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OPERATING INSTRUCTIONS

THERMOREGULATOR SERIES

MRT-5
MRT-6

This instruction is intended for MRT-5, MRT-6 series regulators.
These regulators differ from each other in number of available control functions

MRT-5, MRT-6 type temperature regulators are universal microprocessor-based temperature controllers designed for use in refrigerating systems and cooling-and-heating systems.

MRT-5/C type regulator is used in simple cooling equipment with convection defrosting, without forced air circulation

MRT-5/CW type regulator is used in cooling equipment with convection defrosting and with forced air circulation

MRT-6 type regulator is used in the most advanced cooling equipment and cooling-and-heating equipment

These regulators consist of two elements interconnected with a plug-in ribbon cable:

- reading and setting panel
- control panel

Besides the basic function of controlling the unit, so as to achieve the set temperature and maintain it within the specified limits, MRT-5 and MRT-6 regulators also incorporate other functions:

1. Automatic defrosting performed in the three different optional modes:

- convection defrosting (MRT-6, MRT-5/C, MRT-5/CW);
- defrosting by means of heaters (MRT-6);
- hot steam defrosting (MRT-6).

This mode is controlled by one or two temperature probes and protected with time switch limiting the excessively long defrosting time.

2. Dripping mode.

3. Temperature display blocking during defrosting and dripping with time delay of exiting the block mode.

4. Monitoring and acoustic signaling of exceeding the condenser temperature. This is performed by the third sensor, which can be set as additional defrosting sensor or as the sensor monitoring condenser temperature or the heating control sensor.

5. Condenser fan control function depending on the unit operation and condenser temperature (MRT-6);

6. Evaporator fan control function (MRT-5/CW, MRT-6);

7. Heater control function of the heating system (performed by the third sensor) (MRT-6);

8. The function, which allows to select different cooling control temperatures for day and night operation mode.

9. Monitoring and signaling of temperature sensor damage.

10. Emergency operation mode.

MRT-5, MRT-6 regulators also incorporate the systems for unit operation protection:

- minimal standstill of the unit;
- minimal operation time of the unit;
- maximum operation time of the unit

MRT-5, MRT-6 regulators are equipped with:

- unit on/off switch, which enables at any time to switch off the unit without deenergizing the refrigerating system;
- lighting on/off switch allowing to switch on and off the lighting of the refrigerating system, linked with the function enabling to set up different control temperature settings in the day and night mode;
- manual defrost button, allowing to activate defrosting cycle at any time during operation of the refrigerating system (independently from automatic defrost mode);
- button which allows the preview of the temperature on the defrosting sensor(s) and condenser temperature monitoring and heating temperature sensor. This button also allows to access the mode of programming the regulator function;

- digital temperature display allowing to monitor on a current basis the temperature inside the refrigerating system (the regulator enables to block the indications of the gauge during defrosting phase and recall the indications with delay on exiting defrosting mode).
- light signaling indicating the operating state of the refrigerating system.

CONTROL OUTPUTS OF THE REGULATOR:

