

# **MODEL 9600A LVDT READOUT**

## **DESIGN CONCEPTS INC**

**886 N Jan Mar Ct.  
Olathe, Kansas 66061**

**PHONE : (913) 782-5672  
FAX : (913) 782-5766  
E-MAIL : [info@dcimeters.com](mailto:info@dcimeters.com)**

11-08

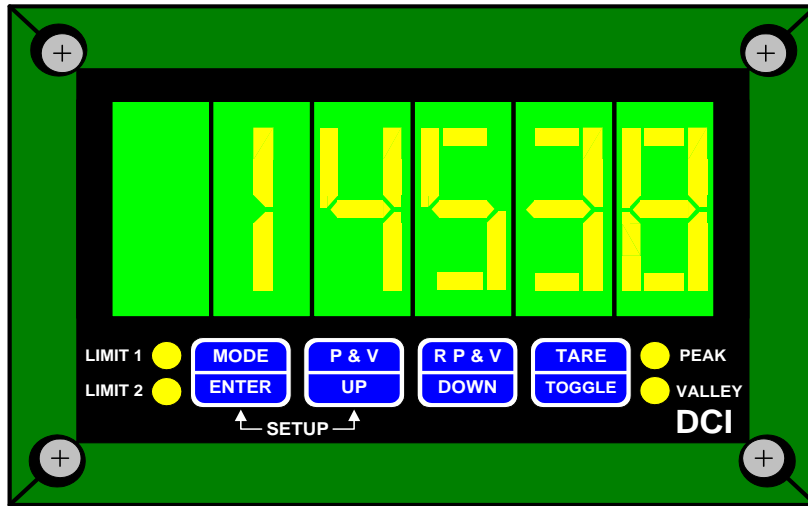
**Table of Contents**

DESCRIPTION .....	1
SWITCH FUNCTIONS .....	1
LED INDICATORS .....	2
SETUP .....	3
High Limit Programming .....	3
Low Limit Programming .....	3
Decimal Point Position .....	3
Baud Rate Selection .....	4
Echo and Line Feed .....	4
Unit Address .....	4
Continuous Update .....	4
Serial Software Command.....	4
Legend Setup .....	5
Serial Software Flow Control .....	5
CALIBRATION .....	5
Sensitivity Programming .....	5
Excitation Frequency .....	6
Zero Point Calibration .....	6
Span Calibration .....	6
PHASE ADJUSTMENT .....	6
FILTER SETTING.....	7
BCD OUTPUT.....	7
ANALOG OUTPUT.....	7
LIMIT OUTPUTS .....	7

**I**

# Table of Contents

SERIAL COMMUNICATIONS .....	8
Echo .....	9
Line Feed .....	9
Address Enable .....	9
Address Disable .....	9
Read Display .....	9
Set Limit .....	10
Verify Limit .....	10
Reset Peak .....	10
Reset Valley .....	10
Remote Tare .....	10
Test Message .....	10
Continuous Reading .....	10
Set Legend .....	10
Remote Serial Command .....	11
Decimal Position .....	11
Reading Mode .....	11
FIGURE 1.0 (Back View) .....	12
FIGURE 2.0 (Input Connections - LVDT With TB1) .....	12
9600 CONNECTIONS .....	13
SCHEMATIC (9000 Series Digital Board) .....	14
SCHEMATIC (9600 LVDT Analog Board) .....	15
DIMENSIONS .....	16
MOUNTING WARRANTY .....	17

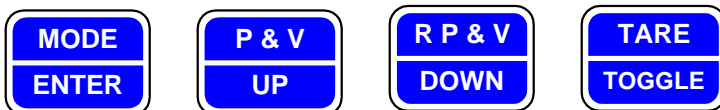


**DESCRIPTION:**

The model 9600 is a versatile readout/controller designed to be used with AC excited LVDT type transducers. It combines a constant amplitude carrier generator, a stable carrier amplifier, and a full wave synchronous demodulator. The zero point can be offset by up to 100% of full scale and the full scale reading can be programmed to be virtually any number between 100 and 19999 counts. Optional analog output, parallel BCD, and serial interfaces are available which make this unit a versatile low cost unit. Two high speed open collector limit outputs are standard. Response time for the analog and limit outputs are dependent on filter selection. The series 9600 is housed in a rugged 1/8 DIN aluminum enclosure with NEMA 4 front bezel.

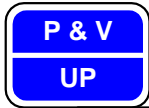
**SWITCH FUNCTIONS:**

On the front of the 9600 you will find four switches that are placed behind the front lens. Each switch is labeled from left to right as MODE [ENTER], P&V [UP], RP &V [DOWN], and TARE [TOGGLE]. A description of each switch function is as follows.





