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DATA TRANSLATION®

UM-10984-A

DT707/DT707-T
User Manual

General Purpose Screw Terminal Panel for Data Acquisition Boards

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How to Use This Manual

This manual describes Data Translation's DT707 and DT707-T screw terminal panels. These panels facilitate user connections to data acquisition boards.

Listed below is an overview of the information presented in this manual.

Chapter 1, "**Getting Started**," introduces you to the major features of the DT707 and DT707-T screw terminal panels and explains how to connect the panels to data acquisition boards.

Chapter 2, "**Using the Screw Terminal Panel**," describes how to connect various input devices to the DT707 and DT707-T.

Reference 1, "**Configuration Resistors**," lists the user-installable resistors on the DT707 and DT707-T.

Reference 2, "**Connector Pin Assignments**," lists the pin assignments for the DT707 and DT707-T's J1 connector.

Reference 3, "**Specifications**," lists the electrical and physical specifications for the DT707 and DT707-T.

Reference 4, "**Troubleshooting**," explains what to do if you encounter difficulty using your screw terminal panel.

Where to Get Help

If you have difficulty installing or using your screw terminal panel, see Reference 4, "Troubleshooting."

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Chapter 1

Getting Started

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*Chapter 1, "**Getting Started,**" describes the DT707 and DT707-T screw terminal panels and explains how to connect them to data acquisition boards. This chapter is organized as follows:*

- *About the Screw Terminal Panels*
- *Unpacking*
- *Connecting to a Data Acquisition Board*

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About the Screw Terminal Panels

The DT707 and DT707-T screw terminal panels are accessory products which permit all user connections to data acquisition boards to be made on screw terminals.

DT707

The DT707 is a general purpose screw terminal panel. The function of each screw terminal on the panel is indicated by a silk-screened label. The DT707 may be used with either single-ended or differential inputs.

The DT707 plugs directly into the 50-pin 3M connector which is common to most Data Translation data acquisition boards.

DT707-T

The DT707-T is a DT707 panel with a thermal sensor for thermocouple cold-junction compensation.

Note *The DT707-T should be used only with high gain (100 and 500) data acquisition boards, since a high gain level is required to measure low-level thermocouple inputs.*

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Required Equipment

The following equipment is required to install and use the DT707 screw terminal panel:

- Data acquisition board
- Flat blade screwdriver

Accessory Products

Data Translation offers a resistor pack (part number EP228) which provides the additional current shunt resistors required to operate data acquisition boards with current loop inputs (0 to 20mA).

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Unpacking

The screw terminal panel package includes the following items:

- DT707 or DT707-T screw terminal panel
- *DT707/DT707-T User Manual*

Note *Save the original packing material in the unlikely event that your panel requires servicing in the future.*

If an item is missing or damaged, call Data Translation's **Customer Service Department** at **(508) 481-3700**. They will guide you through the appropriate steps for replacing missing or damaged items.

Note *If you are located outside the USA, call your local distributor. The name and telephone number of your nearest distributor are listed in your Data Translation catalog.*

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Connecting to a Data Acquisition Board

The following steps explain how to connect the DT707 or DT707-T screw terminal panel to a data acquisition board.

Note *The data acquisition board must be installed in your computer before you begin. Refer to the user manual supplied with your board for installation instructions.*

1. Turn off the computer and all accessories.

2. Position the computer so that you can easily access the data acquisition board's rear panel connector (J1).

4. Attach the free end of the cable to the rear panel connector (J1) of the data acquisition board.

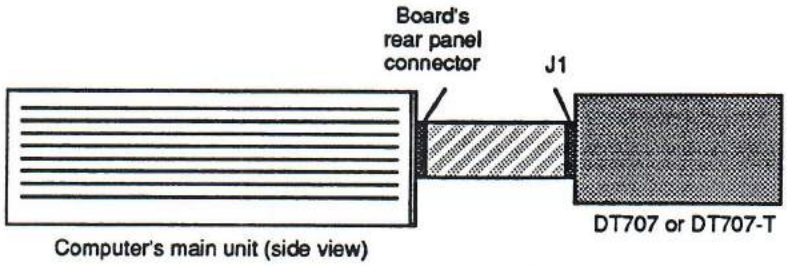


Figure 1: Connecting to a Data Acquisition Board

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Chapter 2

Using the Screw Terminal Panel

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*Chapter 2, "**Using the Screw Terminal Panel**," explains how to connect the screw terminal panel to the various subsystems on the data acquisition board. This chapter is organized as follows:*

