



USER'S MANUAL

Model 818 / 819

Cryopump Monitor

Curve 0	DT-500DI-8B
Curve 1	DT-500DI-8A
Curve 2	DT-500DRC-D
Curve 3	DT-500DRC-E1
Curve 4	CTI Curve C
Curve 5	DT-500DI-8C
Curve 6	DT-470 Curve 10
Curve 7	User Selectable Curve
Curve 8	User Selectable Curve
Curve 9	User Selectable Curve



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CHAPTER 1

INTRODUCTION

1.1 GENERAL

The information contained in this manual pertains to the installation, operation, remote programming, options and accessories and calibration procedures for the Lake Shore Cryotronics, Inc. Model 818 and 819 Cryopump Monitors and the Balzers TMU-121 Cryopump Monitor.

NOTE: The TMU-121 is identical to the Model 818 except for the addition of a back panel keylock switch. Users may wire two silicone diode sensors directly to the TMU-121; the keylock switch selects which input to display. All other front panel and RS-232 operation is identical to the Model 818.

1.2 DESCRIPTION

The Model 818/819 is a microprocessor controlled instrument which provides direct digital display of temperature with up to 4 digits of resolution in K, °C or °F and sensor voltage to 1 mV.

The Model 818 features one input with two alarms. The alarms can be used to safeguard or initiate and control automatic cryopump regeneration cycles. The alarms are configured as HI and ID alarms. Set alarm setpoints from the front panel with function keys and up/down keys, or simply check them without changing their values. The alarm setpoint resolution is 0.1 K, °C or °F over the sensor temperature range. Table 3-1 describes sensor temperature ranges. For security, the up/down keys can be deactivated by a rear panel DIP switch. A deadband around each setpoint reduces or eliminates relay contact chattering.

The Model 819 features four inputs with two alarms (as described above) for each input. The Model 819 can also scan between channels with dwell times of 0 (skip), 5, 10, 30 or 60 seconds for each channel.

The Model 818/819 directly reads temperature from Lake Shore DT-470 or DT-500 Series Temperature Sensors. All DT-470 sensors follow the same temperature response curve and come in four bands of tracking. Low temperature (2 to 100K) accuracies range from 0.25K for band 11 to 1K for band 13. The units have a specified temperature range of 4 to 475 K with DT-470 sensors and 4 to 325 K with DT-500 sensors.

Diode sensor voltages are digitized with a resolution of 100 mV out of 3 volts full scale. The accuracy of the electronics with DT-470 sensors is better than ± 0.01 K below 28K and ± 0.1 K above 28K. The equivalent display temperature rounds to 0.1 above 100 (any units) and 0.01 below 100.

The Model 818/819 features an RS-232C Serial Interface which allows users to monitor temperature, and monitor and change alarm setpoints from a host computer. Sensor input(s), alarm contacts, and RS-232C lines are located on the instrument rear panel.

Table 1-1. Model 818/819 Specifications

THERMOMETRY:	
Inputs: 818 = one; 819 = four.	
Measurement Type: Isolated 4-lead.	
Sensor (order separately): Lake Shore DT-470 or DT-500 Series Silicon Diode Sensors.	
Sensor Temperature Coefficient: Negative	
Sensor Units: Volt (V)	
Input Range: 0 to 3 volts	
Sensor Excitation (constant current): 10 μ A \pm 0.01%	
Update Rate: 818 = One reading per 0.6 second; 819 = One reading per 0.6 second continuous. 1.2 seconds on channel change.	
Scan Dwell Time: 818 = not applicable; 819 = 0(skip), 5, 10, 30, 60 seconds for each channel.	
Example Lake Shore Sensor: DT-470-CO-11	
Sensor Temperature Range: 1.4 to 475 K.	
Standard Curve: Curve 10, DT-500DI-8A, DT-500DI-8B, DT-500DI-8C, DT-500DRC-D, DT-500DRC-E1, CTI Curve C	
Typical Sensor Sensitivity:	Measurement Resolution:
-30 mV/K at 4.2 K	Sensor Units: 0.1 mV
-1.9 mV/K at 77 K	Temperature Equivalence: 4 mK/ $^{\circ}$ C at 4.2 K
-2.3 mV/K at 300 K	53mK/ $^{\circ}$ C at 77 K
-2.2 mV/K at 475 K	42 mK/ $^{\circ}$ C at 300 K
	46 mK/ $^{\circ}$ C at 475 K
Measurement Accuracy:	Measurement Temperature Coefficient:
Sensor Units: \pm 0.3 mV \pm 0.04% of reading	Sensor Units (% reading/ $^{\circ}$ C ambient): 0.0075%/ $^{\circ}$ C
Temperature Accuracy: \pm 0.3 K at 4.2 K	Temperature Equivalence: 4 mK/ $^{\circ}$ C at 4.2 K
\pm 0.62 K at 77 K	40 mK/ $^{\circ}$ C at 77 K
\pm 0.72 K at 300 K	20 mK/ $^{\circ}$ C at 300 K
\pm 1.2 K at 475 K	3 mK/ $^{\circ}$ C at 475 K
Magnetic Field Use: Recommended $T \geq 40$ K and $B \leq 5$ T	
ALARMS:	
Number of Alarms: 818 = Two; 819 = Eight - two per channel	
Alarm Type: One high and one low per channel	
Alarm Deadband: \pm 0.25 K above 100; \pm 0.025 K below 100	
Alarm Contact: One normally open and one normally closed relay contact per alarm, UL rated at 250 VAC or 30 VDC at 5 A, 110 VDC at 0.6 A.	
FRONT PANEL:	
Sensor Display: 4-digit LED display in voltage or temperature (K, $^{\circ}$ C, $^{\circ}$ F).	
Annunciators: 818 = Alarm Status, Channel, Units; 819 = Alarm Status, Channel, Units, Scan	
Display Resolution: 0.1 degree above 100 (any units), 0.01 degree below 100; voltage to 0.001 mV.	
Keys: 818 = HI/LO Alarm, \blacktriangle , \blacktriangledown ; 819 = Channel, HI/LO Alarm, \blacktriangle , \blacktriangledown	
INTERFACE:	
Serial Interface: RS-232C electrical format, 300 baud, RJ-11 connector	
Linearized Analog Output: 818 = 0 to 1 volt represents 0 to 1000 K; 819 = not applicable	
GENERAL:	
Ambient Temperature Range: 15 to 35 $^{\circ}$ C	
Power: 90-125 or 210-250 VAC (selected via rear panel switch), 50 or 60 Hz. 818: 7 VA; 819: 10 VA.	
Dimensions: 105 x 132 x 254 mm (4.125 x 5.25 x 10 inches); Panel mount, $\frac{1}{4}$ EIA.	
Weight: 1.6 kilograms (3.5 pounds)	

CHAPTER 2

INSTALLATION

2.1 GENERAL

This chapter covers Inspection and Unpacking (Paragraph 2.1), Repackaging for Shipment (Paragraph 2.2), Power and Ground Requirements (Paragraph 2.3), and Sensor and Interface Connections (Paragraph 2.4).

2.2 INSPECTION AND UNPACKING

Inspect shipping containers for external damage. Make all claims for damage (apparent or concealed) or partial loss of shipment in writing to Lake Shore within five (5) days from receipt of goods. If damage or loss is apparent, please notify the shipping agent immediately.

Open the shipping containers. Use the packing list included with the system to verify receipt of the instrument, sensor, accessories, and manual. Inspect for damage. Inventory all components supplied before discarding any shipping materials. If there is freight damage to the instrument, file proper claims promptly with the carrier and insurance company and notify Lake Shore. Notify Lake Shore immediately of any missing parts. Lake Shore cannot be responsible for any missing parts unless notified within 60 days of shipment. See the standard Lake Shore Warranty on the A Page (immediately behind the title page).

