

**MODEL 9200  
INCLINOMETER  
READOUT  
DESIGN CONCEPTS INC**

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**DESCRIPTION:**

The Model 9200 is microprocessor based panel readout designed to give a direct readout of a DC operated gravity-referenced inclinometer, with sine of angle outputs of +/- 5 VDC and with auto ranging display resolution. Below 10 degrees the unit will display with .001-degree resolution. At 10 degrees or higher the unit automatically switches to .01-degree display resolution. The unit provides the excitation voltage for the inclinometer and converts the voltage output from the inclinometer to a angular readout. Four function switches are standard and the big (.56") tall character LED display, is easily read at 20-30 feet. Peak and Valley tracking, and Digital Zero are standard on all units.

**SPECIFICATIONS:**

**Accuracy:** .01% full scale +/- 2 counts of LSD from 0 to 60.00 degrees, .1% from 60 to 85 degrees, and .5 % from 85 to 90 degrees. These tolerances are in reference to the input voltage from the inclinometer.

**Input Impedance:** Minimum 1 megohm (Differential or Common-Mode).

**Offset:** Without Digital Zero: +/- .1% full scale; With Digital Zero: +/- .01% full scale; +/- 25ppm/degree Celsius vs. temperature.

**Common-Mode Range:** +/-5V operating, +/-10V max.

**CMRR:** (Common Mode Rejection Ratio) 70DB.

**Analog Output:** (Optional) Range: 0-10VDC, Resolution: Less than 2.5mV; Accuracy: .4% +/-2.5mV; Loading: 5mA, Max.; Response: Tracks display.

**Excitation Output:** +/-15VDC at 50mA Max.

**Conversion Rate:** 2.5 conversions per second.

**Power Requirements:** 115 Volts AC, 50-400 hz, 3 Watts Maximum. Applied to TB1 pins 1 & 2.

Options are available for 5VDC ,12VDC, 24 VDC, and 230 VAC.

## **OPERATION:**

**Power Up:** On power up the unit performs a display test (all display segments on) for a period of 1 second then the unit displays “dciinc” for a period of 1 second. Once this is done the unit displays the model number for about 1 second. After the model number the unit displays the software revision number. The unit then displays “inclin”, and then enters the regular display mode.

**Switch Functions:** On the front of the 9200 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:** 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.

**S2:** Peak and Valley Reset, Pressing this switch will set the peak and valley readings to the current input reading.

**S3:** Tare, Pressing this switch will offset the scale to zero.

**S4:** Zero Tare, Pressing this switch will remove the scale offset from zero.

**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 indicated that limit 1 is active. The LED in the lower left corner indicates that limit 2 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 MODE:**

**Peak, Valley, Direct Readout:** The Series 9200 can, using front panel switch S1, be set to display the Peak, Valley or Direct Readout. The Peak and Valley can be reset and the digital zero may be enabled or disabled at any time using the front panel switches. Peak and Valley readout are indicated by a character preceding the reading (i.e. “P” for Peak and “u” for Valley) using switch S1 the user can toggle through all three display modes at any time. Pressing switch S2 will reset the Peak and Valley. Pressing switch S3 during normal operation will automatically set the digital zero value to the current reading on the display. Pressing switch S4 can be used to clear the digital zero. The digital zero function can be used to compensate for any offsets in the unit and/or the transducer it is interfaced to. Enter the setup mode by pressing switches S1 and S2 at the same time for 1 second.

**Setup Mode:** Once the setup mode is activated the unit will display the first setup parameter by displaying “dci on”. When the unit is in the Setup Mode all four of the front panel switches are functional allowing ease of setup. Pressing switch S1 (Enter) momentarily will advance from one function to the next until it drops out of the setup mode. Pressing switch S2 will increment the current display value. Switch S3 is used to decrement the current display value if possible. All setup parameters are saved in Non-volatile memory.

**Start Up Message:** The unit will display “dci inc”, during normal power up, and will revert back to normal operation after 1 second. If the start up message is not desired on power up then it can be disabled while in the set up mode, by pressing switch S4. Pressing S4 again will restore the start up message. Pressing switch S1 will then advance to the next function.

