A40 High Performance MEMS Accelerometer

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3 SAFETY AND HANDLING INFORMATION

- **ALWAYS USE CAUTION WHEN HANDLING THE MEMS A40!**
- **SUPPLYING TOO HIGH OF INPUT VOLTAGE, COULD PERMANENTLY DAMAGE THE UNIT. Input Power is specified at +5 V Nominal Input for specified performance.**
- The A40 Accelerometer is a sensitive scientific instrument containing shock and vibration sensitive inertial sensors. **Excessive shock and or vibration can damage these sensors** and can adversely affect sensor performance and unit output.
- Avoid exposure to electrostatic discharge (ESD). Observe proper grounding whenever handling the A40 Accelerometer.
- Properly attach connector and ensure that it has been installed correctly before applying power to the A40 Accelerometer.

4 PATENT INFORMATION

The A40 Accelerometer is a newly developed unit containing significant intellectual property and it is expected to be protected by United States of America (USA) and other foreign patents pending. LandMark™ is an official and registered Trademark that identifies Gladiator Technologies brand name for our digital inertial and integrated GPS systems products.

5 APPLICABLE EXPORT CONTROLS

The A40 Accelerometer has been self-classified by Gladiator Technologies with pending Commodity Classification by the U.S. Department of Commerce under the Export Administration Regulations (EAR), as ECCN7A994 and as such may be exported without a license using symbol NLR (No License Required) to destinations other than those identified in country group E of supplement 1 to Part 740 *(commonly referred to as the T-5 countries)* of the Export Administration Regulations. Items otherwise eligible for export under NLR may require a license if the exporter knows or is informed that the items will be used in prohibited chemical, biological or nuclear weapons or missile activities as defined in Part 774 of the EAR. Copies of official U.S. Department of Commerce Commodity Classifications are available upon request.

5.1 Destinations Requiring a License

See the Commerce Country Chart (Supplement No. 1 to Part 738 of the EAR) to determine which countries require a license. Use the country chart column information given on this form in conjunction with the country chart to determine the licensing requirements for your particular items.

6 USER LICENSE

Gladiator Technologies grants purchasers and/or consignees of Gladiator's A40 Accelerometer a no cost, royalty free license for use of the software code (if applicable) for use with the A40 Accelerometer. Companies or persons not meeting the criteria as a purchaser or consignee are strictly prohibited from use of this code. Users in this category wanting to use the code may contact the factory for other user license options.

7 STANDARD LIMITED WARRANTY

Gladiator Technologies offers a standard one year limited warranty with the factory's option to either repair or replace any units found to be defective during the warranty period. Opening the case, mishandling or damaging the unit will void the warranty. Please see Gladiator Technologies' Terms & Conditions of sale regarding specific warranty information.

8 QUALITY MANAGEMENT SYSTEM

Gladiator Technologies' Quality Management System (QMS) is certified to AS9100. Please visit our website at www.gladiatortechnologies.com to view our current certificates.

9 THEORY OF OPERATION

The A40 Accelerometer is a MEMS (Micro Electro-Mechanical Sensor) analog output silicon-based accelerometer. Utilizing Gladiator's proprietary design, precision manufacturing and automated test processes enable this sensor to have performance that far exceeds of many other competing silicon MEMS sensors. The unit is temperature compensated for bias and offers scale factor, bias, misalignment and temperature sensor measured data with each unit.

The unit contains:

- A silicon sensor that is available in standard ranges of: ±6g's, ±10g's or ±15g's. Other ranges are available; please contact the factory for more information.
- An internal temperature sensor output. The temperature sensor is co-located with each sensor to enable accurate temperature compensation of the accelerometer outputs by the end user.
- All units go through an extensive temperature calibration process.
- A precision base plate is used in the A40 Accelerometer enabling low misalignment errors and internal misalignment measurement is done at the factory prior to shipment.
- In addition, "bias thermal" errors associated with the A40 Accelerometers are also minimized to reduce performance errors associated with acceleration inputs.

The A40 Accelerometer data sheet is available to GLADIATOR customers via download on our website. For more information please see GLADIATOR's website at www.gladiatortechnologies.com. Copies of product User's Guides are available upon request at techsupport@gladiatortechnologies.com.

10 PRODUCT DESCRIPTION

10.1 A40 High Performance MEMS Accelerometer

The all new A40 MEMS High Performance Single Axis Accelerometer offers excellent bias with a small light weight form factor and low power. Designed for commercial stabilization and aircraft applications that require a high performance and high g input due to vibration, the unit utilizes standard +5 V DC power and has a voltage output proportional to power. The signature features of the A40 are our impressive bias over temperature performance, low power consumption, light weight and easy connector interface.

Figure 1: A40 Accelerometer with 2 Euro Coin

The unit is highly durable and can withstand environmental vibration and shock typically associated with commercial aircraft requirements. The unit has no inherent wear-out modes for long life. In addition the A40 shares the same form, fit and function as our lower performance A40 enabling users an easy upgrade path if desired.

- Low Cost & High Performance MEMS Single Axis Accelerometer
- Wide G Range Options ***6g to 15g***
- Low Noise <0.08 mg/√Hz for 6g
- Excellent Bias ≤0.7 mg for 6g 2σ
- Bias Repeatability ***1.5 mg for 6g***
- Axis Alignment ***< 8mrad*** 1σ
- Low Power < 10 mA Typical
- Light W eight < ***15 grams***
- Low Voltage +5 V (single sided power)
- Bandwidth ***140 Hz***
- Voltage Output ***Not Ratiometric***
- Reference Voltage ***+2.5 V***
- Rugged EMI Resistant Packaging
- Internal Temperature Sensor
- Self Test
- Shock Resistant ***500g***
- Vibration 6gRMS (10g unit)
- Long Life

The MEMS A40 offers standard g ranges of ±6g, ±10g and ±15g. The A40 is designed for seismic monitoring, automotive crash testing, commercial aircraft applications, platform and antenna stabilization and pointing, general aviation as well as laboratory use where high g input ranges due to vibration are required. The A40 is ideal where low noise, excellent bias over

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temperature performance, low power consumption; light weight, high g range and rugged durability are desired for commercial environments and applications. Thermal model available - consult factory.