Mode [Enter] switch is used to enter data while in the setup mode. It advances you through the various selections in the setup mode.



Peak & Valley[Up] in the standard operating mode, this switch when pressed will display the peak reading, pressed again will display the valley reading, pressed once more and the original reading will be obtained. The secondary operation is in the setup & calibration mode this switch is then used to increase the reading to a desired setting.



Reset Peak & Valley [Down] resets the peak and valley readings in the standard operating mode. The secondary operation is in the setup or calibration mode, this switch is then used to decrease the reading to the desired setting.



Tare [Toggle] when in the standard operation mode, sets the tare (reference zero) at your present reading. If there is a tare present it will be removed. The secondary function of this switch is that it toggles settings and changes the increment/decrement values in the calibration and setup mode.

#### LED INDICATORS:



Illuminates when the display reading exceeds the set high limit.



Illuminates when the display reading is below the set low limit.



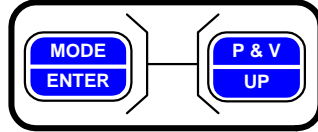
Illuminates when the display is set to peak mode.



Illuminates when the display is set to valley mode.

## SETUP:

Your meter setup is accomplished by using the four front panel switches. The setup mode is entered by pressing the Mode [Enter] and P&V[Up] switches simultaneously. At this point we will examine how to perform the setup procedures.



***NOTE: If not pressed simultaneously the unit may go into peak/valley mode upon exiting the setup mode. The peak/valley LED will be illuminated and the peak/valley reading will be displayed***

### *High Limit Programming:*

Upon entering the setup mode the current high limit setting displays.

**L.H.L.**

To program a new high limit use the P&V [Up] and RP&V [Down] switches to increase or decrease the limit number shown. Use the Tare [Toggle] switch to increment/decrement the limit number. Press the Mode [Enter] and the display will flash

**906L.H**

### *Low Limit Programming:*

**L.L.L.**

Indicates set up of the low limit. To program the low limit the same method is used as in the high limit programming. Press Mode [Enter] and the display momentarily shows.

**906L.L**

### *Decimal Point Position:*

**DP**

Program the desired decimal point position using the Tare [Toggle] switch to move the decimal point. Press Mode [Enter] when done. The unit will return to the normal operating mode if the serial option is not installed.

***NOTE: See the serial communications section on page 8 for more information on the following setup.***

### *Baud Rate Selection:*

**br1200**

Program the desired baud rate using the P&V[Up] or RP&V[Down] and toggle through the available settings (9600, 4800, 2400, 1200, 600, 300, 150, and 75). Select a desired setting and press Mode [Enter] when done.

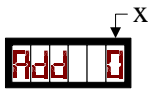
### *Echo and Line Feed Setup:*



The echo command is used to turn the auto echo function on or off. When on, the unit automatically re-transmits all received serial data. When the selected value *X* is a one the echo function is turned on, conversely when *X* is zero the echo function is turned off. To turn the echo function on/off use the P&V [Up] switch.

The line feed command is used to turn the line feed function on or off. When the line feed is on the unit will follow every message with a line feed character. When the selected value is a one the line feed character is transmitted, conversely when *X* is zero the line feed character is not transmitted. To turn the line feed option on/off use the RP&V [Down] switch. Press Mode [Enter] when done.

### *Unit Address Setup:*



The address enable and disable commands can be used when a series of 9600's are connected together on the same serial bus. The address enable command allows the unit specified by the address number *XXX* to be enabled. The address used must be in the range of 0 to 255. To program the unit's address (0 to 255) using the P&V[Up] and RP&V[Down] switches. Press Mode [Enter] when done.

### *Continuous Update Setup:*



The continuous reading command allows an auto serial update mode to be selected. A value of -1 will output data once for every conversion (2.5 times per second). A value of one or greater will indicate the number of seconds between updates, up to the maximum of 3600 seconds between updates. The value of zero will disable the auto update function. To program the continuous update setting (-1 - 3600) using the P&V[Up], RP&V[Down] switches to move you in either direction. The Tare [Toggle] switch sets the increment that you choose to move in. Press Mode [Enter] when done.