**Set Peak Reading:** Advancing to the Set Peak Reading function mode, the unit will display “peak (PEAH)” for about 1 second. The unit will then display one of the following: “norm (NO rM)”, “d peak (D PH)”, “s peak (S PH)” or “ds peak (DS PH)”. The word norm means that the display is showing the normal reading from the inclinometer and no peak is being captured. The “D PH” stands for display and indicates that the peak reading has been captured and displayed only. The “S PH” stands for serial and indicates that the peak reading has been captured and is being transmitted only, on the serial port. “DS PH” stands for display and serial and indicates that the peak reading has been captured and is being displayed and also transmitted on the serial port. Pressing switch S4 will advance through each of these options. Note that this mode can also be achieved for the display by pressing switch S1 during normal operation. Pressing switch S1 will advance to the next function.

**Set Valley Reading:** Advancing to the Set Valley Reading function mode the unit will display “valley (uALLEy)” for about 1 second. The unit will then display one of the following: “norm (NorM)”, “d valley (D uAL)”, “s valley (S uAL), or “ds valley (DS uAL)”. The word norm means that the display is showing the normal reading from the inclinometer and no valley is being captured. The “D uAL” stands for display and indicates that the valley reading has been captured and displayed only. The “S uAL” stands for serial and indicates that the valley reading has been captured and transmitted only, on the serial port. DS uAL stands for display and serial and indicates that the valley reading has been captured and is being displayed and also transmitted on the serial port. Pressing switch S4 will advance through each of these options. Note that this mode can also be achieved for the display by pressing switch S1 during normal operation. Pressing switch S1 will advance to the next function.

**Set Range:** Advancing to the Set Range function the unit will display “FSdISP” for about 1 second. The unit will then display one of the following: 90.00, 1.000, 3.000, 14.50, or 30.00 which represents the current selected full-scale display in degrees. The desired full scale can be set by pressing switch S4 and toggling through the other display readings. Pressing switch S1 will advance to the next function.

**Set Limit 1:** Advancing to the Set Limit 1 function the unit will display “LiMit” for about 1 second. The unit will then display the Limit 1 setting. This number is displayed with three places after the decimal when below 10 degrees, and two decimal places when above 10 degrees. The decimal point must be taken into account to exactly match the display reading. To change this number press switch S2 to increment the number and press switch S3 to decrement the number. Upon entering this function each increment or decrement will change the limit setting by .001. By pressing switch S4 the increment and decrement value will change by a factor of 10. By pressing switch S4 the display will then change by .01. Each press will increment this factor until 10 is reached which will cause the factor to wrap-back around to .001. Note that this number can also go in the minus direction. Also be aware that the limit setting does not take into account the full-scale reading. If the full-scale reading is set to 14.50 and the limit is set to 20.00 then the limit will never trip. Pressing switch S1 will advance to the next function.

**Set Limit 1 Mode:** Advancing to the Set Limit 1 Mode function the unit will display “L1 H”. This mode determines the way the limit functions. When set to H the output will be activate when the display reading is above the limit. When set to L the output will be activate when the display reading is below the limit. Pressing switch S4 will toggle the setting from H to L and back. Pressing switch 1 will advance to the next function.

**Set Limit 2:** Advancing to the Set Limit 2 function the unit will display “Limit 2” for about 1 second. The unit will then display the Limit 2 setting. This number is displayed with three places after the decimal. The decimal point must be taken into account to exactly match the display reading. To change this number press switch S2 to increment the number and press switch S3 to decrement the number. Upon entering this function each increment or decrement will change the limit setting by .001. By pressing switch S4 the increment and decrement value will change by a factor of 10. By pressing switch S4 the display will then change by .01. Each press will increment this factor until 10 is reached which will cause the factor to wrap back around to .001. Note that this number can also go in the minus direction. Also be aware that the limit setting does not take into account the full-scale reading. If the full-scale reading is set to 14.50 and the limit is set to 20.00 then the limit will never trip. Pressing switch S1 will advance to the next function.

**Set Limit 2 Mode:** Advancing to the Set Limit 2 Mode function the unit will display “L2 H”. This mode determines the way the limit functions. When set to H the output will be activate when the display reading is above the limit. When set to L the output will be activate when the display reading is below the limit. Pressing switch S4 will toggle the setting from H to L and back. Pressing switch S1 will advance out of the setup mode.

**Serial Communications Setup:** The following mode deals with the serial communications functions, which 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. When connecting a computer to the string the same format should be used. For this arrangement to work properly all units must have their echo enabled and all must have unique addresses. The RS-485 serial option is only one-way communications and cannot be networked. The RS-485 is for use with a remote readout such as the model 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 baud rate 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 S3 until the baud rate you need is displayed. To enter this number and advance to the next setup function press S1.