2.3 REPACKAGING FOR SHIPMENT

To return the Model 818/819 or accessories for repair or replacement, obtain a Return Goods Authorization (RGA) number from Technical Service in the United States, or from the authorized sales/service representative from which the product was purchased. Instruments may not be accepted without a RGA number. When returning an instrument for service, Lake Shore must have the following information before attempting any repair.

1. Instrument model and serial number.
2. User name, company, address, and phone number.
3. Malfunction symptoms.
4. Description of system.
5. Returned Goods Authorization (RGA) number.

Repack the system in its original container (if available). Affix shipping labels and FRAGILE warnings. Write RGA number on the outside of the container or on the packing slip. If not available, consult Lake Shore for shipping and packing instructions.

2.4 POWER AND GROUNDING REQUIREMENTS

2.4.1 Power Requirements

The Model 818/819 requires a power source of 50 to 60 Hz single phase 90-125 or 210-250 VAC. For the Model 818, replace the fuse with 0.25 A for 110 VAC operation, or 0.125 A for 230 VAC operation. For the Model 819, replace the fuse with 0.5 A for 110 VAC operation, or 0.25 A for 230 VAC operation.

CAUTION: Verify rear panel line voltage selection switch (Figure 3-2, Key 2) matches AC voltage source. Verify proper fuse installation before inserting power cord and turning on instrument.

2.4.2 Power Cord and Grounding Requirements

A three-prong detachable power cord for 120 VAC operation which mates with the rear panel UL/IEC/ICEE Standard plug ships with the instrument.

To protect operating personnel, the National Electrical Manufacturer's Association (NEMA) recommends, and some local codes require, instrument panels and cabinets be grounded. The three-prong power cable, when plugged into an appropriate receptacle, grounds the instrument.

2.5 SENSOR AND INTERFACE CONNECTIONS

2.5.1 J1 Sensor Input Connections

The Model 818 has one rear panel 5-pin sensor input connector designated J1 INPUT 1. The Model 819 has four rear panel 5-pin sensor input connectors designated J1-1, J1-2, J1-3 and J1-4 for inputs 1 thru 4. Table 2-1 lists sensor lead connection definitions and Figure 2-1 illustrates them.

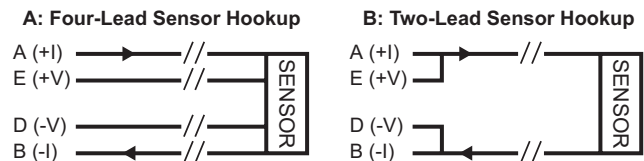
Use four wire connection (Figure 2-1A) to avoid IR drops in the voltage sensing pair resulting in temperature measurement error. Use two wire connection (Figure 2-1B) in less critical applications where lead resistance is small, and small readout errors can be tolerated.

Lake Shore QUAD-LEAD™ 36 Gauge Cryogenic wire is ideal for sensor connections since the four color-coded leads run together. The wire is Phosphor Bronze with a Formvar insulation and Butryral bonding between the four leads. Color coding is red, green, clear and blue for easy wire identification.

Table 2-1. Sensor Connections for the J1 INPUTS

Terminal	Description
A	+ Current Out
B	- Current Out
D	- Voltage Sense
E	+ Voltage Sense
H	Shield

Figure 2-1. Sensor Connections



2.5.2 J2 Serial I/O

The RS-232C Serial Interface connector is a rear panel mounted RJ-11 modular socket. The connector pins are numbered 1 thru 6 from left to right. Table 2-2 lists connector pin assignments.

NOTE: When converting from the RJ-11 to DB-25 connector, pins 5, 6, 8 and 20 of the DB-25 connector may need to be shorted together for proper interface operation.

Table 2-2. Serial I/O Connections

Pin #	Description
1 and 2	Received Data
3 and 4	Signal Ground
5 and 6	Transmitted Data

2.5.3 J3 Alarms

The HI and LO alarm contacts are present on rear panel card edge connections. The Model 818 has one 6-contact card edge connector for the HI and LO alarms. The Model 819 has one 6-contact card edge for Input 1 HI and LO alarms and one 18-contact card edge connector for Input 2 thru Input 4 HI and LO alarms. The top and bottom contacts of the card edge are identical in definition and the mating connector supplied shorts them together. The SPDT alarm contacts are in groups of three: **1 - COM - 2** or **NO - IH - NC** representing the contacts for the Input 1 HI alarm. **1** or **NO** represents the (N)ormally (O)pen state; **2** or **NC** represents the (N)ormally (C)losed state. The card edge is slotted between pins 2 and 3 to allow for mating connector keying. Chapter 3 details alarm action.

2.5.4 J4 Monitors

With an Model 818-MN or 818-LA Option, the J4 Monitors connector is present. Table 2-3 lists connector pin assignments.

Table 2-3. J4 Monitors Connections

Terminal	Description
A	V+ MN Output
B	V- MN Output
D	V+ LA Output
E	V- LA Output
H	Shield

CHAPTER 3

OPERATION

3.1 GENERAL

This chapter covers Controls and Indicators (Paragraph 3.2), Voltage or Temperature Display (Paragraph 3.3), Standard Curves (Paragraph 3.4), Alarm Operation (Paragraph 3.5), and Channel Selection for the Model 819 (Paragraph 3.6).

3.2 CONTROLS AND INDICATORS

Note: The unit completes an internal update cycle of between 1/4 and 1/2 second before responding to a front panel key entry. A key pressed for less than 1/2 second may be ignored.