10.2 Mechanical Interface and Outline Drawing

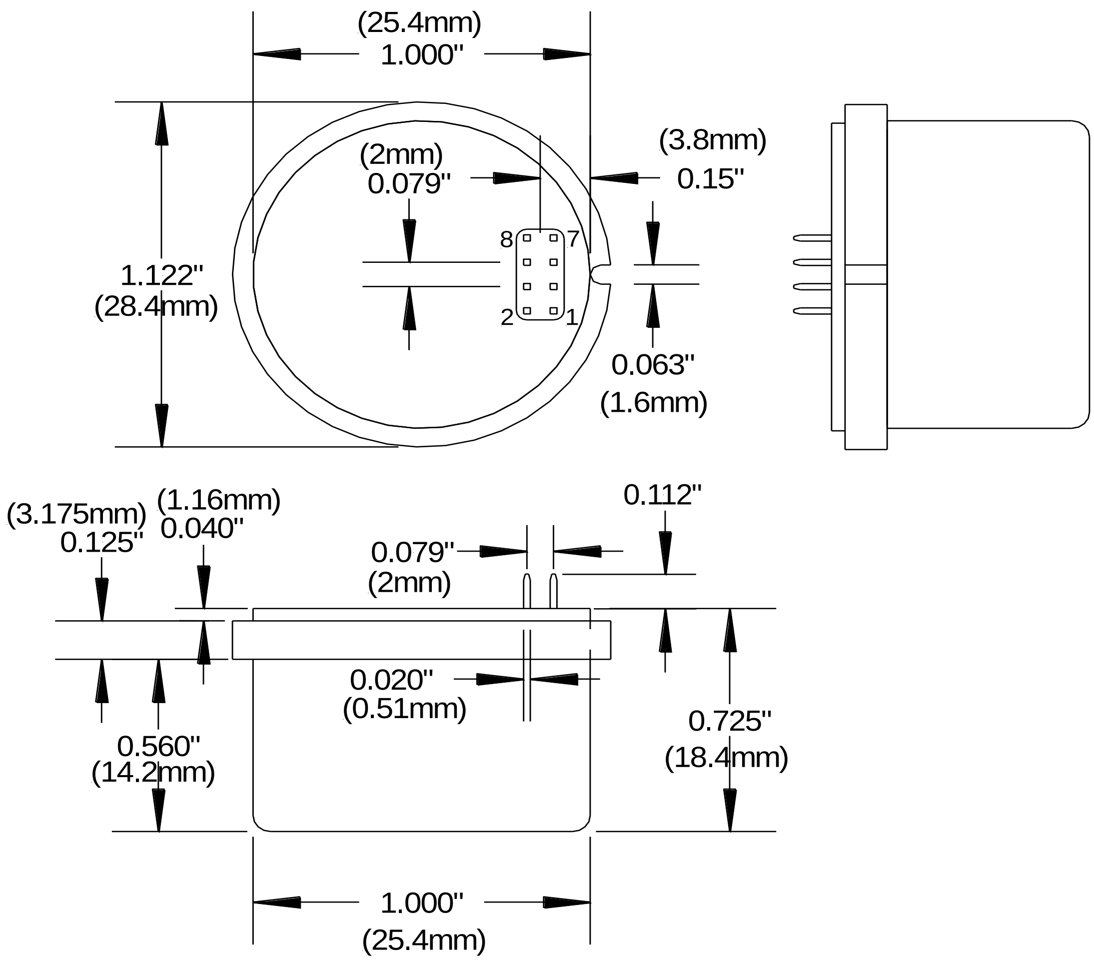

Figure 2: A40 Accelerometer Outline Drawing

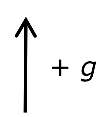

Figure 3: Sensitive Axis

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10.3 A40 Accelerometer Axis Orientation

The accelerometer sensitive axis is along the cylindrical axis of the unit. The effective center of mass of the sensing elements is midpoint along the center axis.

10.4 A40 Accelerometer Block Diagram

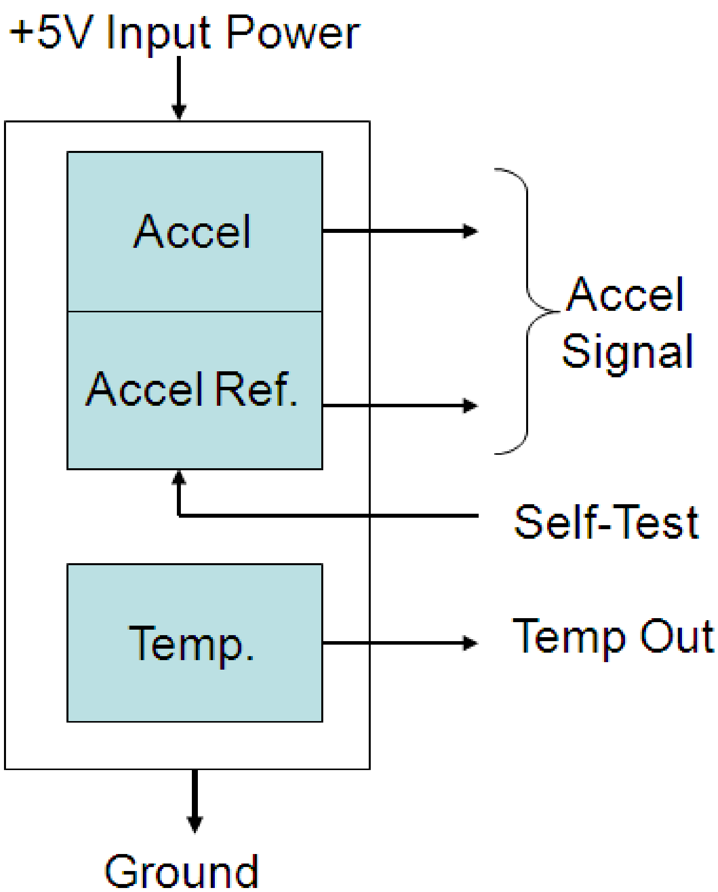

Figure 4: A40 Accelerometer Block Diagram

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10.5 A40 Accelerometer Part Number Configurations

