TTM-000

TOHO

DIGITAL TEMPERATURE CONTROLLER

TTM-000

Most Superior Controller with Advanced Multiple Functions!

Low Price, Easy Operation & Selectable Input!!

TTM-006 TTM-007 TTM-009 TTM-005 TTM-004 TTM-002

TOHO ELECTRONICS INC.

DIGITAL TEMPERATURE CONTROLLER TTM-000 SERIES

TTM-002/004/005/006/007/009

Upgraded Digital Temperature Controller with Various Functions, Easy-to-Use & Multiple Inputs

■Features

●Self-Tuning PID
Most appropriate PID constant is automatically reckoned up for control objects. PID constant is calculated when making alteration of setting value, or it is corrected when occurring disturbance/hunting etc.

●Blind Function
At the request, desirable parameter screen is only displayed and set up.

●Simplified Timer
ON/OFF setting control is available after some certain interval. Function of ON/OFF alarm output is independently usable.

●Priority Display
Demanding parameter screens are monitored and set up under operational mode screen. (max. 9 screens)

●Multiple Inputs
Thermocouple/R.T.D. (Pt 100 & JPt 100) are selectable by front key.

●Standardization of Conformity
UL, cUL, CE, & IP 66 approved. ("S" Grade is under approval)

●Compact Size
It is a compact size. The depth is only 77mm! (95mm for TTM-002)

●Manual Control (Balanceless & Bumpless)
Manual output function is applicable for versatile applications of instrumentation systems.

●Sampling Time
250mS ("S" Grade model, TTM-002 is excluded), 500mS (Normal Grade model)

●Communication Function (RS-485 : TOHO protocol/MODBUS)
The communication distance is extended up to 500 meters, and maximum 31 units of controllers can be connected with a computer at a time. Centralized supervision is available for collection of the whole data and alteration of setting values at remote location.

●Digital PV Filter
For abrupt alteration of input value, filter effect is operational on software.

●PID Over-Shoot Protection
It is functional to inhibit PID Over-Shoot.

●DI (Digital Input) Functions
The following functions are selective.
①SV/SV2
②RUN/READY
③Automatic (RUN)/Manual
④Normal/Reverse Action
⑤Normal (SV2)/Reverse Action (SV)
⑥AT (Auto-Tuning) Start
⑦Timer, Start/Reset

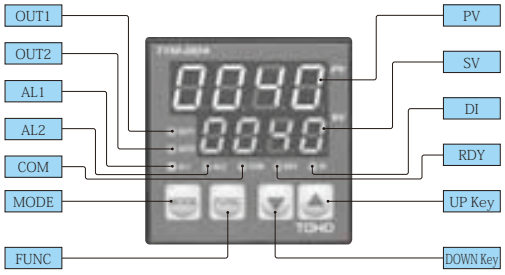
●Heating/Cooling Control
PID control is available on cooling side.

●Others
①CT Input (Input Monitor usable)
②Shift setting of OFF position during ON/OFF control, for both output 1 & 2.

●Ramp Function
Available in "S" Grade model only.

■Front Panel

TTM-004



AL1	Output monitor for event output 1
AL2	Output monitor for event output 2
OUT1	Output monitor for output 1
OUT2	Output monitor for output 2
RDY	Lighting while being operation ready
COM	Lighting while operating communication (option)
MODE	Mode key for shifting display
DI	Lighting while operating DI (option)
FUNC	Function key for digit shift, AT(Auto-Tuning), RUN/READY, Timer Start/ Reset
PV	Indication of process value & character display for alarm, PID etc.
SV	Indication of setting value, manipulation value & residual time of timer.
▲ ▼	Up/Down key for alteration of setting value Pressing 1 to 10sec : 1 digit/100ms 10 to 20sec : 10 digits/100ms over 20sec : 100 digits/100ms