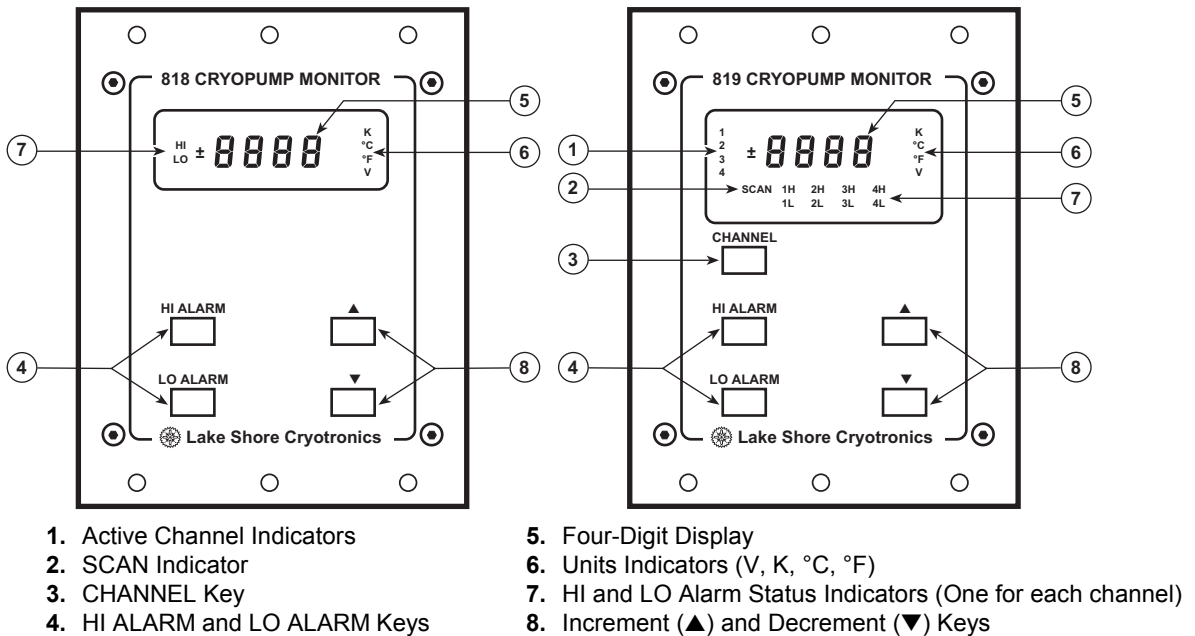


Figure 3-1. Model 818 and 819 Cryopump Monitor Front Panels

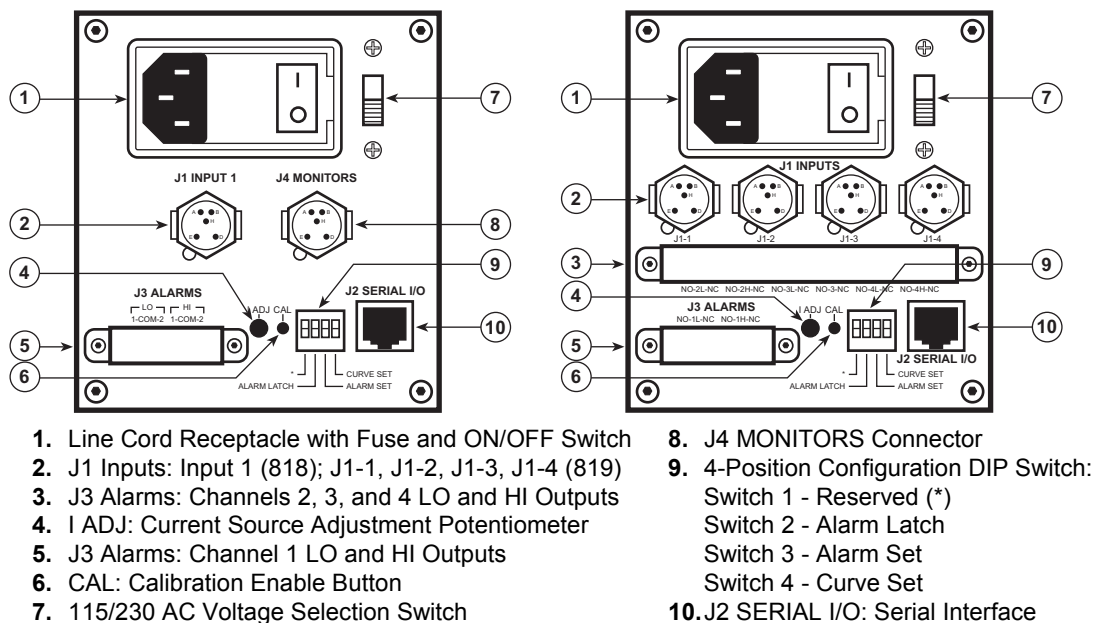


Figure 3-2. Model 818 and 819 Cryopump Monitor Rear Panels

3.3 VOLTAGE OR TEMPERATURE DISPLAY

The Model 818 and 819 Cryopump Monitors read in voltage or temperature (kelvin, Celsius, or Fahrenheit). To change units, press the ▲ key or the ▼ key or send a command over the RS-232C Serial Interface.

3.4 STANDARD CURVES

The unit stores several standard curves. Different curves may be assigned to each channel of the Model 819. These curves, numbered 0 thru 9, are listed on the front cover of this manual as well as in Table 3-1. The front cover also indicates the factory curve configuration of the unit. Curve 6 (DT-470 Curve 19) is the standard curve selected unless specified differently upon ordering. Tables of voltage versus temperature for these standard curves appear in Appendix A.

3.4.1 Curve and Alarm Action Selection

To change or check the selected curve or alarm action, use the procedure below:

1. For the Model 819, press the **CHANNEL** key and the ▲ or ▼ key until the desired channel displays.
2. Turn ON (1) DIP switch number 4 on the instrument rear marked **CURVE SET**.
3. Note the display now shows the number 0 or 1 on the left (alarm action) and a number between 0 and 9 on the right (standard curve).
4. To change the curve, push either the ▲ or ▼ key until the desired curve number displays. If a curve is not present, it is skipped in the sequence. To select the alarm action push the **LO ALARM** key (0) for the Model 818 operation or the **HI ALARM** key (1) for DIGI-K operation.
5. Turn OFF (0) DIP switch number 4 on the instrument rear marked **CURVE SET**. The instrument returns to normal operation with the new curve and alarm action selected.

Note: A different curve can be assigned to each of the four Model 819 channels independently. However, the alarm action applies to all four channels.

Table 3-1. Standard Curves and Alarm Temperature Limits

Curve #	Description	Temp Range (K)
0	DT-500D1-8B	0 - 324.9
1	DT-500D1-8A	0 - 324.9
2	DT-500DRC-D	0 - 324.9
3	DT-500DRC-EI	0 - 324.9
4	CTI Curve C	0 - 324.9
5	DT-500D1-8C	0 - 324.9
6	DT-470 Curve 10	0 - 474.9
7	—	—
8	—	—
9	—	—

3.5 ALARM OPERATION

The Model 818 can set two alarm trip points (HI and LO) associated with the single sensor input. The Model 819 has four sensor inputs and two alarm trip points (HI and LO) for each input.

The deadband is ± 0.025 for the setpoint less than 100 (any units) and ± 0.25 for the setpoint greater than 100. If the display is in voltage, then the deadband assumes appropriate kelvin units.

3.5.1 Checking the Alarm Setpoints

To check the HI alarm setpoint, press the front panel **HI ALARM** key. The HI alarm setpoint displays in the chosen temperature units. If the units are V (volts), the units indicator changes to K (kelvin) and the setpoint displays in kelvin. Similarly, to check the LO alarm, press the **LO ALARM** key.

3.5.2 Alarm Action

The Model 818 and 819 have two different alarms that can be selected when the sensor curve is selected. Alarm action **0** is the Model 818 operation and alarm action **1** is the DIGI-K operation. See Table 3-2A and 3-2B for a truth tables of the respective alarm actions.

Table 3-2A. Alarm Action 0 (Model 818)

Display Reading Compared to:		Contact Positions			
		LO Alarm		HI Alarm	
LO Alarm	HI Alarm	NO - COM	COM - NC	NO - COM	COM - NC
Higher	Higher	Open	Closed	Closed	Open
Higher	Lower	Open	Closed	Open	Closed
Lower	Higher	Closed	Open	Closed	Open
Lower	Lower	Closed	Open	Open	Closed
Power OFF		Open	Closed	Open	Closed

Table 3-2B. Alarm Action 1 (DIGI-K)

Display Reading Compared to:		Contact Positions			
		LO Alarm		HI Alarm	
LO Alarm	HI Alarm	NO - COM	COM - NC	NO - COM	COM - NC
Higher	Higher	Closed	Open	Closed	Open
Higher	Lower	Closed	Open	Open	Closed
Lower	Higher	Open	Closed	Closed	Open
Lower	Lower	Open	Closed	Open	Closed
Power OFF		Open	Closed	Open	Closed

3.5.3 Latching or Non-Latching HI and LO Alarms

When the rear panel **ALARM LATCH** DIP switch is OFF (0), relays close or open as specified in Table 3-2. If the sample sensor temperature oscillates around the HI or LO alarm setpoint temperature, then the relay opens and closes in an oscillatory fashion following the alarm action. There is a deadband around the setpoint as specified in Paragraph 3.5 to eliminate chattering of relay contacts.

