

# **SPECIFICATIONS**

## **- ANALOG I/O**

## **MODULES**

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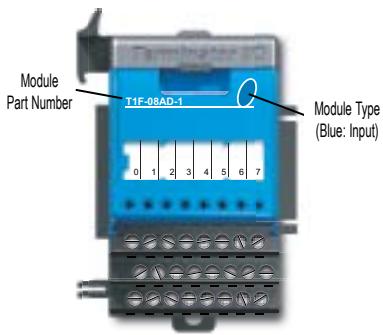
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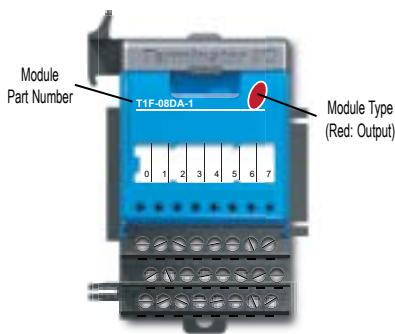
## Analog I/O Modules Overview

There are 13 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.

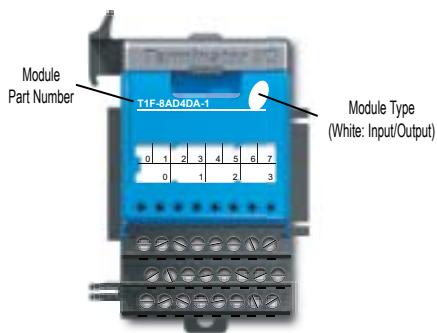
### Analog Input Modules



### Analog Output Modules



### Analog Input/Output Module



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-16TMST</b>	16	Thermistor	6-12
<b>T1F-14THM</b>	14	Thermocouple	6-14

Analog Output Modules			
Part Number	Number of Channels	Description	See Page
<b>T1F-08DA-1</b>	8	Analog Current Output	6-17
<b>T1F-08DA-2</b>	8	Analog Voltage Output	6-18
<b>T1F-16DA-1</b>	16	Analog Current Output	6-19
<b>T1F-16DA-2</b>	16	Analog Voltage Output	6-20

Analog Input/Output Modules			
Part Number	Number of Channels	Description	See Page
<b>T1F-8AD4DA-1</b>	8/4	Analog Current Input/Output	6-21
<b>T1F-8AD4DA-2</b>	8/4	Analog Voltage Input/Output	6-23

# 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-16TMST</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.

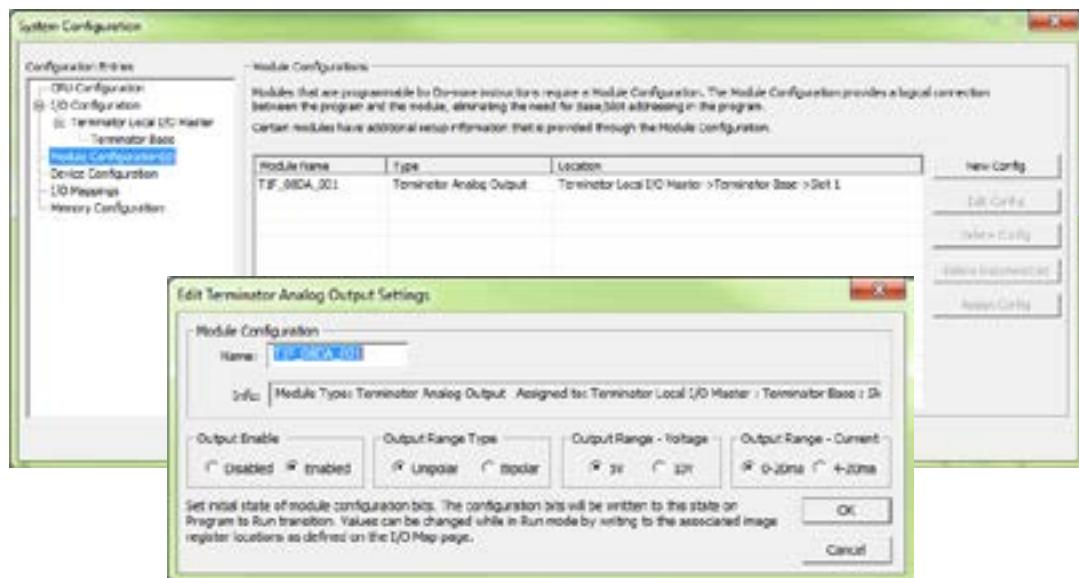
# Analog I/O Modules Overview- continued

## 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

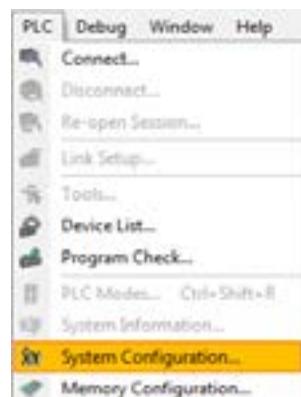
When an analog output module is added to a Do-more project, a Module Configuration with default Module Control Byte values is created. Its settings can be changed under Module Configuration by double-clicking the Module Name or by selecting the New Config or Edit Config buttons on the right hand side.



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 within the program.

## 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 Map**

Slot	Mod ID	Mod Description	Start I/O	X Map	Y Map	WX Map	WY Map
0	1132	T1K-08ND	02	00-02			
1	1132	T1K-08AD	02	03-05			
2	2532	T1F-08ADy	02/0W	06-12			
3	1242	T1K-08TB	07		09-12	00-03	00-02
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"						

**IO Slot Number**      **Module ID**      **Assigned X, Y, WX and WY Addresses**

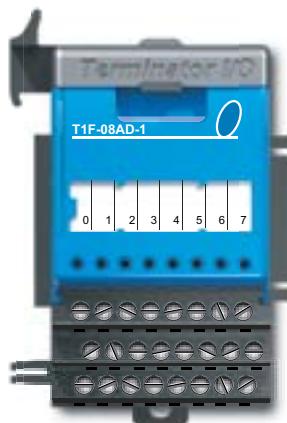
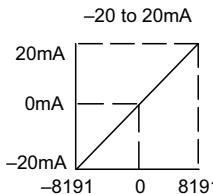
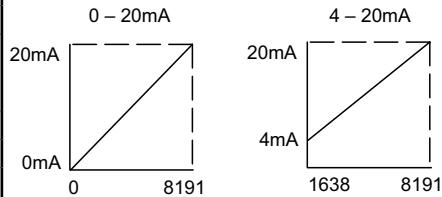
**Mapping Mode**  
In "Auto" mode, the PLC automatically assigns image register addresses to each slot.  
In "Manual" mode, you may enter the desired image register address for one or more slots.  
 Auto     Manual    [Clear Manual entry](#)

**Unused Node Instructions**  
Automatically assigned addresses are shown in gray.  
Manually assigned addresses are shown in black.  
Map range overlaps are errors, and are shown in red.

