

**MODEL 9500
TEMPERATURE
RTD THERMOMETER
READOUT**

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Description:

The Model 9500 RTD Readout is a microprocessor based high resolution instrument. The 9500 utilizes a 16-bit sigma-delta analog to digital converter. It performs a display update at 2.5 times per second. The display is set to a fixed resolution of a tenth of a degree. When the optional analog output is used it also updates 2.5 times per second with a zero to ten volt, or 4-20mA output. When the optional analog output is installed it can be made to output its zero and fullscale at any display reading, including being inverted.

Switch Functions:

On The front of the 9500 you will find four switches that are placed behind the front lens. Each switch is designated from left to right as S1, S2, S3, and S4. The functions for each switch are as follows.

- S1: No Function
- S2: Display Reading, Pressing this switch once will cause the peak reading to be displayed. A second press will cause the valley reading to be displayed. A third press will cause the unit to display the normal input reading.
- S3: Peak and Valley Reset, Pressing this switch will set the peak and valley readings to the current input reading.
- S4: No Function
- S1 + S2: Setup, Pressing switches S1 and S2 at the same time will cause the unit to enter the setup mode.
- S3 + S4: Calibrate, Pressing switches S3 and S4 at the same time will cause the unit to enter the calibration mode. NOTE: It is not advised to enter this mode without fully understanding how to perform this function. Corruption of the calibration data could result.

LED Indicators:

Four LED indicators are placed underneath the numeric display to indicate status conditions. Two LED's are placed on top of each other on each side of the display. The LED in the upper left corner indicates that limit1 is active. The LED in the lower left corner indicates that limit2 is active. The LED in the upper right corner indicates that the display is in the peak display mode. The LED in the lower right corner indicates that the display is in the valley display mode.

Setup:

The various parameters for the meter are setup by using the four pushbuttons which are actuated through holes in the front lens. The switches are labeled from left to right, S1, S2, S3, and S4. To enter the setup mode press S1

and S2 at the same time.

Startup Message:

Upon entering the setup mode the display shows "dci" and then either "on" or "off". By pressing S4 you can toggle back and forth from off and on. When set to off the unit will not display the "dciinc", "9500", and the version number on power up. Pressing S1 will advance to the next setup function.

RTD Type Setup:

The next parameter to be selected is the RTD type setup. The available RTD types are 100Ω Platinum with a .00385 alpha, 100Ω platinum with a .00392 alpha, and 120Ω NO-7. The display will show "rtd-ty" to indicate RTD setup, then display "RTDXXX", where XXX is the RTD type. Pressing S4 will cycle through the available RTD types in the order shown above. After selecting the desired RTD type press S1 to advance to the next setup function.

Legend Selection:

The next parameter to be selected is the display of degrees F, or degrees C. The display will show "F or C" for about 1 second. The unit will then blank the display then display either "F" or "c". Pressing S4 will toggle the display from F to C and back. After selecting the desired legend pressing S1 will advance to the next setup function.

Set Peak Reading Mode:

Advancing to the Set Peak Reading function, the unit will display " PEAK " for about 1 second. The unit will then display either "norm", "d peak", "s peak", or "ds peak". The d stands for display and the s stands for serial. This function determines how the peak reading is used. It can be put on the display, sent over the serial, or can be put or sent to both. Pressing S4 will advance through each of these options. Note that this mode can also be achieved from the normal display mode by pressing S1 as explained on page 2 in the switch functions section. Pressing S1 will advance to the next setup function. Also be aware that even though the meter can be set to send data out the serial port here and in the next step, it will not function if the serial option is not installed.

Set Valley Reading Mode:

Advancing to the Set Valley Reading function the unit will display "valley" for about 1 second. The unit will then display either "norm", "d val", "s val", or "ds val". The d stands for display and the s stands for serial. This function determines how the valley reading is used. It can be put on the display, sent over the serial, or can be put or sent to both. Pressing S4 will advance through each of these options. Note that this mode can also be achieved for the display by pressing S1 twice in the units normal operating mode. Pressing S1 will advance to the next setup function.

Set Analog Output Peak and Valley Mode:

This mode allows the analog output to track the Peak and Valley readings. When this mode is on and the display is showing either peak or valley then the analog output will track those readings. If this mode is not desired then the mode should be turned off. Advancing to this function the unit will display "AOPvXX" where XX is "OF" or "On" for about 1 second. Pressing S4 will toggle this mode on and off. Pressing S1 will advance to the next setup function.

