

# SPECIFICATIONS - ANALOG I/O MODULES

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# CHAPTER 6

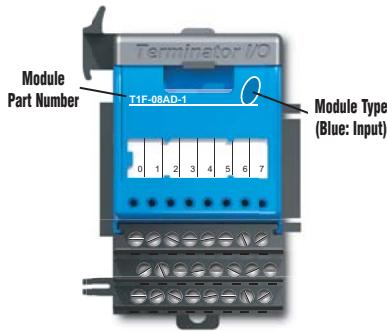
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Analog I/O Modules .....	6-6

## Analog I/O Modules Overview

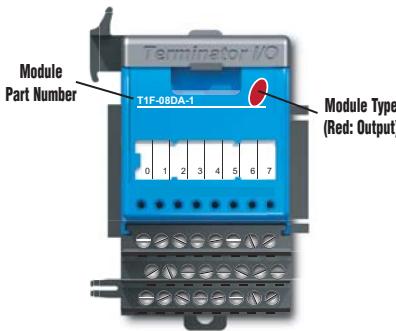
There are 12 analog I/O modules available. The specifications and wiring diagrams for these modules are found in this chapter. Each analog I/O module is identified as an “Input”, “Output” or “Input/Output” module using the color coding scheme shown below. A blue dot on the front panel signifies an Input module, a red dot signifies an Output module and a white dot signifies an Input/Output module.

### Analog Input Modules



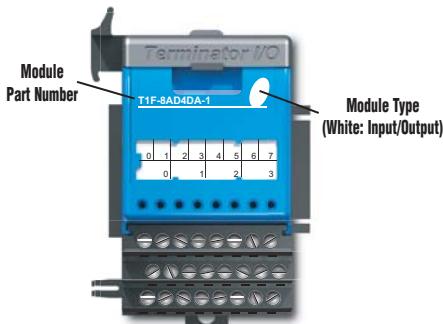
Analog Input Modules			
Part Number	Number of Channels	Description	See Page
<b>T1F-08AD-1</b>	8	Analog Current Input	6-6
<b>T1F-08AD-2</b>	8	Analog Voltage Input	6-7
<b>T1F-16AD-1</b>	16	Analog Current Input	6-8
<b>T1F-16AD-2</b>	16	Analog Voltage Input	6-9
<b>T1F-16RTD</b>	16	RTD	6-10
<b>T1F-14THM</b>	14	Thermocouple	6-12

### Analog Output Modules



Analog Output Modules			
Part Number	Number of Channels	Description	See Page
<b>T1F-08DA-1</b>	8	Analog Current Output	6-15
<b>T1F-08DA-2</b>	8	Analog Voltage Output	6-16
<b>T1F-16DA-1</b>	16	Analog Current Output	6-17
<b>T1F-16DA-2</b>	16	Analog Voltage Output	6-18

### Analog Input/Output Module



Analog Input/Output Modules			
Part Number	Number of Channels	Description	See Page
<b>T1F-8AD4DA-1</b>	8/4	Analog Current Input/Output	6-19
<b>T1F-8AD4DA-2</b>	8/4	Analog Voltage Input/Output	6-21

## Analog I/O Modules Overview- continued



**WARNING:** The T1H Series PLC does not support any Hot-Swap features.

### How to Access the Analog I/O Modules

With the Do-more PLC, the WX and WY memory addresses are assigned to exchange analog data with the analog I/O modules (WX = Analog input data, WY = Analog output data). X addresses are assigned to analog input modules and Y addresses are assigned to configure analog output modules.

The following table shows how many X, Y, WX and WY addresses are assigned to each analog I/O module type.

Analog I/O Module Addressing					
Part Number	Module ID	X	WX	Y	WY
<b>T1F-08AD-1</b>	0x2532	8*	8	-	-
<b>T1F-08AD-2</b>	0x2532	8*	8	-	-
<b>T1F-16AD-1</b>	0x2533	16*	16	-	-
<b>T1F-16AD-2</b>	0x2533	16*	16	-	-
<b>T1F-08DA-1</b>	0x2628	-	-	8	8
<b>T1F-08DA-2</b>	0x2628	-	-	8	8
<b>T1F-16DA-1</b>	0x262C	-	-	8	16
<b>T1F-16DA-2</b>	0x262C	-	-	8	16
<b>T1F-8AD4DA-1</b>	0x2736	8*	8	8	4
<b>T1F-8AD4DA-2</b>	0x2736	8*	8	8	4
<b>T1F-16RTD</b>	0x2573	16**	16	-	-
<b>T1F-14THM (see Note 1)</b>	0x2573	16**	16	-	-

\* X addresses assigned to this module are not used.

\*\* X addresses assigned to this module indicate a broken transmitter.



**NOTE 1:** This module can be configured to operate in unipolar mode which generates a range of values from 0 to 65535 (instead of -32768 to 32767). Use the “:U”(unsigned) cast operator to get the proper representation of the data when using a module that is configured for unipolar. For example: WX0:U, WX1:U.

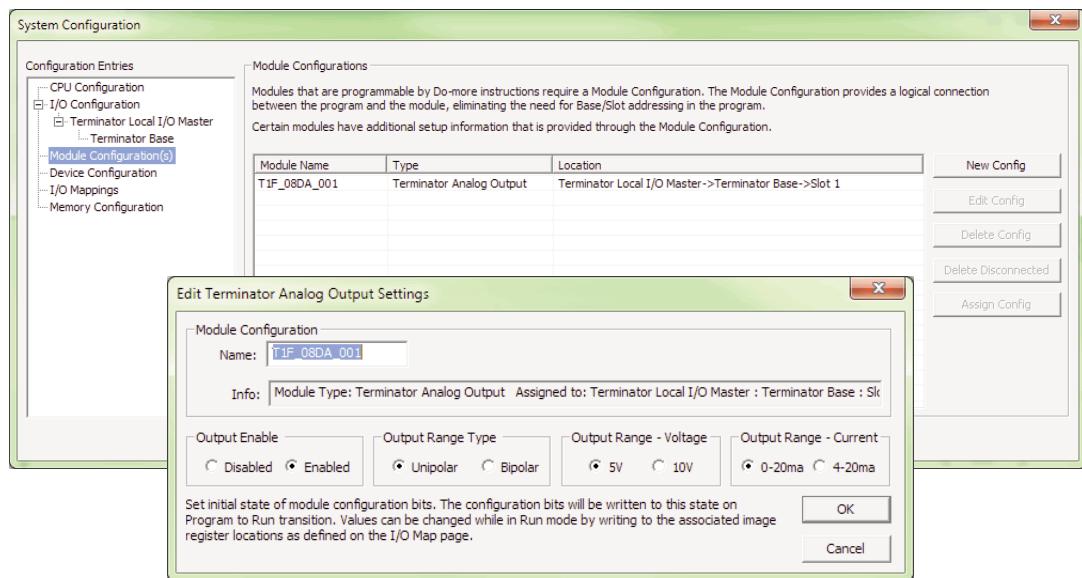
## Analog I/O Modules Overview- continued

### Module Control Byte

Analog output modules have a Module Control Byte that is used to configure some options for the outputs. In the module addressing, this byte shows up as eight Discrete Output (Y) Bits.

- Y0 = Outputs Enabled
- Y(0+1) = Unipolar/Bipolar
- Y(0+2) = 5V/10V Range
- Y(0+3) = 0-20mA/4-20mA
- Y((0+4) through (0+7)) = Reserved

When an analog output module is added to a Do-more project, a Module Configuration with default Module Control Byte values is created. Its settings can be changed under Module Configuration by double-clicking the Module Name or by selecting the New Config or Edit Config buttons on the right hand side.

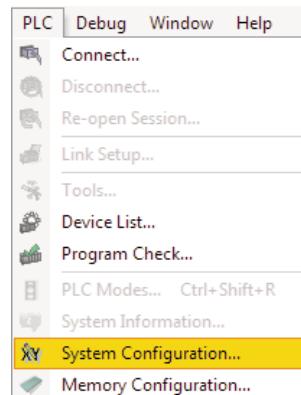


The Do-more T1H Series CPU will write the settings from the Module Configuration into the modules before going to Run mode. The Y Bits can optionally be used to change the Module Control Byte setting programmatically.

## Analog I/O Modules Overview- continued

You can check which X, Y, WX and WY addresses are assigned to each analog I/O module in the I/O Mapping tab of the System Configuration window, as shown below.

Select the pull-down menu PLC > System Configuration to open the System Configuration window and click the I/O Mapping tab.



**System Configuration**

**I/O Slot Number:** A red box highlights the 'I/O Slot Number' entry in the tree view, which is '3'.

**Module ID:** A red box highlights the 'Module ID' entry in the table, which is 'T1K-08TR'.

**Assigned X, Y, WX and WY Addresses:** A red box highlights the row for slot 3, showing the assigned addresses: X0-7, XB-15, XI6-23, and Y0-7.