- *Screw Terminal Assignments*
- *Single-Ended Input Connection*
- *Differential Input Connection*
- *Thermocouple Input Connection (DT707-T only)*
- *Current Loop Input Connection*

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Screw Terminal Assignments

Connections for the data acquisition board's analog input, analog output, digital I/O, external clock, and external trigger signals are made by connecting the board's J1 connector pins to the screw terminals. Each J1 signal name is indicated directly on the panel next to the corresponding screw terminal.

The DT707 screw terminal panel accommodates either single-ended or differential analog inputs. Blank circuit pads provided onboard allow you to install current shunt resistors for current inputs. Table 2 on page 23 lists the resistors and their functions.

Figure 2 illustrates the screw terminal and resistor locations for the DT707 and DT707-T. Refer to this figure while performing the connection procedures listed in the sections that follow.

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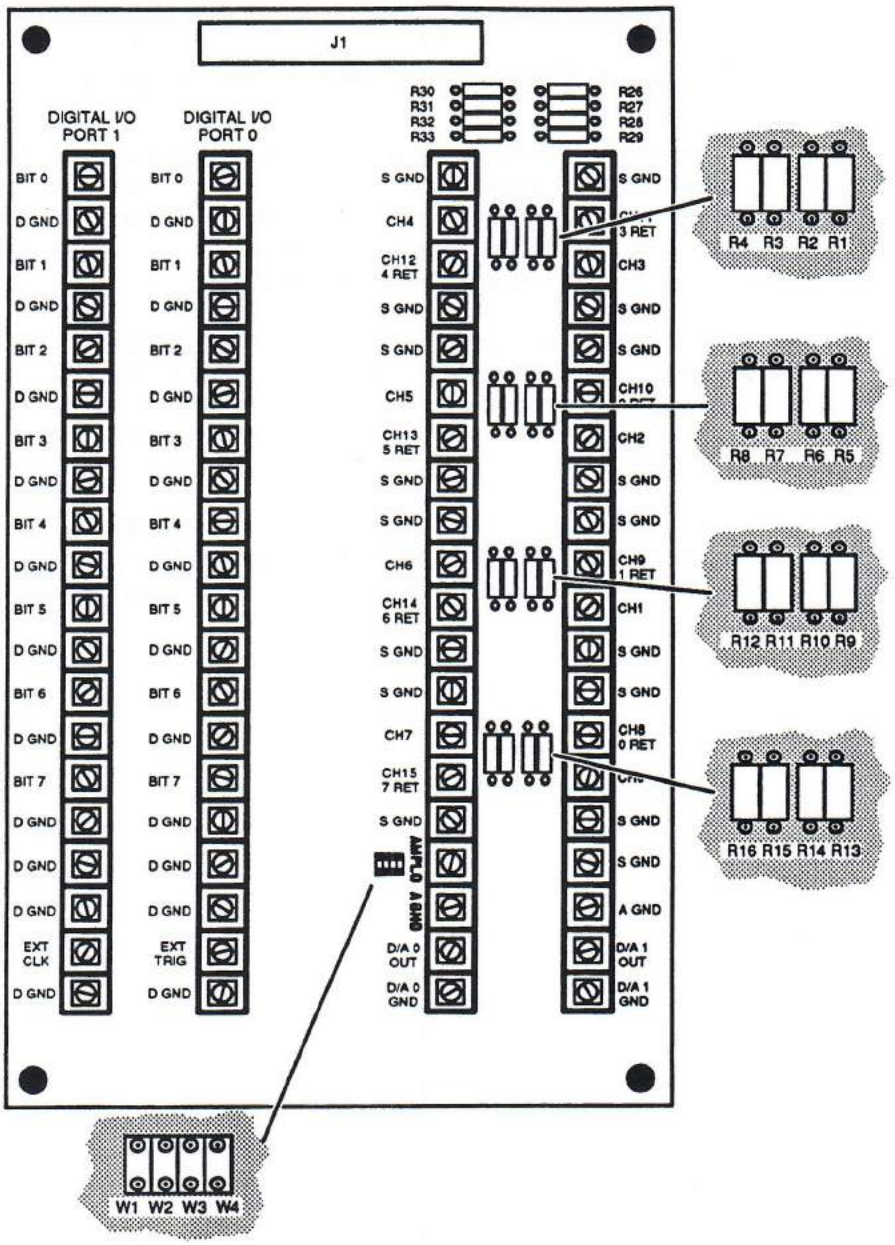


