CONTROLLER FOR REFRIGERATION AND DEFROST WITH ALARM OUTPUT

TC-940Ri

Version 03



TC-940Ri

DEFROST ONLY WHEN IT IS NECESSARY

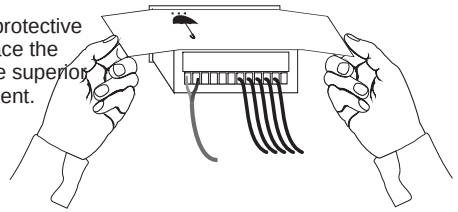
It keeps programming with lacks drawn of energy

Full Gauge CONTROLS

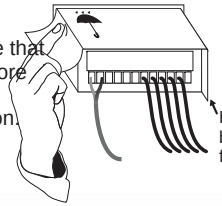
Find manuals of all line on Web:
www.fullgauge.com
comex@fullgauge.com
MADE IN BRAZIL
Phone/Fax: +55 51 34753308

PROTECTIVE VINYL:
It protects the instruments instaled in local subdued to water drops, like in refrigeration balconies, for example. This adhesive vinyl folloies the instrument, inside of ots packing. Only makes the application after to conclude the electric connections.

Remove the protective paper and place the vinyl on all the superior of the instrument.



Set now in the laterals.
Do not remove and do not fold the small borde of the adhesive that surplus in the back side, therefore will form a dripping that will result in additional protection.



Keep the border without fold it.

Note

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1 DESCRIPTION

O TC-940R is a digital controller of temperature that manages defrost cycles and evaporator fans. This instrument also has an output for alarm.
An innovative feature of TC-940R is the possibility that the controller offers initiating a defrost cycle evaporator temperature, detecting the moment that the system needs to do defrost. Thus, it is possible to save energy and increase the efficiency of the system.

2 APPLICATION

- Counters
- Refrigerated balcony
- Control panels
- Plug-in
- Supermarket expositors

3 TECHNICAL SPECIFICATIONS

-Power supply: 12 Vac/Vdc
Other available: 220 Vac, 127 Vca, 24 Vac, 24 Vdc (with external power supply)
-Control temperature: -50 to 75.0 °C
-Resolution: 0.1°C between -10 and 75.0 °C
and 1°C between -50 and -10°C
-Load current: 5 Amperes per output (resistive load)
-Dimensions: 70 x 28 x 60mm
-Sensors:
S1» Ambient sensor (black)
S2» Evaporator sensor (gray)
-Control outputs:
REFR » Compressor, solenoid valve or contactor
FANS » Evaporator fans
DEFR » Defrost (resistance or hot gas)
ALRM » Output for external alarm
-Operation temperature: 0 to 60 ºC
-Operation humidity: 10 to 90% RH (without condensation)

4 PARAMETERS

4.1 Control temperature adjust (SETPOINT):

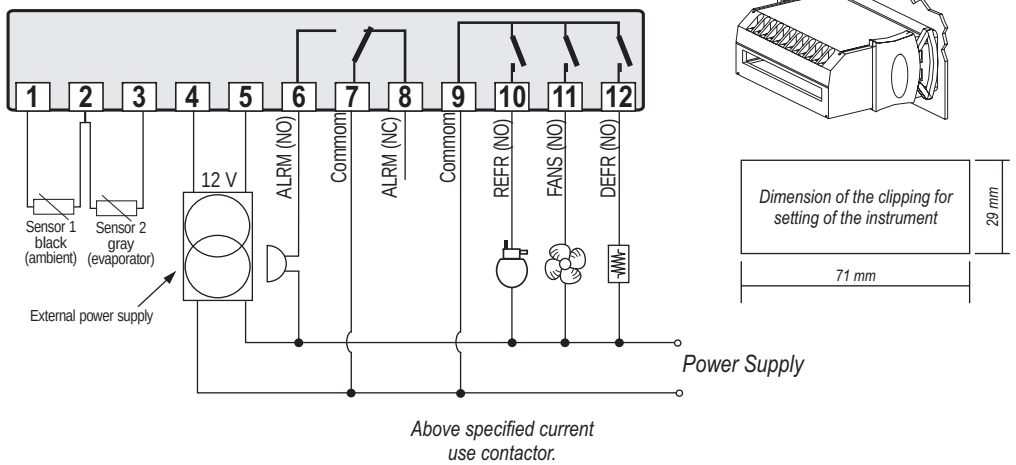
-Press SET for 2 seconds until appears SEt , and release it after that. The adjusted operation temperature will appear. Use the keys ▲ and ▼ to change the value and then press SET to record it.