**Serial Address Selection:** All instruments except for dedicated serial remote readouts allow several units to be connected together to a main computer or printer, and be individually addressed. In order to be able to individually address each unit, each one must have a unique address. This function will set this address. The available addresses are from 0 to 255. Upon entering this function the display will show “AddXXX” where XXX is the unit address. Pressing S2 will increment the address and pressing S3 will decrement the address. If the address is set to 0 the unit will respond to any query sent to it without being sent the AE command. If the address is set to any other number the unit will only respond to the AE command followed by the unit address. Further information on unit addressing can be found in the Serial Communications Section of this manual. After setting the unit address, pressing S1 will advance to the next setup function.

**Echo and Line Feed Selection:** The echo and line feed can be turned on or off depending on the needs of the user. After entering this function the display will show “EHXLFX” where X is 0 for off or 1 for on. To change the setting of the echo press S2, to change the setting of the line feed press S3. With the echo on, the unit will send back any character sent to it. With the line feed “on”, a line feed character follows every message sent from the unit. Note that for proper operation with a Model 9100 remote readout the line feed should be set to “on”. After changing to the desired settings, pressing S1 will advance to the next setup function.



**Continuous Update Time:** When outputting data to a printer or computer at designated time intervals this function will set that time period. After entering this function the display will show “cU” for about 1 second then display a number. This number is the continuous update time. The range of this number is -2 to 3600. When set to zero the output function is disabled. When set to -1 the unit will output data once for every conversion, which is 2.5 times per second. When set to -2 the unit will output data 2 times per second. When set from 1 to 3600 that number corresponds to the number of seconds between each output. Press S2 to increment the number and press S3 to decrement the number. Pressing S4 will increment the multiplier the same as was done in the set limit function. After setting the continuous update time, pressing S1 will advance to the next setup function.

**Serial Device Code Setup:** When several units are connected together to a printer for data logging 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 other's 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 a 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 9200 to communicate with a remote computer, terminal, or printer. Two standard serial options levels are available, RS-232 or RS-485. The host computer can duplicate almost all functions available from the front switches. 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
19	TM	Test Message
22	CR	Set Continuous Reading Mode and Display Mode
27	SC	Set Device Code and Remote Serial Command
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 precede 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 0 in place of the X turns the echo off and a 1 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 0 in place of the X turns the line feed off and a 1 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:** [ADXXc.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 a 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. 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.].

**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 Device Code and Remote Serial Command:** [SCXYYc.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 in the setup mode instructions. “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 at the top of this section where the serial commands are listed. 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 only out the serial port only. 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:**

This unit from the factory has already been calibrated for 0 to +/-5V = 0 TO +/-90 degrees. If the need for recalibration becomes necessary the meter should be sent back to the factory or the calibration can be preformed by the customer. To perform the calibration a stable 0-5VDC input is needed. Apply 0V to the input. Press switch S3 and S4 at the same time. The unit will display “cALAdc” for about 1 second. The unit will then display “S2orS3”. With 0V applied press switch S2, the unit then displays “ 0 “, this performs a zero calibration. With 4.33V applied press switch S3, the unit then displays “ FS “, this performs the full-scale calibration. This method of calibration is not exact since each transducer is different and do not output exactly zero to five volts. If the calibration data for the transducer that will be used with the 9200 is available a more accurate calibration can be obtained, by taking the manufacturers data on the transducer the 9200 can be calibrated to the manufacturers tested output at zero. Calibrate the span on the 9200 with the manufacturers tested data at the 60-degree output. Another method of calibration is one where the transducer is connected to the 9200 and an angular reference is available to compare against the actual display reading. Setting the transducer to 0 degrees and calibrating zero on the 9200 and then setting the transducer to the 60 degree scale and calibrating the 9200 span. (Note: in any of these calibration methods, span is set at 60 degrees even though full scale may be greater than 60 degrees.)

By pressing switch S1 the unit displays “EndcAL”, and reverts back to its normal display mode. The unit is now fully calibrated.