Analog Output Setup:

If the analog output option has been installed the display will show the message "AO 0" for about 1 second and then display a number. This number is what the display reads when the analog output is at zero volts or 4mA. This can be any number over the range of displayable thermocouple inputs. To change this number follow this procedure. Switch S2 increments the number and S3 decrements the number. Switch S4 increases the multiplier that the number is incremented or decremented by. Upon entering any setup function the multiplier defaults to 1. At each press of S4 the multiplier increases by a factor of 10. For example: 1, 10, 100, 1000, 10000, 100000, 1. To enter this number and go to the next setup function press S1.

Again if the analog output option is installed the display will show the message "AO SP". This number is what the display reads when the analog output is at ten volts or 20mA. This can be any number over the range of displayable thermocouple inputs. To change this number follow the same procedure as outlined above. To enter this number and go to the next setup function press S1.

Limit Setup:

The next setup functions deal with setting the limit values and other limit parameters. After coming to the limit functions the display will show "LiMiT1" for about 1 second and then display a number. This number is the limit1 setting. This setting can be changed using the same procedure as outlined above in the analog output function. This setting can be any number as long as it falls within actual displayable readings. After setting this number, pressing S1 will advance to the next limit function. The next function sets whether the limit activates above the limit or below the limit. The unit should now be displaying "L1rtdY" where Y is either "H" which activates the limit above the display reading or "L" which activates the limit below the display reading. To change the above or below activation setting press S3. After setting these parameters pressing S1 will advance to the second limit settings. The above two functions will be repeated for the second limit. After setting the second limit parameters pressing S1 will advance to the next setup function.

Guardband Setup:

The next setup function will allow control over the limit settings for controller applications. After coming to the guardband setup the display will show "GbdXXX" where XXX is the guardband setting in degrees. The guardband setting will allow the reading to fall within a window before limit activation occurs. For example: if the limit were set at 500, the guardband set at 5, and the limit activates as a high limit, if the reading were 490 the limit would be off, if the reading were 501 the limit would be on, if the limit were on and the reading starts to fall the limit would not turn off until the reading falls below 495. This feature is useful when using a heater to control the temperature of a liquid. If the guardband were set to zero the limit output would tend to oscillate around the limit setting. But if the guardband were set to 5 the unit would have a five degree window in which the limit output would not oscillate. To change the guardband setting, pressing S2 will increment the number by one, and pressing S3 will decrement the number by one. After setting the guardband pressing S1 will advance to the next setup function.

Serial Communications Setup:

The following functions which deal with the serial communications functions will only appear when either the RS-232 or RS-485 options are installed. Many of these functions deal with connecting several units together. When all units have the RS-232 option installed the units need to be connected in a series arrangement. The first unit in the string has its transmit pin tied to the receive pin of the next unit and the second unit has its transmit pin tied to the receive pin of the third unit and so on. The final unit then has its transmit pin tied to the receive pin of the first unit. In most all arrangements a computer will also be connected in the string just the same way as a unit. For this arrangement to work properly all units must have their echo enabled and all must have unique addresses. At this point in time the RS-485 serial option is only one way and can not be connected up in the series or a parallel arrangement. The RS-485 is only offered in order to be hooked up to a remote readout with a RS-485 serial option (ie. 9100-02).

Baud Rate Setup:

Upon entering the next function the display will show "brXXXX" where XXXX is the setting of the baud rate. Pressing S3 will cycle through the available baud rate settings. The number displayed is the baud rate for the RS-232/RS-485 output. This unit will operate at the selected baudrate with no parity, 1 stop bit, and 8 data bits. This output can be used in conjunction with a model 9100 remote serial readout to provide the same display reading at a remote location. By pressing S4 the display will cycle through the available baud rates. Press S4 until the baud rate you need is displayed. To enter this number and advance to the next setup function press S1.