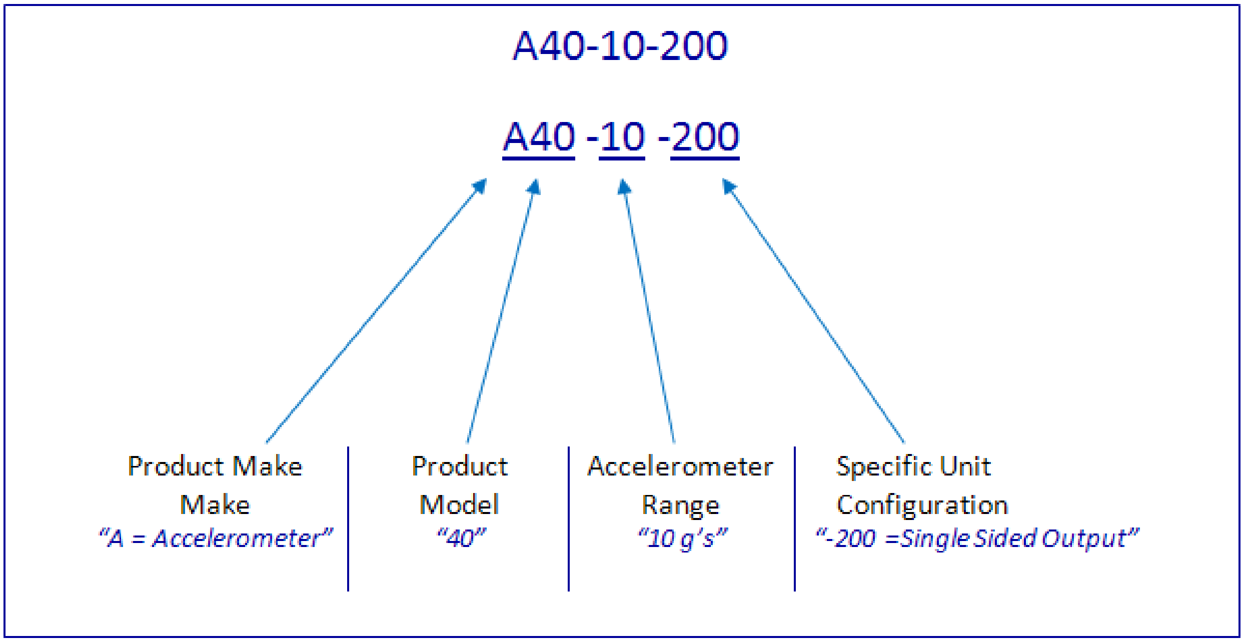

Figure 5: GLADIATOR Part Number Naming Convention

A40 Accelerometer Part Numbers
A40-06-200
A40-10-200
A40-15-200

Figure 6: A40 Accelerometer Part Number Configurations

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10.6 A40 Accelerometer Pin Assignments & Serial Data Sequence

The A40 Accel has an 8 pin connector interface which provides the electrical interface to the host application. The signal pin-out is as follows:

Pin No.	Pin Assignment
1	Accel Output Voltage 0V *Nominal*
2	Temperature +2.5V @ 25°C
3	Power Ground
4	+2.5V Reference Voltage Output
5	**+4.75V to +5.25V DC Input**
6	Signal Ground
7	Self Test Input
8	Case

Accel output is Pin 1 with respect to Pin 6. Temperature is Pin 2 with respect to Pin 6. Self Test On is 3.3V to 5V on Pin 7. Self Test Off is open or < 1V. Accel Load: <100pf >5kΩ Vref and Temp < 500pf >5kΩ

Figure 7: A40 Accelerometer Pin Assignments and Outputs

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10.7 A40 Accelerometer Performance Specification

PARAMETER	A40-06-200	A40-10-200	A40-15-200
Performance			
Input Range *(g)*	6	10	15
Bias *(mg)* 2σ 20°C	0.7	1	1.5
One-Year Bias Repeatability *(mg) 1σ*	1.5	2	2.5
Temperature Sensitivity *(μg/°C) 1σ*	200	200	300
Scale Factor *(mV/g) Nominal*	750	450	300
One-Year Scale Factor Stability *(ppm)*	<1000	<1000	<1000
Temperature Sensitivity *(ppm/°C) 1σ*	<275	<275	<275
Axis Alignment *(mrad) 1σ*	8	8	8
Vibration Rectification *(mg/g² rms) 1σ*	1	0.15	0.2
Intrinsic Noise *(mg/√Hz) 1σ*	0.08	0.15	0.17
Resolution/Threshold *(mg) @ 1Hz*	0.05	0.06	0.07
Bandwidth *(Hz)*	140	140	140
Self Test (logic "1" applied) delta g	1 ± 0.5g	1 ± 0.5g	1.5 ± 0.5g
Environments			
Operating Temperature	- 40°C to + 85°C		
Storage Temperature	- 55°C to + 100°C		
Vibration Operating	6gRMS (10g and up)		
Shock	500g, any axis		
Thermal Modeling			
	Available		
Electrical			
Input Voltage	**+5V ±0.25V (not ratiometric)**		
Power Consumption	9.5mA *typical*		
	12mA *maximum*		
Physical			
Weight (grams)	< 15 grams		
Size (less flange)	1" Diameter X 0.725"		
Case Material	Anodized Aluminum		

Figure 8: A40 Accelerometer Specification (Subject to Change without Notice)

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10.8 Custom Options Available

The A40 can be modified to accommodate both different customer range options and modified bandwidth. One thing to be aware is that our standard A40 Accelerometer is optimized for noise, so typical bandwidth is set at 140 Hz. These are the settings for the standard unit when shipped and the noise may not be optimized for an end-user's specific application. The acceleration bandwidth is ideal for most applications. Highly dynamic applications, such as where high bandwidth would be required to close control loops in flight control in a UAV, might require a higher bandwidth. However, setting the Accel to this higher bandwidth will increase the peak-to-peak noise of the Accel. In contrast, in UAV navigation utilizing a lower bandwidth would be possible and the sensor would see an improvement in p-p noise. Laboratory applications, automotive testing or stabilization applications would likely see the best performance with a factory set 50 Hz bandwidth. Gladiator offers a standard >140 Hz bandwidth A40 for each of our standard Acceleration ranges. Please contact the factory for more information to request the applicable part number for each sensor or to request a custom bandwidth A40 Accel.

10.9 A40 Accel Mating Connector

Each A40 is shipped with a mating connector (crimped pins). Another mating option available is for the factory to install a pre-wired with a 2" color-coded pigtail. Please contact the factory at time of order.

10.10 A40 Self Test

Incorporated into all of Gladiator's Accel and inertial systems products have a self test feature. This allows verification of operation of the sensors prior to using the product. The self test differs from a Built-In-Test (BIT) in that the user has to determine a pass or failure based on the change in the sensor outputs. Each data sheet indicates the change in output depending on the sensor's range (or the sensor range within that particular system model and configuration).

The A40 Accel has this self test function. When initially setting up the Accel please note the Accel output when self-test is not actuated. The self test is activated by a logic level "1" applied to the self test pin. This is 3.3 V logic "1". Normal operation resumes with either an open pin or with a ground applied to the self test pin.

It is best to apply self test in a known, preferably static condition to look for the change. Please note that the self-test feature can also be used while in use without damaging the sensor, but the user will not achieve optimum self-test results.

