

# Autonics Refrigeration Temperature Controller TF3 SERIES INSTRUCTION MAUAL



Thank you for choosing our Autonics product. Please read the following safety considerations before use.

## Safety Considerations

Please observe all safety considerations for safe and proper product operation to avoid hazards. **Warning** symbol represents caution due to special circumstances in which hazards may occur.

- Warning** Failure to follow these instructions may result in serious injury or death.
- Caution** Failure to follow these instructions may result in personal injury or product damage.

## Warning

- Fail-safe device must be installed when using the unit with machinery that may cause serious injury or substantial economic loss. (e.g. nuclear power control, medical equipment, ships, vehicles, railways, aircraft, combustion apparatus, safety equipment, crime/disaster prevention devices, etc.) Failure to follow this instruction may result in fire, personal injury, or economic loss.
- Install on a device panel to use. Failure to follow this instruction may result in electric shock or fire.
- Do not connect, repair, or inspect the unit while connected to a power source. Failure to follow this instruction may result in electric shock or fire.
- Check 'Connections' before wiring. Failure to follow this instruction may result in fire or explosion.
- Do not disassemble or modify the unit. Failure to follow this instruction may result in electric shock or fire.

## Caution

- When connecting the power, communication input and relay output, use AWG 28-12 cable and tighten the terminal screw with a tightening torque of 0.4N-m for the power, communication input terminal, and use AWG 28-12 cable and tighten the terminal screw with a tightening torque of 0.5N-m for the relay output. When connecting the sensor input cable without dedicated cable, use AWG 30-14 cable and tighten the terminal screw with a tightening torque of 0.2N-m. Failure to follow this instruction may result in fire or malfunction due to contact failure.
- Use the unit within the rated specifications. Failure to follow this instruction may result in fire or product damage.
- Use dry cloth to clean the unit, and do not use water or organic solvent. Failure to follow this instruction may result in electric shock or fire.
- Do not use the unit in the place where flammable/explosive/corrosive gas, humidity, direct sunlight, radiant heat, vibration, impact, or salinity may be present. Failure to follow this instruction may result in fire or explosion.
- Keep metal chip, dust, and wire residue from flowing into the unit. Failure to follow this instruction may result in fire or product damage.

## Ordering Information

TF 3 3 - 3 4 H - T	No-mark	No option
Option function <sup>*2</sup>	S	Synchronize defrost
	T	RS485 communication
	R <sup>*3</sup>	RTC (real time clock)
	A <sup>*3</sup>	RS485 communication+RTC (real time clock)
Compressor load capacity	G <sup>*1</sup>	Compressor 20A 1a contact
	A	Compressor 5A 1a contact
	H	Compressor 16A 1c contact
Power supply	1	24VAC 50/60Hz, 12-24VDC
	4	100-240VAC 50/60Hz
Output	1CH 1	Compressor output
	1CH, 3CH 2	Compressor+Defrost or Auxiliary (alarm/evaporator-fan) output
	3CH 3	Compressor+Defrost+Auxiliary (alarm/evaporator-fan) output
Number of input channels	1	1CH input (NTC or RTD) [temperature+digital input (DI)]
	3CH	3CH input (NTC)
	3	[inlet temperature+defrost temperature+outlet temperature or digital input (DI)]
Digits	3	999 (3 digit)
Item	TF	Refrigeration Temperature Controller

\*1: Only for 1CH input, compressor output model (TF31-1-G).  
\*2: Only for 3CH input model (TF33-□□□□). Option function is varied by compressor load capacity and contact.

Option function	Synchronize defrost function	RS485 communication	RTC function	RS485 communication+RTC function	No option
Compressor load capacity & contact	(TF33-□□A-S)	(TF33-□□A-T)	—	(TF33-3□A-A)	—
Compressor 5A 1a contact	—	—	(TF33-3□H-R)	—	(TF33-□□H)
Compressor 16A 1c contact	—	—	—	—	—

\*3: Except compressor+defrost or auxiliary (alarm/evaporator-fan) output model (TF33-2□□□□).  
\*4: Only for 3CH input, compressor+defrost+auxiliary (alarm/evaporator-fan) output model (TF33-3□□□□) supports buzzer.  
\*5: The above specifications are subject to change and some models may be discontinued without notice.  
\*6: Be sure to follow cautions written in the instruction manual, user manual and the technical descriptions (catalog, homepage).