- | | | | | |
|---------|----------|-----------|---------|-----------|
| 1. LBS | 6. F. | 11. KOhms | 16. RPM | 21. Hz |
| 2. TEMP | 7. mV | 12. MOhms | 17. FPM | 22. VAC |
| 3. C | 8. V | 13. PSI | 18. GPM | 23. mRADS |
| 4. C. | 9. A | 14. PSIA | 19. MPH | |
| 5. F | 10. Ohms | 15. PSIG | 20. IPM | |

Many of these will have no use on a thermometer but in the 9400 Voltmeter they become useful. The legends of use for the 9000 include TEMP, F, and C. Notice that there are two different legends for F and C. The F and C can be used when connected to a computer for datalogging. The F. and C. are meant to be used when connected to a 9100 remote readout. When used in this way the decimal point behind the character will send the degree symbol for proper display on the 9100 with the F or C legend. To set the legend number pressing S2 will increment the number and S3 will decrement the number. Pressing S1 after setting the legend number will advance to the next setup function.

Serial Device Code Setup:

When several units are connected together to a printer for datalogging purposes, certain concessions must be made. If all units are connected serially together and all enabled for the same continuous update time, the units will jumble each others messages. The device code enables the units to take turns on the bus and contend with each other. When two or more units are hooked together, the process is this. The first unit in the string has its device code enabled, when the device code is enabled the unit will send out a special unprintable character at the end of its message to the next unit in the string. The next unit will then suppress this character and upon receiving it, perform a serial command specified in the device code setup. The unit may trigger an RD command, which the unit responds by outputting its display reading. This unit may also have its device code enabled, but if there are only two units used then it should not have its device code enabled. All units must have their echo enabled in order to pass the messages along. When entering the device code setup the display will show "dX rYY" where X is either 0 for disabled or 1 for enabled, and YY is a number corresponding to the serial command which can be found in the serial command table. By pressing S2 the device code can be enabled or disabled. By pressing S3 the remote serial command can be incremented. After making these settings pressing S1 will end the setup mode, save the setup information in non-volatile memory and then continue in normal operating mode.

Serial Communications:

If the serial input/output option is installed it allows the Series 9000 to communicate with a remote computer, terminal, or printer. Two standard serial options are available, RS-232 or RS-485. Almost all functions available from the

front switches can be duplicated by the host computer. Listed below are all commands with their associated remote serial command number. Following that list is a full description of each command.

| | | |
|----|----|--|
| 1 | EH | Set Echo Mode |
| 2 | LF | Set Line Feed Mode |
| 3 | AE | Address Enable |
| 4 | AD | Address Disable |
| 5 | RD | Read Display |
| 6 | RP | Read Peak |
| 7 | RV | Read Valley |
| 8 | S1 | Set Limit 1 |
| 9 | S2 | Set Limit 2 |
| 10 | V1 | Read Limit 1 |
| 11 | V2 | Read Limit 2 |
| 12 | SP | Set Peak |
| 13 | SV | Set Valley |
| 14 | SZ | Set Display Zero |
| 15 | SS | Set Display Span |
| 16 | AZ | Set Analog Output Zero |
| 17 | AS | Set Analog Output Span |
| 18 | DM | Set Display Mode CH1 or CH2 |
| 19 | TM | Test Message |
| 22 | CR | Set Continuous Reading Mode and Display Mode |
| 26 | LR | Set Legend |
| 27 | SC | Set Device Code and Remote Serial Command |
| 28 | DP | Set DP Placing |
| 35 | PV | Set Peak and Valley Mode |

The serial data is transmitted as ASCII characters, using the selected baud rate, each word or character is made up of eight data bits, one stop bit and no parity bit. The format of data transmitted depends on the command, and is expected to be transmitted or receive left most character first and terminated with a carriage return (c.r.) when an additional number is required leading zeros or place holders may be omitted. Plus sign is optional but must proceed the number. Received numbers will have the decimal point ignored. Transmitted numbers will have a period to conform to the display format. In the command descriptions below the command string will be shown within brackets ([]), the sign if required will be shown as a lower case (s), and the number as upper case (X). Each command will be executed when received and only once except for display data which may be enabled to continuously update until disabled. Most all commands that set some parameter can be sent to the unit without that parameter and it will respond with the current value of that parameter. This allows the user to check

those values to be sure the unit received the parameter properly.

Echo: [EHXc.r.]

The echo command is used to turn the echo on and off. When the echo is on the unit will send back out anything that comes in. A zero in place of the X turns the echo off and a one turns the echo on.

Line Feed: [LFXc.r.]

