TNEAT

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Digital Thermostat — TN-S32 Series
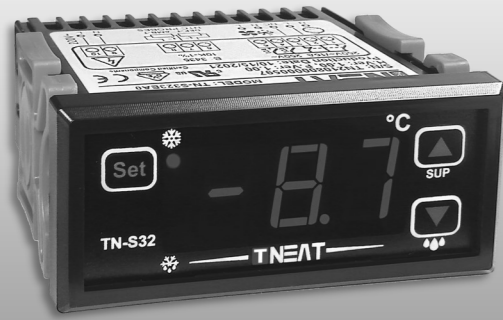
USER MANUAL

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TN-S32 digital thermostat series are microcontroller-based devices suitable for cooling or heating control applications. They utilize two relays: One for driving a compressor or a heater (main relay) and the other one for defrosting.

The TN-S323EA0 model has three relays. In addition to temperature control and defrosting procedure, it also controls the function of the evaporator fan.

TN-S32 devices use two NTC-type sensors and are fully configurable through defined parameters in the settings menu which can be set via keypad.

Feature \ Model	TN-S322xA0[1]	TN- S322xA1	TN-S323EA0
Temperature control	✓	✓	✓
Defrosting	✓	✓	✓
Fan Control	X	X	✓
Buzzer	X	✓	X

1) x indicates the arrangement of relays according to the following table:

X	Relay1(Main relay)	Relay2 (Defrosting)	Relay3 (Fan)
C	15A	15A	X
D	30A	10A	X
E	15A	10A	10A

Features

- Accurate temperature measurement
- Can be used as a cooling or heating controller by setting application mode
- Output delay protection at startup
- Protective delay of consecutive compressor start-up
- Sensors calibration
- Fully programmable defrosting procedure
- Controlling defrosting procedure based on time, temperature or both.
- Two access levels for setting the parameters with two separate passwords
- Supporting manual defrosting
- Supporting super mode

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- Out of Range temperature alarm
- AUX output configuration
- Evaporator fan management (TN-S323EA0)
- Temperature setting range limitation for end users
- Working with one or two sensors
- Alarm Management
- Intelligent audible alarms (only in TN-S322xA1 series)
- Displaying status of the output
- Multiple displaying mode for the first or second temperature sensor values
- Displaying temperature value with decimal point
- Configurable smart function in cabinet sensor failure condition
- Keypad lock function
- Enabling/Disabling buzzer (only in TN-S322xA1 series)
- Enabling/Disabling the second sensor
- Enabling/Disabling the second sensor failure alarm

Technical Specifications

- **Power supply:** 220V AC ±20%, 50~60HZ
- **Power consumption:** < 2w
- **Main Relay Output:** 220V AC, **30A (2hp)/15A (0.75hp)**
- **Defrosting Relay Output:** 220V AC, **15A/10A**
- **Fan Relay Output:** 220V AC, **10A**
- **Sensor Type:** NTC 10KΩ at 25°C
- **Temperature measurement and regulation range:** -40 ~ +99 °C
- **Resolution:** 0.1°C
- **Accuracy:** ±0.5°C
- **Case IP code:** IP20
- **Front panel IP code:** IP54
- **Operating temperature:** -20 ~ +70 °C
- **Storage temperature:** -40 ~ +85 °C
- **Operating humidity:** 20% ~ 85%
- **Connector:** Screw terminals

Dimensions and Weight

- **Installing hole size:** 71 (L) x 29 (W)
- **Front panel size:** 77 (L) x 34.5 (W)
- **Product size:** 77 (L) x 34.5 (W) x 62 (D)
- **Sensor wire length:** 2 meters
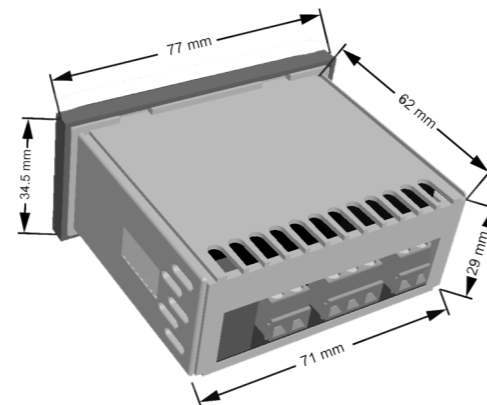