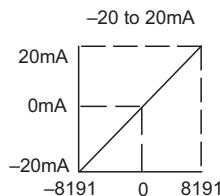
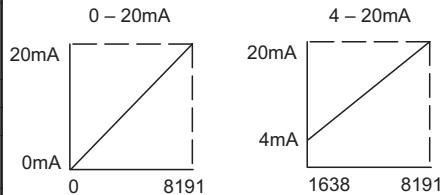
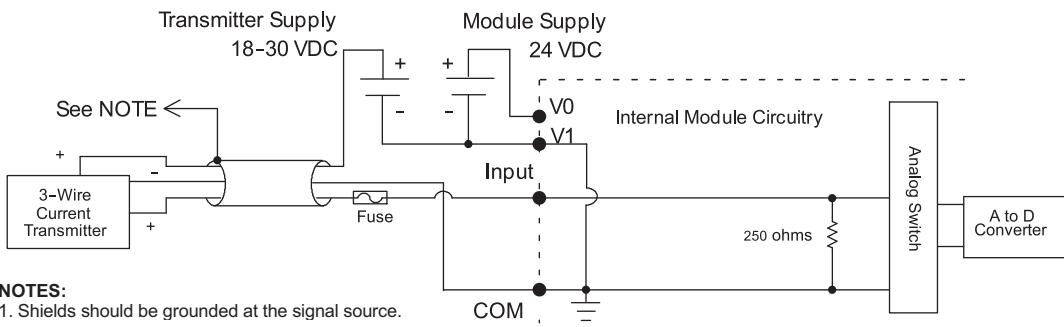
Slot	Mod ID	Mod Description	Slot I/O	X Map	Y Map	WX Map	WY Map
0	1102	T1K-08ND3	8X	X0-7			
1	1102	T1K-08ND3	8X	XB-15			
2	2532	T1F-08ADx	8X / 8WX	XI6-23			
3	1242	T1K-08TR	8Y	Y0-7			
4	*Empty*						
5	*Empty*						
6	*Empty*						
7	*Empty*						
8	*Empty*						
9	*Empty*						
10	*Empty*						
11	*Empty*						
12	*Empty*						
13	*Empty*						
14	*Empty*						
15	*Empty*						
16	*Empty*						
17	*Empty*						

**Mapping Mode:** A red box highlights the 'Auto' radio button in the 'Mapping Mode' section.

**Manual Mode Instructions:** A red box highlights the 'Clear Manual Entries' link in the 'Manual Mode Instructions' section.

**T1F-08AD-1 - 8 Channel Analog Current Input**

Specifications	
<b>Number of Channels</b>	8, single ended (1 common)
<b>Input Ranges</b>	0 - 20 mA, 4 - 20 mA, - 20 to 20 mA
<b>Resolution</b>	14 bit (13 bit plus sign bit)
<b>Module Addressing</b>	8 input bits (X-not used); 8 input words (WX)
<b>Frequency Response</b>	- 3 db @ 500 Hz, - 20 db / decade
<b>Input Resistance</b>	250 Ω
<b>Absolute Maximum Ratings</b>	8V max. Input
<b>Conversion Time (Default: Normal Mode)</b>	Normal Mode: 5 ms per channel Fast Mode: 0.5 ms per channel (Fast Mode supported in module hardware version B or later, and only when using this analog module with the T1H-EBC(100) or T1H-PBC control module)
<b>Linearity Error</b>	+ / - 2 count max.
<b>Input Stability</b>	+ / - 1 count
<b>Full Scale Error (Offset Error not included)</b>	16 counts max.
<b>Offset Error</b>	2 counts max.
<b>Max. Full Scale Inaccuracy (% of full scale); all errors included</b>	0.18% @ 25° C 0.36% @ 60° C
<b>CPU Update Rate</b>	1 channel per scan
<b>Base Power Required</b>	75 mA @ 5 VDC
<b>External Module Power Supply Req.</b>	18 - 30 VDC, 50 mA, class 2
<b>Recommended Fuse</b>	0.032 A @ 5 VDC, Series 217 Fast Acting
<b>Operating Temperature</b>	0° to 60° C (32° to 140° F)
<b>Storage Temperature</b>	- 20° to 70° C (- 4° to 158° F)
<b>Accuracy vs. Temperature</b>	+ / - 50 ppm / °C max. full scale
<b>Relative Humidity</b>	5 to 95% (non-condensing)
<b>Environmental Air</b>	No corrosive gases permitted
<b>Vibration</b>	MIL STD 810C 514.2
<b>Shock</b>	MIL STD 810C 516.2
<b>Noise Immunity</b>	NEMA ICS3-304
<b>Weight</b>	136 g

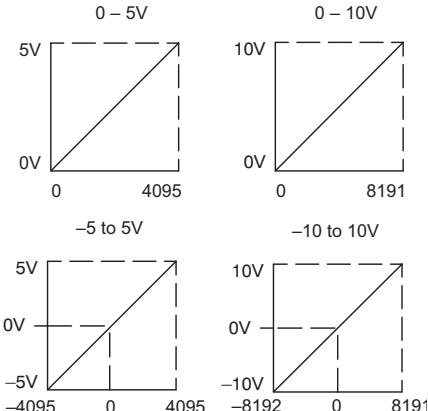
**Input Signal Ranges****Equivalent Input Circuit**

# T1F-08AD-2 - 8 Channel Analog Voltage Input

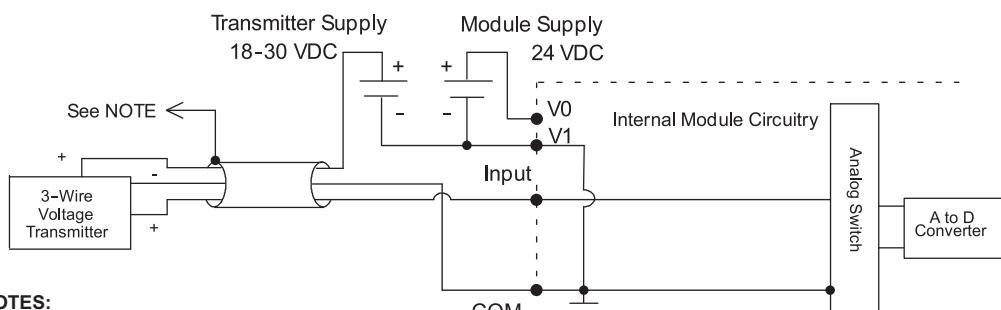
Specifications	
<b>Number of Channels</b>	8, single ended (1 common)
<b>Input Ranges</b>	0 - 5 V, 0 - 10 V, + / - 5 V, + / - 10 V
<b>Resolution</b>	14 bit (13 bit plus sign bit)
<b>Module Addressing</b>	8 input bits (X-not used); 8 input words (WX)
<b>Frequency Response</b>	- 3 db @ 500 Hz, - 20 db / decade
<b>Input Resistance</b>	200 KΩ min.
<b>Absolute Maximum Ratings</b>	Fault Protected Input, 130 V (rms)/ 100 VDC
<b>Conversion Time (Default: Normal Mode)</b>	Normal Mode: 5 ms per channel Fast Mode: 0.5 ms per channel (Fast Mode supported in module hardware version B or later, and only when using this analog module with the T1H-EBC(100) or T1H-PBC control module)
<b>Linearity Error</b>	+ / - 2 count max.
<b>Input Stability</b>	+ / - 1 count
<b>Calibration Full Scale Error</b>	8 counts max.
<b>Calibration Offset Error</b>	2 counts max.
<b>Max. Full Scale Inaccuracy (% of full scale); all errors included</b>	0.08% @ 25°C 0.26% @ 60°C
<b>CPU Update Rate</b>	1 channel per scan
<b>Base Power Required</b>	75 mA @ 5 VDC
<b>External Module Power Supply Req.</b>	18 - 30 VDC, 50 mA, class 2
<b>Operating Temperature</b>	0° to 60° C (32° to 140° F)
<b>Storage Temperature</b>	- 20° to 70° C (- 4° to 158° F)
<b>Accuracy vs. Temperature</b>	+ / - 50 ppm / °C max. full scale
<b>Relative Humidity</b>	5 to 95% (non-condensing)
<b>Environmental Air</b>	No corrosive gases permitted
<b>Vibration</b>	MIL STD 810C 514.2
<b>Shock</b>	MIL STD 810C 516.2
<b>Noise Immunity</b>	NEMA ICS3-304
<b>Weight</b>	136 g