The line feed command is used to turn the line feed on and off. When the line feed is on the unit will follow every message with a line feed character. A zero in place of the X turns the line feed off and a one turns the line feed on.

Address Enable: [AEXXXc.r.]

Address enable is a command used with the RS-485 serial interface when several units will be in parallel on the serial buss, or with RS-232 when several units are connected in series, to enable the unit. This command allows the unit specified by the address number XXX to be turned on or enabled, the address must be in the range of 0 to 255. When the address is set to 0 the unit will respond to any command without first receiving the address enable command. When enabled the unit will respond with [HELLOc.r.].

Address Disable: [ADXXXc.r],[ADc.r.]

Address disable is a command used with the RS-485 serial interface when several units will be in parallel on the serial buss, or with RS232 when several units are connected in series, to disable the unit. This command allows the unit specified by the address number XX to be turned off or disabled. The address must be in the range of 1 to 255. If no number is supplied all units on the serial buss will be turned off or disabled. If the unit is disabled by unit address number the unit will respond with [BYEc.r.].

Read Display: [RDc.r.]

Read display is a command that will return the normal display reading, (display mode when not in Peak, Valley, Span check, etc.) The returned data format will be

[sXXX.XXXc.r.] where (s) is the sign if minus, (X) is the number, and (.) is the decimal point if in the display.

Read Peak: [RPc.r.]

Read peak is a command that will return the peak display reading. The returned data format will be [sXXX.XXXc.r.] where (s) is the sign if minus, (x) is the number, and (.) is the decimal point if in the display.

Read Valley: [RVc.r.]

Read Valley is a command that will return the valley display reading. The returned data format will be [sXXX.XXXc.r.] where (s) is the sign if minus, (X) is the number, and (.) is the decimal point if in the display.

Set Limit: [S#XXXXXc.r.]

Set limit is a command that will set the value of one of the two limits. "S" is the command. "#" is the limit number either 1 or 2. "X" is the numeric value from 1 to 999999. X may be preceded by a "+" or a "-". The + is optional.

Verify Limit: [VXc.r.]

Reads the limits back. V is the command. "X" is the limit number either 1 or 2.

Set Peak: [SPc.r.]

Set peak is a command that will set the current peak value to the current actual display reading or reset the peak to the current lowest reading. The unit will respond with [OKc.r.].

Set Valley: [SVc.r.]

Set valley is a command that will set the current valley value to the current actual display reading or reset the valley to current highest reading. The unit will respond with [OKc.r.].

Set Analog Output Zero: [AZXXXXXXc.r.]

Set analog output zero is a command that will set the analog output zero. This number is what the display reads when the analog output is at zero volts or 4mA. "AZ" is the command. "X" is the numeric value from 1 to 999999. X may be preceded by a "+" or a "-". The + is optional. The unit will respond with [OKc.r.].

Set Analog Output Span: [ASXXXXXXc.r.]

Set analog output span is a command that will set the analog output span. This number is what the display reads when the analog output is at its full scale point, this can be 10 volts, or 20mA. "AS" is the command. "X" is the numeric value from 1 to 999999. X may be preceded by a "+" or a "-". The + is optional. The unit will respond with [OKc.r.].

Test Message: [TMc.r.]

The test message command will cause the unit to output several important values. This command outputs all setup values with their current values. It also outputs the current peak, valley, and display readings.

Continuous Reading: [CRXXXXc.r.]

Continuous reading is a command that will put the unit in a mode where it will send the display reading continuously until disabled by a CRO command. "CR" is the command. "X" is the numeric value from -2 to 3600. A value of 0 will disable the output. A value of -1 will output data once for every conversion which is 2.5 times per second. When set to a value of -2 the unit will output data 2 times per second. When set to a value from 1 to 3600 that number corresponds to the number of seconds between each output. The unit will respond with [OKc.r.].

Set Legend: [LRXXc.r.]

This command will set the legend that is output after the serial display message. "LR" is the command. "X" is a numeric value corresponding to a legend as show in the legend table. This table of values can be found on page 8 in this manual. Also there are more comments about the legend settings in the setup

mode instructions. The unit will respond with [OKc.r.].

Set Device Code and Remote Serial Command: [SCX YYc.r.]