Front Panel
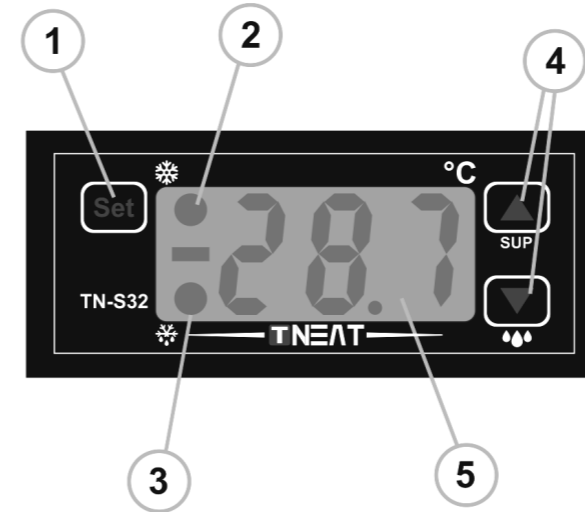
1. **SET Key:** Used In order to enter the device parameters settings and confirm the desired values.
2. **Main output relay (compressor) activation indicator**
3. **Second output relay (defrosting) activation indicator**
4. **UP and DOWN Keys:** Changing the Set Point and Browsing through Menu Parameters and value of parameters. By pressing these keys for a few seconds, Super mode or defrosting operation will start.
5. **Three digit seven segment LED Display**
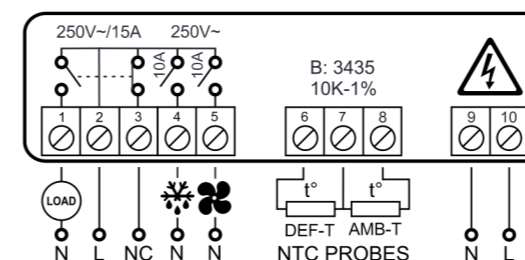
Sample Wiring Diagrams

TN-S322CA1
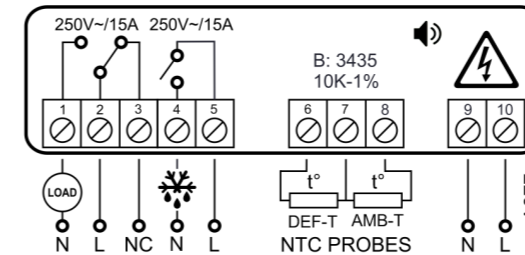
TN-S322DA
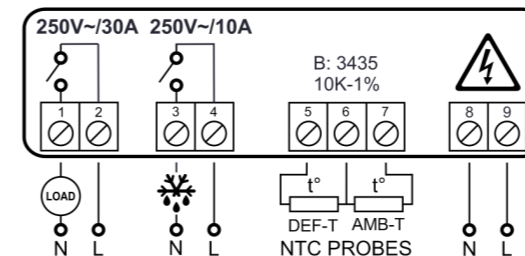
TN-S323EA0

Display

By setting the C4 parameter value with 0 or 1, the temperature value of the first or second sensor can be selected to display on the screen. If C4 value is set to 2, the device will display the temperature values of both sensors, respectively. If C4=1 or C4=2, while the second sensor is activated but its error is disabled, by occurring a failure in the second sensor, the "S2F" (Sensor 2 Fault) will be displayed on the screen instead of its temperature value.

During defrosting and dripping time, "dEF" and "drP" are added to the display expressions, respectively. If any active error occurs, "Ern" notification will be added to the display expressions (n represents the error number). If the Super mode is activated, "SUP" statement is added to the display expressions.

