

MMQ™ 50 IMU

Applications

The MMQ™ 50 has a wide variety of applications.

- General Aviation
- Unmanned Underwater Vehicles
- Land Navigation
- EO/IR Stabilization
- Antenna Pointing
- Unmanned Aerial Vehicles
- Robotics

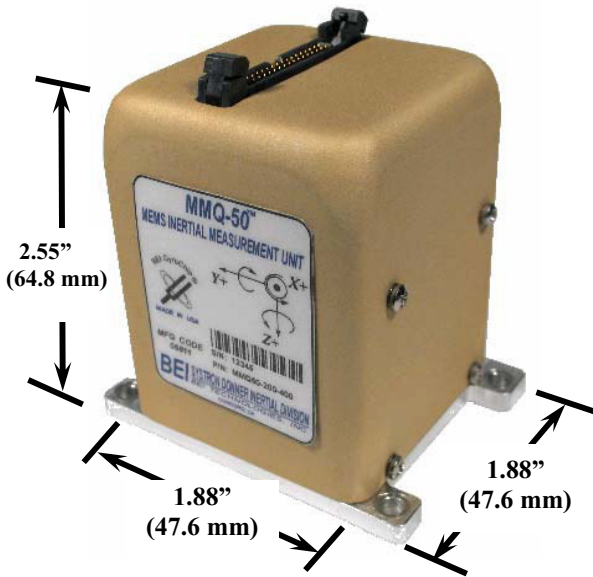


Description

The Miniature MEMS Quartz IMU (MMQ50) represents advancement in the state-of-the-art of inertial measurement units. It is a fully functional, small (less than 9 cubic inches) inertial measurement unit capable of demonstrating bias stability values below 10 deg/hr and angle random walks typically below 0.15 deg/square root hour, while operating in robust environmental conditions.

- RS-232 Serial Temperature Compensated, Digital Outputs
 - Delta Velocity and Delta Angle
 - Three (3) Axes of Angular Rate
 - Three (3) Axes of Acceleration
- Non Hermetic Design Ideal for Embedded Applications

Inertial Measurement Unit



- Extremely Small Size
- Low Unit Price
- Low Power Consumption
- Very Light Weight
- DC Voltage Input
- Proven MEMS Technology
- RS-232 Digital Interface
- Suitable for DO-160D Physical Environment (Fixed Wing, Cockpit, in an embedded System)

PART NUMBER	MMQ50-200-400
GENERAL	
Size (Vol.)	9.0 in ³ (1.88"W x 1.88"D x 2.55"H) (48 mm x 48 mm x 65 mm)
Weight	<0.50 lbs (<0.227 kg)
Power	+ and - 12 Vdc at < 5 watts total
I/O	RS-232
RATE CHANNELS	
Range	200°/ sec
Bias Turn-on to turn-on Stability (fixed temp)	≤100°/hr, 1 σ
Bias In-run Stability (at any temperature)	50-200°/hr, 1 σ
Noise floor (15 mins)	4-15°/hr, 1σ
White Noise (angle random walk)	0.3 °/rt-hr (0.005 °sec/rt-Hz)
Scale Factor	0.01°/sec/count
Scale Factor error	≤5000 ppm (0.5%)
Alignment	≤5 mrad
Bandwidth	50 Hz, nominal
ACCELERATION CHANNELS	
Range *	+/- 10g
Bias Turn-on to turn-on Stability (fixed temp)	≤2.5 mg, 1σ
Bias In-run Stability (at any temperature)	≤3 mg, 1 σ
Noise Floor (15 mins)	0.25 mg, 1 σ
White noise (velocity random walk)	0.5 mg/rt-Hz
Scale Factor Error	≤5000 ppm (0.5%)
Alignment	≤5 mrad
Bandwidth	50 Hz, nominal
ENVIRONMENTAL	
Temperature, operating	-54°C to +70°C
Temperature, storage	-54°C to +85°C
Vibration, random *	6.0g rms, 20Hz -2kHz, flat Meets DO-160D Curves C, C1
Shock, operating *	30g, powered Meets DO-160D operational shock and crash safety
Altitude	35,000 ft. Meets DO-160D Category C
* Output is limited to 10g to comply with Export Control regulations. Accelerometer data will be corrupted if average level exceeds 10g during an output frame. (Frame rate is 450Hz.) Please contact factory for more details.	

