Operating Instructions for 2-D Optical Position Sensor

INTRODUCTION

The 2-D Optical Position Sensor (OPS) is a high accuracy system. It uses a position sensitive detector (PSD) as the basis for producing measurements. The PSD produces 4 analog signals proportional to the position and intensity of a laser beam or any light spot on its surface. These 4 analog signals are converted into digital signals by a 12-bit analog to digital converter (ADC) and then sent to a microprocessor. The digitized signals are used to calculate position, which is then displayed on the LCD screen. The 2-D OPS also removes the effects of ambient light for the highest possible measurement accuracy.

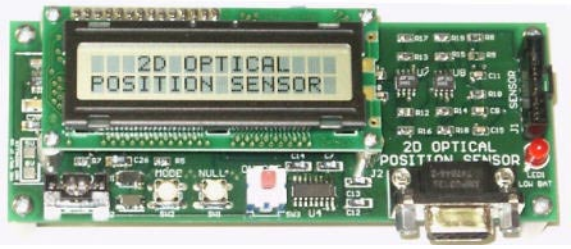

Figure 1: 2-D OPS screen at power-up

APPLICATIONS

Some of the many uses of this system are:

- Measuring the **straightness of travel** of any machine or moveable stage or carriage.

  Method: Mount the laser beam in a stationary position and the detector on the stage. Move the detector the length of travel collecting data. Connect the end points of the data by a line. The deviation from this trend line is straightness error.

- Measuring the **angular movement** of a window or mirror by bouncing a laser beam from its surface.

  Method: Aim laser at surface and zero the LCD display. After mirror moves, angle (in radians) can be calculated by dividing the movement by 2 times the distance between the mirror and the PSD.

- **Direct measurement of travel** of a 2-axis stage.

  Method: Mount detector to a stage and aim the laser at it. The stage motion in directly sensed in two dimensions.

- Measuring the **flatness of a surface.**

  Method: Position laser roughly parallel to surface. Slide detector along surface collecting data. Connect the end points of the data with a line. The deviation from this trend line is flatness error.

OPERATION

Plug cable ends into detector and into main board; toggle the On/Off pushbutton to "On".

The system starts by asking to remove the effects of ambient light. Do this by making sure that the laser beam is *not* on the detector. Press the NULL button and wait for the display to read "Done". At this point the display will read SumLow in the lower right hand corner of the display. This is normal and means there is not sufficient light on the detector (see Figure 2 at right).

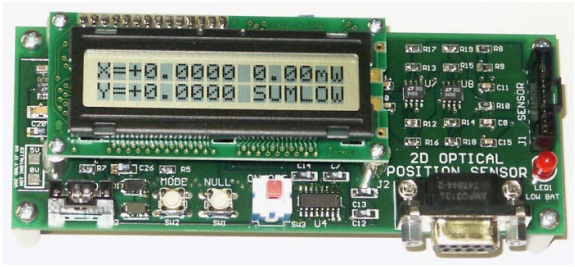

Figure 2: SumLow after pressing NULL button

As soon as a laser beam of power greater than 0.2 mw is presented to the detector, the SumLow error message will disappear and digital data will be visible. This is called the Position Display Mode. The values given are with respect to the center of the detector (see Figure 3).

Note: Position accuracy will slowly degrade when the PSD has incident power higher than 5 mW. This is caused by the onset of photosaturation of the detector. If any of the channels from the detector reaches the maximum voltage, the "DetSat" message is displayed, and the displayed position is not accurate.

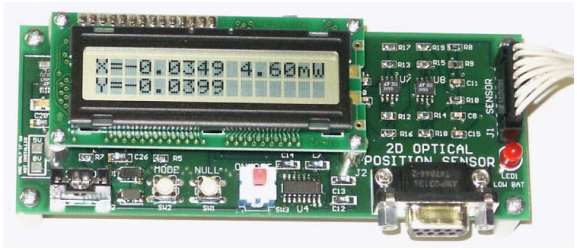

Figure 3: Position Display Mode

Press the MODE button to toggle between Voltage Display Mode and Position Display Mode. Voltage Display Mode presents data from the ADC in raw counts and is used for sending the data serially to a PC for conversion into position data. The Voltage Display Mode is also useful for troubleshooting purposes. The ADC values will range from 0 to 4999 millivolts. If a value of 4999 is ever encountered on any channel it means the optical source is too powerful. If a laser is used, the power must be reduced by the use of an optical filter placed over the PSD or by power adjustment of the laser.

When in Position Display Mode, the current displayed position can be forced to 0.0000 in X and Y. This is very handy for observing small changes from a starting point. Each time the NULL button is pressed the display will force X and Y to zero. To get back to position data with respect to the center of the detector the power must be cycled.

To obtain consistent, accurate position data the effects of ambient light must be removed. This can be done at any time in the following way: in Position Display Mode, press the MODE button to get to the Voltage Display Mode. Then press the NULL button. This will restart the background light subtraction process that is also executed

at power-up. If the system is to be used as a test instrument it is a good idea to mount the detector in an appropriately made case. If this is done install the red filter mentioned previously in front of the detector – it will protect it and offer even more background light suppression. A good filter to use is from edmundoptics.com; the part number is F43-942.

WARNINGS

There is no reverse polarity protection of the system if the batteries are installed backwards.

ADDITIONAL NOTES

- When the Red "Low Bat" LED comes on, replace the batteries.
- System accuracy is <1% when used with a quality laser beam at less than 5 mw of power.
- Position errors will occur as the laser beam "walks off" the edge of the detector.
- Battery life is in excess of 20 hours.
- Adjust LCD screen contrast by turning the knob on the blue potentiometer.
- When using the serial port – COM parameters are: 9600 baud, no parity and 1 stop bit.
- Data is displayed in inches.

SYSTEM SPECIFICATIONS

Power Source	2 AA batteries
Measurement Range	0.2 inches in X and Y
Measurement Resolution	0.0001 inches
Measurement Accuracy	+/- 0.001 inches
Measurement Speed	5 milliseconds (200 Hz)
LCD/Serial Port Update Rate	2 Hz
Serial Port Com	DB9 female, 9600 baud, 8 data bits, 1 stop bit, no parity
LCD Displays	Position Mode and Voltage Mode
Features	Ambient light cancellation; Zeroing of position data.