This command allows setting the device code and the numerical value for the remote serial command. A full explanation of this feature can be found on page 8 in this manual. "SC" is the command. "X" is a 0 to disable the device code or a 1 to enable the device code. "YY" is the corresponding number for the remote serial command. A table of these numbers can be found on page 8 of this manual. The unit will respond with [OKc.r.].

Set Peak and Valley Mode: [PVXc.r.]

This command allows changing the peak and valley display modes. "PV" is the command. "X" is a numerical value corresponding to the display mode. A value of 0 causes the display and serial to operate normally. A value of 1 will cause the peak value to be sent to the display only. A value of 2 will cause the peak value to be sent out only through the serial port. A value of 3 will cause the peak value to be sent to the display and out the serial port. A value of 4 will cause the valley reading to be sent to the display only. A value of 5 will cause the valley reading to be sent out the serial port only. A value of 6 will cause the valley reading to be sent to the display and out through the serial port.

CALIBRATION

Calibration of the Model 9500 is accomplished by pressing (S3) "RP&V/Down" and (S4) "TARE/Toggle" at the same time. The unit will then display the message "Code" for approximately one second. The display will then show "0". Promptly enter your code number., Switch (S2) "P&V/UP" increments the number and (S3) "RP&V/DOWN" decrements the number.

The available codes are zero to 99. The factory sets the code to zero. Pressing (S1) "MODE/Enter" will enter the code. If code is correct, the unit will go to the next function. If the code is incorrect, the unit will return to normal operation.

The unit will now display the message "S2 0", then "S3 FS", then "S4 CH", then "S2orS3". At this point connect all leads together and press S2, the display shows "S1 0". This will calibrate the zero point for channel one. Pressing S4 will change the channel setting to channel two, and this is shown by "CH2" being on the display. After changing the channel to channel two press S2 to calibrate the zero point for channel two. Now connect a 400.0 ohm precision resistor from the input minus points to the two channel positive points. Pressing S3 will calibrate the selected channels full scale point, pressing S4 will again change the channel setting, and again pressing S3 will calibrate the other channels full scale point. Pressing S1 ends the calibration routine. The display can now be checked again the calibration procedure. Refer to the table below for values of resistance to check the displayed reading against.

| .00385 | | .00392 | | 120ohm NO-7 | |
|--------|----------|--------|---------|-------------|---------|
| 50ohm | -125.1°C | 100ohm | 0°C | 100ohm | -29.2°C |
| 100ohm | 0°C | 200ohm | 261.8°C | 200ohm | 99.4°C |
| 200ohm | 266.4°C | 250ohm | 401.3°C | 400ohm | 273.8°C |
| 300ohm | 558.0°C | | | | |

Precision Resistors with .1% accuracy must be used for proper calibration. This completes the calibration procedure.

9500 Connections

- 1 Input Power -
- 2 Input Power +
- 3 RS-232 Transmit/RS-485
- 4 RS-232 Receive/RS-485
- 5 Digital Ground
- 6 Limit 1 Normally-Open
- 7 Limit 1 Common
- 8 Limit 2 Normally-Open
- 9 Limit 2 Common
- 10 Channel 1 RTD Input +
- 11 Channel 1 RTD Input -
- 12 Channel 2 RTD Input + (Excitation Current)
- 13 Channel 2 RTD Input -
- 14 Analog Output
- 15 Analog Ground

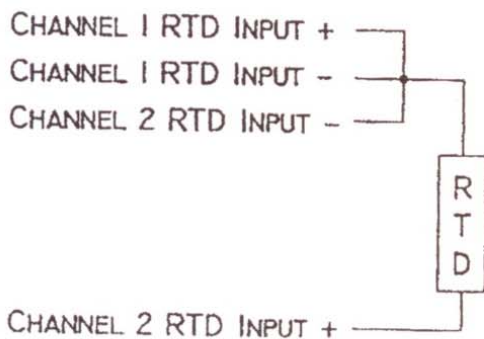
NOTE: This unit should be tied to earth ground for proper line power filtering and safety precautions.

NOTE: Standard Input Power is 115V AC, optional power is listed below.

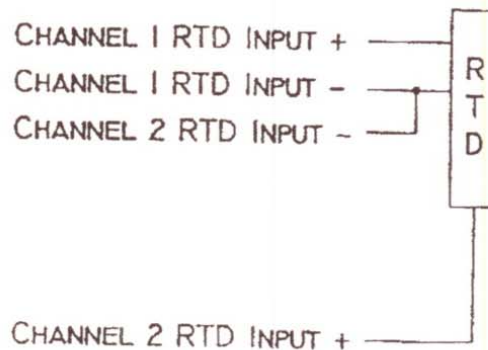
Option 05, Input Power is +5V DC.

