The Series TSX3 Digital Temperature Switch was designed to control the compressor, fan, and defrost in refrigeration applications. This generation of controls has field selectable engineering units and input temperature types in order to reduce the combination of parts that need to be stocked. A built in real time clock is used for HACCP logging of temperature alarms caused by temperatures out of their set limits or loss of power. The Intelligent Defrost parameters manage the defrost cycle in order to save energy cost. The digital input can be used to remotely trigger a defrost cycle, monitor cooler door status, or act as an external alarm. For programming multiple units, the model TS2-K configuration key can be used to quickly download parameter settings.

INSTALLATION
NOTE: Unit must be mounted away from vibration, impacts, water and corrosive gases.

• Cut hold in panel 71 x 29 mm (2.80 x 1.14 in).
• Use the supplied gasket or apply silicone around the perimeter of the hole to prevent leakage.
• Insert unit into hole from the front side of the panel.
• Slide the mounting bracket securely against the panel from the rear of the unit.
• Wiring diagram is displayed on the top of the control.

Wiring
Avoid installing the temperature probe cables and the digital input wires in close proximity of any power cables. If the length of the probe cables is longer than 100 meters, a recalibration adjustment may be made using the P1 parameter.

SPECIFICATIONS
Probe Range:
PTC: -58 to 302°F (-50 to 150°C).
NTC: -58 to 230°F (-50 to 110°C).
Input: PTC (1000Ω @ 25°C) / NTC (10KΩ @ 25°C) Digital Input Contact.
Output: All Models SPST No Relay Resistive Load 16A, Inductive Load 5A, 10 FLA, 60 LRA @ 240 VAC; Dual Output Models also include 8A Resistive, 3A Inductive SPDT @ 240 VAC; Three Output Models also include 8A Resistive SPST NO @ 240 VAC, 5A Resistive SPST NO @ 240 VAC.
Horsepower Rating: 1HP @ 240 VAC.
Control Type: On/Off.
Power Requirement: 115 VAC, 230 VAC, 12 VAC/VDC, 24 VAC/DC (±10%) depending on model.
Power Consumption: 3.6VA (115/230/24 V), 1.5VA (12V).
Accuracy: ±1% FS.
Display: 3 Digits Plus Sign.
Resolution: 0.1°.
Memory Backup: Non-Volatile Memory.
Ambient Temperature: 32 to 131°F (0 to 55°C).
Weight: 2.3 oz (65 g).
Front Protection: IP65.
Agency Approvals: CE, UL.
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Parameter Description

**Compressor / Set Point Menu**

- **Set** Sets the Ambient Temperature set point between r1 and r2
- **r0** Differential or hysteresis for set point
  - (For d0 = re)
  - Ambient temperature ≥ Set + r0 Output On
  - Ambient temperature ≤ Set - r0 Output On
- **r1** Minimum value for set point
- **r2** Maximum value for set point
- **r4** Set point deviation from Set value during night setting
- **r0** Differential or hysteresis for set point
  - (For d0 = in)
  - Ambient temperature ≤ Set - r0 Output On
  - Ambient temperature ≥ Set Output Off
- **r5** Fan Relay Operation
  - F0 Fan turns off when temperature is greater than this value.
  - F1 Determines if fan stops when door is open
  - c0 Minimum time compressor must remain off before being restarted
  - c1 Duration of continuous cold cycle
  - c2 During probe error, time that output is engaged
  - c3 During probe error, time that output is disengaged
  - c4 Minimum time compressor must stay on
  - c5 Minimum time before compressors starts
- **d0** Type of Defrosting
  - re = Defrosting without connecting the compressor
  - in = Defrosting by connecting compressor
- **d1** Defrosting stops when defrost probe temperature is above this value
- **d2** Maximum time the control will be in defrost cycle. If set to zero, control will not defrost
- **d3** Hour of the day for the first defrost. No defrost cycles will take place before this time
- **d4** Upon powering on the control, delay time before first defrost cycle
- **d5** Display during defrost cycle
  - Off = Current temperature displayed
  - On = Temperature at start of defrost cycle displayed until defrost cycle ends and the temperature is less than or equal to starting temperature or after the time is set in d6.
- **d6** Maximum time before the display returns to normal reading after a defrost cycle
- **d7** Time after defrost cycle before the compressor can be started
- **d8** Time between defrost cycles. If set to 0, defrost must be manually actuated
- **d9** Determines if Fan operates during defrost
- **d10** Amount of time after defrost before the fan can restart
- **d11** Minimum duration the control remains in defrost cycle
- **d12** Determines which temperature probe to use to control the defrost cycle
- **d13** Selection of Intelligent Defrost Method
  - off = turns off intelligent defrost
  - Jup = Skips defrost cycles as necessary
  - Git = Adjust time of defrost cycle as necessary
- **d14** Units to count the defrost cycle
  - rt = according to the time the controller was on
  - ct = according to the time the compressor was on
- **d15** The time of the defrost cycle will not be counted if the evaporator temperature is above this value
- **d16** Sets the normal defrost time as a percentage of d2.
- **d17** Value that d8 will be incremented or decremented during Intelligent defrost when d13 = Git
- **d5e** Hours until next defrost cycle
- **nde** Minutes until next defrost cycle
- **d5e** Displays the adjustments to the defrost cycle during intelligent defrost
  - When d13 = Jup, displays number of defrost cycles to skip
  - When d13 = Git, displays increments of d8.

