# KVH® DSP-1760 Multi-axis Gyroscope

## Technical Manual

DSP-1760

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The KVH Industries' DSP-1760 Multi-axis Gyroscope is an ultra-compact, extremely precise, guidance and stabilization system using KVH's advanced proprietary fiber optic gyros. The small, lightweight, low power, and rugged DSP-1760 offers accurate performance in extreme environments, and includes environmental and electromagnetic protection. Its flexible digital data and power interface is designed for ease of integration in new applications and upgrades to existing systems.

**Micro-D Connector**


**Circular Connector**


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# Product Variants

This manual supports the following six DSP-1760 variants (two interface connector options, each with the option of one, two, or three axes of fiber optic gyros).

| Part Number | Number of Gyros | Connector Type | Axes with Configurable Output (see pg. 8) |
|---|---|---|---|
| 01-0352-01 | 1 | Micro-D | Z |
| 01-0352-02 | 2 | Micro-D | X and Z |
| 01-0352-03 | 3 | Micro-D | X, Y, and Z |
| 01-0354-01 | 1 | Circular | Z |
| 01-0354-02 | 2 | Circular | X and Z |
| 01-0354-03 | 3 | Circular | X, Y, and Z |

Information provided in this manual is common to all variants unless otherwise noted. Technical and performance specifications, interface data, mounting guidelines, and a brief troubleshooting guide are included.

# Product Specifications

Product specifications are provided in Figure 1.

***NOTE:*** *Performance specifications are based on a 1000 Hz data rate and 921.6 kbaud baud rate.*

Figure 1: DSP-1760 Specifications

| Attribute | Value |
|---|---|
| **Performance - Gyros** | |
| Input Rate | ±490°/s max. |
| Bias Stability (constant temp.) | ≤0.05°/hr-1σ typical,<br>0.10°/hr-1σ max. |
| Bias Offset (room temp.) | ±2°/hr |
| Bias Temperature Sensitivity | ≤1°/hr-1σ (1°C/minute ramp) |
| Scale Factor Non-Linearity | ≤50 ppm-1σ (full rate) |
| Scale Factor Temperature Sensitivity | ≤200 ppm-1σ |
| Angle Random Walk (ARW) (room temp.) | ≤0.012°/√hr<br>≤0.7°/hr/√Hz |
| Input Axis Misalignment | |

| 1 Axis (Z) | 2 Axis (X-Z) | 3 Axis (X-Y-Z) |
|---|---|---|
| ±8.0 mrad (Z-X) | ±0.4 mrad (Z-X) | ±0.4 mrad (Z-X) |
| ±8.0 mrad (Z-Y) | ±8.0 mrad (Z-Y) | ±0.4 mrad (Z-Y) |
| — | ±8.0 mrad (X-Y) | ±0.4 mrad (X-Y) |

| | |
|---|---|
| Bandwidth (-3 dB) | ≥440 Hz |
| **Environment** | |
| Temperature (operating) | -40°F to +167°F (-40°C to +75°C) |
| Temperature (storage) | -58°F to +185°F (-50°C to +85°C) |
| Vibration (operating) | 8 g rms (20-2000 Hz, random) |
| Vibration (non-operating) | 12 g rms (20-2000 Hz, random) |
| Shock (operating) | 25 g (11 ms, sawtooth) |
| Shock (non-operating) | 40 g (11 ms, sawtooth) |

| Attribute | Value |
|---|---|
| **Digital Data Output** | |
| Format | RS422 |
| Data Rate | 1 to 1000 Hz, user-selectable |
| Baud Rate | 9.6 to 921.6 kbaud, user-selectable |
| Turn-On Time (room temp.) | ≤1.25 s (valid data) |
| Full Performance Time (room temp.) | ≤60 s |
| **Power Supply** | |
| Input Voltage | 9-36 VDC |
| Input Power | 1 Axis: 3 W typical, 6 W max.<br>2 Axis: 4 W typical, 7 W max.<br>3 Axis: 5 W typical, 8 W max. |
| **Package** | |
| Weight (nominal) | 1 Axis: 1.10 lbs (0.50 kg)<br>2 Axis: 1.20 lbs (0.54 kg)<br>3 Axis: 1.32 lbs (0.60 kg) |
| Dimensions (nominal) | Ø3.5" x 2.9" h<br>(88.9 mm x 73.7 mm)<br>Also see Figures 2 & 3 that follow |

***IMPORTANT!***

The DSP-1760 is a precision instrument. Handle the unit with care and avoid exposing it to severe mechanical shock.

General dimensions are provided below.

***NOTE:*** *All dimensions are shown in inches [millimeters] format.*

Figure 2: General Dimensions (Micro-D Connector)