TTM-002

TTM-006

●Size
TTM-002 24×48mm
TTM-004 48×48mm
TTM-005 96×48mm
TTM-006 48×96mm
TTM-007 72×72mm
TTM-009 96×96mm

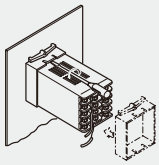
TTM-007

TTM-005

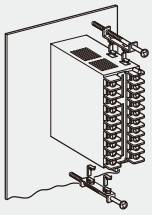
TTM-009

■Panel Installation

●TTM-002, 004



●TTM-005
●TTM-006
●TTM-007
●TTM-009



For this panel installation, please be careful sufficiently to avoid any of damage.

■Standard Specifications

Input Switchable	Thermocouple	K, J, T, R, N, S, B (JIS1602～1995)	
	R.T.D.	Pt100, JPt100 (Load resistance : 10Ω or less)	
	Current• Voltage	Current 4 to 20mA DC (Input resistance 250Ω), Voltage 0 to 5V DC/1 to 5V DC (input resistance 500kΩ over)	
Indication	PV (Character)	4 digits, 7 segments Green 10mm height (7.6mm height for TTM-002, 12mm height for TTM-006/009)	
	SV (Setting Value)	4 digits, 7 segments Red 8mm height (5.25mm height for TTM-002)	
	Various Function Indication	LED : Red (AL1, AL2, OUT1, OUT2 or RDY), LED : Green (COM, DI), COM for TTM-002 is 1st decimal digit of display.	
Control Method	PID Auto-Tuning PID Self-Tuning	Proportional band (P1)	0.1 to 200.0% of setting limiter span
		Proportional band (P2) at Output 2	0.10 to 10.00 times (Times per P)
		Reset time (Integral) (I)	1 to 3600 sec (0 : OFF)
		Rate time (Deviation) (D)	1 to 3600 sec (0 : OFF)
		Cycle time (T1, T2)	1 to 120 sec
		Dead band (DB)	-100.0 to +100.0 or -100 to +100 (℃)
	ON/OFF	Control sensitivity (C1, C2)	0 to 999 or 0.0 to 999.9 (℃)
	OFF Point of Output 1 & 2	Position of setting	-199 to 999 or -199.9 to 999.9 (℃)
Control Output	Relay Contact	250V AC, 3A (Load resistance) 1a contact (On heating/cooling operation, output 2 is 250V AC, 2.4A load resistance, 1a contact)	
	SSR Drive Voltage	0 to 12V DC (Load resistance : 600Ω or more)	
	Current	4 to 20mA DC (Load resistance : Max 600Ω)	
Sampling Time		"S" Grade : 0.25sec (TTM-002 is excluded), Normal Grade : 0.5sec (Output change cycle is also same)	
Setting and Indication Accuracy	Thermocouple	±(0.3% + 1 digit) of process value or ±2℃, either of bigger numerial values is taken. (Ambient temperature : 23℃ ±10℃) -100 to 0℃ : ±3℃, -200 to 100℃ : ±4℃ Thermocouple B under 400℃ is not regulated.	
	R.T.D.	±(0.3% + 1 digit) of process value or ±0.9℃, either of bigger numerial values is taken. (Ambient temperature : 23℃ ±10℃) Ambient temperature 0 to 50℃ : ±(0.5% + 1 digit) or 1.5℃, either of bigger numerial values is taken.	
	Current (4 to 20mA DC), Voltage (0 to 5V DC, 1 to 5V DC)	±(0.3% + 1 digit) in setting limiter span (Ambient temperature : 23℃ ±10℃)	
Memory Element		EEPROM	
Voltage Source		100V AC to 240V AC (50/60Hz)	
Weight		TTM-002/004 : less than 180g, TTM-005/006 : less than 300g, TTM-007 : less than 250g, TTM-009 : less than 380g	
Power Consumption		Less than 10VA (240V AC)	
Accessories		Instruction manual & installation attachment (TTM-002/004) or installation metal instruments (TTM-005/006/007/009)	
Operating Condition		0 to 50℃, 20 to 90%RH (under non-condensation)	
Storage Condition		-25 to 70℃, 5 to 95%RH (under non-condensation)	
Functions	Manipulated Variable Limiter (ML1, MH1, ML2, MH2)	0.0 to 100.0%	
	Setting Limiter (SLL, SLH)	See "Input and Range".	
	Selectable Control Mode (CNT)	Auto-Tuning PID Type A←→B, Normal←→Reverse, Auto-Tuning PID←→ON/OFF	
	PV Correction 0 Point Setting (PVS)	-199 to 999 or -199.9 to 999.9 (℃)	
	PV Correction Gain Setting	0.50 to 2.00 (times)	
	Input Filter	0 to 99 (sec)	
	Manual Reset (PBB)	0.0 to 100.0%, -100.0 to 100.0 (heating & cooling) of proportional band.	
	Timer Operation Mode (TMM)	0.00 minute to 59.59 minutes, 0.00 hour to 99.59 hours. Accuracy : ±(1.5% + 0.5 sec) of setting time.	
	Decimal Point Shift (DP)	Decimal point display available (up to 999.9)	
	Manual Control	Auto/Manual control can be switched by key.	
	Run/Ready	Run and Ready can be switched by key.	
	Blind Function	No indication available for non-required display.	
	Auto-Tuning (AT) Coefficient	After AT, the computed PV band is newly to set up with another coefficient.	
	FUNC Key	"Digit Shift" "AT" "RUN/READY" "Timer Start/Reset"	
	Priority Display	Arbitrary parameter screens are shifted to indication of operation mode by key. (max : 9 screens)	
	Lock Function (LOC)	4 modes (OFF, ALL, Operation Lock, Lock except Operation Mode)	
	Watch Dog Function	Data checked by EEPROM (Err0), A/D converter check (Err1), and Auto-Tuning check (Err2), Built-in watch dog timer.	
	Ramp Function (Available in "S" Grade)	Operation : When SV is changed, it sets variation of SV per minute. The variation for SV & SV2 can be set individually. *SV2 is provided when option DI is selected. Setting Range : 0.0 to 999.9 The Ramp function is turned off by 0.0 setting. Setting Unit : 0.1℃/minute (Thermocouple, R.T.D. input type) 0.1 times/minute of SV setting unit (Analogue input type) Accuracy : ±(1.5% + 0.5sec) *TTM-002 is excluded	
	Event Output 1 (AL1)	Function : PV contact output (8 modes), Special contact output (3 modes), additional functions (3 modes) Setting Range : -199.9 to 999.9 or -1999 to 9999 (℃) Sensitivity : 0.0 to 999.9 or 0 to 9999 (℃) Rating : 250V AC 2.4A (Load resistance) 1a contact Contact polarity : Selectable either normal open or normal close.	