**Alarm Menu**

- **A0** Alarm Differential or Hysteresis
- **A1** High Alarm Set Point (Deviation Value)
  - On when temperature reaches Set + A1 and off at Set + A1 - A0
- **A2** Low Alarm Set Point (Deviation Value)
  - On when temperature reaches Set - A2 and off as Set - A2 + A0
- **A3** Time of Alarm Inhibit after Continuous Cool Cycle
- **A4** Time of Alarm Inhibit after Continuous Defrost Cycle
- **A5** Time of Alarm inhibit after Power Up
- **A7** Time since Alarm Initiated until Validated
- **A8** Probe to be used for Alarm Settings

**Initial Setup Menu**

- **Hor** Real Time Hours
- **nin** Real Time Minutes
- **E0** Assignment of Digital Input
  - Off = Digital input disabled
  - A1 = External alarm condition when short circuited
  - In = Door open if short circuited
  - DEF = Defrost Cycle initiated when short circuited
  - Ndf = Defrost Cycle will be bypassed when short circuited
  - RSt = Night Set Points used when short circuited
- **H0** Restore Factory Configuration
- **H1** Assign Master/Slave for Defrost Cycles
  - Ms = Sends signal through digital input to initiate slave controls to start defrost
  - Svl = Performs defrost when receives defrost signal through digital input
  - (E0 = DEF when using master/slave operation)
- **H2** Keypad Password Protected
  - Yes = code is necessary to start/stop defrost or continuous cold cycle.
  - One minute after entering the code, keypad is locked again
  - No = Keypad not protected
- **H3** Compressor delay time upon power up
- **H4** Address for serial communications (Need Model TS485 communication module)
- **H5** Input code to Parameters (factory set at 0)
- **H6** Input Probe Types: PTC or NTC
- **H7** Assignment for Relay 2
  - Lit = Light
  - Fan = Fan
  - ALA = Alarm
  - dEF = Defrost
- **H8** Assignment for Relay 3 (only available on 3 output models)
  - Lit = Light
  - Fan = Fan
  - ALA = Alarm
  - dEF = Defrost
- **H11** HACCP Alarm recording enabled or disabled
- **d4A** Real Time Date can be programmed by holding the set key for 3 seconds. Then, use arrows to select day. Press set to store day; use arrows to access month and year
- **d1d** The display refreshes at 1 degree if actual temperature is greater than 1 degree higher td seconds before during defrost and open door conditions

**Front Panel Operation**

**Set Point Setup**
- Press the Set key once and SET will be displayed.
- Press Set key again and set point value will be shown.
- Uses the Up and Down arrows to adjust set point.
- Press the Set key to save the new set point.
- Press Set and Down arrow at same time to exit.

**Time Setup**
- Press the Set Key once and SET will be displayed.
- Use the Up and Down arrow until Hor is displayed for adjusting the hours.
- Press the Set key to view the current value.
- Use the Up and Down arrow to adjust to current time.
- Press the Set key for 8 seconds to save the new time (PrO will flash on display once the value is saved).
- Press the Set key to return to the previous menu.
- Use the Up and Down arrow until nin is displayed for adjusting the minutes.
- Repeat steps 3 through 6.
- Press the Set and Down arrow at the same time to exit.

**Display Menu**

- **P0** Selection of Engineering Unit (F or C)
- **P1** Ambient Probe Calibration Adjustment
- **P2** Defrosting Probe Calibration Adjustment
- **P4** Decimal Point Present
- **P5** Probe to display
- **P6** Probe 2 Present
Parameter Programming

The parameters are organized into 6 programming menus (CON, dEF, Pro, ALA, HAC, and Ini) (HAC is only accessible when H11 = yes).

- Press the Set key for 8 seconds until 0 is displayed.
- Use the Up and Down arrows to reach the assigned security code (factory setting for this code is 0).
- Press the Set key to accept the code.
- Use the Up and Down Arrows to select programming menu to enter.
- Press the Set key to reach the parameters under each programming menu.
- Use the Up and Down Arrows to scroll through the parameters.
- Use the Up and Down Arrows to change the values of the parameters.
- Press the Set key to save the changes.
- Press the Set and Down Arrow a second time to exit.

