DTS3250/16Tx
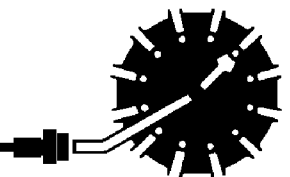**SN 1100 and Higher**
DTS3250/32Tx

DTS3250/64Tx
Thermocouple Scanners
Instruction and Service Manual
Software Version DTS V4.19

8/2014

Scanivalve Corp.

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Configuration Variables

Specifications

Inputs (Tx): 16, 32 , or 64 pairs of screw terminals plus shields. Optional Panel Jack connections available

Thermocouple Types: B, E, J, K, N, R, S, and T

DTS3250 Accuracy[1]:

E. J, K, N and T ±0.5°C
R and S ±2.0°C
B (400°C to 1800°C) ±4.0°C

UTR Accuracy: ±0.1°C

A/D Resolution: 22 Bit (Each channel)

Scan Rate:

DTS3250/16Tx 40 samples/channel/second
DTS3250/32Tx 20 samples/channel/second
DTS3250/64Tx 10 samples/channel/second

Operating Temperature:

Without Heater -10°C to 60°C
With Heater -20°C to 60°C (16 and 32 channel versions only)

Communication: Ethernet 10Base-T (standard)
RS-232 (Configuration Only)

Communication Protocol: TCP/IP or UDP

Mating Connector Type:

Ethernet Bendix PT06A-8-4S-SR, 4 pin female
Power Bendix PTO6A-8-3S-SR, 3 pin female
Trigger/Configuration Bendix JTO6RE8-6S-SR, 6 pin female

Power (21-36Vdc)**:**

DTS3250/16Tx
Standard 28Vdc nominal @, 9 VA quiescent
With Heater 28Vdc nominal @, 70 VA during warmup
DTS3250/32Tx
Standard 28Vdc nominal @, 14 VA quiescent
With Heater 28Vdc nominal @, 140 VA during warmup
DTS3250/64Tx
Standard 28Vdc nominal @, 27 VA quiescent
With Heater Heater Option not available for 64 channel models

External Trigger: 9 to 15 Vdc @ 6.5 mA minimum, leading edge sensing

Common Mode Rejection: 160 db @ 0 - 60 Vdc

Weight:

DTS3250/16Tx	Standard Unit:	13.0 pounds(5.91 kg)
	Panel Jacks:	12.0 pounds(5.45 kg)
DTS3250/32Tx	Standard Unit:	14.5 pounds(6.59 kg)
	Panel Jacks:	14.0 pounds(6.36 kg)
DTS3250/64Tx	Standard Unit:	25.0 pounds(11.36 kg)
	Rack Mount:	28.0 pounds(12.73 kg)

Input/Output Isolation: 1000 Vdc

CE Mark Standards[2]:   IEC 1000-4.2, 1000-4.3, 1000-4.5

[1] System accuracy specifications are valid after a three(3) hour warm up period.
  Accuracy does not include Thermocouples, Thermocouple Extension Wire, or the Panel Jack option.
[2] CE Mark certification applies to the screw terminal versions only.

General Description

The DTS3250 series thermocouple acquisition system represents the next generation of Intelligent temperature scanning. This Digital Thermocouple Scanner incorporates 16, 32 or 64 pair of thermocouple inputs, An 22 bit A/D converter for each input channel, RAM, and a micro-processor, in a rugged temperature controlled stand alone module.

An Isothermal block is incorporated for the Uniform Temperature Reference (UTR), with a ± 0.1 °C accuracy. NIST thermocouple tables for standard thermocouple types are stored in Flash Memory. The microprocessor uses these look-up tables to convert mV inputs to Engineering units. Temperature data may be output in °C, °F, °R, K, Volts, or A/D counts .

The DTS3250 total system error is ± 0.2 °C for E, J, K, and N thermocouples, not including extension wire and external connectors, or panel jacks..

Multiple standard thermocouple types may be used with this intelligent thermocouple scanner. The DTS 3250 can accept grounded and un-grounded thermocouples.

Figure 1 - DTS3250/16Tx Both Versions

Figure 2 - DTS3250/32Tx Screw Terminal Version

Figure 3 - DTS3250/64Tx Screw Terminal Version

DTS3250 Versions

Screw Terminal Version

This is the standard configuration for all DTS3250 modules. DTS3250 modules are available in versions that will accept 16, 32 or 64 shielded thermocouples. The top cover and insulation isolate the UTR from small temperature changes giving this unit the best accuracy. This unit also has CE Mark certification for both Heavy and Light Industrial. The 16 channel version is shown in Figure 1. Dimensions of the DTS3250/16Tx are shown in Figure 6. Dimensions of the DTS3250/32Tx are shown in Figure 7. Dimensions of the DTS3250/64Tx are shown in Figure 8.

Panel Jack Version

DTS 3250 modules may have panel jacks installed as an option in all versions. This option is available for type E, J, K, and T Thermocouples only. This option has a reduced accuracy of ±2.0°C. This error may be calibrated out by a user using the Gain and Offset terms. CE Mark certification is not available for this configuration. A 16 channel type K panel jack version is shown in Figure 1. Unused panel jacks must be plugged to prevent "cold spots" on the UTR which will cause errors.

Panel Mount Version

DTS 3250/64Tx modules may be ordered in either the standard shock mount configuration or in an optional Panel mount configuration.. The Panel Mount configuration is designed to be mounted in a standard 19 inch rack mount cabinet. The mounting ears may be reversed to facilitate mounting. This configuration is shown in Figure 9.

Temperature Measurement Basics

A thermocouple is a temperature sensor consisting of two leads made from different materials. The two leads are connected at one end, which is the measuring point of the thermocouple. The other end of the leads is connected to the DTS3250 cold junction (UTR).

The thermocouple output is a mV signal, typically called Electromotive Force (EMF). The EMF is a function of the difference of the dissimilar metals at the temperature source. The relation between EMF and temperature difference depends on the materials in the two thermocouple leads.

There are a number of standardized thermocouple types available on the market. Each has different properties, which makes them more or less suitable for different temperature ranges and applications.

Accuracy of a thermocouple measurement is highly dependent upon the reference junction connection, its material installation techniques, and temperature.

The DTS3250 intelligent thermocouple scanner measures the mV signal from the thermocouples and compensates for the temperature of the cold junction .

NIST ITS-90 mV-temperature tables for each type thermocouple listed in this manual are stored in the DTS3250 memory. The DTS3250 microprocessor utilizes the compensated EMF and the NIST look-up table for conversion to engineering units. Temperature data are then output via Ethernet with TCP/IP protocol.

Refer to Appendix A for more information on Thermocouples.

Figure 4 below shows a function block diagram of the DTS 3250.
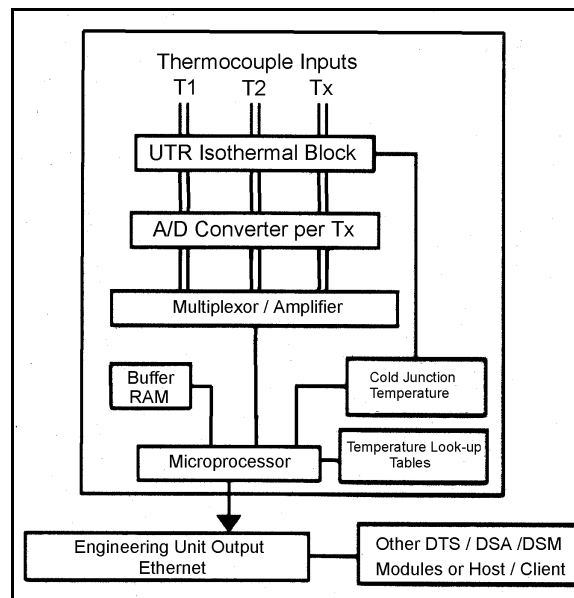
Figure 4 - DTS3250 Block Diagram

DTS Network/Firmware

DTS3250 modules accept software commands via Ethernet only. The DTS3250 modules may be controlled with an external hardware or software scan trigger.

Each DTS module has a unique factory set 48 bit MAC address. When running TCP/IP protocol, the DTS3250 modules support ARP (Address Resolution Protocol) to enable the client/host to determine the relationship between the IP address and the Ethernet address. The IP address is user assignable.

All scan and calibration variables are configured through software by the user. This includes number of frames per scan, number of averages per frame, sampling speed, etc.

The DTS3250 firmware includes an open thermocouple test and an A/D re-zero function. The firmware contains Field calibrations which can be used to modify coefficients which can improve end to end accuracy. The RS232 communication connection may be used for firmware uploads and network configuration only. This connector also contains the external trigger input connections.

Figure 5 below shows a typical Pressure and Temperature Scanning system.
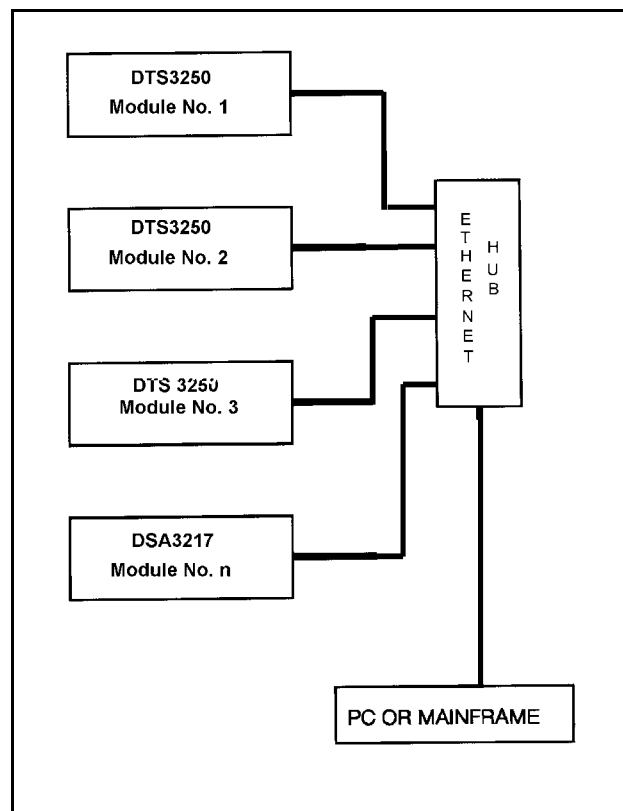
Figure 5 - Typical Pressure/Temperature Scanning System

DTS3250/16Tx Dimensions

13.50 (34.29)

12.00 (30.48)

.39 (0.98)

1.00 (2.54)

6.19 (15.72)

2.09 (5.32)

4.19 (10.64)

6-32 Brass Terminal Screws for Thermocouple wires

NOTE: Lid and Top Insuation removed in this view

Aluminum Alloy Isothermal Block Cold Junction Reference
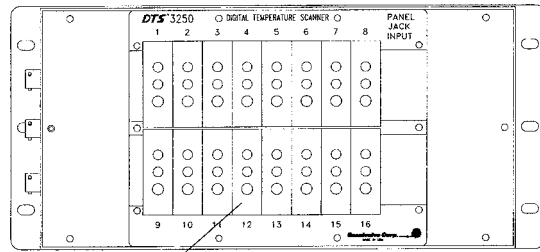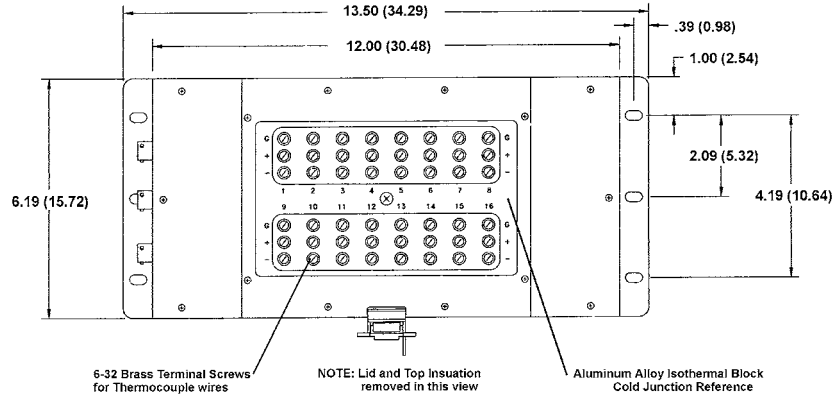
Three terminal Panel Jack connectors mounted directly to the Aluminum IsoThermal Block

NOTE: Lid and Top Insulation are removed in this configuration

Standard Version End View
Not Shown

5.12 (12.99)

Standard Screw Terminal Version

5.34 (13.57)

Panel Jack Version - End View

Panel Jack Version
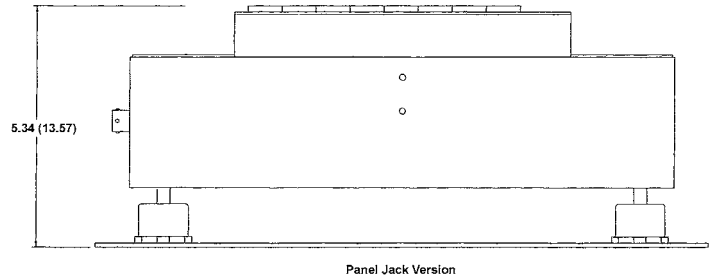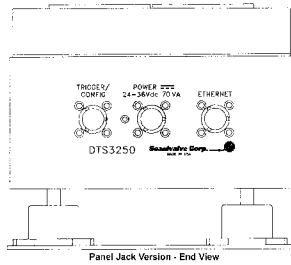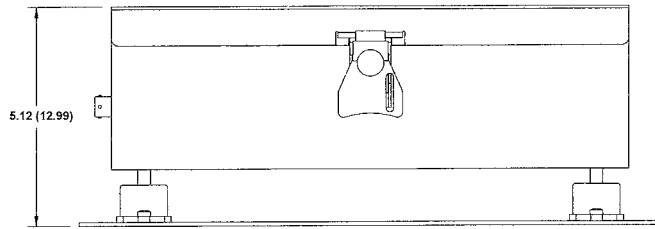
Figure 6 - DTS3250/16 Dimensions

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DTS3250/32Tx Dimensions

10.75 [273]

6-32 BRASS
THERMOCOUPLE
SCREW TERMINALS
FOR THERMOCOUPLE
WIRE CONNECTION

10.5 [266.7]

12.0 [304.8]

ALUMINUM ALLOY
ISOTHERMAL BLOCKS
CHANNELS 1-16
CHANNELS 17-32

REMOVABLE LID
WITH BONDED FOAM,
ADJUST AND CLAMP
OVER THERMOCOUPLE WIRES

SPLASH RESISTANT
STAINLESS STEEL
ENCLOSURE

CAPTIVE
LOCKNUTS

NOTE: LID REMOVED IN THESE VIEWS

10.5 [266.7]

4.8 [121.3]

ETHERNET CONNECTION
10BASE-T

EXTERNAL TRIGGER/
MODULE CONFIGURATION

POWER INDICATOR

VIBRATION AND
SHOCK ISOLATOR

POWER (18-36VDC)

5.6 [142.1]

Figure 7 - DTS3250/32Tx Dimensions

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DTS3250/64Tx Dimensions

Figure 8 - DTS3250/64TX Dimensions

DTS3250/64Tx Panel Mount
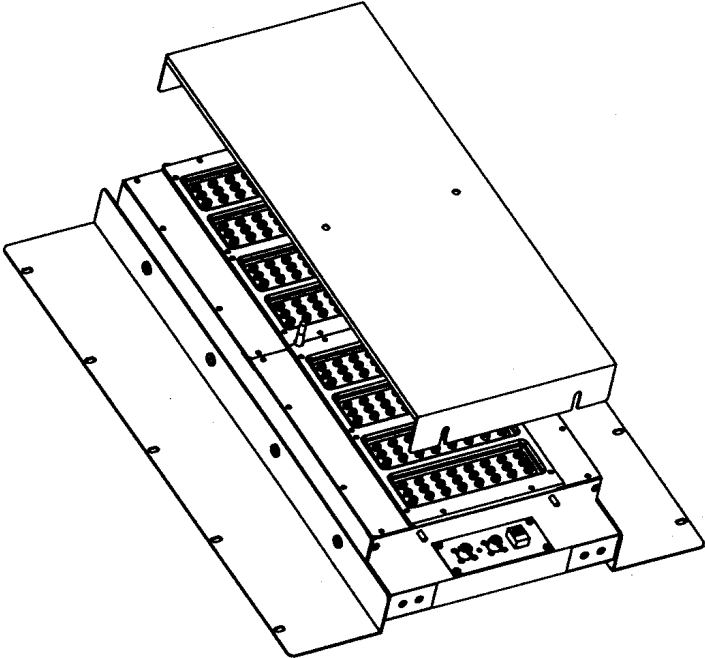
Figure 9 - DTS3250/64Tx Panel Mount

Calibration Requirements

Introduction

All DTS 3250 Thermocouple Scanner Modules are calibrated before they are shipped. The calibration is traceable to NIST. A certificate of Conformance is provided with each unit. Calibration data for each module are maintained in a history file at Scanivalve Corp. These data will be supplied to a customer , if requested.

All DTS3250 Thermocouple Scanner modules must be re-calibrated every six months in order to maintain accuracy. Calibrations may be performed at the Scanivalve factory, or by a customer. Customers who wish to perform their own calibrations should use a free Scanivalve Corp utility program, **TEMPCAL**. This program may be downloaded from the Scanivalve Corp website: www.scanivalve.com

Equipment Required

In order to maintain NIST traceability, customer standards must meet the following criteria:

Secondary Voltage Standard -   Accuracy equal to or better than ±1.5 µV from -10 mV to 131 mVdc
Digital Volt/Ohmmeter -   Accuracy equal to or better than ±10 µV from 95 mV to 105 mV dc
100 ohm Standard Resistor -   Measured value accurate to ±0.001%

Additional equipment required:

Ice Point Reference
Thermocouple Simulator
DTS3250 Hardware and Software Manual
Scanivalve Field Calibration Kit - Scanco P/N: 21079, Consisting of:
      155870-1 DTS Calibration Board Set (a)
      155868-1 DTS RTD Extension Cable
      155869-1 RTD Measurement Cable
      21089-1 Calibration Insulation
      155386-1 TempCal software

Warning: It is very important that proper ESD precautions are followed when the DTS calibration board set is being installed or removed, or whenever cables are connected and disconnected.

Power Requirements

All DTS3250 modules require +28±4Vdc for an input voltage. The current requirements for each model may be found on the Specifications Pages. For modules with optional heaters used in an environment where the ambient temperature is10°C or less, current requirements could remain high. Power connections are made through a three pin connector located on the side of the module. The pinouts of the connector may be found in figure 10. The mating connector is a PT06A-8-3S-SR.
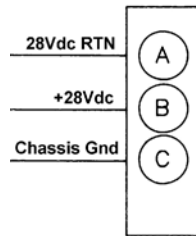
CO-613

Figure 10 - Digital Sensor Array Power Wiring

The power supply used to drive the DTS3250/16 must be capable of providing up to 2.5A initially at power up. The figure below shows the typical current inrush for a 16 channel DTS3250.
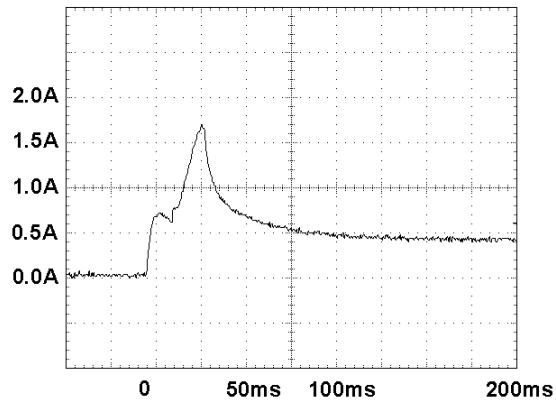
Figure 11 - DTS3250/16 Typical Inrush Current

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Trigger Requirements

Hardware Trigger

The DTS3250 scan functions may be synchronized with other data acquisition devices by using the external trigger. The external trigger input is opto-isolated to prevent grounding problems. It is a TTL level, edge sensing device. It requires a minimum signal of 9Vdc @ 6.5 mA. It may accept voltages as high as 15 Vdc.