When the **ALARM LATCH** switch is ON (1), the alarm relays take on a latching configuration. When the sample sensor temperature forces the alarm to go from NO to NC, the relays remain closed. There are three ways to reopen the relay.

1. From the Front Panel: hold the HI ALARM and LO ALARM keys down for more than 2 seconds. The ALARM STATUS light(s) go out indicating alarms are reopened.
2. From the Rear Panel: disable the MARK LATCH switch (Configuration DIP Switch 2) momentarily.
3. Send the R (RESET) command over the RS232C interface.

3.5.4 Setting the HI and LO Alarms

The alarms may be changed if the rear panel **ALARM SET** switch (Configuration DIP Switch 3) is ON (1). To change the alarms from the front panel:

1. Turn ON (1) rear panel configuration DIP Switch 3, marked **ALARM SET**.
2. Press either the **HI ALARM** or **LO ALARM** key and check the displayed alarm setting. To change the setting, push either the **▲** or **▼** key until the desired setting is reached. Note: the alarms can only be set in temperature. If voltage is the display units, the display defaults to kelvin if an alarm key is pushed. The alarm setpoint resolution is 0.1 K, °C or °F. The alarm setpoint is bounded by the sensor temperature range listed in Table 3-1.
3. For the Model 819, press the **CHANNEL** key and the **▲** or **▼** key until the desired channel is reached, then implement step 2.
4. The alarms take on the new values immediately. The **ALARM SET** switch only deactivates the ability to set the alarms if it is in the OFF (0) position.

3.6 MODEL 819 CHANNEL SELECTION

The Model 819 has four sensor inputs (or channels) numbered 1 thru 4. To change the display input, press the **CHANNEL** key and either the **▲** or **▼** key. The channel input position displays to the left of the display. Hold the **CHANNEL** key for greater than one second to toggle the scan mode, and greater than two seconds to display the dwell time for the selected channel.

3.6.1 Channel Scan

In hold mode, the Model 819 internally scans each channel and updates alarms approximately every 8 seconds. In scan mode, the Model 819 continuously monitors the displayed channel and updates its alarms only. If a channel is excluded from the scan sequence (its dwell time is set to 0), the alarms of this channel are not updated. To enable or disable the scan, hold the **CHANNEL** key in for greater than one second. The Model 819 enters the SCAN mode as indicated by the SCAN annunciator.

3.6.2 Setting Channel Dwell Time

To set the dwell time for a given channel, hold in the **CHANNEL** key for greater than two seconds and use the **▲** or **▼** keys to increment or decrement the dwell times between 0 (skip), 5, 10, 30 and 60 seconds. Next increment the channel and repeat the dwell time setting process.

CHAPTER 4

REMOTE OPERATION

4.1 RS-232C SERIAL INTERFACE

The Models 818 and 819 feature a serial RS-232C interface which allows communication with a host computer (see Table 4-1 below):

Table 4-1. Model 818/819 RS-232C Interface Specifications

Transmission: Three Wire	Bits per Character: 7 (not including start, stop or parity bits)
Connector: RJ-II Modular Socket	Parity Type: odd
Timing Format: Asynchronous	Number of Stop Bits: 1
Transmission Mode: Half Duplex	Data Interface Levels: Transmits/Receives using EIA voltage levels
Baud Rate: 300	

4.2 INTERFACE COMMANDS

The paragraphs below define RS-232C Interface Commands and their format. Enter switch and channel IDs as integers (no decimal point). Enter temperatures to 0.1 degrees. If entered with greater precision, they truncate to the nearest 0.1 degree. Enter temperatures with or without a decimal point. For example, any of the following are valid temperature entries: 5, 5.0, 24, 98.3, 235. Temperature is bounded by upper and lower sensor limits listed in Table 3-1.

4.2.1 Display and Alarm Parameter Commands

F0 Select Display Units

Input: **F0K, F0C, F0F, or F0V**

Returned: Nothing.

Remarks: Sets display units to Kelvin (**K**), Celsius (**C**), Fahrenheit (**F**), or Volts (**V**).

H Set High Alarm Setpoint.

Input: Model 818: **H<Temperature>**, Model 819: **<Channel>H<Temperature>**

Returned: Nothing.

Remarks: Sets the High Alarm setpoint. Channel = **0** to **4**. Example: For a setpoint of 300° on the Model 818, type **H300**. For a setpoint of 31.2° on channel 3 on the Model 819, type **3H31.2**. Select temperature units from the unit keyboard or by using the **F0** command.

L Set Low Alarm Setpoint.

Input: Model 818: **L<Temperature>**, Model 819: **<Channel>L<Temperature>**

Returned: Nothing.

Remarks: Sets the Low Alarm setpoint. Channel = **0** to **4**. Example: For a setpoint of 21.1° on the Model 818, type **L21.1**. For a setpoint of 21.1° on channel 3 on the Model 819, type **3L21.1**. Select temperature units from the unit keyboard or by using the **F0** command.

R Reset Alarms

Input: **R**

Returned: Nothing.

Remarks: Resets the alarms.

4.2.2 Output Request Commands

S (818 Only) Query Sensor Reading, Alarm Setpoints, and Alarm Status

Input: **S**

Returned: \pm <Reading><Units>, \pm <Alarm 1 Setpoint>, \pm < Alarm 2 Setpoint >,<Alarm 1 Status>,<Alarm 2 Status>

Remarks: Units = **K** (Kelvin), **C** (Celsius), **F** (Fahrenheit), or **V** (Volts). Alarm Status = **A** (Active) or **I** (Inactive)

WA Query Switch ID and Alarm Data

Input: **WA**

Returned: Model 818: <Switch ID>, \pm <High Alarm Setpoint>, \pm <Low Alarm Setpoint >.

Model 819: <Switch ID>, \pm <Channel 1 High Alarm Setpoint>, \pm <Channel 1 Low Alarm Setpoint>, \pm <Channel 2 High Alarm Setpoint>, \pm <Channel 2 Low Alarm Setpoint>, \pm <Channel 3 High Alarm Setpoint>, \pm <Channel 3 Low Alarm Setpoint>, \pm <Channel 4 High Alarm Setpoint>, \pm <Channel 4 Low Alarm Setpoint>.

Remarks: Switch ID = **0** to **7**. For Model 819 only, equals the sum of 2 if alarm is set plus 4 for relay latching.

WD Query Sensor Reading(s)

Input: **WD**

Returned: Model 818: \pm <Reading><Units>.

Model 819: \pm <Channel 1 Reading><Units>, \pm <Channel 2 Reading><Units>, \pm <Channel 3 Reading><Units>, \pm <Channel 4 Reading><Units>.

Remarks: Units = Kelvin (**K**), Celsius (**C**), Fahrenheit (**F**), or Volts (**V**).

WS Query Sensor Reading and Alarm Status

Input: **WS**

Returned: Model 818: \pm <Reading><Units>,<High Alarm Status>,<Low Alarm Status>.

Model 819: \pm <Channel 1 Reading><Units>,<Channel 1 High Alarm Status>,<Channel 1 Low Alarm Status>, \pm <Channel 2 Reading><Units>,<Channel 2 High Alarm Status>,<Channel 2 Low Alarm Status>, \pm <Channel 3 Reading><Units>,<Channel 3 High Alarm Status>,<Channel 3 Low Alarm Status>, \pm <Channel 4 Reading><Units>,<Channel 4 High Alarm Status>,<Channel 4 Low Alarm Status>.

Remarks: Units = **K** (Kelvin), **C** (Celsius), **F** (Fahrenheit), or **V** (Volts). Alarm Status = **A** (Active) or **I** (Inactive)

WY Query Scan Data

Input: **WY**

Returned: Model 818: **N** indicating no scanner.

