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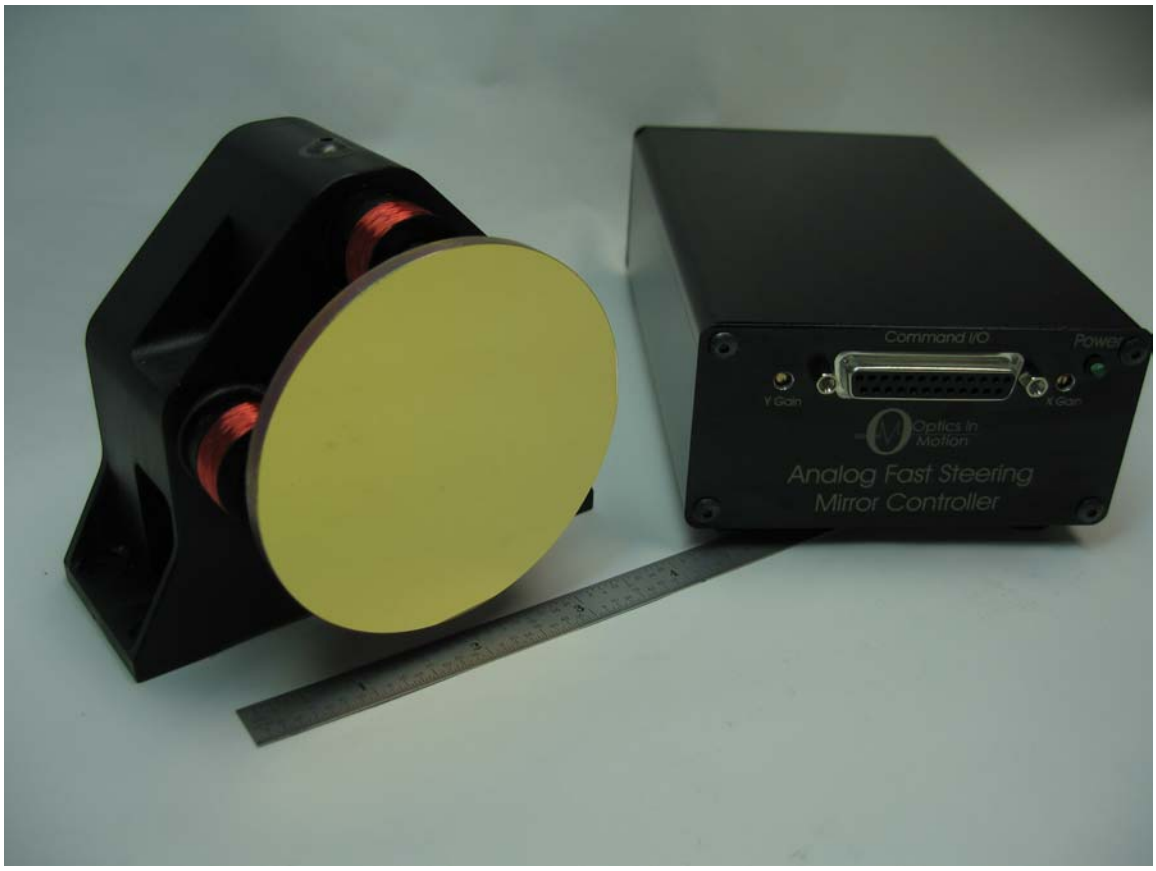
# *Fast Steering Mirror*




# *User's Manual*

## *Models OIM3300*

Optics In Motion

*April 2, 2007*
*Revision B*

# Product Warranty

*Optics-In-Motion LLC warrants this product to be free from defects in material and workmanship for a period of 1 year from the date of shipment. If the product is found to be defective during the warranty period, the product will either be repaired or replaced at Optics-In-Motion's option.*

*This warranty does not apply to defects resulting from modifications or misuse of any product or part.*

*Optics-In-Motion LLC shall not be held liable for any indirect, special, or consequential damages caused by the use of the product.*

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# Fast Steering Mirror Description

Voice coil driven Fast Steering Mirrors (FSM) have been used for several years in military and aerospace applications for target acquisition, scanning, and beam steering. These mirrors were typically low volume – high cost parts. Optics-In-Motion has engineered a line of fast steering mirrors which have many of the attributes of the military versions (low noise, high pointing accuracy, and high acceleration/step speeds) but are available at commercial prices.