The external trigger will only be active if the XSCANTRIG variable is set to 1. When a SCAN command is issued by the Client/Host, the module will enter the SCAN mode and wait for a trigger. An averaged frame of data will be output as soon as the minimum trigger edge level is achieved. Data will be output with each successive trigger pulse to the FPS variable (Frames per Scan) value or until a STOP command is issued.

DTS3250 Modules use a 6 pin connector for a combination Trigger and Serial Communications Interface. The wiring is shown in figure 12. The mating connector is a JT06RE8-6S-SR (Scanco Pn CO-737) .

```
+ Trig    ① 1
- Trig    ② 2
Tx        ③ 3
Rx        ④ 4
Gnd       ⑤ 5
          ⑥ 6
     JT01RE8-6S-SR
```
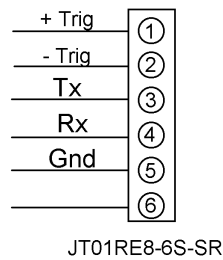
Figure 12 - Trigger wiring

Software Trigger

The DTS3250 may also be triggered with a software trigger. The software trigger will only be active if the XSCANTRIG variable is set to 1. When a SCAN command is issued by the Client/Host, the module will enter the SCAN mode and wait for a trigger. An averaged frame of data will be output as soon as the TRIG command or a <TAB> character (9 HEX or Control I) is received. Data will be output with each successive trigger command to the FPS variable (Frames per Scan) value or until a STOP command is issued.

RS 232 Communications

Every DTS3250 Module has a RS 232 output. It is available at the Serial Communications/Trigger Connector. It is required to configure the module IP address, or upload operating system upgrades. The wiring of the RS 232 output is shown in figure 13.

The RS232 inputs and outputs are not opto-isolated. Therefore, the RS232 connection could cause ground loops if it is connected during data acquisitions. Because the RS232 connection is only used for initial configuration, there is no need to maintain the connection after that setup is completed unless the external trigger function will be used.

If the RS232 connection is part of a combination Serial/Trigger cable, the RS232 connection at the host computer should be disconnected during data operations to prevent problems.

A combination RS232 and External Trigger test cable(Scanco PN 155829) is available as an option. The cable is shown below along with a wiring diagram.
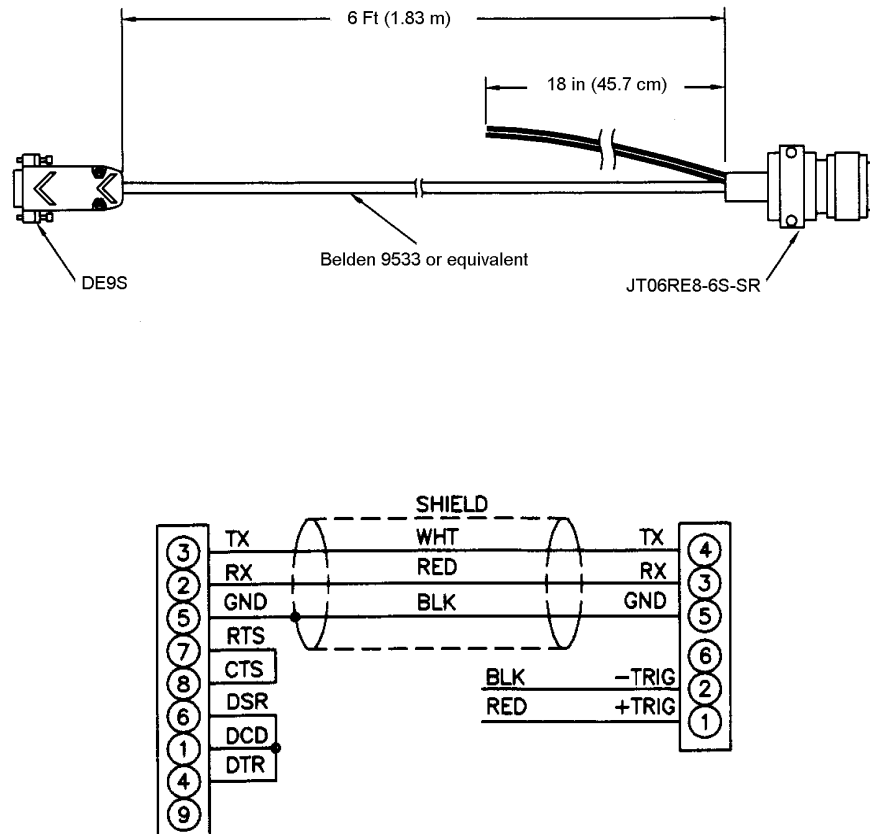
Figure 13 - RS232/ External Trigger Test Cable

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Ethernet Connections

The DTS3250 has provisions for 10Base-T Ethernet connections only. Ethernet 10Base-2 connections may be made with media converters.

10Base-T

The 10Base-T connection uses a Bendix connector at the module, which must be interfaced to the standard RJ-45 connector. A 10Base-T connection may be straight through(pin to pin) or crossover. A straight through cable must be used if the module is connected to a hub. Crossover connections are used if the module is connected directly to the host computer. It is recommended that Category Five cables be used. The maximum length for 10Base-T cables is 100 meters, but signal strength can be attenuated at this distance. A repeater is required for 10Base-T cable runs greater than 100 meters. Cables may be ordered from Scanivalve Corp. The pin to pin cable part number is 155820-01. The crossover cable part number is 155859-01. The cable length must be specified when the cable is ordered.
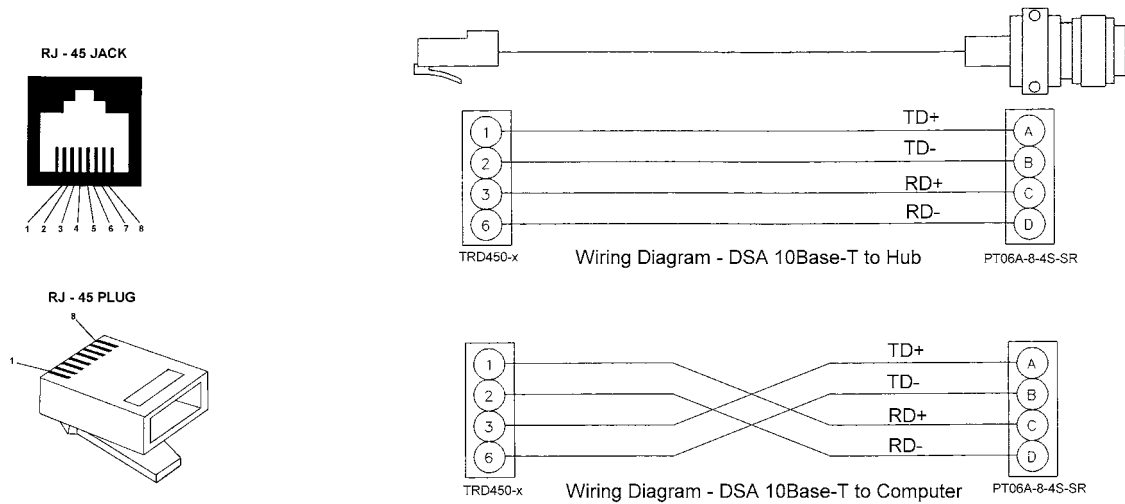
Figure 14 - DTS3250 10Base-T cables

DTS Control and Configuration

The operation of each DTS is controlled by sending ASCII commands over the TelNet port(port 23) to units selected by network addressing. The DTS returns any data or information over the network to the requesting client/host in ASCII or Binary format depending upon the settings of a configuration variable. Binary data transfers are delivered across an additional binary transfer port.

Binary transfers may be in TCP or UDP protocol. TCP requires that a Host provide a Host Binary Server program. When a DTS initiates the connection to the binary port, it can send data to the host in packet form. The port and IP address are configurable. When UDP protocol is used, no connection is required.

DTS Commands

The DTS software runs as embedded software on the DTS 3250 temperature scanner hardware. It performs the following general tasks:

    1) Read and filter the raw A/D counts that represent temperature.
    2) Convert the A/D counts to user chosen temperature units.
    3) Receive and execute commands from the Ethernet Link.
    4) Allow the configuration to be saved through power down.
    5) Output converted data, status, setup and calibration data over the Ethernet Link.
    6) Set the DTS Physical Ethernet Address(MAC Address).
    7) Protocol to be TCP/IP.
    8) Support the user in troubleshooting the DTS hardware and system.

When operating in the ASCII mode or UDP, the DTS is the client. In Binary or TCP mode, the DTS is the Host.

When a DTS module is in a "NOT READY" mode, all commands are disabled except STATUS and STOP.

TCP/IP does not guarantee that packet boundaries will be maintained between a Host and a DTS module. Therefore, **ALL** commands from a Host **MUST** be terminated properly with one of four options. The DTS will detect and adjust to the termination option being used by a Host.

The four options are:
>   CR (ASCII 13)
>   LF (ASCII 10)
>   LF-CR (ASCII 10 - ASCII 13)
>   CR-LF (ASCII 13 - ASCII 10)

The current DTS RS232 interface is designed for initial boot configuration only.

Command List

COMMAND	**A/D CALIBRATION**
COMMAND SYNTAX	**ADCAL**
ARGUMENTS	None
DESCRIPTION	Commands the DTS to calibrate the A/D converters. The A/D converters are calibrated automatically at power up and whenever the period configuration variable is set. It is possible for errors in the conversion if the temperature of the DTS has changed significantly since power up. In this case, the A/D converters can be calibrated by issuing this command.
RETURNS	*<nl>* *<nl>* - end of line.
EXAMPLE	To calibrate the A/D converters after several hours of operation, the following command would be issued: ADCAL <CR> The A/D converters will be calibrated. The time depends upon the setting of CALAVG. If CALAVG is set to 1, the time will be several seconds. If CALAVG is set to 64 this can require several minutes.
NOTE	It is recommended that a user check for A/D errors after the execution of this command. If an A/D times out or does not respond correctly, it will be disabled in software and an error will be logged. The error log is the only indication that this has occurred.

COMMAND	**AUTOSTATUS**
COMMAND SYNTAX	**AUTOSTATUS <enable>** **AS <enable>** **(**Optional)
ARGUMENTS	Enable - 0 or 1
DESCRIPTION	If autostatus enable is set to 1, the DTS will automatically output the status of the DTS whenever the status changes. When set to 0, status can only be determined by issuing a STATUS command. The condition at power up and after a reboot is AUTOSTATUS disabled.
RETURNS	*<nl>* *<nl>* - end of line.

EXAMPLE	To enable automatic output of the DTS status, the following command would be issued:
	    AUTOSTATUS 1
	To disable automatic output of the DTS status, the following command would be issued:
	    AUTOSTATUS 0

NOTE	AUTOTATUS was not set up as a configuration variable that could be saved to prevent conditions where the DTS would be talking on a network when it was not expected to be talking. An optional syntax is available. Either syntax will enable or disable Autostatus.

COMMAND	**CLEAR**
COMMAND SYNTAX	**CLEAR**
ARGUMENTS	None
DESCRIPTION	Commands the DTS to clear any errors that have occurred. The errors are sent to the client in an ASCII Packet. ASCII Packets are described in a subsequent sections.
RETURNS	*<nl>*
	<nl> - end of line.
EXAMPLE	To clear any errors listed in the ERROR Buffer, the following command would be issued:
	CLEAR <CR>
	The ERROR buffer will be cleared

COMMAND	**CLOSE HOST BINARY SERVER CONNECTION**
COMMAND SYNTAX	**CLOBIN**
ARGUMENTS	None
DESCRIPTION	Commands the DTS to close the connection to the Host Binary Server. This command will only be accepted by the DTS when the DTS is in the **READY** mode.
RETURNS	*<nl>*
	<nl> - end of line.
EXAMPLE	To close the connection to the Host Binary Server, the following command would be issued:
	CLOBIN <CR>
	The connection will be terminated

COMMAND	**CONNECT TO HOST BINARY SERVER**
COMMAND SYNTAX	**CONBIN**
ARGUMENTS	None
DESCRIPTION	Commands the DTS to connect to the Host Binary Server configured through the HOST configuration variable. If the DTS is in the UDP mode or if a TCP connection is already established, an Error will be generated. This command will only be accepted when the DTS is in the **READY** mode.
RETURNS	*<nl>*
	<nl> - end of line.

EXAMPLE 1	A DTS is not connected to a server, is not in the UDP mode and is in the READY mode. A CONBIN command is generated to open a connection to the Host. The following command would be issued:
	CONBIN <CR>
	The DTS will be connected to the Host.

EXAMPLE 2	A DTS is not connected to a server, is in the UDP mode and is in the READY mode. A CONBIN command is generated to open a connection to the Host. The following command would be issued:
	CONBIN <CR>
	The DTS will not connect to the Host and an Error will be generated.

EXAMPLE 3	A DTS is not connected to a server, is in the UDP mode and is in the SCAN mode. A CONBIN command is generated to open a connection to the Host. The following command would be issued:
	CONBIN <CR>
	The DTS will not connect to the Host and an Error will be generated.

COMMAND	**CORRECT RTD VOLTAGE TABLES**
COMMAND SYNTAX	**ARPC <Reference Temperature> <board>**
ARGUMENTS	Reference Temperature - The indicated temperature of the standard RTD.
	Board - The board set to be corrected. (1 to 4)

DESCRIPTION	This command calculates the voltage difference, in microvolts between the Reference RTD value and the voltage value of the RTDs in the board set entered in the command. The calculated value is stored in the ARPC variable for that board set. If ARPCON is set to 1, this value will be used to correct the board set RTD voltages before the Calander Van-Duse correction is applied to the RTDs. The ARPC command may only be entered for the number of board sets installed. Board values outside the allowed number will result in an error.

EXAMPLES	To calculate a correction for board 1 in a 16 channel module when the reference RTD is 29.95 degrees C:
	Type: ARPC 29.95 1<Enter>

NOTE	This command will update the ARPC variables, but the data will not be saved until a SAVE command is issued. Scanivalve Corp recommends that a user verify that the correction generated is valid before issuing a SAVE command. The values stored in the ARPC variables will be lost if power is cycled before a SAVE command is executed.
COMMAND	**ENTER CHANNEL CALIBRATION SETPOINTS**

COMMAND SYNTAX	**PT \<index\> \<volts\> [channel]**
ARGUMENTS	Index - The setpoint number, 0 to 7 for setpoints 1 to 8.
	Volts- The applied voltage.
	Channel - Optional, If a channel is not specified, the setpoint voltage will be applied to all channels.
DESCRIPTION	This command syntax is only used when NUMTEMPS is set to 0. This command enters the voltage correction to be applied at a given setpoint for one or more channels. The values for the setpoints do not have specific limitations.
EXAMPLES	To enter a value for setpoint 1 for all channels:
	Type: PT 1 1.256\<Enter\>
	To enter a value for setpoint 2 for channel 9:
	Type: PT 2 1.744 9\<Enter\>
NOTE	This command syntax is used only if NUMTEMPS is set to 0. The value of NUMTEMPS **MUST NOT** be modified by an end user without detailed and specific training from Scanivalve Corp. If the value of NUMTEMPS is modified after the unit has been calibrated, **ALL** current calibration coefficients will be **LOST**.

COMMAND	**ENTER CHANNEL CALIBRATION SETPOINTS**
COMMAND SYNTAX	**PT \<T || R\> \<chan/board\> \<temp ndx\> \<temp\> \<pt ndx\> \<act volts\>**
ARGUMENTS	T || R - T/C or RTD
	Chan/board - A single channel, 1 to 64 for T/C or 1 to 4 for RTD A range of channels, start chan..end chan
	Temp ndx - The temperature index, from 1 to NUMTEMPS.
	Temp - The temperature of this point.
	Pt ndx - The index of this point from 1 to NUMPTS.
	Act volts - The actual applied volts.
DESCRIPTION	This command syntax is only used when NUMTEMPS is set to 1 or greater. This command enters the voltage correction at the temperature entered for a given setpoint for one or more T/C or RTD channels. The values for the setpoints do not have specific limitations.
EXAMPLES	To enter a value for Temperature channels 1 through 16 at 23 degrees Cif NUMTEMPS is set to 5 and NUMPTS is set to 8:
	Type: PT T 1 1..16 5 23 3 .256\<Enter\>
NOTE	This command syntax is used only if NUMTEMPS is set to 1 or greater. The value of NUMTEMPS **MUST NOT** be modified by an end user without detailed and specific training from Scanivalve Corp. If the value of NUMTEMPS is modified after the unit has been calibrated, **ALL** current calibration coefficients will be **LOST**.

COMMAND	**ENTER RTD CALIBRATION SETPOINTS**

COMMAND SYNTAX	**RPC \<index\> \<volts\> \<board\>**
ARGUMENTS	Index - The setpoint number, 0 to 7 for setpoints 1 to 8.
	Volts - The applied voltage.
	Board - The A/D board, 1, 2, 3 or 4
DESCRIPTION	This command enters the voltage correction to be applied at a given setpoint for the RTD's. The values for the setpoints must be between 0.095 Vdc and 0.131 Vdc which represents temperatures from -13 $^\circ$ C to 80 $^\circ$ C . The voltage for board 1 must be inserted in the RTD1 input. The voltage for board 2 must be inserted in the RTD3 input. The voltage for board 3 must be inserted in the RTD5 input. The voltage for board 4 must be inserted in the RTD7 input.

EXAMPLES   To enter a value for setpoint 1 for the RTD's on board 2:
                                     Type: RPC 1 0.095 2\<Enter\>

                       To enter a value for setpoint 2 for the RTD's on board 1:
                                     Type: RPC 2 0.998 1\<Enter\>

COMMAND	**ERROR**
COMMAND SYNTAX	**ERROR**
ARGUMENTS	None
DESCRIPTION	Lists the errors that are stored and listed after a CLEAR. Only the first 72 errors will be listed. If more than 72 errors have occurred, the message: "ERROR: Max Errors exceeded "will appear at the end of the list. The return format is:
	ERROR: error

EXAMPLE   To read the contents of the Error Buffer:
                                     Type: ERROR\<Enter\>

                       The DTS will return the last 72 errors in the format::

                       If no errors have been logged, the DTS will return:
                                     ERROR: No errors

COMMAND	**FILL**
COMMAND SYNTAX	**FILL**
ARGUMENTS	None
DESCRIPTION	Activates the setpoint data. If Setpoints are configured, a FILL will be executed automatically at power-up. A FILL can be executed manually at any time.

EXAMPLE   To execute a FILL and activate the setpoints:
                                     Type: FILL\<CR\>

COMMAND	**HOST BINARY SERVER COMMAND**
COMMAND SYNTAX	**HOST <command>**
ARGUMENTS	Command - An ASCII command that would be recognized by the Host Binary Server.
DESCRIPTION	This command will pass a Host Binary Server command through the DTS to the Host Binary Server
RETURNS	*<nl>*
	<nl> - end of line.

COMMAND	**ICE POINT OFFSET ADJUSTMENT**
COMMAND SYNTAX	**IPO *<start channel> <end channel>***
ARGUMENTS	*<start channel>* - the first channel to be adjusted.
	<end channel> - the last channel to be adjusted
DESCRIPTION	Commands the DTS to calculate and adjust the offset settings for the channels specified. If an end channel is not specified, only the start channel will be modified. This command assumes that 0 degrees C is applied to the specified channels. A SAVE command must be issued when this command is completed to make the changes permanent

COMMAND	**LIST CALIBRATION**
COMMAND SYNTAX	**LIST C**
ARGUMENTS	None
DESCRIPTION	Lists the calibration configuration variables.
EXAMPLE	To view the calibration configuration variable settings:
	Type: LIST C<CR>
	The DTS will return the calibration configuration variable settings. They could appear as follows.
	SET NUMCOEF 3
	SET NUMPTS 8
	SET CALAVG 4

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COMMAND	**LIST CHANNEL CORRECTION SETPOINTS**
COMMAND SYNTAX	**LIST P <channel>**
ARGUMENTS	Channel - is any valid channel number from 0 to 16, 32 or 64 depending on the module type.
DESCRIPTION	Lists the calibration setpoints for the channel listed. If channel 0 is specified, the setpoints for all channels will be listed.
EXAMPLE	To view the calibration setpoints for channel 1:

        Type: LIST P 1<CR>
        The DTS returns:
           SET PT 1 0 -0.010000 -275283
        SET PT 1 1 0.000000 1288
        SET PT 1 2 0.012000 333064
        SET PT 1 3 0.024000 664759
        SET PT 1 4 0.036000 996312
        SET PT 1 5 0.048000 1327909
        SET PT 1 6 0.060000 1659352
        SET PT 1 7 0.070000 1935411

NOTE1	The values shown here are values a typical one module. The actual calibration setpoints in a different module may be different.
NOTE2	This syntax is used only when NUMTEMPS is set to 0.

