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T8000

PC-Programmable MODBUS Temperature Transmiter and Signal Converter

September 2004

Description

The T8000 PC-Programmable MODBUS Temperature Transmitter and Signal Converter accepts a direct signal input from a wide array of sensors and analog devices:

RTD ▪ Thermocouple ▪ Current ▪ Voltage
Millivolt ▪ Ohms ▪ Resistance ▪ Potentiometer

Analog-to-MODBUS Conversion

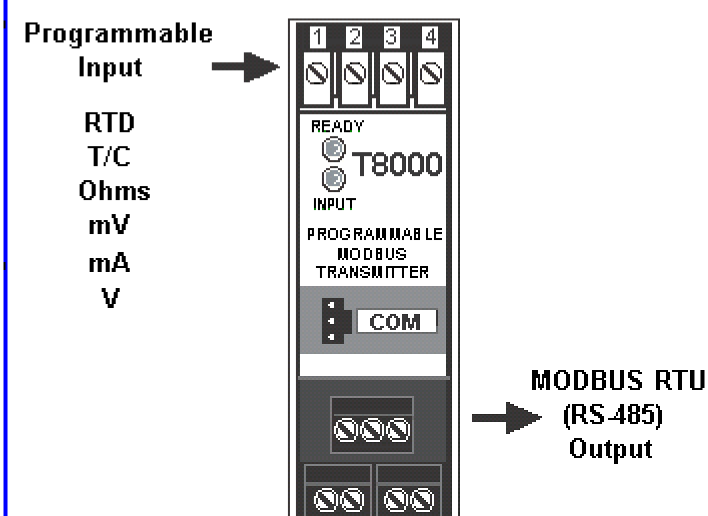
The 4-wire (line/mains-powered) T8000 converts the input to the standard MODBUS RTU (RS-485) communication protocol ready for direct interface with MODBUS-based monitoring and control systems.

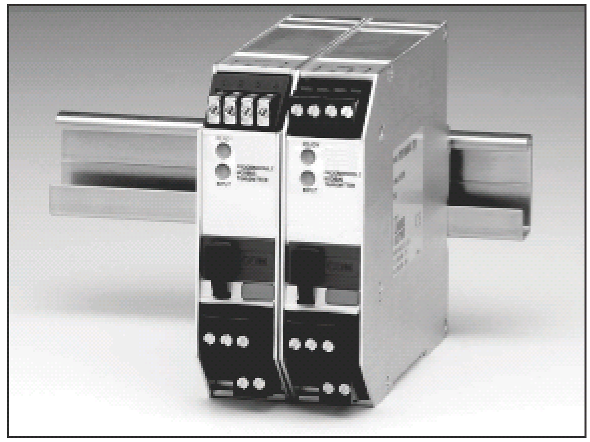
Save Wiring and Installation Costs

When monitoring points are dispersed, or in small clusters, the T8000 is the ideal solution for collecting and concentrating them onto a single MODBUS RTU communication link.

Up to 32 (without repeaters) T8000s can be multidropped onto a single low-cost communication link (such as a twisted wire pair or fiber optic cable). This eliminates the need to run a dedicated wire for each signal, and delivers significant savings on installation, cable, conduit, connection and wire tray costs.

Figure 1. Available T8000 models deliver versatile input and output options.





***The T8000 features a metal, RFI resistant** housing that snaps onto standard DIN-style rails.*

Features

- **20-bit input resolution delivers exceptional digital measurement accuracy.**

The T8000 delivers accuracy of ±0.1°C (±0.18°F) with all platinum RTDs, or ±0.01% of maximum span with current and voltage inputs.

- **Output error is eliminated.**

Since the measurement is delivered to your control system as a digital signal, the output error produced by a traditional analog transmitter is eliminated.

- **PC-programmable with Windows software.**

From a single screen, you can choose, and then view to confirm, all of your application specific operating parameters from a PC.

- **Long-term stability.**

Allows up to 5 years between scheduled calibrations.

- **Isolated and RFI/EMI protection.**

Delivers superior protection against the effects of ground loops, plant noise, radio frequency and electromagnetic interference.