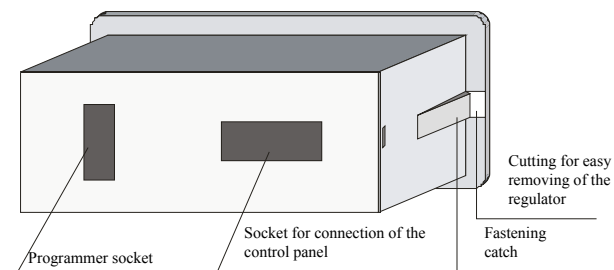
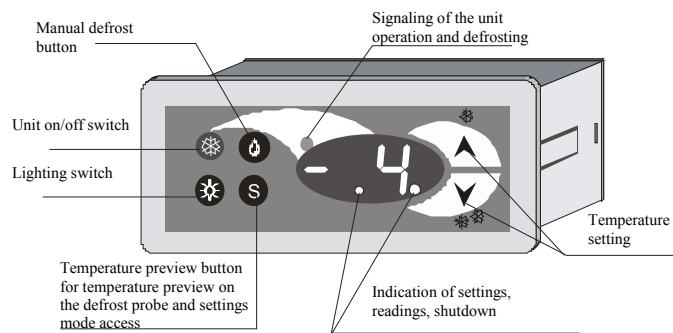
- unit control output (MRT-6, MRT-5/C, MRT-5/CW);
- lighting control output (MRT-6, MRT-5/C, MRT-5/CW);
- evaporator fan control output (MRT-6, MRT-5/CW);
- condenser fan control output during defrosting by hot steam (MRT-6);
- condenser fan control output depending on the selected settings (MRT-6);
- output for control of additional heating element depending on the temperature at the third sensor (MRT-6);
- output for control of heaters or solenoid valve during defrosting (MRT-6);
- output for connecting the limit switch turning off the evaporator fan (MRT-6, MRT-5/CW);

GENERAL TECHNICAL DATA

- cooling control temperature range	-40...+30 °C
- heating control temperature range	0...99 °C
- end-of-defrost temperature range	+1...+30 °C
- alarm signaling temperature range	30...70 °C
- cooling control hysteresis range	1...20°
- heating control hysteresis range	1...10°
- max. defrosting duration	0...3h
- operating time range before defrosting	1...12h
- number of measuring sensors	2 or 3
- length of measuring sensors	0, 9m, 1,5 or 3, 2m
- cooling control relay contacts rating	30A 250V AC
- lighting relay contacts rating	10A 250V AC
- fan relay contacts rating	10A 250V AC
- heater/defrosting valve relay contacts rating	10A 250V AC
- heater relay contacts rating	10A 250V AC
- power supply	230V AC +10%-15%
- ambient temperature	+5...+40 °C
- humidity	20...80%RH
- Degree of protection	IP30

DESIGN

MRT-5, MRT-6 regulators consist of two elements interconnected with a plug-in ribbon cable:



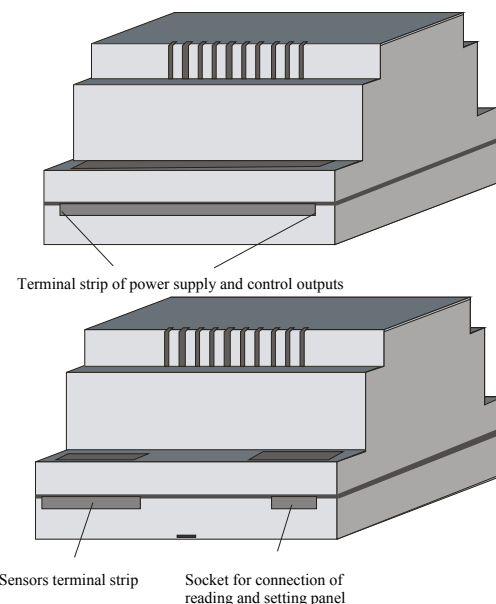
The front of the reading and setting panel includes the following elements:

- lighting switch for turning the light on and off;
- on/off switch of the controlled equipment;
- manual defrost button;
- "S" button – short pressing displays the temperature at additional sensors, pressing and holding down the button for longer time moves the user to the regulator programming mode (see programming);
- buttons used for setting the control temperature;
- LED indicating the operating state of the refrigerating unit – continuous light indicates that the unit is working, flashing light indicates entering the unit into the defrosting mode
- LEDs indicating: setting the control temperature (the last LED flashes), temperature reading at the additional defrosting sensors (2 sensor – the last LED is lit, 3 sensor – both LEDs are lit), shutdown of the unit (both LEDs are lit – the display is off)

The rear side of the reading and setting panel contains:

- slot for connecting the control panel using the ribbon cable;
- the slot for connecting external programmer enabling to program the set operating parameters of the regulator (programming is also possible by accessing the settings mode using button S);

2. Control panel



DESCRIPTION OF THE OPERATING CYCLE OF THE REGULATOR

The refrigerating system thermoregulator works in three phases, following one another:
cooling phase › defrosting phase › dripping phase

On connecting the regulator to the power supply, after 5 sec. delay, the regulator goes into cooling phase. In this phase the temperature on the control sensor (located in the cooling chamber) is compared with the set points and depending on the result the unit control relay is activated and deactivated.

