Autonics



Refrigeration Temperature Controllers

TF3 Series

PRODUCT MANUAL

For your safety, read and follow the considerations written in the instruction manual, other manuals and Autonics website.
The specifications, dimensions, etc. are subject to change without notice for product improvement. Some models may be discontinued without notice.

Safety Considerations

- Observe all 'Safety Considerations' for safe and proper operation to avoid hazards.
- ⚠ symbol indicates caution due to special circumstances in which hazards may occur.

⚠ Warning Failure to follow instructions may result in serious injury or death

01. **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 personal injury, economic loss or fire.
02. **Do not use or store the unit in the place where flammable/explosive/ corrosive gas, high humidity, direct sunlight, radiant heat, vibration, impact or salinity may be present.**
    Failure to follow this instruction may result in explosion or fire.
03. **Install on a device panel to use.**
    Failure to follow this instruction may result in electric shock.
04. **Do not connect, repair, or inspect the unit while connected to a power source.**
    Failure to follow this instruction may result in fire or electric shock.
05. **Check 'Connections' before wiring.**
    Failure to follow this instruction may result in fire.
06. **Do not disassemble or modify the unit.**
    Failure to follow this instruction may result in fire or electric shock.

⚠ Caution Failure to follow instructions may result in injury or product damage

01. **When connecting the power input and relay output, use AWG 28 to 12 cable or over and tighten the terminal screw with a tightening torque of 0.4 N m. When connecting the sensor input and communication cable without dedicated cable, use AWG 30 to 14 cable and tighten the terminal screw with a tightening torque of 0.72 N m.**
    Failure to follow this instruction may result in fire or malfunction due to contact failure.
02. **Use the unit within the rated specifications.**
    Failure to follow this instruction may result in fire or product damage
03. **Use a dry cloth to clean the unit, and do not use water or organic solvent.**
    Failure to follow this instruction may result in fire or electric shock.
04. **Keep the product away from metal chip, dust, and wire residue which flow into the unit.**
    Failure to follow this instruction may result in fire or product damage.

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. Use the designated compensation wire for extending wire.
- Keep away from high voltage lines or power lines to prevent inductive 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.
- When changing the input sensor, turn off the power first before changing. After changing the input sensor, modify the value of the corresponding parameter.
- 24 VAC~, 12-24 VDC⎓ 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.
- Use twisted pair wire for communication line.
- This unit may be used in the following environments.
  - Indoors (in the environment condition rated in 'Specifications')
  - Altitude Max. 2,000 m
  - Pollution degree 2
  - Installation category II

Ordering Information

This is only for reference, the actual product does not support all combinations.
For selecting the specified model, follow the Autonics website .

T F 3 ❶ - ❷ ❸ ❹ - ❺

❶ Input No. of channels
1: 1 channel (NTC or RTD)
[Temperature + digital input (DI)]
3: 3 channel (NTC)
[Inlet + Defrost + Outlet temperature or digital input (DI)]

❷ Output
1: Compressor
2: Compressor + Defrost or Auxiliary (alarm, evaporator-fan)
3: Compressor + Defrost + Auxiliary (alarm, evaporator-fan) + buzzer support

❸ Power supply
1: 24 VAC 50/60 Hz, 12-24 VDC
4: 100-240 VAC 50/60 Hz

❹ Compressor load capacity
G: 20 A 1a (TF31 model)
A: 5 A 1a
H: 16 A 1a

❺ Option per compressor load capacity (3 channel)

Product number	Option	Compressor load capacity	
		5 A 1a	16 A 1c
No mark	No	-	○
S	Synchronize defrost	○	-
T	RS485 Comm.	○	-
R	RTC Function (Real Time Clock)	-	○
A	RS485 Comm. + RTC	○	

Product Components

- Product (+ bracket)
- NTC sensor (5 kΩ) × 1
- Instruction manual

Manual

For proper use of the product, refer to the manuals and be sure to follow the safety considerations in the manuals.
Download the manuals from the Autonics website.