COMMAND	**LIST CHANNEL CORRECTION SETPOINTS**		
COMMAND SYNTAX	**LIST P [<T || R> <chan/board> <temp>]**		
ARGUMENTS	T || R	-	T/C or RTD
	Chan/board	-	A single channel, 1 to 64 for T/C or 1 to 4 for RTD A range of channels, start chan..end chan.
	Temp	-	a single temp, A range of temperature indexes, start temp..end temp.

DESCRIPTION	Lists the calibration setpoints with the following conditions:.

1.   If no variables are specified, the setpoints for all T/C and RTD channels will be listed.
2.   If only T or R is specified, all T/C or all RTD channels will be listed.
3.   If T or R and chan/board are specified, a single channel or range of channels for T/Cs or RTDs will be specified.
4.   If T or R and chan/board and temp are specified, a single channel or range of channels, and a single temperature or range of temperatures

EXAMPLE	To view the calibration setpoints for RTD channel 1 at 23 degrees C:

        Type: LIST P R 1 23<CR>
        The DTS returns:
        SET PT 1 0 -0.010000 -275283

NOTE1	The values shown here are values a typical one module. The actual calibration setpoints in a different module may be different.
NOTE2	This syntax is used only when NUMTEMPS is set to 1 or greater.

COMMAND	**LIST CHANNEL DEFINITIONS**
COMMAND SYNTAX	**LIST DEF <channel>**
ARGUMENTS	Channel - is a valid channel number 1 through 64, depending on the module type.
DESCRIPTION	Lists the channel definitions for the specified channel. Only one channel may be specified at a time because of the size of the returned ASCII string. The definition for each channel may be 2048 bytes
EXAMPLE	To view the calibration setpoints for channel 1:
	Type: LIST DEF 1<CR>
	The DTS returns:
	DEF 1 < ASCII String up to 2048 bytes>

COMMAND	**LIST CONFIGURATION VARIABLES**
COMMAND SYNTAX	**LIST A**
ARGUMENTS	None
DESCRIPTION	Lists all of the Configuration Variables.
EXAMPLE	To view or log the configuration variables:
	Type: LIST A<CR>
	The DTS will return all configuration variables

COMMAND	**LIST GAIN**
COMMAND SYNTAX	**LIST G**
ARGUMENTS	None.
DESCRIPTION	Lists the thermocouple gain correction assigned to the channel listed.
EXAMPLE	To view the thermocouple gain settings in a 16 channel module:
	Type: LIST G <CR>
	The DTS will return all of the thermocouple gain settings. They could appear as follows.

       SET GAIN 1 1.11
       SET GAIN 2 1.01
       SET GAIN 3 0.98
       SET GAIN 4 1.12
       SET GAIN 5 1.01
       SET GAIN 6 1.15
       SET GAIN 7 1.00
       SET GAIN 8 1.11
       SET GAIN 9 0.99
       SET GAIN 10 0.98
       SET GAIN 11 1.10
       SET GAIN 12 1.01
       SET GAIN 13 1.06
       SET GAIN 14 1.00
       SET GAIN 15 0.99
       SET GAIN 16 1.10

COMMAND	**LIST IDENTIFICATION**
COMMAND SYNTAX	**LIST I**
ARGUMENTS	None
DESCRIPTION	Lists the IDENTIFICATION configuration variables.
EXAMPLE	To verify the general module configuration settings:

          Type: LIST I<CR>

The DTS will return:
      SET ECHO 0
      SET AUTOCON 0
      SET HOST 0 0 T
      SET HOSTCMD 0
      SET TCMAXSLEW 50000
      SET RTDMAXSLEW 64000
      SET TITLE1 DTS3250/64Tx
      SET TITLE2 Version 4.12
      SET PORT 23

NOTE	A user must be very careful when modifying one of these variables. An incorrect value in one of these variables could have a detrimental affect on the operation of the module.

COMMAND	**LIST LABELS**
COMMAND SYNTAX	**LIST LA**
ARGUMENTS	None
DESCRIPTION	Lists the channel labels.
EXAMPLE	To view the channel labels:

          Type: LIST LA<CR>

The DTS will return:
      SET LABEL 1 T/C1
      SET LABEL 2 T/C2
      SET LABEL 3 T/C3
      SET LABEL 4 T/C4
      SET LABEL 5 T/C5
      SET LABEL 6 T/C6
      SET LABEL 7 T/C7
      SET LABEL 8 T/C8
      SET LABEL 9 T/C9
      SET LABEL 10 T/C10
      SET LABEL 11 T/C11
      SET LABEL 12 T/C12
      SET LABEL 13 T/C13
      SET LABEL 14 T/C14
      SET LABEL 15 T/C15
      SET LABEL 16 T/C16

COMMAND	**LIST LIMITS**
COMMAND SYNTAX	**LIST LI**
ARGUMENTS	None
DESCRIPTION	Lists the channel high and low limits for alarms

EXAMPLE   To verify the channel limit settings for a 16 channel module:

        Type: LIST LI<CR>

The DTS will return:

```
SET LIMIT 1 1   500.00   -50.00
SET LIMIT 2 1   500.00   -50.00
SET LIMIT 3 1   500.00   -50.00
SET LIMIT 4 1   500.00   -50.00
SET LIMIT 5 1   500.00   -50.00
SET LIMIT 6 1   500.00   -50.00
SET LIMIT 7 1   500.00   -50.00
SET LIMIT 8 1   500.00   -50.00
SET LIMIT 9 1   500.00   -50.00
SET LIMIT 10 1   500.00   -50.00
SET LIMIT 11 1   500.00   -50.00
SET LIMIT 12 1   500.00   -50.00
SET LIMIT 13 1   500.00   -50.00
SET LIMIT 14 1   500.00   -50.00
SET LIMIT 15 1   500.00   -50.00
SET LIMIT 16 1   500.00   -50.00
```

NOTE   For more information, refer to the SET LIMIT configuration variable in the LI Group.

COMMAND	**LIST NETWORK IDENTIFICATION**
COMMAND SYNTAX	**LIST ID**
ARGUMENTS	None
DESCRIPTION	Lists the MODULE NETWORK IDENTIFICATION configuration variables to support the Network ID command.
EXAMPLE	To verify the Network Identification configuration settings:

        Type: LIST ID<CR>

The DTS will return:

```
SET IPADDR <IP Address>
SET MODEL <Model/channels>
SET SERNUM <Serial number>
SET VER <Firmware Version>
```

COMMAND	**LIST OFFSET**
COMMAND SYNTAX	**LIST O**
ARGUMENTS	None
DESCRIPTION	Lists the thermocouple offset correction assigned to the channel specified. If channel 0 is specified, all 16 offsets will be returned. The OFFSET values are A/D counts.
EXAMPLE	To view all of the thermocouple offset settings in a 16 channel module:

      Type: LIST O <CR>

The DTS will return the thermocouple offset settings. They could appear as follows.

      SET OFFSET 1 120
      SET OFFSET 2 77
      SET OFFSET 3 78
      SET OFFSET 4 112
      SET OFFSET 5 101
      SET OFFSET 6 115
      SET OFFSET 7 60
      SET OFFSET 8 11
      SET OFFSET 9 99
      SET OFFSET 10 101
      SET OFFSET 11 44
      SET OFFSET 12 57
      SET OFFSET 13 16
      SET OFFSET 14 124
      SET OFFSET 15 81
      SET OFFSET 16 25

COMMAND	**LIST RTD CORRECTION VALUES**
COMMAND SYNTAX	**LIST RPC <board>**
ARGUMENTS	Board - The A/D board 1, 2, 3 or 4
DESCRIPTION	Lists the RTD correction values
EXAMPLE	This command is used to verify the RTD correction values for each A/D board. To view the RTD correction values for A/D board 3:

      Type: LIST RPC 3<CR>

The DTS will return:

      SET RPC 3 0 0.095000 1271278
      SET RPC 3 1 0.100000 1338897
      SET RPC 3 2 0.105000 1406643
      SET RPC 3 3 0.110000 1474311
      SET RPC 3 4 0.115000 1542011
      SET RPC 3 5 0.120000 1609718
      SET RPC 3 6 0.125000 1677418
      SET RPC 3 7 0.131000 1758718

NOTE:	The values shown here are values for a standard module. The actual calibration setpoints for another module may be different.

COMMAND	**LIST RTD CONVERSION VALUES**
COMMAND SYNTAX	**LIST RTDP**
ARGUMENTS	None
DESCRIPTION	Lists the RTD conversion values for all RTD channels.There will be two values for a 16 channel module, 4 values for a 32 channel module and 8 values for a 64 channel module

EXAMPLE   This command is used to verify the RTD correction values of the DTS.

           Type: LIST RTD\<CR>
           A 64 channel DTS will return:
           SET RTD 1 100.0000 3.908e-0-3 -5.775e-07
           SET RTD 2 100.0000 3.908e-0-3 -5.775e-07
           SET RTD 3 100.0000 3.908e-0-3 -5.775e-07
           SET RTD 4 100.0000 3.908e-0-3 -5.775e-07
           SET RTD 5 100.0000 3.908e-0-3 -5.775e-07
           SET RTD 6 100.0000 3.908e-0-3 -5.775e-07
           SET RTD 7 100.0000 3.908e-0-3 -5.775e-07
           SET RTD 8 100.0000 3.908e-0-3 -5.775e-07

NOTE   The values shown here are values for an ideal module. The actual calibration setpoints may be different.

COMMAND	**LIST RTD CURRENT CONVERSION VALUES**
COMMAND SYNTAX	**LIST RTDX**
ARGUMENTS	None
DESCRIPTION	Lists the RTD current conversion values for all RTD channels. There will be two values for a 16 channel module, 4 values for a 32 channel module and 8 values for a 64 channel module

EXAMPLE   This command is used to verify the RTD current correction values of the DTS. This variable corrects for errors in the RTD excitation circuit.

           Type: LIST RTDX\<CR>
           A 64 channel DTS will return:
           SET RTDX1 1.0000000
           SET RTDX2 1.0000000
           SET RTDX3 1.0000000
           SET RTDX4 1.0000000
           SET RTDX5 1.0000000
           SET RTDX6 1.0000000
           SET RTDX7 1.0000000
           SET RTDX8 1.0000000

NOTE   The values shown here are values for an ideal RTD excitation circuit. The actual values may be different.

COMMAND	**LIST SCAN**
COMMAND SYNTAX	**LIST S**
ARGUMENTS	None
DESCRIPTION	Lists the SCAN configuration variables

EXAMPLE   This command is used to verify the general scan settings of the DTS
                                       Type: LIST s<CR>
                              The DTS will return:
                                       SET PERIOD 6250
                                       SET AVG 1
                                       SET FPS 0
                                       SET XSCANTRIG 0
                                       SET FORMAT 0
                                       SET TIME 2
                                       SET BIN 0
                                       SET QPKTS 0
                                       SET UNITS C
                                       SET RANGEV -9999.999 9999.999
                                       SET RANGET -9999.99 9999.99
                                       SET RATE <value>   This value will be a function of Period,
                                                             Average and the number of channels.

COMMAND	**LIST TYPE**
COMMAND SYNTAX	**LIST T**
ARGUMENTS	None
DESCRIPTION	Lists the thermocouple TYPE assigned to the channel specified. If channel 0 is specified, all channels will be listed.
EXAMPLE	To view the thermocouple type settings:

                                       Type: LIST T <CR>
                              The DTS will return the thermocouple type settings. They could appear as
                              follows in a 16 channel DTS

                                       SET TYPE 1 K 1
                                       SET TYPE 2 K 1
                                       SET TYPE 3 K 1
                                       SET TYPE 4 N 1
                                       SET TYPE 5 N 1
                                       SET TYPE 6 E 0
                                       SET TYPE 7 R 0
                                       SET TYPE 8 R 0
                                       SET TYPE 9 S 1
                                       SET TYPE 10 S 1
                                       SET TYPE 11 T 1
                                       SET TYPE 12 T 1
                                       SET TYPE 13 E 1
                                       SET TYPE 14 J 1
                                       SET TYPE 15 K 1
                                       SET TYPE 16 E 1

COMMAND	**LIST UTR CALIBRATION VARIABLES**
COMMAND SYNTAX	**LIST U**
ARGUMENTS	None
DESCRIPTION	Lists the RTD calibration configuration variables

EXAMPLE

This command is used to verify the calibration configuration settings of the DTS.

     Type: LIST U<CR>

The DTS will return:

     SET RNUMCOEF 3
     SET RNUMPTS 8
     SET MAXDELTA 1.000000
     SET ARPCON 0
     SET ARPC x 0.000   Where x is the board number

NOTES:

The values shown here are values for a standard module. The actual calibration setpoints for a different module may be different.
A 16 channel module will only display ARPC 1, A 32 channel module will display ARPC 1 and ARPC 2, A 64 channel module will display ARPC 1, ARPC 2, ARPC 3, and ARPC 4

COMMAND	**OPEN THERMOCOUPLE TEST**
COMMAND SYNTAX	**OTC**
ARGUMENTS	None
DESCRIPTION	Commands the DTS to test for open thermocouples. The command causes a small current to be applied to each thermocouple. If a thermocouple is found to be open, an error is logged and bit 12 in the channel status element of the data packet is set to a 1 (1000Hex). Also, the channel status code for an open channel will be 2000 if scanning with FORMAT set to 0.This command is NOT performed automatically at power up.
RETURNS	*<nl>*
	<nl> - end of line.

EXAMPLE

To test fo open thermocouples, the following command would be issued:

     OTC<CR>

COMMAND	**REBOOT**
COMMAND SYNTAX	**REBOOT**
ARGUMENTS	None
DESCRIPTION	Commands the DTS to reboot. Any coefficients and configuration variables that have not been saved will be reset to the last saved values.
RETURNS	*<nl>*
	<nl> - End of line.
EXAMPLE	To reboot from the network,
	Type: REBOOT<CR>

COMMAND	**SAVE**
COMMAND SYNTAX	**SAVE**
ARGUMENTS	None
DESCRIPTION	Commands the DTS to save the RAM image of Non Volatile Memory(NVM). Any change to a configuration variable must be followed by a SAVE command if the change is to be permanent.
RETURNS	*<nl>*
	<nl> - End of line.
EXAMPLE	To save the current configuration variable settings and conversion coefficients,
	Type: SAVE<CR>

COMMAND	**SCAN**
COMMAND SYNTAX	**SCAN**
ARGUMENTS	None
RETURNS	Scan data formatted by the setting of EU, BIN, and FORMAT. Refer to the examples for more information. When FORMAT is set to 0, a channel status code will be returned with the data for each channel. If multiple errors exist the code with the highest priority will be the only code displayed

Status Code	Description	Priority
1000	Channel A/D is disabled	1
2000	Channel T/C is open	2
3000	Channel is over range	3
4000	Channel is under range	4
5000	Channel is over limit	5
6000	Channel is under limit	6

DESCRIPTION	Commands the DTS to scan the pressure sensors and send Scan packets to the client. Data are returned immediately if XSCANTRIG is set to 0. If XSCANTRIG is set to 1, data will be returned after a hardware trigger, or a software trigger. For more information on software triggers, refer to the SCAN TRIGGER command. For Hardware trigger requirements, refer to the Trigger Requirements section.
EXAMPLE 1	EU = 1
	BIN = 0
	FORMAT= 0.
	Data are scrolled and will be displayed as follows:

       Frame # <number>
       Time <time> <µs or ms>
       Rtd1   <temp>
         "   "
       RtdMax <temp>
       Units   <unit>
       <chan 1> <temp eu> <channel status code>
          "   "
          "   "
       <chan Max> <temp eu> <channel status code>

EXAMPLE 2

EU = 0
BIN = 0
FORMAT= 0
Data are scrolled and will be displayed as follows:
Frame # <number>
Time <time> <µs or ms>
Rtd1   <temp counts>
            "   "

RtdMax <temp counts
Units   <unit>
<chan 1> <temp counts> <channel status code>
     "   "
     "   "

<chan Max> <temp counts> <channel status code>

EXAMPLE 3

EU = 1
BIN = 0
FORMAT = 1
Data are scrolled in place and will be displayed as follows:
Frame = <number> Time = <time> <µs or ms> Units = <unit>
RTD1 <temp>   .... RTDMax <temp
<chan> <temp eu> <chan><temp eu> <chan> <temp eu> <chan> <temp eu>
<chan> <temp eu> <chan><temp eu> <chan> <temp eu> <chan> <temp eu>
<chan> <temp eu> <chan><temp eu> <chan> <temp eu> <chan> <temp eu>
     "   "   "   "   "   "   "   "

<chan> <temp eu> <chan><temp eu> <chan> <temp eu> <chan> <temp eu>

EXAMPLE 4

EU = 0
BIN = 0
FORMAT = 1
Data are scrolled and will be displayed as follows:
Frame = <number> Time = <time> <µs or ms> Units = <unit>
RTD1 <counts>...........RTDMax <counts>
<chan> <temp cts> <chan><temp cts> <chan> <temp cts> <chan> <temp cts>
<chan> <temp cts> <chan><temp cts> <chan> <temp cts> <chan> <temp cts>
<chan> <temp cts> <chan><temp cts> <chan> <temp cts> <chan> <temp cts>
     "   "   "   "   "   "   "   "

<chan> <temp cts> <chan><temp cts> <chan> <temp cts> <chan> <temp cts>

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COMMAND	**SCAN TRIGGER**
COMMAND SYNTAX	**TRIG**
ARGUMENTS	None
DESCRIPTION	This command acts as a software trigger to the DTS. When XSCANTRIG is set to 1, an averaged frame of data will be output when the DTS receives the TRIG command or a <TAB> character code (9 HEX or Control I). This will continue until a STOP command is issued or the Frames per Scan variable is met. The data format will depend upon the setting of EU, BIN and FORMAT.

EXAMPLE 1	A scan command is executed with EU set to 1, BIN set to 0, XSCANTRIG set to 1, and FORMAT set to 0. The DTS will wait for a Hardware trigger, the TRIG command or a <TAB> character (9 HEX or Control I). When one of the Data are scrolled and will be displayed as follows:

> Frame # <number>
> Time <time> <μs or ms>
> <chan> <temp eu>
>   "   "
>   "   "
> <chan> <temp eu>

For information on other formats, refer to the SCAN command .

COMMAND	**SET**
COMMAND SYNTAX	**SET *<name> <value>***
ARGUMENTS	*<name>* - the Configuration Variable to be set or modified.
	<value> - the value of that Configuration Variable
DESCRIPTION	Commands the DTS to set one of the many Configuration Variables. Configuration Variables are described in a subsequent section.

NOTE	Listing the Configuration Variables with the LIST command outputs the data in the format required by the SET command. This enables the user to upload data from a file that has been created by a LIST download.

COMMAND	**STATUS**
COMMAND SYNTAX	**STATUS**
ARGUMENTS	None
DESCRIPTION	Commands the DTS to send a Status Packet to the client. The Status Packet is described in a subsequent section.

The STATUS command may be entered at any time. This is one of the commands that will not generate an error if entered while the DTS is not READY. The DSM could return one of the following status descriptions:

ADCAL	The DTS is calibrating the A/D converters
CAL	The DTS is executing a PT or RPT command
INVALID	The DTS is in an INVALID operating mode.
LIST	The DTS is outputting a configuration variable LIST
OTC	The DTS is testing for open thermocouples
PERIOD	The DTS is executing a SET PERIOD command
READY	The DTS is operating and ready to accept a command.
SAVE	The DTS is SAVING a configuration
SCAN	The DTS is in the SCAN mode.
TYPE	The DTS is setting the thermocouple type
UPLOAD	The DTS is UPLOADING a file.