In normal operation, main relay output Indicator is "ON", when it is activated and flashes during start delay time or hot gas defrosting mode. Defrosting indicator is "ON" during defrosting procedure and flashes during the dripping time.

View and change set point

1. by pressing ▲ or ▼ keys once, set point will be displayed.
2. Select the desired value by pressing ▲ or ▼ keys.
3. Press Set key to apply and save the selected value as a new temperature set point.

To cancel the operation, don't press any key for a few seconds in steps 1 or 2.

Maximum and minimum acceptable values for set point can be programmed by setting A1 and A2 respectively in main menu.

View and change Parameters

1. Press Set key for a few seconds until "PS" appears on the screen. After a while the device is ready to get the password by displaying the number 0.
2. Use ▲ and ▼ keys to scroll the numbers to find and select the default password, then press Set key.

Entering the predefined number 24 as high access level password, allows the technician to view and change all parameters while entering number 7 as low access level password, allows the end users to change the DT, BZ and LC parameters only.

Please read this manual carefully before using the device.

- Check power supply voltage before connecting to the device.
- All wiring operation must be performed under the power off status.
- Consider the Maximum output current of the relays contact (15A (0.75hp)/30A (2hp) for main relay and 15A/10A for others). Make sure that relays are not overloaded.
- Be careful when connecting wires of sensor, load and supply input. Improper connection will seriously damage the device.
- Do not expose the device to water or moisture. Turn it off and disconnect the power supply before cleaning.
- Ensure that wires of sensor, load and power supply are far enough from each other.
- Don't drop, hit or shake the device.
- Do not install the device in very hot, cold or humid environments.
- Do not attempt to open and service the device yourself.
- This device is designed based on the specifications of its dedicated temperature sensor. using other sensors will reduce the accuracy of temperature measurement.

TN-S32 series main menu parameters

Item	Description	Unit	Min	Max	Def
C0	The temperature difference between the set point and temperature value in which output relay will be switched off	°C	1.0	10.0	2.0
C1	Cabinet temperature sensor calibration[1]	°C	-10.0	10.0	0.0
C2	Activation or deactivation of the second sensor (1: Enable, 0:Disable)		0	1	1
C3	Second temperature sensor calibration[1]	°C	-10.0	10.0	0.0
C4	Display Type (0: Displaying cabinet temperature value, 1: Displaying second temperature value, 2: Displaying cabinet and second temperature values, 3: Displaying second temperature value during defrosting, 4: Displaying the last cabinet temperature value just before starting the defrosting during defrosting operation)	—	0	4	0
C5	Moving average filter size associated with sampling the temperature sensors[2]	—	1	10	8
C6	Selecting between cooling or heating application (0: Heating, 1: Cooling)	—	0	1	1
d0	Selecting the method of implemented defrosting[3] (0: Electrical heater, 1: Hot Gas)	—	0	1	0
d1	Defrosting type (0: Disable, 1: Defrosting terminates according to temperature of the evaporator , 2: Defrosting terminates according to specified time, 3: Defrosting terminates according to evaporator temperature or specified time)[3]	—	0	3	2
d2	Activation of initial defrosting operation after power on (1: Enable, 0:Disable)	—	0	1	1
d3	Defrosting operation Intervals	hour	1	24	6
d4	Maximum defrosting procedure duration	min	5	120	20
d5	Threshold temperature for terminating the defrosting operation[3]	°C	-20	20	1
t0	Activation of main relay output delay at startup	min	1	10	3
t1	Minimum main relay OFF time between two consecutive ON states	min	0	10	4
t2	Main relay ON Time in sensor failure conditions	min	5	120	15
t3	Main relay OFF Time in sensor failure conditions	min	5	120	10
t4	Delay after defrosting operation (dripping time)	min	0	10	2
t5	Delay for cabin temperature out of range alarm announcement after occurrence	min	0	20	5
A0	Enable or disable alarms[4]	—	0	3	3
A1	Maximum set point temperature that can be set by end users	°C	A2+1	120	20
A2	Minimum set point temperature that can be set by end users	°C	-40	A1-1	-30
A3	Higher threshold of cabin temperature. Exceeding this value causes an alarm	°C	-40	120	10
A4	Lower threshold of cabin temperature. Exceeding this value causes an alarm	°C	-40	120	-30
A5	Auxiliary output configuration. If the second and third relays are not used for defrosting or fan controlling, they can be used as alarm outputs[5]. (0: disable, 1: setting defrosting relay as alarm output, 2: setting fan relay as alarm output)	—	0	2	0
F0	Fan operation control method (Refer to fan management section)	—	0	5	1
F1	Reference temperature for controlling the fan according to evaporator temperature	°C	-30	10	2
F2	Fan start delay after dripping time	—	0	10	3
Ld	Reset to factory settings (It is then necessary to turn the device off and on)	—	0	1	0
dt	Activation or deactivation of the decimal point in displaying the temperature	—	0	1	1
LC	Restricting of keys functions. Refer to end users menu section	—	0	3	0
b2	Buzzer Activation (1: Enable, 0:Disable)	—	0	1	1