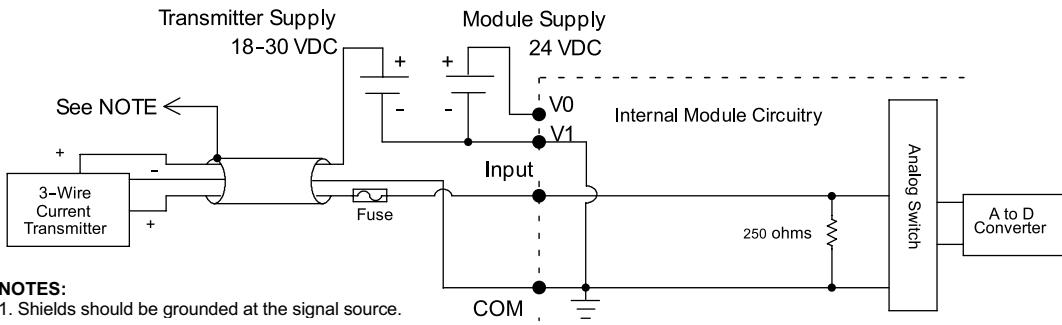
**Help values that exceed memory config are shown in bold red.**  
**Clear manual entry to return it to auto.**

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

Specifications	
<b>Number of Channels</b>	8, single ended (1 common)
<b>Input Ranges</b>	0-20mA, 4-20mA, -20 to 20mA
<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>	-3db @ 500Hz, -20db / decade
<b>Input Resistance</b>	250Ω
<b>Absolute Maximum Ratings</b>	8V max. Input
<b>Conversion Time (Default: Normal Mode)</b>	Normal Mode: 5ms 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>	75mA @ 5VDC
<b>External Module Power Supply Req.</b>	18-30 VDC, 50mA, class 2
<b>Recommended Fuse</b>	0.032 A @ 5VDC, 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>	±50ppm / °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>	136g

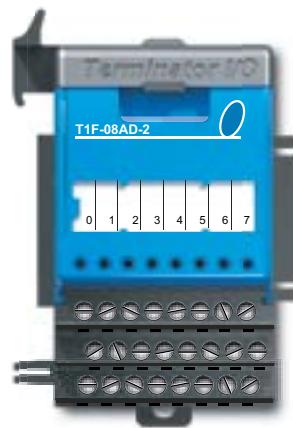
**Input Range/Resolution**

\*Note: T1H-PBC was discontinued 8/2020; no replacement available

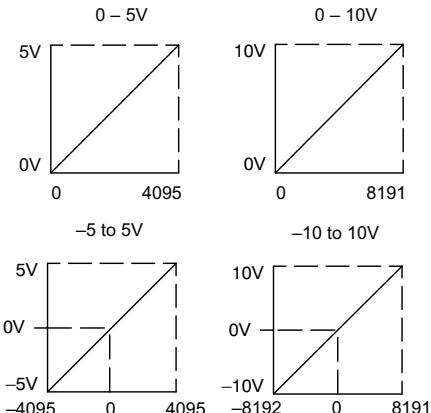
**Equivalent Input Circuit**

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

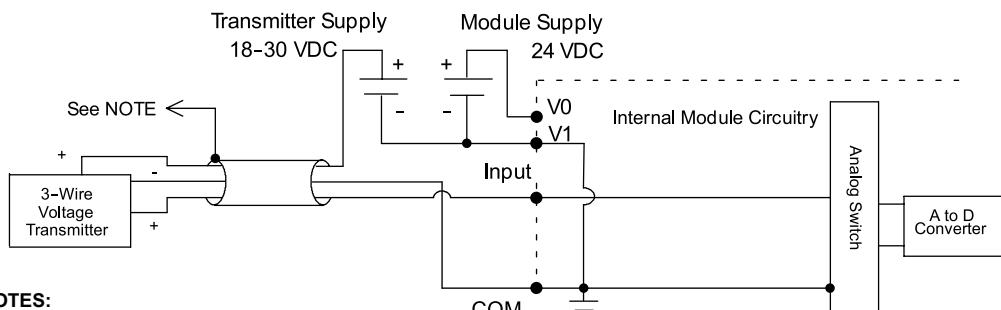
Specifications	
<b>Number of Channels</b>	8, single ended (1 common)
<b>Input Ranges</b>	0-5 V, 0-10 V, ±5V, ±10V
<b>Resolution</b>	14 bit (13 bit plus sign bit)
<b>Module Addressing</b>	8 input bits (X-not used); 8 input words (WX)
<b>Frequency Response</b>	-3db @ 500Hz, -20db / decade
<b>Input Resistance</b>	200kΩ min.
<b>Absolute Maximum Ratings</b>	Fault Protected Input, 130V (rms)/ 100VDC
<b>Conversion Time (Default: Normal Mode)</b>	Normal Mode: 5ms 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>	75mA @ 5VDC
<b>External Module Power Supply Req.</b>	18-30 VDC, 50mA, 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>	±50ppm / °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>	136g



