

VIDEO ENCODER/ DECODER OPERATION

INTRODUCTION

The Video Encoder/Decoder (VED) has four modes of operation—three Encode Modes and a Decode Mode. In the Encode Modes, data is inserted into a video picture in both alpha-numeric form and machine readable edgecode. In the Decode Mode, a moveable crosshair and its coordinates are inserted into a video picture, and edgecode data, if present, is decoded for output along with the crosshair position. In the following paragraphs it is assumed that the VED is controlled through the built-in membrane switch keys. Refer to Appendices A and B for external control via the serial interface or the remote switch inputs.

DECODE MODE OPERATION

The VED powers up in the Decode Mode, inserting a crosshair and its coordinates into the input video picture. The arrow keys are used to move the crosshair. The shift key pressed along with the arrow keys controls the crosshair origin. Shift plus left arrow sets the crosshair origin at the bottom left corner. Shift plus right arrow sets the crosshair origin to screen center. Shift plus up arrow sets the crosshair origin to the current crosshair position, and shift plus down arrow moves the crosshair to its origin. Key 1 changes the cross hair between black and white for improving contrast against the background. Key 2 instructs the VED to decode Edgecode 2 (EC2) data then output the data along with crosshair position. If edgecode is absent or unreadable, only the crosshair position is output and a space is inserted between the X and Y coordinates on the screen to indicate a read failure. A colon (:) is inserted if the read operation is successful. Key 3 transfers control of the crosshair position alternately to the arrow keys or to an external joystick. The shift key pressed along with a number key switches from Decode Mode to Encode Mode 1, 2, or 3. The shift key alone reads the optional Edgecode 2 (EC2) data.

ENCODE MODE OPERATION

Encode Mode 1 displays and edge encodes three channels of voltage or pulse width data. Encode Mode 2 displays and edge encodes three channels of event data. Encode Mode 3 is reserved for custom software/hardware configurations. Encode Modes 1, 2, and 3 are entered from the Decode Mode or from another Encode Mode by simultaneously pressing the shift key and key 1, 2, or 3. Pressing the number of the current Encode Mode along with the shift key enters the Decode Mode. When an Encode Mode is entered, the title line gives the Mode number until the title is changed or turned off. Key 3 turns the title on and off. Key 2 turns the boresight crosshair on and off. Key 1 changes the boresight crosshair between black and white to improve contrast. The left and right arrow keys move the cursor left and right and the up and down arrow keys increment or decrement the character at the cursor position. Offset data entered in this fashion is preserved while switching back and forth between an Encode Mode and the Decode Mode. When switching between different Encode Modes, however, the offset values and the time are cleared to zero. The location of the boresight crosshair can be changed by exiting to the Decode Mode, moving the crosshair, and then returning to the Encode Mode.

TITLE INPUT

The title line is 15 characters long and can be changed either by serial asynchronous input on the COM connector or by using the arrow keys to sequence through the available characters. After an Encode Mode is selected, the title line displays the Mode number until the title is changed or turned off. The title line is turned off and on by Key 3. Serial data is input on Pin 2 of the COM connector and the ground reference is Pin 7. The sequence for entering a title with serial input is 0-15 title characters followed by an escape character (HEX 1B). Upper case letters, numbers, and punctuation (HEX 20 through HEX 60) are valid characters for display in the title line. In addition, a null character (HEX 00) can be used for a clear space rather than the black space provided by the space character (HEX 20).

ADAPTER CABLE

(**Caution:** Do not use a generic cable to directly connect the VED to a computer. Three lines only are to be connected as shown in the table below.)

The DB-9F connector on the adapter cable will plug directly into a COM Port connector on the computer in many cases. Sometimes it will be necessary to further adapt the DB-9F to a DB-25 depending on the computer used. These adapters are widely available.