Software

Download the installation file and the manuals from the Autonics website.

■ DAQMaster

DAQMaster is comprehensive device management program. It is available for parameter setting, monitoring.

Sold Separately

- Dedicated remote display unit for TF3: TFD Series
- Communication Converter: SCM-US / SCM-38I / SCM-US48I / SCM-WF48

Specifications

Series		TF3 Series
Power supply	AC	100 - 240 VAC~ 50/60 Hz
	AC/DC	24 VAC~ 50/60 Hz, 12-24 VDC⎓
Permissible voltage range		90 to 110 % of rated voltage
Power consumption	AC	≤ 8 VA
	AC/DC	AC: ≤ 5 VA, DC: ≤ 3 W
Sampling period		500 ms
Input specification		Refer to 'Input Type and Using Range'.
Option input	Digital input	• Contact - ON: ≤ 1 kΩ, OFF: ≥ 100 kΩ • Non contact - residual voltage ≤ 1 V, leakage current ≤ 1 mA Outflow current: ≈ 4 uA
Control output	Compressor (COMP)	250 VAC~ 5 A / 30 VDC⎓ 5 A / 1a 250 VAC~ 16 A / 24 VDC⎓ 16 A / 1c 250 VAC~ 20 A 1a
	Defrost (DEF)	250 VAC~ 10 A / 24 VDC⎓ 10 A / 1a
	Auxiliary (AUX)	250 VAC~ 5 A / 30 VDC⎓ 5 A / 1a
RS485 communication		Modbus RTU
Display type		7 segment (red), LED type
Control type		ON/OFF Control
Hysteresis		0.5 to 5.0 °C, 2 to 10 °F
Relay life cycle	Mechanical	• COMP (5 A 1a), AUX: ≥ 5,000,000 operations • COMP (16 A 1c), DEF: ≥ 20,000,000 operations • COMP (20 A 1a): ≥ 10,000,000 operations
	Electrical	• COMP (5 A 1a), AUX: ≥ 50,000 operations (load resistance: 250 VAC~ 5 A) • COMP (16 A 1c): ≥ 30,000 operations (load resistance: 250 VAC~ 16 A) • COMP (20 A 1a): ≥ 100,000 operations (load resistance: 250 VAC~ 20 A) • DEF: ≥ 100,000 operations (load resistance: 250 VAC~ 10 A)
Dielectric strength	AC	Between the charging part and the case: 3,000 VAC~ 50 / 60 Hz for 1 min
	AC/DC	Between the charging part and the case: 1,000 VAC~ 50 / 60 Hz for 1 min
Vibration		1.5 mm amplitude at frequency of 10 to 55 Hz in each X, Y, Z direction for 2 hours
Insulation resistance		≥ 100 MΩ (500 VDC⎓ megger)
Noise immunity		Square shaped noise by noise simulator (pulse width 1 μs) ±2 kV R-phase, S-phase
Memory retention		≈ 10 years (non-volatile semiconductor memory type)
Ambient temperature		-10 to 50 °C, storage: -20 to 60 °C (no freezing or condensation)
Ambient humidity		35 to 85%RH, storage: 35 to 85%RH (no freezing or condensation)
Protection structure		IP65 (front panel, IEC standards)
Certification		CE UKCA cULus EAC
Unit weight (packaged)		≈ 105 g (≈ 207 g)

Communication Interface

■ RS485

Comm. protocol	Modbus RTU
Application standard	EIA RS485 compliance with
Maximum connection	31 units (address: 01 to 99)
Synchronous method	Asynchronous
Comm. method	Two-wire half duplex
Comm. effective range	≤ 800 m
Comm. speed	2,400 / 4,800 / 9,600 (default) / 19,200 / 38,400 bps (parameter)
Response time	5 to 99 ms (default: 20 ms)
Start bit	1 bit (fixed)
Data bit	8 bit (fixed)
Parity bit	None (default), Odd, Even
Stop bit	1 bit, 2 bit (default)

Input Type and Using Range

The setting range of some parameters is limited when using the decimal point display.