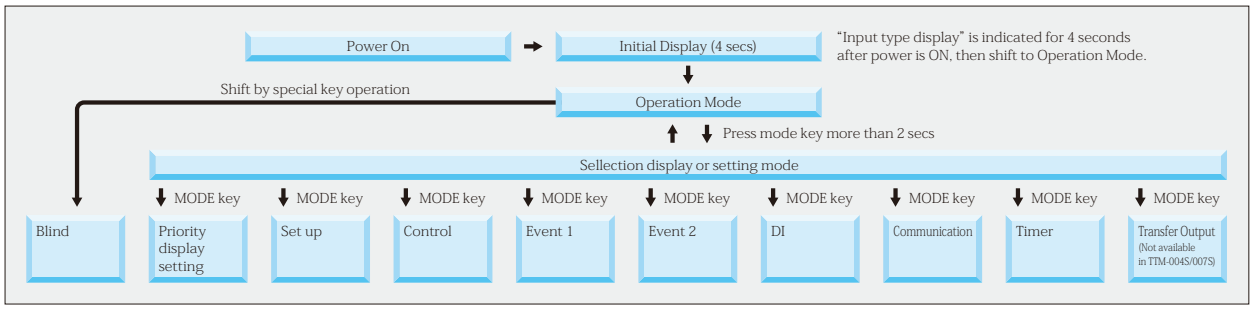
■Additional Functions (Option)