## Fast Steering Mirror Models:

The 3000 series fast steering mirror product line consists of a 3 inch diameter aluminum substrate which has a replicated optical surface. Replication is similar to the process used to create optical gratings, however in this case the replicated surface is a flat mirror.

## Drive Motors:

Both mirror models are driven by a push/pull configuration of voice coils (similar to speaker coil – magnet arrangement). However unlike a speaker the FSM is configured with a moving magnet instead of a moving coil. This arrangement has several advantages. The first being that since the coil is stationary the wires do not have to move which adds greater overall reliability. The second advantage is that the heat generated by the mirror coils is conducted to the mirror housing away from the optical mirror substrate. This prevents thermal distortions of the mirror wavefront quality.

## Mirror Suspension:

The mirror is flexurally suspended in two axes. The flexure is designed for an infinite fatigue life under normal operation (the absence of high levels of external vibration). The mirror rotates in both directions around a single pivot point. The pivot point for model OIM3300 (3" mirror) is located 0.375 inches behind the mirror surface.

## Mirror Angular Position:

Local Position – the mirror has a built in optical position sensor. The position sensor provides mirror feedback information to the controller which can also be monitored by the user. The local position sensor outputs a voltage which is proportional to the mirror angular position. The position sensor scale factor is

10volts = 5.0 degrees and has a range from +10 volts (+5.0 degrees mechanical +10.0 degrees optical) to -10 volts (-5.0 degrees mechanical, -10.0 degrees optical).

External Position – the mirror controller has inputs for a user supplied control signals. Typically these signals are from an external quadrant cell which is used to monitor the position of a beam reflected off the surface of the fast steering mirror. These external signals (x and y position angles) are differentially input into the mirror command connector. A TTL level high input to the command connector INT/EXT switch controls the source of mirror feedback, switching it from local to external position control.

## Mirror Controller:

The mirror controller electronics are housed in a remote enclosure connected to the FSM via a 10 foot cable. Mirror commands are input to the controller through a 25 socket D sub-miniature connector. The commands are differential signals representing the x and y mirror positions, scaled to the +/- 10 volt range. For example, the X- command can be grounded and the X+ command can go from +10volts to -10volts. The input impedance of the command signals is 10K ohms. Monitor signals are provided for the actual mirror positions, error signals (feedback error between commanded position and actual position). The PID gain may be set from the controller front panel potentiometers (See fig. 1). CW rotation reduces gain and CCW rotation increase gain, total range = 25 turns.

## Mirror Power Supply:

The controller is powered by an external +/-15 volt power supply capable of 1.5 amps of current. The external power supply is an air cooled tabletop supply which plug directly into a 110 or 220 volt wall socket.