Certifications

CE **CE Conformant**- EMC Directive 89/336/EEC EN 61326

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Figure 2. Up to 32 (without repeaters) T8000 can be multidropped onto a single MODBUS RTU communication link.

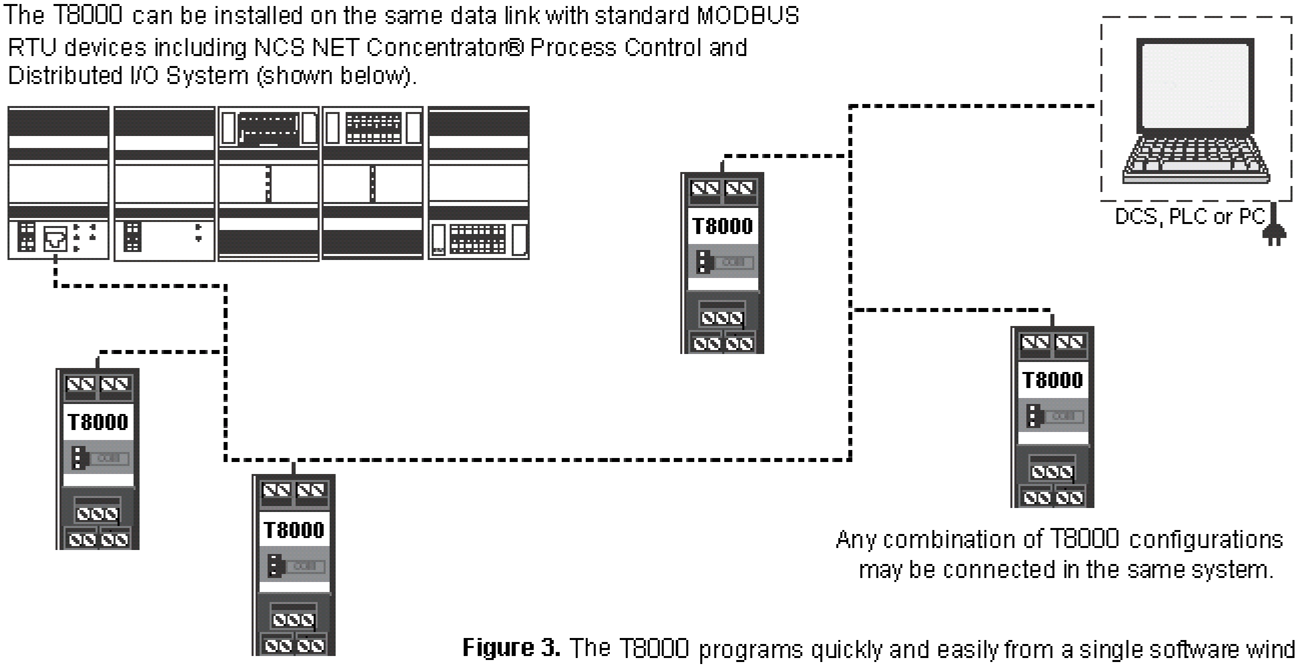
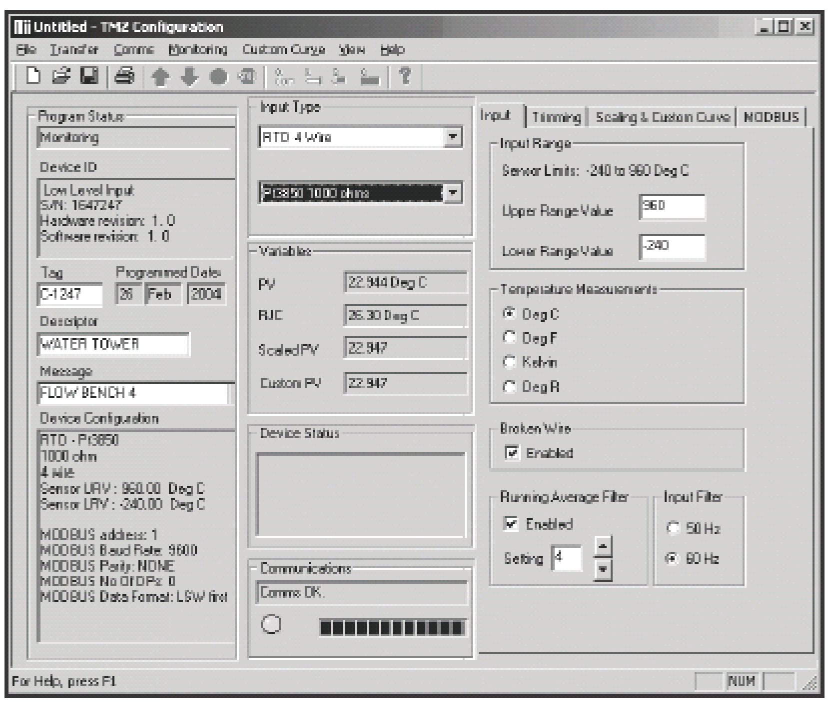