Event Output 1 (AL1) Event Output 2 (AL2 or OUT2)	Function : Setting Range : Sensitivity : Rating :	PV contact output (8 modes), Special contact output (3 modes), additional functions (3 modes) -199.9 to 999.9 or -1999 to 9999 (℃) 0.0 to 999.9 or 0 to 9999 (℃) 250V AC 2.4A (Load resistance) 1a contact When selecting output 2 at contact output 2, the output generates on cooling side during heating/cooling. Contact polarity is selectable, either normal open or normal close.
DI	Function : Input Specifications :	SV/SV2 switchable (OFF : SV2), Auto/Manual switchable (OFF : Manual), Run/Ready switchable (OFF : Ready), Normal/Reverse switchable (OFF : Normal), Normal (SV2)/Reverse (SV2) switchable (OFF : Normal SV2), Timer Start/Reset (OFF : Counting) Minimum input time : 500ms, OFF voltage : 6V DC max, ON current : 6mA max, Permissible resistance value between terminals : ON=333Ω max, OFF=500kΩ min
CT Input	Setting Range 1 to 30A/AC, Accuracy : 5% (setting resolution 1A)	
Heating & Cooling	See "Control Output" in standard specifications.	

Communication

TOHO protocol	MODBUS (TTM-002 is excluded)
RS-485 conformable Protocol : TOHO protocol Network : RS-485 conformable Multi-Drop system (1:31 stations max.) Direction of information : Semi-duplex Synchronous method : Asynchronous Transfer code : ASCII code (BCC is excluded) Interface : Two line system Communication Speed : 1200/2400/4800/9600/19200BPS Character: Start bit 1 bit fixed Stop bit 1/2 bit Data length 7/8 bit Parity Non/odd number/even number BCC check Non/available Address 1 to 99 Response Delay Time : 0 to 250mS Power circuit, CPU circuit and Insulation	RS-485 conformable Protocol : MODBUS (RTU or ASCII) Network : RS-485 conformable Multi-Drop system (1:31 stations max.) Direction of information : Semi-duplex Synchronous method : Asynchronous Transfer code : ASCII code (BCC is excluded) Interface : Two line system Communication Speed : 1200/2400/4800/9600/19200BPS Character: MODBUS (RTU) MODBUS (ASCII) Start bit 1 bit fixed 1 bit fixed Stop bit 1/2 bit 1/2 bit Data length 8 bit 7 bit Parity Non/odd number/even number Non/even number Communication address 1 to 247 stations Response Delay Time : 0 to 250mS Power circuit, CPU circuit and Insulation

■Operation Flow



■Input and Range (Thermocouple & R.T.D. switchable by key)

Thermocouple		Setting Range		Display Range	
		Non-decimal point	Decimal point	Non-decimal point	Decimal point
K	℃	-200 to 1372	-199.9 to 990.0	-210 to 1382	-199.9 to 999.9
J	℃	-200 to 850	-199.9 to 850.0	-210 to 860	-199.9 to 860.0
R	℃	0 to 1700	————	-10 to 1710	————
T	℃	-200 to 400	-199.9 to 400.0	-210 to 410	-199.9 to 410.0
N	℃	-200 to 1300	-199.9 to 990.0	-210 to 1310	-199.9 to 999.9
S	℃	0 to 1700	————	-10 to 1710	————
B	℃	0 to 1800	————	-20 to 1820	————

