital input DI1, DI2. **NON**: input disabled; **SBY**: when input DI1 (DI2) is active, the controller is put on a stand-by. **2SP**: when input DI1 (DI2) is active, the control setpoint is 2SP. **ALR**: when input DI1 (DI2) is active, the controller detects a generic alarm which causes the display to show ALR, to load to be switched off and control to be stopped. When the alarm is over, the controller resumes output control automatically (automatic reset).
D1C D2C		OPN, CLS	Activation of digital input DI1, DI2. **OPN**: active input is open; **CLS**: active input is closed
DxM		NON,HP, LP, OIL, LL, ALR	Function of digital input DI3, DI4, DI5. **NON**: input disabled. **HP**: high pressure alarm. **LP**: low pressure alarm. **OIL**: low compressor oil level. **LL**: low refrigerant level alarm. **ALR**: generic alarm.
DxC		OPN, CLS	Activation of digital input DI3, DI4, DI5 (see D1C).
DxD		0...120min	Activation delay of alarm DI3, DI4, DI5. The digital input must remain in the activation condition for this time before the alarm is detected.
DxA		DSP, SAR, SMR	Reaction following alarm DI3, DI4, DI5. **DSP**: alarm display. **SAR**: in addition to the alarm displayed, a down scaling (SCD) is activated and control is stopped. When the alarm is over, the controller resumes output control automatically (automatic reset). **SMR**: in addition to alarm displayed, all loads are switched off and control is stopped. When the alarm is over, control is resumed but only after the alarm has been acknowledged by pressing button 🔔 (manual reset).
MTC		0...600 (x100hours)	Maintenance. When the operation hours of any load achieve this value, a maintenance warning will flash on display. To eliminate this warning, after performing maintenance, rest the hour counters as described in paragraph "info menu".
SB		NO/YES	Stand-by button enabling.
TLD		1...30min	Delay for min / max input loggin.
SND		NO/YES	Alarm buzzer enabling
ADR		1...255	MS27 address for PC communication.

OPERATION EXAMPLES

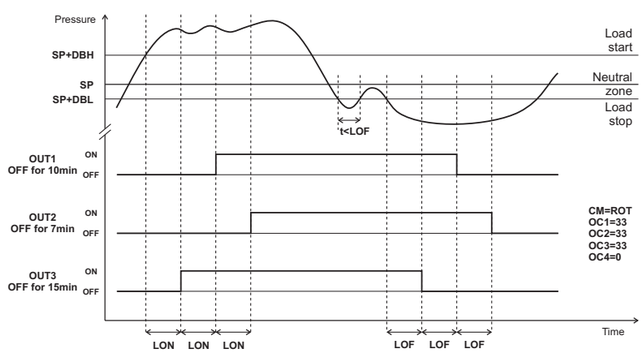


Fig.2 Control by rotation of outputs of equal power

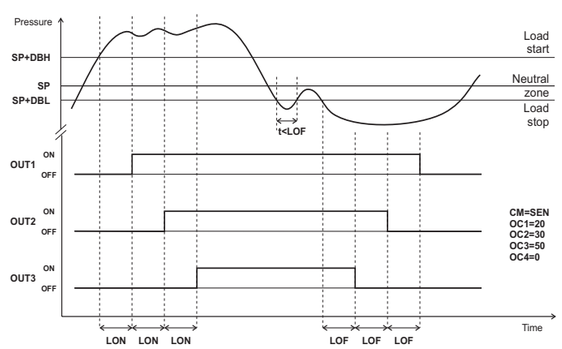


Fig.3 Control by sequential activation of outputs

TMR15

77x35x77 MM

Countdown timer

Panel timer ● Countdown in hours and minutes or minutes and seconds ● Manual start/stop of countdown ● Remote start of countdown ● Manual switching on/off of output ● Mains powered ● Buzzer to warn countdown end ● Keypad lock option.

Applications:

Control of duration of industrial processes, control of dough retarders, control of cooking time in ovens.