Figure 3. The T8000 programs quickly and easily from a single software window.



One Window.
One Minute.
One Setup.

All operating parameters configure quickly and easily using our Intelligent PC Configuration Software.

Programmable functions include:

- Input type and measurement range (zero and full scale values)
- Input trimming
- MODBUS parameters
- T/C reference junction compensation (on/off)
- Standard and custom linearization curves

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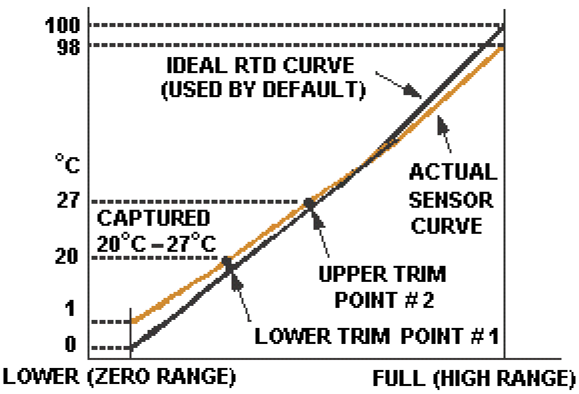
Trim to Specific Curve Segments

The T8000 can be trimmed with two data points within the selected zero and span measurement range. This allows a complete process range to be monitored, while placing measurement emphasis on a critical segment of the range.

In the figure below, the ideal RTD curve is optimized between 20°C and 27°C to match the curve of the sensor used. This provides incredible precision over a limited portion of the span, while measuring the remainder of the span with outstanding accuracy.

Figure 4. The T8000 can be set to measure the segment most critical to the process.



Total Sensor Diagnostics for RTD Inputs

If the RTD input breaks, the user can decide whether or not to trip one alarm to indicate trouble. A plain- English error message on the PC software tells exactly which RTD wire has broken. Specific error messages eliminate the work of removing the sensor or checking all lead wires to diagnose a problem.

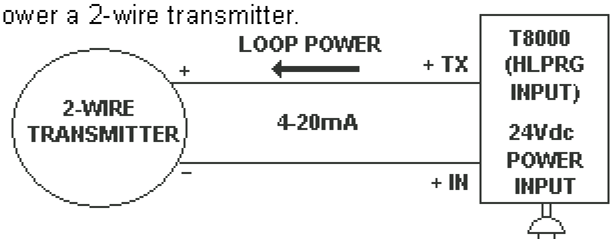
Superior Reference Junction Compensation

Uncompensated plastic terminals are very susceptible to ambient temperature changes that may result in readings that are off by several degrees. T8000 models that accept temperature inputs (TPRG input) feature metal terminals and advanced electronic compensation techniques that provide a stable measurement in ambient temperature conditions.

Powers a 2-Wire Transmitter

The T8000 (HLPRG: current/voltage input model) comes standard with 2-wire transmitter excitation that provides 24Vdc to power the loop. This saves the cost of specifying and installing an additional instrument power supply.