The best way to use self-test while in a static condition is to average 1 to 10 seconds of data from each sensor and store this value. Then apply self test and average 1 to 10 seconds of data in this condition. Now subtract the self test value from the initial stored value. The change should fall within the range shown on the data sheet.

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This means the sensor operation is normal and is ready for usage. Remove the self test signal by either opening the lead or grounding the lead. If the environment is particularly EMI noisy, it is best to ground the lead to avoid false application of self test.

10.11 Mounting

Mounting for the A40 Accelerometer is a ring type flange mount. Be sure that the surface that you are mounting to is clean and level in order to eliminate potential alignment errors. The following figures show the recommended mounting dimensions. The unit can be mounted with servo clamps. Optional mounting ring can be purchased with the unit as 200-MT-RG-001.

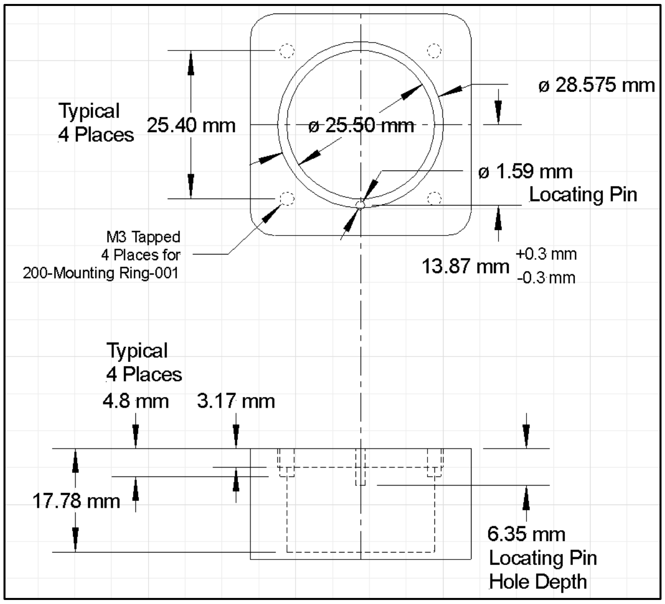

Figure 9: A40 Accelerometer Recommended Mounting

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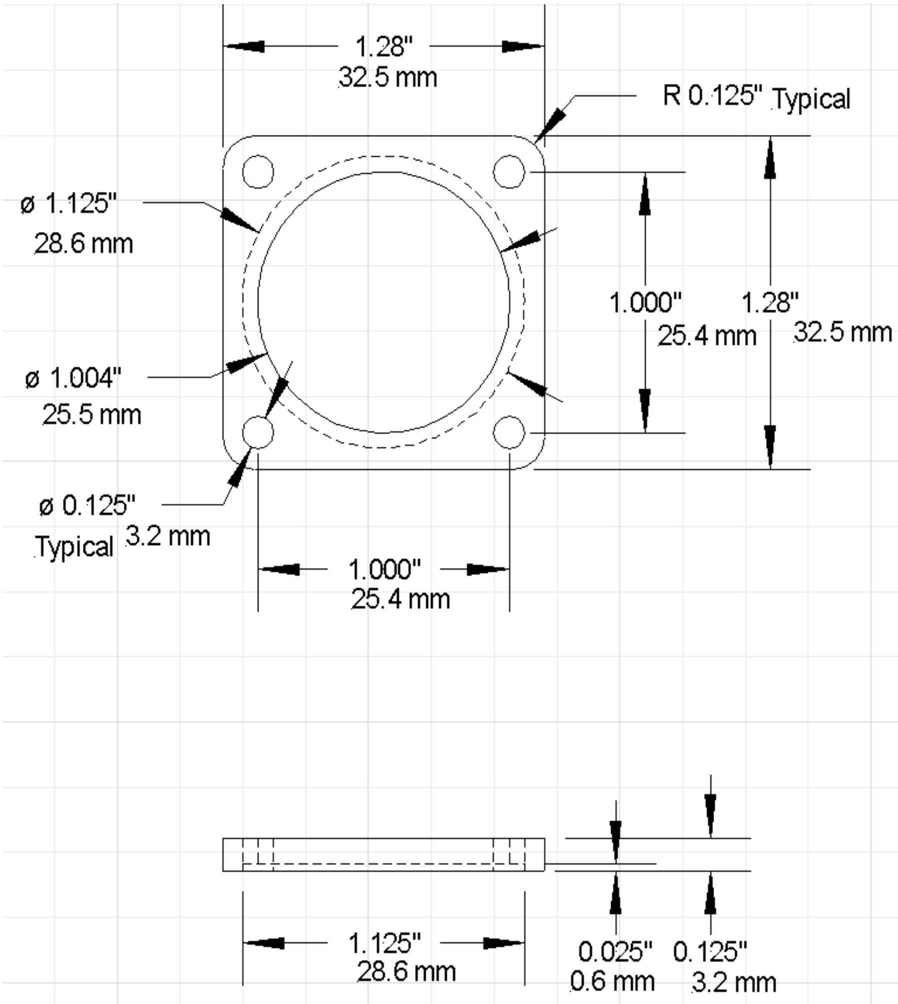

Figure 10: A40 Accelerometer Optional Mounting Ring

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11 OPERATION AND TROUBLESHOOTING