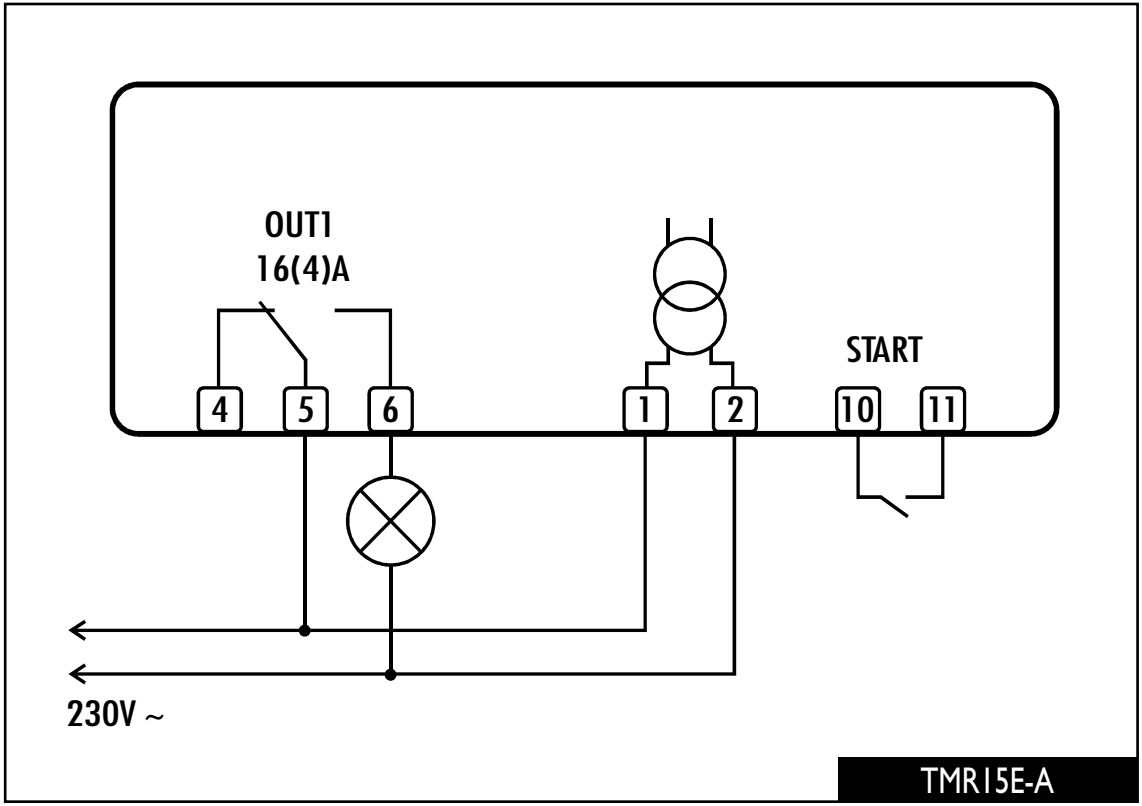
Standard versions	Power supply	Buzzer
TMR15E	230Vac ±10%, 3W	
TMR15E-A	230Vac ±10%, 3W	✓
TMR15D-A	12Vac/dc ±10%, 3W	✓

Versions with 110V supply are also available.

Technical Data

Outputs:	Out 16(4)A 240V~
Power supply:	230Vac ±10% 3W
Front protection:	IP55
Panel cut-out :	71x29 mm

Wiring diagrams | Applications | Instruction


OUT1
16(4)A
START
4
5
6
1
2
10
11
230V ~
TMR15E-A

Control of duration of industrial processes, control of dough retarders, control of cooking time in ovens.

TMR15 INSTRUCTION FOR USE

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.

DESCRIPTION

Fig.1 - Front panel

Start/Stop button

Decrease button

INDICATIONS

Manual mode

Timer started

h•mm Hours-minutes scale

m•ss Minutes-seconds scale

out Output active

Increase button

Manual mode button.

INSTALLATION

■ The TMR15, 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.

■ 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.

OPERATING MODES

The TMR15 features two main operating modes: Normal and Manual; when the unit is powered, its software loads the operating mode active before the TMR15 was switched off.

NORMAL MODE

In the STOP state, the output is off and the display shows the programmed cycle time. Pressing the button or making the remote start contact causes the output to be switched on and the display shows the countdown time. During the countdown, by pressing the buttons or , the total cycle time is displayed. By pressing it's possible to quit the program and switch over to the STOP state at any time. In case of a power failure, the timer always resumes the STOP state.