Option 22, Input Power is 230V AC.

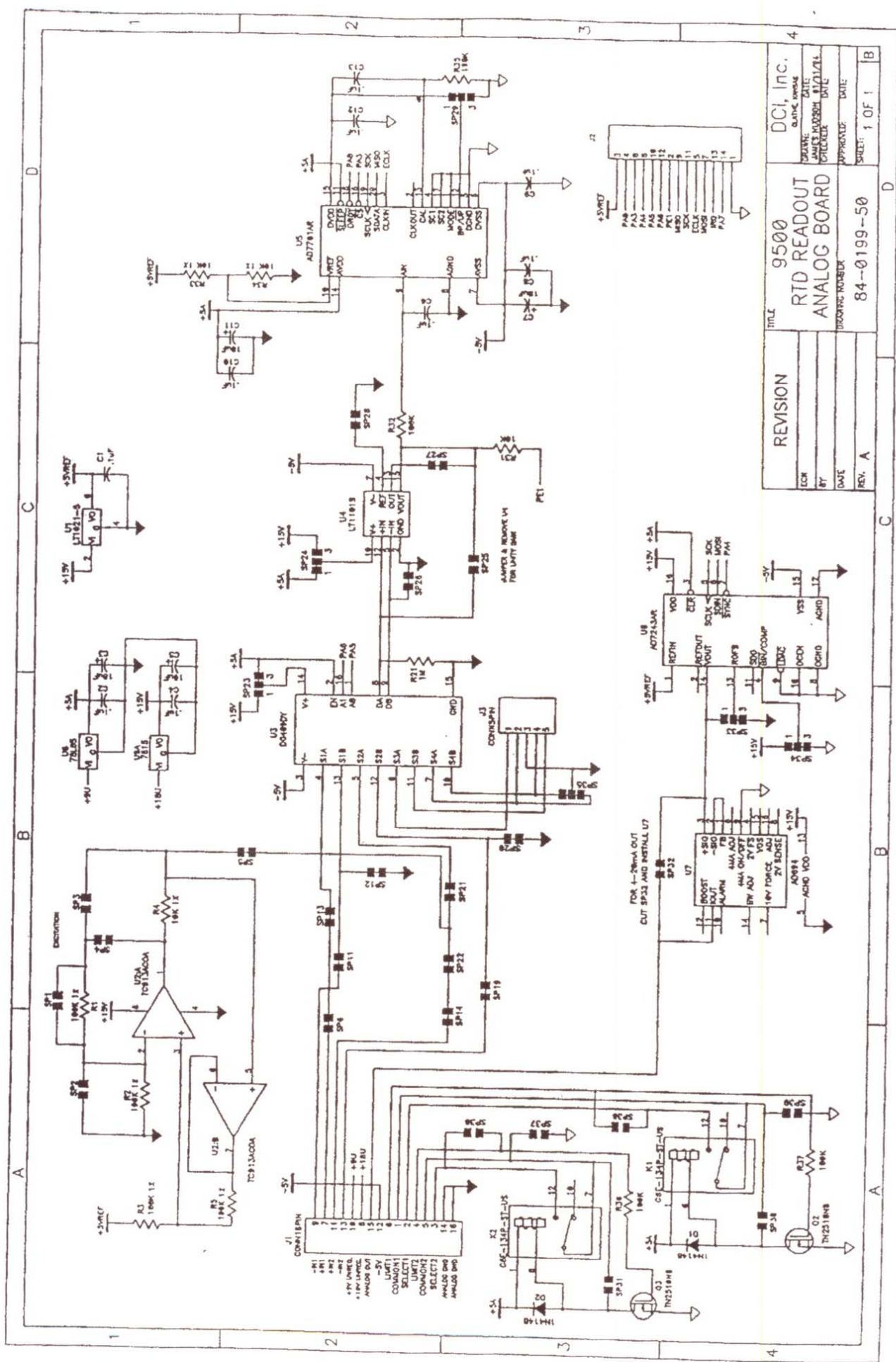
Option 24, Input Power is +10-30V DC.