1: It is highly recommended not to change this parameter. Any change will affect the accuracy of measurement unless in the case of calibrating the device with a more accurate instrument by an expert in a laboratory.

2: Low values assigned to this parameter Increases the fastness of the sensor response to temperature variations but the measured values become more sensitive to noise. High values slowing down the sensor response. However It will provide a more stable and accurate measurement.

3: Refer to **Defrosting Management** section.

4: Following table shows how A0 parameter value can activate the out of range temperature and second sensor (defrosting sensor) failure alarms.

A0 value	Temperature out of range	2nd sensor fault
0	Disable	Disable
1	Enable	Disable
2	Disable	Enable
3	Enable	Enable

5: If this parameter is set to 1, defrosting relay AUX function only works when the d0 parameter is set to 0. If this parameter is set to 2, fan relay AUX function Only works when the F0 parameter is set to 0.

It is highly recommended that only experts users see and change the main menu parameters. These parameters and their corresponding functions are summarized in the table. Note that some of these features may not be supported according to the device model.

End Users Menu

As previously explained, setting some of menu parameters is also accessible for the end users.

dt: activation or deactivation of the decimal point in displaying the temperature. (dt= 1, Decimal point will be displayed)

LC: Changing the set point and secondary function of the keys are locked.

LC= 0: Not restricted.

LC= 1: Changing the set point function is allowed, but Super mode and manual defrosting are locked.

LC= 2: Changing the set point function is locked, but Super mode and manual defrosting are allowed.

LC= 3 :all Keypad functions are Locked. However by pressing ▲ and ▼ keys, only set point is displayed and then it is not possible to change the set point.

Temperature Control

Temperature control is performed according to cabinet temperature measured by the probe. The device is able to control the cooling and heating. C6 programmable parameter enables the user to choose the application mode (heating or cooling mode).

C6=0: Heating Application, C6= 1: Cooling Application

C6 parameter, set point and Temperature difference (C0 parameter) together, specify temperature values in which main relay will be toggled.

In both applications (cooling or heating), the main relay contact will be opened at the set point temperature and will be closed at a calculated temperature according to C6, C0 and set point values. Note that in the cooling application, this calculated temperature is higher than set point temperature and in the heating application is lower than set point temperature.

the temperature difference between the set point and the temperature in which the main relay will be switched off is determined by the C0 parameter.

Example1 (heating): C6= 0, C0= 2.3 and Set Point= 18.5.

The main relay will turn on at 16.2°C and turn off at 18.5°C.

Example2 (cooling): C6= 1, C0= 1.8 and Set Point= -17.3.

The main relay will turn on at –15.5°C and turn off at -17.3°C.