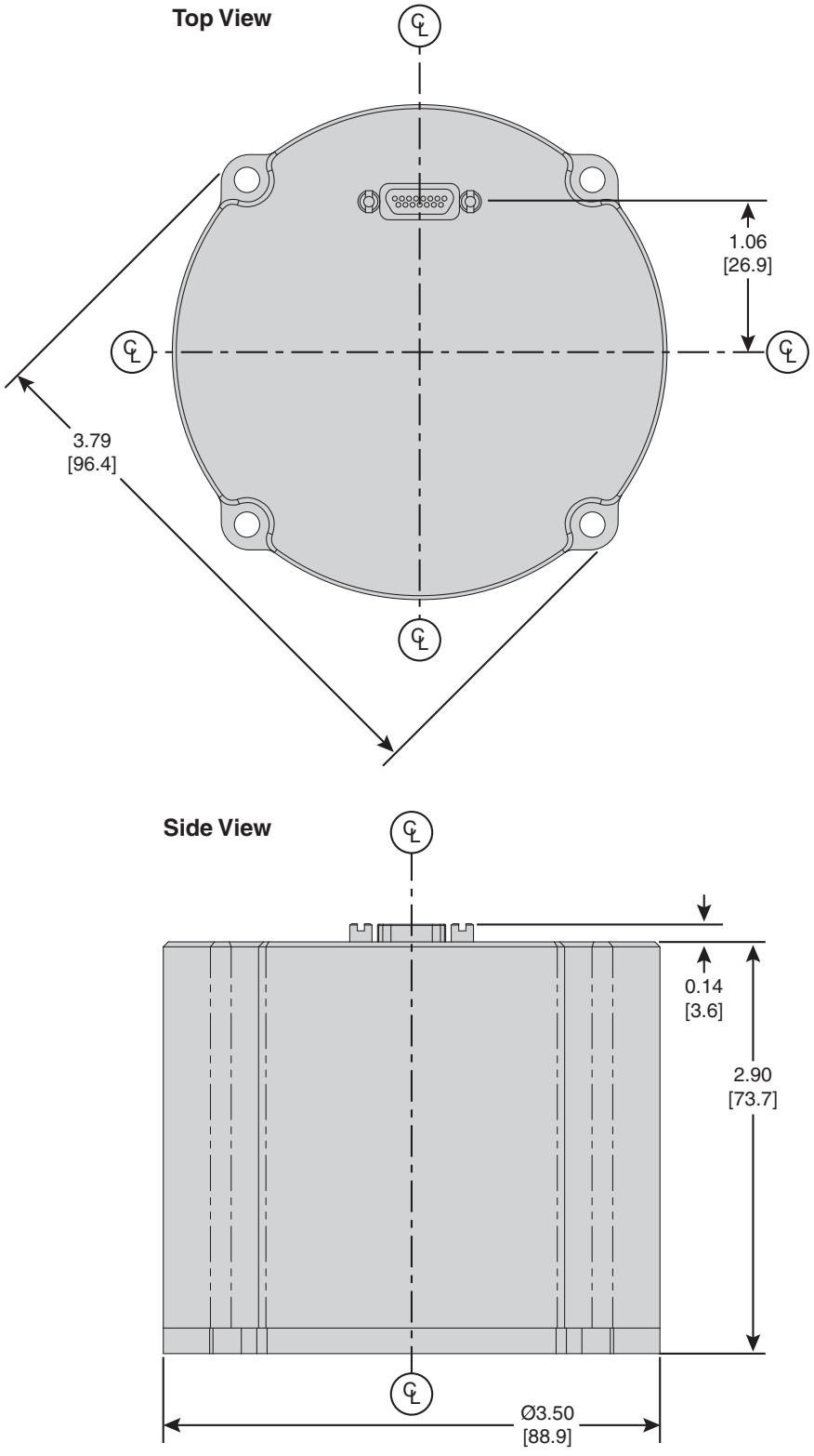
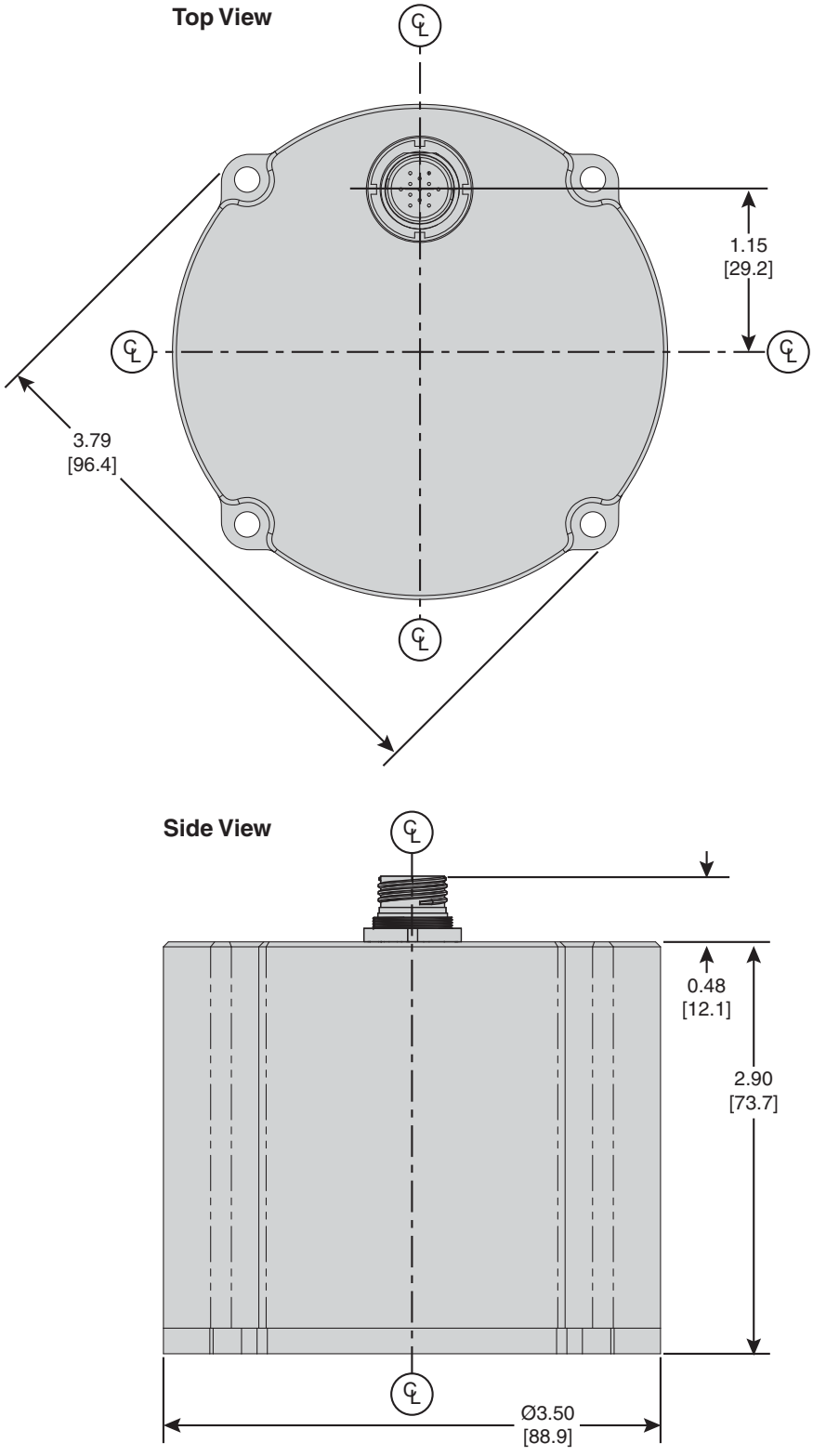


Figure 3: General Dimensions (Circular Connector)



Center of Gravity locations for each variant are provided below.