EXAMPLES   If the STATUS command is entered while the DTS is on, but inactive, the DSM will return:

           Status: READY

If the STATUS command is entered while the DSM is executing a SAVE command, the DSM will return:

           Status: SAVE

COMMAND	**STOP**
COMMAND SYNTAX	**STOP**
ARGUMENTS	None
DESCRIPTION	Commands the DTS to abort the current operation.
RETURNS	*<nl>*
	<nl> - end of line.

EXAMPLE   To abort any function or operation:

           Type: STOP<CR>

COMMAND	**UPLOAD**
COMMAND SYNTAX	**UPLOAD <S or C><filepath\filename>**
ARGUMENTS	S System file to be uploaded
	C Configuration file to be uploaded
DESCRIPTION	Uploads the specified file to the DTS module. The DTS interprets the type of file based on the file type argument.
RETURNS	*<nl>*
	<nl> - end of line.

EXAMPLE   To upload the configuration variable file cv.cfg, located in the DTS files subdirectory on drive c: of the host computer:

                       Type: UPLOAD C c:\DTSfiles\cv.cfg

This file will be downloaded from the machine defined by the configuration port settings. The term "host" might be more accurately described as an "FTP Server". This could be the same computer as the host or a different computer somewhere on a network. The relevant settings are:

                       Host Name
                       Host INET
                       User
                       FTP Password

NOTE   S or C must be uppercase

                       Refer to the DTS3200 Boot Parameter Modification and DTS Operating System Upload Procedures for more information.

COMMAND	**VERSION**
COMMAND SYNTAX	**VER**
ARGUMENTS	None
DESCRIPTION	Outputs the current software version number.
RETURNS	DTS Scanivalve © 2004 Ver x.xx y channels H/W ver z
	x.xx is the software version number.
	y is the number of channels (16, 32 or 64)
	z is the hardware version number

EXAMPLE   To read the current software version in a 64 channel module:

                       Type: VER<CR>

The DTS returns:

Version: DTS Scanivalve © 2008 Ver 4.14 64 channels H/W Ver 9

Configuration Variables

Configuration Variables control the way the DTS functions. The Variables are assigned to one of several groups: SCAN(S), IDENTIFICATION(I), NETWORK IDENTIFICATION(ID), CHANNEL DEFINITION(DEF), CALIBRATION(C), CHANNEL CORRECTION(P), GAIN(G), OFFSET(O), LABELS(LA), LIMIT(LI), THERMOCOUPLE(T), RTD CORRECTION(RP), RTD CONVERSION(RTDP), and RTD CALIBRATION(U). Each variable is assigned a "data type" description.

Scan Variables (Group S)

VARIABLE	**AVG <value>**
VALID VALUES	1 to 240
DEFAULT VALUE	4
DATA TYPE	integer
DESCRIPTION	This sets the number of raw samples to acquire before producing a filtered output.

VARIABLE	**BIN <code>**
VALID VALUES	1 or 0
DEFAULT VALUE	0
DATA TYPE	integer
DESCRIPTION	Sets the format of the data packet output.
	1 = Binary
	0 = ASCII

VARIABLE	**FORMAT *<code>***
VALID VALUES	0, or 1
DEFAULT VALUE	1
DATA TYPE	Integer
DESCRIPTION	Determines if data are to be scrolled on the display. ASCII Output only
	0 - data are scrolled
	1 - data are displayed in place, formatted for a VT100 terminal.

VARIABLE	**FPS <value>**
VALID VALUES	0 to 4294967295
DEFAULT VALUE	0
DATA TYPE	long integer
DESCRIPTION	Sets the number of averaged frames to send to the client. If a 0 is entered, the scan will continue until a STOP command is received.

VARIABLE	**PERIOD \<value\>**
VALID VALUES	781 to 262144 µsec (64 Channel versions)
	781 to 524288 µsec (32 Channel Versions)
	781 to 1048576 µsec (16 Channel Versions)
DEFAULT VALUE	7812
DATA TYPE	integer
DESCRIPTION	Sets the interval between channel samples.

The maximum settings for each version represent the rate limits when AVG is set to 1. The rate limits are:

16 Channels	-	40 Hz/Channel
32 Channels	-	20 Hz/Channel
64 Channels	-	10 Hz/Channel

NOTE	For 16 channel DTS modules running software version 2.04 and lower, periods faster than 6250 microseconds will result in a greater measurement uncertainty. Instrument accuracies listed in the specifications are based on periods of 6250 microseconds or slower.

VARIABLE	**QPKTS \<code\>**
VALID VALUES	0 or 1
DEFAULT VALUE	1
DATA TYPE	integer
DESCRIPTION	This switch will control the action the DTS will take when the data buffer is full.

0 -	frames will be discarded when the data buffer is full. The DTS will continue to scan.
1 -	no frames will be lost. The DTS will stop scanning and log an error if the data buffer is filled.

VARIABLE	**RANGET *\<low range temp value\> \<high range temp value\>***
VALID VALUES	-9999.99 to 9999.99
DEFAULT VALUE	Low range temp value - -9999.99
	High range temp value - 9999.99
DATA TYPE	Integer
DESCRIPTION	Sets the output when units is set to a temperature and the high and/or low range limits are exceeded. When a channel exceeds the low limit, the data display will be setting of the low range value and the channel status code will indicate 4000. When the high limit is exceeded, the data display will be setting of the high range value and the channel status code will indicate 3000.

VARIABLE	**RANGEV *\<low range volt value\> \<high range volt value\>***
VALID VALUES	-9999.99 to 9999.99
DEFAULT VALUE	Low range volt value - -9999.99
	High range volt value - 9999.99
DATA TYPE	Integer
DESCRIPTION	Sets the output when units is set to volts and the high and/or low range limits are exceeded. When a channel exceeds the low limit, the data display will be setting of the low range value and the channel status code will indicate 4000. When the high limit is exceeded, the data display will be setting of the high range value and the channel status code will indicate 3000.

VARIABLE	**RATE *<value>***
VALID VALUES	.01 to 40
DEFAULT VALUE	Depends on the number of channels
DATA TYPE	Integer
DESCRIPTION	Calculates and modifies the setting of PERIOD to give a data output rate in samples per channel per second. The setting of AVG is included in the calculation but is not modified. Conversely, if PERIOD is modified, RATE will be updated to show the data rate based on that setting of PERIOD. If AVG is modified, the value of RATE will be updated to show the new data rate, but PERIOD will not be modified. If the calculated RATE exceeds the maximum allowed for a DTS Version, the rate will not change and an ERROR will be logged.

The maximum rate for each version is:

16 Channel	-	40 Hz/Channel
32 Channel	-	20 Hz/Channel
64 Channel	-	10 Hz/Channel

Rate is calculated by the formula:

$$DataRate = 1 \div (Period \times NumberofChannels \times Average)$$

VARIABLE	**TIME *<code>***
VALID VALUES	0, 1, or 2
DEFAULT VALUE	0
DATA TYPE	Integer
DESCRIPTION	Determines the format of the Time Stamp.

      0 - No Time Stamp
      1 - Time stamp data are in microseconds
      2 - Time stamp data are in milliseconds

VARIABLE	**UNITS <type>**
VALID VALUES	see list below
DEFAULT VALUE	0
DATA TYPE	string
DESCRIPTION	Engineering Unit conversion type. This can be :

A	-	Volts(Vdc) corrected by the RTD voltage
C	-	degrees Celsius(°C)
F	-	degrees Fahrenheit(°F),
K	-	Kelvin(K)
M	-	"Mixed," provides T/C readings in RAW mV and RTD readings in °C
R	-	degrees Rankin(°R)
V	-	Volts(Vdc) Raw uncorrected
0	-	Zero(Raw Counts)

NOTE	The setting of UNITS affects the RTD temperature units.

ASCII Output (BIN = 0)
    When UNITS is set to 0, the RTD temperature is in A/D counts.
    When UNITS is set to V or A, the RTD temperature is in millivolts.
    When UNITS is set to C, F, K, M or R, the RTD temperature is in
    degrees C.
Binary Output (BIN = 1)
    When UNITS is set to 0, the RTD temperature is in A/D counts
    When UNITS is set to any other value, the RTD temperature is in
    degrees C.

VARIABLE	**XSCANTRIG <code>**
VALID VALUES	0 to 15
DEFAULT VALUE	0
DATA TYPE	integer
DESCRIPTION	Sets the External Trigger as the Frame Trigger.

        0   -   The internal clock is the frame trigger

        1   -   The external trigger is the frame trigger

        2 to 15 -   The external trigger is the frame trigger. The external trigger timing will be divided by the number entered. If

NOTES   If XSCANTRIG is set to 2, the triggering will be whatever the input rate is divided by 2. If the trigger rate is 10 Hz, the DTS will be triggered at a 5 Hz rate. If XSCANTRIG is set to 10 and the trigger rate is 10 Hz, the DTS will be triggered at a I Hz rate.

The External Trigger may be a hardware trigger or a Software Trigger. The hardware trigger is a pulse 9 to 15 volts at 6.5 ma. The software trigger is a Tab(Control I) character.

Channel Correction Variables (Group P)

NOTE   The PT variable on this page is used only if NUMTEMPS is set to 0. If NUMTEMPS is set to 1 or greater, the PT variable on the next page should be used. Please refer to the description of the NUMTEMPS variable in the Calibration Variable Group for more detailed information on THE NUMTEMPS variable.

VARIABLE	**PT <channel> <index> <volts applied> <counts applied>**	
VALID VALUES	Channel	- 0 to 16, 32 or 64
	Index	- 0 to 7
	Volts Applied -	any valid number
	Counts Applied -	any valid number
DEFAULT VALUE	Channel	- 0
	Index	- 0
	Volts Applied -	0
	Counts Applied -	0
DATA TYPE	Channel	- Integer
	Index	- Integer
	Volts Applied -	float
	Counts Applied -	Integer

DESCRIPTION   This is the list of setpoints used to calibrate each channel. If zero (0) is entered, all channels will be returned.

EXAMPLE   The List P command is used to view these variables. The variables for each channel are set before the initial factory calibration. To list the values for channel 2, Type:

        LIST P 2<Enter>

The DTS will return:
```
SET PT 2 0 -0.010000 -276468
SET PT 2 1 0.000000 517
SET PT 2 2 0.012000 332795
SET PT 2 3 0.024000 664988
SET PT 2 4 0.036000 997039
SET PT 2 5 0.048000 1329141
SET PT 2 6 0.060000 1661087
SET PT 2 7 0.070000 1937569
```

NOTE   The values shown here are values for a standard module. The actual calibration setpoints for a given module may be different.

NOTE   The PT variable on this page is used only if NUMTEMPS is set to 1 or greater. If NUMTEMPS is set to 0, the PT variable on the previous page should be used. Please refer to the description of the NUMTEMPS variable in the Calibration Variable Group for more detailed information on THE NUMTEMPS variable.

VARIABLE	**PT <T || R> <chan/board> <temp ndx> <temp> <pt ndx> <act volts> <counts>**		
VALID VALUES	T || R	-	T/C or RTD
	Chan/board	-	A single channel, 1 to 64 for T/C or 1 to 4 for RTD
			A range of channels, start chan..end chan
	Temp ndx	-	The temperature index from 1 to NUMTEMPS
	Pt ndx	-	The index of this point from 1 to NUMPTS
	Act volts	-	The actual applied volts
	Counts	-	The A/D counts at this point
DEFAULT VALUE	T || R	-	T
	Chan/board	-	1
	Temp ndx	-	5
	Pt ndx	-	5
	Act volts	-	0
	Counts	-	0
DATA TYPE	T || R	-	char
	Chan/board	-	string
	Temp ndx	-	integer
	Pt ndx	-	integer
	Act volts	-	float
	Counts	-	integer

DESCRIPTION   This is the list of setpoints used to calibrate each channel.

EXAMPLE   The List P command is used to view these variables. The variables for each channel are set before the initial factory calibration. To list the values for RTD channel 2at 23 degrees C, Type:

      LIST P R 2 23<Enter>

The DTS will return:
      SET PT R 2 3 23 3 .256 -276468

NOTE   The values shown here are values for a typical module. The actual calibration setpoints for a given module may be different.

Identification Variables (Group I)

VARIABLE	**AUTOCON <code>**
VALID VALUES	0 or 1
DEFAULT VALUE	0
DATA TYPE	integer
DESCRIPTION	Determines if the DTS will automatically convert to a binary receiver.

      0 -   the DTS will not automatically convert.

      1 -   the DTS will automatically convert.

      .

VARIABLE	**ECHO <code>**
VALID VALUES	0 or 1
DEFAULT VALUE	0
DATA TYPE	integer
DESCRIPTION	Determines if characters received from an ethernet host will be echoed back to the host.

      0 -   the DTS will not echo characters

      1 -   the DTS will echo characters back to the host.

VARIABLE	**HOST <IP address> <port> <protocol>**		
VALID VALUES	IP Address	-	Any valid IP address
	Port	-	Any valid Port
	Protocol	-	T = TCP
			U = UDP
DEFAULT VALUE	IP Address	-	0
	Port	-	0
	Protocol	-	T
DATA TYPE	varies		
DESCRIPTION	Sets the value of the IP address and port number for binary data for the host computer. If IP Address and Port are set to 0, Binary data are sent out over the TelNet Port. If a server address and port number are defined, Binary data are sent out over that port.		

VARIABLE	**HOSTCMD <ASCII string>**
VALID VALUES	any valid host command
DEFAULT VALUE	0
DATA TYPE	ASCII Strings
DESCRIPTION	Sends the ASCII command string contained in this variable to the host computer binary receiver.

VARIABLE	**PORT xxxx**
VALID VALUES	Any valid port number other than 0
DEFAULT VALUE	23
DATA TYPE	integer
DESCRIPTION	Sets the Ethernet port. The default value is 23 which is the TelNet port. A change to this variable does not take effect until the module has been rebooted.

VARIABLE	**RTDMAXSLEW <value>**
VALID VALUES	0 to 32000
DEFAULT VALUE	0
DATA TYPE	Integer
DESCRIPTION	This is the maximum allowable step change in counts per second for an RTD input. If the step change exceeds this value, the DTS will output the last value before the step. If the DTS stays out of range for 5 samples, then the new range will be considered to be the new value. Zero (0) disables this function.
NOTE	This feature is only functional in hardware version 1. The hardware version is reported with the software version when a VER command is executed.

VARIABLE	**TCMAXSLEW <value>**
VALID VALUES	0 to 3000000
DEFAULT VALUE	0
DATA TYPE	Integer
DESCRIPTION	This is the maximum allowable step change in counts per second for a thermocouple input. If the step change exceeds this value, the DTS will output the last value before the step. If the DTS stays out of range for 5 samples, then the new range will be considered to be the new value. Zero (0) disables this function.
NOTE	This feature is functional in all hardware versions. The hardware version is reported with the software version when a VER command is executed.

VARIABLE	**TITLE1 <title>**
VALID VALUES	any valid ASCII string up to 255 characters
DEFAULT VALUE	Scanivalve DTS3250
DATA TYPE	ASCII String
DESCRIPTION	Sets the value of Title number 1.

VARIABLE	**TITLE2 <title>**
VALID VALUES	any valid ASCII string up to 255 characters
DEFAULT VALUE	The current software version.
DATA TYPE	ASCII String
DESCRIPTION	Sets the value of Title number 2.

Calibration Variables (Group C)

VARIABLE	**CALAVG <value>**
VALID VALUES	1 to 64
DEFAULT VALUE	4
DATA TYPE	integer
DESCRIPTION	Determines how much averaging to perform during an A/D Calibration. This setting will have an effect on boot up time.

VARIABLE	**NUMPTS <points>**
VALID VALUES	1 to 8
DEFAULT VALUE	8
DATA TYPE	integer
DESCRIPTION	Determines the number of setpoints in the channel correction list.

VARIABLE	**NUMCOEF <coef>**
VALID VALUES	1 to 3
DEFAULT VALUE	3
DATA TYPE	integer
DESCRIPTION	Determines the number of calibration coefficients for the channel corrections.

      1 -   Offset only

      2 - $y = mx + b$ correction curve

      3 - $y = ax^2 + bx + c$ correction curve

VARIABLE	**NUMTEMPS <numtemps>**
VALID VALUES	0 to 8
DEFAULT VALUE	0
DATA TYPE	integer

DESCRIPTION	When set to 0, system acts like original. If set to 1 or greater, the module will use the following variables:
	    PT Option
	And the following commands:
	    PT Option
	    List P Option

NOTE	The value of NUMTEMPS **MUST NOT** be modified by an end user without detailed and specific training from Scanivalve Corp. If the value of NUMTEMPS is modified after the unit has been calibrated, **ALL** current calibration coefficients will be **LOST**.

Network Identification Variables (Group ID)

VARIABLE	**IPADDRESS <ip address>**
VALID VALUES	Any Valid IP Address
DEFAULT VALUE	Current IP Address stored in Flash Memory
DATA TYPE	integer
DESCRIPTION	Stores the IP Address stored in Flash Memory

VARIABLE	**MODEL <model number/channels>**
VALID VALUES	Any valid model number/channel count
DEFAULT VALUE	Null
DATA TYPE	integer
DESCRIPTION	Lists the module model number and channel count.

VARIABLE	**SERNUM <serial number>**
VALID VALUES	Any valid integer
DEFAULT VALUE	Null
DATA TYPE	integer
DESCRIPTION	The serial number of the module

VARIABLE	**VER <version number>**
VALID VALUES	any valid integer
DEFAULT VALUE	null
DATA TYPE	integer
DESCRIPTION	The firmware version Sends the ASCII command string contained in this variable to the host computer binary receiver.

Channel Identification Variables (Group DEF)

VARIABLE	**DEF <channel> <definition>**	
VALID VALUES	Channel	the channel number
	Definition	any ASCII string up to 2048 bytes.
DEFAULT VALUE	null	
DATA TYPE	integer	
DESCRIPTION	The variable DEF will be available for each channel in the module up to the highest channel number. The variable is intended to be used as a label or definition of the channel assignment.	

Limit Variables (Group LI)

VARIABLE	**LIMIT <channel> <enable> [<high limit> low limit>]**	
VALID VALUES	Channel	- 0 to 16, 32, or 64 if 0 is entered all channels will be set.
	Enable	- 0 disables limits
		1 enables limits
	High limit	- optional, the high limit value
	Low limit	- optional, the low limit value
DEFAULT VALUE	Channel	- 0
	Enable	- 0
	High limit	- 100
	Low limit	- 0
DATA TYPE	Integer	
DESCRIPTION	Sets the high and low limits for each channel. When a channel exceeds the low limit, the channel status code will indicate 6000. When the high limit is exceeded, the channel status code will indicate 5000.	

Channel Labels (Group LA)

VARIABLE	**LABEL <channel> <label>**	
VALID VALUES	Channel	- 1 to 16, 32, or 64
	Label	- channel label up to 31 characters. Spaces are allowed.
DEFAULT VALUE	Channel	- 1
	Label	- T/C <channel>
DATA TYPE	Channel	- Integer
	Label	- ASCII string
DESCRIPTION	Sets the label for each channel..	