## Input Signal Ranges



## Equivalent Input Circuit

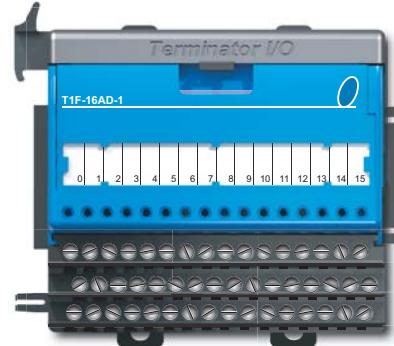
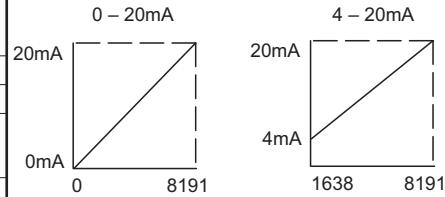
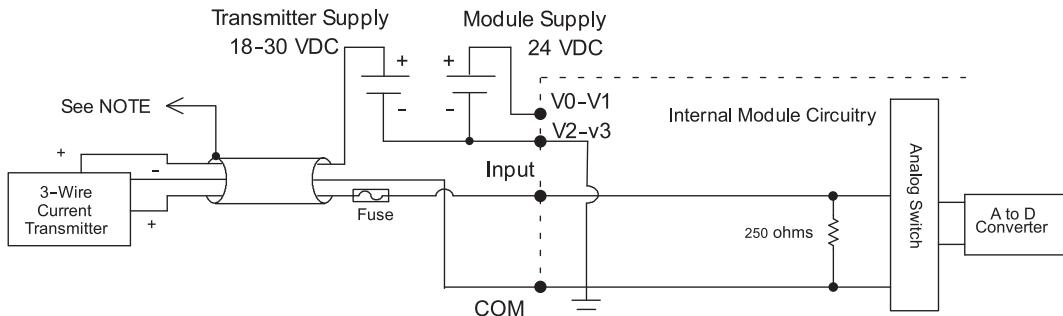


### NOTES:

1. Shields should be grounded at the signal source.

**T1F-16AD-1 - 16 Channel Analog Current Input**

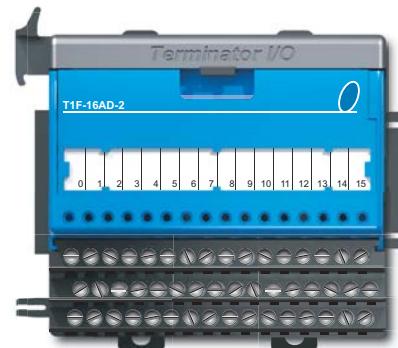
Specifications	
<b>Number of Channels</b>	16, single ended (1 common)
<b>Input Ranges</b>	0 - 20 mA, 4 - 20 mA, - 20 to 20 mA
<b>Resolution</b>	14 bit (13 bit plus sign bit)
<b>Module Addressing</b>	16 input bits (X-not used); 16 input words (WX)
<b>Frequency Response</b>	-3 db @ 500 Hz, -20 db / decade
<b>Input Resistance</b>	250 Ω
<b>Absolute Maximum Ratings</b>	8V max. Input
<b>Conversion Time</b>	5 ms per channel
<b>Linearity Error</b>	+/- 2 count max.
<b>Input Stability</b>	+/- 1 count
<b>Full Scale Error (Offset Error not included)</b>	16 counts max.
<b>Offset Error</b>	2 counts max.
<b>Max. Full Scale Inaccuracy (% of full scale); all errors included</b>	0.18% @ 25°C 0.36% @ 60°C
<b>CPU Update Rate</b>	1 channel per scan
<b>Base Power Required</b>	75 mA @ 5 VDC
<b>External Module Power Supply Req.</b>	18 - 30 VDC, 50 mA, class 2
<b>Recommended Fuse</b>	0.032 A @ 5 VDC
<b>Operating Temperature</b>	0° to 60° C (32° to 140° F)
<b>Storage Temperature</b>	-20° to 70° C (-4° to 158° F)
<b>Accuracy vs. Temperature</b>	+/- 50 ppm / °C max. full scale
<b>Relative Humidity</b>	5 to 95% (non-condensing)
<b>Environmental Air</b>	No corrosive gases permitted
<b>Vibration</b>	MIL STD 810C 514.2
<b>Shock</b>	MIL STD 810C 516.2
<b>Noise Immunity</b>	NEMA ICS3-304
<b>Weight</b>	168 g

**Input Signal Ranges****Equivalent Input Circuit****NOTES:**

1. Shields should be grounded at the signal source.

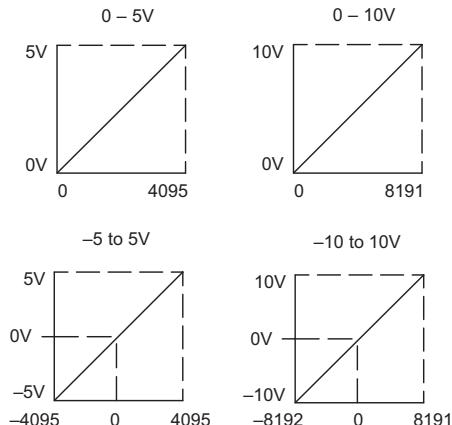
## T1F-16AD-2 - 16 Channel Analog Current Input

Specifications	
<b>Number of Channels</b>	16, single ended (1 common)
<b>Input Ranges</b>	0 - 5 V, 0 - 10 V, + / - 5 V, + / - 10 V
<b>Resolution</b>	14 bit (13 bit plus sign bit)
<b>Module Addressing</b>	16 input bits (X-not used); 16 input words (WX)
<b>Frequency Response</b>	- 3 db @ 500 Hz, - 20 db / decade
<b>Input Resistance</b>	200 KΩ min.
<b>Absolute Maximum Ratings</b>	Fault Protected Input, 130 V (rms)/ 100 VDC
<b>Conversion Time</b>	5 ms per channel
<b>Linearity Error</b>	+ / - 2 count max.
<b>Input Stability</b>	+ / - 1 count
<b>Calibration Full Scale Error</b>	8 counts max.
<b>Calibration Offset Error</b>	2 counts max.
<b>Max. Full Scale Inaccuracy (% of full scale); all errors included</b>	0.08% @ 25°C 0.26% @ 60°C
<b>CPU Update Rate</b>	1 channel per scan
<b>Base Power Required</b>	75 mA @ 5 VDC
<b>External Module Power Supply Req.</b>	21.6 - 26.4 VDC, 50 mA, class 2
<b>Operating Temperature</b>	0° to 60° C (32° to 140° F)
<b>Storage Temperature</b>	- 20° to 70° C (- 4° to 158° F)
<b>Accuracy vs. Temperature</b>	+ / - 50 ppm / °C max. full scale
<b>Relative Humidity</b>	5 to 95% (non-condensing)
<b>Environmental Air</b>	No corrosive gases permitted
<b>Vibration</b>	MIL STD 810C 514.2
<b>Shock</b>	MIL STD 810C 516.2
<b>Noise Immunity</b>	NEMA ICS3-304
<b>Weight</b>	160 g