***NOTE:*** *All dimensions are shown in inches [millimeters] format.*

**Figure 4: Center of Gravity (Micro-D Connector)**

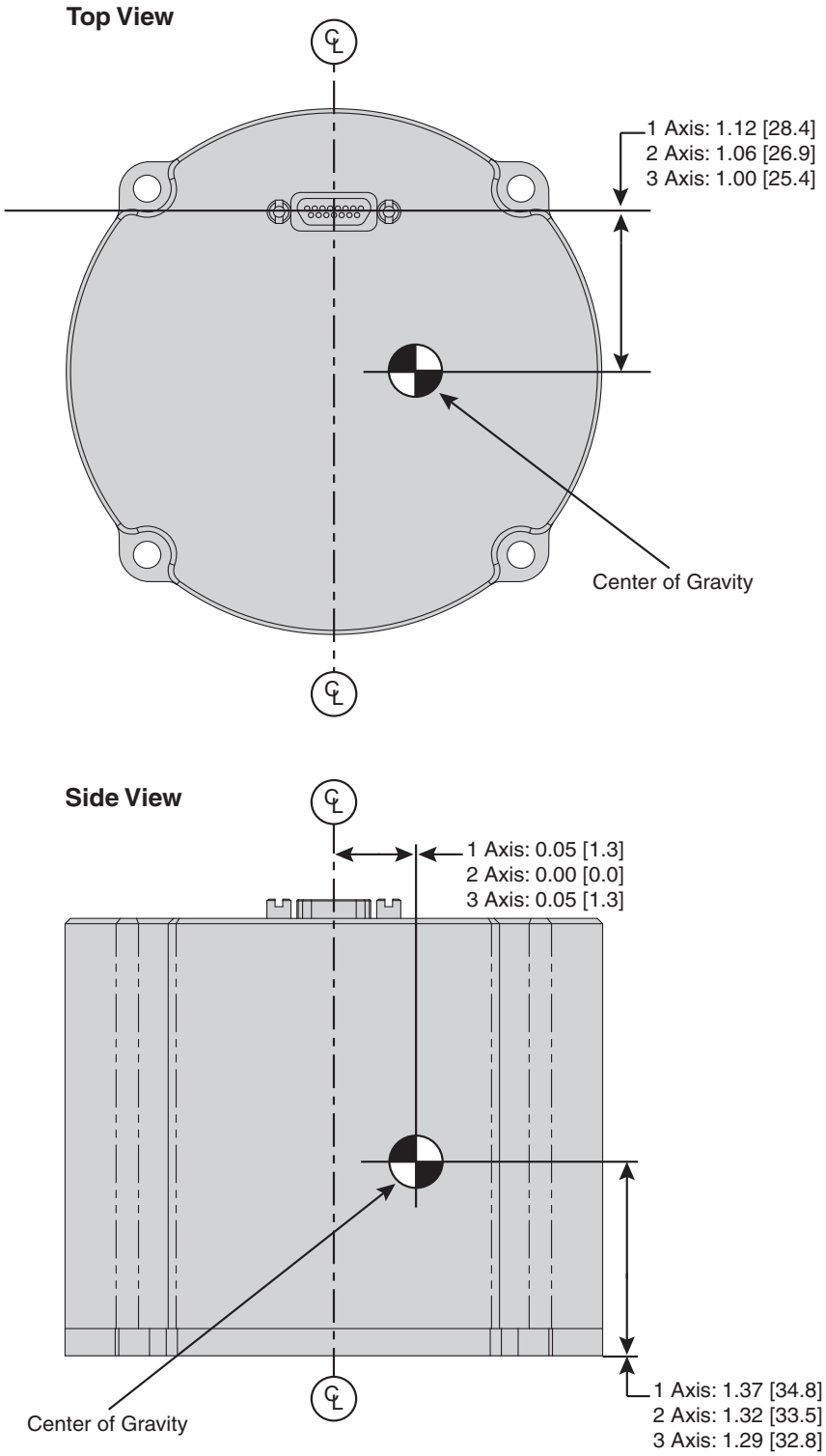
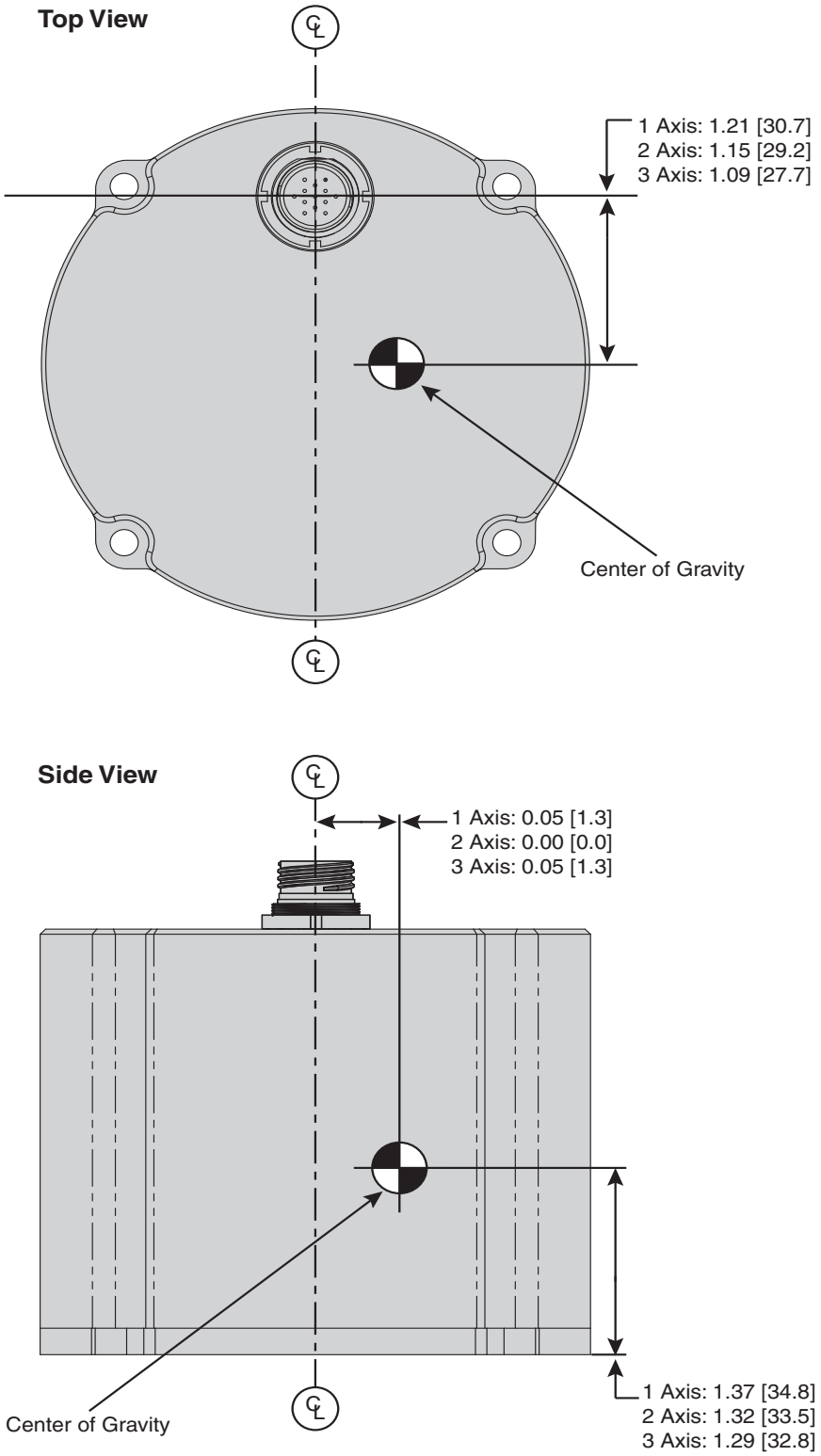


Figure 5: Center of Gravity (Circular Connector)



# Storage and Handling

The DSP-1760 may be stored in a location with an environmental temperature between -58°F to +185°F (-50°C to +85°C). Ideally, the unit should be stored at a room temperature of approximately 70°F (21°C).