1.1 *Authorized Distributors and Technical Sales Representatives:*

http://www.gladiatortechnologies.com/info_salesRepresentatives.htm

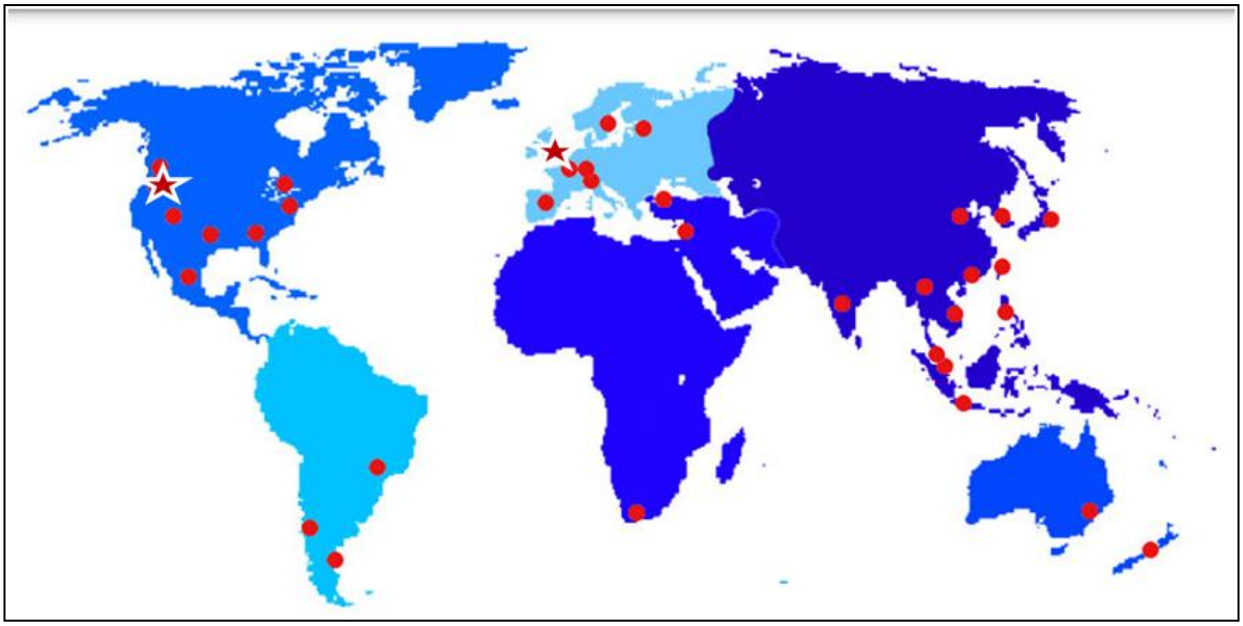

Figure 11: Contact Information & Global Support Locations

1.2 *Technical Assistance*

Please contact us at our website, directly at the factory or your local Gladiator Technologies sales representative's office for technical assistance.

Technical Support - Factory
Gladiator Technologies **Attn: Technical Support** 8020 Bracken Place SE Snoqualmie, WA 98065 USA Tel: 425-396-0829 x222 Fax: 425-396-1129 Email: techsupport@gladiatortechnologies.com Web: www.gladiatortechnologies.com

Figure 12: Factory Contact Information

1.3 *Technical Support Website*

Our Technical support webpage has user training videos, the latest software downloads as well as Remote Desktop Assistance.

Figure 13: Homepage - Technical Support Link

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Figure 14: Technical Support Web Page

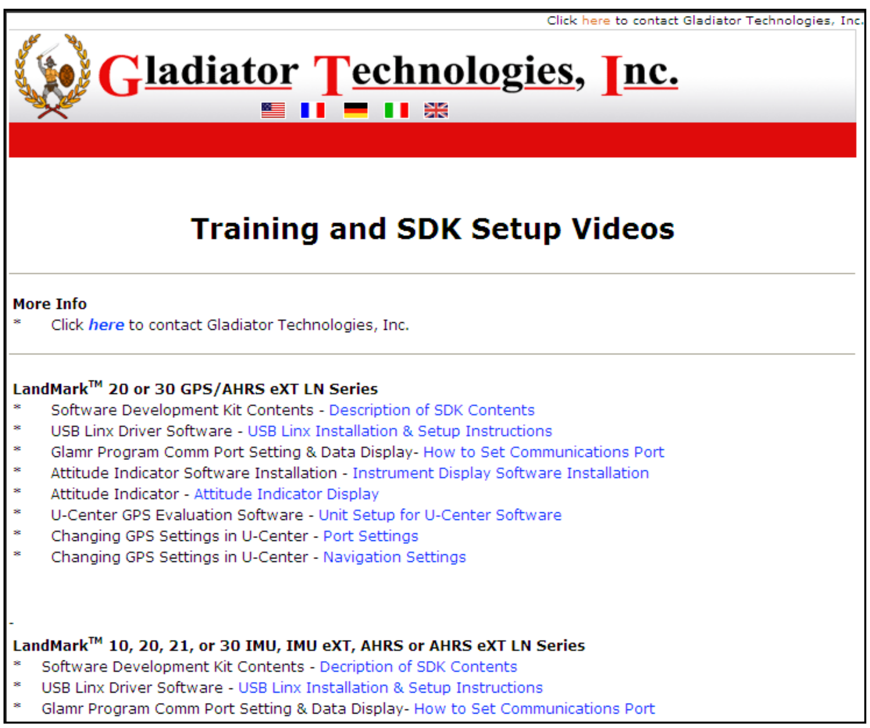

Figure 15: Training & Setup Videos Web Page

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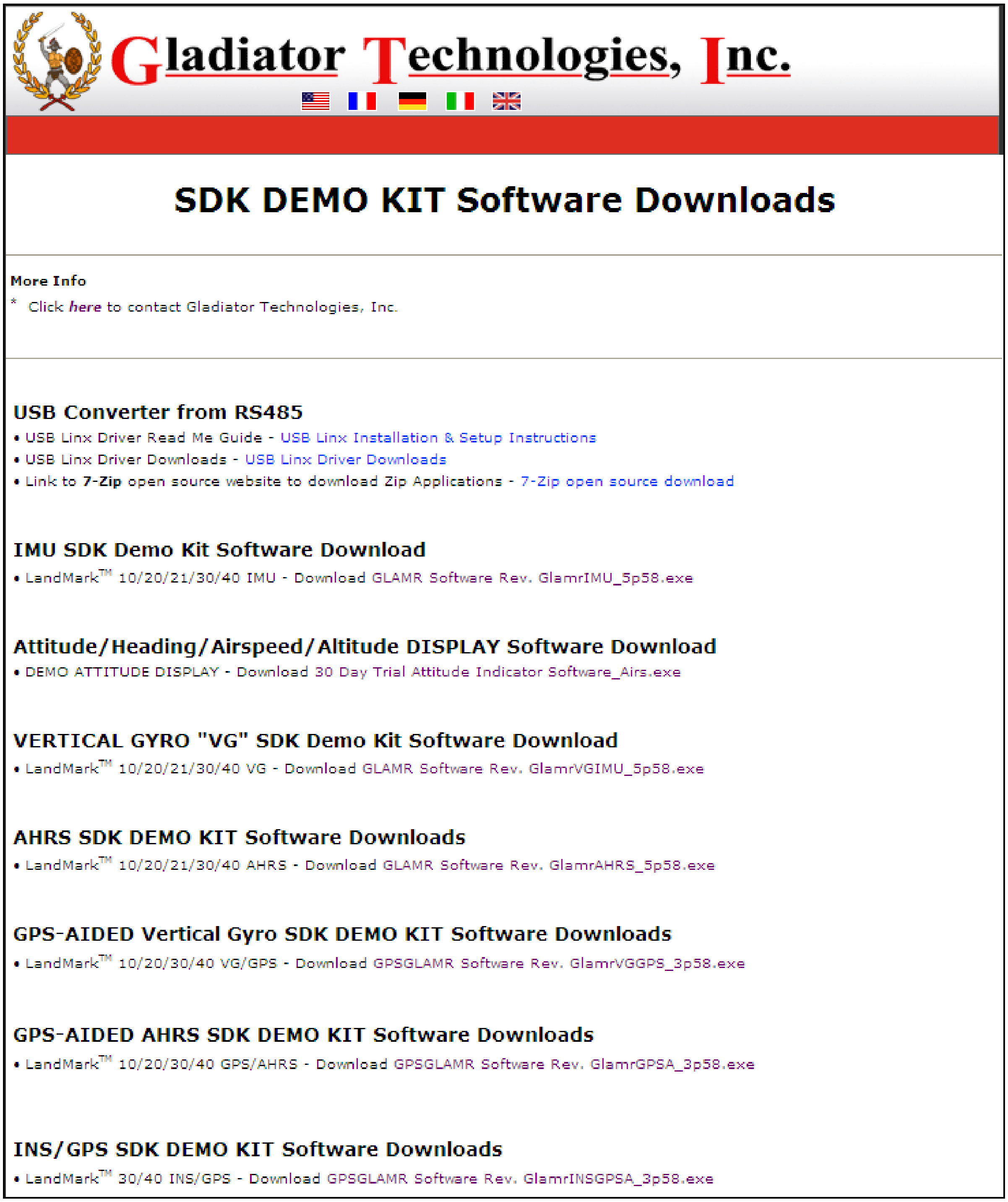
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SDK DEMO KIT Software Downloads