MANUAL MODE

Pressing the button for 3 seconds activates the manual mode, with the buttons and you choose the permanent state of the output (On/Off). This operating mode and the associated state are stored and maintained even in case of power failure. To exit and revert to normal mode, press for 3 seconds.

CYCLE TIME SETTINGS

From the STOP state it's possible to program the time by pressing or till you obtain the desired value. Autoscaling in minutes/seconds and hours/minutes takes place automatically, the respective two dots on the display show the scale active, in other words: 9 minutes and 59 seconds and 9 hours and 99 minutes. Exit from the programming is automatic after 5 seconds of not using the keypad or immediate by pressing .

SETUP

The setup is accessed by pressing and keeping the buttons + pressed for 5 seconds. The available parameters appear in the table here below. Press button to pass from one parameter to the next, viceversa press the button to go back. To display the value of a parameter press , to modify it press + or simultaneously. Exit from the setup is either by pressing or automatic after 20 seconds of not using the keypad.

Par	Adjustment	Description
ALR	YES/NO	Buzzer enabling
LOC	YES/NO	Keypad lock
ADR	1...255	Peripheral address

AUXILIARY FUNCTIONS

MANUAL MODE

The keypad lock avoids undesired, potentially dangerous operations, which might be attempted when the controller is operating in a public place. From the Setup it's possible to assign YES or NO to the parameter Loc. With LOC=YES all keypad commands are inhibited, countdown START therefore takes place through remote command only. To resume normal keypad operation, just re-program LOC=NO.

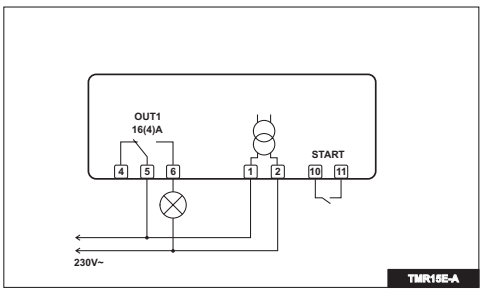
BUZZER

The TMR15 can be fitted with a buzzer to warn that the cycle has come to an end, this function is active with **ALR**=YES.

BUZZER

The TMR15 can have an optional serial port for connection to a PC or 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.

WIRING DIAGRAM



TECHNICAL DATA

Power supply
230Vac±10%, 50/60Hz, 3W

Relay output
16(4)A 240V~

Operating conditions
-10 … +50°C

CE (Reference Norms)
EN60730-1; EN60730-2-9;
EN55022 (Class B);
EN50082-1

Front protection
IP55

WARRANTY

LAE electronic SPA guarantees its products against defects due to faulty materials or workmanship for one (1) year from the date of manufacture shown on the container. The Company shall only replace products which are shown to be defective to the satisfaction of its own technical services. The Company shall not be under any liability and gives no warranty in the event of defects due to exceptional conditions of use, misuse or tampering.
LAE electronic does not accept units back unless LAE electronic has previously given its allowance or request.

TAB
Monitoring, Logging and Programming Software

Wireless Plant Monitoring

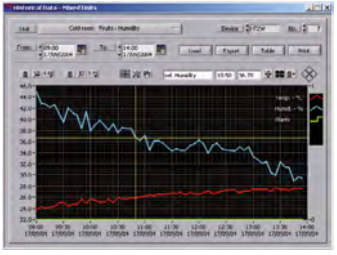
WBS-01 Web Server

DL28W Flexible Data Logger

TAB

Monitoring, Logging and Programming Software

Overall plant monitoring ● Compatible with the wireless communication system ● Storage of temperature, humidity, pressure, alarms ● Display and printing in numerical and graphic form of stored data ● Export of stored data for Excel* or others ● Diagnostics with dynamic graphs of all analog inputs ● Virtual instrument for analysing the system and setting regulator parameters ● Automatic sending or on demand of SMS to trace alarm status ● Connection to remote PC for tele-servicing via Internet ● Several languages available: English, German, Italian, Spanish, Polish etc.