## Input Range/Resolution

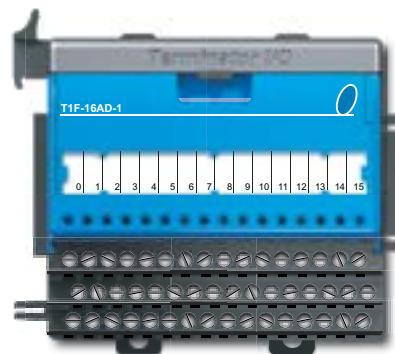


## Equivalent Input Circuit

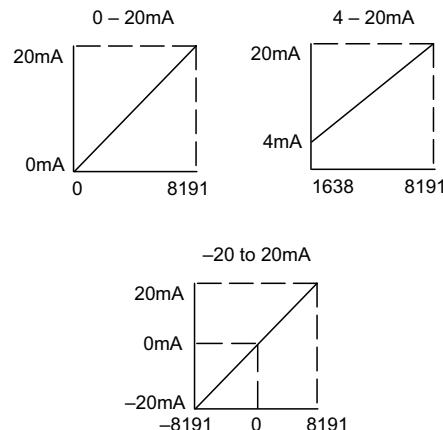


# T1F-16AD-1 - 16 Channel Analog Current Input

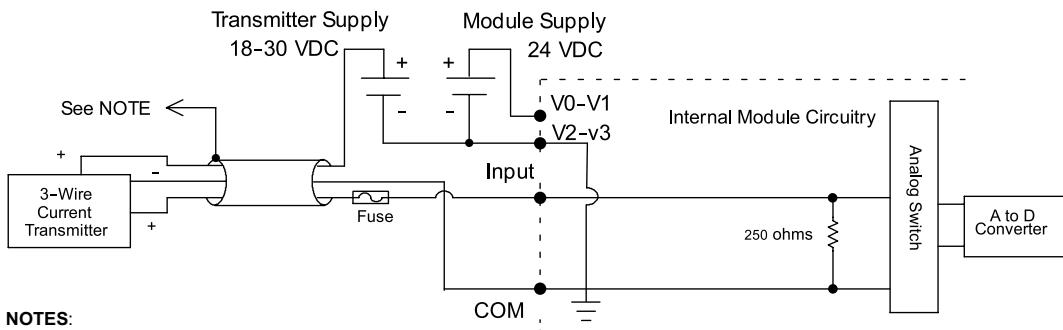
Specifications	
<b>Number of Channels</b>	16, single ended (1 common)
<b>Input Ranges</b>	0-20mA, 4-0mA, -20 to 20mA
<b>Resolution</b>	14 bit (13 bit plus sign bit)
<b>Module Addressing</b>	16 input bits (X-not used); 16 input words (WX)
<b>Frequency Response</b>	-3db @ 500Hz, -20db / decade
<b>Input Resistance</b>	250Ω
<b>Absolute Maximum Ratings</b>	8V max. Input
<b>Conversion Time</b>	5ms 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>	75mA @ 5VDC
<b>External Module Power Supply Req.</b>	18-30 VDC, 50mA, class 2
<b>Recommended Fuse</b>	0.032 A @ 5VDC
<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>	±50ppm / °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>	168g



## Input Range/Resolution



## Equivalent Input Circuit

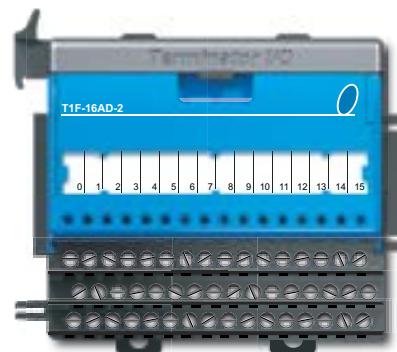


### NOTES:

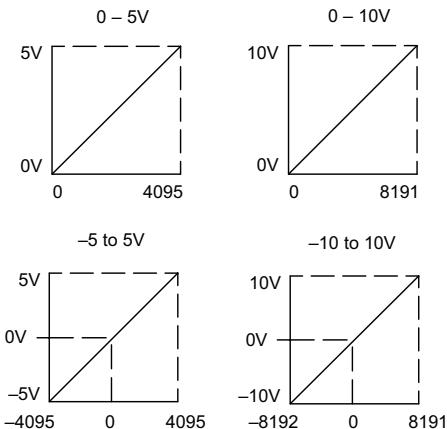
1. Shields should be grounded at the signal source.

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

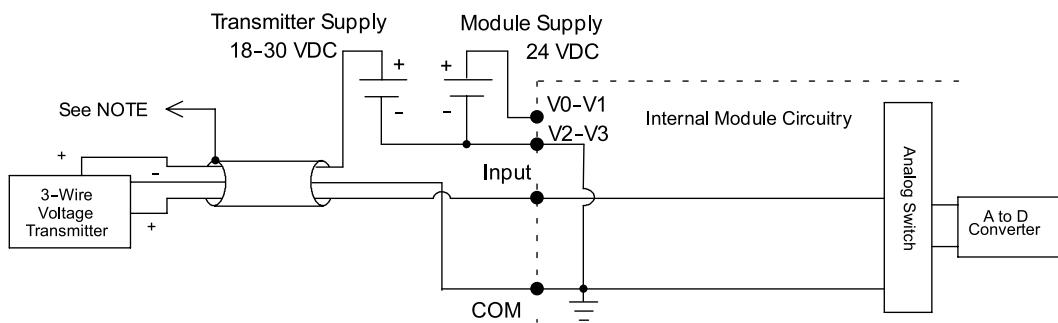
Specifications	
<b>Number of Channels</b>	16, single ended (1 common)
<b>Input Ranges</b>	0-5 V, 0-10 V, ±5V, ±10V
<b>Resolution</b>	14 bit (13 bit plus sign bit)
<b>Module Addressing</b>	16 input bits (X-not used); 16 input words (WX)
<b>Frequency Response</b>	-3db @ 500Hz, -20db / decade
<b>Input Resistance</b>	200kΩ min.
<b>Absolute Maximum Ratings</b>	Fault Protected Input, 130V (rms)/ 100VDC
<b>Conversion Time</b>	5ms 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>	75mA @ 5VDC
<b>External Module Power Supply Req.</b>	21.6-26.4 VDC, 50mA, 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>	±50ppm / °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>	160g



## Input Range/Resolution



## Equivalent Input Circuit

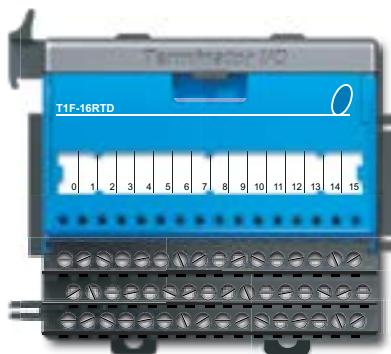


### NOTES:

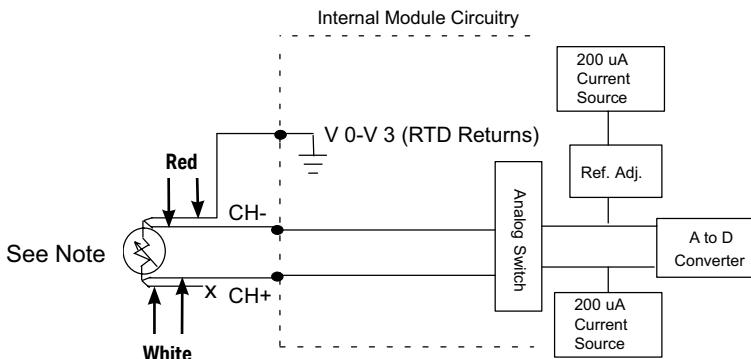
1. Shields should be grounded at the signal source.

