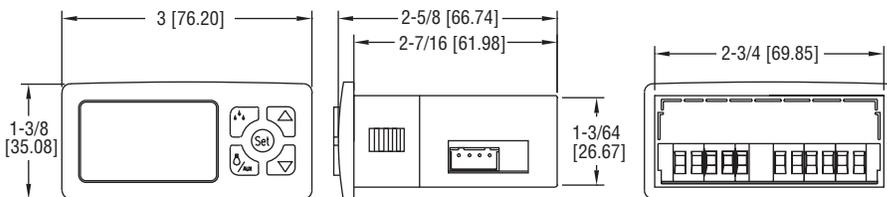# Series TSX3 Digital Refrigeration Temperature Switch

Specifications - Installation and Operating Instructions

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.
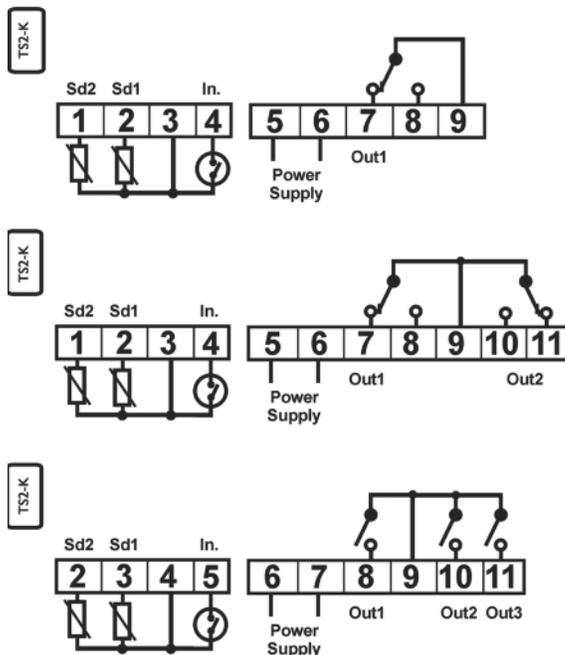
Resolution: 0.1°.

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.