Available options

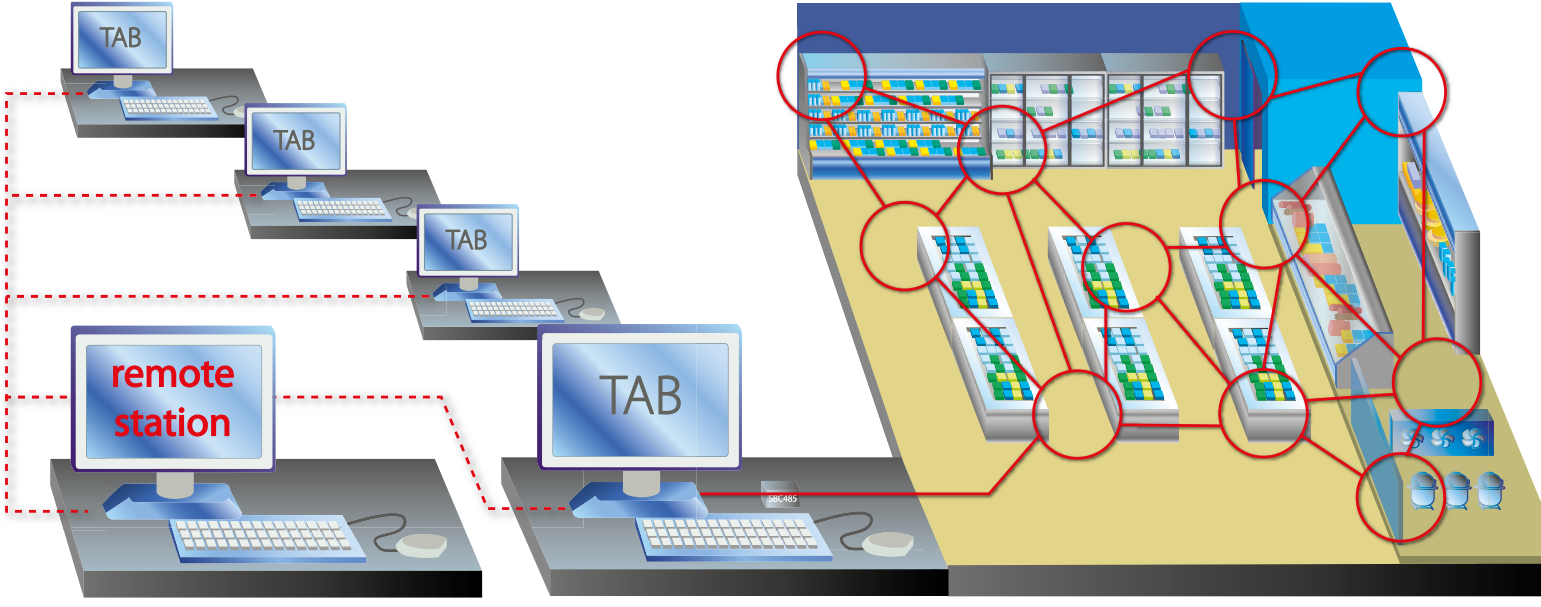
Available as full optional as described above but also in a "low cost version" for data logging only. This version is called TABLV

Minimum System Requirements

- *Computer with Windows XP/Vista/7* operating system installed and properly running, minimum processor and memory as required from Windows* version – USB port – Mouse – CD-ROM drive*
- *1024x768 pixel screen resolution, 16-bit colour*
- *1GB available on Hard Disk*
- *RS232 serial port (COM); an additional port is required if a GSM modem is fitted*
- *In case of wireless communication with the controllers, modules SWB-C and SWB-R are needed. Alternatively, an RS232-RS485 converter mod. SBC485 has to be fitted in case of a hard-wired system.*
- *GSM modem for sending SMS*

Applications

Supervision of the refrigeration process in supermarkets, convenience stores, shops, petrol stations, large kitchens, food factories, cruise ships etc.



Wireless Plant Monitoring

The LAE electronic wireless communication system, combined with the TAB supervisory software, allows equipment run by LAE controllers to be monitored easily without the need of a hard-wired cable. This system will be particularly useful in supermarkets and kitchens where the laying of wires is costly and difficult, both for new and existing units.

The SWB modules developed by LAE electronics, allow all the LAE controllers fitted with a TTL or RS485 port to be incorporated into such a system.

The plant supervisory PC, running the TAB software, is connected via an SWB-C version of the module allowing communication to all controllers within the wireless network

The controllers use the SWB-R module version, so that once connected they will automatically become part of the network.

