



# TC-920Ri

CONTROLLER FOR REFRIGERATION  
AND DEFROST WITH DIGITAL INPUT

Ver.02



TC920V02-2T-11604

## 1. DESCRIPTION

The **TC-920Ri** is a temperature controller device for the frozen food industry, which can also be used to control the evaporator fan and to manage the defrosting cycles.

It works with up to 3 sensors, two of them are for room temperature measurement (air inlet and air return) and the third one can be fixed in the evaporator to control the ending of defrosting operation and returning of fan operation.

It also includes a digital input to receive external pulses for controlling the start of defrosting operation or for monitoring the chamber door status.

Aiming to reduce the power consumption, the **TC-920Ri** allows the configuration of two setpoints: normal and power saving. This is possible when the third sensor is used for measuring the return air temperature, which allows the selection of active setpoint based on the temperature difference between the inlet air sensor and the return air sensor (S3 - S1).

When the difference between the sensors is above the value configured by the user (high level of thermal exchange), the active setpoint is the normal (SP1). When the difference between the sensor is below another value also configured by the user (low level of thermal exchange), the active setpoint is the Power Saving (SP2), which must be configured to a temperature higher than SP1 in order to reduce the compressor ON time, which in turn decreases the electric power consumption.

Product complies with UL Inc. (United States and Canada).

## 2. APPLICATION

- Counters
- Refrigerating balconies

## 3. TECHNICAL SPECIFICATIONS

- Power supply: TC-920Ri: 90 - 264Vac  $\pm$  10%(50/60Hz)  
TC-920RiL: 12Vdc/dc
- Operating temperature: 0 to 50°C / 32 to 122°F
- Operating humidity: 10 to 90% RH (without condensation)
- Resolution: 0.1°C from -10 to 75°C and 1°C outside this range  
1°F in wall range
- Load current (outputs): REFR: 5(3)A/250Vac 1/8HP (compressor, solenoid valve or contactor)  
FANS: 5(3)A/250Vac 1/8HP (evaporator fans)  
DEFROST: 3A/250Vac (defrost - resistance or hot gas)
- Dimensions: 71 x 28 x 71mm
- Sensors:
- S1: Room sensor (inlet / inlet air) - Black cable - Follow the product
- S2: evaporator sensor - Gray cable - Follow the product
- S3: Room sensor (return / outlet air) - Does not follow the product

## 4. CONFIGURATIONS

### 4.1 - Control temperatures adjust (SETPOINTS):

- Press **SET** for 2 seconds until appears **SEt**, and release it after that. It will appear **SP1** and the working temperature adjusted. Use **▲** and **▼** keys to change the value and then press **SET** to record it. Soon after it **SP2** (economic setpoint) will appear, repeats the procedure above to modify the value and leave the function.

### 4.2 - Parameters table

Fun	Description
F01	Access code:123 (one hundred and twenty-three)
F02	Control differential (hysteresis)
F03	Offset indication for room sensor (inlet / inlet air) - Offset S1
F04	Offset indication for evaporator sensor (Offset S2)
F05	Offset indication for room sensor (return / outlet air) - Offset S3
F06	Minimum setpoint allowed to the end user
F07	Maximum setpoint allowed to the end user
F08	Delay when the instrument is powered on
F09	Act point of high room temperature alert (S1)
F10	Refrigeration time (interval between defrosts)
F11	Compressor delay after on (on - off)
F12	Compressor delay after off (off - on)
F13	Compressor status with detached ambient sensor (S1)
F14	Defrost when the instrument is powered on
F15	Evaporator temperature (S2) for end defrost
F16	Maximum duration of defrost (for security)
F17	Fan turned on during defrost
F18	Defrost type
F19	Locked temperature indication (S1) during defrost
F20	Draining time (dripping of defrost water)
F21	Evaporator temperature (S2) for fan return after draining
F22	Maximum time of fan return after draining (fan-delay)
F23	Fan on with compressor off (refrigeration)
F24	Fan stopped for high temperature in the evaporator
F25	Digital input operation mode
F26	S3 sensor enabling
F27	Temperature difference (S3 S1) above which the setpoint SP1 is activated
F28	Temperature difference (S3 S1) below which the setpoint SP2 is activated (economic setpoint)

## 4.3 - Parameters description

### F01 - Access code (123)

To change the parameters it is necessary to use the access code. It is not necessary to use the access code to visualize the adjusted parameters.