The three-way adapter cable supplied with the joystick allows the VED to be simultaneously connected to a computer and to the joystick. The DB-15F is compatible with joysticks designed for operation with a computer. The joystick, however, is slightly modified for the VED. This modification consists of simply grounding the open end of both potentiometers inside the joystick. Switches on the joystick are connected to the remote switch inputs on the VED to allow the data read function and the crosshair black/white function to be controlled from the joystick. The DB-15F connector can be used for other sensor inputs by selecting pins which connect to the desired pins on the VED according to the following table:

FUNCTION	DB-25F	DB-9F	DB-15F
RXD, TXD, GND	2, 3, 7	3, 2, 5	-
GND, + 5VDC	1, 13	-	4, 1
CH1V, CH2V, CH3V	10, 11, 9	-	3, 6, 5
KEY 2 REMOTE	23	-	7
KEY 1 REMOTE	22	-	2

JOYSTICK

The Decode Mode allows control of the crosshair position either by the arrow keys or by a joystick connected to the COM connector via the adapter cable. The joystick is a standard computer version except for a modification which grounds the open ends of the two potentiometers inside the joystick. When in the Decode Mode, Key 3 will switch control back and forth between the arrow keys and the joystick. Switches on the joystick are connected to the remote switch inputs of the VED to allow remote control of Key 1 (crosshair black/white) and Key 2 (data read). The joystick operates by connection to the voltage inputs CH1V and CH2V. When the joystick is connected with the VED in Encode Mode 1, CH1 and CH2 can thus be seen to range from 0 to 5 volts as the joystick is moved.

EVENT INPUTS

The VED has three event inputs, CH1E, CH2E, and CH3E (Pins 6, 5, and 4 on the COM connector, ground reference on Pin 1). The inputs are CMOS schmidt triggers with 10k pull-ups to 5 volts. In any Encode Mode, when an event input is pulled low, an asterisk is displayed after the respective channel heading. Encode Mode 2 makes further use of the event inputs as follows: Each channel has a 0-99 event counter followed by a 0-999 millisecond counter. When the event input is pulled low, the event counter is incremented and the millisecond counter is reset to 000. On each video field the millisecond count represents the time that has elapsed since the current event occurred. The millisecond count can be subtracted from the displayed time to find the event time to millisecond accuracy. When the millisecond counter exceeds 999, the last digit becomes an "S", and the other two digits show seconds of elapsed time. After 59 seconds the "S" becomes an "M", and the display shows minutes. After 59 minutes an "H" indicates hours. This display facilitates a VCR search for an event by giving an indication of how long ago it occurred. It also allows the VedCom software, when configured to trigger on the event counters, to automatically extract from VCR playback the times of all events recorded in Mode 2 and save them to file.

VOLTAGE INPUTS

The CH1V, CH2V, and CH3V inputs (Pins 10, 11, and 9 on the COM connector) accept voltages from 0 to 9.999 VDC for digitization and display. This conversion is made with millivolt resolution and accuracy within 10 millivolts after calibration (See section on adjustments for calibration procedure). Pin 1 on the COM connector is the ground reference for voltage inputs and Pin 13 provides +5 VDC at 50 milliamps to power potentiometers or other external circuitry.

The contents of three four-digit offset registers are subtracted from the digitized voltages before display. The three offset registers are cleared to zero on power up. Whenever the offset register for a particular channel contains zero, the character preceding the sign is a space, otherwise it is a pound sign (#). To set an offset, use the left and right arrow keys to position the cursor under the digit to be changed. The up arrow and down arrow keys will increment and decrement the offset register digit, changing the display accordingly. If it is ever necessary to view the contents of an offset register, ground the voltage input and the offset will be displayed as a negative number. A quick zero function is available to zero the display at the current input voltage. To implement the quick zero function, position the cursor on the character preceding the sign, using the left and right arrow keys. Then use the up arrow to perform a quick zero, which calculates the offset required to zero the display. The down arrow key in the same cursor position will clear the offset register to zero.

Note: When a voltage input is being used, the corresponding pulse width input should be left open to prevent interaction, since both inputs use the same display. In order to use the full 10 volt input range, the input power to the VED must be at least 11.5 volts, such as provided by the wall transformer supplied. If only a 5 volt input range is needed, the VED can be operated with input power as low as 6.5 volts.

PULSE WIDTH INPUTS

The CH1P, CH2P, and CH3P inputs (Pins 16, 14, and 15 on the COM connector) accept pulse width inputs from 0 to 9.999 milliseconds for digitization and display. The conversion yields microsecond resolution and accuracy. Pin 1 on the COM connector is the ground reference for the pulse width inputs and Pin 13 provides +5 VDC at 50 milliamps to power external sensor circuitry. The Vertical Blank pulse (Pin 12) must be used by the external circuit to trigger the pulse to be measured. Starting with the negative transition of the Vertical Blank pulse, the pulse width input should be released from a pulled down condition for the desired length of time, which will be displayed from 0 to 9.999 milliseconds.