4.2 Configurations

Function	Description
F01	Access code: 123 (one hundred and twenty-three)
F02	Control differential (hysteresis)
F03	Offset indication for ambient sensor
F04	Minimum setpoint allowed to end user
F05	Maximum setpoint allowed to end user
F06	Defrost type (0 = resistance; 1 = hot gas)
F07	Initial defrost condition (0 = time; 1 = temperature)
F08	Period between defrost (if F07 = 0)
F09	Maximum time in refrigeration (for security, if F07 = 1)
F10	Temperature in the evaporator for defrost start (if F07 = 1)
F11	Time of pre-defrost (if F07 = 1)
F12	Defrost when the instrument is powered on (0 - no; 1 - yes)
F13	Evaporator temperature (S2) for end defrost
F14	Maximum duration of defrost (for security)
F15	Fan turned on during defrost (0 - no; 1 - yes)
F16	Delay to do the first defrost (if F07 = 0)
F17	Temperature indication (S1) locked during defrost (0 - no; 1 - yes)
F18	Draining time (water dripping of defrost)
F19	Evaporator temperature (S2) for fan return after draining
F20	Maximum time for fan return after draining (fan-delay)
F21	Fan turned on with compressor turned off (in refrigeration) (0 - no; 1 - yes)
F22	Fan stop for high temperature in evaporator
F23	Differential for fan return (after stoping for high temperature in evaporator)
F24	Low temperature alarm (S1)
F25	Alarm differential of low temperature
F26	High temperature alarm (S1)
F27	Alarm differential of high temperature
F28	Inhibition time of alarm when the instrument is powered on
F29	Inhibition time of alarm after draining
F30	Delay when the instrumet is powered on
F31	Minimum time of compressor turned on
F32	Minimum time of compressor turned off
F33	Compressor status with detached ambient sensor (0 = off; 1 = on)

6 ELECTRICAL CONECTIONS

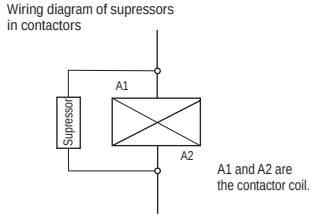
Wiring diagram for TC-940Ri:

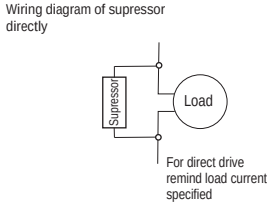


The withdrawal or substitution of the adhesive panel frontal as well as alterations in the electronic circuit by the user implies in warranty cancellation.

IMPORTANT

As chapters of IEC 60 364 norm:
1: Install protectors against over voltage on power supply
2: Sensor cables and computer signals can be together, bowever not at the same place where power supply and load drive pass for
3: Install suppressor of transient in parallel to loads, as for to increase the usefull life of the relays
For more information contact our Application Eng. Department throug e-mail support@ fullgauge.com.br or dial +55 51 34753308.





5.7 Indicators and alarms

The leds indicate the control outputs status:

REFR: Compressor or solenoid of liquid gas

FANS: Evaporator fans

DEFR: Defrost (heating)

ALRM: Alarm output

Er1 Detached ambient sensor or temperature (S1) out the range

Er2 Detached evaporator sensor or temperature (S2) out the range

ALo Low ambient temperature alarm

AHi High ambient temperature alarm

Always that the defrost is finished by time and not for temperature a point located on right inferior side of display will be blinking until the next defrost, indicating that:

- The interval between defrost is very long.
- There are burned resistances
- The hot gas is not circulating
- There is an inoperative fan
- The adjusted time for maximum duration of defrost is short.

PPP Invalid configuration parameters.

- In this situation the outputs will be turned off.
- Check which parameter have invalid information and correct it to return to normal operation.

5.8 Registers of minimum and maximum temperatures

Press ▲ . Will appear t-1 and minimum and maximum temperatures of black sensor (ambient). After appea t-2 and minimum and maximum temperatures of gray sensor (evaporator).

Note: To reset the registers, keep pressed the key ▲ during visualization of minimum and maximum temperatures until appear rSt .

5.9 Alarm inhibition

To inhibit the alarm press the key SET . The messages ALr OFF will appear. After the inhibition, the alarm output returns to be enabled when the instrument leaves the alarm status.