## Specifications

● TF3 Series		
Model	TF31-□□□□ TF33-□□□□	
Number of channels	1CH 3CH	
Power supply	AC power 100-240VAC~50/60Hz AC/DC power 24VAC~50/60Hz, 12-24VDC~	
Allowable voltage range	90 to 110% of rated voltage	
Power consumption	AC power Max. 8VA (100-240VAC~50/60Hz) AC/DC power Max. 5VA (24VAC~50/60Hz), Max. 3W (12-24VDC~)	
Display method	7 Segment LED method (red)	
Character size (W×H)	9.4×19.3mm	
Input type	NTC 5kΩ/10kΩ RTD DP100Ω	
Sampling period	500ms	
Display accuracy	-At room temp. (23°C±5°C): ±1°C±1 digit -Out of room temp. range: ±2°C±1 digit	
Control	Compressor (COMP) 250VAC~5A, 30VDC~5A, 1a / 250VAC~16A, 24VDC~16A, 1c / 250VAC~20A 1a Defrost (DEF) 250VAC~10A, 24VDC~10A, 1a Auxiliary (AUX) 250VAC~5A, 30VDC~5A, 1a	
Communication output	— RS485 communication output (Modbus RTU)	
Digital input	Contact input: ON Max. 1kΩ, OFF Min. 100kΩ No contact input: ON residual voltage: Max. 1V, OFF leakage current: Max. 1mA, outflow current: 4μA	
Control method	ON/OFF control	
Hysteresis	0.5 to 5.0°C, 2 to 10°F variable	
Relay life cycle	Compressor (COMP) 5A 1a 16A 1c 20A 1a	Mechanical: 5,000,000 operations, Electrical: 50,000 operations (250VAC 5A) Mechanical: 20,000,000 operations, Electrical: 30,000 operations (250VAC 16A) Mechanical: 10,000,000 operations, Electrical: 100,000 operations (250VAC 20A)
	Defrost (DEF) Auxiliary (AUX)	Mechanical: 20,000,000 operations, Electrical: 100,000 operations (250VAC 10A) Mechanical: 5,000,000 operations, Electrical: 50,000 operations (250VAC 5A)
Memory retention	Approx. 10 years (non-volatile memory method)	
Insulation resistance	Min. 100MΩ (at 500VDC megger)	
Dielectric strength	AC power 3000VAC 50/60Hz for 1 min (between all terminals and case, power and input circuit) AC/DC power 1000VAC 50/60Hz for 1 min (between all terminals and case power and input circuit)	
Noise resistance	Square-wave noise by the noise simulator (pulse width: 1μs) ±2kV R-phase and S-phase	
Vibration	1.5mm amplitude at frequency of 10 to 55Hz (for 1 min) in each X, Y, Z direction for 2 hours	
Environment	Ambient temp.	-10 to 50°C, storage: -20 to 60°C
	Ambient humi.	35 to 85%RH, storage: 35 to 85%RH
Accessories	Bracket: 2, NTC sensor (5kΩ): 1	
Protection structure	IP65 (front case)	
Approval	CE, UL, etc.	
Weight <sup>*1</sup>	Approx. 207g (approx. 105g)	
● Remote display unit [TFD, sold separately]		
Model	TFD-3 TFD-5	
Power supply	3.3VDC	
Power consumption	Max. 1W	
Display method	7 Segment LED method (red)	
Comm. method	Serial (TTL Level), Half duplex	
Comm. cycle	100ms	
Cable	Ø2.5mm, 3m Ø2.5mm, 5m	
Weight <sup>*1</sup>	Approx. 77g (approx. 48g)	
*1: The weight includes packaging. The weight in parentheses is for unit only. The weight is varied by model option. *2: Environment resistance is rated at no freezing or condensation.		

## Part Description

- Present value (PV) display component (red)**  
RUN mode: Displays present value (PV).  
Setting mode: Displays parameter and setting value.
- Deviation indicator (▲ green, ▼ red)**  
Displays deviation of present value (PV) based on setting value (SV).
- PV deviation temperature**  
More than ±1.8°C ▲ indicator turns ON  
Within ±1.8°C ■ indicator turns ON  
Less than -1.8°C ▼ indicator turns ON
- Compressor (COMP) output indicator (green)**  
Turns ON for compressor output. In case of compressor protection operation and output does not turn ON, it flashes.  
When operating compressor continuously, it turns ON for 2 sec, and turns OFF for 1 sec.
- Defrost (DEF) output indicator (green)**  
Turns ON for defrost output. Flashes for defrost delay operation.  
Turns ON for 2 sec and OFF for 1 sec for manual defrost or Power ON defrost.
- Evaporator-fan (FAN) output indicator (green)**  
Turns ON for evaporator-fan output. Flashes for delay operation of evaporator-fan output.
- Auxiliary (AUX) output indicator (green)**  
Turns ON for alarm output. Flashes for delay operation of alarm output.
- Unit indicator (red)** Displays temperature unit [unit] of parameter 1 group.
- (MODE) key** Used for entering parameter setting group, returning RUN mode, moving parameter or saving SV.
- (AUX) key** Used for entering SV setting group or changing setting value.  
Hold the key over 3 sec to select active/inactive auxiliary output in RUN mode.
- (DEF) key** Used for entering SV setting group or changing setting value.  
Hold the key over 3 sec to execute/top manual defrost in RUN mode.
- (COMP) key** Used for entering SV setting group, changing setting value, moving digits.  
Hold the key over 3 sec to active/inactive compressor output in RUN mode.  
When buzzer alarm occurs, press the key once to stop the sound. (Only for 3CH input, compressor+defrost+auxiliary (alarm/evaporator-fan) output model (TF33-3□□□) supports buzzer. Buzzer [buzzer] of parameter 1 group is set as [on].)
- Data loader port**  
It is for displaying TF3 data at remote display unit (TFD) by connecting phone-jack. In other case, for connecting Autonics SCM-US (USB/Serial converter, sold separately), it is a PC loader port of serial communication for parameter setting by PC.