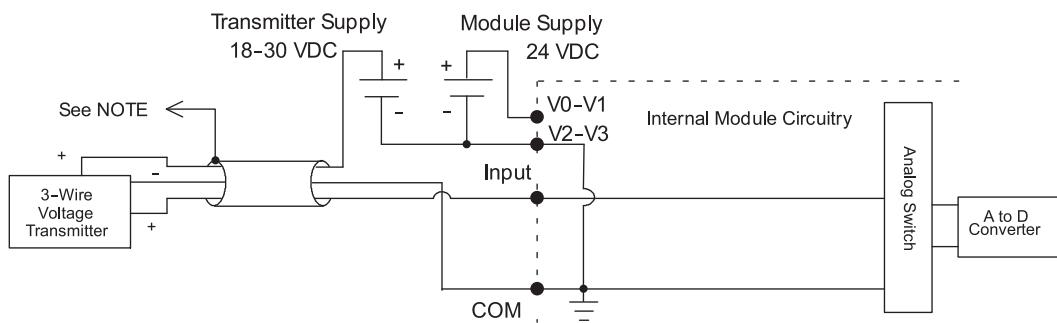


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### Input Signal Ranges

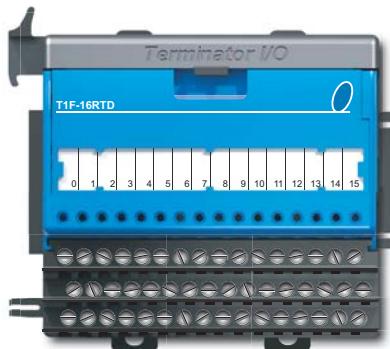


### Equivalent Input Circuit

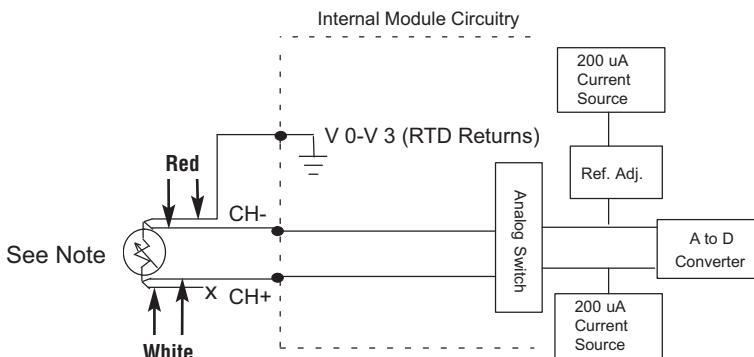


**T1F-16RTD - 16 Channel RTD Input**

Specifications	
<b>Number of Channels</b>	16
<b>Resolution</b>	+ / - 0.1° C or ° F
<b>Module Addressing</b>	16 input bits (X-broken transmitter); 16 input words (WX)
<b>Common Mode Range</b>	0 - 5 VDC
<b>Notch Filter</b>	> 50 db notches @ 50 / 60 Hz; f - 3 db = 13.1 Hz
<b>Absolute Max. Ratings</b>	+ / - 50 VDC
<b>Converter Type</b>	Charge balancing, 24 - bit
<b>Sampling Rate</b>	140 ms / channel
<b>CPU Update Rate</b>	1 channel per scan
<b>Base Power Required</b>	150 mA @ 5 VDC
<b>Operating Temperature</b>	0° to 60° C (32° to 140° F)
<b>Temperature Drift</b>	25 ppm / ° C (max.)
<b>Maximum Inaccuracy</b>	+ / - 1° C
<b>RTD Excitation Current</b>	200 $\mu$ A
<b>Relative Humidity</b>	5 to 95% (non-condensing)
<b>Environmental Air</b>	No corrosive gases permitted
<b>Vibration</b>	MIL STD 810C 514.2
<b>Shock</b>	MIL STD 810C 516.2
<b>Noise Immunity</b>	NEMA ICS3-304
<b>Weight</b>	168 g



RTD Input Ranges	
RTD Type	Range
Pt100	-200° to 850° C (-328° to 1562° F)
Pt1000	-200° to 595° C (-328° to 1103° F)
jPt100	-38° to 450° C (-36° to 842° F)
Type CU - 10 / 25	-200° to 260° C (-328° to 500° F)
120 $\Omega$ Nickel	-80° to 260° C (-112° to 500° F)

**Equivalent Input Circuit****NOTES:**

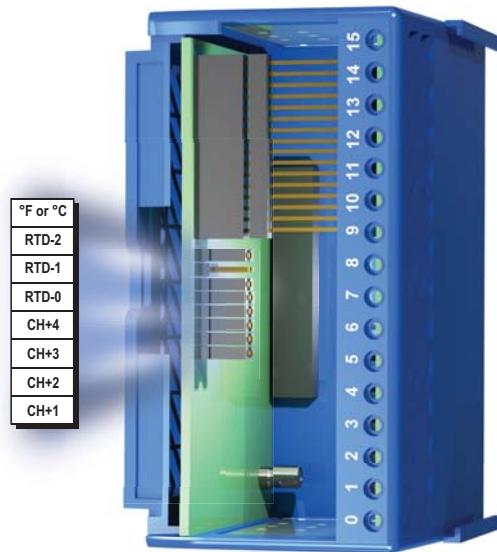
1. If an RTD sensor has four wires, the plus sense wire should be left unconnected as shown.

**T1F-16RTD - 16 Channel RTD Input - continued****Setting Module Jumpers****Select Number of Channels**

Number of Channels	Jumper			
	CH+1	CH+2	CH+3	CH+4
1				
2	X			
3		X		
4	X	X		
5			X	
6	X		X	
7		X	X	
8	X	X	X	
9				X
10	X			X
11		X		X
12	X	X		X
13			X	X
14	X		X	X
15		X	X	X
16	X	X	X	X

X = Jumper Installed

Blank Space = Jumper Removed

**Select Input Type**

RTD Input	Jumper		
	RTD-0	RTD-1	RTD-2
Pt100 $\Omega$	X	X	
Pt1000 $\Omega$			X
jPt100 $\Omega$		X	
Type CU-10 $\Omega$			
Type CU-25 $\Omega$	X		
120 $\Omega$ Nickel	X		X

X = Jumper Installed

Blank Space = Jumper Removed

**Select Temperature Units**

Temperature Unit	Jumper
°F or °C	X
°F	
°C	

X = Jumper Installed

Blank Space = Jumper Removed

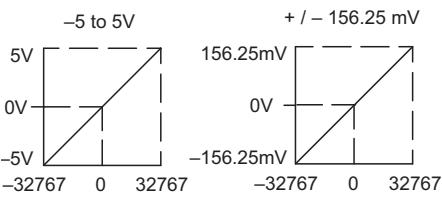
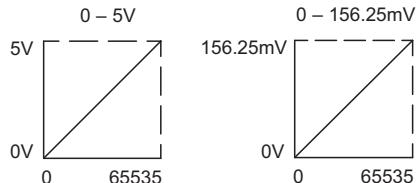
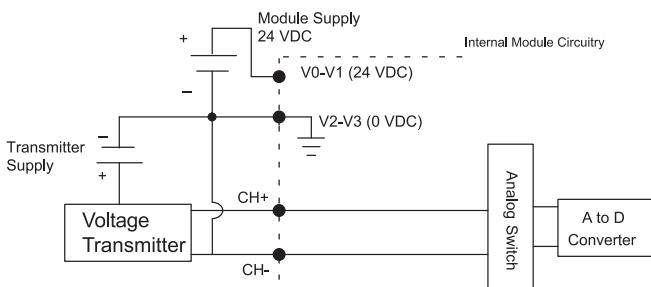
**T1F-14THM - 14 Channel Thermocouple Input**

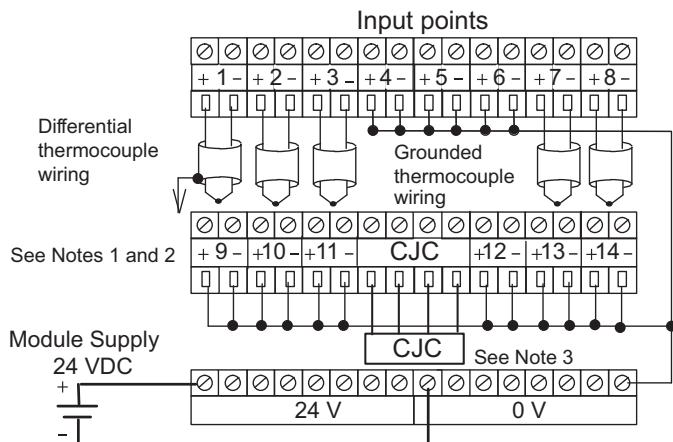
Specifications	
<b>Use with I/O Module Base</b>	T1K-16B screw type terminal base only
<b>Number of Channels</b>	14, differential
<b>Common Mode Range</b>	+ / - 5 VDC
<b>Module Addressing</b>	16 input bits (X-broken transmitter); 16 input words (WX)
<b>Common Mode Rejection</b>	90 db min. @ DC, 150 db min . @ 50 / 60 Hz
<b>Input Impedance</b>	1 MΩ
<b>Absolute Max. Ratings</b>	Fault Protected Input + / - 50 VDC
<b>CPU Update Rate</b>	1 channel per scan
<b>Base Power Required</b>	60 mA @ 5 VDC
<b>External Power Required</b>	24 VDC +/- 5%, 70 mA, class 2
<b>Operating Temperature</b>	0° to 60° C (-4° to 158° F)
<b>Storage Temperature</b>	-20° to 70° C (32° to 140° F)
<b>Accuracy vs. Temperature</b>	+ / - 5 ppm / °C max. full scale
<b>Relative Humidity</b>	5 to 95% (non-condensing)
<b>Environmental Air</b>	No corrosive gases permitted
<b>Vibration</b>	MIL STD 810C 514.2
<b>Shock</b>	MIL STD 810C 516.2
<b>Noise Immunity</b>	NEMA ICS3-304
<b>Weight</b>	168 g