After the specified time has elapsed the regulator goes into defrosting phase. In this phase the main task of the regulator is defrosting i.e. removing ice formed on temperature exchange elements – evaporator. End of defrosting phase is monitored by one or two sensors, and time controlled.

The next operating phase of the regulator is dripping. In this phase the residual water from defrosted elements is removed.

After the dripping phase is finished the regulator switches back to control phase.

In each operating phase of the regulator, the regulator performs a number of extra tasks oriented to optimize control of the refrigerating equipment.

In order to provide proper and efficient control appropriate settings must be selected according to the needs.

Regulator settings are divided into three groups:

- accessible by the user
- accessible by the service personnel
- accessible by the service personnel requiring entering the access code

Regulators in the production stage are preprogrammed using a standard set of settings.

Basic parameters preprogrammed in the production stage are specified on the name plate.

Control phase

SERVICE SETTINGS

1. setting the start and end of the temperature control range (AF, AH)
2. setting the control hysteresis (HI)
3. setting the minimal operation time of the unit (FI)
4. setting the minimal standstill of the unit (FA)
5. setting the maximum operation time of the unit (CE)
6. setting the mode of condenser fan control (AB)

USER'S SETTINGS

1. setting the control temperature using „▲", „,," buttons (if the night mode is set, then the settings should be made individually with the lighting switched on – day mode and off - night mode);
2. starting and shutting down the unit

Defrosting phase

SERVICE SETTINGS

1. setting the number of defrosting sensors (FC)
2. setting the temperature of the end of defrosting (FE)
3. Setting the time between the following starts of defrosting (EC)
4. setting the maximum defrosting time (EF)
5. setting the defrosting method (EI)
6. setting the method of evaporator fan control (HA)
7. Setting the delay time or temperature for starting the evaporator fan after defrosting (HF, CB)

USER'S SETTING

1. preview of the temperature on the defrost sensor – short pressing of S button
2. manual activation of defrosting
- 3.

Dripping phase

SERVICE SETTINGS

1. setting the dripping time (EH)
2. setting the method of starting the evaporator fan after dripping (CC)
3. Setting the time or temperature after which the evaporator fan is turned off after dripping (HF, CB)

Condenser temperature monitoring and alarm function

The regulator incorporates the function of monitoring the condenser temperature and acoustic warning when the admissible value is exceeded. This function is activated after setting 3 measuring sensors accordingly. Then the third sensor can be set as the additional defrosting sensor, condenser temperature monitoring sensor or sensor for control of additional heating element. When setting the sensor as the alarm sensor then alarm will be generated after exceeding the preset value. This function may co-exist with the condenser fan temperature control.

SERVICE SETTINGS

1. Setting the number of sensors (FC)
2. Setting the function of the third sensor (CA)
3. Setting the alarm temperature (CI)

Additional functions

1. Night mode.

The regulator can operate in the day and night mode.

This mode is coupled with the lighting switch. (alternatively – depending on the settings made). The night mode allows to set different control temperatures depending if the lighting is on (day mode) or off (night mode).

SERVICE SETTINGS

1. night mode setting (HE)

USER'S SETTINGS

1. switching off/on the lighting
2. - setting the control temperature in the night or day mode – is done using the setting buttons "▲", "▼" with the lighting turned on or off

2. Control of additional heating system

MRT-6 regulator enables control of additional heating system.