The contents of three four-digit offset registers are subtracted from the digitized pulse widths before display. The three offset registers are cleared to zero on power up. Whenever the offset register for a particular channel contains zero, the character preceding the sign is a space, otherwise it is a pound sign (#). To set an offset, use the left and right arrow keys to position the cursor under the digit to be changed. The up arrow and down arrow keys will increment and decrement the offset register digit, changing the display accordingly. If it is ever necessary to view the contents of the offset register, ground the pulse width input and the offset will be displayed as a negative number. A quick zero function is available to zero the display at the current pulse width input. To implement the quick zero function, position the cursor on the character preceding the sign, using the left and right arrow keys. Then use the up arrow key to perform a quick zero, which calculates the offset required to zero the display. The down arrow key in the same cursor position will clear the offset register to zero.

Note: When a pulse width input is being used, the corresponding voltage input should be left open to prevent interaction, since both inputs share the same display. In order to use the full 10 millisecond range, the input power to the VED must be at least 11.5 volts as provided by the wall transformer supply. If only a 5 millisecond range is needed the VED can be operated with input power as low as 6.5 volts.

EXPANSION CAPABILITY

There are several features which may interest the user who wishes to customize the VED for special applications. Most such applications involve custom firmware and some also require additional interface circuitry. The VED provides for custom applications by reserving Encode Mode 3 for custom firmware and by accepting an expansion circuit card inside the enclosure. Auxiliary connectors on the rear panel give access to the expansion card.

Many custom applications use the standard hardware and involve only firmware changes to make other use of the inputs on the COM connector such as the switch inputs, the serial asynchronous channel, the three Schmidt trigger inputs, the analog inputs, or the pulse width inputs.

Applications which do require additional circuitry may use the available expansion slot inside the VED to enhance capability without the need for an external interface box. An optional expansion card is available to provide one or more of the following additional capabilities:

Synchro or Resolver Inputs. This option is used in conjunction with Encode Mode 3A to read two 16 bit binary angles from synchro/resolver to digital converters on the expansion card for display and edge encoding as AZ (CH1) and EL (CH2). Channel 3 (CH3) is designated FL for focal length and is typically used to monitor the potentiometer on a zoom lens so that the camera field of view can be determined at any zoom position. The FL input is identical to CH3V as described in the Voltage Input paragraph. The binary angle inputs are first converted to an absolute BCD angle ranging from 0 to 359.99 degrees. A five digit offset register is then added to offset the absolute angle to any angle from 0 to 359.99 degrees. The offset register is cleared to zero on power-up. An absolute angle (offset of zero) is indicated when the character preceding the angle is a space. If the offset is other than zero, a pound sign (#) will be displayed. An offset is entered by using the left and right arrow keys to position the cursor under the digit to be changed. The up and down arrow keys will increment and decrement the offset register digit, changing the display accordingly. The contents of the offset register are restricted to 0-359.99. A quick zero function is available to zero the display at the current input angle. To implement the quick zero function, position the cursor on the character preceding the angle using the left and right arrow keys. Then use the up arrow key to perform a quick zero, which calculates the offset required to zero the display. The down arrow key in the same cursor position will clear the offset register to zero.

Channel B Video In/Out This option adds another video input/output channel to the VED. The same information is inserted on both video channels and the Channel B video input must be synchronized with the video input on VED Channel A. The **Video Sync Generator, V-data Model VSG** is available to provide two monochrome composite sync outputs locked to IRIG-B or one pulse per second from a GPS receiver. These sync outputs can be connected to the gen-lock inputs of monochrome and some color cameras supplying video to VED channels A and B. A split screen option allows horizontal or vertical split screen insertion of Channel A video into Channel B.

GPS Receiver A 12 channel GPS receiver allows UTC time display to the millisecond to be derived from GPS timing without need for IRIG-B input. Navigation data from the GPS receiver is displayed and edge encoded according to customer requirements.

Additional RS-232 Channels This option provides two additional RS-232 channels for data input from devices such as GPS receivers, laser rangefinders and digital compasses.

Pulse Width Modulation Outputs This option provides two pulse width modulated outputs for driving the Az and El motors on a pan and tilt pedestal. External full-bridge drivers provide power to the motors. The pulse widths are controlled by the position of the crosshair on the screen as determined by the joystick input.