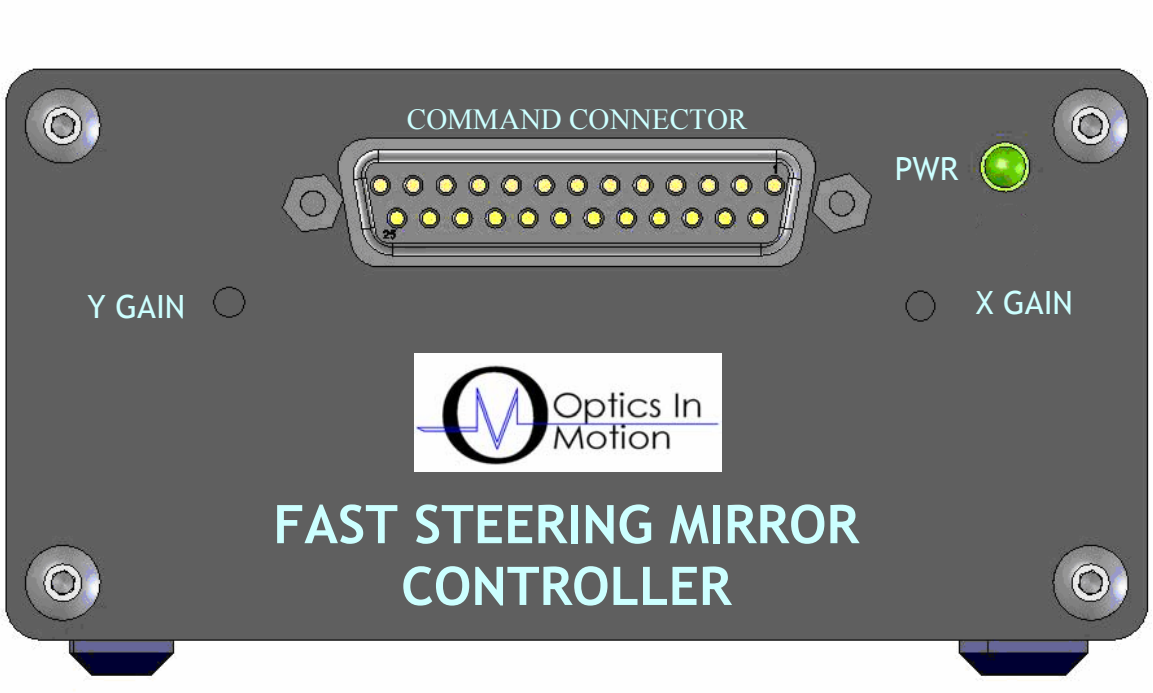



Figure 1: Controller Front View

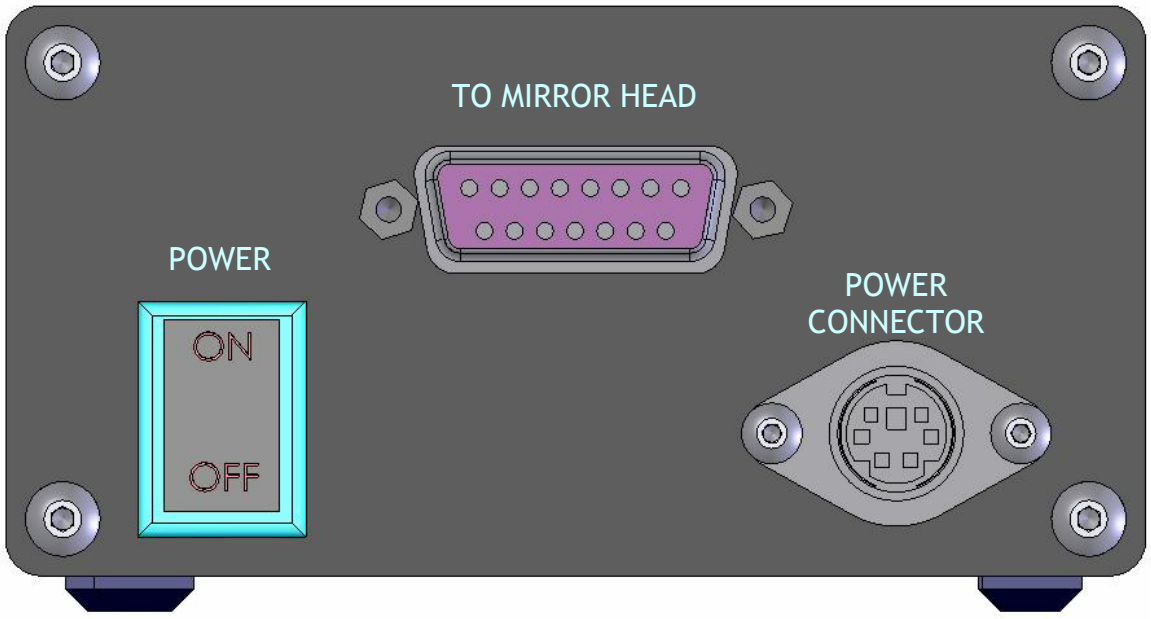



Figure 2: Controller Rear View

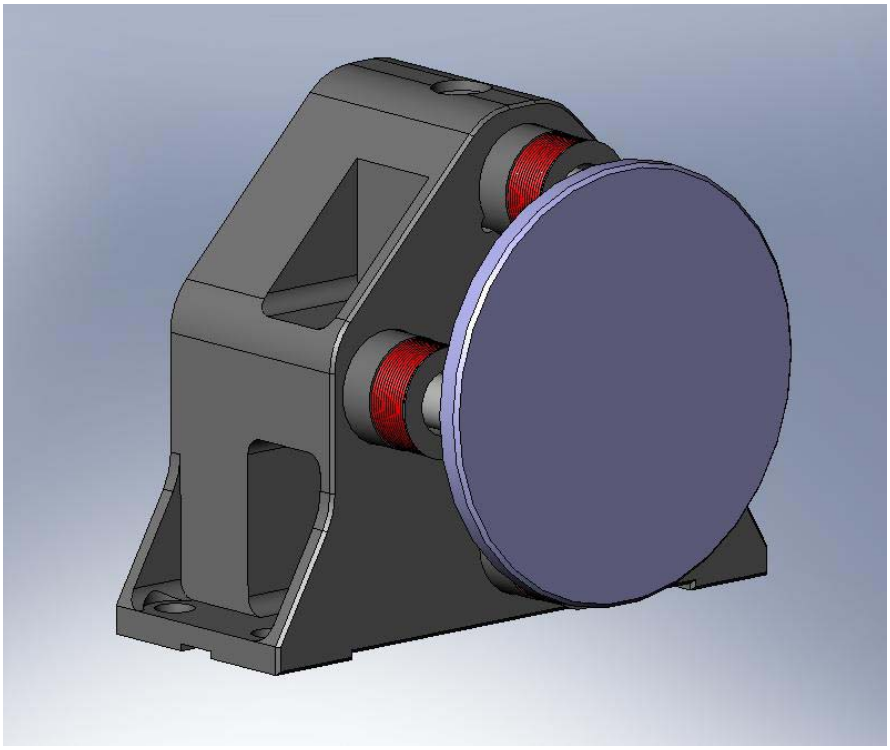


Figure 3: Model OIM3300 Mirror Head Front View

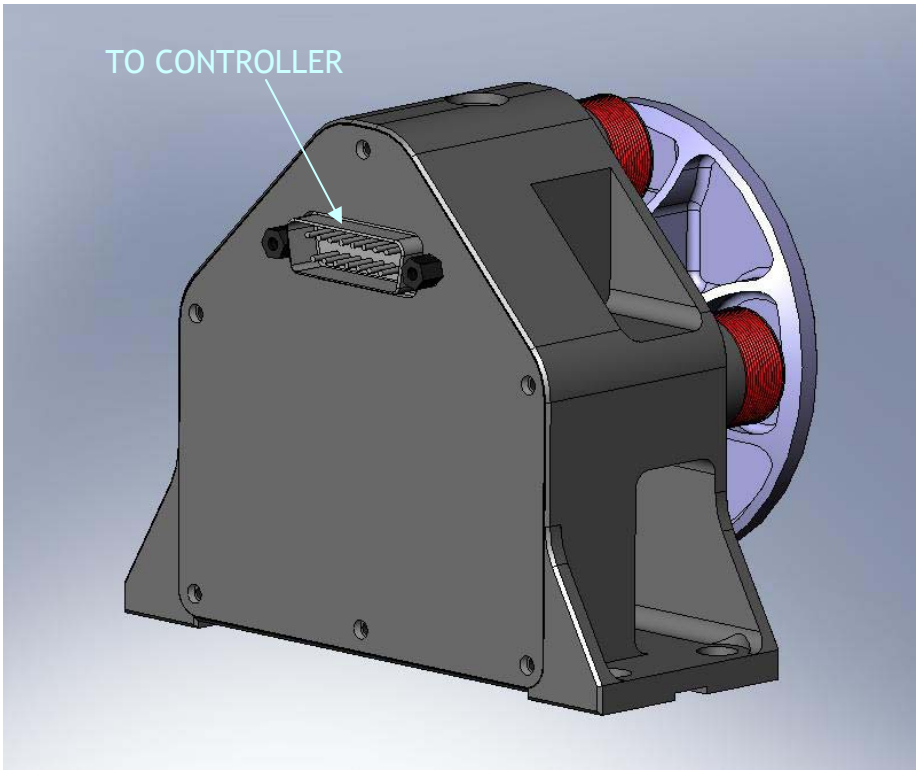



Figure 4: Model OIM3300 Mirror Head Rear View

## Table 1: Command I/O Connector Wiring

25-Socket Sub-miniature D Connector

| Pin Number | Signal Name | I/O Type | Description |
|---|---|---|---|
| 1 | X ERROR | Output | X summing junction error voltage output, difference between commanded and actual position. (referenced to ground) |
| 2 | INT/EXT SWITCH | Input | Normally low TTL input. High level switches the position feedback input from local to external. (used with input pins 10,11 and 17, 5) |
| 3 | X- COMMAND | Input | X mirror position command. Low side of differential command input. Range +/-10 Volts. |