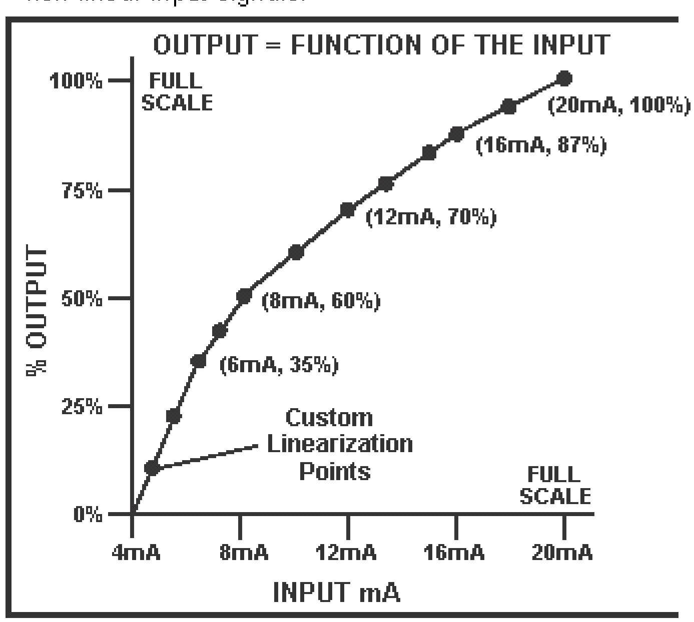
Figure 5. The T8000 provides transmitter excitation to power a 2-wire transmitter.



Custom 128-Point Linearization Curves

The ability to plot a custom linearization curve is beneficial when non-linear input signals must be converted to linear output representations. Typical applications include monitoring a non-linear transducer, the level of odd-shaped tanks, and flow meter linearization.

Figure 6. Custom linearization points can be selected and saved in the T8000's memory to compensate for non-linear input signals.



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Specifications (HLPRG: mA and V Input Model)

Performance

Input Accuracy:
Current, ±0.01% of maximum span (±2 microamps); Voltage, ±0.01% of maximum span (±1mV)

Overall Accuracy:
The overall accuracy of the unit is the input accuracy. It includes the combined effects of linearity, hysteresis, repeatability and adjustment resolution.

Stability:
See Table 1

Response Time:
INPUT UPDATE TIME: 128msec;

MODBUS POLLING TIME:
Dependent upon how fast and how often a MODBUS master requests data.

Isolation:
STANDARD UNIT: 1000Vrms between case and input. 1500Vrms between power and input;
WITH -RF OPTION: 500Vrms between case, input and power.

Power Consumption:
1W maximum

Input Impedance:
Current, 20 ohms; Voltage, 1.1 Mohms

Communications:

Input Over-Range Protection:
Current, ±100mA; Voltage, ±30Vdc

Type:
STANDARD MODBUS RTU protocol interface over RS-485 (parameters as specified in U.S. Standard EIA-RS485)

Address Range:
Configurable from 1 to 247. Unit will assume a MODBUS address of 01 by default.

Baud Rates:
Interface supports the following: 300, 600, 1200, 2400, 4800, 9600, 19.2k and 38.4k

Character Format:
One start bit, 8 data bits and one stop bit

Indicators:

LED Type: INPUT
LED: Dual color LED indicates input failure
READY LED: Green LED indicates unit is operating properly.

Ambient Operating & Storage Range Conditions:
-40°C to +85°C (-40°F to +185°F)

Relative Humidity:
0-95%, non-condensing

Ambient Temperature Effect:
Current, 2 microamps/°C;
Voltage, 1mV/°C

RFI/EMI Immunity:

STANDARD UNIT:
10V/m@20-1000MHz, 1kHz when tested according to IEC1000-4-3-1995

WITH -RF OPTION:
30V/m@20-1000MHz, 1kHz AM when tested according to IEC1000-4-3-1995

Noise Rejection:

Common mode:
100dB@50/60Hz;

Normal Mode:
Current Input, 100dB typical@ 50mAp-p@50/60Hz;
Voltage Input, 100dB typical@1Vp-p@50/60Hz

Weight:
290 g (10.2 oz)

Table 1. Long-Term Stability for HLPRG (mA and V) Input Model

Stability (% of maximum span)	Input-to-Output (Years)		
	1	3	5
Current Inputs	0.081	0.14	0.18
Voltage Inputs	0.093	0.16	0.21