### F02 - Control differential (hysteresis)

It is the difference of temperature (hysteresis) between to turn OFF and turn ON the refrigeration output. Example: To control the temperature in 4.0°C with differential of 1.0°C. Soon, the refrigeration will be turned off in 4.0°C and turned on again in 5.0°C (4.0 + 1.0)

### F03 - Offset indication for sensor S1

It allows to compensate eventual shunting lines in the reading of room temperature (S1) proceeding from the exchange of the sensor or cable length alteration

### F04 - Offset indication for sensor S2

It allows to compensate eventual shunting lines in the reading of evaporator temperature (S2) proceeding from the exchange of the sensor or cable length alteration

### F05 - Offset indication for sensor S3

It allows to compensate eventual shunting lines in the reading of room temperature (S3) proceeding from the exchange of the sensor or cable length alteration

### F06 - Minimum setpoint allowed to the end user

### F07 - Maximum setpoint allowed to the end user

Electronic limits whose purpose is prevent that too high or too low setpoint temperatures are regulated.

### F08 - Delay when the instrument is powered on

When the instrument is powered on, its control is kept disabled during a time, delaying the start of process. During this time, it works only as temperature indicator. It serves to prevent demand of electric energy peaks, in case of lack or return of the same and when exists a lot of equipment connected on the same net. For this, just adjust different times for each equipment. This delay may be of compressor or defrost (when exist defrost on turn on).

### F09 - Act point of high room temperature alert

If the room temperature (sensor S1) reaches this point during refrigeration, this will be signaled visually through the indication blinking on display.

### F10 - Refrigeration time (interval between defrosts)

It is the time which compressor will turn on and turn off only for room temperature and starts to be counted when the fan is turned on, after fan-delay stage (fan return after draining).

### F11 - Compressor delay after on (on-off)

It is the minimum time that compressor will keep on, it means, space of time between the last drive and the next stop. It serves to prevent high voltage events in the electric network.

### F12 - Compressor delay after off (off-on)

It is the minimum time that compressor will keep off, it means, space of time between the last stop and the next drive. It serves to alleviate the discharge pressure and to increase the time of useful life of the compressor.

CELSIUS				FAHRENHEIT			
Min	Max	Unid	Default	Min	Max	Unid	Default
-	-	-	-	-	-	-	-
0.1	20.0	°C	1.5	1	36	°F	3
-20.0	20.0	°C	0	-36	36	°F	0
-20.0	20.0	°C	0	-36	36	°F	0
-20.0	20.0	°C	0	-36	36	°F	0
-50.0	75.0	°C	-50	-58	167	°F	-58
-50.0	75.0	°C	75	-58	167	°F	167
0	30	min.	0	0	30	min.	0
-50.0	75.0	°C	75	-58	167	°F	167
1	999	min.	240	1	999	min.	240
0	999	sec.	0	0	999	sec.	0
0	999	sec.	0	0	999	sec.	0
0 - off	1 - on	-	1	0 - off	1 - on	-	1
0 - no	1 - yes	-	0	0 - no	1 - yes	-	0
-50.0	75.0	°C	40	-58	167	°F	104
0 - inactive	90	min.	45	0 - inactive	90	min.	45
0 - no	1 - yes	-	0 - no	0 - no	1 - yes	-	0
0 - electric	1 - hot gas	-	0 - electric	0 - electric	1 - hot gas	-	0
0 - no	1 - yes	-	0 - no	0 - no	1 - yes	-	0
0	30	min.	10	0	30	min.	10
-50.0	75.0	°C	0	-58	167	°F	32
0	30	min.	1	0	30	min.	1
0 - no	1 - yes	-	1 - yes	0 - no	1 - yes	-	1
-50.0	75.0	°C	75	-58	167	°F	167
0	2	-	0	0	2	-	0
0 - disable	1 - enable	-	1 - enable	0 - disable	1 - enable	-	1 - enable
0.1	20.0	°C	5.0	1	36	°F	9
0.1	20.0	°C	2.0	1	36	°F	4

F13 - Compressor status with detached ambient sensor (S1)  
If the room sensor (S1) will be danified or outside the specified range, the compressor assumes the configured status in this function.

Example: For counters of fruits, it is better to keep the compressor off. In counters of meat it is better to keep the compressor on.

F14 - Defrost when the instrument is powered on  
It makes possible the accomplishment of a defrost at the moment that controller is energized, for example, in the return of electrical energy (in case of energy lack)

F15 - Evaporator temperature (S2) for end defrost  
If the temperature in the evaporator (sensor S2) reaches the adjusted value, the end of defrost will be for temperature. With this, the defrost process is optimized.

F16 - Maximum duration of defrost (for security)  
This function serves to adjust the maximum value of time for defrost. If evaporator temperature does not reach the configured value in F15 in this period a point will blink in the right down side of display indicating that end of defrost occurred for time and not for temperature.