For more information contact:
sales@systron.com
Systron Donner Inertial
 355 Lennon Lane
 Walnut Creek, California 94598
 (925) 979-4500

In Europe:
bei.tech@ukonline.co.uk
Systron Donner Inertial
 Tel: ++44 (0) 7770 268698
 Fax: ++44 (0) 1227 363289
 Whitstable, Kent, England



MMQ50[®] Hardware Developer's Kit (HDK) MMQ50-KIT-300



Reduce critical development time with SDI's MMQ50 Hardware Developer's Kit. The MMQ50-KIT-300 includes the following:

- RS232 / USB Converter
- Interface Cabling
- Power Supply
- Carrying case
- MMQ50 CD Software
- Carrying case

The Hardware Developer's Kit includes vital accessories to help you quickly begin MMQ50 IMU integration into your system.

For more information contact:

sales@systron.com

Systron Donner Inertial

355 Lennon Lane

Walnut Creek, California 94598

(866) BEI-GYRO (866) 234-4976

In Europe:

bei.tech@ukonline.co.uk

Systron Donner Inertial Division

Tel: ++44 (0) 7770 268698

Fax: ++44 (0) 1227 363289

Whitstable, Kent, England

The MMQ50 IMU is sold separately.

MMQ™ AHRS

RELEASED DOCUMENT
 DATE: 07/14/2008

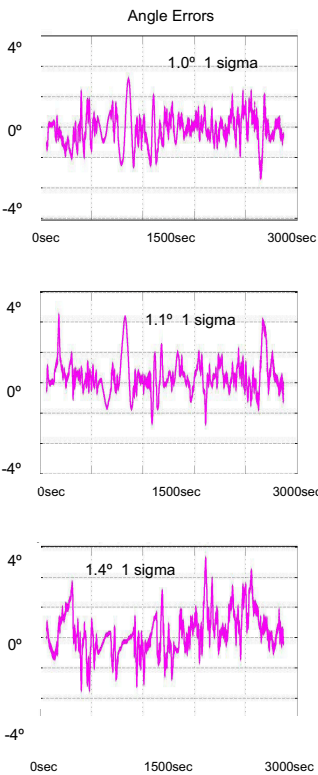
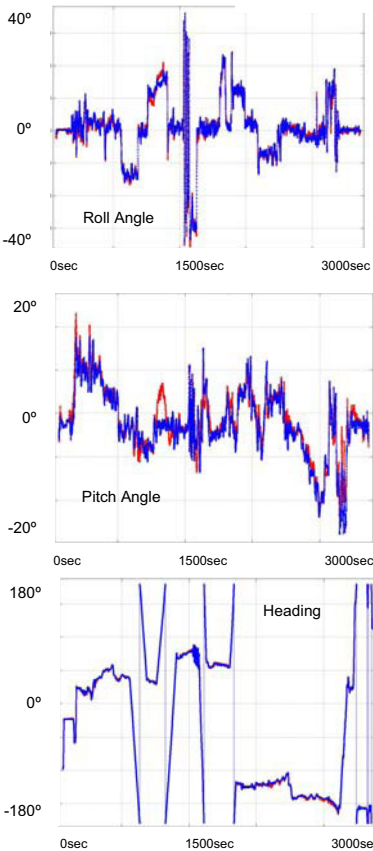
Applications

The MMQ™ AHRS has a wide variety of applications.