Table 2. Long- Term Stability for TPRG (RTD, T/C, mV, Ohms, Pot) Input Model

Stability (% of maximum span)	Input-to-Output (Years)		
	1	3	5
RTD, Ohm & Pot Inputs	0.09	0.16	0.21
T/C & mV Inputs	0.08	0.14	0.18

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Specifications (TPRG: RTD, T/C, Ohms, mV and Pot Input Model)

Performance Input Accuracy:
See Table 5

Overall Accuracy:
The overall accuracy of the unit is the input accuracy. It includes the combined effects of linearity, hysteresis, repeatability and adjustment resolution. It does not include ambient temperature effect. For T/C input, add the RJC error.

Reference Junction Compensation Accuracy (T/C Inputs Only): ± 0.45°C

Stability: See Table 2

Response Time:
INPUT UPDATE TIME: 128msec;

MODBUS POLLING TIME:
Dependent upon how fast and how often a MODBUS master requests data.

Isolation:
STANDARD UNIT: 1000Vrms between case and input. 1500Vrms between power and input; WITH -RF OPTION: 500Vrms between case, input and power.

Power Consumption: 1W maximum

Input Impedance:
T/C and mV inputs, 40 Mohms, nominal

Input Over-Range Protection: ± 0.5 Vdc

Excitation Current (RTD and Ohm Inputs Only): 250 microamps, ±10%

Communications:

Type:
STANDARD MODBUS RTU protocol interface over RS-485 (parameters as specified in U.S. Standard EIA-RS485)

Address Range:
Configurable from 1 to 247. Unit will assume a MODBUS address of 01 by default.

Baud Rates:
Interface supports the following: 300, 600, 1200, 2400, 4800, 9600, 19.2k and 38.4k

Character Format:
One start bit, 8 data bits and one stop bit

Indicators:

LED Type: INPUT
LED: Dual color LED indicates input failure
READY LED: Green LED indicates unit is operating properly.

Ambient Conditions:

Operating & Storage Range
-40°C to +85°C (-40°F to +185°F)

Effect of Ambient Temperature on Cold Junction Compensation T/C Inputs Only):
±0.005°C per °C change of ambient temperature.

Relative Humidity:
0-95%, non-condensing

Ambient Temperature Effect:
See Table 4

RFI/EMI Immunity:

STANDARD UNIT:
10V/m@20-1000MHz, 1kHz when tested according to IEC1000-4-3-1995

WITH -RF OPTION:
30V/m@20-1000MHz, 1kHz AM when tested according to IEC1000-4-3-1995

Noise Rejection:

Common mode:
100dB@50/60Hz;

Normal Mode: See Table 3

Weight:
290 g (10.2 oz)

Table 3. *Normal Mode Rejection Ratio Table*

Sensor Type		Max. p-p Voltage Injection for 100dB at 50/60Hz
T/C: J, K, N, C, E		150 mV
T/C: T, R, S, B		80 mV
Pt RTD:100, 200, 300 ohms		250 mV
Pt RTD:400, 500, 1000 ohms		1 V
Ni: 120 ohms		500 mV
Cu: 9.03 ohms		100 mV
Resistance	**mV**	
1-4 kohms	250-1000	1 V
0.25-1 kohms	62.5-250	250 mV
0.125-0.25 kohms	31.25-62.5	100 mV

Table 4. *Ambient Temperature Effect*

Input Type	Accuracy per 1°C (1.8°F) change in Ambient
* RTD	0.0035°C
Millivolt	0.5 microvolts + 0.005% of reading
Ohm	0.002 ohms + 0.005% of reading
	Thermocouples
Input Type	**Accuracy per 1°C (1.8°F) change in Ambient**
J	0.00016°C + 0.005% of reading
K	0.0002°C + 0.005% of reading
E	0.00026°C + 0.005% of reading
T	0.0001°C + 0.005% of reading
R,S	0.00075°C + 0.005% of reading
B	0.0038°C + 0.005% of reading
N	0.0003°C + 0.005% of reading
C	0.00043°C + 0.005% of reading
mV	0.5 microvolts + 0.005% of reading