More Info

* Click *here* to contact Gladiator Technologies, Inc.

USB Converter from RS485

• USB Linx Driver Read Me Guide - USB Linx Installation & Setup Instructions
• USB Linx Driver Downloads - USB Linx Driver Downloads
• Link to **7-Zip** open source website to download Zip Applications - 7-Zip open source download

IMU SDK Demo Kit Software Download

• LandMark™ 10/20/21/30/40 IMU - Download GLAMR Software Rev. GlamrIMU_5p58.exe

Attitude/Heading/Airspeed/Altitude DISPLAY Software Download

• DEMO ATTITUDE DISPLAY - Download 30 Day Trial Attitude Indicator Software_Airs.exe

VERTICAL GYRO "VG" SDK Demo Kit Software Download

• LandMark™ 10/20/21/30/40 VG - Download GLAMR Software Rev. GlamrVGIMU_5p58.exe

AHRS SDK DEMO KIT Software Downloads

• LandMark™ 10/20/21/30/40 AHRS - Download GLAMR Software Rev. GlamrAHRS_5p58.exe

GPS-AIDED Vertical Gyro SDK DEMO KIT Software Downloads

• LandMark™ 10/20/30/40 VG/GPS - Download GPSGLAMR Software Rev. GlamrVGGPS_3p58.exe

GPS-AIDED AHRS SDK DEMO KIT Software Downloads

• LandMark™ 10/20/30/40 GPS/AHRS - Download GPSGLAMR Software Rev. GlamrGPSA_3p58.exe

INS/GPS SDK DEMO KIT Software Downloads

• LandMark™ 30/40 INS/GPS - Download GPSGLAMR Software Rev. GlamrINSGPSA_3p58.exe

Figure 16: SDK Software Downloads Web Page

Figure 17: Remote Desktop Support Web Page

Figure 18: Web Conferencing Web Page

2 Typical Sample Test Data

Please contact factory for sample test data. Typical data would include (depending upon the sensor, inertial system or GPS-Aided inertial system):

- Gyro Noise Angle Random Walk (ARW)
- Accelerometer Noise Velocity Random Walk (VRW)
- Gyro In-Run Bias
- Accelerometer In-Run Bias
- Gyro Bias Over Temperature
- Accelerometer Bias Over Temperature
- Gyro Scale Factor Over Temperature
- Accelerometer Scale Factor Over Temperature
- Gyro Random Vibration VRC
- Accel Random Vibration VRC
- ATP Spin Test: X,Y & Z Gyro Nominal Scale Factor at Ambient
- ATP Spin Test: X, Y & Z Gyro misalignment (in deg/sec and in mrad)
- ATP Temperature Tumble Test (T^3): X, Y & Z gyro and X, Y & Z accelerometer bias
- ATP Temperature Tumble Test (T^3): nominal X,Y & Z accelerometer scale factor
- ATP Temperature Tumble Test (T^3): X, Y & Z g-sensitivity (in deg/sec/g)
- ATP Temperature Tumble Test (T^3): X, Y & Z accelerometer misalignment (in mrad)
- ATP GPS: Various GPS Performance Data

