OPERATING THE PSD-E4 PHOTODIODE/AMPLIFIER MODULE

GENERAL: This unit consists of a tetralateral-type position sensing photodiode and four independent transimpedance amplifier channels. It is designed for continuous beam position monitoring.

POWER SUPPLY: A bipolar power supply with central ground is required, +,- 6VDC to +,-15VDC, 40mA. Double check wiring prior to turning on power. Improper/reverse wiring will damage the unit.

GAIN: The unit is supplied with a fixed feedback resistance of $10^4$ ohms for each channel. Other gain settings may be specified at the time of order.

POLARITY/BIAS: The standard polarity for the EOS silicon and InGaAs position sensing photodiodes is common cathode. This results in a negative-going signal at the output of the first amplifier stage. The germanium devices are common anode, resulting in a positive-going signal at the output of the first amplifier stage. The PSDs are designed normally for zero bias operation and the E4 unit has no biasing provision.

SIGNAL LEVELS/SATURATION: The PSDs are designed ideally for signal levels on the order of 100uW. Nonlinearity and eventual saturation will occur above 1mW. The unit is threaded on the front (1.035-40) for an adapter to take a 1" diameter optical filter.

DC OFFSETS: Since these units are DC-coupled amplifier offsets are multiplied at the output. In the case of the high shunt impedance silicon and InGaAs devices this is generally not a problem with the levels being 1mV or less. With the low impedance germanium devices the offsets of each channel can be as high as +,- 10mV and the user may have to correct for these if a CW beam is being used.

POSITION RESOLUTION: The position resolution of the PSDs is a function of incident power, total system noise (and effective noise bandwidth), the size of the device, and to a lesser extent the size of the incident beam. In general, the resolution ($\delta$) can be estimated as follows:

$$\delta = \frac{L \times 2In}{Is},$$

where

- $L$ = active size of the PSD (usually 70% of the overall dia)
- $In$ = equivalent input noise current
  - (the equivalent noise current of the parallel combination of the interelectrode resistances, photodiode shot noise and the contribution from the amplifier’s equivalent input noise)
- $Is$ = the signal current from the photodiode (0.9 A/W typical)

For the standard 5mm photodiode and the PSD-E4 amplifier module with 100uW of beam power, this results in approximately:

$$\delta = \frac{(3.5mm \times 5 \times 10^{-11} \text{ A/Hz}^{1/2})}{(0.9 \times 10^{-4})} = 2.0 \times 10^{-6} \text{ mm/Hz}^{1/2}$$

Assuming the full module bandwidth of 50kHz (eq noise bandwidth = 70kHz) this gives a wideband resolution of 0.5x10^{-3}mm, or 0.5um.

CONNECTION: A standard 9-pin D-style connector is used for the power inputs and signal outputs. See the data sheet for specific pin-outs. When ordered with a PS-1 power supply an adapter cable is provided for connection.