Thermocouple Specifications	
<b>Input Ranges</b>	Type J -190° to 760° C (-310° to 1400° F) Type E -210° to 1000° C (-346° to 1832° F) Type K -150° to 1372° C (-238° to 2502° F) Type R 65° to 1768° C (149° to 3214° F) Type S 65° to 1768° C (149° to 3214° F) Type T -230° to 400° C (-382° to 752° F) Type B 529° to 1820° C (984° to 3308° F) Type N -70° to 1300° C (-94° to 2372° F) Type C 65° to 2320° C (149° to 4208° F)
<b>Display Resolution</b>	+ / - 0.1° C or + / - 0.1° F
<b>Cold Junction Compensation</b>	automatic (CJC Part #: T1F-CJC)
<b>Conversion Time</b>	100 ms per channel
<b>Warm Up Time</b>	30 minutes typical, + / - 1° C repeatability
<b>Linearity Error</b>	+ / - 0.05° C maximum, + / - 0.01° C typical
<b>Maximum Inaccuracy</b>	+ / - 3° C

Voltage Specifications	
<b>Input Voltage Ranges</b>	0 - 5 V, 0 - 156.25 mV + / - 5 V, + / - 156.25 mV
<b>Resolution</b>	16 bit (1 in 65535)
<b>Full Scale Calibration Error (Offset Error Included)</b>	+ / - 13 counts typical + / - 33 counts maximum
<b>Offset Calibration Error</b>	+ / - 1 count max. @ 0 V input
<b>Linearity Error (End to End)</b>	+ / - 1 count maximum
<b>Maximum Inaccuracy</b>	+ / - 0.02% @ 25° C (77° F )

**Input Signal Ranges****Equivalent Input Circuit**

**T1F-14THM - 14 Channel Thermocouple Input - continued****NOTES:**

1. Shields should be grounded at the signal source.
2. Unused inputs should be connected to Common (0 VDC).
3. The Cold Junction Compensation (part #: T1F-CJC) temperature sense unit that comes with the module must be installed into the I/O base terminals to perform CJC of the thermocouple inputs.

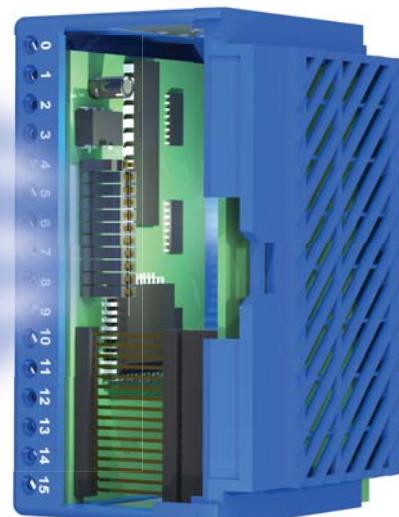
**Setting Module Jumpers****Select Number of Channels**

Number of Channels	Jumper			
	CH+1	CH+2	CH+4	CH+8
1				
2	X			
3		X		
4	X	X		
5			X	
6	X		X	
7		X	X	
8	X	X	X	
9				X
10	X			X
11		X		X
12	X	X		X
13			X	X
14	X	X	X	X

X = Jumper Installed

Blank Space = Jumper Removed

- See Note 1
- Calibrate Enable
  - Units-1
  - Units-0
  - T/C Type 3
  - T/C Type 2
  - T/C Type 1
  - T/C Type 0
  - CH+8
  - CH+4
  - CH+2
  - CH+1



**T1F-14THM - 14 Channel Thermocouple Input - continued**

6

**Select Input Type**

Thermocouple/ Voltage Inputs	Jumper			
	T/C Type 0	T/C Type 1	T/C Type 2	T/C Type 3
J	X	X	X	X
K		X	X	X
E	X		X	X
R			X	X
S	X	X		X
T		X		X
B	X			X
N				X
C	X	X	X	
0 - 5 V		X	X	
± 5 V	X		X	
0 - 156.25 mV			X	
± 156.25 mV	X	X		

X = Jumper Installed  
 Blank Space = Jumper Removed

**Select the Conversion Units**

Jumper	Thermocouple Conversion Units (See Note 2)			
	Magnitude Plus Sign	2's Complement	° F	° C
Units-0	X		X	
Units-1	X	X		

Jumper	Voltage Conversion Units (See Note 3)	
	Magnitude Plus Sign	2's Complement
Units-0	X	X
Units-1	X	

X = Jumper Installed  
 Blank Space = Jumper Removed



**NOTE:** This module can be configured to operate in unipolar mode which generates a range of values from 0 to 65535 (instead of -32768 to 32767). Use the “:U”(unsigned) cast operator to get the proper representation of the data when using a module that is configured for unipolar. For example: WX0:U, WX1:U.



**NOTE 1:** The Calibrate Enable jumper comes from the factory not installed. Installing the jumper disables the thermocouple active burn-out detection circuitry, which enables a thermocouple calibrator to be connected to the module. To make sure that the output of the thermocouple calibrator is within the 5 V common mode voltage range of the module, connect the negative side of the differential voltage input channel to the 0 V terminal, then connect the thermocouple calibrator to the differential inputs (for example, Ch 3+ and Ch 3-).



**NOTE 2:** All thermocouple types are converted into a direct temperature reading with one implied decimal place. Negative temperatures can be represented in either 2's complement or magnitude plus sign format. If the temperature is negative, the most significant bit is the sign bit. 2's complement data format may be required to correctly display bipolar data on some operator interfaces.



**NOTE 3:** The bipolar voltage input ranges may be converted to a 15-bit magnitude plus sign or a 16-bit 2's complement value.

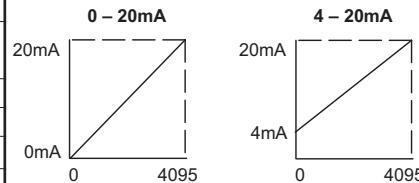
# T1F-08DA-1 - 8 Channel Analog Current Output

Specifications	
<b>Number of Channels</b>	8
<b>Output Ranges</b>	0 - 20 mA, 4 - 20 mA
<b>Output Type</b>	single ended, 1 common
<b>Resolution</b>	12 bit (1 in 4096)
<b>Module Addressing</b>	8 output bits (Y-control byte); 8 output words (WY)
<b>Max. Loop Supply</b>	30 VDC
<b>Peak Output Voltage</b>	30 VDC
<b>Load Impedance</b>	0Ω min.
<b>Max. Load (ohm) / Power Supply</b>	620 / 18 V, 910 / 24 V, 1200 / 30 V
<b>Min. Load (ohm) / Power Supply*</b>	0 / 24 V, 350 / 30 V @ 40° C 250 / 24 V, 600 / 30 V @ 60° C
<b>Linearity Error (end to end)</b>	+ / - 2 counts max. + / - 0.05% of full scale max.
<b>Conversion Settling Time</b>	400 μs max. full scale change
<b>Full Scale Calibration Error</b>	+ / - 12 counts max.
<b>Offset Calibration Error</b>	0 - 20 mA: + / - 5 counts max. 4 - 20 mA: + / - 6 counts max.
<b>Accuracy vs. Temperature</b>	+ / - 50 ppm / °C, full scale calibration change
<b>Max. Full Scale Inaccuracy (% of full scale) all errors included</b>	0.2% @ 25° C 0.4% @ 60° C
<b>CPU Update Rate</b>	1 channel per scan
<b>Base Power Required</b>	75 mA @ 5 VDC
<b>External Module Power Supply Req.</b>	21.6 - 26.4 VDC, 150 mA, class 2
<b>Operating Temperature</b>	0° to 60° C (32° to 140° F)
<b>Storage Temperature</b>	- 20° to 70° C (- 4° to 158° F)
<b>Relative Humidity</b>	5 to 95% (non-condensing)
<b>Environmental Air</b>	No corrosive gases permitted
<b>Vibration</b>	MIL STD 810C 514.2
<b>Shock</b>	MIL STD 810C 516.2
<b>Noise Immunity</b>	NEMA ICS3-304
<b>Weight</b>	145 g

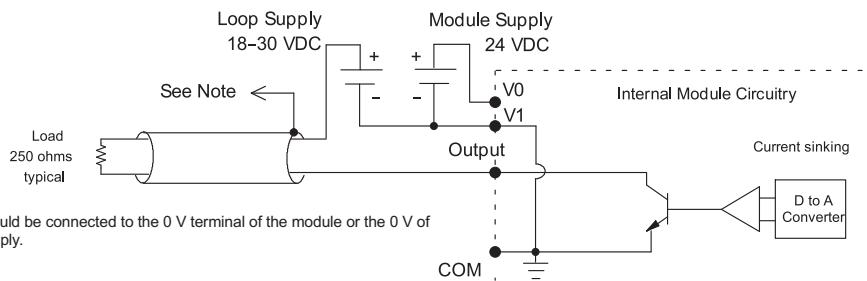
\*Max. allowable output power dissipation. For example, at 60 °C and 24 VDC, there must be a load of at least 250 Ω on the output circuit. Smaller loads will damage the analog output circuit.