CELSIUS				FAHRENHEIT				For operator user
Minimum	Maximum	Unit	Standard	Minimum	Maximum	Unit	Standard	
-99	999	-	-	-99	999	-	-	
0.1	20.0	°C	1.5	1	36	°F	3	
-20	20.0	°C	0.0	-36	36	°F	0	
-50	75.0	°C	-50	-58	167	°F	-58	
-50	75.0	°C	75.0	-58	167	°F	167	
0	1	-	0	0	1	-	0	
0	1	-	0	0	1	-	0	
1	999	min.	240	1	999	min.	240	
1	240	hour	24	1	240	hour	24	
-50	75.0	°C	-5.0	-58	167	°F	23	
0	90	min.	10	0	90	min.	10	
0	1	-	0	0	1	-	0	
-50	75.0	°C	40.0	-58	167	°F	104	
0	90	min.	45	0	90	min.	45	
0	1	-	0	0	1	-	0	
0	999	min.	0	0	999	-	0	
0	1	-	0	0	1	-	0	
0	30	min.	10	0	30	min.	10	
-50	75.0	°C	0.0	-58	167	°F	32	
0	30	min.	1	0	30	min.	1	
0	1	-	1	0	1	-	1	
-50	75.0	°C	75.0	-58	167	°F	167	
0.1	20.0	°C	2.0	1	36	°F	4	
-50	75.0	°C	-50	-58	167	°F	-58	
0.1	20.0	ºC	1.0	1	36	ºF	2	
-50	75.0	°C	75.0	-58	167	°F	167	
0.1	20.0	°C	1.0	1	36	°F	2	
0	999	min.	0	0	999	min.	0	
0	999	min.	0	0	999	min.	0	
0	999	min.	0	0	999	min.	0	
0	999	sec.	0	0	999	sec.	0	
0	999	sec.	0	0	999	sec.	0	
0	1	-	1	0	1	-	1	

4.3 Functions

F01 - Access code (123)
It is necessary to change the configuration parameters. To visualize the adjusted parameters, it is not necessary to insert this access code.

F02 - Control differential (hysteresis)
It is the difference of temperature (hysteresis) between ON and OFF the refrigeration.
Example: You need to control temperature in 4.0 ºC with differential of 1.0 ºC.
So, the refrigeration is turned off in 4.0 ºC and will be turned on in 5.0 ºC (4.0 +1.0).

F03 - Offset indication for ambient sensor
It allows to compensate eventual shuting lines on reading of ambient temperature (S1), proceeding of sensor exchange or cable length alteration

F04 - Minimum setpoint allowed to end user
F05 - Maximum setpoint allowed to end user
It is to prevent that incorrect high or low temperatures be regulated.

F06 - Defrost type
"0" = Electrical defrost (resistances),where is kept on only the defrost output.
"1" = Hot gas defrost, where defrost and compressor outputs are kept on.

F07- Initial defrost condition
It defines if the defrost start will be for temperature or time. Is this function has the value "1",
when the evaporator temperature reaches the configured value in "F10" the instrument starts to count the
pre-defrost time and, after, will do the defrost.

F08 - Period between defrosts (if F07 = 0)
It determines the time between two consecutives defrost cycles, and starts to be counted from the last defrost.
Attention, the defrost only will start if the temperture in S2 (evaporator sensor) is lower than F13.

F09 - Maximum time in refrigeration (for security, if F07 = 1)
It acts as security time if (F07 = 1) and evaporator
temperature will not reach the configured value in "F10". This function determines the maximum time that
controller will stay without defrost.

F10 - Temperature in the evaporator for defrost start (if F07 = 1)
When evaporator temperature reaches the configured value in this function the controller will start to count the pre-defrost period (F11).

5.4 Initial defrost condition

The function "F07" determines if the start of the defrost will be for time or temperature.

F07 = 0 The start of defrost will happen after elapsed the configured time in F08.

F07 = 1 When the temperature in the evaporator reaches the configured value in F10, the count of pre-defrost period will start (F11). After elapsed this time, if the temperature keeps low the defrost will start. If the temperature increases, the controller returns to refrigeration stage.