Model 819: <Scan Status>,<Current Channel>,<Channel 1 Dwell Time Index>,<Channel 2 Dwell Time Index>,<Channel 3 Dwell Time Index>,<Channel 4 Dwell Time Index>.

Remarks: Scan Status = **H** (Holding) or **S** (Scanning). Channel = **0** to **4**. Dwell Time Index: **0** = 0 seconds (skip), **1** = 5 seconds, **2** = 10 seconds, **3** = 30 seconds, **4** = 60 seconds.

4.2.3 Model 819 Scan Parameter Commands

Y Set Channel Dwell Time

Input: Y<Channel><Dwell Time Index>

Returned: Nothing.

Remarks: Channel = **0** to **4**. Dwell Time Index: **0** = 0 seconds (skip), **1** = 5 seconds, **2** = 10 seconds, **3** = 30 seconds, **4** = 60 seconds. Example: For a 30 second dwell time on channel 2, type **Y23**.

YC Select Channel

Input: YC<Channel>

Returned: Nothing.

Remarks: Channel = **0** to **4**. Example: Type **YC3** to move scanner to channel 3.

YS Enable Scan

Input: YS

Returned: Nothing.

YH Hold (Disable) Scan

Input: YH

Returned: Nothing.

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CHAPTER 5

MAINTENANCE

5.1 CHECKING OR REPLACING FUSE

CAUTION: To prevent shock hazard, turn off instrument and disconnect it from AC line power and all test equipment before replacing fuse.

1. Set POWER switch to OFF and disconnect power cord from unit.
2. The fuse compartment is located to the right of the power connector. Carefully pry open the fuse compartment cover with a small screw driver.
3. Remove the upper fuse holder by sliding it out of its position with the screw driver.

CAUTION: For continued protection against fire hazard, replace only with fuse of same type and rating specified for the line voltage selected.

4. For the Model 818, replace the fuse with 0.25 A for 110 VAC operation, or 0.125 A for 230 VAC operation. For the Model 819, replace the fuse with 0.5 A for 110 VAC operation, or 0.25 A for 230 VAC operation.
5. Replace fuse holder, close fuse compartment, and connect the power cord.

5.2 LINE VOLTAGE SELECTION

The rear panel, three-pronged line power connector permits the Model 818/819 to be connected to 115 or 230 VAC line voltages. Use the following procedure to change the line voltage:

CAUTION: To prevent shock hazard, turn off instrument and disconnect it from AC line power and all test equipment before changing the line voltage.

1. Set POWER switch to OFF and disconnect power cord from unit.
2. The line voltage selection switch is located to the right of the power connector. Use a small screw driver to slide the switch to the 115 or 230 VAC position.
3. Install the proper fuse as outlined in Section 5.1.

5.4 CALIBRATION

Required equipment:

1. Digital Voltmeter/Multimeter (DVM) - 4½ digit resolution or better.
2. Precision Resistors - 25 kΩ and 125 kΩ with a tolerance of ±0.01% or better.

Warm-up unit for one hour to achieve rated specifications.

5.4.1 Current Source Calibration

1. Configure the 125 kΩ resistor to simulate a sensor in the two-lead configuration shown in Figure 2-1. For the Model 819, install the 125 kΩ resistor in INPUT 1. Set the Model 819 into scan mode with all dwell times set to 0, and select channel 1 as the display channel.
2. Connect DVM voltage leads across resistor and adjust the rear panel trimpot marked I ADJ until voltage across resistor is 1.2500 volts ±100 microvolts.

5.4.2 A/D Converter Calibration

1. Set the display unit to V.

NOTE: A/D calibration accuracy using resistors depends on current source calibration accuracy. Complete Current Source Calibration (Paragraph 5.4.1) prior to A/D Converter Calibration.

2. Configure the 125 k Ω resistor to simulate a sensor in the two-lead configuration shown in Figure 2-1. For the Model 819, install the 125 k Ω resistor in INPUT 1 and select channel 1 as the display channel.
3. Press the rear panel **CAL ENABLE** push button.
4. The unit displays **-CAL-** to indicate readiness to store a new A/D calibration. Within 2 seconds, press the **▲** key (if not pressed within 2 seconds, the display returns to normal display operation). The unit displays **-CAL-** for approximately 15 seconds to indicate active calibration. When calibration is complete, the display returns to normal display operation. The instrument should now display **1.250V**.
5. Replace the 125 k Ω resistor with the 25 k Ω resistor.
6. Press the rear panel **CAL ENABLE** push button.
7. The unit displays **-CAL-** Within 2 seconds, press the **▼** key. Again, the unit displays **-CAL-** for approximately 15 seconds and then returns to normal operation. The instrument should now display **0.250V**.
8. Calibration is complete for the Model 818. For the Model 819, repeat steps 2 through 7 for channels 2, 3, and 4.

APPENDIX A

CURVE INFORMATION

Table A-1. Curve #0: DT-500DI-8B Voltage/Temperature Characteristics

BP#	Temp. K	PROM Voltage	BP#	Temp. K	PROM Voltage	BP#	Temp. K	PROM Voltage
29	4.0	2.41773	19	29.0	1.11353	7	175.0	0.72353
	4.2	2.40475	18	30.0	1.10729		180.0	0.70936
	4.4	2.39217	17	32.0	1.09810		185.0	0.69532
	4.6	2.37946	16	34.0	1.09125		190.0	0.68125
	4.8	2.36668	15	36.0	1.08547		195.0	0.66713
	5.0	2.35378		38.0	1.08038		200.0	0.65302
	5.5	2.32126	14	40.0	1.07549		205.0	0.63889
	6.0	2.28869		45.0	1.06400		210.0	0.62475
	6.5	2.25643	13	50.0	1.05273		215.0	0.61066
	7.0	2.22480		55.0	1.04123	6	220.0	0.59646
	7.5	2.19395	12	60.0	1.02954		225.0	0.58262
28	8.0	2.16053		65.0	1.01748		230.0	0.56877
	8.5	2.13552	11	70.0	1.00528		235.0	0.55504
	9.0	2.10809		75.0	0.99263	5	240.0	0.54136
	9.5	2.08197		77.4	0.98666		245.0	0.52801
	10.0	2.05687		80.0	0.97988		250.0	0.51469
	11.0	2.00852	10	85.0	0.96711	4	255.0	0.50155
	12.0	1.96003		90.0	0.95397		260.0	0.48815
	13.0	1.90579		95.0	0.94086		265.0	0.47486
27	14.0	1.85614		100.0	0.92767		270.0	0.46148
	15.0	1.80479		105.0	0.91443		275.0	0.44800
26	16.0	1.74703	9	110.0	0.90124	3	280.0	0.43451
	17.0	1.67479		115.0	0.88776		285.0	0.42064
	18.0	1.60665		120.0	0.87434		290.0	0.40675
	19.0	1.53675		125.0	0.86087		295.0	0.39274
	20.0	1.46370		130.0	0.84735	2	300.0	0.37875
	21.0	1.38832		135.0	0.83377		305.0	0.36436
25	22.0	1.31868	8	140.0	0.82032		310.0	0.35002
	23.0	1.26476		145.0	0.80647		315.0	0.33559
24	24.0	1.21712		150.0	0.79274		320.0	0.32109
23	25.0	1.17857		155.0	0.77896		325.0	0.30656
22	26.0	1.15106		160.0	0.76513	1	330.0	0.29222
21	27.0	1.13317		165.0	0.75125			
20	28.0	1.12169		170.0	0.73733			