R.T.D.		Setting Range		Display Range	
		Non-decimal point	Decimal point	Non-decimal point	Decimal point
Pt100 (JIS/IEC)	℃	-190 to 500	-199.9 to 500.0	-199 to 530	-199.9 to 530.0
JPt100 (JIS)	℃	-190 to 500	-199.9 to 500.0	-199 to 520	-199.9 to 520.0

Current, Voltage		Setting Range		Display Range
		Non-decimal point	Decimal point	
0 to 5V	V	-1999 to +9999	-199.9 to 999.9 -19.99 to 99.99 -1.999 to 9.999	Approx. -2% of SV low limiter setting (SLL) to Approx, +12% of SV high limiter setting (SLH), within the setting range.
1 to 5V	V	-1999 to +9999	-199.9 to 999.9 -19.99 to 99.99 -1.999 to 9.999	Approx. -12% of SV low limiter setting (SLL) to Approx, +12% of SV high limiter setting (SLH), within the setting range.
4 to 20mA	mA	-1999 to +9999	-199.9 to 999.9 -19.99 to 99.99 -1.999 to 9.999	Approx. -12% of SV low limiter setting (SLL) to Approx, +12% of SV high limiter setting (SLH), within the setting range.

■Event Contact Output Mode (Alarm)

Abnormal PV/heater code

0	None
1	Abnormal PV contact output
2	Abnormal heater contact output
3	Abnormal PV contact output + abnormal heater control output

Only 0 or 1 available, when no selecting CT input.

■Timer Operation Mode

Start Mode

1	Auto start : ON delay
2	Manual start : ON delay
3	Event start : ON delay
4	Auto start : OFF delay
5	Manual start : OFF delay
6	Event start : OFF delay
7	SV start : OFF delay

ON delay : Control start or event output is ON, after time-up
OFF delay : Control stop or event output is OFF, after time-up
* Output is selectable, either main control output or event output.

■Timer Drive Setting

0	Non-use timer function
1	Control output
2	Event 1 output

PV Event Code (Alarm)

0	None
1	Deviation high and low limit
2	Deviation high limit
3	Deviation low limit
4	Deviation high and low range
5	Abusolute value high and low limit
6	Abusolute value high limit
7	Abusolute value low limit
8	Abusolute value high and low range

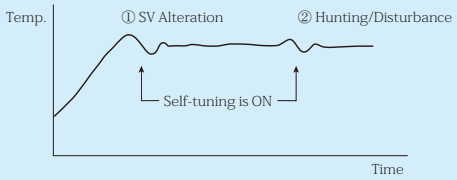
Additional Functions

0	None
1	Holding
2	Awating sequence
3	Holding + awaiting sequence

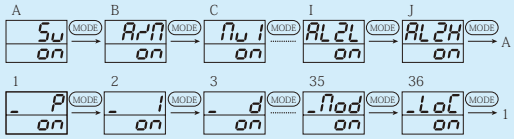
When special function is 0, only code 0 or 1 selectable.

■Advanced Features

●Self-Tuning PID (Standard)



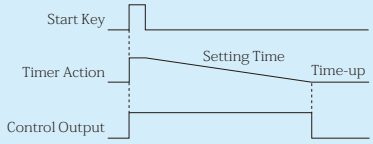
●Blind Function (Standard)



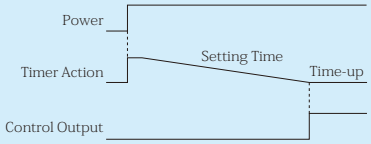
The mode screen or the parameter screen whichever you demand can be displayed by merely pressing a key, at the request.
When the SV screen is erased, the set value is normally not indicated but the measured value (PV) is only shown.

●Timer Function (Standard)

1. Bread Oven Machine
   - ●Put dough into oven and press the timer start key.
   - ●While setting timer, temperature in oven is controlled by heater.
   - ●After timer counts up, control of oven is stopped automatically.
   (This example is for control stop after the timer counts up.)