Thermocouple Variables (Group T)

VARIABLE	**TYPE <channel> <type> [shield connect]**
VALID VALUES	channel - the channel number, 0 through 16, 32 or 64
	type - B, E, J, K, N, R, S, or T
DEFAULT VALUE	channel - 0
	type - K
	shield connect - 0
DATA TYPE	integer
DESCRIPTION	Determines the thermocouple conversion for each channel. If the channel is entered as 0, all 16 channels will be set to the thermocouple type specified. The shield connection switch should be set based on the method used to ground or shield the thermocouple. If shield connect is set to 0, the switch will be open. The default setting is 1 or closed. Refer to the figures below for more information on how to properly define this parameter.
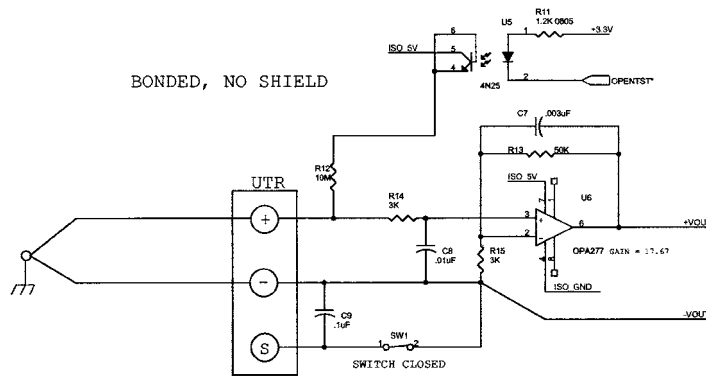
Figure 15 - Bonded Thermocouple, No Shield
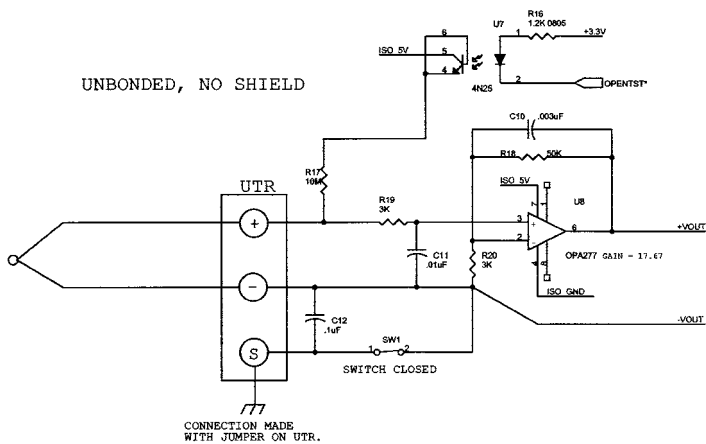
Figure 16 - Unbonded Thermocouple, No Shield
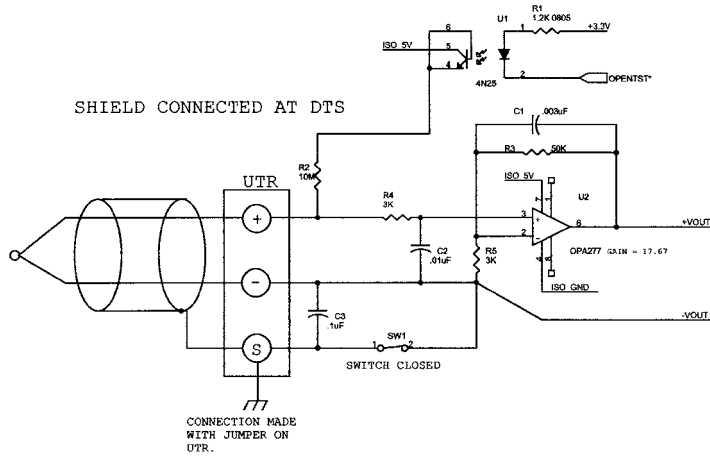
Figure 17 - Shielded Thermocouple, Shield connected at the DTS
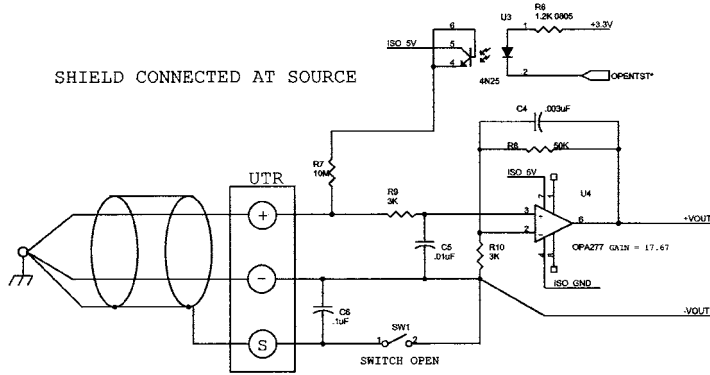
Figure 18 - Shielded Thermocouple, Shield connected at the source
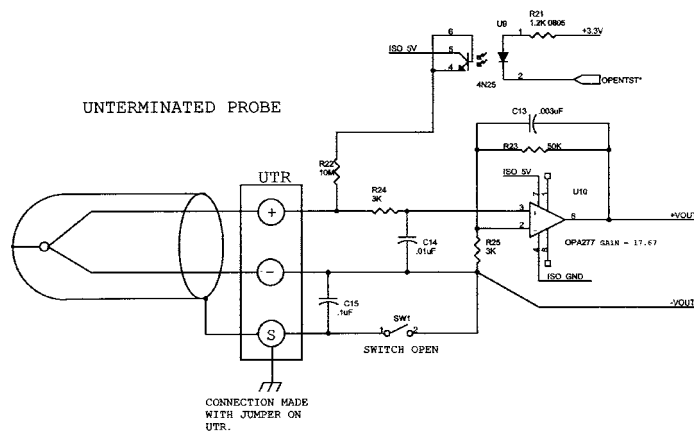
Figure 19 - Unterminated Probe

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RTD Correction Variables (Group RPC)

VARIABLE	**RPC <channel> <index> <volts applied> <counts applied>**
VALID VALUES	Channel - RTD channel, 1, 2, or 4
	Index - 0 to 7
	Volts Applied - any valid number
	Counts Applied - any valid number
DEFAULT VALUE	Channel - 1
	Index - 0
	Volts Applied - 0
	Counts Applied - 0
DATA TYPE	Index - Integer
	Volts Applied - float
	Counts Applied - Integer
DESCRIPTION	This is the list of setpoints used to calibrate the RTD's. Each RTD pair is corrected by the same setpoints. Each module type has one (1) RTD A/D and consequently one (1) channel for each pair of RTD's. A 16 channel module has 1 channel, a 32 channel module has 2 channels and a 64 channel module has 4 channels.

EXAMPLE	The List RP command is used to view these variables. The variables are set to the following before the initial factory calibration:
	    SET RPC 1 0 0.095000 1287022
	    SET RPC 1 1 0.115000 1557974
	    SET RPC 1 2 0.131000 1774736

NOTE	The values shown here are values for an ideal RTD channel. The actual calibration setpoints may be different.

RTD Conversion Volts to Ohms (Group RTD)

VARIABLE	**RTD 1 <R0> <A> <B>**	All Versions
VALID VALUES	any real numbers	
DEFAULT VALUES	R0 100.00000	
	A 3.908E-03	
	B -5.775E-07	
DATA TYPE	float	
DESCRIPTION	The conversion factors for RTD 1 to convert ohms to millivolts for temperature conversion. The actual values are provided by the manufacturer. The values for A and B must be entered as exponents.	

VARIABLE	**RTD 2 <R0> <A> <B>**	All Versions
VALID VALUES	any real numbers	
DEFAULT VALUES	R0 100.00000	
	A 3.908E-03	
	B -5.775E-07	
DATA TYPE	float	
DESCRIPTION	The conversion factors for RTD 2 to convert ohms to millivolts for temperature conversion. The actual values are provided by the manufacturer. The values for A and B must be entered as exponents.	

VARIABLE	**RTD 3 <R0> <A> <B>**	32 and 64 Channel Versions
VALID VALUES	any real numbers	
DEFAULT VALUES	R0 100.00000	
	A 3.908E-03	
	B -5.775E-07	
DATA TYPE	float	
DESCRIPTION	The conversion factors for RTD 3 to convert ohms to millivolts for temperature conversion. The actual values are provided by the manufacturer. The values for A and B must be entered as exponents.	

VARIABLE	**RTD 4 <R0> <A> <B>**	32 and 64 Channel Versions
VALID VALUES	any real numbers	
DEFAULT VALUES	R0 100.00000	
	A 3.908E-03	
	B -5.775E-07	
DATA TYPE	float	
DESCRIPTION	The conversion factors for RTD 4 to convert ohms to millivolts for temperature conversion. The actual values are provided by the manufacturer. The values for A and B must be entered as exponents.	

VARIABLE	**RTD 5 <R0> <A> <B>**	64 Channel Versions
VALID VALUES	any real numbers	
DEFAULT VALUES	R0 100.00000	
	A 3.908E-03	
	B -5.775E-07	
DATA TYPE	float	
DESCRIPTION	The conversion factors for RTD 1 to convert ohms to millivolts for temperature conversion. The actual values are provided by the manufacturer. The values for A and B must be entered as exponents.	

VARIABLE	**RTD 6 <R0> <A> <B>**	64 Channel Versions
VALID VALUES	any real numbers	
DEFAULT VALUES	R0 100.00000	
	A 3.908E-03	
	B -5.775E-07	
DATA TYPE	float	
DESCRIPTION	The conversion factors for RTD 2 to convert ohms to millivolts for temperature conversion. The actual values are provided by the manufacturer. The values for A and B must be entered as exponents.	

VARIABLE	**RTD 7 <R0> <A> <B>**	64 Channel Versions
VALID VALUES	any real numbers	
DEFAULT VALUES	R0 100.00000	
	A 3.908E-03	
	B -5.775E-07	
DATA TYPE	float	
DESCRIPTION	The conversion factors for RTD 3 to convert ohms to millivolts for temperature conversion. The actual values are provided by the manufacturer. The values for A and B must be entered as exponents.	

VARIABLE	**RTD 8 <R0> <A> <B>**	64 Channel Versions
VALID VALUES	any real numbers	
DEFAULT VALUES	R0 100.00000	
	A 3.908E-03	
	B -5.775E-07	
DATA TYPE	float	
DESCRIPTION	The conversion factors for RTD 4 to convert ohms to millivolts for temperature conversion. The actual values are provided by the manufacturer. The values for A and B must be entered as exponents.	

Channel Gain Correction Variables (Group G)

VARIABLE	**GAIN <channel> <gain value>**
VALID VALUES	any real number
DEFAULT VALUE	1
DATA TYPE	float
DESCRIPTION	Sets the GAIN correction for a given channel using the formula:

Adjusted Counts = (GAIN * counts) + OFFSET.

Channel Offset Correction Variables (Group O)

VARIABLE	**OFFSET <channel> <gain value>**
VALID VALUES	any real number
DEFAULT VALUE	1
DATA TYPE	float
DESCRIPTION	Sets the OFFSET correction for a given channel using the formula:

Adjusted Counts = (GAIN * counts) + OFFSET.

RTD Calibration Variables (Group U)

VARIABLE	**ARPC <board> <value>**
VALID VALUES	board - 1, 2, 3 or 4
DEFAULT VALUE	0.0000
DATA TYPE	floating point
DESCRIPTION	This value is the offset value that will be added to the RTD volts value before the Calendar Van-Dusen conversion. This value is calculated from the ARPC command. The software will update the ARPC variable setting after an ARPC command is executed. A LIST U command will only display the number of boards installed. That is: a 16 channel module will only display ARPC 1. A 32 channel module will display ARPC 1 and ARPC 2. A 64 channel module will display ARPC 1, ARPC 2, ARPC 3 and ARPC 4. The software will only allow entry of values for the number of boards installed.

VARIABLE	**ARPCON <value>**
VALID VALUES	0 or 1
DEFAULT VALUE	0
DATA TYPE	integer
DESCRIPTION	When set to one, this variable will enable the ARPC correction.

VARIABLE	**MAXDELTA <value>**
VALID VALUES	any real number
DEFAULT VALUE	.25
DATA TYPE	Integer
DESCRIPTION	This is the maximum allowable difference between the readings of RDT1 and RTD2 in degrees C. If MAXDELTA exceeds this setpoint, an error is logged and bit 12 is set in the general status element of the data packet.

VARIABLE	**RNUMPTS <points>**
VALID VALUES	1 to 8
DEFAULT VALUE	8
DATA TYPE	integer
DESCRIPTION	Determines the number of setpoints in the RTD correction list.

VARIABLE	**RNUMCOEF <coef>**
VALID VALUES	1 to 7
DEFAULT VALUE	5
DATA TYPE	integer
DESCRIPTION	Determines the number of calibration coefficients in the RTD correction list.

$$1 - \quad \text{Offset only}$$
$$2 - \quad y = mx + b$$
$$3 - \quad y = ax^2 + bx + c$$
$$4 - \quad y = ax^3 + bx^2 + cx + d$$
$$5 - \quad y = ax^4 + bx^3 + cx^2 + dx + e$$
$$6 - \quad y = ax^5 + bx^4 + cx^3 + dx^2 + ex + f$$
$$7 - \quad y = ax^6 + bx^5 + cx^4 + dx^3 + ex^2 + fx + g$$

DTS Packet Definitions

When requested the DTS sends an application packet to the client. Each packet sent to the client starts with a Packet Type Word. This word defines the packet type.

Packet Type Table

PACKET NAME	PACKET ID	BYTES	NOTES
16 Channel Data	0Hex	168	
Host Control	1Hex	168	Command Packet
32 Channel Data	2Hex	304	
64 Channel Data	3Hex	576	
ASCII	20Hex	Variable	Text Packet may be formatted or un-formatted. The format is determined by the setting of the FORMAT Configuration Variable. **NOTE:** When the first integer of the packet is 20Hex or greater, the packet is assumed to be in ASCII FORMAT.

Host Control Packets

Command Packet

FUNCTION DESCRIPTION	BYTES	DESCRIPTION
Packet Type	4	1Hex
Host ASCII Command Data (Refer to the Command Section of this manual for more information)	164	ASCII string received by DTS as the Host command. Each line must be terminated with a CR, LF, CR-LF or LF-CR.

DTS to HOST

Binary Data Packets

DTS3250/16 Channel Module

FUNCTION	BYTES	DATA TYPE	DESCRIPTION
Packet Type	4	Integer	0Hex
General Status	4	Integer	Refer to Table 1 in this section
Frame Number	4	Integer	The current frame number if in the scan mode
Temperature 1 to 16	64	Float	Channel temperatures in units set by bits 4 - 6 of the General Status Byte.
RTD1 Temperature	4	Float	Temperature in units defined by the setting of the variable: UNITS. See Table 3
RTD2 Temperature	4	Float	Temperature in units defined by the setting of the variable: UNITS. See Table 3
Time Stamp	4	Integer	Time Stamp in units set by bit 8 of the General Status Byte.
Channel Status 1 to 16	64	Integer	Refer to Table 2 in this section
Spares	16	Integer	Spares

DTS3250/32 Channel Module

FUNCTION	BYTES	DATA TYPE	DESCRIPTION
Packet Type	4	Integer	2Hex
General Status	4	Integer	Refer to Table 1 in this section
Frame Number	4	Integer	The current frame number if in the scan mode
Temperature 1 to 32	128	Float	Channel temperatures in units set by bits 4 - 6 of the General Status Byte.
RTD1 Temperature	4	Float	Temperature in units defined by the setting of the variable: UNITS. See Table 3
RTD2 Temperature	4	Float	Temperature in units defined by the setting of the variable: UNITS. See Table 3
RTD3 Temperature	4	Float	Temperature in units defined by the setting of the variable: UNITS. See Table 3.
RTD4 Temperature	4	Float	Temperature in units defined by the setting of the variable: UNITS. See Table 3
Time Stamp	4	Integer	Time Stamp in units set by bit 8 of the General Status Byte.
Channel Status 1 to 32	128	Integer	Refer to Table 2 in this section
Spares	16	Integer	Spares

DTS3250/64 Channel Module

FUNCTION	BYTES	DATA TYPE	DESCRIPTION
Packet Type	4	Integer	3Hex
General Status	4	Integer	Refer to Table 1 in this section
Frame Number	4	Integer	The current frame number if in the scan mode
Temperature 1 to 64	256	Float	Channel temperatures in units set by bits 4 - 6 of the General Status Byte.
RTD1 Temperature	4	Float	Temperature in units defined by the setting of the variable: UNITS. See Table 3
RTD2 Temperature	4	Float	Temperature in units defined by the setting of the variable: UNITS. See Table 3
RTD3 Temperature	4	Float	Temperature in units defined by the setting of the variable: UNITS. See Table 3
RTD4 Temperature	4	Float	Temperature in units defined by the setting of the variable: UNITS. See Table 3
RTD5 Temperature	4	Float	Temperature in units defined by the setting of the variable: UNITS. See Table 3
RTD6 Temperature	4	Float	Temperature in units defined by the setting of the variable: UNITS. See Table 3
RTD7 Temperature	4	Float	Temperature in units defined by the setting of the variable: UNITS. See Table 3
RTD8 Temperature	4	Float	Temperature in units defined by the setting of the variable: UNITS. See Table 3
Time Stamp	4	Integer	Time Stamp in units set by bit 8 of the General Status Byte.
Channel Status 1 to 64	256	Integer	Refer to Table 2 in this section
Spares	16	Integer	Spares

General Status Byte

Bits 0 - 3   Not used

Bits 4 - 6   Temperature Units

Bit 7   Not Used

Bit 8   Time Stamp

Bits 9 - 11   Not Used

Bits 12 - 15   RTD Delta Errors

Table 1 - General Status Byte

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0 - Raw A/D Counts (Uncorrected)	X	X	X	X	X	X	X	X	X	0	0	0	X	X	X	X
V - Raw Voltage (Uncorrected)	X	X	X	X	X	X	X	X	X	0	0	1	X	X	X	X
A - Corrected Voltage	X	X	X	X	X	X	X	X	X	0	1	0	X	X	X	X
C - Degrees C	X	X	X	X	X	X	X	X	X	0	1	1	X	X	X	X
F - Degrees F	X	X	X	X	X	X	X	X	X	1	0	0	X	X	X	X
K - Degrees K	X	X	X	X	X	X	X	X	X	1	0	1	X	X	X	X
R - Degrees R	X	X	X	X	X	X	X	X	X	1	1	0	X	X	X	X
Number of Temp Scales (Not Used)	X	X	X	X	X	X	X	X	X	1	1	1	X	X	X	X
Time Stamp in microseconds	X	X	X	X	X	X	X	X	0	X	X	X	X	X	X	X
Time Stamp in milliseconds	X	X	X	X	X	X	X	X	1	X	X	X	X	X	X	X
No Errors	0	0	0	0	X	X	X	X	X	X	X	X	X	X	X	X
UTR1 Delta Error (16, 32, 64)	0	0	0	1	X	X	X	X	X	X	X	X	X	X	X	X
UTR2 Delta Error (32, 64)	0	0	1	0	X	X	X	X	X	X	X	X	X	X	X	X
UTR3 Delta Error (64)	0	1	0	0	X	X	X	X	X	X	X	X	X	X	X	X
UTR4 Delta Error (64)	1	0	0	0	X	X	X	X	X	X	X	X	X	X	X	X

Channel Status Byte

Bits 0 - 4   Thermocouple Type
Bits 5 - 11   Not Used
Bits 12 - 15   Error Codes

Table 2 - Channel Status Byte

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Type J	X	X	X	X	X	X	X	X	X	0	0	0	0	0	0	0
Type E	X	X	X	X	X	X	X	X	X	0	0	0	0	0	0	1
Type K	X	X	X	X	X	X	X	X	X	0	0	0	0	0	1	0
Type N	X	X	X	X	X	X	X	X	X	0	0	0	0	0	1	1
Type R	X	X	X	X	X	X	X	X	X	0	0	0	0	1	0	0
Type S	X	X	X	X	X	X	X	X	X	0	0	0	0	1	0	1
Type T	X	X	X	X	X	X	X	X	X	0	0	0	0	1	1	0
Type B	X	X	X	X	X	X	X	X	X	0	0	0	0	1	1	1
A/D Disabled	0	0	0	1	X	X	X	X	X	X	X	X	X	X	X	X
Open T/C	0	0	1	0	X	X	X	X	X	X	X	X	X	X	X	X
High Range Error	0	0	1	1	X	X	X	X	X	X	X	X	X	X	X	X
Low Range Error	0	1	0	0	X	X	X	X	X	X	X	X	X	X	X	X
High Limit Exceeded	0	1	0	1	X	X	X	X	X	X	X	X	X	X	X	X
Low Limit Exceeded	0	1	1	0	X	X	X	X	X	X	X	X	X	X	X	X

Table 3 - RTD Units

UNITS	RTD Units
A	millivolts
C	Degrees C
F	Degrees C
K	Degrees C
R	Degrees C
V	millivolts
0	A/D counts

ASCII Data Packet

This packet will be transmitted when the host issues one of the following commands:
> 1) SCAN with BIN set to 0
> 2) LIST n
> 3) ERROR
> 4) STATUS

FUNCTION DESCRIPTION	BYTES	DATA TYPE	VALUE
ASCII Data (The first two bytes must **NOT** be 1Hex through 1FHex). Refer to the Command Section of this manual for the proper Command return formats.	1 to 1492	String	Unique to Packet. Each line is terminated with a CR, LF, CR-LF, or LF-CR.