Figure 2: DT707 Screw Terminal Assignments

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Single-Ended Input Connection

The DT707 screw terminal panel accommodates connections for up to 16 single-ended analog inputs to the data acquisition board. When the data acquisition board is configured in the single-ended mode, the return sides of all the channels are connected together to the low point of the board's analog input circuitry (Amp Low). Single-ended connections should be restricted to applications with high-level voltage inputs and short lead lengths.

Single-ended inputs share a common return path. The high side of each analog input connects to the corresponding CH "x" terminal on the screw terminal panel. The low side of each analog input connects to an S GND (Signal Ground) terminal. There is an S GND terminal next to each input channel terminal. The screw terminal panel internally connects the S GND terminals to A GND (Analog Ground) via jumper W3 through a 0Ω resistor.

When the single-ended connection scheme is used, Amp Low on the data acquisition board must be referenced to A GND. The screw terminal panel automatically connects Amp Low to A GND via jumper W4. This jumper has no effect when the data acquisition board is configured for differential inputs.

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To use the screw terminal panel with single-ended inputs:

1. Ensure that the data acquisition board is configured to accept single-ended analog inputs.

2. Verify that jumpers W3 and W4 are installed on the screw terminal panel.

3. Make each single-ended input connection as shown in Figure 3.

   Note *Connection to channel 15 is illustrated in the example below. You may use any available input channel.*

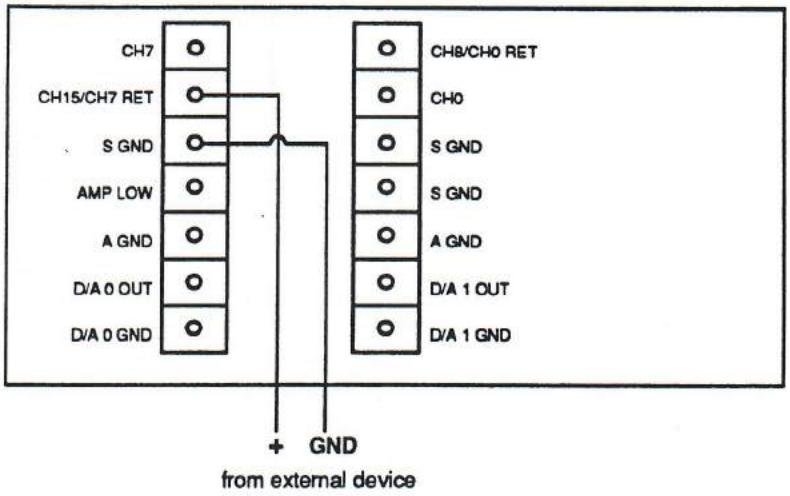


Figure 3: Single-Ended Input Connection

4. Connect all unused analog input channels to A GND. Failure to do so can result in inaccurate A/D conversions on all channels, with those closest to the ungrounded channel(s) affected most.

   Note *In certain situations, when the A GND terminal on the screw terminal panel is connected directly to an external ground, ground loops may result and produce noise and inaccurate data. If ground loops are a problem in a specific application, install a 1kΩ resistor at resistor location R17 on the screw terminal panel.*

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Differential Input Connection

The DT707 and DT707-T screw terminal panels accommodate connections for up to 8 differential analog inputs to the data acquisition board. When the data acquisition board is configured in the differential mode, the return side of each channel is connected to a separate ground. Although it halves the channel capacity, the differential mode permits measurements of low-level signals, despite common-mode input noise.