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

Specifications	
<b>Number of Channels</b>	16
<b>Resolution</b>	$\pm 0.1^\circ\text{C}$ or $^\circ\text{F}$
<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>	>50db notches @ 50/60Hz; f - 3db = 13.1 Hz
<b>Absolute Max. Ratings</b>	$\pm 50\text{VDC}$
<b>Converter Type</b>	Charge balancing, 24-bit
<b>Sampling Rate</b>	140ms / channel
<b>CPU Update Rate</b>	1 channel per scan
<b>Base Power Required</b>	150mA @ 5VDC
<b>Operating Temperature</b>	0 to 60°C (32 to 140°F)
<b>Temperature Drift</b>	25ppm / °C (max.)
<b>Maximum Inaccuracy</b>	$\pm 1^\circ\text{C}$
<b>RTD Excitation Current</b>	200 $\mu\text{A}$
<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>	168g



RTD Input Ranges	
RTD Type	Range
Pt100 $\Omega$	-200 to 850°C (-328 to 1562°F)
Pt1000 $\Omega$	-200 to 595°C (-328 to 1103°F)
jPt100 $\Omega$	-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:**

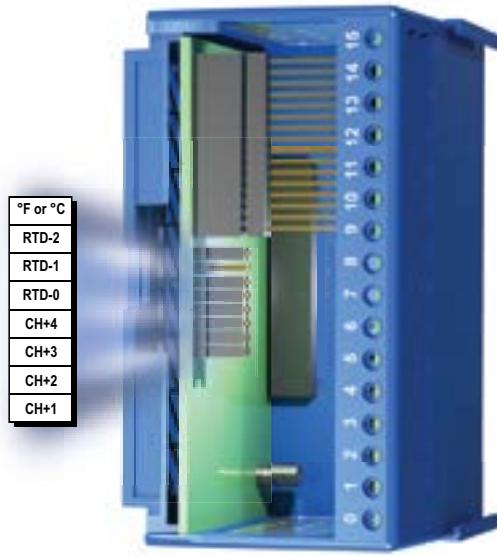
- If an RTD sensor has four wires, the plus sense wire should be left unconnected as shown.

**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
Pt100Ω	X	X	
Pt1000Ω			X
jPt100Ω		X	
Type CU-10Ω			
Type CU-25Ω	X		
120Ω Nickel	X		X

X = Jumper Installed

Blank Space = Jumper Removed

**Select Temperature Units**

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

X = Jumper Installed

Blank Space = Jumper Removed

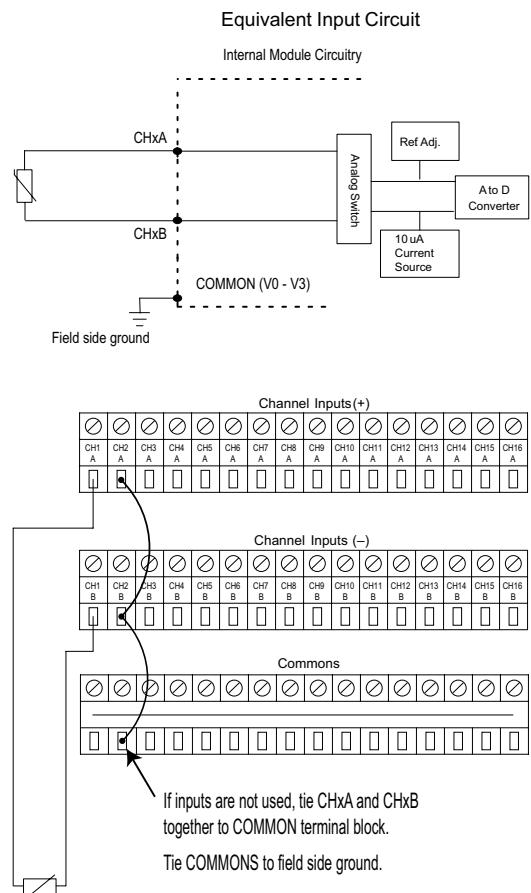
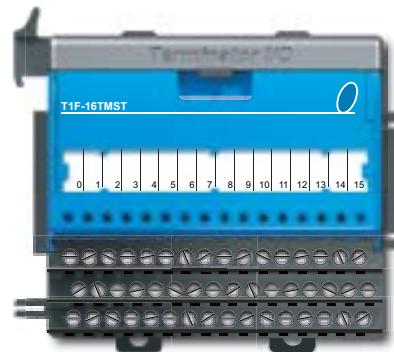
# T1F-16TMST - 16 Channel Thermistor Input

Specifications	
<b>Number of Channels</b>	16
<b>Resolution</b>	+ / - 0.1° C or °F
<b>Input Impedance</b>	> 1MΩ
<b>Common Mode Range</b>	0 - 5 VDC
<b>Absolute Max. Ratings</b>	+ / - 50 VDC
<b>Converter Type</b>	Charge balancing, 24-bit
<b>Sampling Rate</b>	140 ms / channel
<b>Master Update Rate</b>	16 channels per scan max.
<b>Input Points Required</b>	512 discrete pts. or 16 dwords (d (double) word = 32 bit word) Network Interface dependent
<b>Base Power Required</b>	150 mA @ 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>Temperature Drift</b>	25 ppm / °C (max.)
<b>Maximum Inaccuracy<sup>1</sup></b>	+ / - 1° C
<b>Excitation Current</b>	10 µA
<b>Electrical Isolation</b>	1500VDC field wire to backplane
<b>Relative Humidity</b>	5 to 95% (non-condensing)
<b>Environmental Air</b>	No corrosive gases permitted
<b>Vibration</b>	IEC 60068-2-6 (Test FC)
<b>Shock</b>	IEC 60068-2-27 (Test Ea)
<b>Noise Immunity</b>	EN61131-2:2007 <sup>2</sup>
<b>Recommended Cable</b>	AutomationDirect P/N: PLTC3-18-1S-XXX Belden 8761 or equivalent
<b>Weight</b>	168 g

<sup>1</sup>"Accuracy" pertains to module only and does not include tolerances of thermistor element, wiring resistance, etc. For example, 22 gauge wire is 0.016Ω per foot, so 200 feet of wire adds 3.2Ω.

<sup>2</sup>Meets EMC & Safety Requirements

Thermistor Input Ranges	
Input Ranges	Range
10K-AN (Type 3)	-40° to 150° C (-40° to 300° F)
10K-CP (Type 2)	-40° to 150° C (-40° to 300° F)
5K	-40° to 150° C (-40° to 300° F)
3K	-40° to 150° C (-40° to 300° F)
2252	-40° to 150° C (-40° to 300° F)
1.8K	-40° to 150° C (-40° to 300° F)



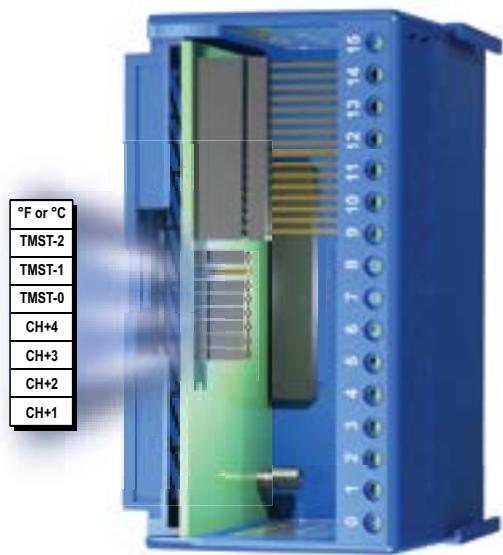
# T1F-16TMST - 16 Channel Thermistor Input - continued