### *Serial Command Setup:*



Remote serial command is most widely used if several units are connected together in series to the same printer. A device code allows the units to "take turns" on a serial bus. When two or more units are connected serially and set for the same bus, the first unit in the string can have its device code enabled. All units should have the echo function enabled in order to pass messages along in the string. When the serial command is sent a value (*XY*) the first attached number (*X*) disables the device code, conversely a one enables the device code. The second attached number (*YY*) is the corresponding number for the remote serial command. A table of these numbers can be found in the serial communication section on page 8. Use the P&V[Up] switch to turn the device code on/off. Use the RP&V [Down] switch to select the device code. Press Mode [Enter] when done.

*Legend Setup:*



The legend setup command allows the selection of a unit to define the transmitted reading. Use the P&V [Up], and RP&V [Down] switches to select a legend number from the legend table. Press Mode [Enter] when done.

<u>Legend Table</u>	
0 - No Legend	3 - Millimeters
1 - Inches	4 - Centimeters
2 - Feet	5 - Meters

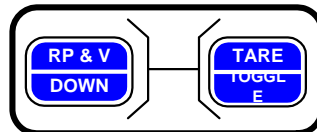
*Serial Software Flow Control Setup*



The software flow control operates with a code that indicates the current state of the software flow. It regulates the flow of data transmitted to other units. To turn on/off the flow control use the P&V [Up], or RP&V [Down] switches to toggle the setting. One being on and zero being off. Press Mode [Enter] and this will conclude the setup procedure. The unit now returns to normal operation mode.

**CALIBRATION:**

The calibration mode is entered by pressing the RP&V [DOWN] and TARE[TOGGLE] switches simultaneously. (*This is the only method to check or change the calibration of this unit externally*).



**Note:** *Do not enter the calibration mode unless you have an appropriate signal sources for zero and span calibration.*

*Sensitivity Programming:*



Upon entering the calibration mode the current sensitivity setting (.2V to .9V full scale) is shown. The programmable sensitivity provides a means for matching the expected LVDT output to the input required by the 9600 for maximum resolution. Determine the sensitivity required using the LVDT specification, the maximum expected displacement, and the 9600 excitation voltage of 1.1Vrms. Pick a sensitivity setting that is as close as possible to the expected full scale input without going under it. The full sale voltage may be obtained by multiplying the sensitivity of the LVDT by the excitation voltage and the full scale displacement.



*Example: Assume the LVDT sensitivity is 5mV/V/.001", and the expected full scale displacement is .100", Therefore, the expected full scale voltage input is  $5mV/V \times 100 \times 1.1V = .55V$  so use a sensitivity setting of 0.6V for the 9600.*

Program the desired setting using the P&V [Up], and RP&V[Down] switches. Press Mode [Enter] when done.

*Excitation Frequency:*

**FREQ**

The current excitation frequency (2500Hz to 10000Hz) is shown. Program the desired excitation frequency according to the type of sensor requirements. Use the P&V [Up], and RP&V [Down] switches to advance through the various selections. Press Mode [Enter] when done.

*Zero Point Calibration:*

**CAL 0**

Is shown momentarily on the display. The unit then shows a live reading of the raw A/D data (15bits plus sign). This reading can be used as an aid in determining a null position for the LVDT or gage head. *Note: It must be kept in mind that offsets exist in both the transducer and the 9600 meter, therefore a raw data reading of zero does not necessarily correspond to a true mechanical null.* Once the LVDT or gage head has been placed in its null position, press the Tare [Toggle] switch. The zero calibration point has now been entered. Press Mode [Enter] The unit should now return to it's previous reading.

**906 0**

*Span Calibration:*

**CAL FS**

is shown on the display followed by the current CAL number. Move the LVDT or gage head to its calibration position and enter the desired CAL number (program the CAL number the same way the limits are entered in setup mode). Press the Mode [Enter] switch when done. The calibration sequence is now complete and the unit returns to normal operating mode.

**906 FS**

**PHASE ADJUSTMENT:**

The phase angle can be adjusted using the potentiometer located on the rear of the unit. When the potentiometer is set all the way in the CCW direction, no phase shift is provided by the unit. Conversely, dialing the potentiometer in the CW direction causes an increasing phase shift internal to the unit (up to 120 degrees of phase shift can be obtained in this manner). In most applications no phase compensation is required, therefore the potentiometer should be set all the way in the CCW direction.

## **FILTER SETTING:**

The active filter cut off frequency can be changed from the default setting of 250Hz to 1 KHz by adding jumpers to both of the two pin headers located on the rear of the unit. See figure 1.0 on page 12 for the location of the phase adjustment and filter settings.

## **BCD OUTPUT (OPTIONAL):**

Connector J1 (located on rear of unit) provides 4 & 1/2 digits of parallel BCD along with sign and over range bits. The BCD is always valid and is updated each time the display is updated. See the pin out sheet (9600 Connections) on page 13 for signal location and description.