Network Protocols Supported

Physical Layer :   10Base-T   IEEE 802.3
Link Layer: INTERNET Protocol (IP)
Transport Layer: Transmission Control Protocol (TCP)
                            User Datagram Protocol (UDP)

Operation

This section contains information and procedures required for the proper operation of DTS3250 Modules.

Ethernet Connections

All DTS3250 Modules are equipped with an Ethernet port. The Ethernet speed is 100Base-T connections.. No variables need to be modified to use this connection.

IP Address

All DTS3250 Modules have a preset IP address that can be modified by a user, if desired. The preset IP address for each type is:

DTS3250/16Tx -   191.30.55.xxx where xxx is the serial number of the unit.
DTS3250/32Tx -   191.30.60.xxx where xxx is the serial number of the unit.
DTS3250/64Tx -   191.30.160.xxx where xxx is the serial number of the unit.

The IP Address in a DTS3250 module may be changed by the user. IP Address may only be modified using the Serial Port during the boot up process. A procedure for this may be found in the DTS3250 Boot Parameter Modification Section.

Network Identification

DTS3250 Modules may be interrogated by a network host. This is similar to a "Whois" command. DTS3250 modules listen on port 7000 for a IP broadcast. The format of this broadcast must be 255.255.255.255 or any IP address with 255 set in the octet where the subnet mask is set to 0. When this is received, the DTS3250 will respond on port 7001 with the following:

<IP Address>, <Model/channels>, <Sernum> from ADDR: <IP Address>

For more information, please refer to the LIST ID command, or the Network Identification Group configuration variables.

TelNet Host Operation - Windows 95 and 98

A host computer may be used to control a DTS3250 Module without special software. The host to DTS3250 connection should be made using an Ethernet connection.

        Open a **TelNet** session.

        Select: Terminal

        Select: Preferences

            Enable Local Echo

            Set the Emulation to VT100/ANSI

        Select: Connect

        Select: Remote System

            Host Name: Enter: 191.30.yyy.xxx Where: yyy is the model octet

                                                    xxx is the serial number octet

            Port: Select: Telnet

            TermType: Select: vt100

        If the computer opens a Dial Up Box,

            Click on Cancel

When the TelNet session is open, any command listed in the Software Requirements Specification may be entered. Responses will be displayed in the TelNet Window. Please refer to the Software Section of this manual.

HyperTerminal Ethernet Operation - Windows NT, 2000, and XP

Open the HyperTerminal program

        Select: Start

        Select: Programs

        Select: Accessories

        Click on Hyperterminal

A HyperTerminal Window will open

        Double Click: Hyperterminal.exe

A New Connection Window will open

        Enter a name for the session and Click OK

A Connect to Window will open

        Click on the down arrow by the Connect Using Box and click on TCP/IP(Winsock)

        Enter the IP address of the DTS3250 Module in the Host Address Box

        The HyperTerminal window will indicate that a connection has been made.

Check the setup

        Select: File

        Select: Properties

A Properties Window will open.

        Click on the Settings Tab

        Emulation Mode should be Auto Detect

        Terminal should be ANSI

Click on the ASCII Setup Button

        For best operation, The check boxes for:

        Send line ends with line feeds, and Echo typed characters locally may have to be checked

DTS3250 Recommended Operation

1.   Energize the unit and allow 3 hours for warm-up.
2.   While the unit is warming up, connect the thermocouples to the inputs.
3.   Verify that the thermocouple types are set correctly. The following command should be used:
        List T 0   All channels will be listed. The thermocouple type will be shown as well as the
                          shield connection. Refer to the figures in Thermocouple variable group
                          section for more information.
4.   Enter labels for the thermocouples, if desired. The current label entries may be viewed by the following
        command:
        List LA   Labels may be changed by using the SET LABEL x function where x is the
                          channel number.
5.   Enter channel range limits. This is the number that will be displayed if the input exceeds the calibrated
        range of the unit. Refer to RANGEV and RANGET variables for more information.
6.   Enter channel limits. These are the temperature limits that will be used for alarm outputs. The current
        channel limits may be viewed by typing:
        List LI
7.   Verify the SCAN variable settings. Type:
        List S   The scan variables will be listed. Set PERIOD, AVG or RATE to obtain the
                          desired scan rate
8.   When the unit has completed the warmup, Issue the following commands:
        ADCAL   Re-zero the A/D converters
        OTC   Test for open thermocouples
        ERROR   Check for errors
9.   If no errors are logged, the unit is ready for test.
10.   It is also recommended that the user check for errors every time the ADCAL command is executed.
        If an A/D times out or does not respond correctly during the execution of that command, the A/D will
        be disabled in software. The only indication that this has occurred will be an error logged in the error
        buffer.

Special Operational Notes

1.   If any RTD reading is outside the range -10.0 $^{\circ}$C to 70.0 $^{\circ}$C, the last good reading is used. NO error
        will be logged.
2.   If any thermocouple reading is outside the range for that thermocouple type, the last good reading is
        used. NO error will be logged. Please refer to the standard NIST tables for the range of each
        supported thermocouple type.
3.   If any A/D converters are disabled due to errors, an error will be logged and bit 12 of the channel status
        element in the data packet will be set.

DTS3250 Boot Parameter Modification

The DTS3250 Series modules use an operating system licensed from VxWorks. The boot parameters are set at the factory, but these parameters may be modified to suit the needs of a specific installation. This section documents the modification of the boot parameters.

1. De-energize the DTS3250. Connect the DTS3250 trigger/serial test cable (Scanco part #155829) from the DTS3250 to a host PC.
2. Start HyperTerminal, or an equivalent communication program. Connect the DTS3250 to a COM port on the PC Host. Set the serial parameters to 9600 BAUD, no parity, 8 data bits and 1 stop bit.
3. Energize the DTS3250. The following sign-on information should be displayed.

    VxWorks System Boot
    Copyright 1984-1997 Wind River Systems, Inc.

    CPU: HITACHI hs7709
    Version: 5.3.1
    BSP version: 1.1/0
    Creation date: Feb 9 2000, 12:41:05

    Scanivalve (c)2000, Boot loader version 1.01
    Press any key to stop auto-boot...

4. Press any key within 3 seconds to stop the auto-boot process. If a key is not pressed within the 3 seconds time, the system will proceed to auto-boot with the existing operating system using the current setup.
    NOTE: The boot-loader will continue to reboot until stopped by pressing a key under the following conditions:
        A.   If boot-from-flash is selected, and no operating system is present in flash.
        B.   if boot-from-net is selected and the FTP server is not correctly set up.
5. When the auto-boot process is stopped, the boot-loader will prompt with:
        [VxWorks Boot]:
    To get a list of the existing boot parameters:
        Type: p <Enter>
    The following list is the default setup:

boot device	: cs
processor number	: 0
host name	: host
file name	: c:/dsa_hs/vxWorks.st
inet on ethernet (e)	: 191.30.60.100
host inet (h)	: 191.30.101.109
user (u)	: DSA_HS
ftp password (pw)	: scanivalve
flags (f)	: 0x0
other (o)	: flash,000.096.093.250.000.002,10baseT

6.   Modify the parameters as required by typing the change command at the [VxWorks Boot] prompt
                Type: c<Enter>   The boot-loader prompts you for each parameter.

        If a particular field has the correct value and does not need to be changed,
                Press: <Enter>
        NOTE: If any other key is pressed, that will replace the existing information.

        To clear a field,
                Type: . <Enter>

        To quit before viewing all of the parameters,
                Type: CTRL+D.

7.   After all changes have been made, verify the settings:
                Type: p<Enter>   The settings are saved in flash at this point.
8.   Restart the operating system, with the new settings,
                Type: @ <Enter>   This is the "Load and Go" command.
9.   If the DTS3250 boots correctly, de-energize the DTS3250 and disconnect the serial test cable.
10.   Re-apply power to the DTS3250.

Boot parameters and their functions:

boot device	Must not be changed from cs
processor number	Must not be changed from 0
host name	Must not be changed from host.
file name	The full pathname of the operating system file name to be booted from, when booting from the network. The default path and file in this line is the path and file used at Scanivalve.
inet on ethernet(e)	The IP address of this DTS3250.
	Although it is not necessary, The subnet mask may be specified when entering this parameter by entering a colon followed by the subnet mask in hex notation. I.e.　　191.30.85.100:FFFFFF00
inet on backplane (b)	Must be left blank
host inet (h)	The IP address of the host for boot from net, or file upload
gateway inet (g)	The IP address of a gateway node if the host is not on the same network as the DTS3250.
user (u)	The user name that the DTS3250 uses to access the host. This is the name that must be set up in the FTP server on the host. The FTP server must be set up to provide that user name with the proper permission to read from the host directory and the password must be set correctly.
ftp password (pw)	The user password. This must be supplied to boot from host.
flags (f)	Must be 0x0
target name (tn)	Must be blank
startup script (s)	Must be blank
other (o)	This specifies the place to boot from, the MAC address, and the network media. The line must not contain any spaces and each parameter is separated by a comma. The syntax is:

                    \<bootloc\>,\<mac address\>,\<media type\>

               Valid values are case sensitive and are as follows:

                    \<bootloc\>   net - Boot from network

                               flash - Boot from flash.

                  \<mac address\> ddd.ddd.ddd.ddd.ddd.ddd

                  \<media type\> 10base2 - 10Base2 type

                               10baset - 10BaseT type

DTS3250 Operating System Upload

This section describes the method for upgrading and uploading a new operating system to the DTS3250. Two programs are used in the DTS3250, the boot-loader and the operating system/DTS3250 application, referred to as the operating system.

The purpose of the boot-loader is to start the operating system from local flash or from a location on the network, such as a disk file on a host PC and to allow setting of certain key operating system parameters. The boot-loader can only be installed with special flash programming equipment. However, the boot-loader, under most normal upgrade conditions, would not need to be changed.

When upgrading a new DTS3250 operating system, the following procedure should be followed:

1.   Install an FTP server, on your host PC. Scanivalve Corp recommends the War Daemon FTP Server. The installation is described in the FTP Server Installation/Configuration Procedure.
2.   Use the boot parameter modification procedure to modify the boot parameters:
     A   Change the file name parameter to the location of the vxWorks.st file.
     B.   Change the host IP address to match the host computer.
     C.   Insure that the user parameter is set to DSA_HS. It must match the user in the FTP server. This name may be modified by a user
     D.   Set the password to scanivalve. It must match the password in the FTP server. The password may be modified by a user.
3.   Connect to the DTS3250 using TelNet
4.   Issue the "UPLOAD S <full file path>" command from TelNet. Only back slashes can be used in the path name and the S must be upper case.
5.   Monitor the operation with the STATUS command. When it returns READY, the upload is complete. The upload will require about 2.5 minutes to complete. If READY is returned immediately, something has been entered incorrectly.
6.   When the DTS3250 returns READY, The new operating system is installed in flash memory, but not in RAM.
7.   The new operating system will be effective when power is recycled.

DTS3250 Buffer Description

The DTS3250 buffer is a software buffer. It is set up as a FIFO. It is factory set to hold 10000 averaged frames of data. Each frame uses 292 bytes of memory.

The software buffer is always in use regardless of the setting of QPKTS variable. The effect of QPKTS occurs when the buffer is filled. If QPKTS is set to 1, the scan will stop when the buffer is full. If QPKTS is set to 0, subsequent frames will be discarded when the buffer is full.

The buffer is the liaison between the scan task and the scan output task. The scan output task has a higher priority than the scan task. Under initial conditions, when the buffer is empty, the scan task places one frame of data in the buffer. It then signals the scan output task to read the buffer until it is empty. However, when multiple frames of data are in the buffer, the output task continues until the buffer is empty. Multiple frames of data will accumulate if the scan output task is blocked by the network while outputting data.

WarFTP Server

Installation

Copy the file: Warftp.exe into a temporary directory.
Double click: Warftp.exe to unzip the installation files.
Double click: Setup.exe
A window will open prompting for an installation directory. Click Next.
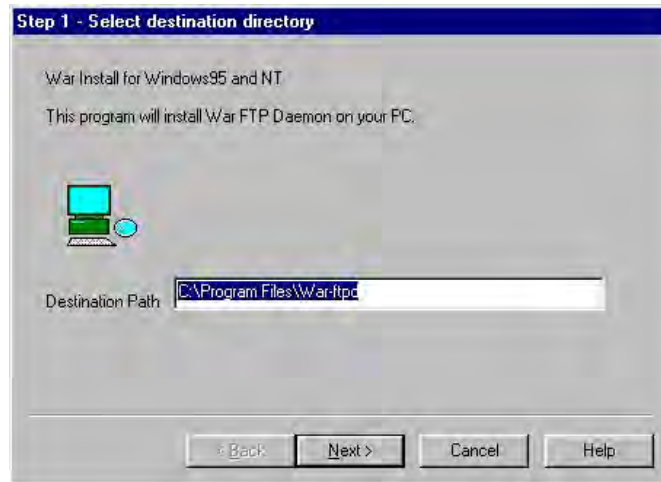
A window will open prompting for an installation type.
        Select: Typical, and click Next.
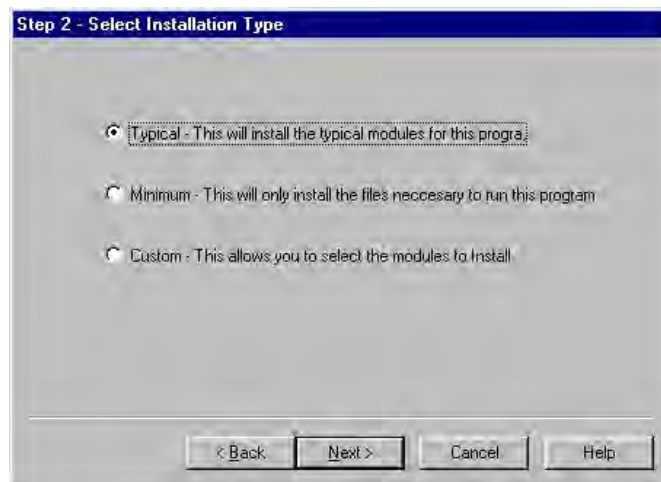
A Window will open prompting for a program folder. Use the default folder, and click Next.

Step 3 - Select Program Folder

Select a name for the Start Menu entry (or Program Folder in Windows NT 3.51).

Folder

War FTP Daemon

HP LaserJet
Internet
Peripherals
ScanPlus Flash Programmer
Software Development
StartUp
Viewers
War FTP Daemon

[< Back] [Next >] [Cancel] [Help]

A window will open prompting to finish the installation.
Click: Finish to complete the installation.

Finish the installation

War Install is ready to finish the installation

[< Back] [Finish] [Cancel] [Help]
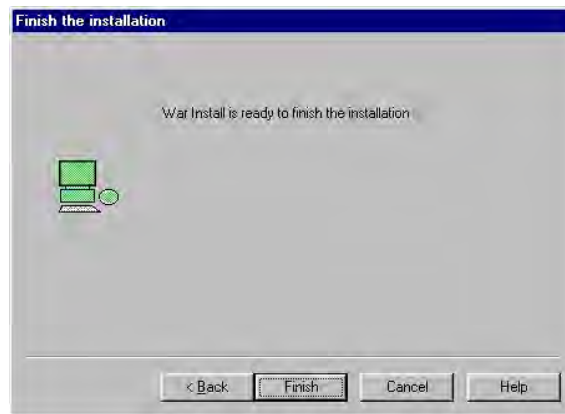
If the installation is successful, a window will open with this message. Click OK

SETUP

⚠ Installation complete. You can now run the installed program.

[OK]

Create a folder for the DTS files.
        Create the directory: C:\DTS_HS.
        Copy the file: VxWorks   into this directory.

Configuration and Setup

Start the application by double clicking the war-ftpd.exe icon in the C:\Program Files\War-ftp directory.

The War FTP Daemon information window will open
       Enable the "Do not show this banner again" check box and click OK.

The main display window will open. It will look similar to the window below.
       Select: Properties
       Select: Options

From the General Tab, Enable the "Go online when started and minimize" check boxes.
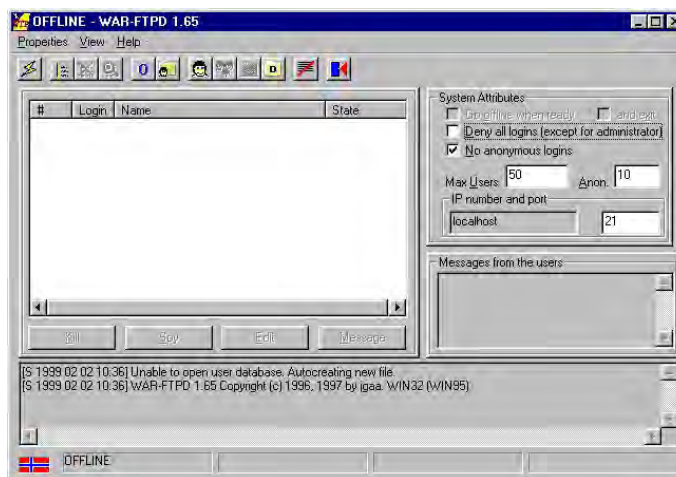
Select the Server Name Tab.
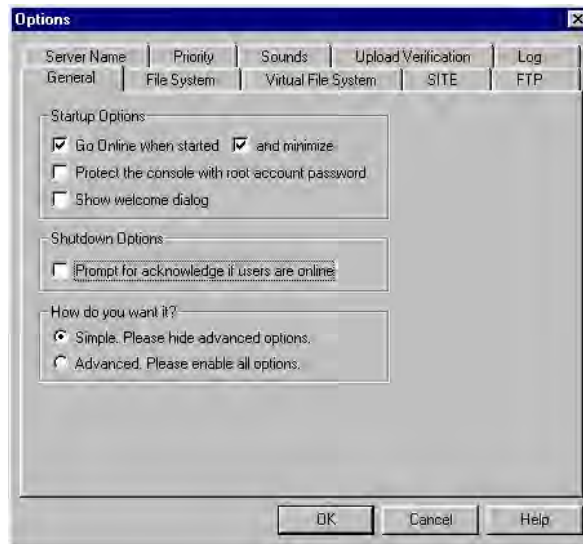
Enter a name for the FTP server.
In this example the server will be named :   host.
          Click OK.
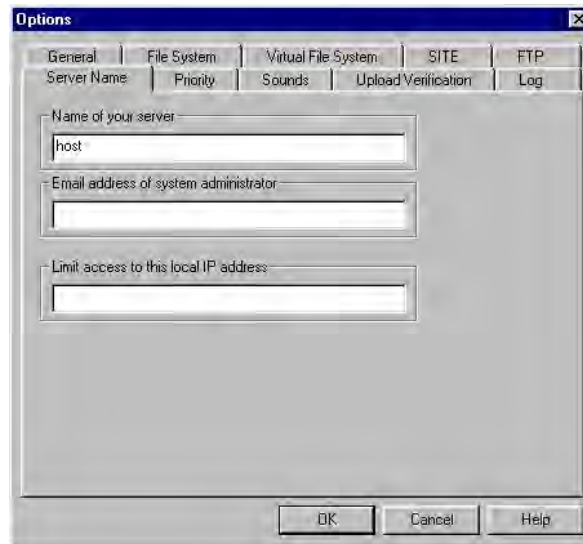
The main window will re-open

Open the User Maintenance window:
> Click on the large smiling face icon
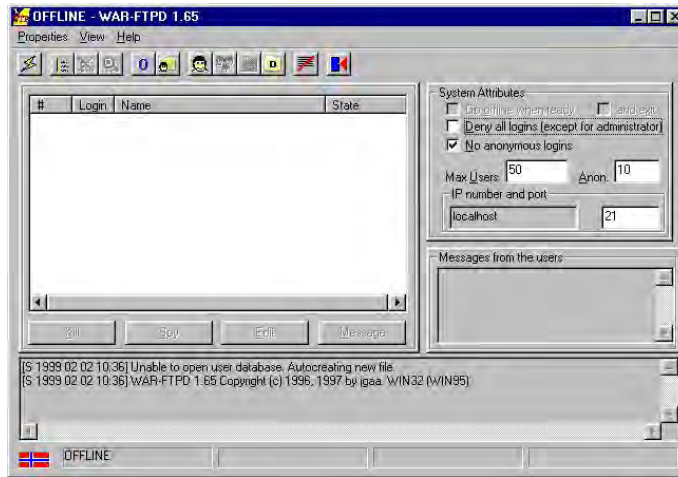
When the User Maintenance Window opens,
> Click the Add button
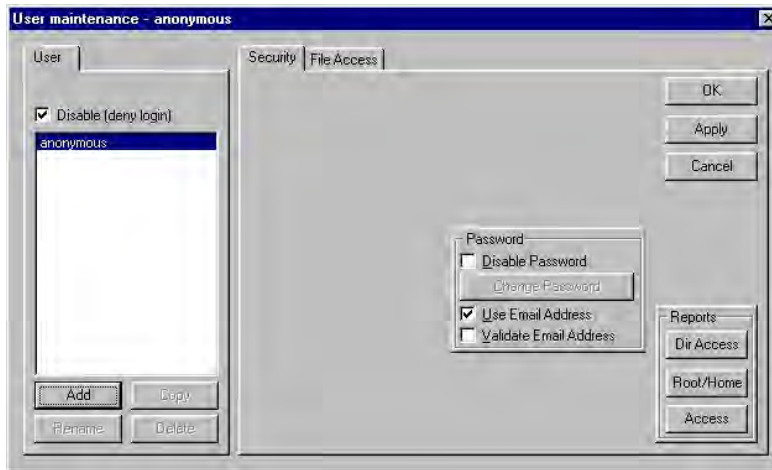
A window will open prompting a User name for the DTS
Enter a user name for the DTS.
> For this example, the User Name will be:DTS_HS
> Click OK.