Differential inputs use a separate return path for each channel. The high side of each analog input connects to a CH "x" terminal on the screw terminal panel. The low side of each input connects to the corresponding CH "x" RET terminal.

In addition, an external return path must be established between CH "x" RET and A GND. This is accomplished by installing 10kΩ 1/4 watt resistors on the screw terminal panel. Table 2 on page 23 lists the resistors and the input channels to which they correspond.

Note *You must supply these resistors when using the DT707 screw terminal panel in differential mode. These resistors are available in the EP228 accessory. These resistors are factory-installed on the DT707-T screw terminal panel.*

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To use the screw terminal panel with differential inputs:

1. If you are using a DT707, install 10kΩ 1/4 watt resistors at locations R2, R3, R6, R7, R10, R11, R14, and R15.

   Note *These resistors are factory-installed on the DT707-T.*

2. Ensure that the data acquisition board is configured to accept differential analog inputs.

3. Connect the screw terminal panel to the data acquisition board.

4. Make each input connection as shown in Figure 4.

   Note *Connection to channel 7 is illustrated in the example below. You may use any available input channel (channels 0 through 7).*

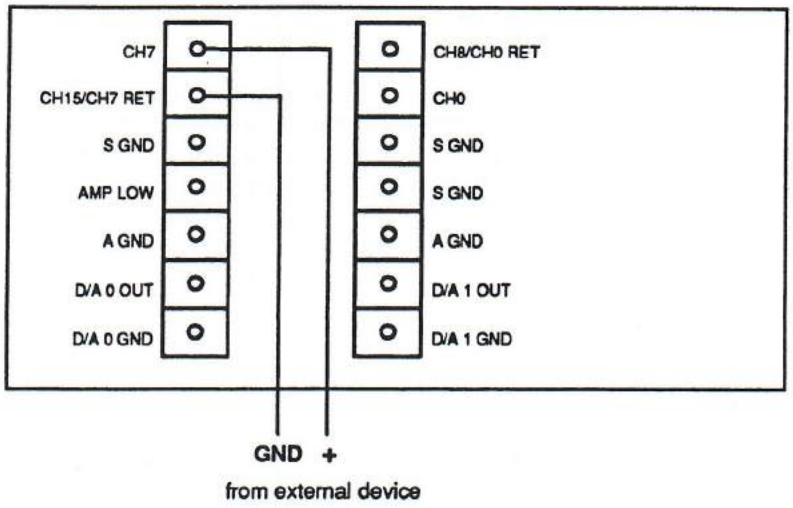


Figure 4: Differential Input Connection

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Thermocouple Input Connection (DT707-T only)

The DT707-T screw terminal panel provides hardware cold-junction compensation for any type of thermocouple. Thermocouples output very low voltage signals. These signals are very susceptible to electrical noise.

Note *High gain (100 and 500) data acquisition boards are recommended for use with thermocouple inputs, since a high gain is required to measure low-level thermocouple signals.*

The DT707-T provides open input detection circuitry. An open input (broken thermocouple wire) will result in a plus full scale output code for gains of eight or greater.

When the wires from a measurement thermocouple are connected to the screw terminals on the panel, a second cold-junction thermocouple is formed. This cold-junction thermocouple is the same type as the measurement thermocouple, but has opposite electrical polarity. Therefore, the signal created by the cold-junction thermocouple tends to reduce that of the measurement thermocouple.

Since the cold-junction thermocouple is referenced to the ambient temperature of the panel, and the ambient temperature varies over time, this variance can result in large measurement errors. To compensate for these errors, the DT707-T screw terminal panel contains a thermocouple cold-junction compensation (CJC) circuit. The CJC circuit allows you to determine the temperature of the panel, so you can calculate the true temperature at the thermocouple.