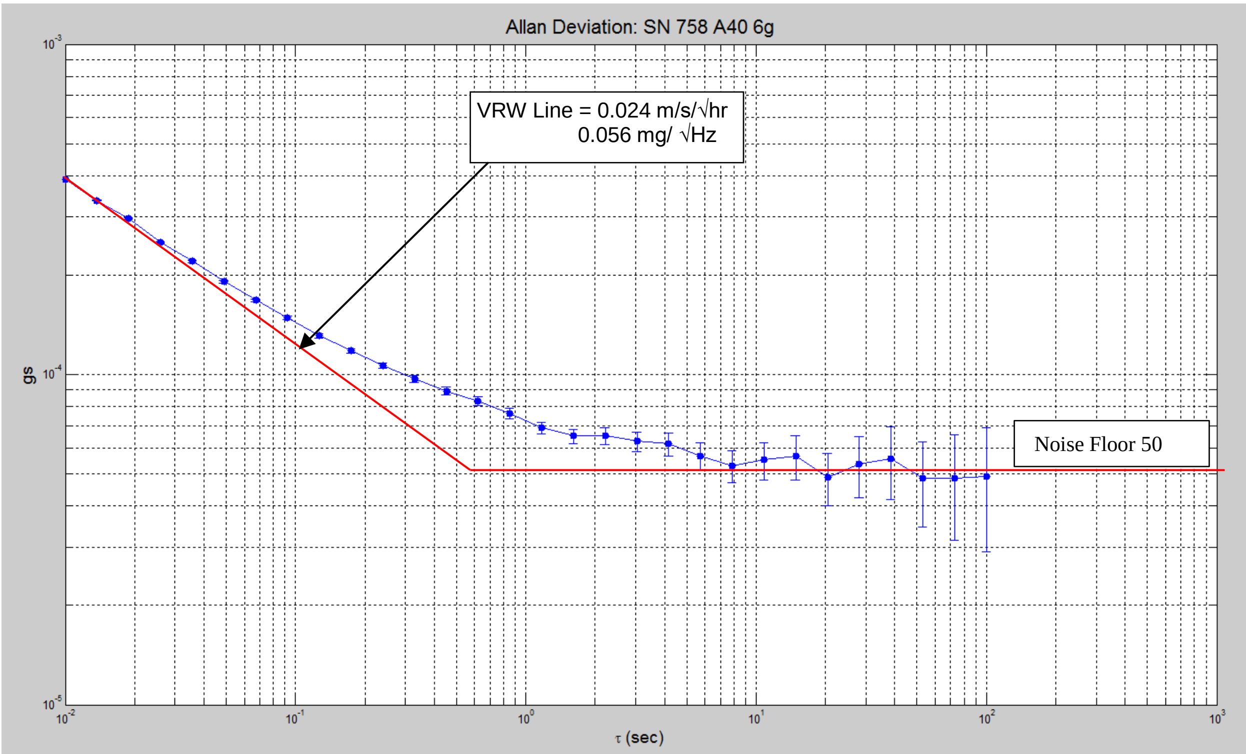

Figure 19: Typical VRW 6g Accelerometer

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12 GLOSSARY OF TERMS

Gladiator Technologies has attempted to define terms as closely as possible to the IEEE Gyro and Accelerometer Panel Standards for Inertial Sensor Terminology. Please note that in some instances our definition of a term may vary and in those instances Gladiator Technology's definition supersedes the IEEE definition. For a complete listing of IEEE's standard for inertial sensor terminology please go to www.ieee.org.

2.1 *Abbreviations and Acronyms*

6DOF: six degrees-of-freedom

AHRS: Attitude and Heading Reference System

CVG: Coriolis Vibratory Gyro

ESD: Electro Static Discharge

IEEE: The Institute of Electrical and Electronics Engineers

GPS/AHRS: Inertial Measurement Unit

MEMS: Micro Electro-Mechanical Systems

NLR: No License Required

12.1 Definitions of Terms

Acceleration-insensitive drift rate (gyro): The component of environmentally sensitive drift rate not correlated with acceleration.
NOTE—Acceleration-insensitive drift rate includes the effects of temperature, magnetic, and other external influences.

Acceleration-sensitive drift rate (gyro): The components of systematic drift rate correlated with the first power of a linear acceleration component, typically expressed in (°/h)/g.

Accelerometer: An inertial sensor that measures linear or angular acceleration. Except where specifically stated, the term accelerometer refers to linear accelerometer.

Allan variance: A characterization of the noise and other processes in a time series of data as a function of averaging time. It is one half the mean value of the square of the difference of adjacent time averages from a time series as a function of averaging time.

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Angular acceleration sensitivity:
(accelerometer): The change of output (divided by the scale factor) of a linear accelerometer that is produced per unit of angular acceleration input about a specified axis, excluding the response that is due to linear acceleration.
(gyro): The ratio of drift rate due to angular acceleration about a gyro axis to the angular acceleration causing it.
NOTE—In single-degree-of-freedom gyros, it is nominally equal to the effective moment of inertia of the gimbal assembly divided by the angular momentum.

Bias:
(accelerometer): The average over a specified time of accelerometer output measured at specified operating conditions that have no correlation with input acceleration or rotation. Bias is expressed in [m/s^2, g].
(gyro): The average over a specified time of gyro output measured at specified operating conditions that have no correlation with input rotation or acceleration. Bias is typically expressed in degrees per hour (º/h).
NOTE—Control of operating conditions may address sensitivities such as temperature, magnetic fields, and mechanical and electrical interfaces, as necessary.

Case (gyro, accelerometer): The housing or package that encloses the sensor, provides the mounting surface, and defines the reference axes.

Composite error (gyro, accelerometer): The maximum deviation of the output data from a specified output function. Composite error is due to the composite effects of hysteresis, resolution, nonlinearity, non-repeatability, and other uncertainties in the output data. It is generally expressed as a percentage of half the output span.

Coriolis acceleration: The acceleration of a particle in a coordinate frame rotating in inertial space, arising from its velocity with respect to that frame.

Coriolis vibratory gyro (CVG): A gyro based on the coupling of a structural, driven, vibrating mode into at least one other structural mode (pickoff) via Coriolis acceleration.
NOTE—CVGs may be designed to operate in open-loop, force-rebalance (i.e., closed-loop), and/or whole-angle modes.

Cross acceleration (accelerometer): The acceleration applied in a plane normal to an accelerometer input reference axis.

Cross-axis sensitivity (accelerometer): The proportionality constant that relates a variation of accelerometer output to cross acceleration. This sensitivity varies with the direction of cross acceleration and is primarily due to misalignment.

Cross-coupling errors (gyro): The errors in the gyro output resulting from gyro sensitivity to inputs about axes normal to an input reference axis.

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Degree-of-freedom (DOF) (gyro): An allowable mode of angular motion of the spin axis with respect to the case. The number of degrees-of-freedom is the number of orthogonal axes about which the spin axis is free to rotate.

Drift rate (gyro): The component of gyro output that is functionally independent of input rotation. It is expressed as an angular rate

Environmentally sensitive drift rate (gyro): The component of systematic drift rate that includes acceleration-sensitive, acceleration-squared-sensitive, and acceleration-insensitive drift rates.

Full-scale input (gyro, accelerometer): The maximum magnitude of the two input limits.

G: The magnitude of the local plumb bob gravity that is used as a reference value of acceleration.
NOTE 1—g is a convenient reference used in inertial sensor calibration and testing. NOTE 2—In some applications, the standard value of g = 9.806 65 m/s^2 *may be specified.*

Gyro (gyroscope): An inertial sensor that measures angular rotation with respect to inertial space about its input axis(es).
NOTE 1—The sensing of such motion could utilize the angular momentum of a spinning rotor, the Coriolis effect on a vibrating mass, or the Sagnac effect on counter-propagating light beams in a ring laser or an optical fiber coil.

G sensitivity (gyro): the change in rate bias due to g input from any direction.

hysteresis error (gyro, accelerometer): The maximum separation due to hysteresis between upscale-going and down-scale-going indications of the measured variable (during a full-range traverse, unless otherwise specified) after transients have decayed. It is generally expressed as an equivalent input.

Inertial sensor: A position, attitude, or motion sensor whose references are completely internal, except possibly for initialization.

Input angle (gyro): The angular displacement of the case about an input axis.

Input axis (IA):
(accelerometer): The axis(es) along or about which a linear or angular acceleration input causes a maximum output.
(gyro): The axis(es) about which a rotation of the case causes a maximum output.