To control this system a third sensor is used. This sensor can be set as additional heater control sensor. This function cannot be used together with:

- condenser fan temperature control function
- alarm function and
- function of additional defrosting sensor.

SERVICE SETTINGS

1. Setting the number of sensors (FC)
2. Setting the function of the third sensor (CA)
3. setting the control temperature (AC)
4. setting the control hysteresis (AO)

CONTROL DIAGRAM

The following is a list of programmable parameters, having effect on control of particular outputs of MRT-6 regulator with the function symbols

Unit control



- ◀cooling temperature setting (AF,AH,▲,▼)
- ◀setting the day/night operation mode (HE)
- ◀setting the control hysteresis (HI)
- ◀setting the minimal operation time of the unit (FI)
- ◀setting the minimal standstill of the unit (FA)
- ◀ setting the maximum operation time of the unit (CE)
- ◀ defrosting mode settings (see above)
- ◀ dripping mode settings (see above)

Defrosting control



- ◀setting the mode of defrosting (EI)
- ◀setting the time between the following defrosting cycles (EC)
- ◀setting the number of sensors (FC)
- ◀setting the function of the third sensor (CA)
- ◀setting the temperature for defrosting end (FE)
- ◀setting the maximum defrosting time (EF)
- ◀dripping mode settings (see above)

evaporator fan control



- ◀selecting the mode of operation of evaporator fan (HA)
- ◀defrosting mode settings (see above)
- ◀dripping mode settings (see above)
- ◀ setting the delay of starting the ventilator (CC)
- ◀setting the time delay (HF)
- ◀setting the evaporator temperature at which the ventilator is stopped (CB)
- ◀status of the limit switch output (short circuit – fan stop)

Condenser fan control



- ◀selecting the mode of operation of condenser fan (AB)
- ◀setting the number of sensors (FC)
- ◀setting the function of the third sensor (CA)
- ◀ setting the temperature at which the condenser fan is stopped (AC)
- ◀setting the hysteresis for restarting the condenser fan (CO)

The regulator has also a separate output for control of the condenser fan when defrosting by hot steam. The parameters of this control are not programmable.

Principle of operation:

- ⇒during operation of the regulator in temperature control phase - the fan is operating following the unit cycle
- ⇒during defrosting – fan is not operating despite operation of the unit
- ⇒during dripping – fan is not operating

Condenser temperature alarm



- ◀setting the number of sensors (FC)
- ◀setting the function of the third sensor (CA)
- ◀ setting the alarm activation temperature (CI)

Additional heater control



- ◀setting the number of sensors (FC)
- ◀setting the function of the third sensor (CA)
- ◀ setting the heater control temperature (AC)
- ◀setting the control hysteresis (AO)

Displaying the measured temperature



- ◀actual temperature on the control sensor
- ◀setting the display lock function (HH)
- ◀defrosting mode settings
- ◀setting the time delay for leaving the lock mode (EE)

PROGRAMMING

MRT-6 type regulator can be programmed in two ways:

Automatically - using the external programmer plugged into the slot located on the rear of the reading and setting panel. Automatic programming is done with the regulator being connected to the power supply but with the unit off (two indicating LEDs are lit, the display is off) – see MRT programmer Instructions;

Manually – pressing and holding down "S" button for approx. 15s allows the user to access the manual programming mode.

AA symbol, which stands for the access code, appears on the display.

If correct access code is not entered, subsequent pressing of S button will move the user to the depleted array of possible settings.

In this mode it is possible to make the settings for the following functions:

- lower temperature range
- upper temperature range
- control hysteresis
- end-of-defrost temperature
- time between subsequent defrosting phases

Full range of settings is open on entering the correct access code.