The CJC circuit consists of a solid state temperature sensor mounted inside an aluminum isothermal bar. This sensor is used to measure the temperature of the screw terminal panel. The isothermal bar is mounted near the screw terminals and helps to keep them at a uniform temperature.

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The CJC circuit is enabled when jumpers W1 and W2 are installed. These jumpers connect the CJC circuit's output to differential channel 0. When jumpers W1 and W2 are not installed, the CJC circuit is disconnected from channel 0. Table 1 summarizes the CJC circuit jumper positions.

Table 1: Enabling the CJC Circuit

CJC Circuit	W1	W2
Enabled to Ch 0	In	In
Disabled	Out	Out

The following procedure describes how to use the CJC to compensate for the cold-junction thermocouple when thermocouple type X is connected to the screw terminal panel's terminal for one of the differential channels (channels 1 to 7):

Note *Connection to channel 7 is illustrated in the example below. You may use any available input channel, except for channel 0.*

1. Install jumpers W1 and W2 to enable CJC and connect its output to differential channel 0.

2. Make each input connection as shown in Figure 5.

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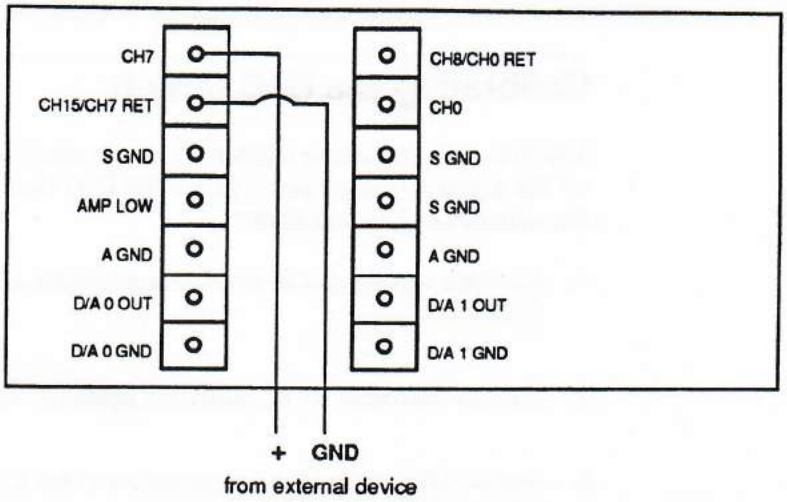


Figure 5: Thermocouple Input Connection

3. Calculate the temperature of the screw terminal panel by reading the voltage at channel 0 on the data acquisition board.

   The temperature (T1) can be determined as follows:

   $$T1 = V / (0.5\ mV / °C)$$

   where V is the voltage present on channel 0, in millivolts.

4. Using the tables or formula for thermocouple type X, determine the error voltage, Ve, for thermocouple type X at T1 (°C).

   Note *The following document provides reference tables:* Thermocouple Reference Tables, *NBS Monograph 125, National Bureau of Standards, Washington, D.C., 1979.*

5. Read the thermocouple's sample voltage, Vs, on channel 7.

6. Obtain the corrected voltage, Vc, as follows:

   $$Vc = Vs + Ve$$

7. Using the tables or formula for thermocouple type X, determine the temperature, T2, of the thermocouple input on channel 7 by finding the temperature corresponding to Vc.

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Calibrating the CJC Circuit

The following procedure explains how to calibrate the CJC circuit on the screw terminal panel. When the CJC circuit is calibrated, the sensor's output is 0.5mV/°C.

1. Connect a voltmeter to the screw terminals labeled CH0 and CH0 RET.

2. Set the voltmeter for a 100mV full scale DC range.

3. Adjust R23 on the screw terminal panel for a reading of E_{mv}, using the following formula:

$$E_{mV} = T \times (0.5\ mV / °C)$$

where T is the temperature of the screw terminal panel in °C, as measured with an accurate, high-quality thermometer (1°C or better accuracy).

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Current Loop Input Connection

You can configure the DT707 to accommodate connections for up to eight current loop inputs by installing the corresponding resistors in the EP228 resistor pack accessory. (Table 2 on page 23 lists the current loop resistors and the input channels to which they correspond.)