The DSP-1760 is a sensitive measuring device. Take normal safety precautions when handling to ensure the integrity of the device. During unpacking and installation, proper ESD handling procedures should be enforced.

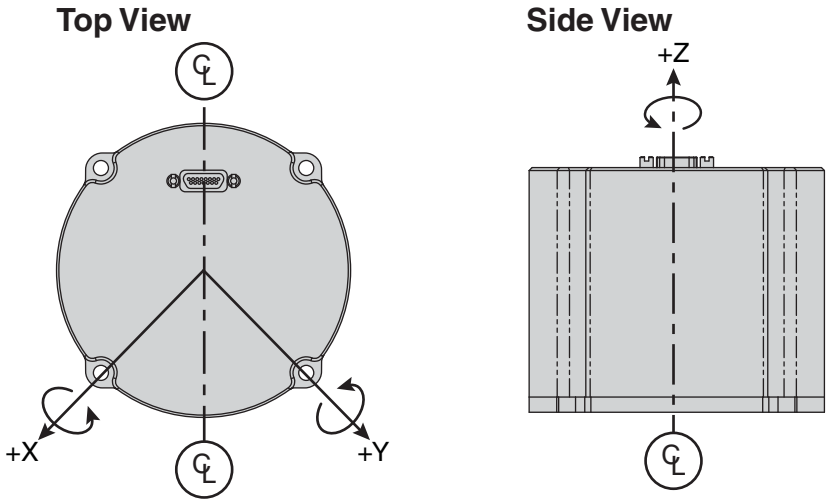
# Maintenance

The DSP-1760 is supplied as a sealed unit; there are no field maintainable components. Opening the enclosure will void the warranty and may violate the contract under which the unit was supplied.

# Output Orientation

The DSP-1760 senses rotation on up to three configurable axes. The measurement axes are shown in Figure 6. You may configure a rotation matrix to set the output axes relative to the physical orientation of these measurement axes, allowing the gyro to measure motion in arbitrarily orthogonal axes (see "User-Configurable Parameters" on page 17). These settings are saved and reapplied on restart. You may revert to the factory default settings at any time (see "Resetting Parameters to Factory Defaults" on page 18).

Figure 6: Gyro Measurement Axes Orientation (shown with Micro-D Connector)



# Interface Connector

The DSP-1760 is equipped with one of the following male connector types:

- 15-pin Micro-D interface connector:
  Meets MIL-DTL-83513

- 13-pin circular interface connector:
  Comparable to MIL-DTL-D38999

Figure 7 shows the location for either type connector. Figure 8 describes the function of each pin for the Micro-D connector, and Figure 9 describes the function of each pin for the circular connector.

Figure 7: Interface Connector Location

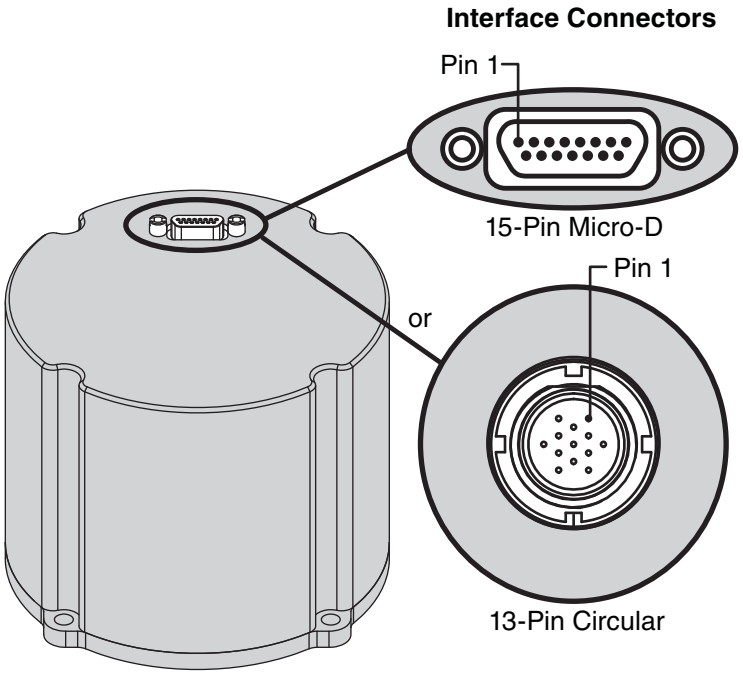


Figure 8: Micro-D Interface Connector Pins

| Pin | Type | Description |
|---|---|---|
| 1 | RS422-TX (+) | Gyro RS422 Transmit High |
| 2 | RS422-TX (–) | Gyro RS422 Transmit Low |
| 3 | RS422-RX (–) | Gyro RS422 Receive Low |
| 4 | RS422-RX (+) | Gyro RS422 Receive High |
| 5-8 | – | Reserved – Do Not Connect |
| 9 | Power (–) | Power Return |
| 10 | Power (+) | 9-36 VDC Power Input |
| 11 | MSync | Master Sync Input (External Clock) (Optional) |
| 12 | TOV-Out | Time of Validity Signal (Optional) |
| 13 | Config-RST-In | Gyro Configuration Reset (Software) |
| 14 | EXT-RST | Gyro Reset (Power) |
| 15 | Signal-GND | Common Ground |

Figure 9: Circular Interface Connector Pins

| Pin | Type | Description |
|---|---|---|
| 1 | RS422-RX (–) | Gyro RS422 Receive Low |
| 2 | RS422-TX (+) | Gyro RS422 Transmit High |
| 3 | Power (–) | Power Return |
| 4 | Power (+) | 9-36 VDC Power Input |
| 5 | TOV-Out | Time of Validity Signal (Optional) |
| 6 | Signal-GND | Common Ground |
| 7 | – | Reserved – Do Not Connect |
| 8 | RS422-RX (+) | Gyro RS422 Receive High |
| 9 | RS422-TX (–) | Gyro RS422 Transmit Low |
| 10 | MSync | Master Sync Input (External Clock) (Optional) |
| 11 | Config-RST-In | Gyro Configuration Reset (Software) |
| 12 | EXT-RST | Gyro Reset (Power) |
| 13 | – | Reserved – Do Not Connect |

# Interface Cable

The power and data interface cable must be fitted with one of the following:

- If equipped with the 15-pin Micro-D interface connector:
  A 15-socket (female) Micro-D connector per MIL-DTL-83513 with a Flourosilicone interfacial seal is required to comply with the environmental testing performed at KVH. You can purchase a 24" (60 cm) shielded interface cable with this connector from KVH (KVH part no. 32-1173-02).