| 4 | X+ COMMAND | Input | X mirror position command. High side of differential command input. Range +/-10 Volts. |
| 5 | X- EXTERNAL | Input | X external mirror position. Low side of differential position input (from external quad or similar position sensor) |
| 6 | GND | Output | Ground Reference |
| 7 | -15 VOLTS | Output | -15 VDC for external loads of less than 100ma. |
| 8 | RESERVED | | |
| 9 | N/C | | |
| 10 | Y+ EXTERNAL | Input | Y external mirror position. High side of differential position input (from external quad or similar position sensor) |
| 11 | Y- EXTERNAL | Input | Y external mirror position. Low side of differential position input (from external quad or similar position sensor) |
| 12 | Y- COMMAND | Input | Y mirror position command. Low side of differential command input. Range +/-10 Volts. |
| 13 | Y+ COMMAND | Input | Y mirror position command. High side of differential command input. Range +/-10 Volts. |
| 14 | X POSITION | Output | X mirror angular position readout from local position sensor. (referenced to ground) |
| 15 | +5 VOLTS | Output | 5 VDC for external loads of less than 100ma. |
| 16 | GND | Output | Ground Reference |
| 17 | X+ EXTERNAL | Input | X external mirror position Low side of differential position input (from external quad or similar position sensor) |
| 18 | RESERVED | | |
| 19 | +15 VOLTS | Output | +15 VDC for external loads of less than 100ma. |
| 20 | GND | Output | Ground Reference |
| 21 | RESERVED | | |
| 22 | GND | Output | Ground Reference |
| 23 | Y POSITION | Output | Y mirror angular position readout from local position sensor. (referenced to ground) |
| 24 | Y ERROR | Output | Y summing junction error voltage output, difference between commanded and actual position. (referenced to ground) |
| 25 | RESERVED | | |