## Output Signal Ranges

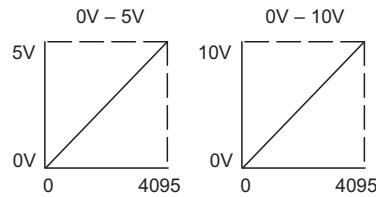
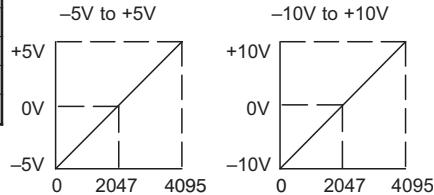
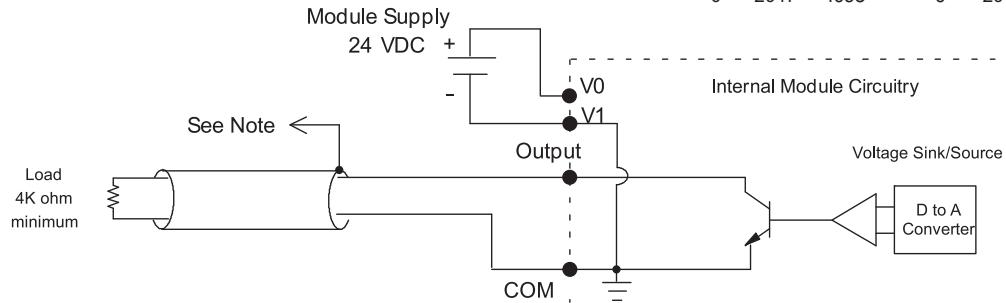


## Equivalent Output Circuit



**T1F-08DA-2 - 8 Channel Analog Voltage Output**

Specifications	
<b>Number of Channels</b>	8
<b>Output Ranges</b>	0 - 5 V, 0 - 10 V, + / - 5 V, + / - 10 V
<b>Output Type</b>	single ended, 1 common
<b>Resolution</b>	12 bit (1 in 4096)
<b>Module Addressing</b>	8 output bits (Y-control byte); 8 output words (WY)
<b>Peak Output Voltage</b>	15 VDC
<b>Load Impedance</b>	4 KΩ min.
<b>Load Capacitance</b>	0.01 μF max.
<b>Linearity Error (end to end)</b>	+ / - 2 counts max. + / - 0.05% of full scale max.
<b>Conversion Settling Time</b>	100 μs max. full scale change
<b>Full Scale Calibration Error</b>	+ / - 12 counts max.
<b>Offset Calibration Error</b>	10 V ranges: + / - 6 counts max. 5 V ranges: + / - 11 counts max.
<b>Accuracy vs. Temperature</b>	+ / - 50 ppm / °C, full scale calibration change
<b>Max. Full Scale Inaccuracy (% of full scale) all errors and temp drift included</b>	10 V ranges: + / - 0.2% @ 25°C + / - 0.4% @ 60°C 5 V ranges: + / - 0.3% @ 25°C + / - 0.5% @ 60°C
<b>CPU Update Rate</b>	1 channel per scan
<b>Base Power Required</b>	75 mA @ 5 VDC
<b>External Module Power Supply Req.</b>	21.6 - 26.4 VDC, 150 mA, class 2
<b>Operating Temperature</b>	0° to 60° C (32° to 140° F)
<b>Storage Temperature</b>	- 20° to 70° C (- 4° to 158° F)
<b>Relative Humidity</b>	5 to 95% (non-condensing)
<b>Environmental Air</b>	No corrosive gases permitted
<b>Vibration</b>	MIL STD 810C 514.2
<b>Shock</b>	MIL STD 810C 516.2
<b>Noise Immunity</b>	NEMA ICS3-304
<b>Weight</b>	145 g

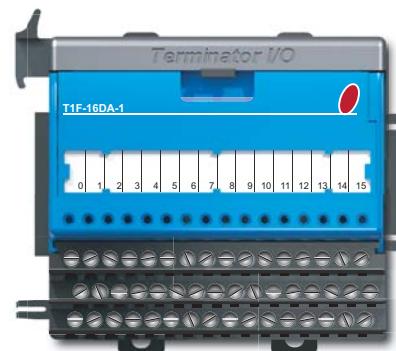
**Unipolar Ranges****Bipolar Ranges****Equivalent Output Circuit****NOTES:**

1. Shields should be connected to the 0 V terminal of the module or the 0 V terminal of the power supply.

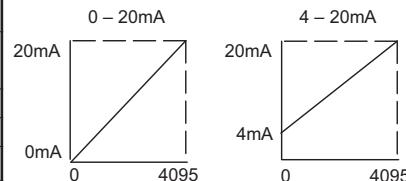
# T1F-16DA-1 - 16 Channel Analog Current Output

Specifications	
<b>Number of Channels</b>	16
<b>Output Ranges</b>	0 - 20 mA, 4 - 20 mA
<b>Output Type</b>	single ended, 1 common
<b>Resolution</b>	12 bit (1 in 4096)
<b>Module Addressing</b>	8 output bits (Y-control byte); 16 output words (WY)
<b>Max. Loop Supply</b>	30 VDC
<b>Peak Output Voltage</b>	30 VDC
<b>Max. Load (ohm) / Power Supply</b>	620 / 18 V, 910 / 24 V, 1200 / 30 V
<b>Min. Load (ohm) / Power Supply*</b>	0 / 24 V, 350 / 30 V @ 40°C 250 / 24 V, 600 / 30 V @ 60°C
<b>Linearity Error (end to end)</b>	+ / - 2 counts max. + / - 0.05% of full scale max.
<b>Conversion Settling Time</b>	400 $\mu$ s max. full scale change
<b>Full Scale Calibration Error</b>	+ / - 12 counts max.
<b>Offset Calibration Error</b>	0 - 20 mA: + / - 5 counts max. 4 - 20 mA: + / - 6 counts max.
<b>Accuracy vs. Temperature</b>	+ / - 50 ppm / °C, full scale calibration change
<b>Max. Full Scale Inaccuracy (% of full scale) all errors included</b>	0.2% @ 25°C 0.4% @ 60°C
<b>CPU Update Rate</b>	1 channel per scan
<b>Base Power Required</b>	75 mA @ 5 VDC
<b>External Module Power Supply Req.</b>	21.6 - 26.4 VDC, 150 mA, class 2
<b>Operating Temperature</b>	0° to 60° C (32° to 140° F)
<b>Storage Temperature</b>	-20° to 70° C (-4° to 158° F)
<b>Relative Humidity</b>	5 to 95% (non-condensing)
<b>Environmental Air</b>	No corrosive gases permitted
<b>Vibration</b>	MIL STD 810C 514.2
<b>Shock</b>	MIL STD 810C 516.2
<b>Noise Immunity</b>	NEMA ICS3-304
<b>Weight</b>	172 g

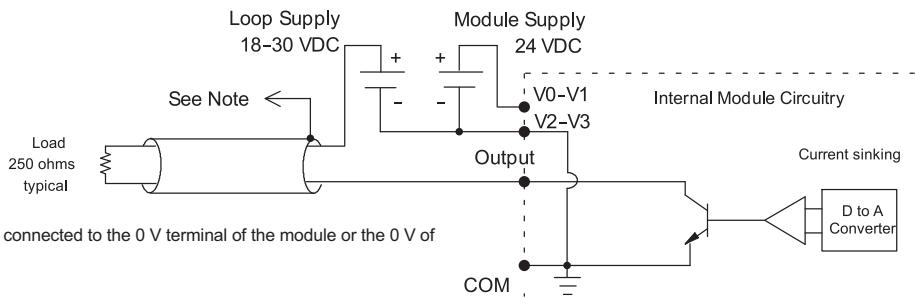
\*Max. allowable output power dissipation. For example, at 60 °C and 24 VDC, there must be a load of at least 250  $\Omega$  on the output circuit. Smaller loads will damage the analog output circuit.