- If equipped with the 13-pin circular interface connector:
  A Cleeve Technologies FAE-1B-01-007-26MT8-13SA 13-socket (female), or a Glenair® Series Mighty Mouse 801-007-26MT8-13SA 13-socket (female) circular connector with a shielded cable harness is required to comply with the environmental testing performed at KVH. You can purchase a 24" (60 cm) shielded interface cable with this connector from KVH (KVH part no. 32-1173-01).

If your application requires a serial cable or interface adapter (such as an RS422-USB serial adapter), make sure it is compatible with the gyro and supports speeds of at least 921.6 kbaud. Also be sure to use shielded cables to prevent signal loss and noise interference.

# Data Communications Equipment

A computer or other data communications device is necessary to communicate with the gyro. This equipment's serial port communications must match the gyro's serial port settings for proper operation.

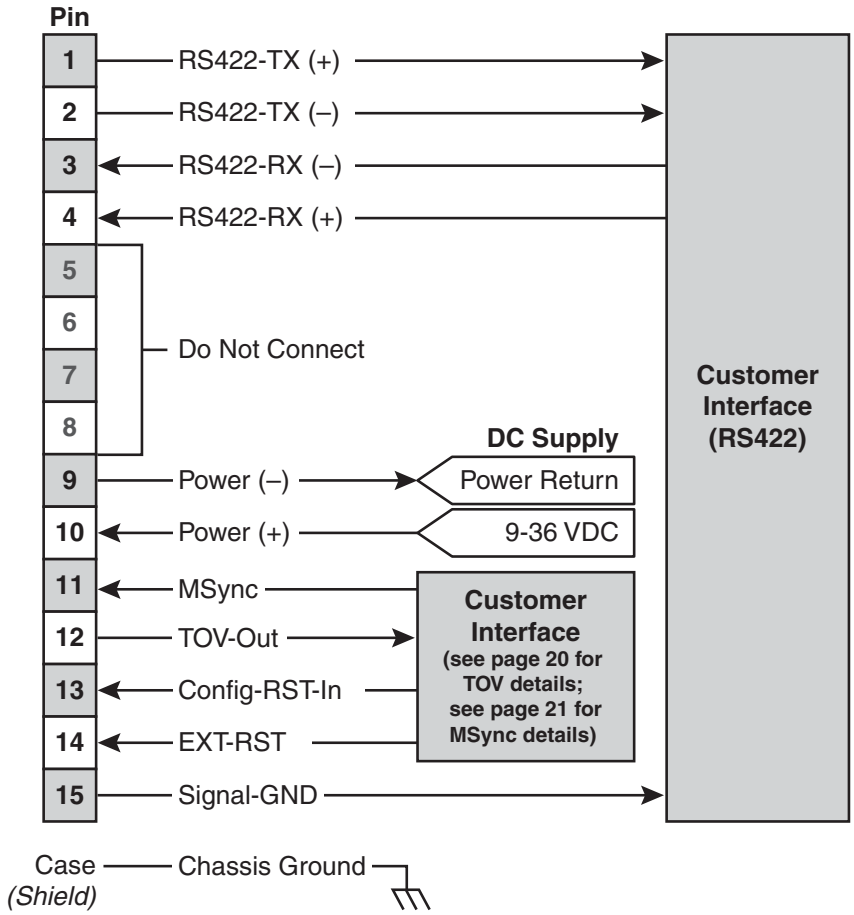
When connected to the gyro, you can enter commands directly from the terminal or through a terminal emulation application, such as Windows® HyperTerminal.

***NOTE:*** *The DSP-1760 outputs binary data which may be interpreted as control codes. To ensure reliable communications, select an appropriate terminal emulator or proper emulation options.*

# Wiring the Gyro

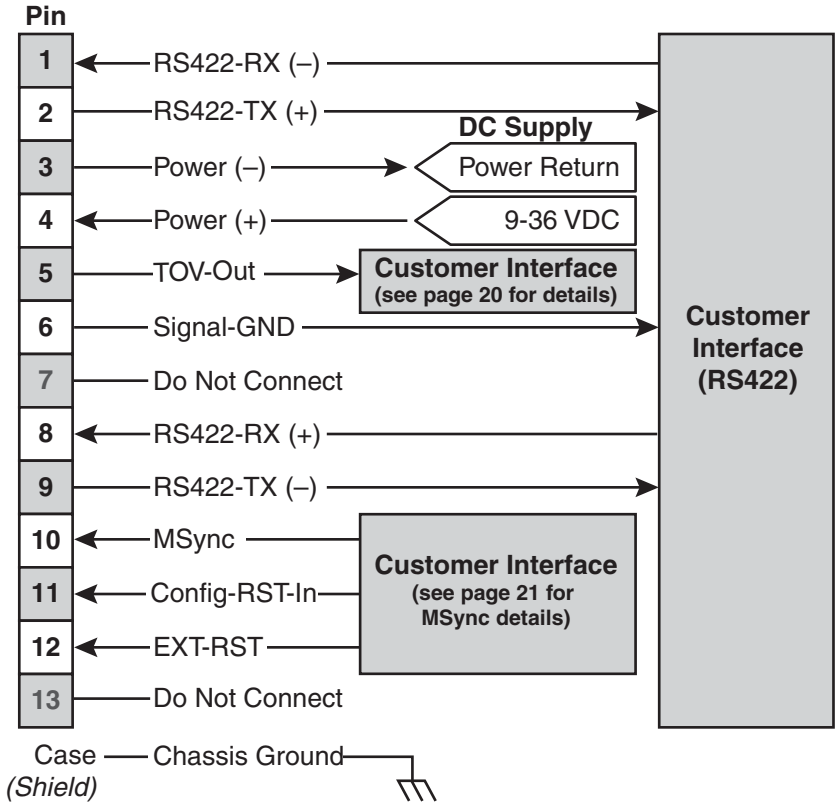
Use Figure 10 or Figure 11 as a guide to connect the gyro to your application.

Figure 10: Wiring Diagram (15-pin Micro-D Connector)




***NOTE:*** *Pins 11 through 14 are referenced to signal ground on pin 15 (not the power ground on pin 9). Signal ground and power ground are tied together internally at the gyro.*

Figure 11: Wiring Diagram (13-pin Circular Connector)




***NOTE:*** *Pins 5 and 10 through 12 are referenced to signal ground on pin 6 (not the power ground on pin 3). Signal ground and power ground are tied together internally at the gyro.*

# Digital Data Output

The gyro provides a digital interface with the following characteristics:

Figure 12: Interface Characteristics

| Parameter | Value |
|---|---|
| Type | RS422 |
| Baud Rate (kbaud) | Selectable: 9.6, 19.2, 38.4, 57.6, 115.2, 460.8, 576.0, **921.6 (default)** |
| Parity | None |
| Start Bits | 1 (space, binary 0) |
| Data Bits | 8 (1 message byte, starting with LSB) |
| Stop Bits | 1 (mark, binary 1) |
| Flow Control | None |

An idle line is always marking (in a binary 1 state). Thirty-six (36) characters in sequence constitute a basic message.