When the main relay is activated, the corresponding LED is turned on.

Defrosting Management

Selecting the method of implemented defrosting: it can be programmed by setting the d0 value. If defrosting is implemented by the electrical heater this value must be 0 and if it is implemented by hot gas method it must be 1.

These series of devices support both automatic and manual defrosting methods.

Automatic defrosting: the defrosting procedure will be started with programmable time intervals (can be programmed by setting the d3 parameter).

Defrosting operation mode actually determines that how this process terminates. It can be programmed by setting the parameter d1.

d1= 0 the defrosting procedure is disable and the second relay can be used as an assigned output for AUX function.

d1= 1: The defrosting process will terminate when the evaporator temperature exceeds the temperature that is set in parameter d5.

d1= 2: The defrosting process will continue for the time that is set in parameter d4 (in minute).

d1= 3 : It is a combination of the two previous methods. Both time and temperature conditions can terminate the process.

Manual defrosting: In addition to automatic defrosting, these series of devices support manual defrosting. To perform defrosting operations manually, Press ▼ key for a few seconds until "dEF" appears on the screen, the defrosting procedure will be started and lasts as long as programmed time or until evaporator temperature reaches programmed temperature. During the manual defrosting procedure, pressing the ▼ key for a few seconds will stop the defrosting procedure.

In these cases the manual defrosting is disable:

1) when defrosting procedure is disabled with assigning a zero value to the parameter d1.

2) When defrosting procedure is defined depending on the evaporator temperature (d1= 1 or d1= 3) and evaporator temperature at the start of the pressing of the ▼ key is higher than the defined temperature (d5 parameter).

3) When keypad is locked by setting the LC parameter.

During the defrosting procedure, the "dEF" is added to the display expressions and the defrosting indicator LED stays ON.

After the defrosting operation, both outputs (compressor and defrosting) will be OFF for a specified period of time (can be programmed by t4 parameter) and "dEF" is replaced by "drP" on display.

Fan Management (TN-S323EA0)

F0 parameter is used to configure evaporator fan function:

F0= 0: Fan always OFF. (the third relay can be used as an auxiliary output)

F0= 1: Fan always ON in normal operation and OFF during defrosting.

F0= 2: Fan always ON except dripping time and delay after dripping.

F0= 3: Fan switches ON and OFF with the compressor and doesn't run during defrosting

F0= 4: Fan switches ON and OFF with the compressor and runs during defrosting.

F0= 5: Controller turns the fan ON when evaporator temperature is below the value F1 - 2 and turns it OFF when evaporator temperature is above the F1 value.

F2: during dripping time fan is OFF (t4 parameter value determines dripping time). after dripping time fan will stay OFF for a further period defined by the value of F2 (in minute). This feature is used to avoid blowing warm air into the refrigerator cabin.

Super Mode

By pressing ▲ key for a few seconds, Super mode will be activated and "SUP" will appear on the display. Activation of Super mode ignores the next defrosting operation. So refrigerator continuously decreases the cabin temperature more quickly to freeze the foodstuffs inside the cabin. It helps to keep frozen foodstuffs fresher. By pressing ▲ key for a few seconds Super mode will be terminated. Note that when the device is performing the defrosting operation, entering Super mode cancels the current defrosting operation.

Device Errors

The cabinet temperature sensor failure is a major and important error and it can not be disabled by the user. However about the other two errors, they can be activated or masked by setting up the parameter A0. For more information refer to main menu parameters table.

Adjusting the allowable temperature range of the cabinet can be done by setting up the A3 and A4 parameters. The value of the parameter t5 in minute determines the delay of displaying the alarm on the screen. If any active error occurs, these notifications will appear on the screen after the specified delay:

Er1: Cabinet sensor failure.
Er2: The second sensor failure.
Er3: Cabinet temperature is out of the specified range.
Er6: Unacceptable operation or assignment value.

Also in devices that are equipped with a buzzer, a corresponding audible alarm will be generated.