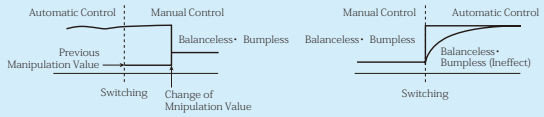


2. Package Machine and Industry Machinery
   (In case of start of control after the relative equipments are prepared)
   - ●When power is "ON", the timer starts to count.
   - ●While setting timer, control output is stopped.
   - ●After the timer counts up, control is started automatically.
   (For control start after the timer counts up.)

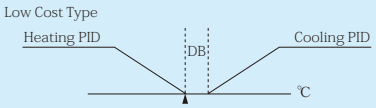


●Automatic/Manual Control (Standard)

Automatic/Manual control can be switched by front key for DI or communication.
When checking the manipulation action for valve and heater during a system test run, or when normal control is not operational due to sensor failure, the system can be operated manually in this mode.

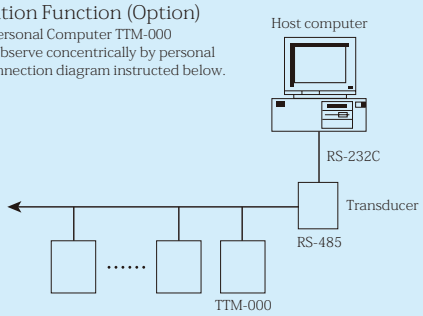


●Heating/Cooling PID Control (Option)



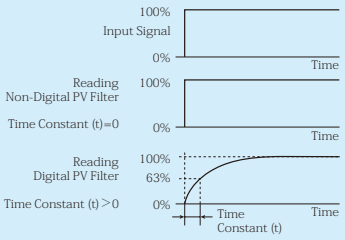
●Communication Function (Option)

Connection to Personal Computer TTM-000 controllers can observe concentrically by personal computer, as connection diagram instructed below.



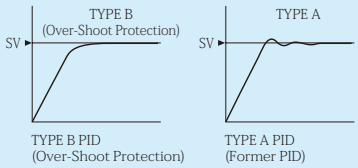
●Digital PV Filter (Standard)

This is a function to realize a CR filter effect on software by means of primary delay arithmetic on the measured value (PV).
The filter effect can be set by time constant (t).
(The time constant is a period to reach 63% of PV value, when the input changes stepwise.)



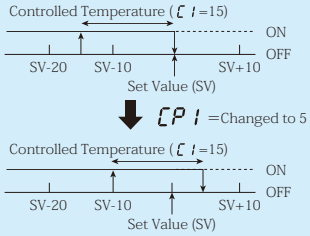
Digital PV filter with the following uses
1) To eliminate high frequency noise : When electric noise is added to the input, the adverse effect is reduced.
2) When input changes abruptly, the response delay is possibly made.

●Over-Shoot Protection PID (Standard)



●Shifting OFF Position in ON-OFF Control (Standard)

When the Shift value is set to 0 (zero), the OFF position is the set value position.

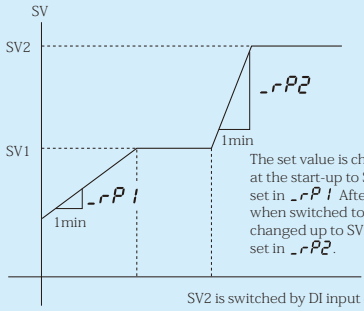


When the OFF position setting is shifted by +5, ON/OFF position shifts to that of +5 minutes upper than the original position, though the set value is not changed. When the OFF position setting is shifted toward the minus direction, the OFF position shifts in the reverse direction.

●Ramp

When SV (set value) is changed, this function slopes the curve. The actual action is performed in such a manner that dummy SV is gradually changed toward the new set value, and the control is performed to the dummy set value.
Set the change of SV per minute to use the ramp function.
When the characteristic of the item to be controlled does not permit a sudden change of the manipulated variable, or when the change rate (slope) of the variable is important, the ramp function is very effective.