Input type		Decimal point	Display	Using range (°C)	Using range (°F)
Thermistor (NTC)	NTC 5 kΩ	1	n5.H	-40 to 99	-40 to 212
		0.1	n5.L	-40 to -20	-40 to -20
				-19.9 to 99.9	-19.9 to 99.9
				-	100 to 212
	NTC 10 kΩ	1	n1.H	-40 to 99	-40 to 212
		0.1	n1.L	-40 to -20	-40 to -20
				-19.9 to 99.9	-19.9 to 99.9
				-	100 to 212
RTD[01]	DPt100 Ω	1	dPt.H	-99 to 99	-148 to 212
		0.1	dPt.L	-19.9 to 99.9	

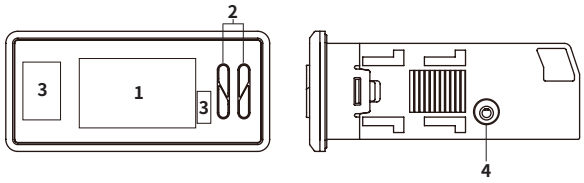
01) Only for 1 channel Input model.

- TF3 Series displays only 3 digits. If PV decimal number of shaded temperature range is out of 3 digit, TF3 does not display the numbers below decimal point. You can check it at the comprehensive device management program (DAQMaster) by communicating via PC.

■ Display accuracy

Using temperature	Display accuracy
At room temperature (23°C ±5 °C)	±1 °C ±1 digit
Out of room temperature range	±2 °C ±1 digit

Unit Descriptions



1. PV Display part (Red)

- Run mode: Displays PV (present value)
- Setting mode: Displays parameter name

2. Input key

Display	Name
[MODE]	Mode key
[◀], [▼], [▲]	Setting value control key

3. Indicator

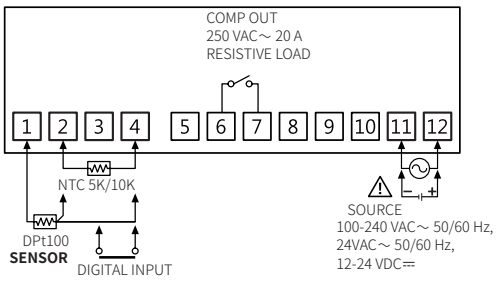
Display	Name	Color	Description	
▲	Deviation	Red	Displays deviation of PV (present value) based on SV (setting value).	ON: over 1.8 °C
■		Green		ON: within ± 1.8 °C
▼		Red		ON: under − 1.8 °C
COMP	Compressor output	Green	Turns ON when compressor output is ON. Flashes when output is OFF or protection operation. When operating compressor continuously, it turns ON for 2 sec, and turns OFF for 1 sec.	
DEF	Defrost output	Green	Turns ON when defrost output is ON. Flashes when defrost delay operation. Turns ON for 2 sec and OFF for 1 sec for manual defrost or Power ON defrost.	
FAN	evaporator-fan output	Green	Turns ON when evaporator-fan output is ON. Flashes when evaporator-fan output delay operation.	
AUX	Auxiliary output	Green	Turns ON when alarm output is ON. Flashes when alarm output delay operation.	
°C, °F	Temperature unit	Red	Displays selected unit (parameter).	

4. PC loader port: For connecting Remote Display Unit (TFD series) or communication converter (SCM series).

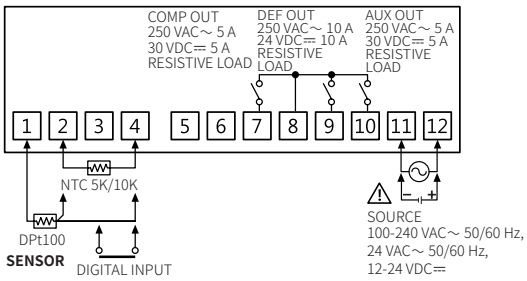
Connections

- Supported terminals may differ by model.