### Input Type and Temperature Range

Input type	Decimal point	Display method	Temperature range (°C)	Temperature range (°F)
Thermistor (NTC)	1	n5H	-40 to 99	-40 to 212
	0.1	n5L	-40 to -20 -19.9 to 99.9	-40 to -20 -19.9 to 99.9
NTC 10kΩ	1	n1H	-40 to 99	-40 to 212
	0.1	n1L	-40 to -20 -19.9 to 99.9	-40 to -20 -19.9 to 99.9
RTD <sup>*1</sup>	1	dPH	-99 to 99	-148 to 212
	0.1	dPL	-99 to -20 -19.9 to 99.9 <sup>*2</sup>	-148 to 212

\*1: Only for 1CH input model (TF31-□□□□).  
\*2: If PV with "-" sign is over 3 digits (e.g.: -99.9), the numbers below decimal point does not display. You can check it at the comprehensive device management program (DAQMaster) by communicating via PC.

## Connections

### TF31-1-G

### TF31-□□A

### TF33-□□H

### TF33-□□A

※1: Only for compressor+defrost or auxiliary (alarm/evaporator-fan) output model (TF31-1-G), compressor+defrost+auxiliary (alarm/evaporator-fan) output model (TF33-3□□□).  
※2: Only for compressor+defrost+auxiliary (alarm/evaporator-fan) output model (TF33-3□□□).  
※3: Only for synchronize defrost function model (TF33-□□A-S), or RS485 communication model (TF33-□□A-T/A).

## Dimensions

### TF3 Series

### NTC sensor (5kΩ)

### Bracket

### TFD (sold separately)

### Panel cut-out

Series	Size	A	B	C	D
TF3	Min. 100 <sup>*1</sup>	Min. 55	70.3 <sup>*2</sup>	28.2 <sup>*3</sup>	25.4 <sup>*3</sup>
TFD	Min. 65	Min. 40	45.7 <sup>*4</sup>	25.4 <sup>*3</sup>	—

\*1: When connecting remote display unit (TFD), or SCM-US, Min. 120

## Remote Display Unit (TFD) [sold separately]

Remote display unit (TFD) displays current temperature or output status of TF3 at remote place. TFD cable is TFD-3: 3m, TFD-5: 5m. Connect the phone-jack of remote display unit (TFD) to the data loader port of TF3. This unit is dedicated for PC, PLC, etc. and it does not directly communicate with upper devices (PC, PLC, etc.). If TFD communication with TF3 error occurs, TFD flashes display component for 1 sec. Check the connection with TF3.

※When connecting TFD to the data loader port of TF3, you cannot connect Autonics SCM-US (USB to Serial converter, sold separately) for communication. Use SCM-US48 (USB to RS485 converter, sold separately), SCM-38 (RS232C to RS485 converter, sold separately).

## SV Settings

You can set the temperature to control with **(AUX)**, **(DEF)**, **(COMP)** keys. Set range is within SV low-limit value [L5u] to SV high-limit value [H5u]. E.g.) In case of changing SV from 19°C to 10°C

- Press any key among **(AUX)**, **(DEF)**, **(COMP)** in RUN mode to enter into SV setting mode. Last digit (10<sup>th</sup> digit) on SV display part flashes.
- Press **(AUX)** key to move digit. (10<sup>th</sup> → 10<sup>1st</sup> → 10<sup>2nd</sup> → 10<sup>3rd</sup> → 10<sup>4th</sup>)
- Press **(AUX)**, **(DEF)** key to raise or lower the set value. (9 → 0)
- Press **(MODE)** key to save the set value. If there is no additional key operations in 3 sec, the changed SV is automatically saved.

## Comprehensive Device Management Program [DAQMaster]

DAQMaster is comprehensive device management program. It is available for parameter setting, monitoring, and user parameter group setting, parameter mask setting for only TF3 Series.

Item	Minimum specifications
System	IBM PC compatible computer with Pentium III or above
Operations	Windows 98/NT/XP/Mista/7/8/10
Memory	256MB+
Hard disk	1GB+ of available hard disk space
VGA	Resolution: 1024×768 or higher
Others	RS232C serial port (9-pin), USB port

## Parameter Mask

This function is able to hide unnecessary parameters to user environment or less frequently used parameters in parameter group. You can set this in the comprehensive device management program (DAQMaster). Masked parameters are only not displayed. The setting value of masked parameters are applied. For more information, refer to DAQMaster user manual. Visit our web site to download DAQMaster program and the user manual.

Before applying mask: **PR1** → **inT** → **S2** → **S3** → **uEr** → **UnT** ...

After applying mask: **PR1** → **inT** → **S2** → **uEr** ...

The above is masking input sensor 3 selection [S3], temperature unit [uEr] of parameter 1 group for 3CH input model (TF33-□□□□).

## Parameter User Group [PRU]

This function is able to set the frequently used parameters to the user parameter group. You can quickly and easily set parameter settings. User parameter group can have up to 30 parameters in the comprehensive device management program (DAQMaster). For more information, refer to the DAQMaster user manual.