***NOTE:*** *The gyro's RS422 RX signals are internally terminated to 100Ω.*

## Message Structure

The output message contains 36 bytes. The most significant **byte** is sent first; and the most significant **bit** of each byte is sent first. Figure 13 and Figure 14 define the format of the message.

Figure 13: Message Format

| Function | Total # Bytes | Description |
|---|---|---|
| Header | 4 | Always 0xFE81FF55; this value will never occur anywhere else |
| Message data | 28 | See Figure 14 |
| CRC *(Cyclic Redundancy Check)* | 4 | See Figure 16 on page 16 |

Figure 14: Message Data

| Datum | Byte Number(s) | Data Type* | Selectable Units/ Range/Format | Notes |
|---|---|---|---|---|
| X rotational data** | 0,1,2,3 | SPFP | Radians or degrees; Rate of rotation or delta angle | Byte 0 is output first |
| Y rotational data** | 4,5,6,7 | SPFP | Radians or degrees; Rate of rotation or delta angle | Byte 4 is output first |
| Z rotational data | 8,9,10,11 | SPFP | Radians or degrees; Rate of rotation or delta angle | Byte 8 is output first |
| Reserved | 12,13,14,15 | N/A | N/A | |
| Reserved | 16,17,18,19 | N/A | N/A | |
| Reserved | 20,21,22,23 | N/A | N/A | |
| Status | 24 | DISC | 1 = valid data<br>0 = invalid data | See Figure 15 on page 16 |
| Sequence Number | 25 | UINT8 | 0-127 | Increments for each message and resets to 0 after 127 |
| Temperature | 26,27 | INT16 | °C or °F, selectable | Rounded to the nearest whole degree |

* *SPFP = Single Precision Floating Point (IEEE-754); DISC = Discrete Data; UINT8 = Unsigned 8-bit integer; INT16 = Signed 16-bit integer.*

** *Ignore this field if the associated gyro is not installed.*

Figure 15: Status Byte Format

| Function | Bit # | Notes |
|---|---|---|
| Gyro X status* | 0 | LSB |
| Gyro Y status* | 1 | |
| Gyro Z status | 2 | |
| Reserved | 3 | Always 0 |
| Reserved | 4 | |
| Reserved | 5 | |
| Reserved | 6 | |
| Reserved | 7 | Always 0 |

***NOTE:*** *In addition to this general status information, an extended built-in test (BIT) may be initiated at any time by entering the "**?bit**" command. (Extended BIT data is also output whenever the gyro is first powered on.) The extended BIT provides six bytes of diagnostic data. For details, refer to the DSP-1760 Electrical Signaling ICD (KVH part no. 56-0288).*

* *If not included, a value of 0 (zero) is reported.*

Figure 16: CRC Format

| Parameter | Value |
|---|---|
| Width | 32 |
| Poly | 0x04C11DB7 |
| Reflect In | False |
| XOR In | 0xFFFFFFFF |
| Reflect Out | False |
| XOR Out | 0 |

## User-Configurable Parameters

The DSP-1760 offers several configurable parameters (see Figure 17).

Figure 17: User-Configurable Parameters

| Parameter | Command | Options | Default |
|---|---|---|---|
| Baud Rate (kbaud) | =baud | • 9.6 • 115.2<br>• 19.2 • 460.8<br>• 38.4 • 576.0<br>• 57.6 • 921.6 | 921.6 kbaud |
| Data Rate (Hz) | =dr | • 1 • 100<br>• 5 • 250<br>• 10 • 500<br>• 25 • 750<br>• 50 • 1000 | 1000 Hz |
| Temperature Units | =tempunits | • °C<br>• °F | °C |
| Angular Units | =rotunits | • Radians<br>• Degrees | Radians |
| Rotational Data | =rotfmt | • Delta Angle *(radians or degrees)*<br>• Rate of Rotation *(radians or degrees/second)* | Delta Angle |
| Output Filter | =filten | • Enabled<br>• Disabled | Enabled |
| | =filttype,g | • Chebyshev<br>• Butterworth<br>• Uniform Averager<br>• Custom | Chebyshev |
| | =fc,g | Gyro filter coefficients (custom filter) | Chebyshev filter |

| Parameter | Command | Options | Default |
|---|---|---|---|
| X, Y, Z Axis Definitions | =axes | Floating point values defining a 3x3 rotation matrix *(sets the output axes relative to the physical orientation of the measurement axes - see page 8)* | 1 0 0<br>0 1 0<br>0 0 1 |
| Output Synchronization | =msync | • Gyro (internal clock)<br>• External | Gyro |

For complete details on modifying settings, refer to the DSP-1760 Electrical Signaling ICD (KVH part no. 56-0288). Settings are saved and reapplied on restart. You may revert to the factory default settings at any time (see "Resetting Parameters to Factory Defaults").

***NOTE:*** *Changing parameters from their default values may impact performance.*

With the exception of baud rate, you can query the current value of any parameter by entering the corresponding "**?**" command. For example, to view the current data rate, you would enter the "?dr" command.

To enter any configuration command, the gyro must first be set to Configuration mode. In Configuration mode, the gyro stops sending data and listens for user commands (a terminal prompt indicates the gyro is ready to accept commands). To put the gyro in Configuration mode, enter the "**=config,1**" command. When you are done configuring the unit, enter the "**=config,0**" command to exit Configuration mode and return to the Normal mode of operation.

## Resetting Parameters to Factory Defaults

There are two options for resetting all of the user-configurable parameters to their factory default values.

**Option 1**: Enter the "**=rstcfg**" command in Configuration mode.

**Option 2**: Apply +3.3V to gyro Configuration Reset (Config-RST-In) on pin 13 of the Micro-D interface connector, or pin 11 of the circular interface connector. During startup, the gyro monitors this pin and will reset the user-configurable parameters if it detects +3.3V. The pin is ignored during normal operation. The pin may be left disconnected until you need to perform a reset.

# User Commands

In addition to the configuration commands described in "User-Configurable Parameters" on page 17, the following commands are also available to the user. For complete details on using these commands, refer to the DSP-1760 Electrical Signaling ICD (KVH part no. 56-0288).