## **ANALOG OUTPUT (OPTIONAL):**

Pin 14 of TB1 provides a high speed analog output of 0 - +/- 5V. The analog output is derived directly from the filtered and the amplified demodulator output and is tarred digitally to coincide with the display tare. Since the analog output is derived directly from the input, a full scale display reading does not necessarily produce 5V on the analog output. In most instances a full scale reading on the display will result in less than 5V.

## **LIMIT OUTPUTS:**

Pins 6 & 8 of TB1 provide two open collectors limited outputs, rated at 35Vmax at 50mA. The signal input for the limit comparators is derived from the filtered and amplified demodulator output. Response time is 1msec or 4msec depending on filter selection. The set points for the limit outputs are digital, and coincide with the high and low programmed display limits. The digital set points are accurate to 1/2048. To help maintain stability, the limit outputs have a significant amount of hysteresis associated with them. This hysteresis is usually about +/- 25% of the display reading.

## SERIAL COMMUNICATIONS:

If the serial communications option is installed it allows the 9600 series 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 panel switches can be duplicated by the host computer. Listed below are all commands with their associated remote serial command number. Later in this section a full description is given for 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		NOT USED
7		NOT USED
8	S1	Set Limit One (high limit)
9	S2	Set Limit Two (low limit)
10	V1	Read Limit One (high limit)
11	V2	Read Limit Two (low limit)
12	SP	Peak Reset
13	SV	Valley Reset
14	SZ	Remote Tare
15		NOT USED
16		NOT USED
17		NOT USED
18		NOT USED
19	TM	Test Message
20		NOT USED
21		NOT USED
22	CR	Set Continuous Reading Mode
23		NOT USED
24		NOT USED
25		NOT USED
26	LR	Set Legend
27	SC	Remote Serial Command
28	DP	Set Decimal Point Position
29		NOT USED
34		NOT USED
35	PV	Set Display, Serial Reading modes

Serial data is transmitted/received 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. The left most character is transmitted or received first and terminated with a carriage return (c.r.). When additional digits are required, the leading zeros or place holders may be omitted. A plus sign is optional but if used, it must precede the numbers. Any received numbers will have the decimal point ignored. Transmitted numbers will have a decimal point (when needed) 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). Commands that are used to set a parameter can be sent to the unit without that parameter attached. The unit will respond with the current setting for that parameter, this allows verification of parameter settings. Once a valid command is received and executed, the unit responds by transmitting [Okc.r.] on the serial bus. The following is a list of all serial commands with a description of their meaning, along with programming instructions.

ECHO: [EHXc.r.]

The echo command is used to turn the auto echo function on or off. When the echo is on, the unit automatically re-transmits all received serial data. When the applied value X is a one the echo function is turned on, conversely when X is zero the echo function is turned off.

LINE FEED: [LFXc.r.]

The line feed command is used to turn the line feed on or off. When the line feed is on the unit will follow every message with a line feed character. When the applied value X is a one the line feed character is transmitted, conversely when X is zero the line feed character is not transmitted.

ADDRESS ENABLE: [AEXXXc.r.]

The address enable and disable commands can be used when a series of 9600's are connected together on the same serial bus (i.e. a RS-485 serial interface where several units are in parallel on the serial bus, or a RS-232 serial interface where several units are connected in series). The address enable command allows the unit specified by the address number XXX to be enabled. The address used must be in the range of 0 to 255. When the unit address is set to 0, the unit will respond to commands without first receiving the address enable command. When enabled with the address enable command the unit will respond with [HELLOc.r.].

ADDRESS DISABLE: [ADXXXc.r.], [ADc.r.]

This command allows the unit specified by the address number XXX to be turned off or disabled. The address must be in the range of 1 to 255. If an address is not supplied with the command all units on the serial bus will be turned off or disabled. If the unit is disabled by the unit address number the unit will respond with [BYEc.r.].

READ DISPLAY: [Rdc.r.]

When the read display command is received the unit will return either the current reading, the current peak reading, or the current valley reading, depending on the serial reading mode selected by the reading mode command (see below). *The returned data format will be [sXXXX.Xc.r.] where (s) is the minus sign (if needed), (XXXXX) is the reading, and (.) is the decimal point (if needed).*

SET LIMIT: [S#XXXXXXc.r.]

The set limit command is used to program a limit number for the high or low limit. The first number following the command (#) specifies whether the high limit or low limit is being programmed. A one in this field specifies the high limit, while a two specifies the low limit. The number following this (XXXXXX) is the actual limit number to be entered.