## 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

Thermistor Input	Jumper		
	TMST-0	TMST-1	TMST-2
10K-AN (Type 3)			
10K-CP (Type 2)	X		
5K		X	
3K	X	X	
2252			X
1.8K	X		X
Future use		X	X
Future use	X	X	X

X = Jumper Installed  
Blank Space = Jumper Removed

### Select Temperature Units

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

X = Jumper Installed  
Blank Space = Jumper Removed

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

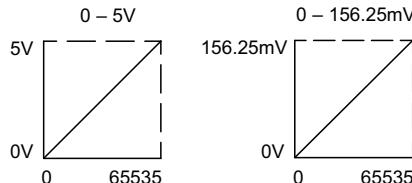
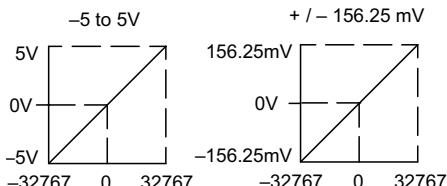
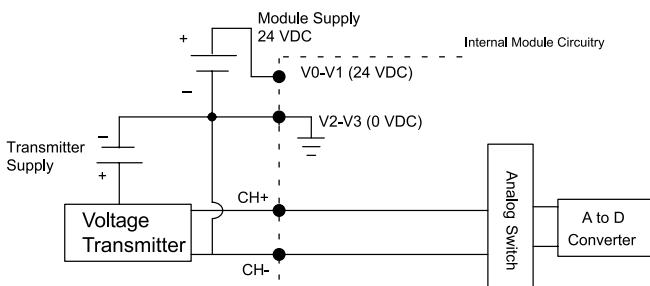
Specifications	
<b>Use with I/O Module Base</b>	T1K-16B screw type terminal base only
<b>Number of Channels</b>	14, differential
<b>Common Mode Range</b>	±5VDC
<b>Module Addressing</b>	16 input bits (X-broken transmitter); 16 input words (WX)
<b>Common Mode Rejection</b>	90db min. @ DC, 150db min. @ 50/60Hz
<b>Input Impedance</b>	1MΩ
<b>Absolute Max. Ratings</b>	Fault Protected Input ±50VDC
<b>CPU Update Rate</b>	1 channel per scan
<b>Base Power Required</b>	60mA @ 5VDC
<b>External Power Required</b>	24VDC ±5%, 70mA, 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>	±5ppm/ °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>	168g

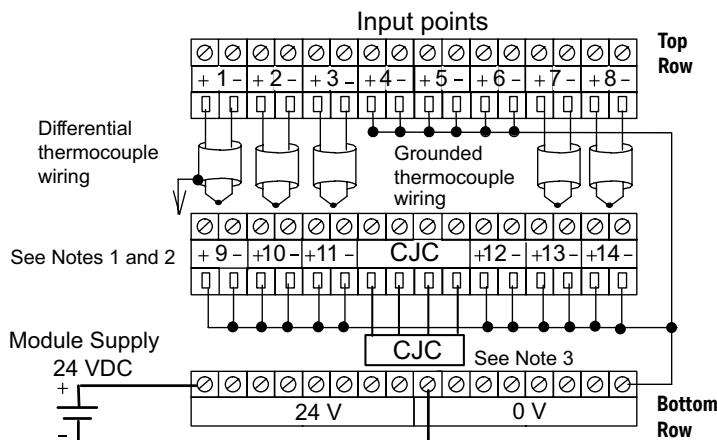


Thermocouple Specifications	
<b>Input Ranges</b>	Type J -190 to 760°C (-310 to 1400°F) Type E -210 to 1000°C (-346 to 1832°F) Type K -150 to 1372°C (-238 to 2502°F) Type R 65 to 1768°C (149 to 3214°F) Type S 65 to 1768°C (149 to 3214°F) Type T -230 to 400°C (-382 to 752°F) Type B 529 to 1820°C (984 to 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>	100ms 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 ±5V, ±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. @ 0V input
<b>Linearity Error (End to End)</b>	±1 count maximum
<b>Maximum Inaccuracy</b>	± 0.02% @ 25°C (77°F)

**Input Range/Resolution****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.

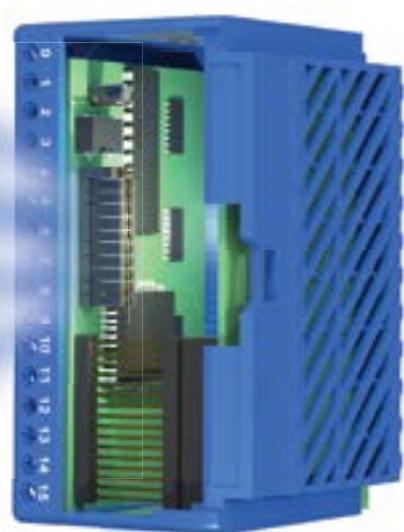
**Setting Module Jumpers (See Notes 1 and 2)****Select Number of Channels**

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

- 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**

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	
0-5V		X	X	
$\pm 5V$	X		X	
0-156.25 mV			X	
$\pm 156.25 mV$	X	X		

X = Jumper Installed

Blank Space = Jumper Removed

Select the Conversion Units

(See Notes 3 and 4)

Jumper	Thermocouple Conversion Units	
	2's Complement	
$^{\circ}F$	$^{\circ}C$	
Units-0	X	
Units-1		

Jumper	Voltage Conversion Units	
	2's Complement	
Units-0	X	
Units-1		

X = Jumper Installed

Blank Space = Jumper Removed

 **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.

**NOTE 2:** 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 0V terminal, then connect the thermocouple calibrator to the differential inputs (for example, Ch 3+ and Ch 3-).

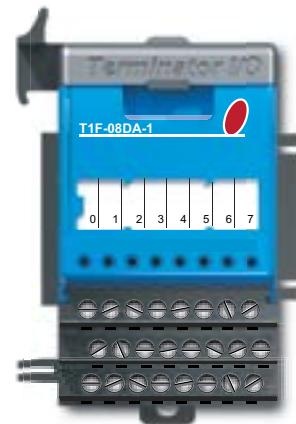
**NOTE 3:** All thermocouple types are converted into a direct temperature reading with one implied decimal place. Negative temperatures are represented in 2's complement format. 2's complement data format is required to correctly display bipolar data on some operator interfaces.