The end of defrost by time (which is not desired) can happen on the following situations:

- Adjusted temperature (F15) too high;
- Maximum time of defrost (F16) too short;
- Detached S1 sensor or without contact with evaporator.

F17 - Fan turned on during defrost  
It makes possible the fan functioning during defrost.  
Example: Natural defrost or by resistances installed outside the evaporator.

F18 - Defrost type  
"0" = Electrical defrost (resistances), where the defrost output is active.  
"1" = Defrost by hot gas, where compressor and defrost outputs are actives.

F19 - Locked temperature indication (S1) during defrost  
This function prevents that room temperature elevation during defrost be visualized, keeping the last indication before defrost. The indication is released again in the initial of refrigeration cycle, after fan-delay.

F20 - Draining time (dripping of defrost water)  
Necessary time for dripping, it means, for draining the last water drops of evaporator. All the outputs are kept off. If this stage will not be desired, adjust this time for "zero".

F21 - Evaporator temperature (S2) for fan return after draining (fan-delay)  
The fan-delay cycle starts after draining. The refrigeration output (REFR) is active, therefore the ambient temperature is high, but the fan is activated only after the temperature in evaporator is less than the adjusted value. This process is necessary to remove the heat that still exists in the evaporator because of defrost, preventing to transfer this heat to the ambient.

F22 - Maximum time of fan return after draining (fan-delay)  
For security, if the temperature in the evaporator does not reach the adjusted value in F21 or sensor S2 is detached, the fan-delay will happen on the adjusted time in this function.

F23 - Fan on with compressor off  
During the refrigeration cycle, the fan activation may depends on the compressor status.  
"0" = The fan is activated only while the compressor is active. This alternative, in some cases, allows great economy of electric energy.  
"1" = The fan is kept on during all refrigeration cycle.

F24 - Fan stopped for high temperature in evaporator  
It has for purpose the cycle of evaporator ventilation until the ambient temperature approaches the desired temperature in the refrigerating installation project, preventing high temperatures and pressures that can damage the compressor. If the temperature in evaporator exceed the adjusted value, the fan is turned off and turned on again with a fixed hysteresis of 2°C below this value.

F25 - Digital input operation mode  
The digital input can be configured to operate as follows:  
0 - Off  
1 - Defrost start signal  
2 - Door status monitor

FG26 - S3 sensor enabling  
Select as follows to enable or disable sensor S3  
0 - Disabled  
1 - Enabled

NOTE: If sensor S3 is out of operation or disabled (F26=0), temperature control is performed by setpoint SP1.

F27 - Temperature difference (S3 S1) above which the setpoint SP1 is activated  
The device operates with setpoint SP1 when the temperature is above the value configured for this function.

F28 - Temperature difference (S3 S1) below which the setpoint SP2 is activated  
The device operates with setpoint SP2 when the temperature is below the value configured for this function.

## 5. OPERATION

### 5.1 - Parameters visualization

- a) Press at the same time and for 2 seconds until appear **FUn**, releasing them after that. Soon, appears **F01**.
- b) Use and to access the desired function.
- c) After selecting the function, press **SET** (short touch) to visualize the configured value.
- 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 **---**.

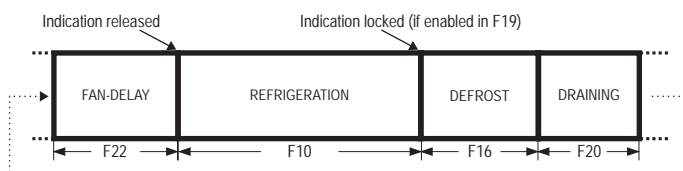
### 5.2 - Parameters configuration

- a) Access the function F01 by pressing at the same time and for 2 seconds until appear **FUn**, releasing then after that. Soon will appear **F01**, and then press **SET** (short touch).
- b) Use and to enter the access code (123), and then press **SET**.
- c) Select the desired function and visualize the configured value (see itens 5.1-b and 5.1-c).
- d) Use 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 tim, sensors S2 and S3 temperature and differential S3-S1

Press . The stage of the process will appear, the elapsed time (in minutes), the evaporator temperature (S2), sensor S3 temperature and the differential S3-S1.

- Process stages:
- dEL** Initial delay (delay to start the control)
  - FAn** Fan-delay (delay to fan return)
  - rEF** Refrigeration
  - dEF** Defrost
  - drE** Draining



### 5.4 - Manual defrost

To do a manual defrost, regardless of the programming, keep pressed 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**.