Figure 18: User Commands

| Command | Description |
|---|---|
| ?bit | Initiates an extended built-in test in Normal mode |
| =config | Puts the unit into or out of Configuration mode |
| ?config | Reports whether or not the gyro is currently running in Configuration mode |
| =echo *(or ?echo)* | Reports how many times the echo command has been called; useful for verifying communications to the unit |
| =help *(or ?help)* | Displays a list of available commands |
| ?is | Reports the serial number of the system |
| =restart | Restarts the gyro |
| =rstcfg | Resets all user-configurable parameters to their factory default values |
| ?temp | Reports the internal temperature of the gyro; detected by the controller board |
| =testfilt *(or ?testfilt)* | Tests the configured output filter response to a unit impulse |
| ?volt | Reports all available voltages on the controller board |
| ?ws | Reports the axis quantity and software versions of gyro components |

All commands must be entered while the gyro is in Configuration mode except "?bit" *(entered in Normal mode)* and "=config" *(entered in Configuration or Normal mode)*.

# Time of Validity (TOV) Output

The DSP-1760 provides an optional Time of Validity output (TOV-Out) on pin 12 of the Micro-D interface connector, or pin 5 of the circular interface connector, to indicate the precise timing of the gyro's measurement data.

**Figure 19: TOV Output Timing Relative to Serial Port Activity**

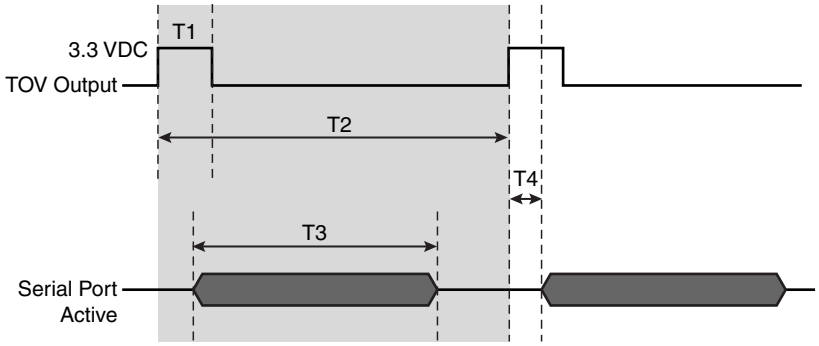



**Figure 20: TOV Timing Parameters**

| Parameter | Description | Value |
|---|---|---|
| T1 | TOV active | 10% of the TOV period<br>*(at default data rate of 1000 Hz, T2 = 1 ms and T1 = 100 μs)* |
| T2 | TOV period | Determined by the output data rate<br>*(at default data rate of 1000 Hz, T2 = 1 ms)* |
| T3 | Duration of serial port output | Depends on baud rate; equal to the number of characters output (36) multiplied by the number of bits per character (10) divided by the baud rate<br>*(at default baud rate of 921.6 kbaud, T3 = 390.6 μs)* |
| T4 | Time between rising edge of TOV-Out and start of data transmission | <500 μs |

# Master Sync (External Clock)

The DSP-1760 can accept an optional user-supplied master sync signal on pin 11 of the Micro-D connector, or pin 10 of the circular connector. The gyro's output will be triggered on the rising edge of this master sync signal. The signal's amplitude must be +3.3V and the driver must be capable of sourcing at least 10 mA.

Figure 21: Master Sync

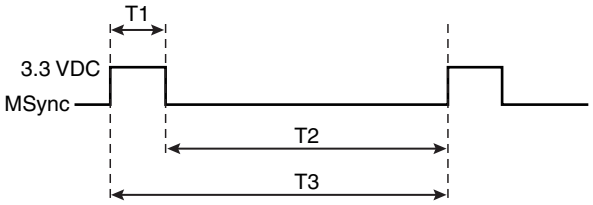



Figure 22: MSync Timing Parameters

| Parameter | Description | Value |
|---|---|---|
| T1 | MSync high | ≥30 µs |
| T2 | MSync low | ≥100 µs |
| T3 | Period between rising edges | 1-2000 ms |

To synchronize the gyro's output with an external signal on pin 11 (Micro-D connector) or pin 10 (circular connector), enter the "**=msync,ext**" command in Configuration mode. Upon initiating the "**=msync,ext**" command, the gyro automatically clears any user-selected output filter and switches to the Uniform Averager setting. This allows you to use the MSync signal as an asynchronous request for data, rather than an external clock. However, you may override this behavior by choosing any output filter using the appropriate Output Filter commands provided in Figure 17 on page 17. Be sure to enter the Output Filter commands AFTER you have entered the "**=msync,ext**" command.

***NOTE:*** *Consecutive rising edges of the MSync signal must be between 1-2000 ms apart. Pulsing MSync faster than 1 ms may result in inaccurate or corrupt data output. If the gyro does not detect a rising edge within 2000 ms, it will output data upon reaching 2000 ms.*

# Hardware Restart

Pin 14 (EXT-RST) of the Micro-D interface connector, or pin 12 of the circular interface connector, can be used to reboot the gyro. The gyro monitors this pin at all times and will reboot if it detects +3.3V. The pin may be left disconnected until you need to restart the gyro.

# Mounting the Gyro

The DSP-1760 is easily mounted to a structure using the four ∅0.173" (∅4.39 mm) mounting holes on the base of the enclosure (see Figure 23). An alignment hole ∅0.198" (∅5.03 mm) and an alignment slot 0.218" x 0.198" (5.54 mm x 5.03 mm) are provided at the middle edge of the enclosure for alignment purposes. They are designed for ∅0.1970"-0.1973" (∅5.004-5.012 mm) dowel pins with 0.1" (2.5 mm) protrusion.

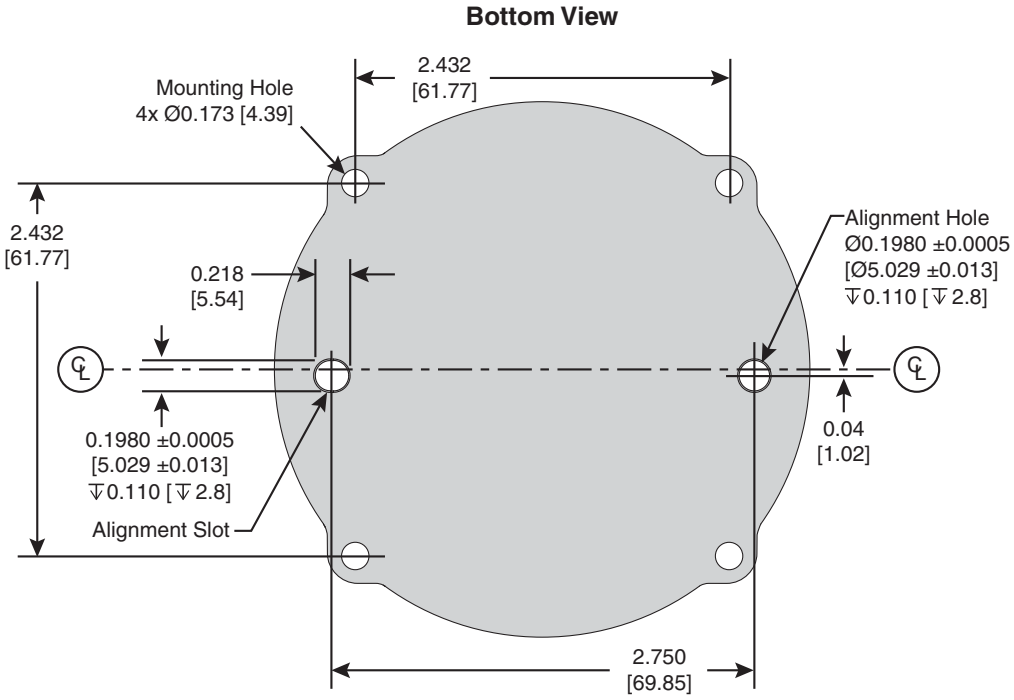
***NOTE:*** *To ensure precise alignment, rotate the gyro clockwise before tightening the mounting screws.*