Note *To ensure high accuracy of the current to voltage conversion, the current shunt resistors must be within ±0.02% tolerance, have a temperature coefficient of 15 ppm/° C or better, and have at least 1/4W power dissipation.*

The current loop mode converts current signals to voltage levels. Current loops are less sensitive to noise pickup, and allow data to be transmitted over long distances and through relatively high noise environments. Current loop inputs use a separate return path for each channel. The current shunt resistors cause the data acquisition board's A/D converter to receive a 0V signal with a 0mA input and a +5V signal with a 20mA input. The high side of each analog input is connected to the corresponding CH "x" terminal on the panel. The low side of each analog input is connected to the corresponding CH "x" RET terminal on the panel.

Note *It is recommended that data acquisition boards with a programmable gain of two and a 0 to +10V range be used to obtain maximum accuracy in reading current loop inputs.*

Many devices configured for current-loop operation supply 4 to 20mA ranges. The lower portion (20%) of the A/D converter's input range (0 to +1V) is not available. This results in some loss of resolution, and may require you to compensate in software for the fact that the low end of the input range (4mA) does not produce an output code of 0000 0000 0000 (binary) from the A/D converter.

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To use the screw terminal panel with current loop inputs:

1. Make sure the data acquisition board is configured for unipolar differential inputs.

   A gain of two is recommended to enable the board to accept a 0 to +5V analog input range.

2. Install 250Ω current shunt resistors at DT707 resistor locations R1, R4, R5, R8, R9, R12, R13, and R16.

3. Make each input connection as shown in Figure 6.

   Note *Connection to channel 7 is illustrated in the example below. You may use any available input channel.*

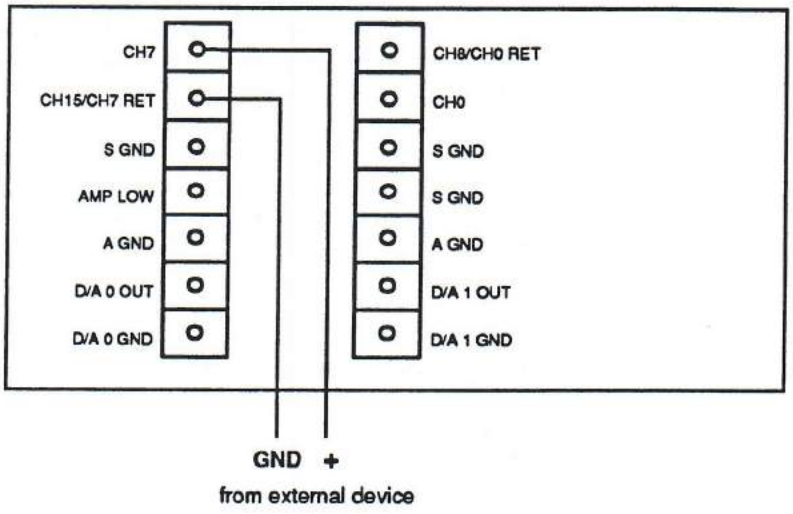


Figure 6: Current Loop Input Connection

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Reference 1

Configuration Resistors

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*Reference 1, "**Configuration Resistors**," lists the user-installable resistors on the DT707 and DT707-T.*

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User-Installable Resistors

Table 2 lists the user-installable resistors for the DT707 and DT707-T.

Table 2: User-Installable Resistors

Channel	(10KΩ, 10%) Bias Current Return (DI)	(250Ω, .02%) Current Loop I to V	(100MΩ, 10%) Thermocouple Break Detect
7	R15	R16	R30
6	R11	R12	R31
5	R7	R8	R32
4	R3	R4	R33
3	R2	R1	R29
2	R6	R5	R28
1	R10	R9	R27
0	R14	R13	R26

Notes

These resistors are not factory-installed on the DT707.

The bias current return and thermocouple break detect resistors are factory-installed on the DT707-T.

The bias current return and current loop resistors are provided in the EP228 resistor pack accessory.