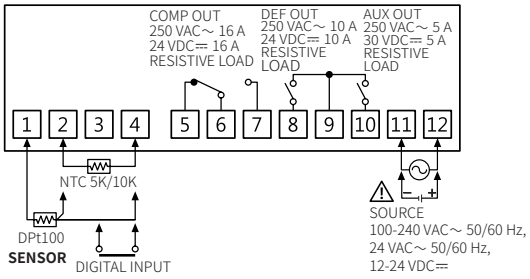
■ TF31-1□G



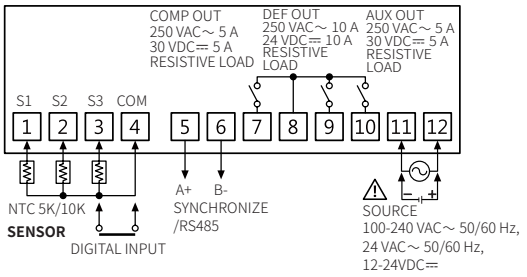
■ TF31-□□A



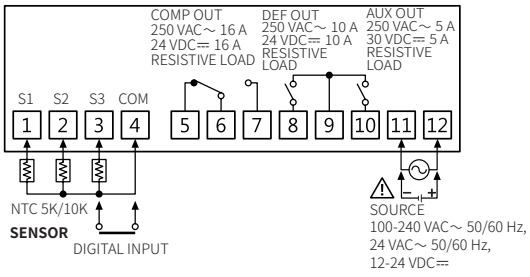
■ TF31-□□H



■ TF33-□□A-□

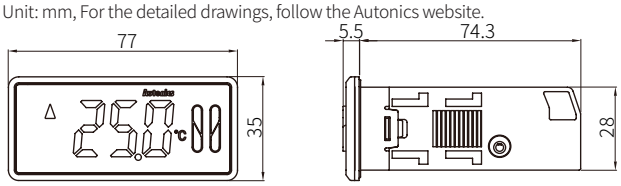


■ TF33-□□H-□

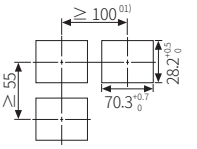


Dimensions

• Unit: mm, For the detailed drawings, follow the Autonics website.

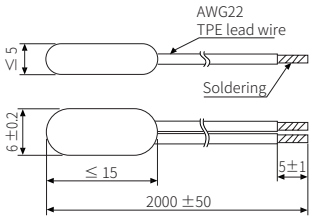


■ Panel cut-out

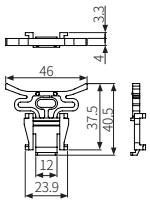


01) When Remote Display Unit (TFD series) or communication converter (SCM series) is connected: ≥ 120

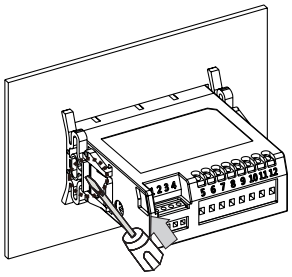
■ NTC sensor (5kΩ)



■ Bracket



Installation Method



Insert the unit into a panel, fasten the bracket by pushing with tools with a flathead screwdriver.

Errors

Display	Description	Troubleshooting
oPn	ER□ and error display are cross flashed when input sensor is disconnected or sensor is not connected.[01]	Check input sensor status.
HHH	ER□ and error display when if the input value is above the input range.[02]	When input is within the rated input range, this display disappears.
LLL	ER□ and error display are cross flashed if the input value is below the input range.[02]	
LbA	ER□ and error display are cross flashed when input sensor is normal but freezer temperature does not change more than 1.0 °C (2 °F) during loop break alarm (LBA) time.	Check the compressor and hold the [▲]+[▼] key at the same time for 3 sec. It clears when input is within the adequate range.

01) ERV (virtual temperature) is not applicable.