5.5 How to determine the end defrost for temperature

a) Adjust the follow functions with maximum values:
- Interval between defrosts (F08 = 999 min)
- Evaporator temperature for end defrost (F13 = 75 ºC)
- Defrost maximum duration (F14 = 90 min)

b) Wait until an ice layer to be created on the evaporator
c) Do a manual defrost, pressing the key ▲ for 4 seconds, until appear dEF On .
d) Follow the melting.
e) Wait until melt all defrost on evaporator to consider the defrost finalized.
f) Check the temperature in evaporator read by the sensor S2 at this moment, pressing the key ▼ (see item 5.3) and copy this value to the function F13 - *Evaporator temperature (S2) for end defrost.*
g) As security, adjust again the function F14 - *Maximum duration of defrost,* that depends of the defrost type. *Exemple:* Electrical defrost (resistence) =45 minutes as maximum
Defrost for hot gas = 20 minutes as maximum
h) Now adjust the function F08 - *Refrigeration time* as desired value.

5.6 Manual defrost

To do a manual defrost, regardless of the programming, keep pressed the key ▲ for 4 seconds, until appears the indication dEF On .

If the instrument is in defrost and you want to finish it, follow the above instructions, until appears the indication dEF OFF .

d) Press again SET (short touch) to return the functions menu.

e) To reset the menu and return to normal operation (temperature indication), press SET until appear - - -.

5.2 Parameters alteration

a) Access the function F01 pressing at the same time the keys ▲ and ▼ for 2 seconds until appear Fun, releasing then after that. Soon will appear F01, and then press SET (short touch).

b) Use the keys ▲ and ▼ to enter the access code (123), and then press SET.

c) Select the desired function and visualize the configured value, like explained the itens“5.1-b” and “5.1-c”.

d) Use the keys ▲ and ▼ to change the value and then press SET to record the configured value and return to the functions menu.

e) To reset the menu and return to normal operation (temperature indication), press SET until appear - - -.

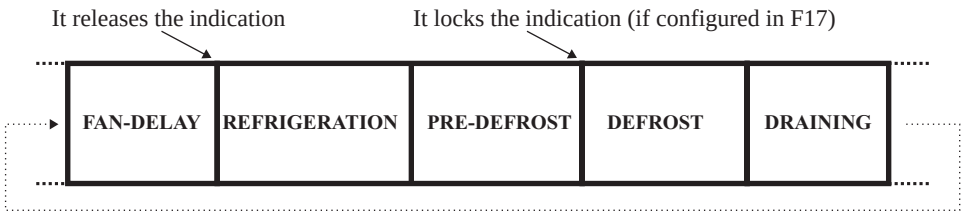
5.3 Process stage, elapsed time and evaporator temperature (S2)

Press the key ▼. The stage of the process will appear, the elapsed time (in minutes) and evaporator temperature (S2).

In case of detached sensor or temperature out specified range will appear Er2.

Process stages:

- dEL Initial delay (delay to turn on the instrument)
- FAn Fan-delay (delay to fan return)
- rEF Refrigeration
- PrE Pre-defrost (only if F07 = 1)
- dEF Defrost
- drE Draining



F11 - Time of pre-defrost (se F07=1)

At the moment that the temperature in evaporator decreases and reaches the configured value in “F10”, start to be counted the pre-defrost time. During the pre-defrost stage, if the temperature is kept low the defrost starts, else if the temperature increase at least 1 ºC in relation to configured value, the system returns to refrigeration stage.

F12 - Defrost when the instrument is powered on

It possibilities the defrost at the moment that the controller is turned on, for example, in return of electrical energy (in case of energy lacks).

F13 - Evaporator temperature (S2) for end defrost

If evaporator temperature (sensor S2) reaches the adjusted value, the end defrost will happen for temperature. With this , the defrost process is optimized.

F14 - Maximum duration of defrost

This function serves to adjust the maximum value of time to defrost. If in this period the evaporator temperature will not reach the configured value in F13 a point will be blinking on inferior down right side of display indicating that the end defrost ocurred for time and not for temperature

This can happen when the adjusted temperature is very high, the limit time will be not enough, the S2 sensor is detached or not in contact with the evaporator.

F15 - Fan turned on during defrost

It possibilities the fan functioning during defrost.

F16 - Delay to do first defrost (if F07=0)

This function defines an extra time that the instrument will keep in refrigeration before do the first defrost, to prevent that lot of counters enter in defrost at the same time. This time only appears before the first defrost, when F07 = 0 (initial defrost for time).