Input-axis misalignment (gyro, accelerometer): The angle between an input axis and its associated input reference axis when the device is at a null condition.

Input limits (gyro, accelerometer): The extreme values of the input, generally plus or minus, within which performance is of the specified accuracy.

Input range (gyro, accelerometer): The region between the input limits within which a quantity is measured, expressed by stating the lower- and upper-range value. For example, a linear displacement input range of ±1.7g to ±12g.

Input rate (gyro): The angular displacement per unit time of the case about an input axis. For example, an angular displacement input range of ±150°/sec to ±300°/sec.

Input reference axis (IRA) (gyro, accelerometer): The direction of an axis (nominally parallel to an input axis) as defined by the case mounting surfaces, or external case markings, or both.

Linear accelerometer: An inertial sensor that measures the component of translational acceleration minus the component of gravitational acceleration along its input axis(es).

Linearity error (gyro, accelerometer): The deviation of the output from a least-squares linear fit of the input-output data. It is generally expressed as a percentage of full scale, or percent of output, or both.

Mechanical freedom (accelerometer): The maximum linear or angular displacement of the accelerometer's proof mass, relative to its case.

Natural frequency (gyro, accelerometer): The frequency at which the output lags the input by 90°. It generally applies only to inertial sensors with approximate second-order response.

Non-gravitational acceleration (accelerometer): The component of the acceleration of a body that is caused by externally applied forces (excluding gravity) divided by the mass.

Nonlinearity (gyro, accelerometer): The systematic deviation from the straight line that defines the nominal input-output relationship.

Open-loop mode (Coriolis vibratory gyro): A mode in which the vibration amplitude of the pickoff is proportional to the rotation rate about the input axis(es).

Operating life (gyro, accelerometer): The accumulated time of operation throughout which a gyro or accelerometer exhibits specified performance when maintained and calibrated in accordance with a specified schedule.

Operating temperature (gyro, accelerometer): The temperature at one or more gyro or accelerometer elements when the device is in the specified operating environment.

Output range (gyro, accelerometer): The product of input range and scale factor.

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Output span (gyro, accelerometer): The algebraic difference between the upper and lower values of the output range.

Pickoff (mechanical gyro, accelerometer): A device that produces an output signal as a function of the relative linear or angular displacement between two elements.

Plumb bob gravity: The force per unit mass acting on a mass at rest at a point on the earth, not including any reaction force of the suspension. The plumb bob gravity includes the gravitational attraction of the earth, the effect of the centripetal acceleration due to the earth rotation, and tidal effects. The direction of the plumb bob gravity acceleration defines the local vertical down direction, and its magnitude defines a reference value of acceleration (g).

Power spectral density (PSD): A characterization of the noise and other processes in a time series of data as a function of frequency. It is the mean squared amplitude per unit frequency of the time series. It is usually expressed in $(°/h)^2$/Hz for gyroscope rate data or in $(m/s^2)^2$/Hz or g2/Hz for accelerometer acceleration data.

Principal axis of compliance (gyro, accelerometer): An axis along which an applied force results in a displacement along that axis only.

Proof mass (accelerometer): The effective mass whose inertia transforms an acceleration along, or about, an input axis into a force or torque. The effective mass takes into consideration rotation and contributing parts of the suspension.

Quantization (gyro, accelerometer): The analog-to-digital conversion of a gyro or accelerometer output signal that gives an output that changes in discrete steps, as the input varies continuously.

Quantization noise (gyro, accelerometer): The random variation in the digitized output signal due to sampling and quantizing a continuous signal with a finite word length conversion. The resulting incremental error sequence is a uniformly distributed random variable over the interval 1/2 least significant bit (LSB).

Random drift rate (gyro): The random time-varying component of drift rate.

Random walk: A zero-mean Gaussian stochastic process with stationary independent increments and with standard deviation that grows as the square root of time.

Angle random walk (gyro): The angular error buildup with time that is due to white noise in angular rate. This error is typically expressed in degrees per square root of hour [$°/\sqrt{h}$].

Velocity random walk (accelerometer): The velocity error build-up with time that is due to white noise in acceleration. This error is typically expressed in meters per second per square root of hour [$(m/s)/\sqrt{h}$].

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Rate gyro: A gyro whose output is proportional to its angular velocity with respect to inertial space.

Ratiometric output: An output method where the representation of the measured output quantity
(e.g., voltage, current, pulse rate, pulse width) varies in proportion to a reference quantity.

Rectification error (accelerometer): A steady-state error in the output while vibratory disturbances are acting on an accelerometer.

Repeatability (gyro, accelerometer): The closeness of agreement among repeated measurements of the same variable under the same operating conditions when changes in conditions or non-operating periods occur between measurements.

Resolution (gyro, accelerometer): The largest value of the minimum change in input, for inputs greater than the noise level, that produces a change in output equal to some specified percentage (at least 50%) of the change in output expected using the nominal scale factor.

Scale factor (gyro, accelerometer): The ratio of a change in output to a change in the input intended to be measured. Scale factor is generally evaluated as the slope of the straight line that can be fitted by the method of least squares to input-output data.

Second-order nonlinearity coefficient (accelerometer): The proportionality constant that relates a variation of the output to the square of the input, applied parallel to the input reference axis.

Sensitivity (gyro, accelerometer): The ratio of a change in output to a change in an undesirable or secondary input. For example: a scale factor temperature sensitivity of a gyro or accelerometer is the ratio of change in scale factor to a change in temperature.

Stability (gyro, accelerometer): A measure of the ability of a specific mechanism or performance coefficient to remain invariant when continuously exposed to a fixed operating condition.

Storage life (gyro, accelerometer): The non-operating time interval under specified conditions, after which a device will still exhibit a specified operating life and performance.

Strapdown (gyro, accelerometer): Direct-mounting of inertial sensors (without gimbals) to a vehicle to sense the linear and angular motion of the vehicle.

Third-order nonlinearity coefficient (accelerometer): The proportionality constant that relates a variation of the output to the cube of the input, applied parallel to the input reference axis.

Threshold (gyro, accelerometer): The largest absolute value of the minimum input that produces an output equal to at least 50% of the output expected using the nominal scale factor.

Turn-on time (gyro, accelerometer): The time from the initial application of power until a sensor produces a specified useful output, though not necessarily at the accuracy of full specification performance.

Warm-up time (gyro, accelerometer): The time from the initial application of power for a sensor to reach specified performance under specified operating conditions.

Zero offset (restricted to rate gyros): The gyro output when the input rate is zero, generally expressed as an equivalent input rate. It excludes outputs due to hysteresis and acceleration.

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