Easy-to-install and powerful

The radio communication protocol used, allows a "mesh" type wireless communication network to be created. This means that the data may reach even the furthest controller via SWB-R modules linked through the intermediate controllers. In this way, the actual creation of a network is greatly simplified. To add a controller to an existing network, you just have to ensure it is within 30-40m of an individual module. If there are no SWB-R modules within communications range, a stand-alone SWB-R can be powered up half way, to boost the signal and bridge the gap. This style of network can easily cover even vast areas with controllers separated by long distances.

Safe and reliable

Once that the installation procedure has been performed successfully, the network consisting of SWB modules will automatically close the access to any other foreign wireless device which may work on the same radio channel. In this way no interference and intrusions of any type are possible and therefore data reliability and integrity are ensured.

Flexible

The SWB modules may be used to create a fully wireless network (a module for each controller); to connect segments of a cabled RS485 line to the wireless network (more controllers with RS485 port connected to an SWB-R module), or to add individual controllers to an existing network without laying additional cables.

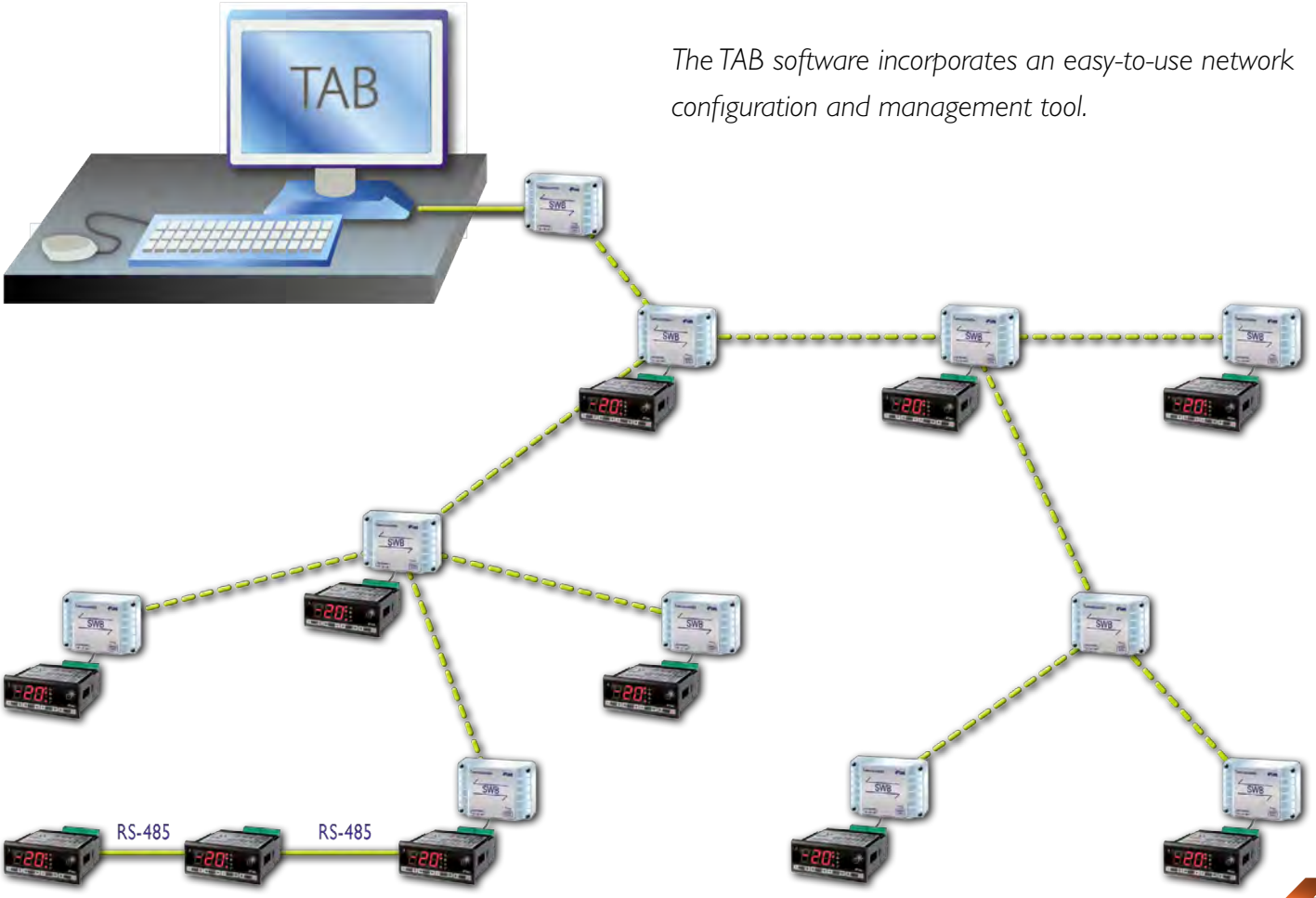
Technical specifications of SWB modules

- *Radio frequency band: ISM 2.4GHz*
- *Range: up to 40m indoor with obstacles*
- *Serial port SWB-C: RS232 on DB-9 connector*
  SWB-R: selectable TTL/RS485, on Ampmodu II 4-way connector
- *Max. number of peripherals on RS485 port: 63*
- *LED's: power supply / associated to network, serial port transmission, serial port receive*
- *Power supply: 230Vac/3W*
- *Dimensions: 110x75x53 mm*

Components of the system to be ordered

- *TAB software*
- *SWB-C module, PC side*
- *SWB-R modules (one for every controller or one for every "x" controllers wired with each other through the RS485 serial line)*