Another window will open prompting for a password
Enter a password for the DTS.
For this example, the password will be: scanivalve.
Click OK.

The User Maintenance window will re-open.
        Highlight DTS_HS
        Select the File Access Tab
        Click on the Add Button.
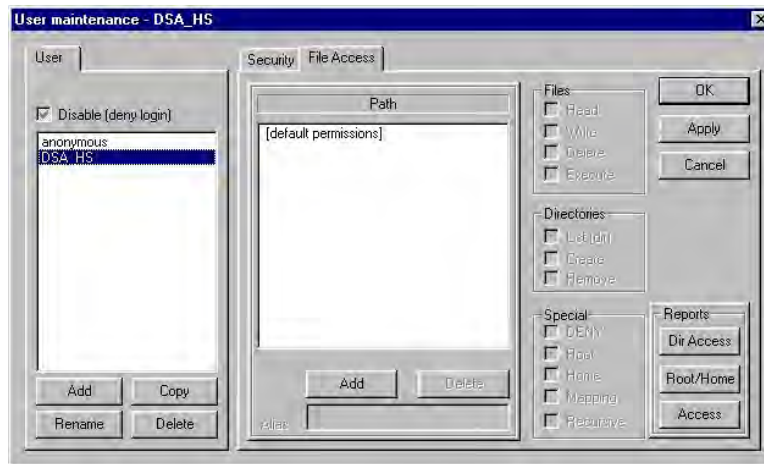
A Select Directory Window will open
        Highlight the DTS_HS directory.
        Click OK.

Enable the Read and Write checkboxes in the Files frame.
    Click :   Apply
    Click: OK
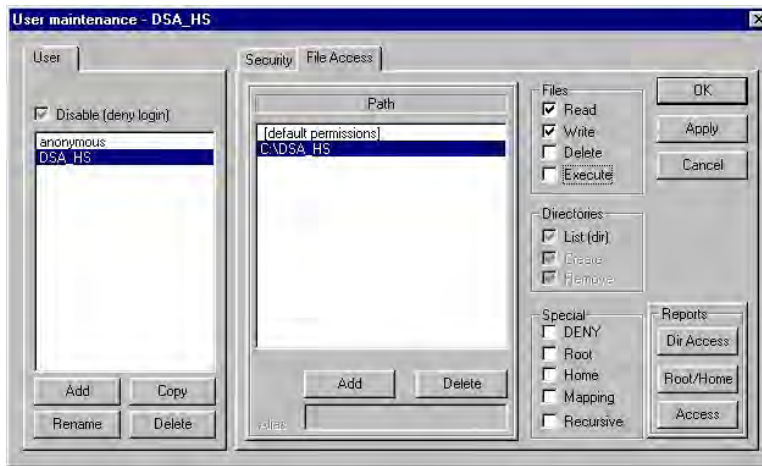
The Main Window will re-open
Put the server online:
    Click on the lightning bolt..
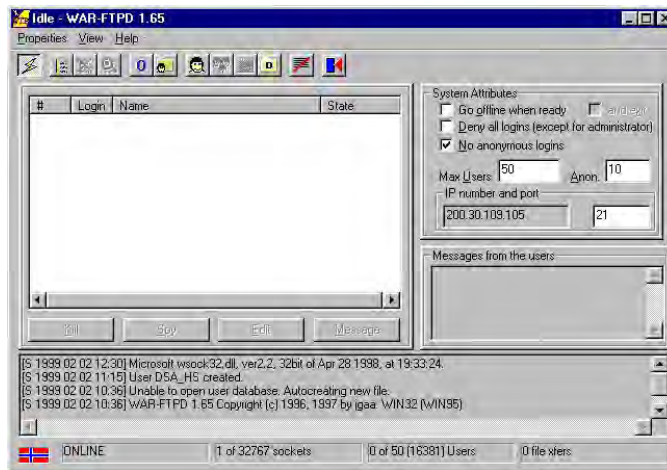
The WarFTP server is now ready
The server can be started manually as needed, or it could be configured to start automatically by placing a shortcut to War-Ftpd.exe in the Windows/Start Menu directory.

Appendix A - Accessories

Power Supply - PDM 1500

A single output 24 Vdc power supply is available as an accessory to the DTS3250. This power supply will drive one DTS3250. The Scanivalve part number is 145078-1. The unit will operate from 100 to 240 Vac at 47 to 63 Hz. The output is 24 Vdc at 2.5 A. A 10 foot (3 meter) interconnecting cable, Scanivalve part number 155819-1, is included. Longer cables are available. For more information on the power supply and cables, contact Scanivalve Corp, Customer Service Department.

NOTE: The PDM1500 is a direct replacement for the previous PDM1000 power supply.

POWER ENTRY
90-264VAC 47-63 Hz

2.0
[50.8]

A

A

5.9
[149.2]

1.4
[34.3]

S/V PART #CO-740
AMP #206430-1, SCKT #66105-4

MATING CONNECTOR
AMP #206429-1, PIN #66103-4
AMP #207490-1, CABLE GRIP
AMP #207489-1, CABLE BOOT

VIEW A-A

CO-740		
P1	+VDC	RED
P2	RTN	BLK
P3	GROUND	GRN
P4	UNUSED	

OUTPUT
FOR 145078-1
24VDC
2.62A, 63W

FOR 145078-2
12VDC
4.75A, 57W

CABLE #155819-1

Power Supply - PDM 3200

For users with multiple DTS3250 units, A 24 Vdc power supply capable of powering multiple units is available. This power supply will drive up to four DTS3250s. The Scanivalve part number is 21080-1. The unit will operate from 88 to 264 Vac at 47 to 63 Hz. Each output is 24 Vdc at 2.5 A. Interconnecting cables are not included, but mating connectors are provided. Scanivalve Corp will manufacture interconnecting cables, if requested. A standard 10 foot (3 meter) interconnecting cable, Scanivalve part number 155819-1, is available. Longer cables are available on request. . For more information on the power supply and cables, contact Scanivalve Corp, Customer Service Department.

Appendix B - Thermocouple Information

Thermocouple Basics

When two dissimilar metals are joined together to form a closed loop, and if one junction is held at a different temperature from the other, an Electromotive Force(EMF) is generated. The amount of EMF generated is predictable based on the materials used and the temperature of the junction.

The EMF is generated by the wires, not the junction. A temperature gradient must exist before the EMF can be generated.

Three laws have been established that govern thermoelectric circuits.

Law of Homogeneous Materials
> A thermoelectric current cannot be sustained in a circuit of a single homogeneous material, however it varies in cross section, by the application of heat alone.
> Simply stated, two different materials are required for any thermocouple circuit. If current can be detected in a homogeneous wire when it is heated, this is evidence that the wire is inhomogeneous.

Law of Intermediate Materials
> The algebraic sum of the thermoelectromotive forces in a circuit composed of any number of dissimilar materials is zero if all of the circuit is at a uniform temperature.
> This law states that a third homogeneous material can be added to a circuit with no effect on the net EMF of the circuit as long as temperature of the junctions remain the same.

Law of Successive or Intermediate Temperature
> If two dissimilar homogeneous materials produce a thermal EMF of E_1 when the junctions are at temperature T_1 and T_2, and a thermal EMF of E_2 when the junctions are at T_2 and T_3, the EMF generated when the junctions are at T_1 and T_3 will be $E_1 + E_2$.
> This law states that a thermocouple calibrated for one reference temperature can be used with any other reference temperature with a correction. Also, extension wires having the same characteristics as those of the thermocouple wires can be introduced to the circuit without affecting the circuit.

Thermocouple Circuits

A basic thermocouple circuit consists of two dissimilar homogenous materials extending from the measuring junction to the reference junction.
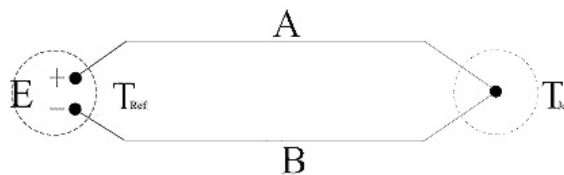
When more than one thermocouple is to be measured, each thermocouple should be two continuous wires between the measuring and reference junctions. This is the most common circuit for thermoelectric testing.
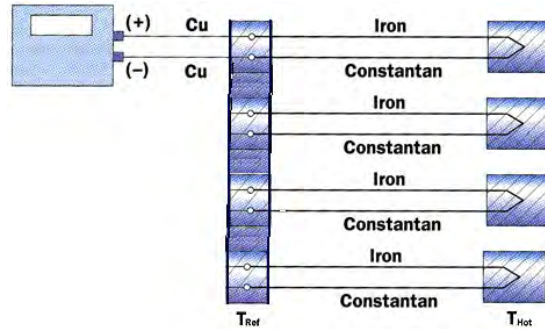
Thermocouple Accuracy

Thermocouple accuracy can be defined as relative and absolute accuracy.

Relative Accuracy

This is the ability of the system to repeat a given measurement. This depends upon the quality of the sensors, the measuring system used and how the system is installed.

Absolute Accuracy

This is the ability of the system to determine a standard accepted value. This can be achieved by calibration relative accepted and recognized standards.

Thermocouple Calibration

Calibration will not change the characteristics of a thermocouple. It does validate the system and ensure proper readings by allowing corrections to be entered for each thermocouple in the system. Calibrations should conform to ISO 10012-1:1992.

Sources of Error in Thermocouple Measurements

Measuring Junction

The thermocouple junction at the temperature measuring point is the measuring junction. Errors at this point depend upon the age of the junction, the method of joining and materials used to form the junction. Generally, errors from the measuring junction are small.

Extension Wires

Extension wires are any elements inserted between the measuring junction and the reference junction. Extension wires should have the same characteristics as the thermocouple wire. Extension wires introduce four junctions to each circuit. This can cause errors as large as ±2 °C. The errors can be minimized by calibrating the system with the extension wires in place. If possible, extension wires should not be used.

Reference Junctions
> The thermocouple junction maintained at a known temperature is the reference junction. Reference junctions can introduce errors as large as ±0.6 °C.

Copper Connecting Wires
> These wires are used to connect the reference junction to the measuring device. The errors caused by these wires are very small.

Thermocouple Switches
> When used, these devices can induce errors as large as ±1 °C. Switching should occur in the copper wires between the reference junction and the measuring device.

Noise in Thermocouple Circuits

The external effects that can cause errors in thermocouple circuits include: electrical and magnetic fields, cross-talk, and common mode voltage.

Electric fields radiated from voltage sources are capacitively coupled to thermocouple extension wires. This imposes an AC voltage on the thermoelectric EMF. This can be minimized by shielding the thermocouple extension wire and grounding the shield.

Magnetic fields produce noise current in the thermocouple extension wire. This can be minimized by twisting the thermocouple extension wire pairs.

In a multipair thermocouple extension wire, adjacent pairs can pick up noise from a pulsating signal. This can be minimized by shielding the individual pairs.

Common mode noise will be generated if a grounded thermocouple is connected to a grounded instrument. This can be minimized by grounding the thermocouple and shield as close as possible to the measuring point.

Thermocouple Design

The thermocouple used in an application should be selected specifically for the application.

Size
> The temperature sensed will be the average temperature across the length of the sensor.

Shape
> The shape must conform to the shape of the surface if the thermocouple is measuring surface temperatures.

Response
> The response time of a thermocouple is mass dependent. Therefore the size of the thermocouple must be small in relation to the object being measured. The response time should be approximately 5 times shorter than the fastest rate of temperature change to be monitored.

Heat Conduction
> Thermocouple extension wires can conduct heat into or out of the thermocouple. The wire must be insulated from the environment if this can occur.

Sensor Position
> The thermocouple measures the temperature of the object it is touching or the environment in which it is installed. Therefore the thermocouple must be positioned very carefully to insure that the temperature is being sensed at the correct point.

Thermocouple Types and Descriptions

The DTS family of Temperature Scanners will accept inputs from Type E, J, K, N, R, S, and T Thermocouples. The accuracy of the measurement will depend upon the type of thermocouple and the quality of the extension wire used for the measurement.

Type B

Positive leg	70% platinum, 30% rhodium
Negative leg	94% platinum, 6% rhodium
Range	0 to 1800°C
Usable range	400 to 1704°C
Notes	Easily contaminated and damaged by reducing atmospheres. This thermocouple should be protected with a gas tight ceramic tube, a secondary tube of porcelain and a silicon carbide or metal outer tube.

Type E - Chromel Constantan

Positive leg	90% nickel, 10% chromium
Negative leg	43% nickel, 57% copper
Range	-270 to 1000 °C
Usable range	0 to 900 °C
Notes	Highest EMF output per degree of all recognized thermocouples. Has similar drift between 316 and 593 °C as a Type K thermocouple

Type J - Iron Constantan
    Positive leg   100% iron
    Negative leg   43% nickel, 57% copper
    Range   -210 to 1200 $°C$
    Usable range   0 to 816 $°C$
    Notes   Not susceptible to aging from 371 to 538 $°C$. Very stable, should be used with a 96% pure MgO insulation and stainless steel sheath to prevent corrosion of the iron lead. Most commonly used thermocouple.

Type K - Chromel Alumel
    Positive leg   90% nickel, 10% chromium
    Negative leg   95% nickel, 2% aluminum, 2% manganese, 1% silicon
    Range   -270 to 1372 $°C$
    Usable range   -36 to 1260 $°C$
    Notes   Not recommended from 316 to 593 $°C$ because of aging that can cause drift rates of 2 $°C$ in a few hours. Best used when corrosion may be a problem.

Type N
    Positive leg   14% chromium, 1.4% silicon, 84.6% nickel
    Negative leg   95.6% nickel, 4.4% silicon
    Range   -270 to 1372 $°C$
    Usable range   0 to 1260 $°C$
    Notes   Less aging from 316 to 593 $°C$ than a Type K thermocouple.

Type R
    Positive leg   87% platinum, 13% rhodium
    Negative leg   100% platinum
    Range   -50 to 1767 $°C$
    Usable range   0 to 1482 $°C$
    Notes   Has a higher output than Type S thermocouples. Easily contaminated. This thermocouple should be protected by compacted mineral insulation and a metal outer sheath.

Type S
    Positive leg   90% platinum, 10% rhodium
    Negative leg   100% platinum
    Range   -50 to 1767 $°C$
    Usable range   0 to 1482 $°C$
    Notes   Easily contaminated. This thermocouple should be protected with a gas tight ceramic tube, a secondary tube of porcelain and a silicon carbide or metal outer tube.

Type T - Copper Constantan
    Positive leg   Pure copper
    Negative leg   43% nickel, 57% copper
    Range   -270 to 400 $°C$
    Usable range   -262 to 350 $°C$
    Notes   Good for low temperature and cryogenic applications

International Thermocouple and Extension Wire Color Codes

Country	USA	USA	United Kingdom	United Kingdom	Germany	Japan	France
Standard	ANSI MC96.1 T/C	ANSI MC96.1 Extension	BS 1843	BS 4937	DIN 43714	JIS C1610-1981	NFE C42-323
B Overall B Positive B Negative	---------	Grey Grey Red	---------	---------	Grey Red Grey	Grey Red Grey	---------
E Overall E Positive E Negative	Brown Purple Red	Purple Purple Red	Brown Brown Blue	Brown Brown Blue	Black Red Black	Purple Red White	---------
J Overall J Positive J Negative	Brown White Red	Black White Red	Black Yellow Blue	Black Black White	Blue Red Blue	Yellow Red White	Black Yellow Black
K Overall K Positive K Negative	Brown Yellow Red	Yellow Yellow Red	Red Brown Blue	Green Green White	Green Red Green	Blue Red White	Yellow Yellow Purple
N Overall N Positive N Negative	Brown Orange Red	Orange Orange Red	-------	-------	-------	-------	-------
R Overall R Positive R Negative	-------	Green Black Red	Green White Blue	Orange Orange White	White Red White	Black Red White	Green Yellow Green
S Overall S Positive S Negative	-------	Green Black Red	Green White Blue	Orange Orange White	White Red White	Black Red White	Green Yellow Green
T Overall T Positive T Negative	Brown Blue Red	Blue Blue Red	Blue White Blue	Brown Brown White	Brown Red Brown	Brown Red White	Blue Yellow Blue

Appendix C - DTS3250 Error List

Bootup/Initialization Errors

A/D 2 timeout error channel %ld RTD
A/D 2 verify error channel %ld RTD
A/D Board version
A/D F/W version not 1, 2 or 3, Board %ld Fw %ld Hw %l
A/D F/W version not all the same
A/D H/W version not 9, Board %ld Fw %ld Hw %ld
A/D timeout error channel %ld RTD
A/D timeout error channel %ld
A/D verify error channel %ld RTD
A/D verify error channel %ld
Board index not between 1 and %ld
End board not between 1 and %ld
End channel invalid
End channel less than start channel
End channel not between 1 and %ld
End channel out of range
Hardware version is not 9
FifoLevel frames not between 1 and 480
FifoLevel frames value not valid

All of these errors are fatal errors that indicate a serious hardware problem. They may only be viewed on the serial connection during bootup. If any of these errors are indicated, the module must be returned to the Scanivalve factory for repairs.

Configuration Variable Errors

ARPC Board missing
ARPC board not found
ARPC Board out of range
ARPC Board value not valid
> The board value was not entered, less than 1, greater than the maximum number of boards, or not numeric
ARPC Reference temperature missing
ARPC Reference temperature value not valid
> The RTD reference temperature was not entered, or is not a numeric value
ARPC value not found
ARPC value not valid
> The board value was not entered, less than 1, greater than the maximum number of boards, or not numeric
ARPCON value not found
ARPCON value not valid
> The value was not entered, or not 0 or 1
AUTOCON value not found
AUTOCON value not valid
> The value for AUTOCON was not entered, or not 0 or 1.
Average value above range
> The value entered was greater than 240
Average value below range
> The value entered was less than 1

AVG value not found
AVG value not valid
>The value was not entered, negative or not numeric

BIN value not found
BIN value not valid
>The value was not entered, or not 0 or 1

CALAVG value not between 1 and 64
>The value is too high or too low

CALAVG value not found
CALAVG value not valid
>The value was not entered or not numeric

Calculated period value above range for 16 channel unit
>The value is greater than 262144 µsec

Calculated period value above range for 32 channel unit
>The value is greater than 524288 µsec

Calculated period value above range for 64 channel unit
>The value is greater than 1048576 µsec

Calculated period value below range
>The value is less than 781 µsec

Calculated period value may be too fast for some applications
>Refer to software documentation

Channel index not between 1 and %ld
Channel out of range
>The PT Channel index entered was less than 1 or greater than 7.