## CONNECTIONS:

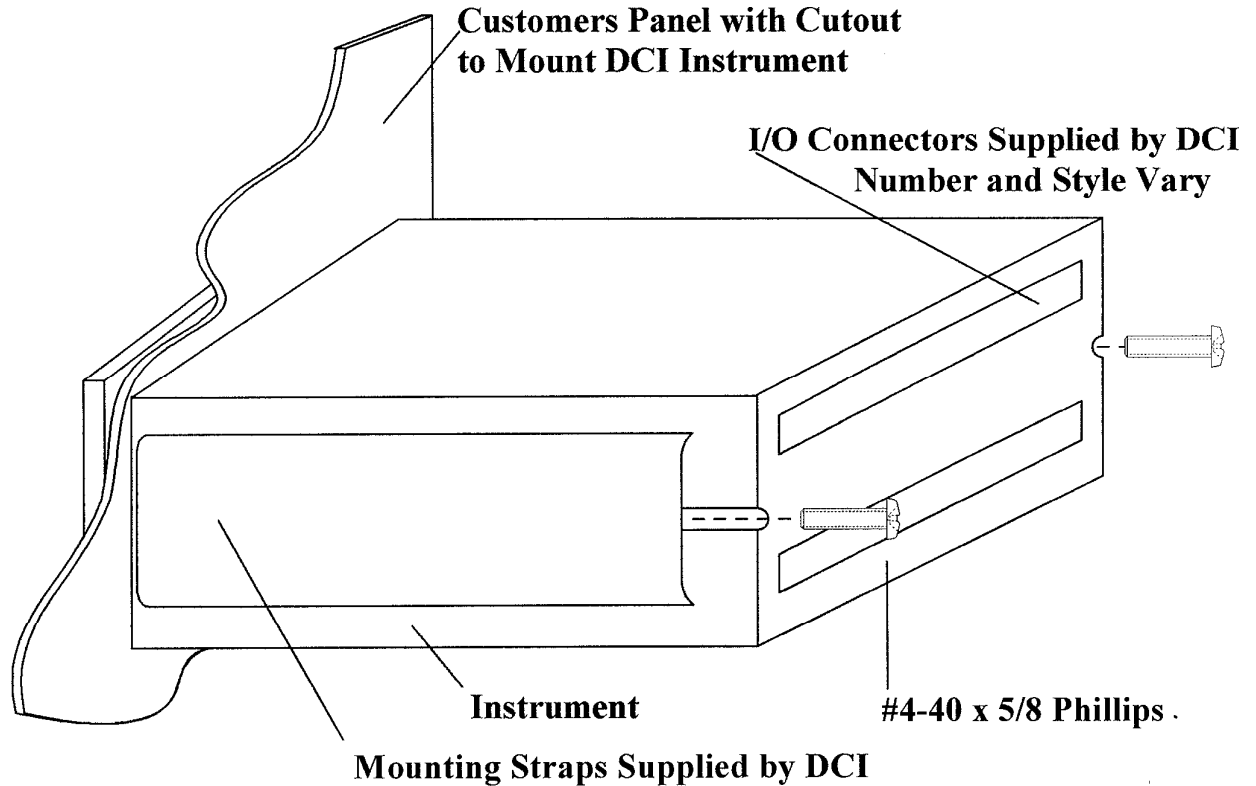
PIN	
1	115VAC (Line)
2	115VAC (Neutral)
3	RS-232 TRANSMIT
4	RS-232 RECEIVE
5	DIGITAL GROUND
6	LIMIT 1 (NORMALLY OPEN)
7	LIMIT 1 (COMMON)
8	LIMIT 2 (NORMALLY OPEN)
9	LIMIT 2 (COMMON)
10	VOLTAGE INPUT +
11	VOLTAGE INPUT –
12	+15V EXCITATION
13	-15V EXCITATION
14	ANALOG OUTPUT
15	ANALOG GROUND

**NOTE:** Tie case to earth ground using ground stud on rear panel, for proper filtering and safety precautions.

**NOTE:** For proper AC line filtering and safety precautions Pin 1 must be connected to Line, Pin 2 connected to neutral and unit must be tied to earth ground.

**NOTE:** Standard Input Power is 115VAC (Optional power is listed below).  
Option 05, Input Power is + 5VDC, Pin 1 (-) Pin 2 (+)  
Option 12, Input Power is + 9VDC to 18 VDC, Pin 1 (-) Pin 2 (+)  
Option 22, Input Power is 230VAC  
Option 24, Input Power is + 18VDC to +36VDC Pin 1 (-) Pin 2 (+)

# MOUNTING



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

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