**RUN mode**

**PRU** → **PR1** ... **PR5**

**d5t** → **HYS** → **nHY** → **dEF** → **dEt** → **RHY**

The above is setting user parameter group in the DAQMaster with delay display period [d5t] of parameter 1 group, hysteresis [HYS], night mode hysteresis [nHY] of parameter 2 group, defrost method [dEF], defrost time [dEt] of parameter 3 group, alarm output hysteresis [RHY] of parameter 4 group.

## Virtual Temperature Rate [uEr]

(only for 3CH input model: TF33-□□□□)

In case of 3CH input model (TF33-□□□□), input sensor 3 selection [S3] of parameter 1 group is set as outlet temperature [t5]. You can set virtual temperature rate. If the temperature of inlet and outlet is significantly different at freezer, virtual temperature helps to control temperature efficiently. Virtual temperature is designated by the rate of input sensor 1 (inlet temperature) and input sensor 3 (outlet temperature). There is virtual temperature calculation formula.

$$\text{Virtual temperature (PV)} = \frac{[(100 - \text{virtual temperature rate}) \times \text{input sensor 1 temperature}] + [\text{virtual temperature rate} \times \text{input sensor 2 temperature}]}{100}$$

If virtual temperature rate [uEr] is set as [0], virtual temperature (PV) = input sensor 1. If virtual temperature rate [uEr] is set as [100], virtual temperature (PV) = input sensor 3. E.g.) If inlet temperature of input sensor 1 is 0°C, and outlet temperature of input sensor 3 is 10°C, set virtual temperature rate [uEr] as [50] and virtual temperature is 5°C to control temperature.

$$5 = \frac{[(100 - 50) \times 0] + [50 \times 10]}{100}$$

Setting range of virtual temperature rate: 0 to 100 (%)

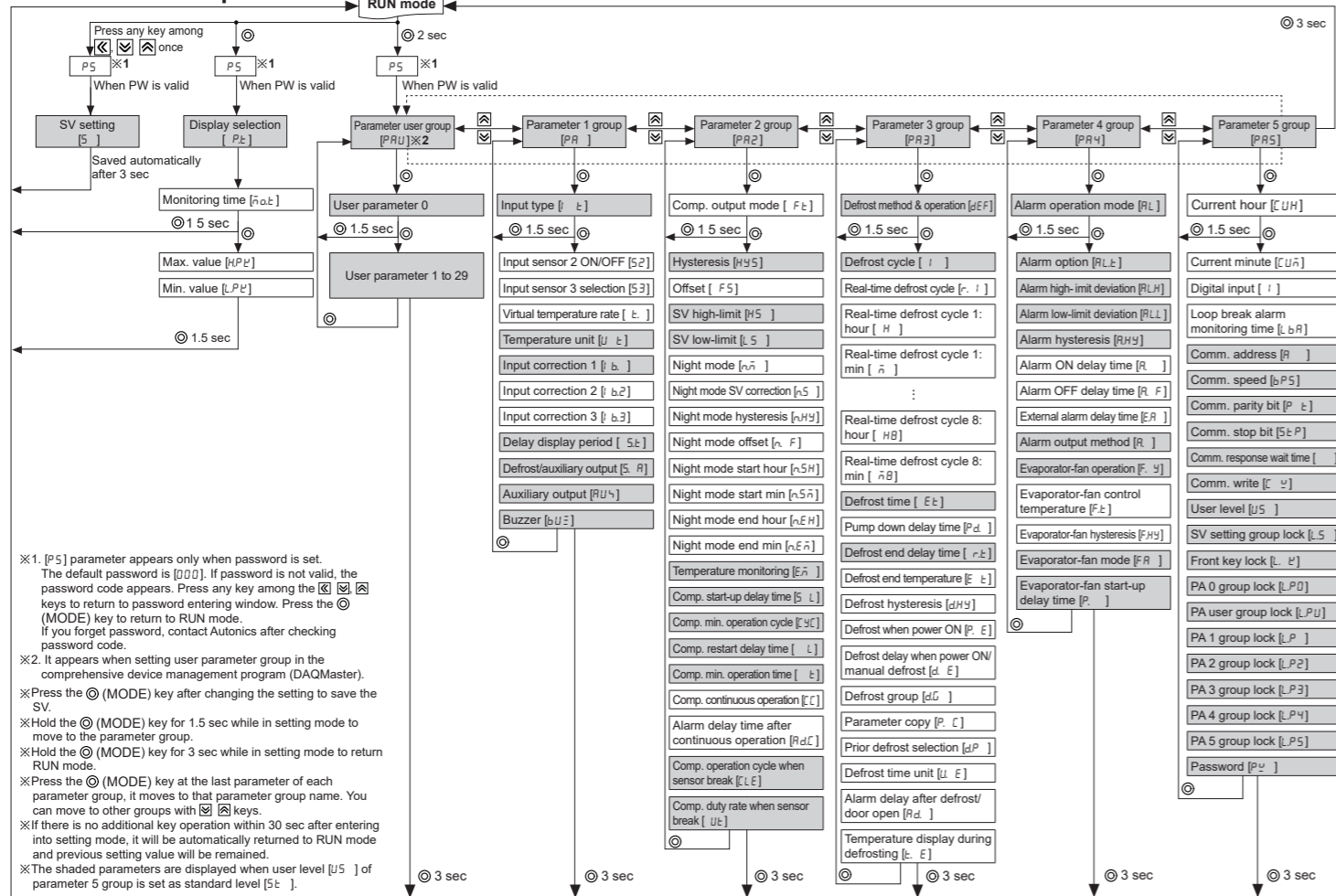
## Display Selection [dPE]

(only for 3CH input model: TF33-□□□□)

You can select input sensor to display at present value (PV) display component in RUN mode.

