

MCDU 31 is an advanced and comprehensive microprocessor based unit for the control of small, medium and large-sized fridges, freezers, cold storage rooms, display counters etc. It integrates the following functions:

- THERMOSTAT
- DEFROST CONTROLS AND OPTIMISATIONS
- EVAPORATOR FAN CONTROL
- DEEP FREEZING CONTROL
- MULTI SOURCE ALARM CONTROL
- DATA EXCHANGE WITH PC SUPERVISOR

1 INSTALLATION

1a For proper functioning the instrument needs an ambient temperature between -10°...+50°C and 15%...80% rH. Moreover it must be installed away from contactors or cables carrying strong electrical currents.

1b The instrument is inserted into the panel through a 90x42 mm hole and secured via the suitable brackets.

1c A and B probe, power supply and outputs must be connected strictly following the diagram indicated on the enclosure, where the maximum switching powers are indicated too.

1d The A probe (black) is used to measure “air temperature” and must be located in a place where it may strictly follow the temperature of the goods. The B probe (grey) measures the evaporator temperature and must be secured to it in a place where the maximum formation of frost occurs. To ensure better protection of the probes against electro-magnetic interference which may compromise their function, place the cables away from power lines and earth the screen.

Caution: where delicate or valuable products have to be maintained in special conditions, we recommend not to use the same instrument for both control and limit functions.

* When writing [KEY]+[KEY] it’s meant that keys are pressed sequentially and simultaneously.

2 THERMOSTAT FUNCTION

When the unit is switched On, the upper and lower displays show “—” for 5 sec. during which the unit carries out a self-check; then, to emphasise that a black-out occurred, the lower display shows “Strt” and the upper one the maximum temperature achieved. To thaw the displays and obtain air temperature on the upper display and setpoint value at the bottom, press any of the keys.

At power-up the cooler start is delayed by the sum of c.oFF and **c.rSt**; this latter is used in those applications where it is necessary to avoid several simultaneous compressor starts which may cause line overload. For ex.: c.oFF = 3.00, c.rSt = 0.05; after power-up, at least 03 min. and 05 sec. must elapse before the cooler starts. **c.oFF** and **c.run** are, respectively, the cooler minimum Off and On time. This means that the relay which controls the cooler, after switching Off or On, will remain in that status for at least the pre-programmed time.

The cooler switching Off temperature is the setpoint. To change its value, press key [F], “SEt.P” appears on the upper display, thus indicating access to setpoint programming. While this key is kept pressed, by pushing key [D] or [E] you change it within the limits **c.SP.L** and **c.SP.h**. After setting, release [F] to store the new value.

The cooler switching On temperature is achieved by adding **c.hYS** to the setpoint. When a failure or overrange of the A probe occurs, the cooler run isn’t controlled according to setpoint but determined by **c.d.cY** which represents the cooler duty cycle, i.e. (on time)/(10 minute cycle). For ex.: 40%= 4 min. On time, 6 min. Off time.

The c.d.cY value has to be set taking into consideration the normal cooler duty cycle. This function allows to avoid damage to the goods when the actual temp. can’t be measured as a result of probe failure.

3 DEFROST FUNCTION

To maintain the best efficiency of the evaporator, when it’s covered with a too thick layer of ice, a defrost must be executed.

MCDU 31 gives many interesting possibilities to run the defrost process, both with respect to when it must take place and its control. In addition it provides the means to check the defrost process: displaying the evaporator temperature, by pressing key [F]; the time elapsed since the last defrost start, by pressing key [E]; displaying its duration; starting or aborting a manual defrost, by pressing key [D] + [F] for 4 seconds.

The moment when defrost must be started can be chosen according to:

- REGULAR INTERVAL
- FROST ACCUMULATION TIME
- EVAPORATOR EFFICIENCY
- COOLING DEMAND PRIORITY

REGULAR INTERVAL: this counting system, which is selected with **d.oPt = con**, provides defrost starts at regular intervals determined by d.rEP time. Ex.: d.rEP = 004, a defrost takes place every 4 hours.

FROST ACCUMULATION (LAE Patent): in this case, **d.oPt = Acc**, you enable defrost optimisation through frost accumulation time. The built-in timer counts only when the evaporator has the favourable condition for the ice to form. This occurs when the fin temp. is below 0°C and lower than the dew point and it’s detected by the A and B probe. The partial times are totalised until they attain the d.rEP time. This optimisation system is recommended when the setpoint is around 0°C. With this easy setting method the defrost frequency is function to the thermal load and the climatic condition (air temp. and humidity). Where temperature is << 0°C, the optimisation mainly depends on the delta between air and evaporator temp., therefore on the cooler On times. Ex. if the cooler cycle is 5 min. run and 5 min. stop and d.rEP = 04h, defrost will take place every 8h approx.

EVAPORATOR EFFICIENCY (LAE Patent): with this optimisation, **d.oPt = Auto**, you program the maximum thermal head between evaporator and air temperature as condition of automatic defrost start. This principle is based on the increase of Δt consequently to ice formation on the evaporator. For a correct control, the A probe must be located near the evaporator fans and the B probe fixed to the evaporator close to the suction pipe; **d.Aut** can be chosen according to experience or controlling the Δt by displaying the evaporator temperature when the maximum ice layer is accumulated. Anyway, the minimum time between two defrosts is determined by setting **d.rEP**.