- Heading and Attitude Applications
- Targets and drones
- EO/IR Stabilization
- Unmanned Aerial Vehicles
- Remotely Operated Vehicles (Underwater)
- General Aviation (Experimental)
- Land Navigation
- Robotics
- Electronic Flight Instrumentation System (EFIS) Integration



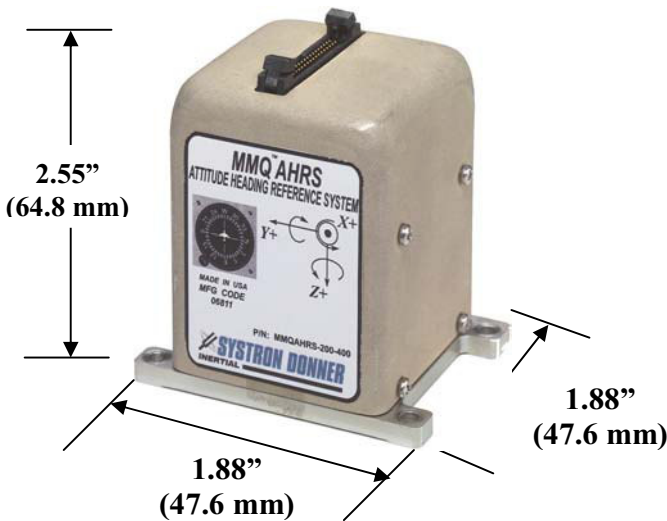
Blue – Reference INS
 Red – MMQ VG



Description

The MMQ AHRS offers a unique combination of the Systron Donner Inertial solid-state MMQ50 Inertial Measurement Unit (IMU) and advanced software that calculates an Attitude and Heading Reference (AHRS) solution from the gyro and accelerometer sensors, and an external 3-axis magnetometer. The MMQ AHRS's MEMS quartz rate sensors and MEMS accelerometers make up an IMU system that is used to calculate a highly accurate Roll, Pitch and Heading angle solution in varying dynamic applications. Roll and Pitch are stabilized by the accelerometers, and heading is stabilized by an external 3-Axis magnetometer. The user can configure the MMQ AHRS to output data at various sample rates with extremely low output rate jitter, and the data output format is simple to understand containing the 6 sensor outputs, the angle outputs, a Built-In-Test (BIT) word output and a multi-parameter revolving word output that provides system information including version string. The MMQ AHRS combines tremendous performance and versatility with an extremely compact size, low power consumption and low weight.

Miniature MEMS Quartz Attitude and Heading Reference System



- Extremely Small Size
- AHRS Solution for many Dynamic Applications
- RS-232 Digital Interface
- Low Power Consumption (<5W)
- Configurable Output Rate
- Jitter Free Output Rate (400 Hz Max)
- Tested to meet TSO-C4c bank (roll) and pitch angle performance
- Tested to meet TSO-C6d heading angle performance
- MMQ AHRS Demo Software supplied to facilitate integration

PHYSICAL CHARACTERISTICS	
Part Number	MMQ AHRS-200-400
Size (Vol.)	9.0 ins (1.88"W x 1.88"D x 2.55"H) (48 mm x 48 mm x 65 mm)
Weight	<0.50 lbs (<0.227 kg)
Power	+ and - 12 Vdc at < 5 watts total
I/O	RS-232 - 400 Hz Output Rate with < 100 microsecond jitter
ATTITUDE AND HEADING PERFORMANCE	
Static Accuracy (Roll, Pitch, Heading)	< 0.5 Deg
Dynamic Accuracy (Roll/Pitch)	1.5 Deg RMS - Tested to TSO-C4c roll and pitch performance standards
Dynamic Accuracy (Heading)	3.0 Deg RMS - Tested to TSO-C6d heading performance standards
RATE CHANNELS	
Range	200°/ sec
Bias Turn-on to turn-on Stability (fixed temp)	≤100°/hr, 1 σ
Bias In-run Stability (at any temperature)	50-200°/hr, 1 σ
White Noise (angle random walk)	0.3 °/rt-hr (0.005 °sec/rt-Hz)
Scale Factor error	≤5000 ppm (0.5%)
Alignment	≤5 mrad
Bandwidth	50 Hz, nominal
ACCELERATION CHANNELS	
Range	+/- 10g
Bias Turn-on to turn-on Stability (fixed temp)	≤2.5 mg, 1σ
Bias In-run Stability (at any temperature)	≤3 mg, 1 σ
White noise (velocity random walk)	0.5 mg/rt-Hz
Scale Factor Error	≤5000 ppm (0.5%)
Alignment	≤5 mrad
Bandwidth	50 Hz, nominal
ENVIRONMENTAL	
Temperature Range	-54°C to +70°C (operating)
Vibration, random	6.0g rms, 20Hz -2kHz, flat Meets DO-160D Curves C, C1
Shock, operating	30g, powered Meets DO-160D operational shock and crash safety
Altitude	35,000 ft. Meets DO-160D Category C