Parameter	Description
S1	Displays PV of input sensor 1 (inlet temperature).
S2	Displays PV of input sensor 2 (defrost temperature).
S3	Displays PV of input sensor 3 (outlet temperature).
u5	Displays virtual temperature.

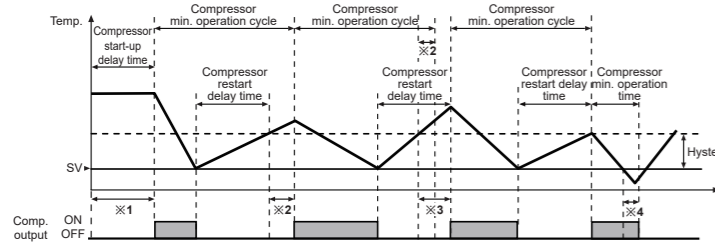
## Parameter Group



## Compressor Protection

This function is for preventing compressor from life cycle shortening or malfunction by overload and frequent ON/OFF of compressor. As compressor protection settings, when compressor output does not ON, the front compressor (COMP) output indicator (green) is flashing.

- Compressor start-up delay time [Sdt]**  
If power turns ON instantly from break-down or power OFF, it delays start-up during the set time of compressor. Setting range: 0 to 60 (min)
- Compressor restart delay time [r.dL]**  
To prevent frequent compressor ON/OFF, set compressor ON time after compressor turns OFF. Setting range: 0 to 60 (min)
- Compressor min. operation time [onL], Compressor min. operation cycle [CYC]**  
To prevent frequent compressor ON/OFF, set min. operation time and min. operation cycle. Setting range of compressor min. operation time: 0 to 60 (min). Setting range of compressor min. operation cycle: 0 to 60 (min)



- When starting compressor, if present value (PV) is out of hysteresis range, compressor output does not turn ON and the compressor (COMP) output indicator is flashing during compressor start-up delay time.
- When compressor delay is completed and it is within compressor min. operation cycle, compressor output does not turn ON and the compressor (COMP) output indicator is flashing. (The latest one has priority between compressor restart delay time and compressor min. operation cycle.)
- When present value (PV) is out of hysteresis, compressor output does not turn ON and the compressor (COMP) output indicator is flashing during compressor restart delay time.
- If present value (PV) is below the SV, compressor output maintains ON status during compressor min. operation time. After compressor min. operation time, it turns OFF.
- If compressor output does not turn ON due to compressor output condition or parameter settings for compressor protection, the compressor (COMP) output indicator is flashing.

\*For more information about parameters for compressor prevention, refer to user manual.

## Compressor Control When Sensor Break

If normal temperature control is impossible due to sensor break, it controls compressor output by the set operation cycle and duty ratio to protect control object. Until error is cleared, operation cycle and duty ratio are applied repeatedly. When error is cleared, the compressor operates after completing the currently applied operation cycle and compressor restart delay time.

- Compressor operation cycle when sensor break [LLE]**  
Set compressor operation cycle when sensor break. Set as [L] and compressor output turns OFF when sensor break. Setting range: 0 to 100 (min)
- Compressor duty ratio when sensor break [dUt]**  
Set compressor ON duty ratio when sensor break. Setting range: 0 to 100 (%)  
E.g.) When compressor operation cycle when sensor break [LLE] is set as 60 min and compressor duty ratio when sensor break [dUt] is set as 50%, compressor output has 60 min cycle and turns ON for 30 min and turns OFF for 30 min.

## Defrost Control (except 1CH, compressor output model: TF31-1□□)

When operating a compressor for a long time, an evaporator and a freezer are freezing and thermal efficiency of compressor is decreased. For increasing thermal efficiency, defrost operation helps to remove frost or ice around of evaporator.

Set defrost cycle, time, and end temperature, etc. to operate defrost (heater/hot-gas defrost). The front defrost (DEF) output indicator (green) turns ON during defrost output and it flashes during defrost delay operation.

In case of compressor+defrost or auxiliary (alarm/evaporator-fan) output model (TF33-2□□□), defrost operation is available when defrost/auxiliary output [SdR] of parameter 1 group is set as defrost [dEF].

Parameter	Defrost method	Defrost operation
Ht n	Heater defrost	Operates during the set defrost cycle/time
Gt n	Hot-gas defrost	
Ht t	heater defrost	
Gt t	Hot-gas defrost	Operates when PV is lower than defrost end temperature during the set defrost cycle/time (only for 3CH input model (TF33-□□□□))

**Defrost cycle [dI n], Defrost time [dEt]**  
Set defrost cycle and time to operate defrost at every set cycle and during the set time. Defrost cycle setting range: 0 to 24 (hour)/0 to 100 (min). Defrost time setting range: 1 to 100 (min/sec)

\*Compressor operation during defrost is varied by defrost method. In case of heater defrost, compressor output turns OFF, and in case of hot-gas defrost, compressor output turns ON. Evaporator-fan operation is varied by evaporator-fan operation mode setting.