# Fast Steering Mirror Block Diagram

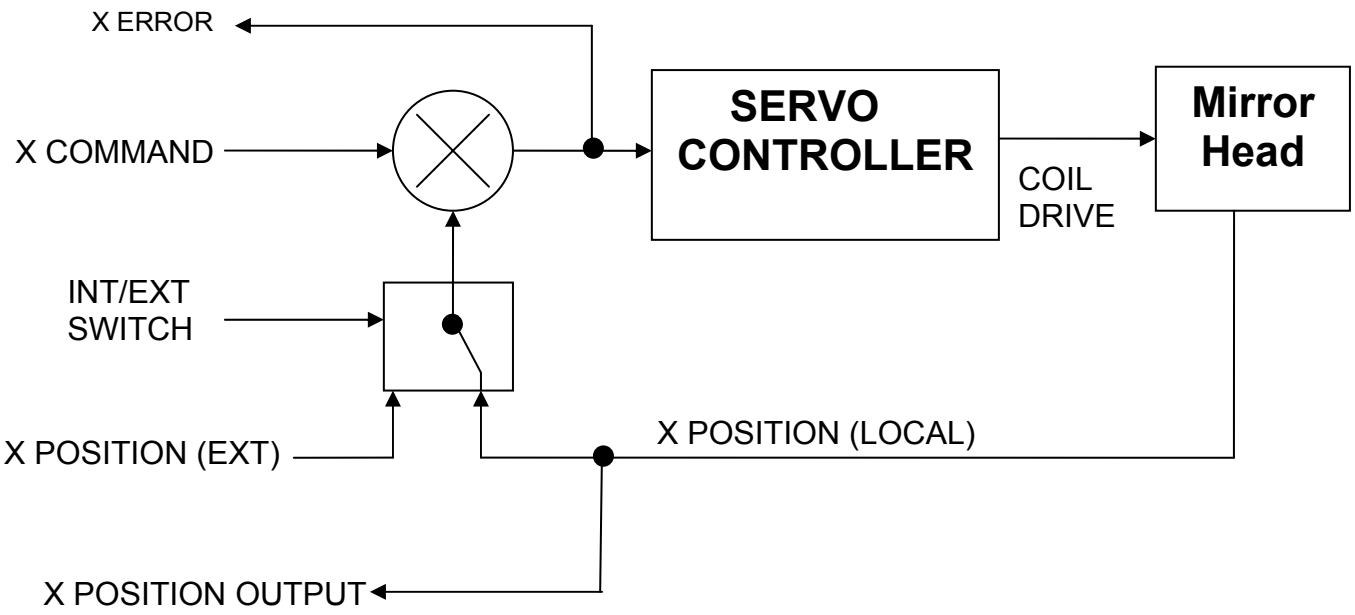



Figure 5: Block diagram for X-axis control

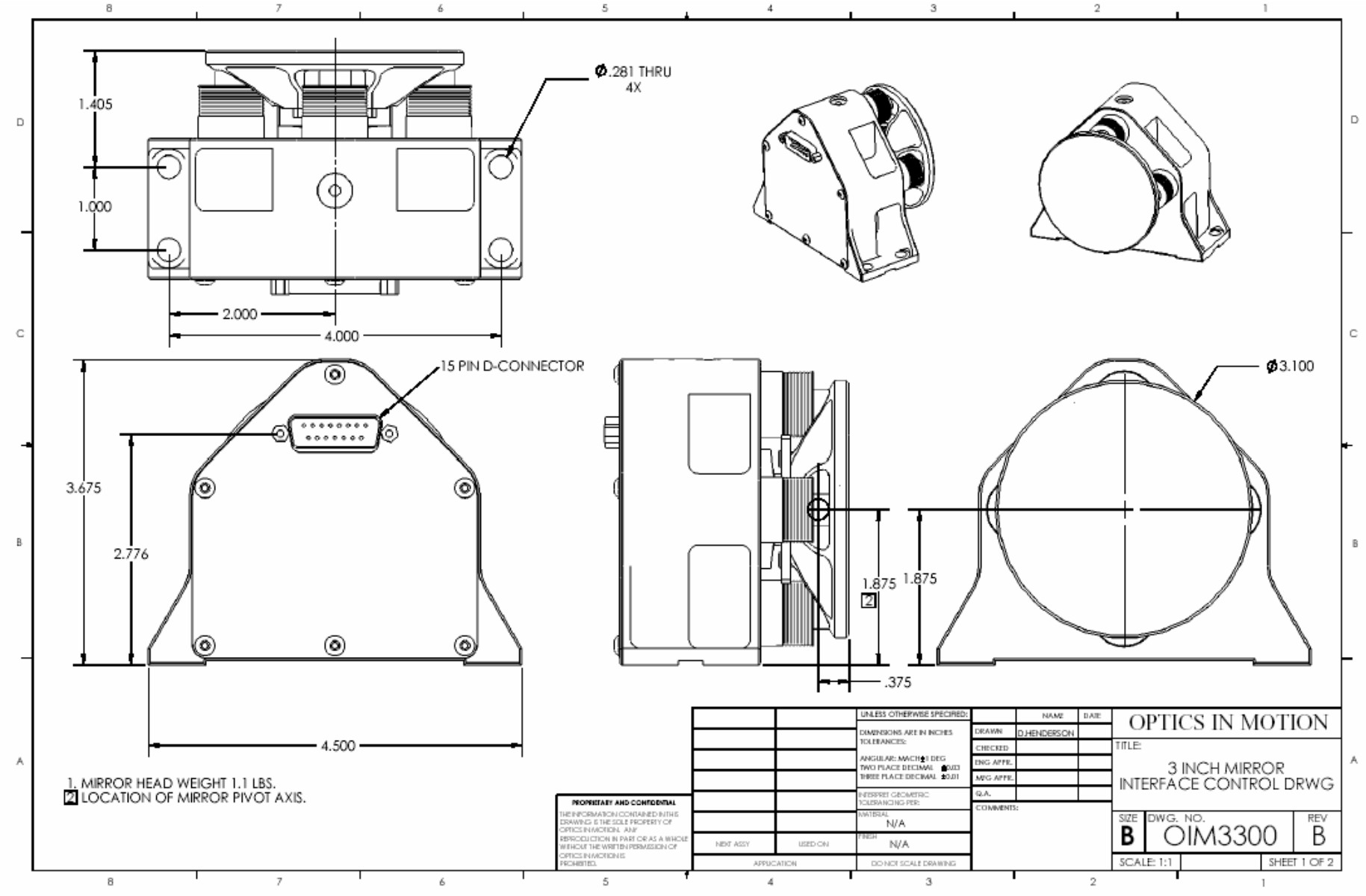