TIME INPUT

Time from days to milliseconds is developed from the internal crystal clock and from IRIG-B time code input, if present. The time starts at zero on power up and counts until IRIG-B time is detected. Whenever valid IRIG-B is being decoded and displayed, the character between units of days and tens of hours is a space, otherwise an asterisk in that position indicates that the clock is in search mode. The IRIG-B input voltage must be within a few tenths of a volt of the standard 3 volt peak-to-peak signal to properly drive the opto-isolated receiver. The time display can be changed by using the left and right arrow keys to position the cursor under a digit to be incremented or decremented by the up and down arrow keys. This is easier if the clock is stopped. To stop the clock, position the cursor under the asterisk indicating IRIG fail and push the down arrow key once to force the clock to internal mode as indicated by a colon in place of the asterisk. Another push of the down arrow key will stop the clock. Pushing the up arrow key at the same position will restart the clock in internal mode. Another push of the up arrow key will return the clock to search mode. In addition to the standard IRIG-B input on the BNC connector, there is an input for digital IRIG-B on Pin 8 of the COM connector. This input is compatible with digital IRIG-B from the LED drivers of the **V-data Global Time and Position unit, Model GTP**.

ADJUSTMENTS

There are two potentiometer adjustments inside the VED enclosure. One controls the horizontal dot clock and the other calibrates the voltage span for conversion of voltage inputs. Both are accessible by removing the four screws on the rear panel and sliding the panel and attached circuit board out a few inches. It is not necessary to disconnect the ribbon cable to the front switch panel.

Dot Clock Adjustment

Facing the rear panel, the potentiometer on the left (P1) is the dot clock adjustment. It controls the frequency of the dot clock which determines the width of the horizontal or x-axis display. The adjustment is nominally correct when the line of data at the bottom of the screen in an Encode Mode is centered, with the monitor set to normal scan (edgecode not visible). For a more precise 1:1 adjustment, display a grid from a pattern generator (or view a symmetrical object with a video camera) and verify that the X dimension of a square or circle is equal to the Y dimension when measured by the cursor coordinates in the Decode Mode.

Voltage Span Adjustment

Facing the rear panel, the potentiometer on the right (P2) is the span adjustment for the analog to digital converter. The adjustment is nominally correct when CH1, CH2, and CH3 display +5.000 in Encode Mode 1 with the voltage inputs (Pins 10,11, and 9) jumpered to the 5 volt output (Pin 13) on the COM connector. For a more precise adjustment, monitor the 5 volt output with a millivolt resolution digital voltmeter with the desired accuracy and adjust to the meter readout. For accuracy to units of millivolts it will be necessary to calibrate carefully and avoid wide variations in temperature. Another approach to precision measurement would be to monitor the sensor reference with one of the input channels. Since the display is highly linear, the ratio of sensor voltage to reference voltage will compensate for errors of scale.

SERIAL DATA INPUT

Up to 80 characters of RS232 or NMEA 0183 data can be displayed in the Encode Modes. Serial data is input on Pin 2 of the COM connector and the ground reference is on Pin 7. Many NMEA 0183 devices, such as GPS receivers, output multiple messages. The first six characters of the title can be used to screen the serial input for the message of interest. If the first title character is a \$ then the first six characters of a message must match the first six characters of the title in order to be displayed. A black space in the title is a "don't care" and does not require a match, providing for a screening which allows groups of messages to pass. If the first title character is not a \$ then default screening is performed for the \$GPRMC message. Upper case letters, numbers, and punctuation (HEX 20 through HEX 60) are valid characters for display. In addition, a null character (HEX 00) can be used for a clear space rather than the black space provided by the space character (HEX 20). A carriage return (HEX 0D) terminates the input and enables display.

VedCom SOFTWARE

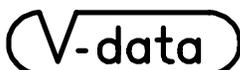
The VedCom software provides an easy and flexible interface between the VED and a MS-DOS compatible computer. VedCom allows you to control the VED from the computer keyboard and to read data from the VED manually or automatically, display the data and store it to file in any format you wish. First make a working copy of the VedCom disk. If you want to run VedCom from disk, select the appropriate drive, type VEDCOM and press ENTER. If you want to install VedCom on your hard drive, type INSTALL C: and press ENTER. Connect the VED to COM1 or COM2 on your computer (and to the joystick if desired) using the supplied adapter cable. Provide a video input (normally a VCR playback of Encode Mode video) to the VED and connect a monitor to the video output. With on-screen help and experimentation you will quickly become familiar with the operation of VedCom. If you have two VED's you can use one in Encode Mode with camera input as a video source for the other in Decode Mode under VedCom control. This configuration allows you to explore the Encode/Decode features without using a VCR. It also comprises a real-time data link where picture and data can be sent several hundred feet over a single co-ax between encoder and decoder.