CHANNEL value not between 1 and %ld
CHANNEL value not found
CHANNEL value not valid
>The Channel number entered was less than 1, greater than max channels, or not numeric.

COUNTS value not found
>The COUNTS value was not entered or not numeric

DEF channel not between 1 to max channels
>The value is less than 1 or more than 16, 32, or 64

DEF channel not found
DEF channel not valid
>The value was not entered, negative or not numeric

ECHO value not found
ECHO value not valid
>The value was not entered or not 0 or 1

FORMAT value not found
FORMAT value not valid
>The value was not entered or not 0 or 1

FPS value not found
FPS value not valid
>The value was not entered, less than 0, or greater than 4294967295

Gain CHANNEL value not between 1 and %ld
Gain channel value not found
Gain channel value not valid
>The channel number entered was less than 1, greater than the maximum channel number for this module, or not numeric.

Gain value not found
Gain value not valid
>The gain value was not entered or not numeric.

HOST IP address value not valid
>The IP address entered is not a valid IP address

HOST server port value not valid
>The port number entered is not a valid port number

HOST value not found
>No modifiers were entered for the HOST variable

Invalid list parameter
>The list parameter entered is not defined. Refer to the Software Specification.

Invalid set parameter
>The SET parameter entered is not a valid configuration variable name

Invalid channel value
>The channel number entered is less than 1 or greater than the maximum channel number for this module.

IPO Channel out of range
>The channel number entered is less than 1 or greater than the maximum channel number for this module.

IPO end channel invalid
>The channel number entered is greater than the maximum channel number for this module.

IPO end channel less than start channel
>The channel number entered is less than the start number.

IPO end channel out of range
>The channel number entered is less than 1, or greater than the maximum channel number for this module, or not a numeric value.

IPO Invalid start channel value
IPO Start channel not present
>The channel number entered is less than 1 or not a numeric value.

IPO Exceeded max iterations
>The IPO routine could not calculate a zero offset correction

LABEL channel not between 1 and %ld
LABEL channel value not found
>The channel number entered was less than 1, greater than the maximum channel number, or not entered.

LABEL value not valid
>The channel number entered was not numeric.

Limit channel value not between 0 and %ld
Limit channel value not found
>The channel number entered was less than 1, greater than the maximum channel number, or not entered

Limit channel value not valid
>The channel number entered was not numeric

Limit enable value not found
Limit enable value not valid
>The value was not entered, or was not 0 or 1.

List A task spawn failed
>Fatal error - coefficients could not be found

List DEF channel not found
List DEF channel value not valid
>The channel number was not entered or not numeric.

List DEF channel out of range
> The channel number entered was less than 1 or greater than the maximum channel number.

List P BOARD value not between 1 and %ld
> The value entered was 0 or greater than the number of boards installed.

List P BOARD value not valid
> The board number was not entered or not numeric.

List P CHANNEL value not between 1 and %ld
> The value entered was 0 or greater than the number of boards installed.

List P CHANNEL value not valid
> The board number was not entered or not numeric

List P CHANNEL value not found
> The board number was not entered or not numeric

List P TEMP value not between 0 and %ld

List P TEMP value not valid
> The temperature, or temperature range entered was less than 0, greater than the maximum module temp, or not numeric.

List value not found
> The list command type was not specified

MAXDELTA value not found

MAXDELTA value not valid
> The value was not entered or not numeric

Missing R or T parameter from LIST P
> The List P command must include a R or T modifier.

Model value not found

Model value not valid
> The model number and channel value was not entered or is not a valid model number.

Number of boards is not 1, 2, or 4
> These are the only valid values for any board term.

NUMCOEF value not between 1 and 3

NUMCOEF value not found

NUMCOEF value not valid
> The NUMCOEF value entered was less than 1, greater than 3 or not entered.

NUMPTS value not between 1 and 8

NUMPTS value not found

NUMPTS value not valid
> The NUMPTS value entered was less than 1, greater than 8 or not entered.

NUMTEMP value not between 0 and 8

NUMTEMP value not found

NUMTEMP value not valid
> The NUMTEMP value entered was less than 1, greater than 3 or not entered.

Offset CHANNEL value not between 1 and %ld

Offset channel value not found

Offset channel value not valid
> The CHANNEL number entered was less than 1, greater than max channels, or not entered.

Offset value not found

Offset value not valid
> The Offset gain value was not entered, or not numeric.

Period value above range for 16 channel unit
> The value is greater than 262144 µsec

Period value above range for 32 channel unit
> The value is greater than 524288 µsec

Period value above range for 64 channel unit
        The value is greater than 1048576 µsec
Period value below range
        The value is less than 781 µsec
Period value may be too fast for some applications
        Refer to software documentation
Period value not found
Period value not valid
        The value was not entered, negative or not numeric
PORT value not found
PORT value not valid
        The value entered was not a valid port number or not numeric.
PT index invalid
PT index not present
        The value was not entered, negative or not numeric
PT Volts missing
        The value was not entered.
QPKTS value not found
QPKTS value not valid
        The value was not entered, negative or not numeric
Range Temp Hi value not found
Range Temp Hi value not valid
        The value was not entered, negative or not numeric
Range Temp Lo value not found
Range Temp Lo value not valid
        The value was not entered, negative or not numeric
Range Volt Hi value not found
Range Volt Hi value not valid
        The value was not entered, negative or not numeric
Range Volt Lo value not found
Range Volt Lo value not valid
        The value was not entered, negative or not numeric
Rate value is too slow
        The value is less than 0.01samples/channel/sec
Rate value not found
Rate value not valid
        The value was not entered, negative or not numeric
RNUMCOEF value not between 1 and 7
RNUMCOEF value not found
RNUMCOEF value not valid
        The value entered was less than 1, greater than 7, not numeric, or not entered
RNUMPTS value not between 1 and 8
RNUMPTS value not found
RNUMPTS value not valid
        The value entered was less than 1, greater than 8, not numeric, or not entered
RPC Board missing
RPC board number not found
RPC board number not valid
RPC board number out of range
        The board value entered in the RPC command was omitted, greater than the number of
        boards in the module, less than one, or not numeric

RPC board number value not valid
RPC Board out of range
RPC Board value not valid
> The board value entered in the List RPC command was omitted, greater than the number of boards in the module, less than one, or not numeric

RPC index not present
RPC INDEX value not found
> The RPC Index value was not entered or not numeric.

RPC INDEX value not between 0 and 7
RPC INDEX value not valid
> The RPC index value was negative, greater than 7, or not numeric

RPC Volts missing
RPC VOLTS value not found
> The RPC volts value was not entered or not in the correct format.

RPC COUNTS value not found
RPC COUNTS value not valid
> The RPC counts value was not entered or not numeric

RTD A term value not found
> The A term was not entered or not in the correct format

RTD B term value not found
> The B term was not entered or not in the correct format

RTD Channel board number out of range
> The channel/board number must be 1 to 64 for a thermocouple channel, or 1 to 4 for an RTD. The 1 to 4 in the RTD indicates the board number. The board number cannot be greater than the number of boards in the module.

RTD channel out of range
RTD channel value not found
RTD channel value not valid
> The value entered was less than 1, greater than the maximum number of channels in the module, not entered or not numeric.

RTD Ohms value not found
> The ohms value was not entered

RTD Point index value not found
RTD Point index value not valid
> The value entered must be 0 to 7

RTDMAXSLEW value not found
RTDMAXSLEW value not valid
> The value entered was less than 0, greater than 32000, or not numeric.

RTDX channel out of range
RTDX channel value not found
RTDX channel value not valid
> The RTDX channel value was less than 1, greater than the maximum number of RTD channels, not numeric, or not entered.

RTDX value not found
RTDX value not valid
> The value for RTDX was not entered or not numeric.

SerNum value not found
SerNum value not valid
> The value was not entered or not numeric

TCMAXSLEW value not found
TCMAXSLEW value not valid
> The value entered was less than 0, greater than 3000000, or not numeric.

Temperature index is missing
Temperature index not between 0 and %ld
Temperature index value not valid
>   The temperature index value entered in the PT command must be between 1 and the value
>   of NUMTEMPS
Temperature value not valid
Temperature is missing
>   The temperature value entered in the PT T/R command was omitted or not numeric.
Temperature is not between -10.0 and 75
>   The temperature value entered in the Set PT T/R command was less than -10 or more than
>   75 degrees F.
TIME value not found
TIME value not valid
>   The value for TIME must be a 0, 1, or 2
TITLE1 value not valid
TITLE2 value not valid
>   The TITLE values may not exceed 255 ASCII characters
Type channel value not between 0 and %ld
Type channel value not found
Type channel value not valid
>   The value entered was not between 1 and maximum channel, not entered, or not numeric
Type shield connect switch not 0 or 1
>   The value was not entered, not 0 or 1, or not numeric
Type value not found
Type value not supported
Type value not valid
>   The T/C type was not entered or not a supported type.
Units value not found
Units value not valid
>   The UNITS value was not entered or not a supported type
UPLOAD <S or C> value not found
>   The UPLOAD type must be S or C
UPLOAD file name not found
>   The file name or path entered is not valid
UpLoad task spawn failed
>   Fatal Error
Voltage index is missing
Voltage index not between 0 and %ld
Voltage index value not valid
>   The SET PT T/R voltage index entered was less than 0, more than NUMPTS, not entered,
>   or not numeric
Voltage is missing
Voltage is not between -25mv and 100mv
>   The SET PT T voltage entered was less than -25 mv, more than 100 mv, or not entered.
Voltage is not between 75mv and 150mv
Voltage value not valid
>   The SET PT R voltage entered was less than 75 mv, more than 150 mv, not entered, or not
>   numeric.
VOLTS value not found
>   The SET PT voltage was not entered, or not numeric

XSCANTRIG value not found
XSCANTRIG value not valid
> The value was not entered, negative or not numeric
XSCANTRIG value out of range
> The value was not between 1 and 15

Command Errors

AUTOSTATUS value not found
AUTOSTATUS value not valid
> The value for AUTOSTATUS was not entered, or not 0 or 1.
Cannot open file %s
> The file name or path entered is not valid
Cal data error
> Fatal error - No raw data were received from a PT command. The calibration failed.
HOSTCMD value not valid
> The ASCII command string was not entered or is not a valid ASCII command string
Invalid command
> The command entered was not a valid DTS command
Mode ready, invalid command
> The command entered was not a valid DTS command
Invalid range of board
> The board number entered was greater than the number of board in the module.
Invalid range of channel
> The channel entered was greater than the maximum number of channels in the module
Invalid single channel
> The channel number entered is not supported in this module
Invalid single board number
> The RTD number in a PT T/R command was not entered, less than 0, or greater than the number of RTDs
Max errors exceeded
> The error buffer is full. More than 15 errors have been logged.
Open T/C for channel %ld
Otc data error
> The OTC command has detected a possible open channel. Reboot to clear the error
RawData frames value not valid
RCal data error
> Data returned from a PT command were faulty. The calibration failed.
Set value not found
> A SET command was issued with no variable or modifiers
Start board not between 1 and %ld
> The start board value must be between 1 and the maximum number of boards in the module.
Start channel not between 1 and %ld
> The start channel value must be between 1 and the maximum number of channels in the module.

Communication/Hardware Errors

Alignment error
Allignment rb%lu f%1lX lbx%1lX lb%1lX tx%1lX t%1lX cx%1lX c%1lX
> Fatal Error - Reboot module
JTAG <9572, 95288, DTS95288> value not found
JTAG file name not found

Jtag task spawn failed
JTAG type must be 9572, 95288, DTS95288, A2DMUX, or A2Dn
> Fatal errors - Reboot, if error recurs, the module must be returned for repair.
Closing slave socket with read error
> Fatal error - reboot
Could not bind a socket
Could not bind a UDP socket
Could not connect to server
> The path to the host is not valid or the Ethernet connection is open.
Could not create a socket
Could not create a UDP socket
Could not create client socket
> Operating system fatal error - reboot module.
Could not open flash file for read config variables
Could not open flash file for write
Could not open flash file for write config variables
Could not open remote config file
Could not open system file
> Fatal errors - Reboot, if error recurs, the module must be returned for repair.
Could not spawn a load rtd task
Could not spawn adcal and load rtd task
Could not spawn Arpc task
Could not spawn cal task
Could not spawn ipo task
Could not spawn ListP task
Could not spawn ListPTemp task
Could not spawn ListPTemp task
Could not spawn otc task
Could not spawn RPC cal task
Could not spawn scan out task
Could not spawn scan task
Could not spawn Tcp Server
Could not spawn Type task
Could not spawn Udp Id Server
Could not spawn Udp Server
Could not spawn Web Server
Could not create output message queue
Could not listen on a socket
Could not open binary socket
Save task spawn failed
Slave task spawn failed
> Fatal errors - attempt reboot - if errors recur the module must be returned for repair
Data buffer overflow
> Fatal Error - reboot

Data overflows allocated MAX_LEN buffer size
> Fatal error - attempt reboot - if errors recur the module must be returned for repair
LoadRtd data error
MadCal A/D command write error channel %ld
MadCal A/D offset read error channel %ld
MadCal A/D span read error channel %ld

MadCal A/D span verify error channel %ld
MadCal A/D verify offset error channel %ld
>   Fatal errors - attempt reboot - if errors recur the module must be returned for repair
Read address invalid
Read address not present
Read bad offset, retry %ld A %ld C %ld O %ld
Read bad span, retry %ld A %ld C %ld S %ld
Read repeat not between 1 and 200
ReadMadCal A/D offset read error channel %ld
ReadMadCal A/D span read error channel %ld
>   These errors indicate a bad A/D was detected during the execution of an ADCAL command.
>   Repeat the command, if the errors recur, the module must be returned for repair.
Receive message queue
Send message queue
Send queue is full
>   These errors indicate a network blockage.
TCP OUT Mismatch Req %d Act %ld
>   The host did not receive the number of bytes requested. Req is the bytes requested, Act is
>   the number received. This could be caused by a firewall.
Timeout Ad hdwResetAd
>   Fatal error - attempt reboot - if errors recur the module must be returned for repair

Appendix D - Software Change Log

Version 3.00   -   Released October 2004
        Completely revised software for 16, 32, and 64 channel modules.
        Supports all 32 and 64 channel modules
        Supports 16 channel modules Serial Number 1100 and higher

Version 3.01   -   Released February 2005
        Corrected a bug in RTDMAXSLEW for RTD's 3, 4, 5, 6 , 7 and 8

Version 3.02   -   Released May 2006
        Added Network Identification
                Listen on port 7000 for 255.255.255.255
                Respond on port 7001 with <IP Address>, <Model/Ch>, <Serial Number>
        Added Network Identification Group (ID)
                IP Address
                Model
                Sernum
                Ver
                Def x

Version 3.03   -   Not Released

Version 3.04   -   Not released

Version 3.05   -   Released January 2007
        Removed Def x from the Network Identification Group (ID)
        Created a new group: Channel Definition Group (Group DEF) with DEF as the only variable
        Increased the DEF variable definition from 64 bytes per channel to 2048 bytes per channel
        Added a new command: List Channel Definitions
                LIST DEF <channel>
        Added the command: Ice Point Offset Adjustment
                IPO <start channel> <end channel>
        Added an abbreviated syntax for AUTOSTATUS. Autostatus can be enabled or disabled by either the full command: AUTOSTATUS <enable>, or the abbreviated command: AS <enable>
        Corrected a bug in the ADCAL function that set the offset calculated during an ADCAL to four times the correct value.
        Corrected a bug that blocked the output of RTD data from RTDs 5, 6, 7, and 8 in TCP binary configuration.
        Modified the following variable defaults
                NUMPORTS 8
                CALAVG 8
                RNUMCOEF 5
                RNUMPTS 8
                TYPE n K 0
        Disabled the Nagle Algorithm in TCP and UDP data transmission. This will guarantee one frame per packet in either data transmission format.
        Added ARPCON variable to the UTR Calibration Variable Group. This variable enables the ARPC correction.
        Added ARPC variable to the UTR Calibration Variable Group. This variable is a correction factor to the Calendar Van-Dusen conversion.
        Added a scan trigger divider. Limited to values from 1 to 15.
        Added the command: ARPC to calculate the ARPC correction for each board.

Version 3.06   -   Not Released

Version 3.07   -   Released August 2010
        Software changes to permit use of additional A/D board versions. These modifications are transparent
        to a user.

Version 4.00   -   Not Released

Version 4.01   -   Released October 2007
        Added NUMTEMPS to Calibration Variable Group (Group C)
                Added commands to be active only if NUMTEMPS is set to 1 or greater
                        PT
                        LIST P
                Added variable to be active only if NUMTEMPS is set to 1 or greater.
                        PT
        Removed temperature data test limits -200 to +1800 degrees C
        Added temperature data test limits for NIST range of each TC type. A range error will result in a code
        5000 or 6000 in the channel status of the output packet.
        Added error if A/D Xilinx versions for each A/D board are different.

Version 4.02   -   Released October 2007
        Removed NUMTEMP optional reference temperature parameter.
        Removed ability of List P to list both T and R data
        Range check added to A/D span and offset values
        Adjusted delay time for Read/Write Retry.

Version 4.03   -   Released November 2007
        Modified display to show RTD temps in degrees when NUMTEMPS is greater than 0 and Units is set
        to Volts.

Version 4.04   -   Released November 2007
        Changed default value of NUMTEMPS from 8 to 0. This will prevent loss of calibration coefficients if
        the firmware is upgraded in the field.

Version 4.05   -   Released November 2007
        Changed oversampling rate of the RTD A/Ds to 8X from 5X.

Version 4.06   -   Released January 2008
        Corrected an index problem in the PT R command
        Corrected a Range Input problem in the PT R command
        Corrected a Range Input problem in the PT T command
        Corrected an overwrite problem in the PT T command
        Corrected a problem with the List PT R 0 command.

Version 4.07   -   Released February 2008
        Corrected the error code output for the PT Command. An error will be generated if the PT command
        is below -10 degrees C

Version 4.08   -   Not released

Version 4.09   -   Released June 2008
   Corrected a bug in the setting of Max and Min counts when NUMTEMPS is non-zero.
   Added debug command, RADCAL, to read A/D offsets and span register. Data from this read are
   output to the back door. This command is not for customer use.
   Improved the algorithm to set PERIOD in the A/Ds
   Changed A/D multiplier to 5
   Changed RTD multiplier to 5
   Added a re-sync of the RTD A/D when PERIOD is set

Version 4.10   -   Not released

Version 4.11   -   Released July 2008
   Corrected a bug in the LIST P T <chan> <temp> command
   Added a range check, 0 or 1, to the TYPE configuration variable
   Added a limit check, 31 characters, to LABEL
   Corrected a bug in the flash write routine when a STATUS command is received before the write is
   completed.
   Added an error check to the flash write

Version 4.12   -   Released May 2009
   Modified Register setup during the boot process. This has no effect on the commands or variables.

Version 4.13   -   Released November 2009
   Removed high limit check on period and rate.
   Made several changes to improve software performance. These changes do not affect the
   documentation.

Version 4.14   -   Released November 2010
   Added a Noise test. This test is only used during circuit board tests

Version 4.15   -   Released November 2011

Version 4.16   -   Released May 2013
   Updated to check for and support A/D firmware version 4 as well as expected vs actual RTD handling
   Changed RTD registry low byte setting to FF by default

Version 4.17   -   Released November 2013
   Resolved a bug that prevented the RTDMAXSLEW filtering from being applied to RTDs 5, 6, 7 & 8.
   Changed the operation of the RESTART command to restart the hardware as well as the software.

Version 4.18   -   Released February 2014
   Removed the modification to the RESTART command implemented in V4.17. The changes made
   were not functional on all processor boards and could result in a hardware lockup requiring physical
   power cycle for recovery.

Version 4.19   -   Released August 2014
   Removed the RTD registry default setting of FF as it caused inconsistent RTD readings at with some
   PERIOD settings. Removed unnecessary debug data output with NUMTEMPS set greater than 0.