Table A-2. Curve #1: DT-500DI-8A Voltage/Temperature Characteristics

BP#	Temp. K	PROM Voltage	BP#	Temp. K	PROM Voltage	BP#	Temp. K	PROM Voltage
30	4.0	2.46386	17	29.0	1.11741		175.0	0.71308
	4.2	2.44821	16	30.0	1.11007		180.0	0.69891
	4.4	2.43188	15	32.0	1.09942		185.0	0.68469
	4.6	2.41500	14	34.0	1.09178		190.0	0.67043
	4.8	2.39781	13	36.0	1.08559		195.0	0.65615
29	5.0	2.37578	12	38.0	1.07992		200.0	0.64185
	5.5	2.33823		40.0	1.07502		205.0	0.62754
	6.0	2.29906		45.0	1.06307		210.0	0.61333
	6.5	2.26440		50.0	1.05136	6	215.0	0.59901
28	7.0	2.23248		55.0	1.03951		220.0	0.58502
	7.5	2.20480	11	60.0	1.02744		225.0	0.57099
	8.0	2.17716		65.0	1.01475		230.0	0.55715
	8.5	2.14994		70.0	1.00193	5	235.0	0.54327
27	9.0	2.12245	10	75.0	0.98892		240.0	0.52983
	9.5	2.10065		77.4	0.98264		245.0	0.51639
	10.0	2.07844		80.0	0.97557		250.0	0.50302
	11.0	2.03712		85.0	0.96216		255.0	0.48965
	12.0	1.99736		90.0	0.91877		260.0	0.47625
	13.0	1.95641	9	95.0	0.93535	4	265.0	0.46292
26	14.0	1.91202		100.0	0.92166		270.0	0.44925
	15.0	1.85236		105.0	0.90798		275.0	0.43559
	16.0	1.79177		110.0	0.89426		280.0	0.42178
	17.0	1.73193		115.0	0.88052	3	285.0	0.40797
25	18.0	1.66870		120.0	0.86676		290.0	0.39375
	19.0	1.59215		125.0	0.85298		295.0	0.37951
	20.0	1.51139	8	130.0	0.83936		300.0	0.36515
	21.0	1.43234		135.0	0.82531	2	305.0	0.35078
24	22.0	1.34993		140.0	0.81142		310.0	0.33599
23	23.0	1.28434		145.0	0.79749		315.0	0.32121
22	24.0	1.23212		150.0	0.78351		320.0	0.30643
21	25.0	1.18995		155.0	0.76950		325.0	0.29159
20	26.0	1.16027		160.0	0.75544	1	330.0	0.27665
19	27.0	1.14015		165.0	0.74135			
18	28.0	1.12689	7	170.0	0.72739			

Table A-3. Curve #2: DT-500DRC-D Voltage/Temperature Characteristics

BP#	Temp. K	PROM Voltage	BP#	Temp. K	PROM Voltage	BP#	Temp. K	PROM Voltage
	1.4	2.5984	24	21.0	1.3505		180.0	0.70757
	1.5	2.5958		22.0	1.3006		185.0	0.69344
	1.6	2.5932	23	23.0	1.2507		190.0	0.67931
	1.7	2.5906		24.0	1.2114		195.0	0.65518
	1.8	2.5880	22	25.0	1.1720		200.0	0.65105
	1.9	2.5854	21	26.0	1.1486		205.0	0.63693
30	2.0	2.5828	20	27.0	1.1308		210.0	0.62280
	2.2	2.5735	19	28.0	1.1190		215.0	0.60867
	2.4	2.5643	18	29.0	1.1116	8	220.0	0.59455
	2.6	2.5551	17	30.0	1.1058		225.0	0.58080
	2.8	2.5458	16	32.0	1.0970		230.0	0.56707
29	3.0	2.5366	15	34.0	1.0902		235.0	0.55334
	3.2	2.5226		36.0	1.0850	7	240.0	0.53960
	3.4	5.5086		38.0	1.0798		245.0	0.52649
	3.6	2.4946	14	40.0	1.0746		250.0	0.51337
	3.8	2.4807		45.0	1.0633		255.0	0.50026
	4.0	2.4667		50.0	1.0520		260.0	0.48714
	4.2	2.4527	13	55.0	1.0407	6	265.0	0.47403
	4.4	2.4387		60.0	1.0287		270.0	0.46057
	4.6	2.4247		65.0	1.0166		275.0	0.44711
	4.8	2.4108	12	70.0	1.0046		280.0	0.43365
	5.0	2.3968		75.0	0.99172	5	285.0	0.42019
	5.5	2.3618		80.0	0.97890		290.0	0.40613
	6.0	2.3269		85.0	0.96609		295.0	0.39208
	6.5	2.2919	11	90.0	0.95327		300.0	0.37802
	7.0	2.2570		95.0	0.93987	4	305.0	0.36397
	7.5	2.2220		100.0	0.92647		310.0	0.34940
	8.0	2.1871		105.0	0.91307		315.0	0.33482
	8.5	2.1521		110.0	0.89966		320.0	0.32025
28	9.0	2.1172		115.0	0.88626		325.0	0.30568
	9.5	2.0909		120.0	0.87286		330.0	0.29111
	10.0	2.0646		125.0	0.85946		335.0	0.27654
	11.0	2.0119	10	130.0	0.84606		340.0	0.26197
	12.0	1.9592		135.0	0.83228	3	345.0	0.24739
27	13.0	1.9066		140.0	0.81850		350.0	0.23325
	14.0	1.8338		145.0	0.80472		355.0	0.21911
26	15.0	1.7610		150.0	0.79094		360.0	0.20497
	16.0	1.6984		155.0	0.77716	2	365.0	0.1908.
25	17.0	1.6359		160.0	0.76338		370.0	0.17774
	18.0	1.5646		165.0	0.74961		375.0	0.16464
	19.0	1.4932	9	170.0	0.73582	1	380.0	0.15155
	20.0	1.4219		175.0	0.72170			

Table A-4. Curve #3: DT-500DRC-E1 Voltage/Temperature Characteristics

BP#	Temp. K	PROM Voltage	BP#	Temp. K	PROM Voltage	BP#	Temp. K	PROM Voltage
30	1.4	2.6591		18.0	1.6527		145.0	0.8035
	1.5	2.6567		19.0	1.5724		150.0	0.7896
	1.6	2.6542		20.0	1.4922		155.0	0.7758
	1.7	2.6518		21.0	1.4120		160.0	0.7620
	1.8	2.6494		22.0	1.3317		165.0	0.7482
	1.9	2.6470		23.0	1.2837	7	170.0	0.7344
29	2.0	2.6446		24.0	1.2357		175.0	0.7202
	2.2	2.6355	21	25.0	1.1877		180.0	0.7060
	2.4	2.6265	20	26.0	1.1559		185.0	0.6918
	2.6	2.6175	19	27.0	1.1365		190.0	0.6777
	2.8	2.6084	18	28.0	1.1239		195.0	0.6635
28	3.0	2.5994	17	29.0	1.1150		200.0	0.6493
	3.2	2.5868	16	30.0	1.1080		205.0	0.6351
	3.4	2.5742	15	32.0	1.0981		210.0	0.6210
	3.6	2.5616	14	34.0	1.0909		215.0	0.6068
	3.8	5.5490	13	36.0	1.0848	6	220.0	0.5926
27	4.0	2.5364		38.0	1.0797		225.0	0.5789
	4.2	2.5221	12	40.0	1.0746		230.0	0.5651
	4.4	2.5077		45.0	1.0630		235.0	0.5514
	4.6	2.4934		50.0	1.0515		240.0	0.5377
	4.8	2.4791		55.0	1.0399		245.0	0.5246
	5.0	2.4648	11	60.0	1.0284		250.0	0.5115
	5.5	2.4290		65.0	1.0159		255.0	0.4984
	6.0	2.3932		70.0	1.0035		260.0	0.4853
	6.5	2.3574		75.0	0.9944	4	265.0	0.4722
	7.0	2.3216		77.35	0.9849		270.0	0.4588
	7.5	2.2858		80.0	0.9780		275.0	0.4454
	8.0	2.2500		85.0	0.9649		280.0	0.4320
	8.5	2.2142		90.0	0.9518	3	285.0	0.4186
26	9.0	2.1784		95.0	0.9388		290.0	0.4045
	9.5	2.1516	9	100.0	0.9257		295.0	0.3904
	10.0	2.1247		105.0	0.9122		300.0	0.3763
	11.0	2.0708		110.0	0.8988	2	305.0	0.3622
	12.0	2.0170		115.0	0.8853		310.0	0.3476
25	13.0	1.9632		120.0	0.8718		315.0	0.3330
	14.0	1.9011		125.0	0.8584		320.0	0.3184
	15.0	1.8390	8	130.0	0.8449		325.0	0.3038
	16.0	1.7769		135.0	0.8311	1	330.0	0.2893
	17.0	1.7148		140.0	0.8173			