Figure 6: FSM Head ICD

**J2: Mirror Head Connector**

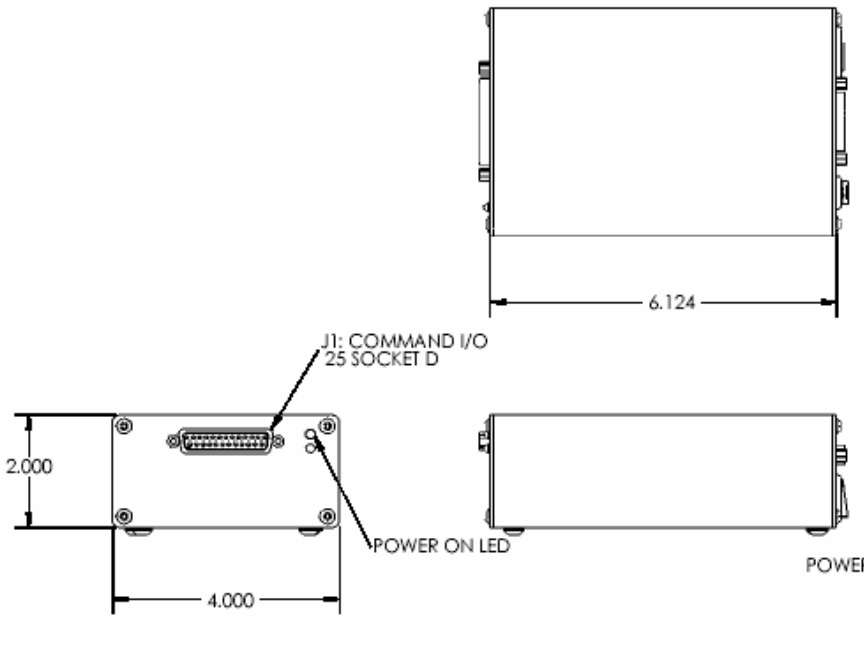
15 Socket Sub-miniature D Connector (PINOUT FOR REFERENCE)