* Accuracy of Ni672 is 0.002°C

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Table 5. Accuracy with RTD, thermocouple, Ohms, and Millivolt Inputs (Models with TPRG Input)

Input	Type	α*	Ω	Conformance Range	Minimum Span	Input Accuracy	Maximum Range
RTD 2, 3, 4 Wire		0.003850	100	-200 to 850°C -328 to 1562°F	10°C (18°F)	±0.10 °C (±0.18 °F)	-240 to 960°C -400 to 1760°F
			200				
			300				
			400				
			500				
			1000				
		0.003902	100	-100 to 650°C -148 to 1202°F			-150 to 720°C -238 to 1328°F
			200				
			400				
			500				
			1000				
		0.003916	100	-200 to 510°C -328 to 950°F			-240 to 580°C -400 to 1076°F
	Nickel	0.006720	120	- 80 to 320°C -112 to 608°F			-100 to 360°C -148 to 680°F
	Copper	0.004720	9.035	- 50 to 250°C - 58 to 482°F		±0.85°C (±1.53°F)	- 65 to 280°C - 85 to 536°F
Ohms	Direct Resistance	n/a	0-4000Ω	0-4000Ω	10Ω	±0.4Ω	0-4000Ω
	Potentiometer		4000Ω	0-100%	10%	±0.1%	0-100%
T/C	J	n/a	n/a	-180 to 760°C -292 to 1400°F	35°C (63°F)	±0.25°C (±0.45°F)	-210 to 770°C -346 to 1418°F
	K	n/a	n/a	-150 to 1370°C -238 to 2498°F	40°C (72°F)	±0.30°C (±0.54°F)	-270 to 1390°C -454 to 2534°F
	E	n/a	n/a	-170 to 1000°C -274 to 1832°F	35°C (63°F)	±0.20°C (±0.36°F)	-270 to 1013°C -454 to 1855°F
	T	n/a	n/a	-170 to 400°C -274 to 752°F	35°C (63°F)	±0.25°C (±0.45°F)	-270 to 407°C -454 to 764°F
	R	n/a	n/a	0 to 1760°C 32 to 3200°F	50°C (90°F)	±0.55°C (±0.99°F)	- 50 to 1786°C - 58 to 3246°F
	S	n/a	n/a	0 to 1760°C 32 to 3200°F	50°C (90°F)	±0.55°C (±0.99°F)	- 50 to 1786°C - 58 to 3246°F
	B	n/a	n/a	400 to 1820°C 752 to 3308°F	75°C (135°F)	±0.75°C (±1.35°F)	-200 to 1836°C -392 to 3336°F
	N	n/a	n/a	-130 to 1300°C -202 to 2372°F	45°C (81°F)	±0.40°C (±0.72°F)	-270 to 1316°C -454 to 2400°F
	C	n/a	n/a	0 to 2300°C 32 to 4172°F	100°C (180°F)	±0.80°C (±1.44°F)	- 0 to 2338°C - 32 to 4240°F
mV	mV	n/a	n/a	-50 to 1000mV	4mV	15μV	- 50 to 1000mV

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Ordering Information

Unit	Input	Output	Power	Options	Housing
T8000 PC-Programmable MODBUS Temperature Transmitter and Signal Converter	**HLPRG** Programs to accept: Current: Any range between 0-50mA including: 0-20mA 4-20mA 10-50mA Voltage: Any range between 0-10 Vdc including: 0-5Vdc 1-5Vdc 0-10Vdc **TPRG** Programs to accept (see Table 5 for details): RTD: 2-, 3 and 4 wire; platinum, copper and nickel Thermocouple: J, K, E, T, R, S, N, C, B Ohms: 0-4000 ohms (potentiometer, 4000 ohms maximum) Millivolts: -50 to +1000mV	**MB** MODBUS RTU (RS-485) communications	**24 Vdc** ±10%	**- RF** Enhanced RFI / EMI protection (see "Specifications" for details)	**DIN** Universal DIN-style housing mounts on 32mm (EN50035) G-type and 35mm (EN50022) Top Hat DIN-rails **FLB** Externally mounted flange provides a secure mount and ensures resistance to vibration