If it is desire to have great influence on PV (measurements), the result of expectation might not be obtained because only SV is changed.



The set value is changed from the temperature at the start-up to SV1 by the amount of change set in rP1. After that, when switched to SV2 by DI input, a set value is changed up to SV2 by the amount of change set in rP2.

SV2 is switched by DI input communication key.

* When the SV2 option is selected, the above is possible to operate.

■Ordering Information (Model Configurations)

TTM− [Model] [Grade] − [Input] − [Output 1] − A [Option]

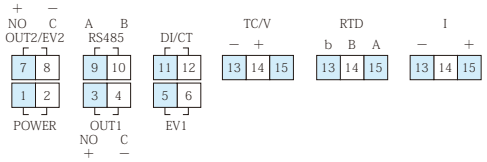
* "A (EV1 : Alarm 1)" provided for in the standard specifications.
* Without output 2, EV2 is not available. Output 2 is equally used as EV2, but not activated simultaneously.
* Transfer Output (H, K, J, F, G, I) is only available in "S" Grade.
* Communication "X" (TOHO protocol+ MODBUS) is only availavle in "S" Grade.
* Option of "M" & "X" can not be selected at the same time.
* Ramp Function can be used when "S" Grade is selected.
* "S" Grade is not provided in TTM-002.

Model	002	24×48mm 1/32 DIN			
	004	48×48mm 1/16 DIN			
	005	96×48mm 1/8 DIN VERTICAL			
	006	48×96mm 1/8 DIN HORIZONTAL			
	007	72×72mm 3/16 DIN			
	009	96×96mm 1/4 DIN			
Grade		Normal Grade (Sampling Time : 500mS)			
	S	"S" Grade (Ramp function & Sampling Time : 250mS) Not available in TTM-002			
Input		Thermocouple (K, J, T, R, N, S, B), R.T.D. (Pt100, JPt100)			
	2	4 to 20mA DC, 0 to 5V DC, 1 to 5V DC			
Output 1	R	Relay contact			
	P	SSR drive voltage 12V DC			
	I	Current 4 to 20mA			
Option		None			
	B	Output 2	Relay contact or EV2	B or P selectable	
	P	Output 2	SSR drive voltage		
	R	EV2	Relay contact TTM-002/004 : Not optional TTM-005/006/007/009 : Not available when DI is selected.		
	D	CT Input	Not provided when I is selected for Output 1. TTM-002/004 : Not provided when DI is selected.		
	E	DI (Digital Input)	TTM-002/004 : Not usable when CT is selected. TTM-005/006/007/009 : Not obtained when EV2 is selected.		
	M	Communication	RS-485 (TOHO protocol) Available when Normal Grade is selected.		
	X		RS-485 (TOHO protocol+ MODBUS) Available when "S" Grade is selected.		
	H	Transfer Output	0 to 10mV DC	Only one can be selected from H, K, J, F, G, I Available when "S" Grade is selected. Not available in TTM-004S/007S.	
	K		0 to 1V DC		
	J		0 to 5V DC		
	F		1 to 5V DC		
	G		0 to 10V DC		
	I		4 to 20mA DC		

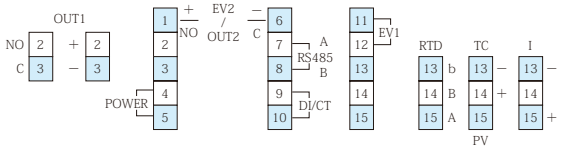
Please refer to this table for appropriate specifications when placing order.