For more information contact:
sales@systron.com
Systron Donner Inertial
 355 Lennon Lane
 Walnut Creek, California 94598
 (925) 979-4500

In Europe:
bei.tech@ukonline.co.uk
Systron Donner Inertial
 Tel: ++44 (0) 7770-268698
 Fax: ++44 (0) 1227 363289
 Whitstable, Kent, England

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MMQ™ VG

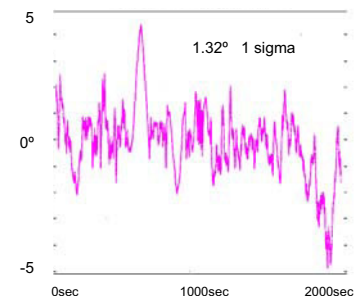
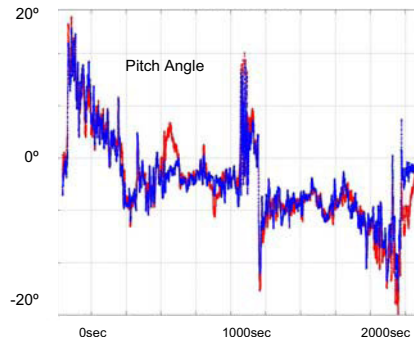
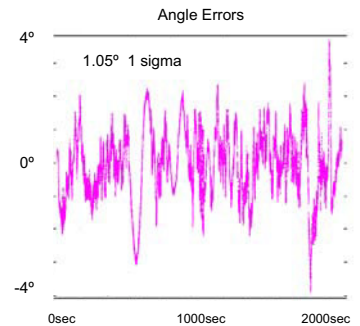
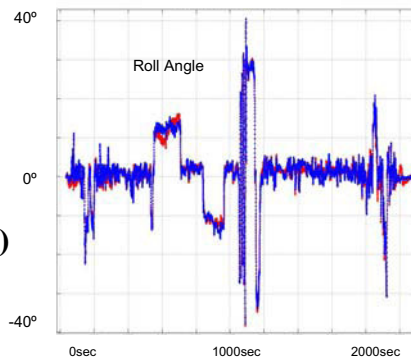
Applications

The MMQ™ VG has a wide variety of applications.

- Antenna Pointing
- Targets and drones
- EO/IR Stabilization
- Unmanned Aerial Vehicles
- Remotely Operated Vehicles (Underwater)
- General Aviation (Experimental)
- Agriculture (Smart Farming)
- Robotics
- Automotive Testing