TROUBLESHOOTING

The decoding of input edgecode is designed with error detection and will read accurately or not at all. Edgecode is easily read from a quality still field such as from a VCR with shuttle and jog controls. Only high-end commercial VCR's will display every field in jog. Mid-range VCR's will display every other field. Edgecode from VCR's with poor quality still fields may not always be readable, but reading at normal playback speed should not be a problem with any VCR. The VED has been tested with a wide range of cameras and VCR's but there will inevitably be incompatibilities. Unless there is obvious noise in the picture, edgecode reading problems can usually be traced to a problem with the video level into the VED and can be corrected by inserting a video distribution amp with adjustable level. To evaluate the readability of a tape, play it back into the VED in Decode Mode and observe the character between the X and Y position display while pressing Key 2 for continuous reads. A colon (:) is written to that character on every successful read and a space is written on every read failure. The steadiness of the colon will be an indication of decoding performance.



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Appendix A : I/O and Control

Power In: 7-15 VDC, 100mA, (9-32 VDC Optional)
 Video In: BNC Connector, RS-170, NTSC, 75 ohm
 Video Out: BNC Connector, RS-170, NTSC, 75 ohm
 IRIG-B In: BNC Connector, 3V p-p IRIG-B, opto-isolated

COM Connector: DB-25 F

PIN	GROUP	FUNCTION
2,3,7	Serial async. data	Receive in, transmit out, GND
10,11,9,13,1	Sensor voltage	CH1V, CH2V, CH3V, + 5, GND
16,14,15	Sensor pulsewidth	CH1P, CH2P, CH3P
6,5,4	Event closure	CH1E, CH2E, CH3E
12	Vertical blank	Pulsewidth trigger
17-24,25	Remote panel switches	8 front panel switches, GND
8	IRIG-B	Demodulated IRIG-B in from GTP

Serial COM protocol: 4800 Baud, 8 data bits, no parity, 1 stop bit, no handshaking

Output Data Format

Character	Parameter	Characters
1-4	X position	Sign, hundreds, tens, units
5-8	Y position	Sign, hundreds, tens, units
9-10	Hours	Tens, units
11-12	Minutes	Tens, units
13-14	Seconds	Tens, units
15-17	Milliseconds	Hundreds, tens, units
18-22	CH1	D1(MSD), D2, D3, D4, D5(LSD)
23-27	CH2	D1(MSD), D2, D3, D4, D5(LSD)
28-32	CH3	D1(MSD), D2, D3, D4, D5(LSD)
33	Carriage return	0D (hex)

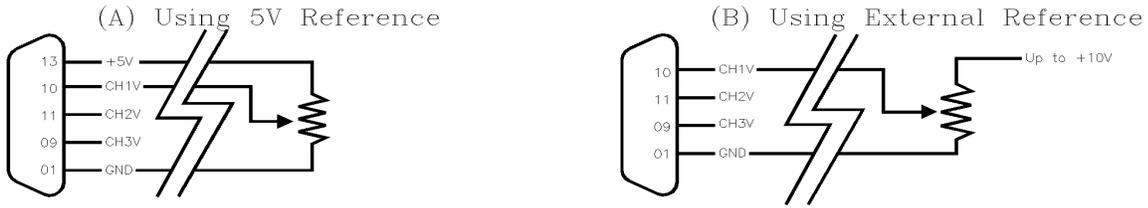
NOTE: If edgecode is absent or unreadable, only characters 1-8, and 33 are output.