- *Connection cable from SWB-C module to a PC*
- *Connection cable from SWB-R module to a controller*

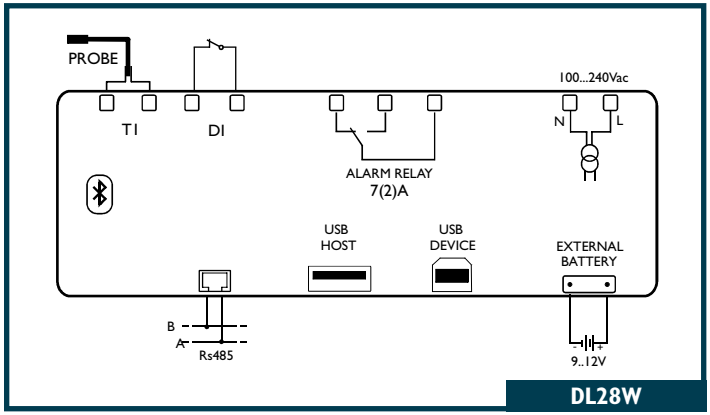
The TAB software incorporates an easy-to-use network configuration and management tool.



DL28W

Flexible Data Logger

- Recording of temperatures and states such as defrosts, alarms etc.
- It may work both as a stand alone and as a unit collecting data from LAE controllers connected to it.
- Recorded data may be downloaded through PC, USB, Bluetooth®
- Universal mains power supply
- Optional power supply for refrigerated transports
- Continuity of operation in case of power failure through internal or external backup battery
- Relay output for remote alarm
- PC software for data logger configuration and display of recordings on graph or Excel tables



Applications:

HACCP, plant diagnostics, alarm event recording.

TECHNICAL DATA

Temperature Input	*Type*	*NTC 10KΩ @ 25°C*
	Range	*-50... 110°C*
	Accurancy	*<0.5°C*
Output	*Max. Load*	*5(1)A; 240Vac*
Max. No. of devices connected		*4 devices through RS485*
Internal Mass Memory		*4 MByte*
Bluetooth	*Specification compliant*	*V2.1 - V3.0*
	Range	*class-2*
USB	*Connection Type*	*A2.0, B2.0*
Internal backup battery		*>20 day, self-rechargeable*
External Battery	*Voltage*	*7…12V*
	Consumption	*75mAh*
	Connector	*XAP-02V-1 (JST)*
Power supply		*100...240 Vac, 50/60 Hz, 3W*
Operating Conditions		*-10 … +50°C; 15% … 80% r.H.*

WBS-01
Web Server

The WBS-01 is a complete and integrated web-based solution for remote monitoring, data logging and alarm management in plants where LAE electronic controllers are fitted.

The incorporated web server grants access to the measured values, to the configuration parameters of controllers, to the alarm states, to recorded data and to configuration of the WBS-01 through an ordinary browser.

Various users may be enabled to get access to the system with different rights and each of them can receive recorded data and alarm messages to his/her e-mail address.