**NOTE 4:** The bipolar voltage input ranges may be converted to a 16-bit 2's complement value.

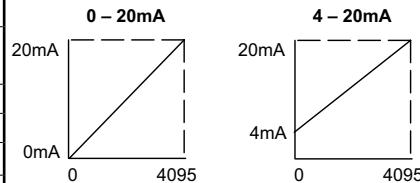
# T1F-08DA-1 - 8 Channel Analog Current Output

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>	30VDC
<b>Peak Output Voltage</b>	30VDC
<b>Load Impedance</b>	0Ω min.
<b>Max. Load (ohm) / Power Supply</b>	620Ω/ 18V, 910Ω/ 24V, 1200Ω/ 30V
<b>Min. Load (ohm) / Power Supply*</b>	0Ω/ 24V, 350Ω/ 30V @ 40°C 250Ω/ 24V, 600Ω/ 30V @ 60°C
<b>Linearity Error (end to end)</b>	±2 counts max. ±0.05% of full scale max.
<b>Conversion Settling Time</b>	400μs 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>	±5ppm / °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>	75mA @ 5VDC
<b>External Module Power Supply Req.</b>	21.6-26.4 VDC, 150mA, 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>	145g

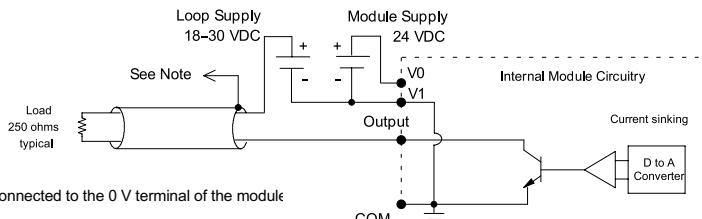
\*Max. allowable output power dissipation. For example, at 60 °C and 24VDC, there must be a load of at least 250Ω on the output circuit. Smaller loads will damage the analog output circuit.



## Output Range/Resolution



## Equivalent Output Circuit

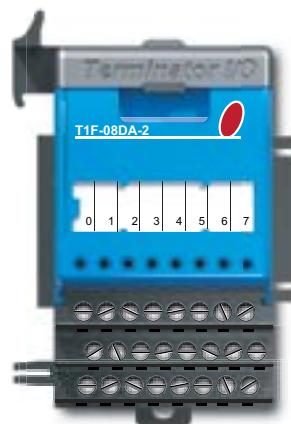
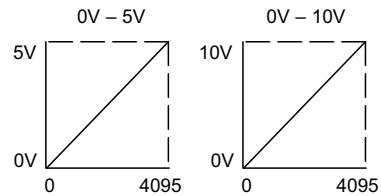
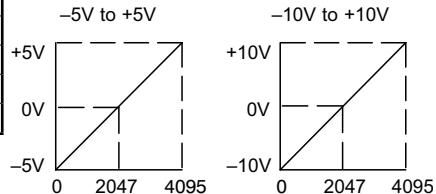
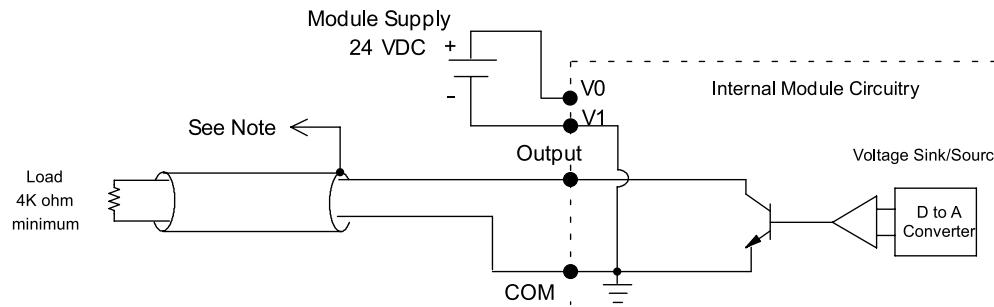


### NOTES:

1. Shields should be connected to the 0 V terminal of the module power supply.
2. Unused current outputs should remain open (no connections).

**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, ±5V, ±10V
<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>	15VDC
<b>Load Impedance</b>	4kΩ 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>	100μs max. full scale change
<b>Full Scale Calibration Error</b>	±12 counts max.
<b>Offset Calibration Error</b>	10V ranges: ±6 counts max. 5V ranges: ±11 counts max.
<b>Accuracy vs. Temperature</b>	±50ppm / °C, full scale calibration change
<b>Max. Full Scale Inaccuracy (% of full scale) all errors and temp drift included</b>	10V ranges: ±0.2% @ 25°C ±0.4% @ 60°C 5V ranges: ±0.3% @ 25°C ±0.5% @ 60°C
<b>CPU Update Rate</b>	1 channel per scan
<b>Base Power Required</b>	75mA @ 5VDC
<b>External Module Power Supply Req.</b>	21.6 - 26.4 VDC, 150mA, 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>	145g

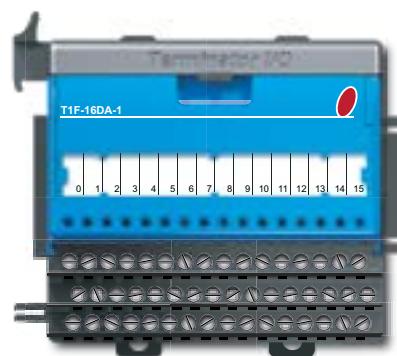
**Unipolar Range/Resolution****Bipolar Range/Resolution****Equivalent Output Circuit****NOTES:**

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

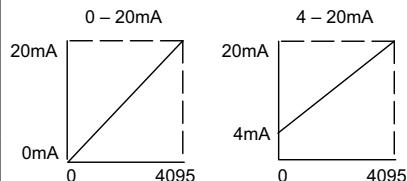
# T1F-16DA-1 - 16 Channel Analog Current Output

Specifications	
<b>Number of Channels</b>	16
<b>Output Ranges</b>	0-20mA, 4-20mA
<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>	30VDC
<b>Peak Output Voltage</b>	30VDC
<b>Max. Load (ohm) / Power Supply</b>	620Ω/ 18V, 910Ω/ 24V, 12000Ω/ 30V
<b>Min. Load (ohm) / Power Supply*</b>	0Ω/ 24V, 350Ω/ 30V @ 40°C 250Ω/ 24V, 600Ω/ 30V @ 60°C
<b>Linearity Error (end to end)</b>	±2 counts max. ±0.05% of full scale max.
<b>Conversion Settling Time</b>	400μs max. full scale change
<b>Full Scale Calibration Error</b>	±12 counts max.
<b>Offset Calibration Error</b>	0-20mA: ±5 counts max. 4-20mA: ±6 counts max.
<b>Accuracy vs. Temperature</b>	±50ppm / °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>	75mA @ 5VDC
<b>External Module Power Supply Req.</b>	21.6-26.4 VDC, 150mA, 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>	172g

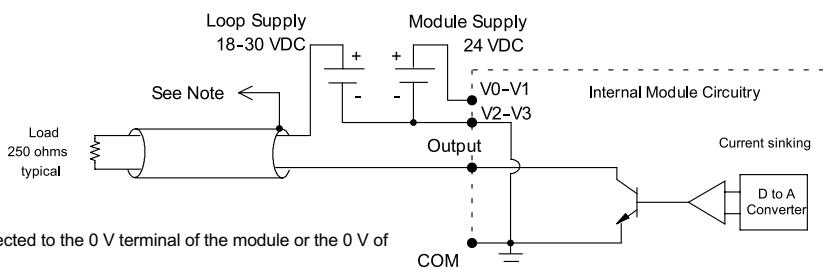
\*Max. allowable output power dissipation. For example, at 60°C and 24VDC, there must be a load of at least 250Ω on the output circuit. Smaller loads will damage the analog output circuit.