COOLING DEMAND PRIORITY: while with the previous two optimisation methods the evaporator condition is monitored, with **d.oPt = SMrt** (smart optimisation), the MCDU 31 carries out a control on the room temperature and it ensures that the cooling plant works when the room needs it. In this case, defrost interval, d.rEP, may be ‘stretched’, up to a maximum of 50%, until the request for refrigeration ends. For ex.: if d.rEP = 04h, defrost is executed after min. 04h, max. 06h depending on need.

Regardless of the defrost start cause, the defrost procedure is always the same. The parameters which control it are: **d.Li.t** determines the evaporator temp. which terminates the heating phase; **d.tM.o** provides a time-out for the heating phase, thus ensuring a safe control; after the heating phase, **driP** time allows a regular temperature spread all over the evaporator, suspending the heating and postponing the cooler re-start; this phase is very important especially for large evaporators, thus ensuring energy saving. During defrost, the lower display shows the time elapsed since the beginning of the phase, the upper one is controlled according to the parameter **d.diS**. If it’s = 0, the actual air temperature will be displayed continuously. If -1, then the upper display shows “dEFr” until the setpoint is achieved; if = 1...30 min., after the defrost phase, “dEFr” is still displayed until the time programmed has elapsed unless the setpoint is reached before. The ice melting method, determines the

activation of the outputs and is chosen among the following:

- AIR BLOWING
- ELECTRIC HEATER
- HEAT PUMP

AIR BLOWING: d.tYP = FAn, this method is applicable where the air temperature is higher than 0°C and no heating element is used. The evaporator fans are kept On, cooler and defrost outputs are Off.

ELECTRIC HEATER: d.tYP = ELE, when defrost starts, the cooler and the fans are switched Off and the defrost output turned On.

HEAT PUMP: d.tYP = GAS, this method uses the hot gas coming out of the compressor to heat the evaporator. For this process, the fans are turned Off, while defrost and cooler outputs are On.

In case of a power failure, when the power comes On again, the defrost timer re-starts the counting from the point where it was interrupted, with ±30 min. approximation. Nevertheless, the start is delayed by an amount of time which is determined by the c.rSt value multiplied by 60; this function is used in those applications where it’s necessary to avoid simultaneous defrost start of several plants. For ex. c.rSt = 0.20; if a power failure occurs after 04h59 of timer counting and returns after 05 min., the timer is reloaded with 04h10. The defrost LED is lit when the corresponding output is On; it blinks during defrost through “air blowing” and during the dripping time. Defrost is suspended in case of high alarm or B probe failure/overrange.

4 EVAPORATOR FAN CONTROL

To obtain the best temperature and humidity regulations within the room, it’s important to suitably control the evaporator fans during the cooling process. With **F.ctL** parameter the fans can be controlled in three different ways. With -1, the fans work continuously; if 0, the fans are stopped simultaneously with the cooler; if 1...10 min., after the cooler stops, the fans will continue to run for the programmed amount of minutes. The fans are switched On simultaneously with the cooler. When defrost dripping phase is concluded, the fans re-start according to **F.rSt**. It is the necessary temperature difference between B probe and setpoint to obtain fan re-start. For ex. if setpoint is -20°C and F.rSt = +2.0°K; the fans are switched On as soon as the evaporator reaches -18°C.

5 DEEP FREEZING FUNCTION

This function allows to exploit an “alternative” setpoint, **c.Fr.S**, during a given time, that can be programmed and started at any moment. To display the freezing time, press [F]+[D] keys for 4 sec., its value is displayed on the lower display while “cold” appears on the upper one. To change the time, press [D] or [E] while [F] is kept pressed; to escape from programming, release [F] key. When the freezing function is requested, keep [F]+[D] keys pressed for 8 sec. Defrost starts first, thus ensuring evaporator maximum efficiency during pull-down. After defrost, the deep freezing phase is started and the lower display shows the freezing time count-up. If, during the freezing time, c.Fr.S is reached, fans and cooler will be thermostatically controlled. To abort the freezing phase, push [F]+[D] again for 8 sec. During the freezing time the corresponding LED blinks, the low alarm and defrost are inhibited. When the deep freezing is over, the normal control functions are resumed.

6 ALARM FUNCTION AND PROBE FAILURE

A.Lo.t and **A.hi.t** determine, respectively, the lower and higher temperature alarm threshold. **c.SP.L** is the maximum programmable value for the lower alarm; **c.SP.h** is the minimum programmable value for the higher alarm. **A.dLY** provides the time during which the

temperature must be over the alarm thresholds before the relevant output (relay/buzzer) is switched On.

If this parameter is 0.00, the alarm output is On immediately when the condition is detected. If it’s 0.01...2.00 hh.mm, the alarm is delayed for the programmed time.