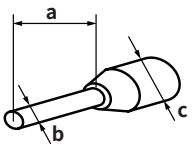
02) Be careful that when HHH / LLL error occurs, the control output may occur by recognizing the maximum or minimum input depending on the control type.

• □: Indicates input sensor number of error display priority which occurs error.

• Error display priority: ER1 (input sensor 1) → ER2 (input sensor 2) → ER3 (input sensor 3) → ERV (virtual temperature) → ERR

Crimp Terminal Specifications

• Unit: mm, Use the crimp terminal of follow shape.



Terminal number		a	b	c
Common	1 to 4	4 to 6	≤ 1.7	≤ 3.7
TF3□-□□H	5 to 10	6 to 8	≤ 2.3	≤ 4.5
TF3□-□□A	5 to 6	6	≤ 1.9	≤ 4.0
	7 to 10	6 to 8	≤ 2.3	≤ 4.5
TF3□-□□G	6 to 7	6 to 8	≤ 2.3	≤ 4.5
Common	11 to 12	6	≤ 1.9	≤ 4.0

Initial Display When Power is ON

When power is supplied, after all display will flash for 1 sec, model name is displayed sequentially. After input sensor type will flash twice, enter into RUN mode.

1. All display	2. Model	3. Input specification	4. Compressor load capacity/ option	4. Run mode
8.8.8	tF3	334	AA	524

Mode Setting

RUN

- Auto before entering to mode (When using password) → **Password input**

	Key input	Entering mode
Pass	Auto	Selected mode
Fail	[◀], [▲], [▼]	Password input
	[MODE]	Run mode

- [◀], [▲], [▼] → **SV setting** (Move digits: [◀] Change value: [▲], [▼] / Save: [MODE] or no key input over 3 sec) →
- [MODE] over 2 sec → **Parameter Group** ([MODE] over 3 sec) →
- [◀] + [▲] + [▼] over 5 sec → **Parameter reset** (Refer to 'Parameter Reset') →
- [MODE] → **Display selection** ([MODE] over 1.5 sec) →
- [▲] over 3 sec → **Auxiliary output activation** ([MODE] over 1.5 sec) →
- [◀] over 3 sec → **Compressor output activation** ([MODE] over 1.5 sec) →
- [▼] over 3 sec → **Manual defrost execution** ([▼] over 3 sec) →

RUN

Parameter Reset

01. Press the [◀] + [▲] + [▼] keys for over 5 sec. in run mode, INIT turns ON.
02. Change the setting value as YES by pressing the [▲] , [▼] keys.
03. Press the [MODE] key to reset all parameter values as default and to return to run mode.

Parameter Setting

- Some parameters are activated/deactivated depending on the model or setting of other parameters.
- The 'Parameter mask' feature, which hide unnecessary or inactive parameters, and the 'User parameter group' feature, which quickly and easily set up certain parameters that are frequently used, can be set up in DAQMaster.
- Refer to the user manual for the details.

■ Parameter 0 group

Parameter	Display	Default
Display selection	dP.t	S 1
Monitoring time	n o.t	-
Max. value	H.PU	-
Min. value	L.PU	-

■ Parameter 1 group

Parameter	Display	Default
Input specification	I nt	n5.H
Input 2 ON/OFF	S2	oFF
Input 3 selection	S3	d1
Virtual temperature rate	ut.r	0
Temperature unit	Unt	°C
Input correction 1	I b.1	0
Input correction 2	I b.2	0
Input correction 3	I b.3	0
Delay display period	dS.t	0.5
Defrost/Auxiliary output	S.dA	dEF
Auxiliary output	AUS	oFF
Buzzer	bUZ	on