2-WIRE RTD CONNECTIONS

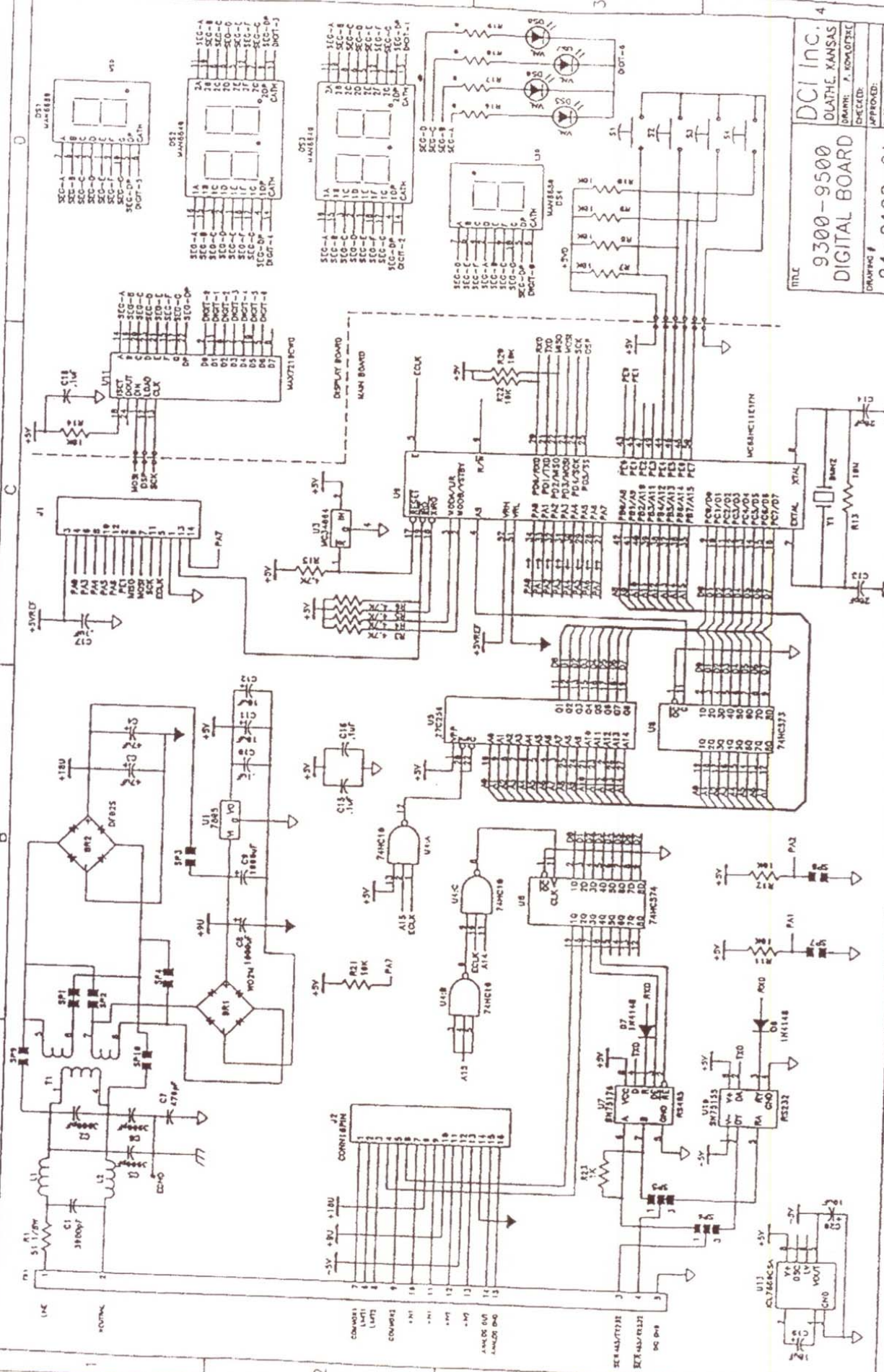


3-WIRE RTD CONNECTIONS



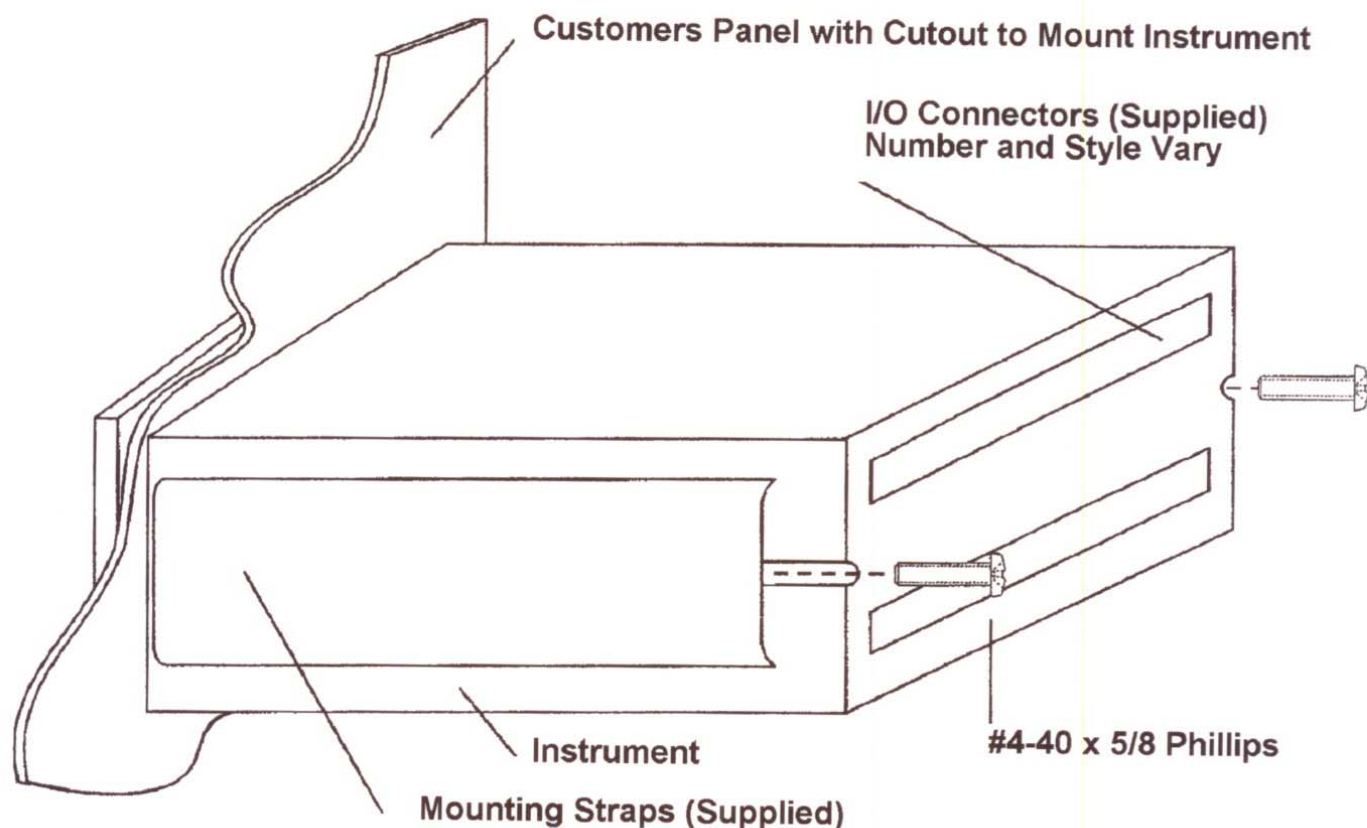
| | | | |
|--------|--------|------------|--------------------------|
| REV. A | REV. A | 84-0199-50 | DCI, Inc. |
| DATE | DATE | 9500 | RTD READOUT ANALOG BOARD |
| BY | DATE | 84-0199-50 | DCI, Inc. |
| DATE | DATE | 1 OF 1 | |

| | | | |
|--------|--------|------------|--------------------------|
| REV. A | REV. A | 84-0199-50 | DCI, Inc. |
| DATE | DATE | 9500 | RTD READOUT ANALOG BOARD |
| BY | DATE | 84-0199-50 | DCI, Inc. |
| DATE | DATE | 1 OF 1 | |



DCI Inc.
9300-9500
DIGITAL BOARD
DRAWING # 84-0198-2A
DATE: DEC 2 1982
SHEET: 1 OF 1

MOUNTING



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