Parameter List

Operation	Parameter	Description	Units	Range	Factory Setting
Compressor/ Set Point (COn)	Set	Set Point	Degrees	R1 to R2	3.0
	r0	Differential or Hysteresis	Degrees	0.1 to 20	1.0
	r1	Minimum Value for Set Point	Degrees	-99.9 to R2	-50.0
	r2	Maximum Value for Set Point	Degrees	R1 to 302	150
	r4	Night Set point Variation	Degrees	-20.0 to 20.0	0.0
	r6	Fan Operation	Range	On/Off/COn	COn
	F0	Fan Stoppage Temperature	Degrees	-99.9 to 302	28.0
	F1	Fan Stops when Door Open	Option	Yes/No	Yes
	c0	Minimum Compressor Stoppage Time	Minutes	0 to 240	1
	c1	Continuous Cycle Time	H-M	0.0 to 18	1.0
	c2	On Time of Fault Cycle	Minutes	0 to 999	5
	c3	Off Time of Fault Cycle	Minutes	0 to 999	5
	c4	Minimum On Time of Compressor	Minutes	0 to 240	0
	c5	Minimum Time Between Compressor Starts	Minutes	0 to 240	1
Defrost (DEF)	d0	Type of Defrosting	Option	Re/In	Re
	d1	Temperature to Stop Defrosting	Degrees	-99.9 to 302	80.0
	d2	Maximum Defrosting Time	Minutes	0 to 240	30
	d3	First Hour of Day for Defrost	H-M	00.0 to 18.0	00.0
	d4	Delay of First Defrost	Minutes	0 to 999	0
	d5	Display During Defrost	Option	Off/on/-d-	-d-
	d6	Display Return Limit	Minutes	0 to 240	15
	d7	Compressor Drip Time	Minutes	0 to 240	0
	d8	Interval Between Defrosts	H-M	00.0 to 18.0	8.0
	d9	Fan works while Defrosting	Option	Yes/No	No
	d10	Fan Drip Time	Minutes	0 to 240	0
	d11	Minimum Defrosting Time	Minutes	0 to 240	0
	d12	Fan/Defrosting Control Probe	Option	sd1/sd2	sd2
	d13	Intelligent Defrosting	Option	Off/JuP/CiC	Off
	d14	Units to Count Defrost Cycle	Option	CT/RT	RT
	d15	Evaporator Set	Degrees	-50.0 to 20.0	-10.0
	d16	D2 Maximum Time %.	%	0 to 100	50
	d17	CiC Time Variation	Minutes	0 to 120	10
	HdE	Next Defrost Time	Hours	Read Only	
	ndE	Next Defrost Time	Minutes	Read Only	
	JdF	Defrosts to Skip	Number	Read Only	
Display (Pro)	P0	Temperature Scale	Option	F/C	C
	P1	Ambient Probe Adjustment	Degrees	-20.0 to 20.0	0.0
	P2	Defrosting Probe Adjustment	Degrees	-20.0 to 20.0	0.0
	P4	Decimal Point	Option	Yes/No	Yes
	P5	Probe to Display	Option	sd1/sd2	sd1
	P6	Probe 2 Present	Option	Yes/No	Yes
Alarm (ALA)	A0	Alarm Differential	Degrees	0.1 to 20.0	4.0
	A1	Maximum Alarm Temperature	Degrees	0.1 to 99.9	8.0
	A2	Minimum Alarm Temperature	Degrees	0.1 to 99.9	8.0
	A3	Time Without Alarm After Continuous Cycle	H-M	0.0 to 18.0	1.1
	A4	Time Without Alarm After Defrost	H-M	0.0 to 18.0	1.1
	A5	Time Without Alarm After Opening Door	H-M	0.0 to 18.0	1.1
	A6	Time Without Alarm After Power On	H-M	0.0 to 18.0	1.1
	A7	Alarm Verification Time	H-M	0.0 to 18.0	1.1
	A8	Probe for Alarm	Option	sd1/sd2	sd1
Initial Setup (Ini)	Hor	Real Time Hours	Hours	0 to 23	0
	nin	Real Time Minutes	Minutes	00 to 59	00
	E0	Configure Digital Input	Option	Off/A1/In/DEF/Rst	Def
	H0	Factory Default	Range	0 to 2	0
	H1	Assign Master/Slave	Option	Mst/Slv	Mst
	H2	Keypad Protection	Option	Yes/No	No
	H3	Delay Time on Connecting	Seconds	0 to 240	0
	H4	Serial Communication Address	Range	0 to 999	0
	H5	Keypad Code	Range	0 to 999	0
	H6	Type of Probe	Option	PTC/NTC	PTC
	H7	Relay 2 Setup	Option	Lit/FAn/ALA/dEF	dEF
	H8	Relay 3 Setup	Option	Lit/FAn/ALA/dEF	Fan
	H11	HACCP Activated	Option	Yes/No	No
	dAt	Real Time Date	Range	dxx, nxx, yxx	d01, n01, y00
	td	Display Refresh Rate	Seconds	0-999	0

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	Output Off

(For d0 = in)

Ambient temperature ≤ SEt - r0	Output On
Ambient temperature ≥ SEt	Output Off

r1 Minimum value for set point
r2 Maximum value for set point
r4 Set point deviation from Set value during night setting
r6 Fan Relay Operation
On = Fan is always on while temperature < F0
Off = Fan is always off during regulation
CON = Fan is on when compressor is on
F0 Fan turns off when temperature is greater than this value.
Fan turns on when temperature is less than this value + A0
F1 Determines if fan stops when door is open
No = Fan does not stop working when door is open
Yes = 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 between compressors starts

Defrost Menu

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
CiC = Adjusts 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 = CiC
Hde Hours until next defrost cycle
nde Minutes until next defrost cycle
JdF Displays the adjustments to the defrost cycle during intelligent defrost
When d13 = JuP, displays number of defrost cycles to skip
When d13 = CiC, displays increments of d8.

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

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
A6 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 shirt circuited
Ndf = Defrost Cycle will be bypassed when shirt circuited
RSt = Night Set Points used when short circuited
H0 Restore Factory Configuration
H1 Assign Master/Slave for Defrost Cycles
Mst = Sends signal through digital input to initiate slave controls to start defrost
Slv = 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
dAt 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
td 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.

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.
   • Press the Set key to view the value of 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 to go back to the programming menu selection.
   • 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 defrost cycle is active.
✿   Indicates that the Fan in 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
AEH	High Temperature and External Alarm
AEL	Low Temperature and External Alarm
ooo	Open Probe Error
---	Short Circuited 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 d16*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 - CiC, the defrosting cycle 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.