The programming procedure is presented below:

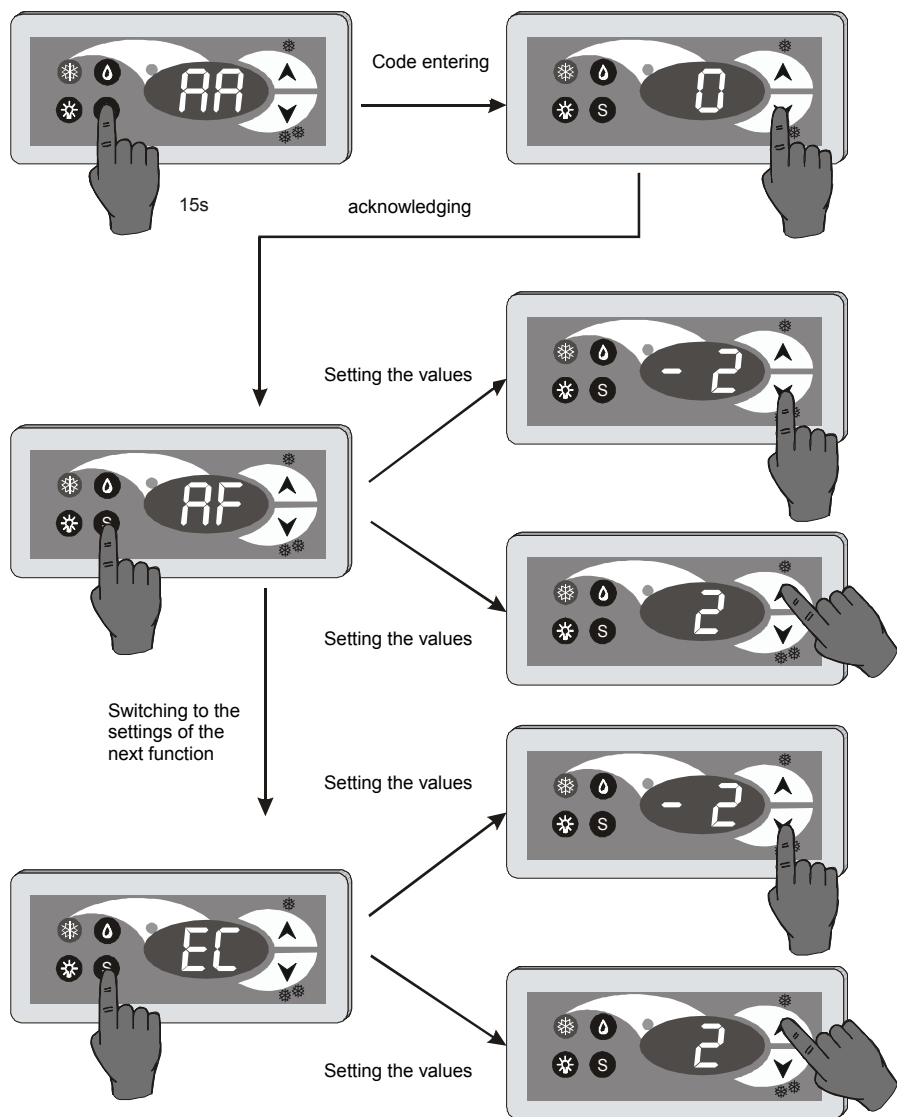


TABLE OF PARAMETERS

The table below contains parameters with the corresponding symbols and range of admissible settings. The table applies to regulators of all types. The shaded lines denote that the parameters are not available for the type:

MRT-5/C – lighter + darker shading

MRT-5/CW – darker shading

In these types of regulators the settings highlighted in the table should not be changed.