VERIFY LIMIT: [VXc.r.]

The verify limit command is used to read the current high and low limit settings from the unit. The applied number (x) specifies whether the high or low limit value is to be returned. A one specifies the high limit, while a two specifies the low limit.

RESET PEAK: [Sp.c.r.]

The reset peak command performs a remote reset to the peak reading.

RESET VALLEY: [Svc.r.]

The reset valley command performs a remote reset to the valley reading.

REMOTE TARE: [SZXc.r.]

The remote tare command is used to perform a tare function comparable to the front panel tare switch. When the command is received with a number (X) attached, the tare value is set or cleared depending on whether the unit was already tarred or not. When the command is received without a number attached the current tare value is returned.

TEST MESSAGE: [TMc.r.]

The test message command is a diagnostic aid. When the test message command is received the unit will output all current settings, readings and the model number with software revision.

CONTINUOUS READING: [CFXXXXc.r.]

The continuous reading command allows an auto serial update mode to be selected. It updates all the units with corresponding display data at the selected time interval. The attached number (XXXX) is the numeric value from -1 to 3600. A value of 0 will disable the auto update function. A value of -1 will output data once for every conversion (2.5 times per second). A value of one or greater indicates the number of seconds between updates up to a maximum of 3600 seconds between updates.

SET LEGEND: [LRXc.r.]

The set legend command allows the selection of a unit indicator which will be added onto reading update from the serial output. The number (X) applied to the command indicates which unit from the legend table (on the top of page 5) will be appended to the serial reading. REMOTE SERIAL COMMAND: [SCX Yyc.r.]

For data logging purposes, certain concessions must be made if several units are connected together to the same printer. If the units are connected serially and set for the same auto update time, there is a possibility resulting in jumbled data. A device code allows the units to “take turns” on the serial bus. When two or more units are connected to the same bus the first unit in the string can have its device code enabled, the unit will then send a non-printable character at the end of its message string. The next unit will then suppress this character and perform a serial command specified in the remote serial command setup (for example a RD command). The second unit may also have the device code enabled and so on. All units should have the echo function enabled in order to pass messages along in the string.

When the SC command is sent a value of zero for the first attached number (X) disables the device code, conversely a one enables the device code. The second attached number (YY) is the corresponding number for the remote serial command. A table of these numbers can be found in the serial communications section.

#### DECIMAL POSITION: [DPXc.r.]

The decimal position command allows programming a decimal point position for the display and serial communication readings. The attached number (X) can have a range of 0 to 5 the table below shows the each value and its corresponding effect on the decimal point position.

X = 0: No decimal point  
X = 1: YYYYY.Y  
X = 2: YYY.YY  
X = 3: YY.YYY  
X = 4: Y.YYY  
X = 5: .YYYYY

#### READING MODE: [PVXc.r.]

The reading mode command is used to set the display and serial interface reading modes (i.e., reading, peak, or valley). The attached number (X) has a range from 0 to 6 with each value representing a particular combination of displays and serial reading modes. The list of combinations follows:

X = 0: Display = reading, Serial = reading  
X = 1: Display = peak, Serial = reading  
X = 2: Display = reading, Serial = peak  
X = 3: Display = peak, Serial = peak  
X = 4: Display = valley, Serial = reading  
X = 5: Display = reading, Serial = valley  
X = 6: Display = valley, Serial = valley