## Output Range/Resolution



## Equivalent Output Circuit

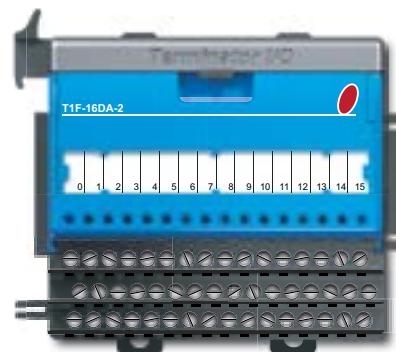


### NOTES:

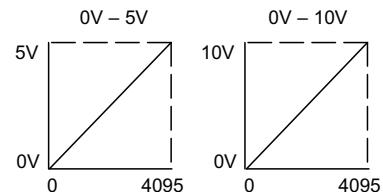
1. Shields should be connected to the 0 V terminal of the module or the 0 V of the power supply.

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

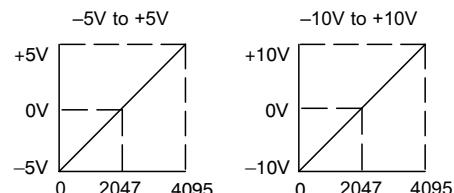
Specifications	
<b>Number of Channels</b>	16
<b>Output Ranges</b>	0-5 V, 0-10 V, ±5V, ±10V
<b>Output Type</b>	Single ended, 1 common
<b>Resolution</b>	12 bit (1 in 4096)
<b>Module Addressing</b>	8 output bits (Y-control byte); 16 output words (WY)
<b>Peak Output Voltage</b>	15VDC
<b>Load Impedance</b>	4kΩ 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>	100μs max. full scale change
<b>Full Scale Calibration Error</b>	±12 counts max.
<b>Offset Calibration Error</b>	10V ranges: ±6 counts max. 5V ranges: ±11 counts max.
<b>Accuracy vs. Temperature</b>	±50ppm / °C, full scale calibration change
<b>Max. Full Scale Inaccuracy (% of full scale) all errors and temp drift included</b>	10V ranges: ±0.2% @ 25°C ±0.4% @ 60°C 5V ranges: ±0.3% @ 25°C ±0.5% @ 60°C
<b>CPU Update Rate</b>	1 channel per scan
<b>Base Power Required</b>	75mA @ 5VDC
<b>External Module Power Supply Req.</b>	21.6-26.4 VDC, 150mA, 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>	172g



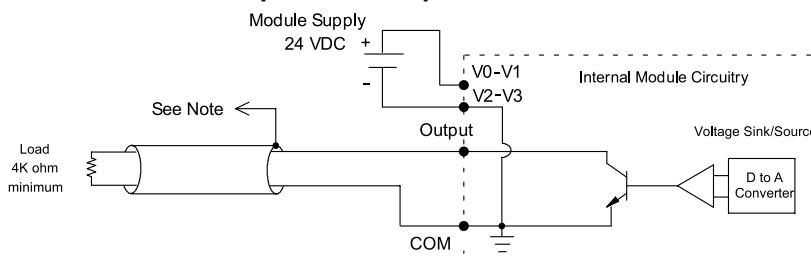
## Unipolar Range/Resolution



## Bipolar Range/Resolution



## 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.

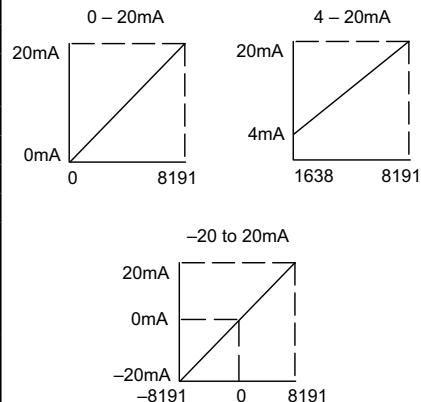
# T1F-8AD4DA-1 - 8 Channel Analog Current Input / 4 Channel Analog Current Output

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

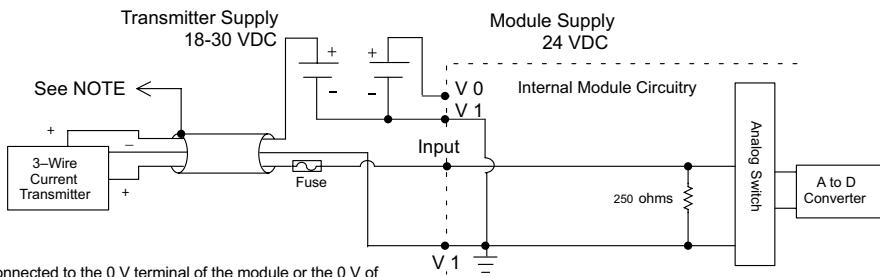


Input Channel Specifications	
Number of Channels	8, single ended (1 common)
Input Ranges	0–20mA, 4–20mA, -20 to 20mA
Resolution	14 bit (13 bit plus sign bit)
Module Addressing	8 input bits (X-not used); 8 input words (WX)
Frequency Response	-3db @ 100Hz, -20db/ decade
Input active low-pass filter	
Input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