When the alarm is entered, the upper display holds the min. or max. attained temperature, the lower display shows the duration of the abnormal temperature, the relevant output is On and the corresponding LED blinks.

By pressing any of the keys, the alarm is “acknowledged”, if it’s over (temperature within the setpoint limits), every alarm indications disappear. Otherwise if the alarm condition is still On, the displays are ‘thawed’ but the alarm LED continues to blink; in addition, as long as the condition exists, every 30 min. the output (relay/buzzer) will be energised for 1 min.

When a high alarm condition is detected, defrosts are suspended.

As a result of probe failure or overrange, the alarm output is switched On immediately, regardless of the adjusted delay, “PA.or” (A probe) or “Pb.or” (B probe) is shown on the upper display; the lower one shows the duration of this malfunction. Also in this case the condition must be acknowledged by pressing any of the keys.

The parameter **A.dor** is used if the unit is equipped with the door sensor input in order to control the alarm, fans and cooler when a cabinet door is opened. If -1 is selected, the input is disabled. If 0...20min., when the door is opened, the fans are stopped immediately. After the programmed time, the cooler stops too, the alarm output is switched On and the lower display shows “door”. As far as the door alarm is concerned, when it is “acknowledged”, the output won’t come up again. The alarm output contacts are also closed when the instrument is powerless.

7 PROBE OFFSET AND RE-CALIBRATION

In some cases, owing to the structure of the cabinet or air stratification, the probe can’t correctly measure the temperature of the environment. If necessary, the read-out can be changed by introducing an offset via the parameter **oFS.A** and **oFS.b** for, respectively, A and B probe.

Should it be necessary to recalibrate the unit, for instance in consequence of probe replacement, then act in the following way: get an accurate reference thermometer or calibrator; make sure that the offset ofFS.x of the probe to be re-calibrated is 0; press [F]+[D]+[E] keys for 4 sec., until the recalibration mode is activated.

By pushing [F]+[D] or [F]+[E] choose the desired calibration section: **r.Lo.A** and **r.Lo.b** allow 0°C calibration of either A or B probe, i.e. a constant offset across the whole range; **r.hi.A** and **r.hi.b** allow high temperature calibration to rectify a span error. Use [D] or [E] to match the read-out value with the one of the reference instrument.

Exit from the recalibration occurs after 10 sec. of no key activation. Therefore, to avoid exit, keep [F] pressed as long as you need.

8 SETUP

MCDU 31 configuration is achieved by programming the control parameters, achievable through a sequence of operations preventing accidental access. Press [F]+[D]+[E] keys for 4 sec. The upper display shows the mnemonic symbol that identifies the parameter of which value is displayed underneath. Scroll through the parameters by pressing [F]+[D] (to go forwards) or [F]+[E] (to go backwards). Once the desired parameter is pointed, change its value by means of keys [D] or [E]. Exit from the SETUP occurs after 10 sec. of no key activation.

9 DATA COMMUNICATION WITH PC SUPERVISOR

MCDU 31 can be fitted with RS 485 serial output in order to take part as slave in a data communication network managed by a master PC supervisor. The available database includes:

temperature and auxiliary inputs; **MCDU 31** status; all the SETUP parameters as well as control functions like defrost and freezing start/stop, inhibition of local setting.

You can buy a LAE software, running in WINDOWS ambient, for remote monitoring and control of several instruments (not only **MCDU 31** or LAE manufactured), permitting an optimised management of large refrigeration and/or air conditioning plants. Via a PC, this software allows to remotely display and change the parameters of the units, it collects and stores the data coming from the field and represents it graphically. The information can be retrieved locally or from any remote locations, thanks to a network of PC’s and modems.

The **dE.n** parameter allows to assign an address number to the unit which has to be identified by PC.

TECHNICAL DATA

Dimensions	48x96x138 mm
Operating temp.	-10°...+50°C
Range	-199.9°...+199.9°C
Resolution	0.1°K
Available inputs	PTC 1000/Pt 100
Relay rating	ref. to data on unit
Probe connections	2.8mm, spade
Relay and pwr	6.3mm, spade
Power supply	230Vac ±10%, 50/60 Hz
Consumption	4VA
Front protection	IP 40

WARRANTY

LAE electronic Srl warrant that their products are free of any defects in workmanship and materials for a period of 1 (one) year from date of production shown on the enclosure. LAE electronic Srl shall only repair or replace those products of which defects are due to LAE electronic Srl and recognised by their technicians. LAE electronic Srl are not liable for damages resulting from malfunctions of the products. Defects due to exceptional operating conditions, misapplication and/or tampering will void the warranty.

All transport charges for returning the product to the manufacturer, after prior authorisation by LAE electronic Srl, and for the return to the purchaser are always for the account of the purchaser.

The sequence of four pushbuttons to have access to re-calibration, appearing in paragraph 7, is wrong.
The correct sequence is the following:
[PROGR.J]+[THERMO.J]+[v]+[^],
La sequenza di quattro tasti, indicata al paragrafo 7 per accedere alla ricalibrazione, è errata.
La sequenza corretta è la seguente:
[PROGR.J]+[THERMO.J]+[v]+[^].