■ Parameter 2 group

Parameter	Display	Default
Compressor output mode	oFt	C
Hysteresis	HYS	1
Offset	oFS	0
SV high limit	HSu	99
SV low limit	LSu	-40
Night mode	n.n d	oFF
Night mode SV correction	n.Su	1
Night mode hysteresis	n.HY	1
Night mode offset	n.oF	0
Night mode start hour	n.SH	0
Night mode start min	n.Sn	0
Night mode end hour	n.EH	8
Night mode end min	n.En	0
Temperature monitoring	E.no	oFF
Compressor start up delay time	SdL	0
Compressor Min. operation cycle	CYC	0
Compressor restart delay time	rdL	0
Compressor Min. operation time	ont	0
Compressor continuous operation	CC	0
Alarm delay time after continuous operation	Ad.C	2
Sensor error, compressor operation cycle	CLE	0
Sensor error, compressor duty ratio	dUt	50

■ Parameter 3 group

Parameter	Display	Default
Defrost method & operation	dEF	Ht n
Defrost cycle	d1 n	4
Real time defrost cycle	r.d1	oFF
Real time defrost cycle 1 hour	dH 1	oFF
Real time defrost cycle 1 min	dn 1	oFF
I	I	I
Real time defrost cycle 8 hour	dH8	oFF
Real time defrost cycle 8 min	dn8	oFF
Defrost Time	dEt	30
Pump down delay time	Pdd	0.00
Defrost end delay time	dr.t	1.00
Defrost end temperature	Edt	4
Defrost hysteresis	dHY	1
Defrost When Power is ON	P.dE	oFF
Defrost delay When Power is ON/manual defrost	d.dE	0
Defrost group	d.Gr	oFF
Parameter copy	P.dC	oFF
Prior defrost selection	d.Pr	oFF
Defrost time unit	U.dE	HGH
Alarm delay after defrost/ door open	Add	1
Temperature display during defrosting	t.dE	oFF

■ Parameter 4 group

Parameter	Display	Default
Alarm output operation mode	AL	AL.d
Alarm option	AL.t	AL.A
Alarm high limit deviation	AL.H	139
Alarm low limit deviation	AL.L	139
Alarm hysteresis	AHY	1
Alarm ON delay time	Aon	0
Alarm OFF delay time	AoF	0
External alarm delay time	E.Ad	0
Alarm output method	An	no
Evaporator-fan operation	F.tY	FAn
Evaporator-fan control temperature	F.t	4
Evaporator-fan hysteresis	F.HY	1
Evaporator-fan Operation mode	FAn	EF 1
Evaporator-fan start up delay time	P.dr	1.00

■ Parameter 5 group

Parameter	Display	Default
Current hour	CUH	Arbitrary hour
Current min	CUn	Arbitrary min
Digital input	d1	oFF
Loop break alarmtTime	LbA	0
Comm. address	Adr	01
Comm. speed	bPS	96
Comm. parity bit	Prt	non
Comm. stop bit	StP	2
Comm. response time	rYt	20
Comm. write	CoY	EnA
User level	USr	Std
SV setting lock	L.Su	oFF
Front key lock	L.dU	oFF
Parameter 0 group lock	L.P0	oFF
Parameter user group lock	L.PU	oFF
Parameter 1 group lock	L.P1	oFF
Parameter 2 group lock	L.P2	oFF
Parameter 3 group lock	L.P3	oFF
Parameter 4 groups lock	L.P4	oFF
Parameter 5 group lock	L.P5	oFF
Password setting	PYd	000

Function: Alarm

■ Operation

• **H**: Alarm output hysteresis

Mode	Name	Alarm operation	Description
oFF	-	-	No alarm output
AL.d	Deviation high, low limit	ON H OFF H ON PV 90°C, SV 100°C, PV 110°C High, Low deviation: Set as 10°C	If deviation between PV and SV as high/low-limit is higher than set value of deviation temperature, the alarm output will be ON.

■ Option

Mode	Name	Description	Condition of re-apply
AL.A	Standard alarm	If it is an alarm condition, alarm output is ON. If it is a clear alarm condition, alarm output is OFF.	-
AL.b	Alarm latch	If it is an alarm condition, alarm output is ON and maintains ON status.	-
AL.C	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.	Power ON
AL.d	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 1alarm condition, alarm latch operates.	
AL.E	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 alarm condition, alarm output does not turn ON. After clearing alarm condition, standard alarm operates.	Power ON, change SV, change alarm temperature / operation or change STOP to RUN mode
AL.F	Alarm latch and standby sequence 2	Basic operation is same as alarm latch and standby sequence1. 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 alarm condition, alarm output does not turn ON. After clearing alarm condition, alarm latch operates.	