## Input Range/Resolution



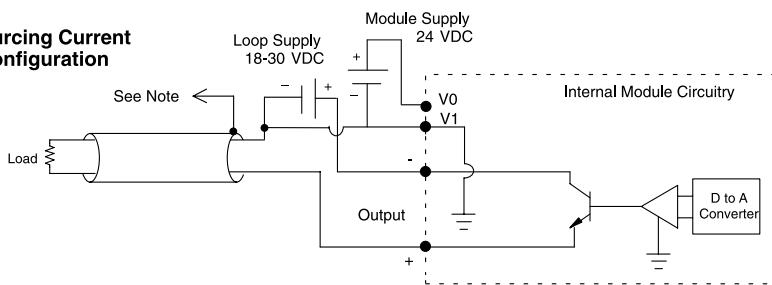
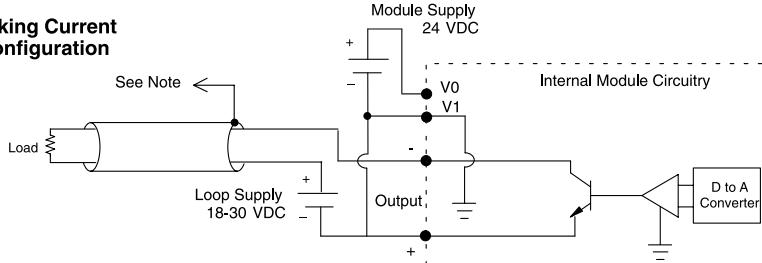
## Equivalent Input Circuit



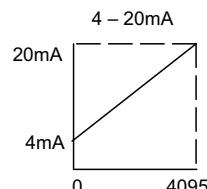
**T1F-8AD4DA-1 - continued**

Output Channel Specifications	
<b>Number of Channels</b>	4, sink/source; individually configured by wiring
<b>Output Range</b>	4-20mA
<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>	30VDC
<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 / 18V, 0-900 Ω / 24V, 0-1200 Ω / 30V
<b>Total Load (Sink plus Source)</b>	600Ω / 18V, 900Ω / 24V, 1200Ω / 30V

Output Channel Specifications	
<b>Linearity Error (end to end)</b>	±2 count maximum ±0.050% of full scale maximum
<b>Conversion Settling Time</b>	400μs 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. @ 400Ω load ±18 counts max. @ 250Ω load ±12 counts max. @ 125Ω load
<b>Offset Calibration Error</b>	SINK: ±6 counts max. @ any load SOURCE: ±10 counts max. @ 400Ω load ±8 counts max. @ 250Ω load ±6 counts max. @ 125Ω 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: 400Ω load 0.63% @ 25°C 400Ω load 0.83% @ 60°C 250Ω load 0.44% @ 25°C 250Ω load 0.64% @ 60°C 125Ω load 0.30% @ 25°C 125Ω load 0.50% @ 60°C

**Equivalent Output Circuit****Sourcing Current Configuration****Sinking Current Configuration****NOTES:**

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

**Output Range/Resolution**

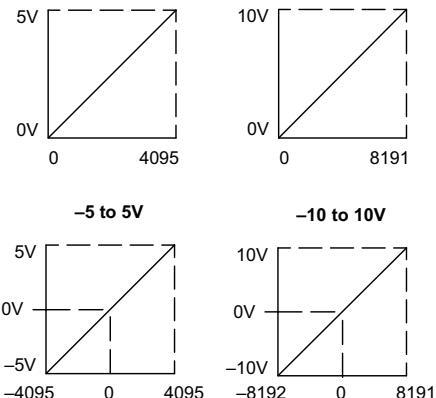
# T1F-8AD4DA-2 - 8 Channel Analog Voltage Input / 4 Channel Analog Voltage Output

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

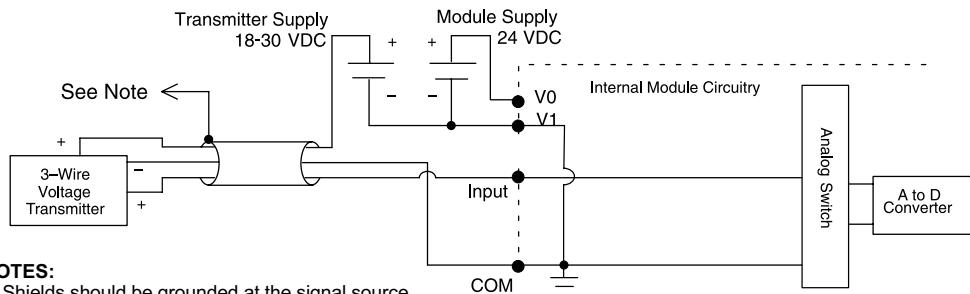


Input Channel Specifications	
Number of Channels	8, single ended (1 common)
Input Ranges	0–5 V, 0–10 V, ±5V, ±10V
Resolution	14 bit (13 bit plus sign bit)
Module Addressing	8 input bits (X-not used); 8 input words (WX)
Frequency Response	-3db @ 500Hz, -20db / decade
Input Resistance	200kΩ min.
Absolute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

## Input Range/Resolution

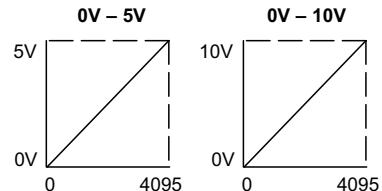
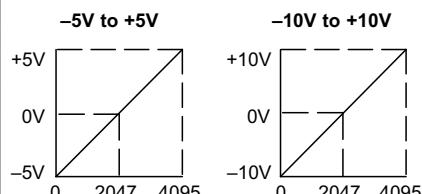
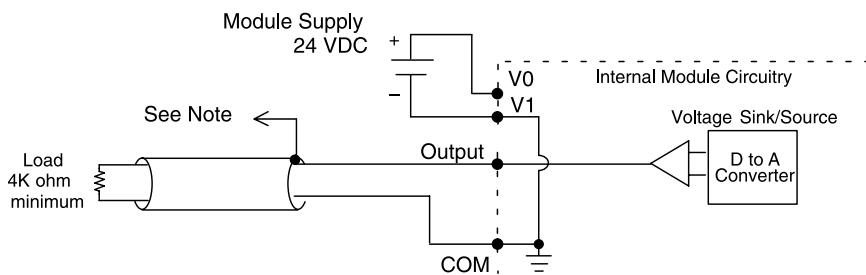


## Equivalent Input Circuit



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

Output Channel Specifications	
<b>Number of Channels</b>	4
<b>Output Ranges</b>	0-5 V, 0-10 V, ±5V, ±10V
<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>	15VDC
<b>Load Impedance</b>	4kΩ minimum
<b>Load Capacitance</b>	0.01 μF maximum
<b>Linearity Error (end to end)</b>	±2 count maximum
<b>Conversion Settling Time</b>	300μs maximum full scale change
<b>Full Scale Calibration Error</b>	±12 counts maximum
<b>Accuracy vs. Temperature</b>	±50ppm/ °C; full scale calibration change
<b>Offset Calibration Error</b>	10V ranges: ±5 counts 5V ranges: ±9 counts
<b>Max. Full Scale Inaccuracy (% of full scale); all errors and temperature drift included</b>	10V ranges: ±0.2% @ 25°C ±0.4% @ 60°C 5V ranges: ±0.3% @ 25°C ±0.5% @ 60°C
<b>CPU Update Rate</b>	1 channel per scan

**Unipolar Range/Resolution****Bipolar Range/Resolution****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.