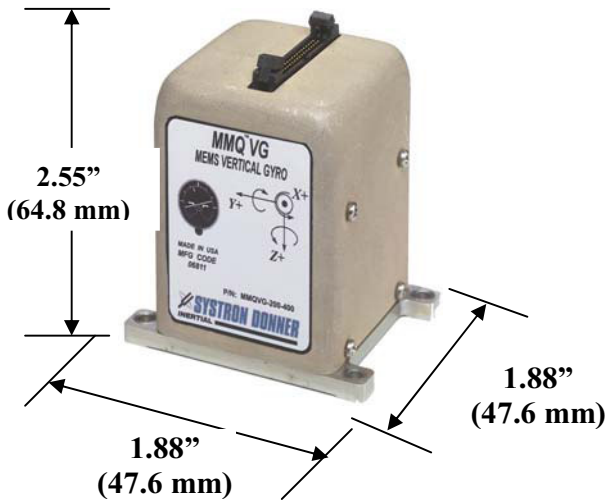
Blue – Reference INS
 Red – MMQ VG



Description

The MMQ VG offers a unique combination of the Systron Donner Inertial solid-state MMQ50 Inertial Measurement Unit (IMU) and advanced software that calculates a Vertical Gyro (VG) solution from the gyro and accelerometer sensors. The MMQ VG's MEMS quartz rate sensors and MEMS accelerometers make up an IMU system that is used to calculate a highly accurate Roll and Pitch angle solution in varying dynamic applications. The user can configure the MMQ VG to output data at various sample rates with extremely low output rate jitter, and the data output format is simple to understand containing the 6 sensor outputs, the angle outputs, a Built-In-Test (BIT) word output and a multi-parameter revolving word output that provides system information including version string. The MMQ VG combines tremendous performance and versatility with an extremely compact size, low power consumption and low weight.

Miniature MEMS Quartz Vertical Gyro



Features

- Extremely Small Size
- Vertical Gyro Solution for many Dynamic Applications
- RS-232 Digital Interface
- Low Power Consumption (<5W)
- Configurable Output Rate
- Jitter Free Output Rate (400 Hz Max)
- Tested to meet TSO-C4c bank (roll) and pitch angle performance
- Proven MEMS Technology
- MMQ VG Demo Software supplied to facilitate integration

PHYSICAL CHARACTERISTICS	
Part Number	MMQ VG-200-400
Size (Vol.)	9.0 ins (1.88"W x 1.88"D x 2.55"H) (48 mm x 48 mm x 65 mm)
Weight	<0.50 lbs (<0.227 kg)
Power	+ and - 12 Vdc at < 5 watts total
I/O	RS-232 - 400 Hz Output Rate with < 100 microsecond jitter
ATTITUDE PERFORMANCE	
Static Accuracy (Roll/Pitch)	< 0.5 Deg
Dynamic Accuracy (Roll/Pitch)	1.5 Deg RMS - Tested to TSO-C4c bank and pitch performance standards
RATE CHANNELS	
Range	200°/ sec
Bias Turn-on to turn-on Stability (fixed temp)	≤100°/hr, 1 σ
Bias In-run Stability (at any temperature)	50-200°/hr, 1 σ
White Noise (angle random walk)	0.3 °/rt-hr (0.005 °sec/rt-Hz)
Scale Factor error	≤5000 ppm (0.5%)
Alignment	≤5 mrad
Bandwidth	50 Hz, nominal
ACCELERATION CHANNELS	
Range	+/- 10g
Bias Turn-on to turn-on Stability (fixed temp)	≤2.5 mg, 1 σ
Bias In-run Stability (at any temperature)	≤3 mg, 1 σ
White noise (velocity random walk)	0.5 mg/rt-Hz
Scale Factor Error	≤5000 ppm (0.5%)
Alignment	≤5 mrad
Bandwidth	50 Hz, nominal
ENVIRONMENTAL	
Temperature Range	-54°C to +70°C (operating)
Vibration, random	6.0g rms, 20Hz -2kHz, flat Meets DO-160D Curves C, C1
Shock, operating	30g, powered Meets DO-160D operational shock and crash safety
Altitude	35,000 ft. Meets DO-160D Category C

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sales@systron.com
Systron Donner Inertial
 355 Lennon Lane
 Walnut Creek, California 94598
 (925) 979-4500

In Europe:
bei.tech@ukonline.co.uk
Systron Donner Inertial
 Tel: ++44 (0) 7770 268698
 Fax: ++44 (0) 1227 363289
 Whitstable, Kent, England

MotionPak™

Multi-Axis Inertial Sensing System



Applications

- Vehicle Instrumentation
- Robotics
- Automotive Testing
- Attitude Reference Systems
- Control Systems
- Dead Reckoning Aiding GPS
- Flight Testing
- Buoy Instrumentation

Description

The MotionPak™ is a “solid-state” six degree of freedom inertial sensing system used for measuring linear accelerations and angular rates in instrumentation and control applications. It is a highly reliable, compact, and fully self-contained motion measurement package. It uses three orthogonally mounted “solid-state” micromachined quartz angular rate sensors, and three high performance linear servo accelerometers mounted in a compact, rugged package, with internal power regulation and signal conditioning electronics.