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Reference 2

Connector Pin Assignments

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*Reference 2, "**Connector Pin Assignments**," lists the pin assignments for the J1 connector on the DT707 and DT707-T.*

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J1 Connector

Table 3 lists the pin assignments for the J1 connector on the DT707 and DT707-T.

Table 3: J1 Pin Assignments

Description	Pin		Description
A/D Input, Ch 0	1	26	Digital Ground
A/D Input, Ch 8 (DI Ch 0 Ret)	2	27	Digital Ground
A/D Input, Ch 1	3	28	Port 0 DIO Bit 0
A/D Input, Ch 9 (DI Ch 1 Ret)	4	29	Port 0 DIO Bit 1
A/D Input, Ch 2	5	30	Port 0 DIO Bit 2
A/D Input, Ch 10 (DI Ch 2 Ret)	6	31	Port 0 DIO Bit 3
A/D Input, Ch 3	7	32	Digital Ground
A/D Input, Ch 11 (DI Ch 3 Ret)	8	33	Port 0 DIO Bit 4
A/D Input, Ch 4	9	34	Port 0 DIO Bit 5
A/D Input, Ch 12 (DI Ch 4 Ret)	10	35	Port 0 DIO Bit 6
A/D Input, Ch 5	11	36	Port 0 DIO Bit 7
A/D Input, Ch 13 (DI Ch 5 Ret)	12	37	Digital Ground
A/D Input, Ch 6	13	38	Port 1 DIO Bit 0
A/D Input, Ch 14 (DI Ch 6 Ret)	14	39	Port 1 DIO Bit 1
A/D Input, Ch 7	15	40	Port 1 DIO Bit 2
A/D Input, Ch 15 (DI Ch 7 Ret)	16	41	Port 1 DIO Bit 3
A/D Analog Ground	17	42	Digital Ground
Amp Low	18	43	Port 1 DIO Bit 4
+15V Out	19	44	Port 1 DIO Bit 5
–15V Out	20	45	Port 1 DIO Bit 6
Power Ground	21	46	Port 1 DIO Bit 7
DAC 0 Analog Output	22	47	Digital Ground
DAC 0 Analog Ground	23	48	Digital Ground
DAC 1 Analog Output	24	49	A/D External Trigger
DAC 1 Analog Ground	25	50	A/D External Clock

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Reference 3

Specifications

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*Reference 3, "**Specifications**," lists the electrical and physical specifications for the DT707 and DT707-T. All specifications are typical at +25°C and rated voltage unless otherwise specified.*

- *Electrical Specifications*
- *Physical Specifications*

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Electrical Specifications

Thermocouple CJC Circuit (DT707-T only)

Output Impedance	Amplifier output 100mΩ, 800Ω divider
Output voltage equation	Output voltage = T x (0.5mV / °C) (where T = temperature of panel in °C)
Operating temperature range	0 to +55°C
Power requirements	15V from screw terminal panel 5.5mA (+15V), 0.5mA (–15V)

Current Loop Operation

Resistor value	250Ω (0 to 20mA current range)
Resistor tolerance	±0.02% or better
Resistor power dissipation	1/4 watt minimum
Resistor temperature coefficient	±15ppm/°C or better

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Physical Specifications

PCB dimensions	5.2"H x 8.75"W x 0.875"D) (13.21 cm x 22.23 cm x 2.22 cm)
Weight	12.5 ounces (355 grams)
Screw terminal	80 barrier strip connections: 4 sections with 20 connections each
Barrier strip screws	
Size	6-32 screws, magnum
Barrier strip material	Polyester, UL grade, 94V-0 polypropylene
Acceptable wire size	18 to 22 AWG

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Reference 4

Troubleshooting

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*Reference 4, "**Troubleshooting**," describes what to do if you have difficulty using your screw terminal panel. This section is organized as follows:*

- *General Checklist*
- *Service and Support*

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General Checklist

Should you experience difficulty using your screw terminal panel, the following section describes some possible problems and suggest steps you can take to correct them.

If you are experiencing a problem not described here, or have followed the steps suggested and are still having problems, please follow the instructions provided in "Service and Support."