## Output Signal Ranges

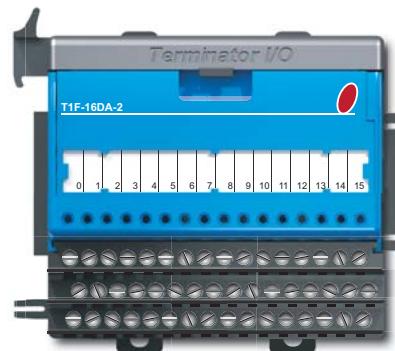
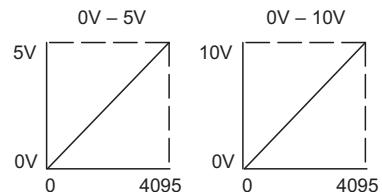
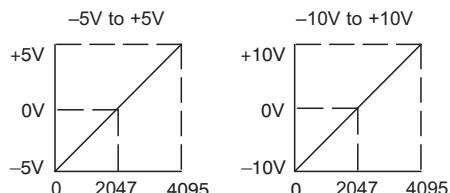
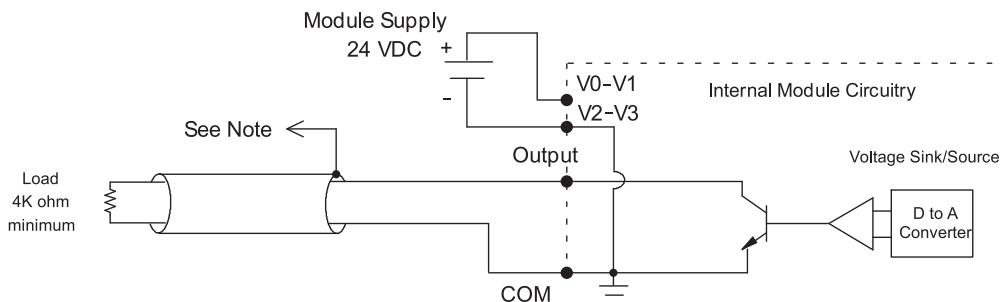


## Equivalent Output Circuit



**T1F-16DA-2 - 16 Channel Analog Voltage Output**

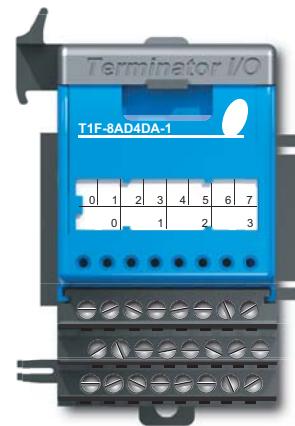
Specifications	
<b>Number of Channels</b>	16
<b>Output Ranges</b>	0 - 5 V, 0 - 10 V, +/- 5 V, +/- 10 V
<b>Output Type</b>	single ended, 1 common
<b>Resolution</b>	12 bit (1 in 4096)
<b>Module Addressing</b>	8 output bits (Y-control byte); 16 output words (WY)
<b>Peak Output Voltage</b>	15 VDC
<b>Load Impedance</b>	4 KΩ min.
<b>Load Capacitance</b>	0.01 μF max.
<b>Linearity Error (end to end)</b>	+/- 2 counts max. +/- 0.05% of full scale max.
<b>Conversion Settling Time</b>	100 μs max. full scale change
<b>Full Scale Calibration Error</b>	+/- 12 counts max.
<b>Offset Calibration Error</b>	10 V ranges: +/- 6 counts max. 5 V ranges: +/- 11 counts max.
<b>Accuracy vs. Temperature</b>	+/- 50 ppm / °C, full scale calibration change
<b>Max. Full Scale Inaccuracy (% of full scale) all errors and temp drift included</b>	10 V ranges: +/- 0.2% @ 25°C +/- 0.4% @ 60°C 5 V ranges: +/- 0.3% @ 25°C +/- 0.5% @ 60°C
<b>CPU Update Rate</b>	1 channel per scan
<b>Base Power Required</b>	75 mA @ 5 VDC
<b>External Module Power Supply Req.</b>	21.6 - 26.4 VDC, 150 mA, class 2
<b>Operating Temperature</b>	0° to 60° C (32° to 140° F)
<b>Storage Temperature</b>	-20° to 70° C (-4° to 158° F)
<b>Relative Humidity</b>	5 to 95% (non-condensing)
<b>Environmental Air</b>	No corrosive gases permitted
<b>Vibration</b>	MIL STD 810C 514.2
<b>Shock</b>	MIL STD 810C 516.2
<b>Noise Immunity</b>	NEMA ICS3-304
<b>Weight</b>	172 g

**Unipolar Ranges****Bipolar Ranges****Equivalent Output Circuit****NOTES:**

1. Shields should be connected to the 0 V terminal of the module or the 0 V of the power supply.

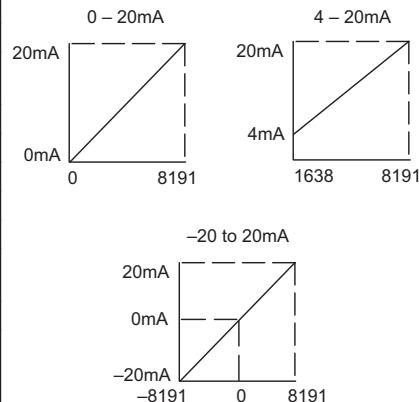
# T1F-8AD4DA-1 - 8 Channel Analog Current Input / 4 Channel Analog Current Output

Module General Specifications	
<b>CPU Update Rate</b>	1 channel per scan
<b>Base Power Required</b>	75 mA @ 5 VDC
<b>External Module Power Supply</b>	21.6 - 26.4 VDC, 50 mA, class 2 (plus 20 mA per channel loop)
<b>Operating Temperature</b>	0° to 60° C (32° to 140° F)
<b>Storage Temperature</b>	- 20° to 70° C (- 4° to 158° F)
<b>Accuracy vs. Temperature</b>	+ / - 50 ppm / °C max. full scale
<b>Relative Humidity</b>	5 to 95% (non-condensing)
<b>Environmental Air</b>	No corrosive gases permitted
<b>Vibration</b>	MIL STD 810C 514.2
<b>Shock</b>	MIL STD 810C 516.2
<b>Noise Immunity</b>	NEMA ICS3-304
<b>Weight</b>	136 g

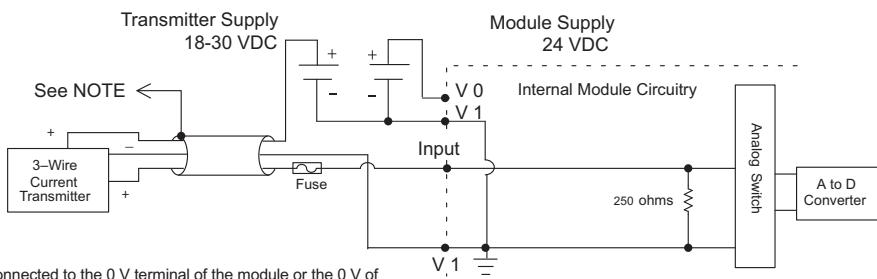


Input Channel Specifications	
<b>Number of Channels</b>	8, single ended (1 common)
<b>Input Ranges</b>	0 - 20 mA, 4 - 20 mA, - 20 to 20 mA
<b>Resolution</b>	14 bit (13 bit plus sign bit)
<b>Module Addressing</b>	8 input bits (X-not used); 8 input words (WX)
<b>Frequency Response</b>	- 3 db @ 100 Hz, - 20 db / decade
<b>Input active low-pass filter</b>	
<b>Input Resistance</b>	250 Ω
<b>Absolute Maximum Ratings</b>	8V max. Input
<b>Conversion Time</b>	5 ms per channel
<b>Linearity Error</b>	+ / - 2 count max.
<b>Input Stability</b>	+ / - 1 count
<b>Full Scale Error (Offset Error not included)</b>	16 counts max.
<b>Offset Error</b>	2 counts max.
<b>Max. Full Scale Inaccuracy (% of full scale); all errors included</b>	0.18% @ 25° C 0.36% @ 60° C
<b>Recommended Fuse</b>	0.032 A, Series 217 Fast Acting

## Input Signal Ranges



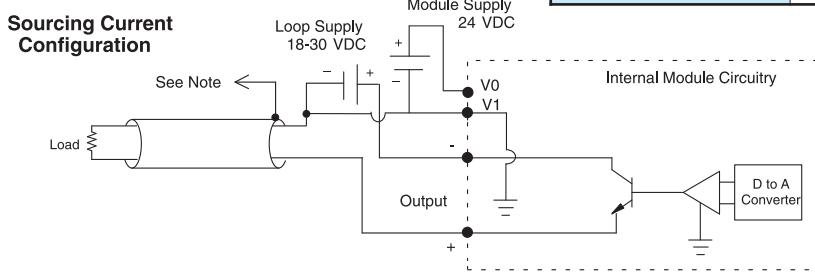
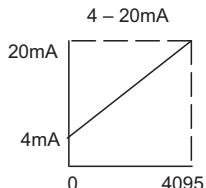
## Equivalent Input Circuit