■Wiring

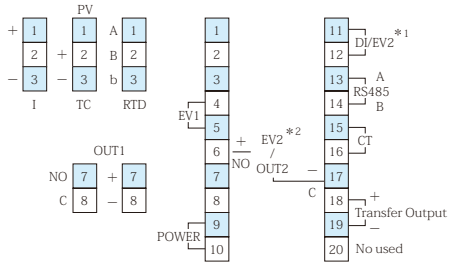
TTM-002 when makig DI with open collector output, terminal #11 needs to be "+ (plus)".



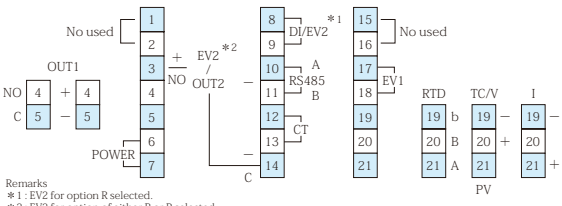
TTM-004 when makig DI with open collector output, terminal #9 needs to be "+ (plus)".



TTM-005/006/009 when makig DI with open collector output, terminal #11 needs to be "+ (plus)".



TTM-007 when makig DI with open collector output, terminal #8 needs to be "+ (plus)".



Remarks
* 1 : EV2 for option R selected.
* 2 : EV2 for option of either B or R selected.

●Specifications are subject to change without notice.
Note: The color printed in this catalog may be different from actual color.

■Terminals

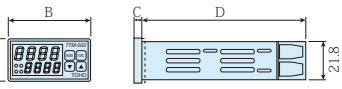
DI	No 9 + side
Communication	Connect T/R (A) and T/R (B) (Use transducer, except RS-485 in use)
Relay Output	C : Common, NO : Normal open
SSR Drive Output	Connect directly to + & - input of SSR
EV1, 2	Changeable normal open & normal close
CT	Connect specific current transformer (CTL)
R.T.D. Input	Connect to A, B and b
Thermocouple Input	Connect to porarity (+, -)

* When OUT2 is "P", connect directly + & - on input of SSR side.
* Make sure the polarity (+, -) for Transfer Output, when you wire.

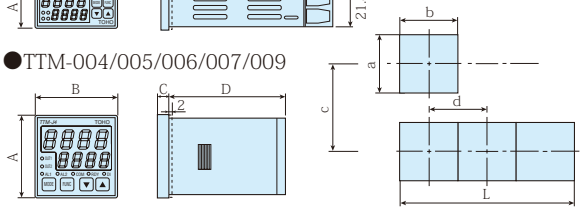
■Dimensions

●TTM-002

*European terminal AWG less than 18 (Upper side)
AWG less than 16 (Lower side)



●TTM-004/005/006/007/009



Model	a	b	c	d	A	B	C	D	L
TTM-002	22.2 $^{+0.3}_{-0}$	45 $^{+0.6}_{-0}$	60	48	24	48	3.5	96.5	(B×N-2.5) $^{+0.6}_{-0}$
TTM-004	45 $^{+0.6}_{-0}$	45 $^{+0.6}_{-0}$	60	48	48	48	6	77	(B×N-3) $^{+0.6}_{-0}$
TTM-005	92 $^{+0.6}_{-0}$	45 $^{+0.6}_{-0}$	120	48	96	48	6.5	76.5	(B×N-3) $^{+1}_{-0}$
TTM-006	45 $^{+0.6}_{-0}$	92 $^{+0.6}_{-0}$	48	120	48	96	6.5	76.5	(A×N-3) $^{+1}_{-0}$
TTM-007	68 $^{+0.6}_{-0}$	68 $^{+0.6}_{-0}$	90	72	72	72	8.5	77	(B×N-3) $^{+1}_{-0}$
TTM-009	92 $^{+0.6}_{-0}$	92 $^{+0.6}_{-0}$	120	96	96	96	9	77	(B×N-3) $^{+1}_{-0}$

"L" is for installation of multiple units.
When you use compressed lead wire to install multiple units, please be careful sufficiently not to touch the other lead wires.
Please clean by the well squeezed cloth with neutral detergent.

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