ACCESS CODE	AA	- 11
Lower control temperature range	AF	-40.....+30 °C
Upper control temperature range	AH	-40.....+30 °C
Control hysteresis	HI	1.....20 °
Minimal standstill of the unit	FA	0.....30 min every 1 min (0 - no function)
Minimal operation time of the unit	FI	0.....60 min every 1 min (0 - no function)
Number of measuring sensors	FC	1 - 2 sensor 2 - 3 sensors
End-of-defrost temperature *	FE	1.....30 °C
Time between the following starts of defrosting phase *	EC	0.....12 h every 0,5 h (0 - no function)
Maximum time of defrosting phase	EF	0.....3 h every 0,1 h (0 - no function)
Dripping time	EH	0.....60 min. every 1 min. (0 - no function)
Defrosting method	EI	0 - convection 1 - heaters 2 - by hot steam
Evaporator fan output control	HA	0 - turned off during defrosting and dripping 1 - continuous operation 2 - turned off during dripping
Time of the delay in starting the evaporator fan	HF	0.....30 min every 1 min. (0 - no function)
Night operation mode	HE	0 - none 1 - on
Display lock in the defrosting phase	HH	0 - none 1 - on
Delay in switching off the display blocking	EE	0.....30 min. every 1 min (0 - no function)
Maximum operation time of the unit	CE	0.....9,5 h every 0,5 h (0 - no function)
Setting the function of sensor no. 3 **	CA	0 - defrosting sensor 1 - condenser sensor 2 - heating control sensor
Alarm temperature on the condenser sensor **	CI	30.....70°C (every 1 °C)
Condenser fan and heater output control **	AB	0 - condenser fan-continuous operation 1 - condenser fan-operation according to condenser temperature 2 - condenser fan-operation according to unit operation and condenser temperature 3 - condenser fan-operation according to unit operation 4 - heater
Deactivation temperature of the condenser fan and heating **	AC	0.....99 °C (every 1 °C)
Deactivation hysteresis of the condenser fan and heating **	AO	1.....10 °C (every 1 °C)
Type of delay in starting the evaporator fan **	CC	0 - time delay 1 - temperature delay
Activation temperature of the evaporator fan **	CB	-20.....+20 °C (every 1 °C)

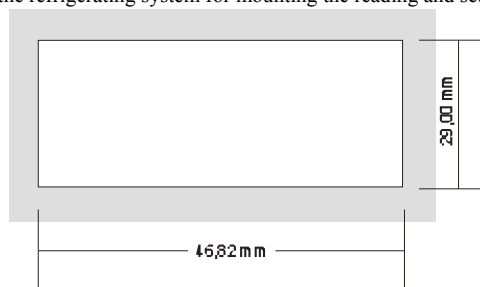
* Functions accessible without entering the access code

** Functions accessible on activation of three sensors (FC=2)

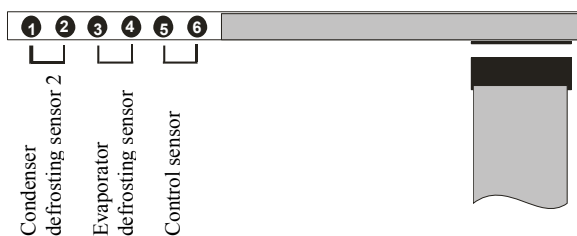
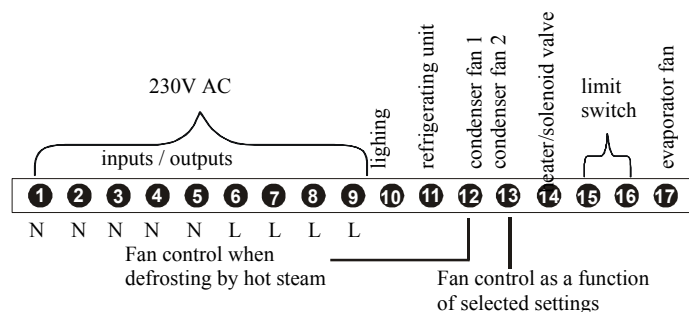
CONNECTING THE REGULATOR TO THE REFRIGERATING SYSTEM

In order to connect the regulator to the refrigerating system proceed as follows:

1. Make the hole in the refrigerating system for mounting the reading and setting panel



2. Insert the panel into the prepared hole.
3. Fit the control panel in the convenient location paying attention to the ambient temperature, which may not exceed 40 °C.
4. Connect the reading and setting panel with the control panel using the ribbon cable
5. Place the control sensor inside the cooling chamber in the place most convenient for taking temperature measurements, and at the same time protected from being accidentally damaged by stored food products. This sensor has a black wire.
6. Place the defrosting sensor(s) on the evaporator in the place where the lowest temperature exists. This sensor has a white wire.
7. In case of using the alarm mode, place the alarm sensor on the condenser or the filter
8. Hook up the regulator according to the markings indicated on the name plate



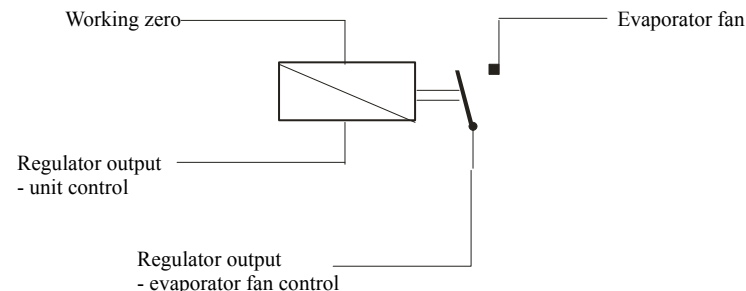
NOTE:

Short-circuit in the external limit switch, connected to outputs 15-16, stops operation of the evaporator fan as long as the fault exists.

Method of connecting the evaporator fan in the following operating cycle:

- control phase – fan is operating following the unit operating cycle;
- defrosting and dripping phase – fan is not operating
- leaving the defrosting and dripping mode – fan starts with time or temperature delay.

This function requires using additional contactor connected according to the following diagram:



Program settings:

- Evaporator fan output control HA = 0
- Selection of delay type CC = 0 time delay
CC = 1 temperature delay
- Selection of delay time HF = from within 0 to 30 min
- Selection of start temperature CB = from within -20 to +20 °C

SENSOR FAILURE SIGNALING

If sensor failure is detected by the regulator, the regulator excludes this sensor and goes into the emergency operation mode. At the same time on the display, instead of the indicated temperature, C0 symbol appears – which indicates the control sensor failure
C1 – indicating defrosting sensor failure
C2 – indicating failure to the third sensor (existing if in the settings mode the third sensor has been selected)

Emergency operating mode:

- Control sensor failure – Regulator goes into periodic duty i.e. according to the following settings: maximum operation time of the unit (CE), minimal standstill of the unit (FI); Defrosting function works normally. The display shows sensor failure –C0
- Defrosting sensor failure – Regulator set in temperature control mode is working normally; defrosting function changes into periodic operation i.e. the function starts after elapsing of the preset time between the following starts of defrosting cycle (EC) and runs according to the settings selected for the maximum defrosting time (EF). The display shows sensor failure –C1
- Failure of the third sensor – the regulator is operating normally (third detector is eliminated). The display shows sensor failure –C2

Note:

To ensure proper operation of the regulator in the emergency mode it is crucial to properly set the following parameters:

- maximum operation time of the unit (CE);
- minimal standstill of the unit (FI);
- maximum defrosting time (EF).

TEMPERATURE RECORDING

MRT-5, MRT-6 type temperature regulators are adapted for work with R-01, R-02, R-03 type temperature recorders. The purpose of these recorders is recording and storing in the internal memory the temperature data existing in refrigerating systems related to actual date and time. The recorded data are read using the computer, which can be connected permanently or temporarily only when reading the saved data.

For more detailed information regarding recorder-regulator connection and recorder operation please refer to the instructions of the particular recorder type.

CONTROL PANEL KEYPAD