The gyro base material is aluminum with a clear chromate finish per MIL-DTL-5541, class 3. To ensure optimal heat transfer (conductive cooling) and electrical grounding through the chassis, mount the gyro base to a clean, flat, unpainted metal surface.

Also be sure to orient the gyro with the desired measurement axes. As an alternative, you may configure a rotation matrix to set the output axes relative to the physical orientation of the measurement axes (see "User-Configurable Parameters" on page 17).

***NOTE:*** *All dimensions are shown in inches [millimeters] format.*

**Figure 23: Mounting Holes (Bottom View)**



# Troubleshooting

This chapter explains how to diagnose basic problems.

***IMPORTANT!***

The DSP-1760 is supplied as a sealed unit. Breaking the QA seals voids the warranty and may violate the contract under which the unit was supplied. The warranty does not apply if the unit has been damaged by misuse or as the result of service or modification other than by KVH Industries.

Figure 24: Basic Troubleshooting

| Problem | Solution |
|---|---|
| The unit does not power up. | Check the input power supply. 12 VDC (nominal) is recommended for stable performance. The supply should also draw between 3-8 W over the entire operating temperature range. If the power supply is OK, check the power cable and wiring. |
| The unit does not communicate. | Check the interface cable and make sure your equipment's serial port settings match the gyro's settings (see Figure 12 on page 14). |
| Incoherent data is streaming. | Ensure the baud rate of your interface port is set to one of the valid configurable baud rates (see Figure 12 on page 14 for details). Also make sure your parsing algorithm is correct. |
| The unit is not sending data at the set data rate. | Ensure the set baud rate is fast enough to support the chosen data rate (see Figure 25 on page 25). Verify with an oscilloscope. |

Figure 25: Recommended Baud Rate/Data Rate Limits

| Baud Rate (kbaud) | Maximum Data Rate (Hz) |
|---|---|
| 9.6 | 10 |
| 19.2 | 25 |
| 38.4 | 50 |
| 57.6 | 100 |
| 115.2 | 100 |
| 460.8 | 500 |
| 576.0 | 750 |
| 921.6 | 1000 |

## Built-In Test (BIT)

The gyro's built-in test (BIT) monitors system performance and status to ensure it is operating within its specifications. BIT test results are output in three ways:

- **Continuous BIT –** The Continuous BIT is output as part of the gyro's output message during operation (see "Continuous BIT Status Information" on page 26).
- **Startup Extended BIT –** When the gyro is powered on, it outputs the extended BIT status message (see "Extended BIT Status Information" on page 26).
- **User-requested Extended BIT –** When you enter the "**?bit**" command in Normal mode, the gyro outputs the extended BIT status message (see "Extended BIT Status Information" on page 26).

## Continuous BIT Status Information

As indicated in Figure 14 on page 15, byte 24 of the gyro's output message (excluding the message header) reports the general status of the gyros. Converted to hexadecimal, a status byte of "01" for the 1 axis version, "02" for the 2 axis version, and "03" for the 3 axis version indicates normal status.

Figure 26: Status Byte Format

| Datum | Bit # | Notes |
|---|---|---|
| Gyro X | 0 (LSB) | 1 = Valid data, 0 = Invalid data* |
| Gyro Y | 1 | 1 = Valid data, 0 = Invalid data* |
| Gyro Z | 2 | 1 = Valid data, 0 = Invalid data |
| Reserved | 3 | Always 0 |
| Reserved | 4 | |
| Reserved | 5 | |
| Reserved | 6 | |
| Constant Zero | 7 | Always 0 |

* *Unpopulated gyros have a status of zero.*

## Extended BIT Status Information

When the gyro is first powered on, and upon user request, the gyro outputs an extended BIT message consisting of six bytes of detailed status information for diagnostics. Converted to hexadecimal, the following message indicates normal status:
"FE 81 00 AA 7F 7F 7F 7F 7F 7F 23".

Figure 27: Extended BIT Message Format

| Function | Total # Bytes | Description |
|---|---|---|
| Header | 4 | Always 0xFE8100AA |
| Message data | 6 | Refer to the DSP-1760 Electrical Signaling ICD (KVH part no. 56-0288) for details |
| Checksum | 1 | Calculated by accumulating the sum of each byte of data, modulo 256 |

# Technical Support

For technical support, please e-mail your question or a description of your problem to **fogsupport@kvh.com**.

# Appendix A: Patent Protection

One or more of the following U.S. and international patents* protect the technology in KVH fiber optic gyros:

| KVH Patent Numbers | |
|---|---|
| DE 69722994 | US 6,041,149 |
| DE 69734809.1 | US 6,134,356 |
| EP 60130780 T2 | US 6,351,310 B1 |
| EP 1,314,002 | US 6,370,289 B1 |
| FR 0802397 | US 6,429,939 |
| GB 0802397 | US 6,466,596 |
| US 5,126,666 | US 6,542,651 |
| US 5,340,371 | US 6,563,589 |
| US 5,444,534 | US 6,718,097 |
| US 5,481,358 | US 6,763,153 |
| US 5,552,887 | US 6,836,334 |
| US 5,739,944 | US 7,120,323 |
| US 5,768,462 | |

**Additional patents pending*

# KVH Industries Limited Warranty
# DSP-1760

**LIMITED WARRANTY ON HARDWARE**

KVH Industries, Inc. warrants the KVH Fiber Optic Gyro purchased against defects in materials and workmanship for a period of ONE (1) year from the date of original retail purchase by the original purchaser. If you discover a defect, KVH will, at its option, repair, replace or refund the purchase price of the product at no charge to you, provided you return it during the warranty period, transportation charges prepaid, to the factory direct.

Please attach your name, address, telephone number, a description of the problem and a copy of the bill of sale or sales receipt as proof of date of original retail purchase, to each product returned to warranty service.

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