FIGURE 1.0

**BACK VIEW**

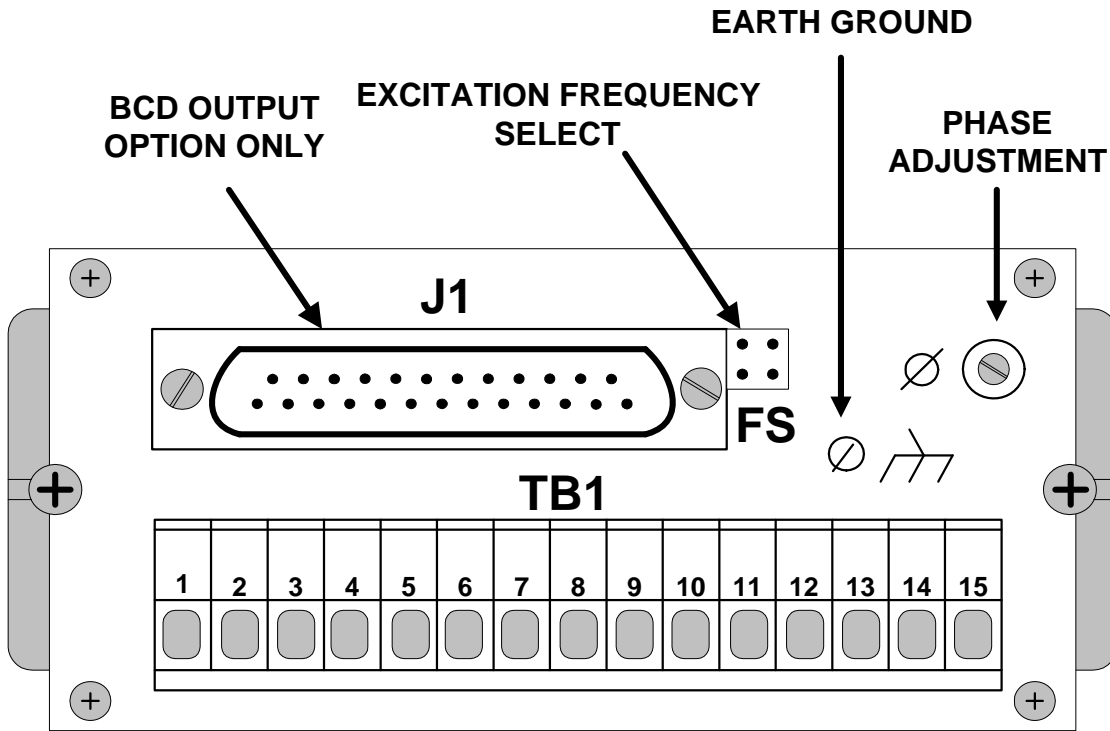
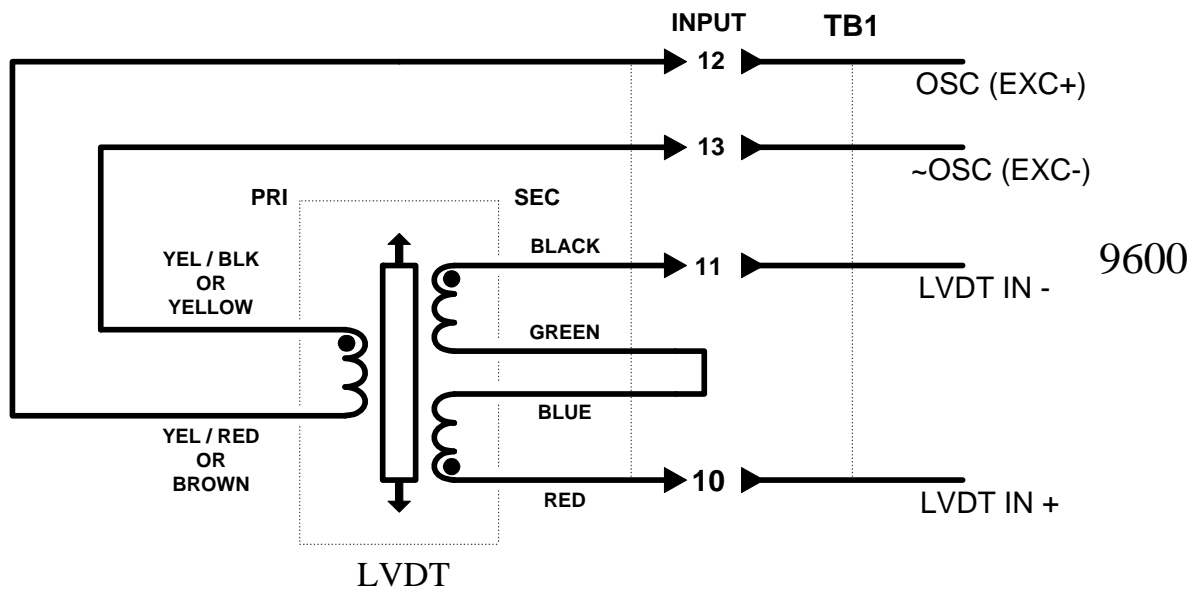


FIGURE 2.0

**INPUT CONNECTIONS - LVDT WITH TB1**



## 9600 CONNECTIONS

TB1 Connector	J1 Connector BCD OUT (OPTIONAL)
1. 115VAC Line	1. Digit0 bit1
2. 115VAC Neutral	2. Digit0 bit2
3. RS-232 Transmit/RS-485	3. Digit0 bit4
4. RS-232 Receiver/RS-485	4. Digit0 bit8
5. Digital Ground	5. Digit1 bit1
6. High Limit	6. Digit1 bit2
7. NC	7. Digit1 bit4
8. Low Limit	8. Digit1 bit8
9. NC	9. Digit2 bit1
10. LVDT IN+	10. Digit2 bit2
11. LVDT IN-	11. Digit2 bit4
12. OSC (EXC+)	12. Digit2 bit8
13. OSC (EXC-)	13. Digit3 bit1
14. Analog Output	14. Digit3 bit2
15. Analog Ground	15. Digit3 bit4
	16. Digit3 bit8
	17. Digit4 bit1
	18. Sign
	19. Overrange
	20. NC
	21. NC
	22. NC
	23. NC
	24. NC
	25. DGND