In case of RTC function model (TF33-3□□□-R/A), defrost operates at every specific time. Set real-time defrost cycle [r.dI] of parameter 3 group as [on] and 8 real-time defrost times are available to set.

**Defrost end temperature [Et], Defrost hysteresis [dHY] (only for 3CH input model TF33-□□□□)**  
Set defrost end temperature and defrost hysteresis from input sensor 2 (defrost temperature). When the measured temperature of defrost sensor is same as the set defrost end temperature, defrost operation is stopped. It is available when input sensor 2 ON/OFF [S2] is set as [on] and defrost method and operation [dEF] is set as [Ht t] or [Gt t].

Defrost end temperature setting range: -40 to 99 (°C) / -40 to 212 (°F)  
Defrost hysteresis setting range: 1 to 5 (1.0 to 5.0) (°C) / 2 to 10 (°F)

### Manual defrost

Execute defrost manually regardless of the set defrost cycle which consists of defrost method and operation setting. Hold the front [F] key over 3 sec or, turn ON the digital input when digital input [dI] of parameter 5 group is set as [r.dI] to operate defrost during the set defrost time. The front defrost (DEF) output indicator turns ON for 2 sec and turns OFF for 1 sec during manual defrost. Hold the front [F] key over 3 sec or turn OFF the digital input during manual defrost, and the set defrost cycle restarts.

### Defrost synchronization (only for synchronize defrost function model TF33-□□A-S, RS485 communication model TF33-□□A-T/A)

When connecting over 2 units of TF3, defrost and compressor operation is able to synchronize via synchronize terminal/RS485 communication. It is available for synchronize defrost function model (TF33-□□A-S), or RS485 communication model (TF33-□□A-T/A).

- [Setting Order]
- Connect each other synchronize terminals or RS485 communication terminals of the units which are synchronized for defrost.
  - Set defrost cycle [dI n] same as among the units. (if error occurs, defrost cycle is the setting of each unit)
  - Set defrost group [dG] as 1 master unit [nR5] and slave unit(s) (up to 5 units) [SLR].
  - According to defrost operation of Master, the defrost operation of slave(s) executes. (when changing the defrost parameters of master, defrost operations of slave(s) are also changed forcibly as same as the defrost operation of master via connected terminals. The defrost parameters of slave(s) are not changed.)
- \*Defrost operation by real-time defrost cycle is not able to synchronize.
  - \*Defrost operation of master is prior to the compressor operation of slave.
  - \*For more information about parameters for defrost operations, refer to user manual.

## Alarm (except 1CH, compressor output model: TF31-1□□)

Set both alarm operation and alarm option by combining. Alarm function is available for compressor+defrost or auxiliary (alarm/evaporator-fan) output model (TF33-2□□□). Also defrost/auxiliary output [SdR] of parameter 1 group should be set as auxiliary [RAU], and auxiliary output [RAU] should be set as alarm [RL n]. In case of compressor+defrost+auxiliary (alarm/evaporator-fan) output model (TF33-3□□□), auxiliary output [RAU] of parameter 1 group should be set as alarm [RL n].

Mode	Name	Alarm operation	Description
oFF			No alarm output.
RLd	Deviation high, low-limit alarm	ON: PV > SV + Δ OFF: PV < SV - Δ High-limit deviation [RLH]: Set as 20, Low-limit deviation [RLL]: Set as 10	If deviation between present value (PV) and setting value (SV) is higher than high-limit or low-limit deviation SV, alarm output turns ON.

Mode	Name	Description
RLA	Standard alarm	If it is an alarm condition, alarm output is ON. If it is a clear alarm condition, alarm output is OFF.
RLb	Alarm latch	If it is an alarm condition, alarm output is ON and maintains ON status.
RLC	Standby sequence 1	First alarm condition is ignored and from second alarm condition, standard alarm operates. When power is supplied and it is an alarm condition, this first alarm condition is ignored and from the second alarm condition, standard alarm operates.
RL	Alarm latch and standby sequence 1	If it is an alarm condition, it operates both alarm latch and standby sequence. When power is supplied and it is an alarm condition, this first alarm condition is ignored and from the second alarm condition, alarm latch operates.
RLd	Standby sequence 2	First alarm condition is ignored and from second alarm condition, standard alarm operates. When re-applied standby sequence and if it is an alarm condition, alarm output does not turn ON. After clearing alarm condition, standard alarm operates.
RLF	Alarm latch and standby sequence 2	Basic operation is same as alarm latch and standby sequence 1. It operates not only by power ON/OFF, but also alarm set value, or alarm option changing. When re-applied standby sequence and if it is an alarm condition, alarm output does not turn ON. After clearing alarm condition, alarm latch operates.