Sold Separately: TFD Series (Dedicated remote display unit for TF3)



Remote display unit (TFD) displays current temperature or output status of TF3 at remote place.

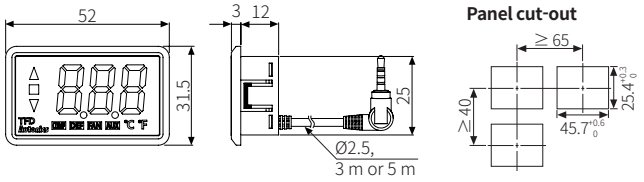
- This unit is dedicated for TF3 Series and it does not directly communicate with upper devices (PC, PLC, etc.)
- If TFD communication with TF3 error occurs, TFD flashes display component for 1 sec. Check the connection with TF3.
- TFD cable is TFD-3: 3m, TFD-5: 5m.
- Connect the phone-jack of remote display unit (TFD) to the data loader port of TF3.
- 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-US48I(USB to RS485 converter, sold separately), SCM-38I(RS232C to RS485 converter, sold separately).

■ Specifications

Series	TFD Series
Power supply	3.3 VDC⎓
Power consumption	≤ 1 W
Comm. method	Serial (TTL Level), Half duplex
Comm. cycle	100 ms
Display type	7 Segment (red), LED type
Connection	Ø 2.5 mm
Vibration	1.5mm amplitude at frequency of 10 to 55Hz (for 1 min) in each X, Y, Z direction for 2 hours
Ambient temperature	-10 to 50 °C, storage: -20 to 60 °C (no freezing or condensation)
Ambient humidity	35 to 85%RH, storage: 35 to 85%RH (no freezing or condensation)
Protection structure	IP67 (Front panel, IEC standards)
Approval	CE UK
Unit weight (packaged)	≈ 48 g (≈ 77 g)

■ Dimension

• Unit: mm, For the detailed drawings, follow the Autonics website.



Segment Table

The segments displayed on the product indicate the following meanings. It may differ depending on the product.

7 Segment			
0	0	I	I
1	1	J	J
2	2	K	K
3	3	L	L
4	4	M	M
5	5	N	N
6	6	O	O
7	7	P	P
8	8	Q	Q
9	9	R	R
A	A	S	S
b	B	T	T
C	C	U	U
d	D	V	V
E	E	W	W
F	F	X	X
G	G	Y	Y
H	H	Z	Z

11 Segment			
0	0	I	I
1	1	J	J
2	2	K	K
3	3	L	L
4	4	M	M
5	5	N	N
6	6	O	O
7	7	P	P
8	8	Q	Q
9	9	R	R
A	A	S	S
b	B	T	T
C	C	U	U
d	D	V	V
E	E	W	W
F	F	X	X
G	G	Y	Y
H	H	Z	Z

12 Segment			
0	0	I	I
1	1	J	J
2	2	K	K
3	3	L	L
4	4	M	M
5	5	N	N
6	6	O	O
7	7	P	P
8	8	Q	Q
9	9	R	R
A	A	S	S
b	B	T	T
C	C	U	U
d	D	V	V
E	E	W	W
F	F	X	X
G	G	Y	Y
H	H	Z	Z

16 Segment			
0	0	I	I
1	1	J	J
2	2	K	K
3	3	L	L
4	4	M	M
5	5	N	N
6	6	O	O
7	7	P	P
8	8	Q	Q
9	9	R	R
A	A	S	S
b	B	T	T
C	C	U	U
d	D	V	V
E	E	W	W
F	F	X	X
G	G	Y	Y
H	H	Z	Z