Go through the following checklist when troubleshooting to help isolate your problem.

1. Make sure that all connections are made properly.

   Refer to Chapter 2, "Using the Screw Terminal Panel," for the appropriate connection scheme.

2. Verify that all cables associated with the board are firmly connected.

3. Make sure that all unused analog input channels are referenced to analog ground.

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Service and Support

Please be prepared to answer the following questions when you call for technical support. This information helps to identify specific system and configuration-related problems.

- What is the serial number of the product?
- What other boards or applications are installed in your system?
- Have you verified that all your connections are secure and are made properly?
- Have you been able to isolate the source of your problem: input or output device, board, software?
- Is the problem intermittent or permanent?
- Are all unused input channels grounded?
- Have you run the diagnostics shipped with your data acquisition board?

In addition, if your problem appears to be software-related, specify whether or not it has occurred more than once and, if possible, document the sequence of steps that caused the problem. This information helps us to reproduce the problem in-house.

If your problem is not solved by the steps outlined in the previous sections, the Technical Support staff is available to provide prompt, reliable assistance. They can be reached by calling:

(508) 481-3700

If you are located outside the USA, call your local distributor. The name and telephone number of your nearest distributor are listed in your Data Translation catalog.

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If Your Board Needs Factory Service

If your screw terminal panel must be returned to Data Translation:

1. Call the Customer Service Department and obtain a Return Material Authorization (RMA) number.

   All return shipments to Data Translation must be marked with the correct RMA numbers to ensure proper processing.

2. Package the board as follows:

   - Wrap the board in an electrically conductive plastic material, handling it with ground protection. *A static discharge can destroy components on the board.*

   - Pack the board in its original shipping container, if available and in good condition. If it is not available, use any secure shipping container.

3. Return the board to the following address, making sure the RMA number is visible on the outside of the box.

   Customer Service Dept.
   Data Translation, Inc.
   100 Locke Drive
   Marlboro, MA 01752-1192

Outside the USA

If you are located outside the USA, call your local distributor for authorization and shipping instructions. The name and telephone number of your nearest distributor are listed in your Data Translation catalog.

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WARRANTY AND SERVICE POLICY

WARRANTY

Data Translation, for the effective period of the warranty set out below, warrants that its standard hardware products and software media will be free from defects in materials and workmanship under normal use and service. Data Translation's obligation under this warranty shall not arise until the Buyer returns the defective product, freight prepaid, to Data Translation's facility or another specified location. The only responsibility of Data Translation under this warranty is, at its option, to replace or repair, free of charge, any defective component part of such products.

EFFECTIVE PERIOD OF WARRANTY

All boards, modules, systems, and software media are warranted for one year from date of invoice. Products repaired or replaced within this warranty period maintain their original warranty. Products repaired or replaced outside the warranty period are warranted for 30 days from invoiced date of return.

RETURN OUTSIDE USA AND CANADA

Contact the local sales representative or factory for authorization and shipping instructions.

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The warranty set forth above does not extend to and shall not apply to:

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2. Products which have been subject to misuse, neglect, accident, or improper installation.

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b. A Quick Turnaround Plan is available to expedite servicing. Contact the Data Translation Customer Service Department for details.

c. If a product should fail during the warranty period, it will be repaired free of charge. For out-of-warranty repairs, the customer will be invoiced for repair charges.

RETURN/REPAIR PROCEDURES

Upon determining that repair services are required, or to return a product to Data Translation, contact the Data Translation Customer Service Department at (508) 481-3700, extension 394 to obtain a Return Material Authorization (RMA) number. Have the following information ready when you call: complete product model number, product serial number, name, address, and telephone number of person returning product; and any special repair instructions.

Carefully package the product in anti-static packaging, making sure the RMA number appears on the outside of the package. Ship prepaid to:

Customer Service Department
Data Translation, Inc.
100 Locke Drive
Marlboro, MA 01752-1192 USA

On completion of required service, an invoice is issued stating charges, when applicable, and the work that has been completed. A packing slip is enclosed in the return shipment.

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