Configuration is extremely easy and quick to make thanks to the templates for various controllers that LAE makes available and thanks to the automatic detection of the connected devices.

In the event that an Internet access is not available, remote connection may take place even through GSM/GPRS with the addition of an external modem, which will also send out SMS messages.

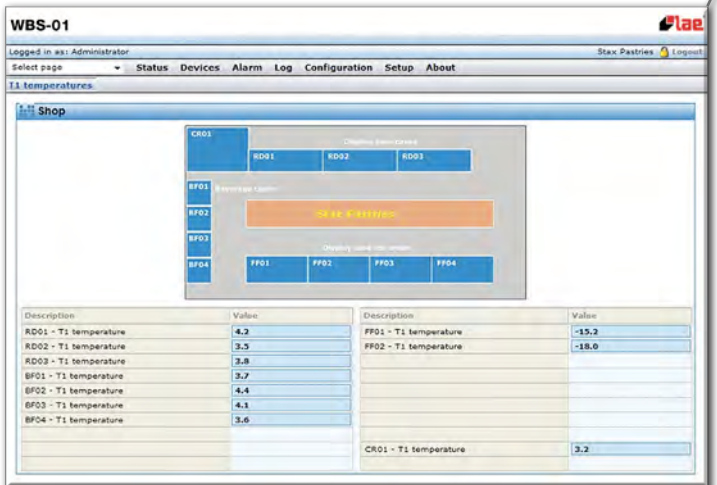
Furthermore, it's possible to use the online netbiter.net portal offering data collection and storage, graph representation, parameter programming and alarm management services and it makes these functions available through a simple link to just one website.
In this way there will be no need for a static IP address, a firewall configuration modification or the use of a specific SIM card for GSM/GPRS connection, moreover a centralized management of more plants will turn out to be easier.

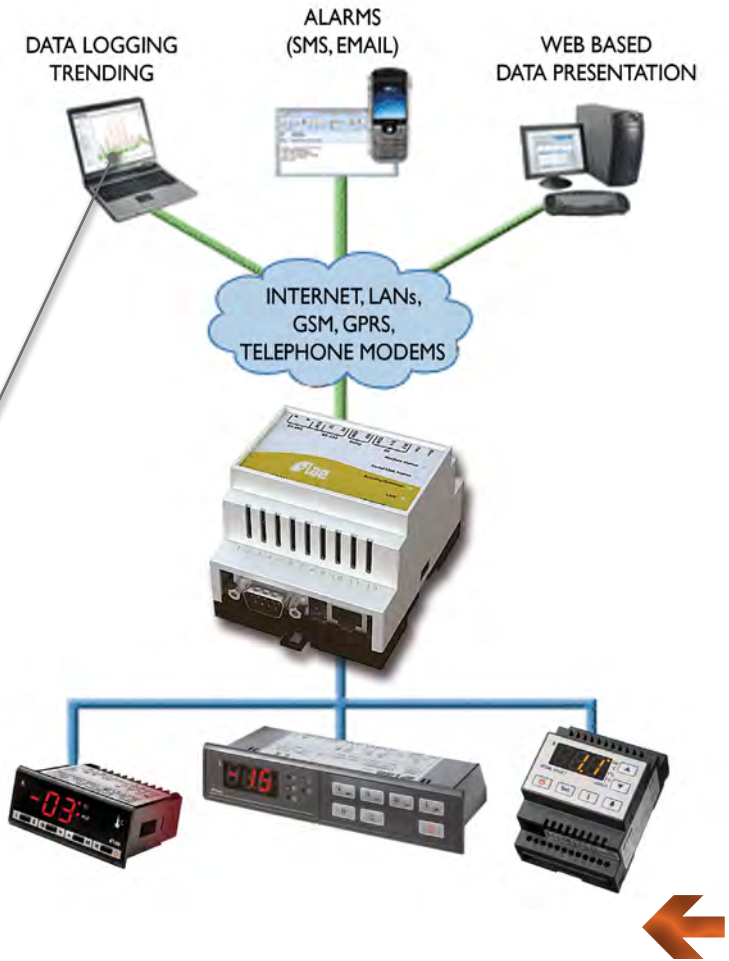
Main features

Built-in web server for accessing device data and configuration ● Data logger with graph representation and data export in text format ● Alarm management with list of current events, list of stored events, e-mail or SMS sending ● Management of several users with different access rights and alarm messages reception ● Simplified configuration through templates of LAE controllers and automatic detection of the connected devices ● Communication ability in absence of Internet line and SMS sending by connecting an external analog or GSM/GPRS modem ● Ability to get access to data through Internet portal ● 2 digital inputs that may be monitored and controlled as external alarm sources.