Control Commands

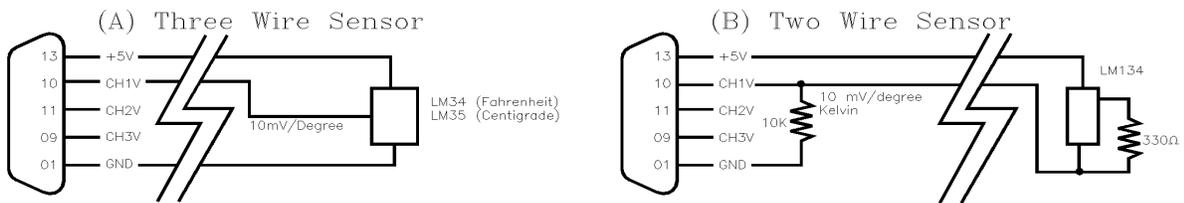
Command		Result			
Front Panel Switch	ASCII	Decode Mode	Encode Mode 1	Encode Mode 2	Encode Mode 3
1	a	Crosshair black/white	←	←	←
2	s	Send data, EC1	Crosshair on/off	←	←
3	d	Joystick on/off	Title on/off	←	←
Shift	z	Send data, EC2	-	-	-
Right arrow	r	Crosshair right	Cursor right	←	←
Left arrow	q	Crosshair left	Cursor left	←	←
Up arrow	w	Crosshair up	Increment	←	←
Down arrow	e	Crosshair down	Decrement	←	←
Shift + 1	j	Encode Mode 1	Decode Mode	Encode Mode 1	Encode Mode 1
Shift + 2	k	Encode Mode 2	Encode Mode 2	Decode Mode	Encode Mode 2
Shift + 3	l	Encode Mode 3	Encode Mode 3	Encode Mode 3	Decode Mode
Shift + right arrow	p	Origin center	Not used	←	←
Shift + left arrow	u	Origin lower left	Not used	←	←
Shift + up arrow	i	Origin at current pos.	Not used	←	←
Shift + down arrow	o	Crosshair home	Not used	←	←

Appendix B: Application Notes

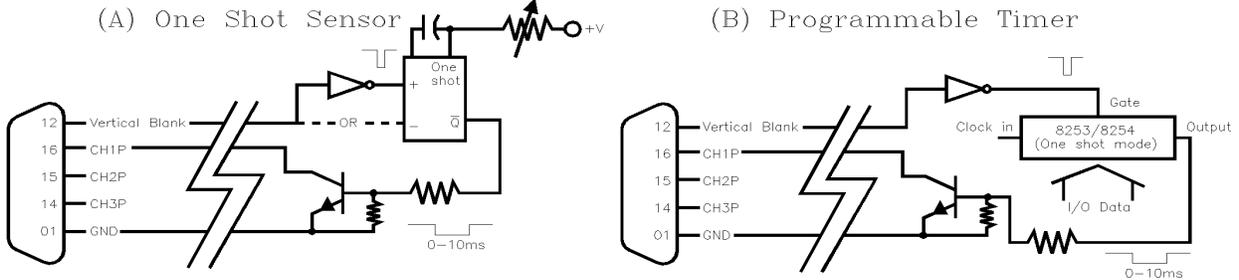
• Potentiometer Sensors



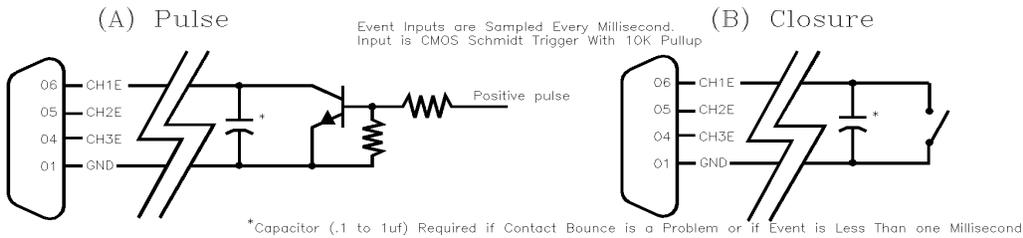
• Temperature Sensors



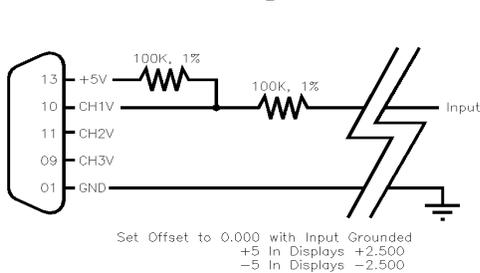
• Pulse Width Sensors



• Event Input



• Bi-Polar Input



• Remote Front Panel Switches