### 5.5 - How to determine the end defrost by temperature

- a) Adjust the follow functions with maximum values:
  - Refrigeration time (F10 = 999 min)
  - Evaporator temperature for end defrost (F15 = 75 °C)
  - Maximum duration of defrost (F16 = 90 min)
- b) Wait until an ice layer to be created on the evaporator
- c) Do a manual defrost, pressing for 4 seconds, until appear **dEF On**.
- d) Observe the melting process.
- e) Wait until melt all ice layer on the evaporator to consider the defrost finished.
- f) Check the evaporator temperature read by the sensor S2 at this moment, pressing the key (see item 5.3) and copy this value to the function F15 - Evaporator temperature (S2) for end defrost.
- g) As security, adjust again the function F16 - Maximum duration of defrost, that depends of the defrost type.  
Example: Electrical defrost (resistance) = 45 minutes as maximum  
Defrost for by hot gas = 20 minutes as maximum
- h) Now adjust the function F10 - Refrigeration time with the desired value.

### 5.6 - Minimum and maximum temperatures register

Press , soon **E-1** appears and the minimum and maximum temperatures of S1 sensor (room temperature). After soon **E-2** appears and the minimum and maximum temperatures of S2 sensor (evaporator).

Note: To reset the registers keep pressed the key during the visualization of the minimum and maximum temperatures until **rSE** to be showed.

## 6 - INDICATORS AND ALARMS

The leds indicate the control outputs status:

**REFR**: Compressor or solenoid of liquid gas

**FANS**: Evaporator fans

**DEFR**: Defrost (heating)

**E-1** Room sensor S1 (inlet / inlet air) disconnected or out of range.

**E-2** Evaporator sensor S2 disconnected or out of range.

**E-3** Room sensor S3 (return / outlet air) disconnected or out of range.

**HH** High room temperature alarm.

**OPN** Alert of open door

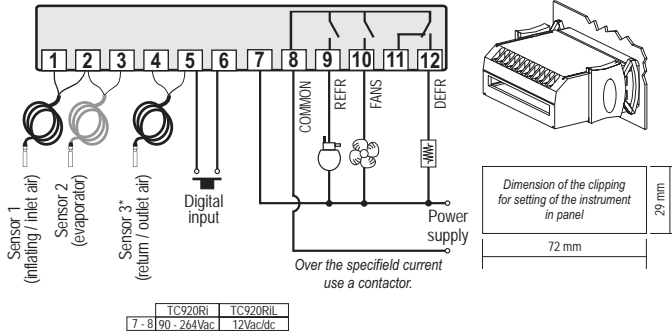
Always that defrost ends for time and not for temperature, a point located in the right down side of display will blink until the next defrost indicating that:

- The interval between defrosts is too high;
- There are burned resistances;
- The hot gas is not circulating.
- There is an inoperative fan or the adjusted time is too short for the maximum duration of defrost.
- PPP** Invalid configuration parameters
- In this situation the outputs are turned off.
- Check which parameters have invalid data and correct them to return to normal operation.

## 7 - UNIT SELECTION (°C / °F)

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 **UNIT**. **UNIT** will appear. Press **SET** than use **▼** or **▲** to choose between **°C** or **°F** and confirm with **SET**. After select the unit **F01** will appear and the instrument returns to the function "F01". Every time that the unit is changed, the parameters must be configured again, because they assume the standard values

## 8. WIRING DIAGRAM



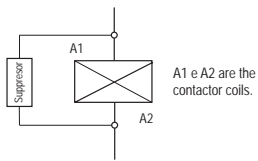
\*Sensor 3 sold separately

### IMPORTANT

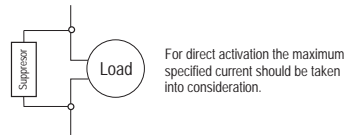
According to the chapters from the IEC60364 standard:

- 1: Install protectors against over voltage on power supply
  - 2: Sensor cables and computer signals can be together, however not at the same place where power supply and load wires pass for
  - 3: Install suppressor of transient in parallel to loads to increase the usefull life of the relays
- For more information contact our application eng. department through e-mail [support@fullgauge.com](mailto:support@fullgauge.com) or dial +55 51 3475.3308.

### Contact suppressor connection diagram



### Diagram for suppressor installation for direct drive load inputs



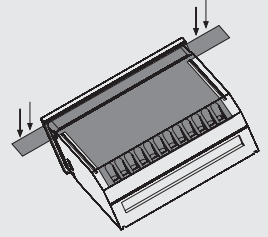
Note: The sensor cable length can be increased by the user until 200 meters using 2 x 24 AWG cable.



### PROTECTIVE VINYL:

This adhesive vinyl (included inside the packing) protects the instruments against water drippings, as in commercial refrigerators, for example. Do the application after finishing the electrical connections.

Remove the protective paper and apply the vinyl on the entire superior part of the device, folding the flaps as indicated by the arrows.



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