Technical Data

Ethernet port:	*10/100 Mbit/s, RJ45 connector*
Serial port #1:	*RS-485, screw terminal*
Serial port #2:	*RS-232 DSUB 9-pin connector*
Power supply:	*9÷24V AC/DC 2W*
Operating temperature:	*-40÷65°C*
Housing:	*DIN rail, 4 modules, 90x70x58mm*
Certification:	*EN 61000-6-2:2005 and 61000-6-4:2001, UL 508*





Temperature Probes

SN2B..P

Sensor type:	NTC2K, 2000Ω @ 25°C
Range:	-40÷120°C
Accuracy:	±0.3°C @ 25°C
Sheath:	Ø6x29mm; TPE
Cable:	2 wires x 0.35mm²; -40÷120°C; TPE; points
Protection:	IP67

SN4B..P

Sensor type:	NTC10K, 10000Ω @ 25°C
Range:	-40÷120°C
Accuracy:	±0.3°C @ 25°C
Sheath:	Ø6x29mm; TPE
Cable:	2 wires x 0.35mm²; -40÷120°C; TPE; points
Protection:	IP67

ST1K..C/P

Sensor type:	KTY81-121, 990Ω @ 25°C
Range:	-40÷105°C
Accuracy:	±1.5°C @ 25°C
Sheath:	Ø6x34mm; TPE
Cable:	2 wires x 0.35mm²; -40÷105°C; TPE; connector or points
Protection:	IP67

Humidity transmitters

HT2WAD

Sensor type:	Capacitive
Output signal:	0÷1Vdc
Range:	0%÷100%r.H
Accuracy:	±5%r.H. (25%÷75%r.H.)
Sheath:	Ø14x40mm
Protection:	IP65 (electronics)
Operating temperature:	0÷75°C (sensor) / 0÷50°C (electronics)
Dimensions of the enclosure:	110x53x75mm (electronics)
Power supply:	12Vdc, 0.2W

Pressure transmitter

PGT35

Sensor type:	Piezoresistive gauge
Output:	4÷20mA
Range:	-0,5÷35,0 bar
Accuracy:	max±1%FS (0÷50°C)
Sheath:	Ø17x58 mm
Connections:	mPm connector
Pressure port:	7/16"-20UNF male, steel AISI 316L
Protection:	IP65
Ambient temperature:	-40÷100°C
Power supply:	8÷32Vdc

Pt100

SPIN..P-X

Sensor type:	Pt100 class "B" (DIN 43760), 100Ω @ 0°C
Range:	-40÷120°C
Accuracy:	±0.3°C (0÷60°C)
Sheath:	Ø6x70mm; stainless steel
Cable:	3 wires x 0.22mm2; -40÷120°C; PETE; points
Protection:	IP67

SPTO

Sensor type:	Pt100 class "B" (DIN43760), 100Ω @ 0°C
Range:	0 ÷400°C
Accuracy:	±0.3°C or ±0.5°C (in the worst case scenario)
Response time:	10 seconds in water
Sheath:	Ø6x160mm; stainless steel AISI316
Cable:	3 wires x 0.24mm2; L=100cm, fiber glass, points
Protection:	IP65

Thermocouples

TJ.ECO

Sensor type:	J thermocouple
Range:	0 ÷450°C
Accuracy:	±2.5°C or ±0.75% (in the worst case scenario)
Response time:	10 seconds in water
Sheath:	Ø6x160mm; stainless steel AISI316
Cable:	2 wires x 0.50mm2; L=300cm, fiber glass, points
Protection:	IP65

TK.ECO

Sensor type:	k thermocouple
Range:	0 ÷ 600°C
Accuracy:	±2.5°C or ±0.75% (in the worst case scenario)
Response time:	approx. 2 seconds in water
Sheath:	Ø4.5x160mm; INCONEL600
Cable:	2 wires x 0.24mm2; L=300cm, fiber glass, points
Protection:	IP65