- \*1: To clear alarm, turn OFF the power (also digital input [dI] is set as RUN/STOP [S.tP] and input is ON for pausing compressor output) or press the front [F] key once. (press twice when buzzer is set)
- \*2: Condition of re-applied standby sequence for standby sequence: Power ON, changing temperature, alarm settings, switching STOP mode to RUN mode (also digital input [dI] is set as RUN/STOP [S.tP] and input turns OFF from ON for operation mode by releasing pause compressor output)

## Digital Input [dI]

Parameter	Function
oFF	FF: No digital input
RUN/STOP	S.tP: Pauses compressor output. All output indicators turn OFF. When digital input is OFF, it controls normally after compressor restart delay time.
Door switch	dS: By connecting freezer door switch and digital input contact, it controls compressor/defrost/evaporator-fan according to the door status. - Digital input ON (door open): Compressor, defrost, evaporator-fan output turns OFF - Digital input OFF (door close): After 1 min, it returns the previous status of door open. (not applied compressor protection operations) Alarm occurs after the time of alarm delay after defrost/door open [Rd] of parameter 3 group. When operating compressor continuously, compressor start-up time is extended as long as the door open time.
Night mode ON/OFF	n: When digital input turns ON, night mode is active.
External alarm	ER: When digital input turns ON, alarm output turns ON forcibly. (except alarm is ON) When external alarm delay time [ER] of parameter 4 group is set, alarm turns ON after the set time.
Defrost ON/OFF	E.F: When digital input turns ON and it is defrost operation condition, defrost output turns ON. Even though it is defrost operation condition, if digital input turns OFF, defrost output turns OFF also.
Manual defrost	n.F: When digital input turns ON, it executes manual defrost.

\*1. Except 1CH, compressor output model (TF31-1□□).

## Evaporator-fan Control (except 1CH, compressor output model: TF31-1□□)

To improve the efficiency of cooling, install and control evaporator-fan at evaporator. It is available for compressor+defrost or auxiliary (alarm/evaporator-fan) output model (TF33-2□□□). Also defrost/auxiliary output [SdR] of parameter 1 group should be set as auxiliary [RAU], and auxiliary output [RAU] should be set as evaporator-fan [FR n].

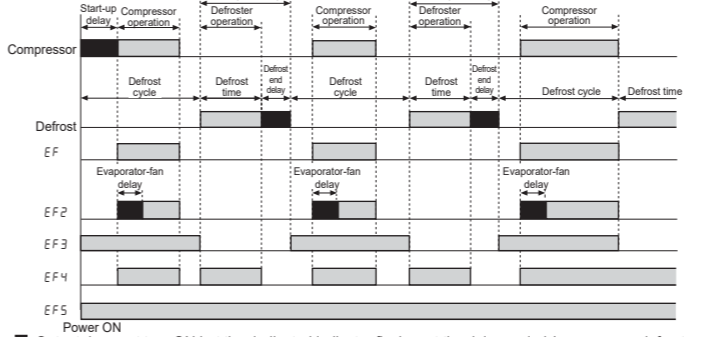
It is available for compressor+defrost+auxiliary (alarm/evaporator-fan) output model (TF33-3□□□). Also, auxiliary output [RAU] of parameter 1 group should be set as evaporator-fan [FR n].

- Evaporator-fan operation [F.tY]**  
Evaporator-fan operates by two control methods; [dEF] controls evaporator-fan by measured temperature from defrost sensor or [FR n] controls evaporator-fan by compressor/defrost operation.
- Evaporator-fan control temperature [F.tY] and hysteresis [F.HU]**  
When evaporator-fan operation [F.tY] is set as [dEF] controls (evaporator-fan is controlled by measured temperature from defrost sensor), and the temperature of defrost sensor is same as evaporator-fan control temperature [F.t], evaporator-fan output turns OFF. Set evaporator-fan control temperature [F.t] and evaporator-fan control hysteresis [F.HU].  
Evaporator-fan control temperature setting range: -40 to 99 (°C), -40 to 212 (°F)  
Evaporator-fan control hysteresis setting range: 1 to 5 (0.5 to 5.0) (°C), 2 to 10 (°F)
- Evaporator-fan operation mode [FR n] and evaporator-fan start-up delay time [P.d.r]**  
When evaporator-fan operation [F.tY] is set as [FR n] for control by compressor/defrost operation, it is available to set [FR n] for evaporator-fan operation mode for compressor/defrost operation.

Parameter	Operation method
EF	When compressor operates, evaporator-fan also operates. When compressor operation is finished, evaporator-fan also operation turns OFF. (except compressor operation for hot gas defrost)
EF2	When compressor operates, evaporator-fan operates after the set evaporator-fan start-up delay time. When compressor operation is finished, evaporator-fan operation turns OFF. (regardless of defroster operation)
EF3	When power turns ON, evaporator-fan operates. When defroster operates, evaporator-fan stops. (regardless of compressor operation)
EF4	Evaporator-fan operates only when operating compressor or defrost. Evaporator-fan stops when compressor and defroster stops. (for above zero temperature control)
EF5	Evaporator-fan operates from power ON to power OFF. (regardless of defroster operation of freezer. When door is open (digital input [I] is set as RUN/STOP [S.tP] or door switch [dS]), evaporator-fan stops.

If evaporator temperature is increased by defrost operation, warm air may flow into cooling system by evaporator-fan operation. Set evaporator-fan start-up delay time [P.d.r] to prevent warm air inflow, and it may increase cooling efficiency.