F17 - Temperature indication (S1) locked during defrost

This function prevents that ambient temperature elevation be visualized. During defrost the last measured temperature in refrigeration cycle will be locked on display. The indication will be released when this temperature will be reached again or 15 mintes after the ibegin of next refrigeration cycle.

F18 - Draining time (water dripping of defrost)

Necessary time for dripping, it means, to drain the last water drops of the evaporator. All the outputs keep turned off. If you do not need this stage, adjust this time for "zero".

F19 - Evaporator temperature (S2) for fan return after draining(fan-delay)

After the draining, the fan-delay cycle starts. The refrigeration (REFR.) output is turned on, because the evaporator temperature is high, but the fan only is turned on after evaporator temperature decreases the adjusted value. This process is necessary to remove the heat that exists in the evaporator because the defrost, preventing to pass it pass it to the ambient.

F20 - Maximum time for fan return after draining (fan-delay)

For security, if the evaporator temperature does not reach the adjusted value in F19 or the S2 sensor is detached, the fan-delay will happen after passed the adjusted time in this function.

F21 - Fan turned on with compressor turned off (in refrigeration)

During refrigeration, the fan can be depend of the compressor status.

"0" = The fan keeps turned on while compressor is turned on (this alternative, in some cases, possibilities a great economy of electrical energy).

"1" = The fan keeps turned on during all refrigeration cycle.

F22 - Fan stop for high temperature in evaporator

This function cycles the evaporator fan until that ambient temperature approaches of the temperature desired in the refrigerating installation project. This preventing high temperature and suction pressures that can damage the compressor. If the temperature in evaporator pass the adjusted value, the fan is turned off, turning on again with a configurable hysteresis in F23.

F23 - Differential for fan-delay (after stopping for high temperature in evaporator)

It allows to determine the difference of temperature to fan-delay had to a stop for temperature above desired in evaporator.

F24 - Low temperature alarm (S1)

If the ambient temperature (sensor S1) decreases above this point during refrigeration, this will be signalized through the message AL o on display and the output (NO) of alarm will be turne on.

F25 - Alarm differential of low ambient temperature

It is the difference of temperature to turn off the alarm output for low ambient temperature.

F26 -High temperature alarm (S1)

If the ambient temperature (sensor) reaches this point during the refrigeration, this will be signalized through the message AH1 on display and the output (NO) of alarm will be turn on.

F27 - Alarm differential of high temperature

It is the temperature to turn off the alarm output for high ambient temperature.

F28 - Inhibition time of alarm when the instrument is powered on

During this time the alarm is kept turned off waiting that the system starts to working.

F29 - Inhibition time of alarm after draining

This function serves to inhibit the alarm during a period after draining, because it is normal an elevation of the temperature proceeding of the defrost.

F30 - Delay when the isnstrument is powered on

When the instrument is turned on, it can keep a time with its control disabled, delaying the process initial. During this time it functions only as temperature indicator. It serves to prevent demand peaks of electrical energy, in case of lack or return of the same, when a lot of equipments are connected in the same line. For this, adjust different times for each equipment. This delay can be of compressor or defrost (when exists defrost on start)

F31 -Minimum time of compressor turned on

It is the time that the compressor will keep turned on, it means, the time period between the last started and the next stopped.

F32 - Minimum time of compressor turned off

It is the minimum time that the compressor will keep turned off, it means, the time period between the last stopped and the next started. It serves to alliviate the discharge pressure and to increase the useful life of the compressor.

F33 - Compressor status with detached ambient sensor (S1)

If the ambient sensor (S1) is detached or out specified range, the compressor assumes the configured status in this function.

Exemple: For counters that storage fruits it is better that the compressor keeps turned off, but in counters that storage meats it is better that the compressor keeps turned on.

4.3.1 Unit selection (ºC/ºF)

To determine the unit that the instrument will work, access the function "F01" with the access cod 231 and confirm with the key SET. Press the key ▲. Uni will appear. Press ▲ and ▼ To choose between oC or oF and confirm. After select the unit FAC will appear and the instrument returns to the function "F01". Every time that the init is change, the parameter must be configurated again, because they assume the standard values (item 4.2).

5 Operation

5.1 Parameters visualization

a) Press at the same time the keys ▲ and ▼ for 2 seconds until appear Fun , releasing them after that. Soon, appears F01.

b) Use the keys ▲ and ▼ to access the desired function.

c) After select the function, press SET (short touch) to visualize the configured value.