Table A-5. Curve #4: CTI Diode Voltage/Temperature Characteristics

BP#	Temp. K	PROM Voltage	BP#	Temp. K	PROM Voltage	BP#	Temp. K	PROM Voltage
29	10.0	1.4000		55.0	1.0235		190.0	0.6545
28	11.0	1.3850	21	60.0	1.0100	8	195.0	0.6408
27	12.0	1.3656	20	65.0	0.9958		200.0	0.6270
	13.0	1.3400		70.0	0.9822		205.0	0.6133
26	14.0	1.3161		75.0	0.9690		210.0	0.5885
	15.0	1.2750	19	77.4	0.9626		215.0	0.5858
	16.0	1.2350		80.0	0.9560		220.0	0.5720
	17.0	1.1910	18	85.0	0.9440		225.0	0.5583
25	18.0	1.1500	17	90.0	0.9314		230.0	0.5445
24	19.0	1.1290	16	95.0	0.9184		235.0	0.5308
23	20.0	1.1162	15	100.0	0.9049		240.0	0.5170
	21.0	1.1135		105.0	0.8907		245.0	0.5032
	22.0	1.1109	14	110.0	0.8769	7	250.0	0.4896
	23.0	1.1084	13	115.0	0.8625		255.0	0.4757
	24.0	1.1058		120.0	0.8500		260.0	0.4620
	25.0	1.1033	12	125.0	0.8376		265.0	0.4481
	26.0	1.1007	11	130.0	0.8245	6	270.0	0.4341
	27.0	1.0981		135.0	0.8109		275.0	0.4197
	28.0	1.0955	10	140.0	0.7971	5	280.0	0.4050
	29.0	1.0929		145.0	0.7828	4	285.0	0.3911
	30.0	1.0903		150.0	0.7685		290.0	0.3775
	32.0	1.0851		155.0	0.7543	3	295.0	0.3640
	34.0	1.0799		160.0	0.7400		300.0	0.3510
22	36.0	1.0747	9	165.0	0.7255	2	305.0	0.3382
	38.0	1.0693		170.0	0.7114		310.0	0.3243
	40.0	1.0640		175.0	0.6972		315.0	0.3106
	45.0	1.0505		180.0	0.6830	1	320.0	0.2968
	50.0	1.0370		185.0	0.6690			

Table A-6. Curve #5: DT-500DI-8C Voltage/Temperature Characteristics

BP#	Temp. K	PROM Voltage	BP#	Temp. K	PROM Voltage	BP#	Temp. K	PROM Voltage
29	4.0	2.6187	23	24.0	1.2317		135.0	0.8377
	4.2	2.6074	22	25.0	1.1900		140.0	0.8243
	4.4	2.5956	21	26.0	1.1602		145.0	0.8108
	4.6	2.5834	20	27.0	1.1402	7	150.0	0.7974
	4.8	2.5709	19	28.0	1.1269		155.0	0.7837
	5.0	2.5580	18	29.0	1.1173		160.0	0.7701
28	5.2	2.5484	17	30.0	1.1100		165.0	0.7564
	5.4	2.5312	16	31.0	1.1039		170.0	0.7427
	5.6	2.5173		32.0	1.0991		175.0	0.7289
	5.8	2.5033	15	33.0	1.0949	6	180.0	0.7152
	6.0	2.4890		34.0	1.0913		185.0	0.7013
	6.5	2.4524	14	35.0	1.0879		190.0	0.6874
	7.0	2.4151		36.0	1.0850		195.0	0.6734
	7.5	2.3773		37.0	1.0822		200.0	0.6595
	8.0	2.3394	13	38.0	1.0795		205.0	0.6455
27	8.5	2.2976		39.0	1.0770		210.0	0.6315
	9.0	2.2643		40.0	1.0746		215.0	0.6176
	9.5	2.2277		42.0	1.0697	5	220.0	0.6036
	10.0	2.1919	12	44.0	1.0649		225.0	0.5898
	10.5	2.1566		46.0	1.0603		230.0	0.5761
	11.0	2.1221		48.0	1.0558		235.0	0.5625
	11.5	2.0881		50.0	1.0512	4	240.0	0.5490
	12.0	2.0545		52.0	1.0467		245.0	0.5358
	12.5	2.0211		54.0	1.0421		250.0	0.5226
	13.0	1.9875		56.0	1.0376		255.0	0.5096
	13.5	1.9537		58.0	1.0330		260.0	0.4966
	14.0	1.9193	11	60.0	1.0285		265.0	0.48.6
	14.5	1.8843		65.0	1.0168		270.0	0.4705
	15.0	1.8480		70.0	1.0049		275.0	0.4574
	15.5	1.8110	10	75.0	0.9930	3	280.0	0.4442
	16.0	1.7748		77.4	0.9870		285.0	0.4307
26	16.5	1.7441		80.0	0.9805		290.0	0.4171
	17.0	1.7047		85.0	0.9680		295.0	0.4035
	17.5	1.6702		90.0	0.9553	2	300.0	0.3898
	18.0	1.6361	9	95.0	0.9427		305.0	0.3758
	18.5	1.6022		100.0	0.9297		310.0	0.3618
	19.0	1.5676		105.0	0.9168		315.0	0.3477
	19.5	1.5316		110.0	0.9038		320.0	0.3336
	20.0	1.4950		115.0	0.8907		325.0	0.3194
	21.0	1.4218	8	120.0	0.8777	1	330.0	0.3054
25	22.0	1.3461		125.0	0.8643			
24	23.0	1.2840		130.0	0.8510			