Evaporator-fan start-up delay time setting range: 0:00 to 9:59 (0 min 00 sec to 9 min 59 sec)



\*Output does not turn ON but the dedicated indicator flashes at the delay period (compressor, defrost, evaporator-fan).  
\*For more information about parameters for evaporator-fan control, refer to user manual.

## Parameter Reset

Hold [F] keys for 5 sec to reset all parameters in memory to default value. Set [n] parameter to [E5] to reset all parameters. In case password function is ON, it is required to enter valid password to reset parameters. Password is also reset.

## Error Display

Flashing in turn	Description	Troubleshooting
E r 1 → P n	When input sensor is break or sensor is disconnected.	Check input sensor status.
E r 1 → L L L	If the measured temperature of the dedicated sensor is lower than low-limit temperature among temperature setting range.	t clears when input is within the display range.
E r 1 → H H H	If the measured temperature of the dedicated sensor is higher than high-limit temperature among temperature setting range.	Check the compressor and hold the [F] key at the same time for 3 sec. It clears when input is within the adequate range.
E r r → L b R	Even though input sensor is normal, freezer temperature does not change over 1.0°C (1.8°F) during loop break alarm monitoring time [L b R].	Check the compressor and hold the [F] key at the same time for 3 sec. It clears when input is within the adequate range.

\*1: [ ] indicates input sensor number of error display priority which occurs error.  
Error display priority: E r 1 (input sensor 1) → E r 2 (input sensor 2) → E r 3 (input sensor 3) → E r u (virtual temperature) → E r r

\*2: E r u (virtual temperature) is not applicable.

## Factory Default

Parameter	Factory default	Parameter	Factory default
Su	0	dPt	5 l
<b>Parameter 0 group</b>			
naL	nSH	UnL	°C
S2	oFF	l b	bU
S3	dI	dSt	0.5
uLr	0	SdR	dEF
<b>Parameter 1 group [P1]</b>			
naL	nSH	UnL	°C
S2	oFF	l b	bU
S3	dI	dSt	0.5
uLr	0	SdR	dEF
<b>Parameter 2 group [P2]</b>			
oFt	L	nSu	l
HY5	l	nHY	l
oF5	0	naF	0
HSu	99	nSH	0
LSu	40	nLH	0
nLn	oFF	nEH	8
<b>Parameter 3 group [P3]</b>			
dEF	Ht n	dEt	30
rIn	4	Pdd	0.00
r.dI	oFF	drL	0.00
dH	oFF	Edt	4
dLn	oFF	dHY	l
<b>Parameter 4 group [P4]</b>			
RL	RLd	RHY	l
RLb	RLA	Ron	0
RLH	l39	Rof	0
RLL	l39	ERd	0
<b>Parameter 5 group [P5]</b>			
UH	Random hour	Rd	0 l
Un	Random min	bP5	96
dI	oFF	Prt	na n
LbR	0	S.tP	2

## User Manual

For the detail information and instructions, please refer to user manual and user manual for communication, and be sure to follow cautions written in the technical descriptions (catalog, homepage).

## Cautions during Use

- Follow instructions in 'Cautions during Use'. Otherwise, it may cause unexpected accidents.
- Check the polarity of the terminals before wiring the temperature sensor.
- For RTD temperature sensor, wire it as 3-wire type, using cables in same thickness and length.
- For thermocouple (CT) temperature sensor, use the designated compensation wire for extending wire.
- Keep away from high voltage lines or power lines to prevent induced noise.
- In case installing power line and input signal line closely, use line filter or varistor at power line and shielded wire at input signal line.
- Do not use near the equipment which generates strong magnetic force or high frequency noise.
- Do not apply excessive power when connecting or disconnecting the connectors of the product.
- Install a power switch or circuit breaker in the easily accessible place for supplying or disconnecting the power.
- Do not use the unit for other purpose (e.g. voltmeter, ammeter), but temperature controller.
- 24VAC, 12-24VDC power supply should be insulated and limited voltage/current or Class 2, SELV power supply device.
- Make a required space around the unit for radiation of heat.
- For accurate temperature measurement, warm up the unit over 20 min after turning on the power.
- Install a surge absorber at each end of inductive load coil when controlling high-capacity power relay or inductive load (e.g. magnet).
- Make sure that power supply voltage reaches to the rated voltage within 2 sec after supplying power.
- Do not wire to terminals which are not used.
- This unit may be used in the following environments.

- Indoors (in the environment condition rated in 'Specifications')
- Altitude max. 2,000m
- Pollution degree 2
- Installation category II

## Major Products

- Photoelectric Sensors
- Fiber Optic Sensors
- Door Sensors
- Door Side Sensors
- Area Sensors
- Proximity Sensors
- Pressure Sensors
- Rotary Encoders
- Connector/Sockets
- Switching Mode Power Supplies
- Control Switches/Lamps/Buzzers
- I/O Terminal Blocks & Cables
- Stepper Motors/Drivers/Motion Controllers
- Graphic Logic Panels
- Field Network Devices
- Laser Marking System (Fiber, Co., Nd: yag)
- Laser Welding/Cutting System
- Temperature Controllers
- Temperature/Humidity Transducers
- SSRs/Power Controllers
- Counters
- Timers
- Panel Meters
- Tachometer/Pulse (Rate) Meters
- Display Units
- Sensor Controllers