| Pin Number | Signal Name | I/O Type | Description |
|---|---|---|---|
| 1 | PSD B | N/A | Signal from position sensor built into FSM head |
| 2 | PSD C | N/A | Signal from position sensor built into FSM head |
| 3 | GND | N/A | Ground Reference |
| 4 | N/C | | |
| 5 | +5V | N/A | Supply voltage to power FSM head laser diode |
| 6 | Y RTN | N/A | Y coil drive return |
| 7 | X RTN | N/A | X coil drive return |
| 8 | Y OUT | N/A | Y coil drive signal range +/- 15 VDC |
| 9 | PSD A | N/A | Signal from position sensor built into FSM head |
| 10 | PSD D | N/A | Signal from position sensor built into FSM head |
| 11 | GND | N/A | Ground Reference |
| 12 | N/C | | |
| 13 | GND | N/A | Ground Reference |
| 14 | EARTH GND | N/A | Earth ground, connected to FSM head housing |
| 15 | X OUT | N/A | X coil drive signal range +/- 15 VDC |

**J1: Command I/O Connector Wiring**

25-Socket Sub-miniature D Connector

| Pin Number | Signal Name | I/O Type | Description |
|---|---|---|---|
| 1 | X ERROR | Output | X summing junction error voltage output, difference between commanded and actual position. (referenced to ground) |
| 2 | INT/EXT SWITCH | Input | Normally low TTL input. High level switches the position feedback input from local to external. (used with input pins 10,11 and 17, 5) |
| 3 | X- COMMAND | Input | X mirror position command. Low side of differential command input. Range +/-10 Volts. |
| 4 | X+ COMMAND | Input | X mirror position command. High side of differential command input. Range +/-10 Volts. |
| 5 | X- EXTERNAL | Input | X external mirror position. Low side of differential position input (from external quad or similar position sensor) |
| 6 | GND | Output | Ground Reference |
| 7 | -15 VOLTS | Output | -15 VDC for external loads of less than 100ma. |
| 8 | RESERVED | | |
| 9 | N/C | | |
| 10 | Y+ EXTERNAL | Input | Y external mirror position. High side of differential position input (from external quad or similar position sensor) |
| 11 | Y- EXTERNAL | Input | Y external mirror position. Low side of differential position input (from external quad or similar position sensor) |
| 12 | Y- COMMAND | Input | Y mirror position command. Low side of differential command input. Range +/-10 Volts. |
| 13 | Y+ COMMAND | Input | Y mirror position command. High side of differential command input. Range +/-10 Volts. |
| 14 | X POSITION | Output | X mirror angular position readout from local position sensor. (referenced to ground) |
| 15 | +5 VOLTS | Output | 5 VDC for external loads of less than 100ma. |
| 16 | GND | Output | Ground Reference |
| 17 | X+ EXTERNAL | Input | X external mirror position Low side of differential position input (from external quad or similar position sensor) |
| 18 | Error Corr ON/OFF | Input | Ground this pin if you want to disable onboard digital error correction. |
| 19 | +15 VOLTS | Output | +15 VDC for external loads of less than 100ma. |
| 20 | GND | Output | Ground Reference |
| 21 | RESERVED | | |
| 22 | GND | Output | Ground Reference |
| 23 | Y POSITION | Output | Y mirror angular position readout from local position sensor. (referenced to ground) |
| 24 | Y ERROR | Output | Y summing junction error voltage output, difference between commanded and actual position. (referenced to ground) |
| 25 | RESERVED | | |




OPTICS IN MOTION

TITLE: 3 INCH MIRROR ELECTRONICS ICD

SIZE B | DWG. NO. OIM3300 | REV B

SCALE: 1:2 | SHEET 2 OF 2

Figure 7: FSM Electronics ICD