**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).**

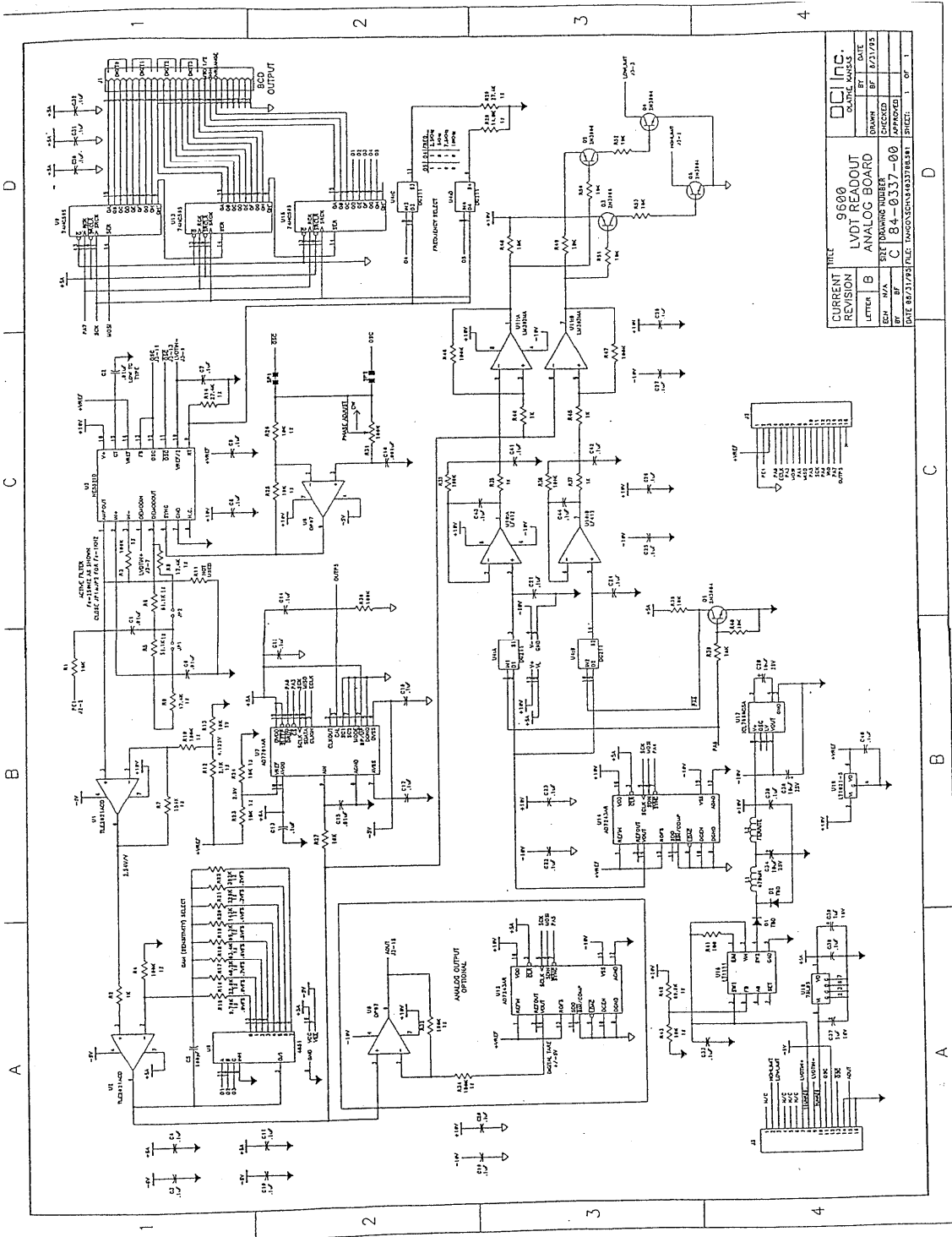
**Option 05, Input Power is +5VDC, Pin 1 (-) and Pin 2 (+)**