Table A-7. Curve #6: DT-470 Voltage/Temperature Characteristics

BP#	Temp. K	PROM Voltage	BP#	Temp. K	PROM Voltage	BP#	Temp. K	PROM Voltage	BP#	Temp. K	PROM Voltage
29	1.4	1.69808		10.5	1.40615		52.0	1.06700		260.0	0.61465
	1.5	1.69674		11.0	1.39287		54.0	1.06346		265.0	0.60273
	1.6	1.69521		11.5	1.38021		56.0	1.05988		270.0	0.59080
	1.7	1.69355	25	12.0	1.36687		58.0	1.05629		275.0	0.57886
	1.8	1.69177		12.5	1.35647	14	60.0	1.05277	6	280.0	0.56707
	1.9	1.68987		13.0	1.34530		65.0	1.04353		285.0	0.55492
28	2.0	1.68912		13.5	1.33453		70.0	1.03425		290.0	0.54294
	2.1	1.68574		14.0	1.32412		75.0	1.02482		295.0	0.53093
	2.2	1.68352		14.5	1.31403	13	77.4	1.02044		300.0	0.51892
	2.3	1.68121		15.0	1.30422		80.0	1.01525		305.0	0.50689
	2.4	1.67880	24	15.5	1.29340		85.0	1.00552		310.0	0.49484
	2.5	1.67632		16.0	1.28527		90.0	0.99565		315.0	0.48278
	2.6	1.67376		16.5	1.27607	12	95.0	0.98574		320.0	0.47069
	2.7	1.67114		17.0	1.26702		100.0	0.97550		325.0	0.45858
	2.8	1.66845		17.5	1.25810		105.0	0.96524		330.0	0.44647
	2.9	1.66571		18.0	1.24928		110.0	0.95487		335.0	0.43435
	3.0	1.66292		18.5	4.24053	11	115.0	0.94455	5	340.0	0.42238
	3.1	1.66009		19.0	1.23184		120.0	0.93383		345.0	0.41003
	3.2	1.65721		19.5	1.22314		125.0	0.92317		350.0	0.39783
	3.3	1.65430	23	20.0	1.21555		130.0	0.91243		355.0	0.38561
	3.4	1.65134		21.0	1.19645		135.0	0.90161		360.0	0.37337
	3.5	1.64833		22.0	1.17705	10	140.0	0.89082		365.0	0.36110
	3.6	1.64529		23.0	1.15558		145.0	0.87976		370.0	0.34881
	3.7	1.64219	22	24.0	1.13598		150.0	0.86873		375.0	0.33650
27	3.8	1.64112	21	25.0	1.12463		155.0	0.85764		380.0	0.32416
	3.9	1.63587	20	26.0	1.11896		160.0	0.84650		385.0	0.31180
	4.0	1.63263	19	27.0	1.11517	9	165.0	0.83541	4	390.0	0.29958
	4.2	1.62602	18	28.0	1.11202		170.0	0.82404		395.0	0.28700
	4.4	1.61920		29.0	1.10945		175.0	0.81274		400.0	0.27456
	4.6	1.61220		30.0	1.10702		180.0	0.80138		405.0	0.26211
	4.8	1.60506	17	31.0	1.10465		185.0	0.78999		410.0	0.24963
	5.0	4.59782		32.0	1.10263		190.0	0.77855		415.0	0.23714
	5.2	1.59047		33.0	1.10060	8	195.0	0.76717		420.0	0.22463
	5.4	1.58303		34.0	1.09864		200.0	0.75554		425.0	0.21212
	5.6	1.57551		35.0	1.09675		205.0	0.74398		430.0	0.19961
	5.8	1.56792	16	36.0	1.09477		210.0	0.73238	3	435.0	0.18696
	6.0	1.56027		37.0	1.09309		215.0	0.72075		440.0	0.17464
	6.5	1.54097		38.0	1.09131		220.0	0.70908		445.0	0.16221
	7.0	1.52166		39.0	1.08955		225.0	0.69737		450.0	0.14985
	7.5	1.50272		40.0	1.08781	7	230.0	0.68580		455.0	0.13759
	8.0	1.48443		42.0	1.08436		235.0	0.67387	2	460.0	0.12536
	8.5	1.46700	15	44.0	1.08105		240.0	0.66208		465.0	0.11356
26	9.0	1.44850		46.0	1.07748		245.0	0.65026		470.0	0.10191
	9.5	1.43488		48.0	1.07402		250.0	0.63841	1	475.0	0.09032
	10.0	1.42013		50.0	1.07053		255.0	0.62654			

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APPENDIX B

MODEL 818/819 MOUNTING ADAPTER

To mount the Model 818/819 in a ¼-panel EIA rack space, use the optional Model 818/819 Mounting Adapter shown in Figure B-1.

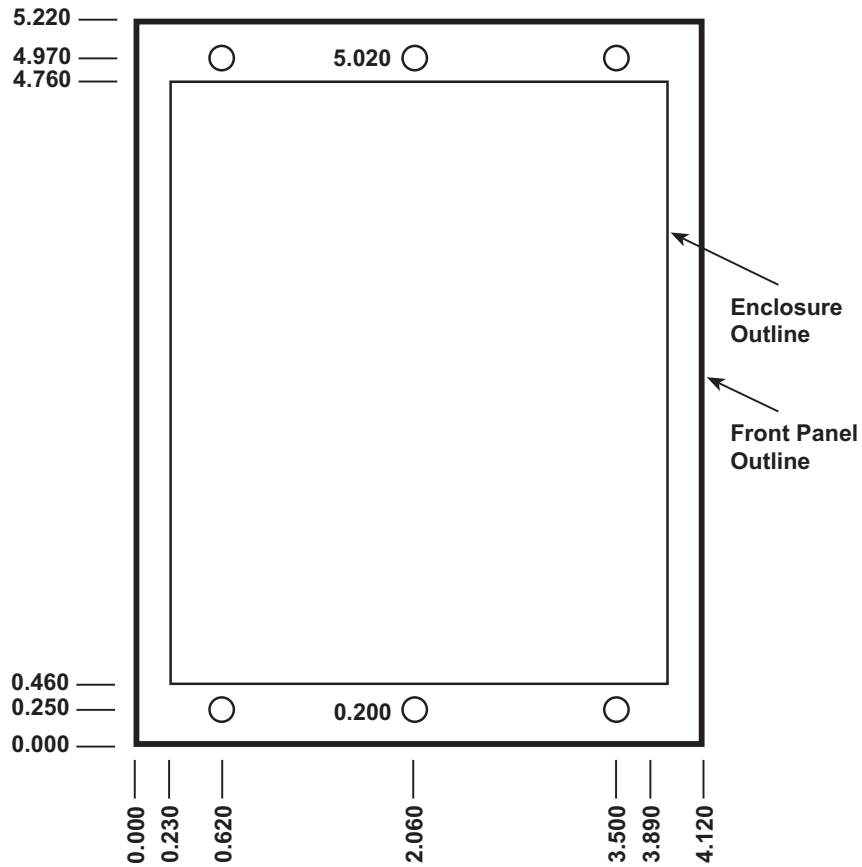


Figure B-1. Model 818/819 Mounting Detail

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APPENDIX C

SAMPLE RS-232 QUICK BASIC COMMUNICATION PROGRAM

```
1:      OPEN "com1:300,o,7,1,RS" FOR RANDOM AS #1 LEN = 256
2:  L1:  INPUT "ENTER COMMAND"; A$
3:      PRINT #1, A$ + CHR$ (13) + CHR$ (10);
4:      LINE INPUT #1, B$
5:      PRINT B$
6:      GOTO L1
```

Line 1: Defines COM1 port for input/output at 300 baud, odd parity, 7 data bits, and 1 stop bit. The (LEN) value selects the maximum length of the input/output string in ASCII characters.

Line 2: Prompts for the command and enters it into variable **A\$**.

Line 3: Sends the command to the Model 818/819. **CHR\$ (13)** is a Carriage Return and **CHR\$ (10)** is a Line Feed. The semi-colon at the end suppresses the automatic Carriage Return.

Line 4: Retrieves the Model 818/819 response. If the Model 818/819 does not respond, the program stops and waits for a response. It stores the response in variable **B\$**.

Line 5: Prints the Model 818/819 response on the screen.

Line 6: Jumps back to line 2, in effect, starting the program over.

To stop the program, or if the program receives no response from the Model 818/819, press and hold the Control (CTRL) key and the Break on the computer keyboard.

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