Date Setup

- Access the Data Parameter (dAt) in the Initial Setup Menu.
- Press the Set key once to display the day (dXX).
- Press and hold the Set button for 8 seconds will cause the digits to flash and allow the value to be changed.
- Use the Up or Down arrow to adjust the value for the day.
- Press and hold the Set button for 8 seconds to store the value (Pro will flash when the value has been stored).
- Use the Up or Down arrows to switch from day (dXX) to month (nXX) or year (yXX).
- Follow the same steps to adjust the month and year values.

Factory Default

- Go to H0 menu in the Initial Setup Menu.
- Adjust value to 1 for two output models or 2 for three output models.
- Press the Set key for 8 seconds.
- Press the Set key and Down Arrow simultaneously to exit menu.

Manual Default

Press the key for 8 seconds to activate/deactivate defrost cycle.

Continuous Cold Cycle

Press the Down key for 8 seconds to activate or deactivate a continuous cold cycle. (CON will flash upon starting cycle and COF will flash upon completion of cold cycle).

Resetting Keypad Security Code

Press the Set key during power up will reset the security code to 0.

Alarm Validation

Pressing the Down Arrow and the Set Key simultaneously will acknowledge an alarm condition. The Alarm indicator and the buzzer will turn off after acknowledging the alarm condition.

On/Off Lights

If one of the relays is set up to control a light, pressing the button for 3 seconds will turn on or off the light.

LED Indicators

- Indicates that the Compressor is engaged. It will blink when there is a call for the compressor to turn on during minimum compressor stoppage.
- Indicates that the Fan is engaged.
- Indicates an error or Alarm or error condition.
- HACCP indicates that a HACCP event is being recorded.

Display Messages

In normal operation the probe temperature will be displayed. The display blinks when waiting for a parameter to be saved or when there is an error saving a parameter to memory. The following messages can also appear:

- **Err** Memory Reading Error
- **ERP1, ERP2** Probe Error (check wiring or replace probe)
- **Eri** Internal Parameter Error (factory default programming)
- **ALH** High Temperature Alarm
- **ALL** Low Temperature Alarm

**ALE** External Alarm Condition

**AEL** Low Temperature and External Alarm

**ER0** Open Probe Error

**DON** Defrosting Activated

**DOF** Defrosting Finished

**CON** Continuous Cold Cycle Activated

**COF** Continuous Cold Cycle Finished

**-d-** Defrosting Cycle

During Probe error, the compressor will be cycled according to parameters c2 and c3. Manual defrosting and manual continuous cold cycle operations can be activated.

During memory error, the compressor will be cycled 5 minutes on and 5 minutes off. Manual defrosting and manual continuous cold cycle operations can not be activated.

**HACCP**

If this option is activated, the digital temperature switch can register up to 5 alarms which could be high, low, or blackout. These alarms can be seen in the menu registry of alarms (HAC).

This first value that appears is the number of registered alarms. Afterwards, for each alarm (if any have occurred), the value of the temperature and time the alarm occurred will be displayed. Once the alarm returns to normal state, the temperature will be recorded along with the amount of time it took to return to this temperature will be displayed.

When the elapsed time is shown, it will appear as xxd for the number of days. Pressing the Up arrow will display xxH for the number of hours, followed by xxn for the number of minutes. Pressing the Up and Down Arrows together for 2 seconds will delete the current record being displayed. If the Up and Down arrows are pressed for 2 seconds while in the HAC menu, all of the records will be erased.

**Defrosting Cycles**

The amount time between defrost can be based off the total time that the instrument is on or it can be limited to the amount of time the compressor is running. The first defrost will be performed at the hour of the day set with d3 and the following cycles will occur in intervals of d8 after the initial defrost.

**Intelligent Defrost**

By turning on the intelligent defrost, the time between defrost will vary. This time is only counted if the evaporator temperature is below the value of d15.

Selecting d13 = JuP, some of the defrosts may be skipped. After a defrost, the next defrost(s) will be skipped based on the value of JdF. JdF is initially 0 and increments if a defrost ends before a time d10*d2, otherwise it is decremented until the value is 0. Maximum value for JdF is 3. After JdF = 3, if the next defrost ends before d16*d2, JdF will be set to 1. Otherwise, JdF will be set to 0.

Selecting d13 - GdF, the defrost cycles may vary. If a defrost ends before d16*d2, then the time between defrosts is incremented d17 minutes, otherwise it is decremented d17 minutes. The initial and minimum value for the time between defrost is set by parameter d8. The number of time that the time between defrost has been incremented can be viewed in parameter JdF.

**Communication Connector**

The communication connector can be used with the TS2-K to read or write the parameter configuration to the Series TSX3. The connector can also be used with a TS485 module to communicate with a computer or other device.

**MAINTENANCE**

After final installation of the Series TSX3 Digital Temperature Switch, no routine maintenance is required. Clean the surface of the display controller with a soft and damp cloth. Never use abrasive detergents, petrol, alcohol or solvents. Upon final installation of the TSX3 Temperature Digital Controller, no routine maintenance is required. A periodic check of the system calibration is recommended. The Series TSX3 is not field serviceable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.