**Option 22, Input Power is 230V AC**

**Option 24, Input Power is + 24VDC to +28V DC, Pin 1 (-) Pin 2 (+)**

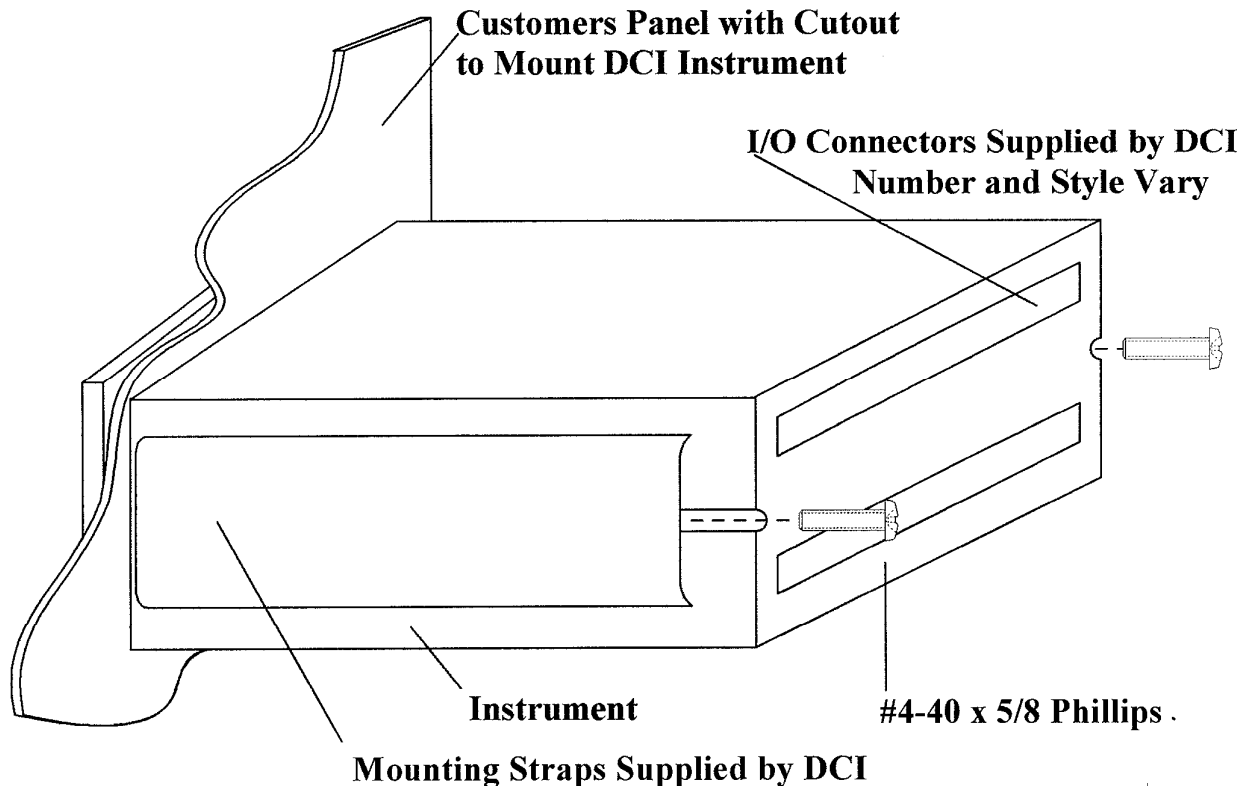






TITLE	9600	DCI INC
CURRENT REVISION	LVDT READOUT ANALOG BOARD	DATE
LETTER	B	BY
DESIGNER	84-0337-00	DATE
APPROVED		
DRAWN		
CHECKED		
DATE		
SHEET	1	OF 1

# MOUNTING



**Note: Ground Case per FIGURE 1.0, page 16**

**Design Concepts, Inc.**  
**886 N Jan Mar Ct.**  
**Olathe, KS 66061**  
**Phone: 913-782-5672**  
**Fax: 913-782-5766**  
e-mail [info@dcimeters.com](mailto:info@dcimeters.com)

## WARRANTY

THE FOLLOWING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

All new products sold by Design Concepts Inc. are warranted against defects in materials and workmanship for one (1) year from the date of the original shipment. During the warranty period, Design Concepts Inc. will repair or, at its option, replace without charge any Design Concepts Inc. product stated above, is limited to the repaired portion and is valid for ninety (90) days from the date of its reshipment. These warranties do not apply if the product has been damaged by accident, misuse, or modification in the absence of authorization from Design Concepts Inc. Design Concepts Inc. will not be responsible or liable for contingent, incidental, secondary or consequential costs of damages.