**T1F-8AD4DA-1 - continued**

Output Channel Specifications	
<b>Number of Channels</b>	4, sink/source; individually configured by wiring
<b>Output Range</b>	4 - 20 mA
<b>Output Type</b>	Single ended, 1 common
<b>Resolution</b>	12 bit (1 in 4096)
<b>Module Addressing</b>	8 output bits (Y-control byte); 4 output words (WY)
<b>Maximum Loop Supply</b>	30 VDC
<b>Source Load (ohms) / Loop Power Supply</b>	0 - 400 Ω / 18 - 30 V
<b>Sink Load (ohm) / Loop Power Supply</b>	0 - 600 Ω / 18 V, 0 - 900 Ω / 24 V, 0 - 1200 Ω / 30 V
<b>Total Load (Sink plus Source)</b>	600 Ω / 18 V, 900 Ω / 24 V, 1200 Ω / 30 V

Output Channel Specifications	
<b>Linearity Error (end to end)</b>	+ / - 2 count maximum + / - 0.050% of full scale maximum
<b>Conversion Settling Time</b>	400 μs maximum full scale change
<b>Full Scale Calibration Error (Note: source error depends upon the load from source terminal to ground)</b>	SINK: + / - 12 counts max. @ any load SOURCE: + / - 26 counts max. @ 400 Ω load + / - 18 counts max. @ 250 Ω load + / - 12 counts max. @ 125 Ω load
<b>Offset Calibration Error</b>	SINK: + / - 6 counts max. @ any load SOURCE: + / - 10 counts max. @ 400 Ω load + / - 8 counts max. @ 250 Ω load + / - 6 counts max. @ 125 Ω load
<b>Max. Full Scale Inaccuracy (% of full scale); all errors included</b>	SINK: (any load) 0.3% @ 25° C (any load) 0.5% @ 60° C SOURCE: 400 Ω load 0.63% @ 25° C 400 Ω load 0.83% @ 60° C 250 Ω load 0.44% @ 25° C 250 Ω load 0.64% @ 60° C 125 Ω load 0.30% @ 25° C 125 Ω load 0.50% @ 60° C

**Equivalent Output Circuit****Output Signal Range****Sinking Current Configuration**

See Note ←

Loop Supply 18-30 VDC

Module Supply 24 VDC

Load

V0 V1

Output

D to A Converter

Internal Module Circuitry

**NOTES:**

1. Shields should be connected to the 0 V terminal of the module or the 0 V of the power supply.

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Do-more T1H Series PLC User Manual, 1st Edition - T1H-DM-M

# T1F-8AD4DA-2 - 8 Channel Analog Voltage Input / 4 Channel Analog Voltage Output

## Module General Specifications

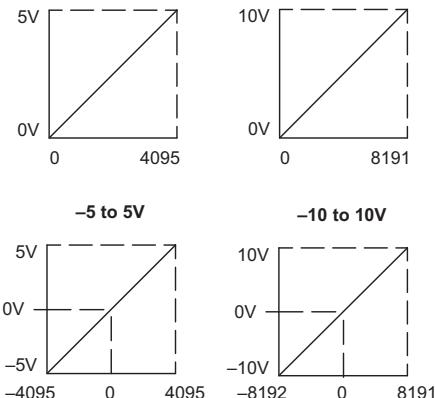
<b>CPU Update Rate</b>	1 channel per scan
<b>Base Power Required</b>	75 mA @ 5 VDC
<b>External Module Power Supply</b>	21.6 - 26.4 VDC, 70 mA, class 2
<b>Operating Temperature</b>	0° to 60° C (32° to 140° F)
<b>Storage Temperature</b>	- 20° to 70° C (- 4° to 158° F)
<b>Accuracy vs. Temperature</b>	+ / - 50 ppm / °C max. full scale
<b>Relative Humidity</b>	5 to 95% (non-condensing)
<b>Environmental Air</b>	No corrosive gases permitted
<b>Vibration</b>	MIL STD 810C 514.2
<b>Shock</b>	MIL STD 810C 516.2
<b>Noise Immunity</b>	NEMA ICS3-304
<b>Weight</b>	136 g



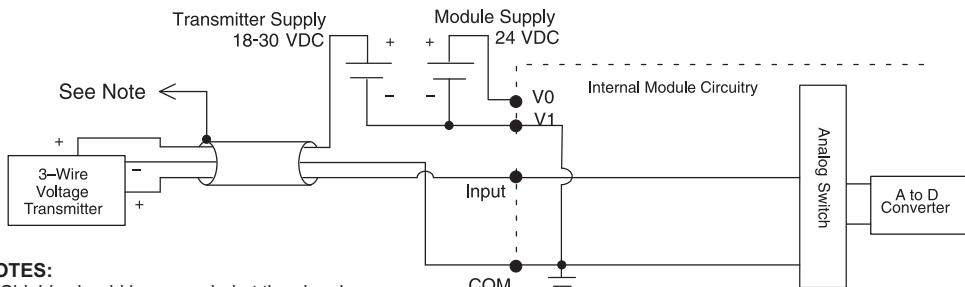
## Input Channel Specifications

<b>Number of Channels</b>	8, single ended (1 common)
<b>Input Ranges</b>	0 - 5 V, 0 - 10 V, + / - 5 V, + / - 10 V
<b>Resolution</b>	14 bit (13 bit plus sign bit)
<b>Module Addressing</b>	8 input bits (X-not used); 8 input words (WX)
<b>Frequency Response</b>	- 3 db @ 500 Hz, - 20 db / decade
<b>Input Resistance</b>	200 KΩ min.
<b>Absolute Maximum Ratings</b>	Fault Protected Input, 130 V (rms) or 100 VDC
<b>Conversion Time</b>	5.5 ms per channel
<b>Linearity Error</b>	+ / - 2 count max.
<b>Input Stability</b>	+ / - 1 count
<b>Calibration Full Scale Error</b>	8 counts max.
<b>Calibration Offset Error</b>	2 counts max.
<b>Max. Full Scale Inaccuracy (% of full scale); all errors included</b>	0.08% @ 25° C 0.26% @ 60° C
<b>External Transmitter Power Supply</b>	18 - 30 VDC, 70 mA, class 2

## Input Signal Ranges

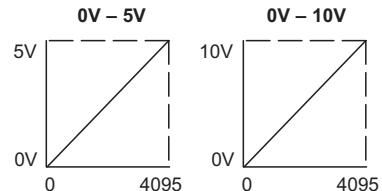
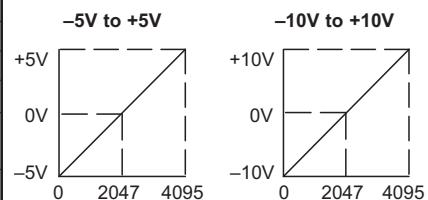
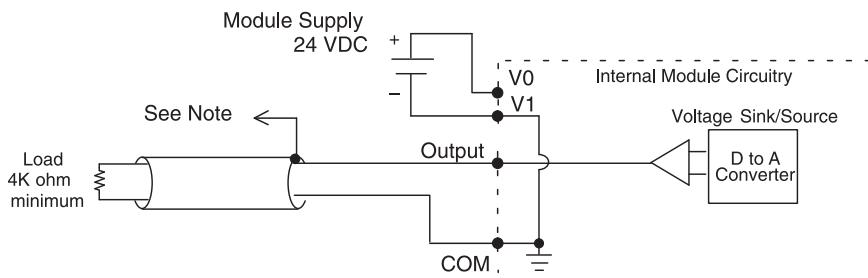


## Equivalent Input Circuit



**T1F-8AD4DA-2 - continued**

Output Channel Specifications	
<b>Number of Channels</b>	4
<b>Output Ranges</b>	0 - 5 V, 0 - 10 V, + / - 5 V, + / - 10 V
<b>Output Type</b>	single ended, 1 common
<b>Resolution</b>	12 bit (1 in 4096)
<b>Module Addressing</b>	8 output bits (Y-control byte); 4 output words (WY)
<b>Peak Output Voltage</b>	15 VDC
<b>Load Impedance</b>	4 KΩ minimum
<b>Load Capacitance</b>	0.01 μF maximum
<b>Linearity Error (end to end)</b>	+ / - 2 count maximum + / - 0.050% of full scale maximum
<b>Conversion Settling Time</b>	300 μs maximum full scale change
<b>Full Scale Calibration Error</b>	+ / - 12 counts maximum
<b>Accuracy vs. Temperature</b>	+ / - 50 ppm/ °C; full scale calibration change
<b>Offset Calibration Error</b>	10 V ranges: + / - 5 counts 5 V ranges: + / - 9 counts
<b>Max. Full Scale Inaccuracy (% of full scale); all errors and temperature drift included</b>	10 V ranges: + / - 0.2% @ 25°C + / - 0.4% @ 60°C 5 V ranges: + / - 0.3% @ 25°C + / - 0.5% @ 60°C
<b>CPU Update Rate</b>	1 channel per scan

**Unipolar Ranges****Bipolar Ranges****Equivalent Output Circuit****NOTES:**

1. Shields should be connected to the 0 V terminal of the module or the 0 V of the power supply.