When ordering, specify: Unit / Input / Output / Power / Options [Housing]
Model number example: T8000 / TPRG / MB / 24DC / -RF [DIN]

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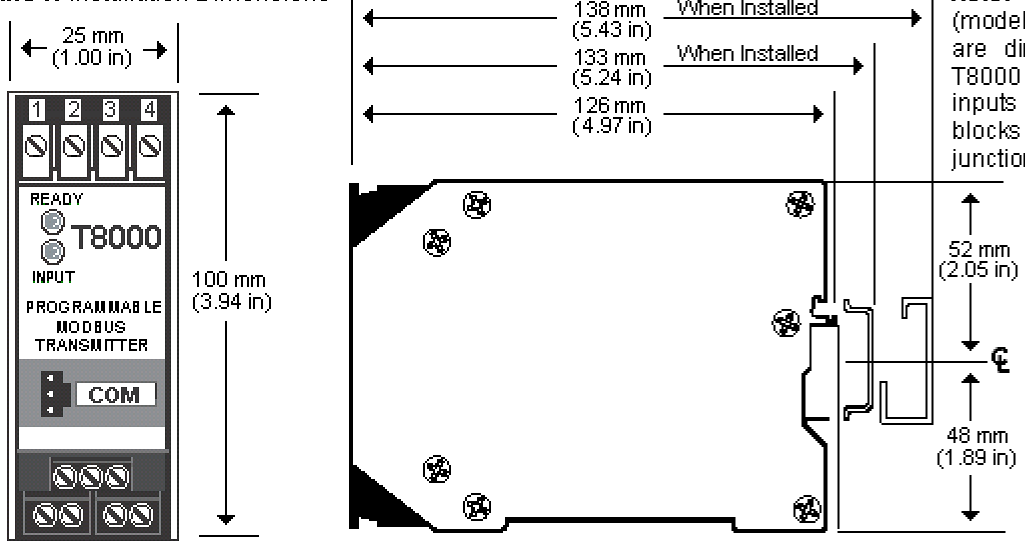
Table 7. Installation Dimensions



Note: While all T8000 models (model with TPRG input shown) are dimensionally identical, the T8000 that accepts temperature inputs features metal terminal blocks for enhanced reference junction compensation.

Table 6. Terminal Designations

Input Type	Top Terminals (Left to Right)			
	T1	T2	T3	T4
RTD, Ohms, Potentiometer, T/C & Mv Inputs				
Current Input	Tx	+I	COM	Not Used
Voltage Input	Not Used	Not Used	COM	+V

		Bottom Terminals			
		B1	B2	B3	B4
Row 1	MODBUS Output	A	B	S	Not Used
Row 2	Power	Not Used	Not Used	+	–

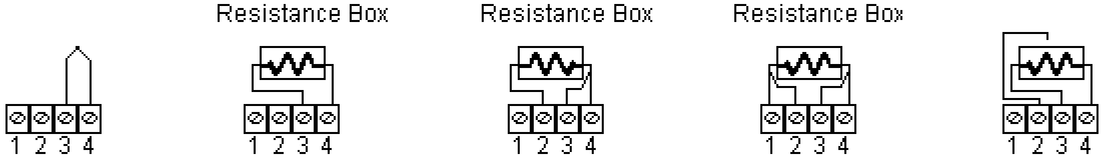
KEY:	
	I = Current Input
	V = Voltage Input
	COM = Common Terminal
	TX = Power for 2-wire Transmitter
	A = A MODBUS
	B = B MODBUS
	S = S MODBUS
	+ = Positive Power Input
	– = Negative Power Input

NOTES:

1. Terminal blocks can accommodate 14-22 AWG solid wiring.

Figure 8. Temperature Sensor Hook-Up Guide (Models with TPRG Input)

Thermocouple and Millivolt Input | 2-Wire RTD or Decade Resistance Box | 3-Wire RTD or Decade Resistance Box | 4-Wire RTD or Decade Resistance Box | Potentiometer Input



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