Features

- “Solid State” Sensors
- Compact, Rugged Package
- Long Operating Life
- Low Cost
- High Level Analog Outputs
- Wide Bandwidth
- Fast Start-Up
- Fully Self-Contained System

Operation

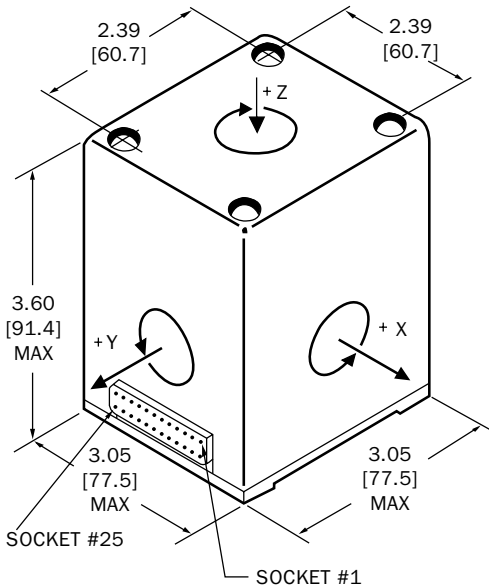
Angular rates are sensed using micromachined quartz gyroscopes. Linear accelerations are sensed using linear servo accelerometers. The MotionPak™ is directly powered by a + and - 15 Vdc input and provides six high-level, wide-bandwidth analog signal outputs. There are three outputs for linear acceleration and three for angular velocity. The package contains internal power regulators and includes temperature sensors for high performance applications.



For applications assistance or more information on any of Systron Donner Inertial micromachined inertial sensors, Call 1-800-227-1625.

MotionPak™

Multi-Axis Inertial Sensing System



NOTES:

1. MOTIONPAK™ IS SUPPLIED WITH A MATING CONNECTOR (ADB-25) AND FOUR MOUNTING BOLTS.
2. OUTPUT VOLTAGE POLARITY MATCHES COORDINATE FRAME (RIGHT HAND RULE).
3. DIMENSIONS ARE IN INCHES/[MM].
4. MOTIONPAK™ COVER IS FOR DUST AND MECHANICAL PROTECTION ONLY.
5. SIGNAL RETURNS AND POWER GROUND ARE COMMON.

Connector Pin Assignment
+Vdc Input
-Vdc Input
Power Ground
Case Ground
Rate-X Output
Rate-X Return
Rate-Y Output
Rate-Y Return
Rate-Z Output
Rate-Z Return
Accel-X Output
Accel-X Return
Accel-Y Output
Accel-Y Return
Accel-Z Output
Accel-Z Return
Bit Out X QRS
Bit Out Z QRS
Bit Out Y QRS
Temp Out X Accel
Temp Out Y Accel
Temp Out Z Accel

Typical pin-out shown. Specific model pin-out may vary depending on options selected.

PARAMETER	RATE CHANNELS	ACCELERATION CHANNELS
Power Requirements		
Input Voltage	+ and - 15 Vdc ±10%	
Input Current	<270mA (each supply)	
Performance		
Standard Range**	±100°/sec	±1, 2, 3, 5, 10 g's
Full Scale Output (Nominal)	±2.5 Vdc	±7.5 Vdc
Scale Factor, Calibration (at 22°C)	≤1% of value	
Scale Factor, Temperature Sensitivity	<0.03%/°C	
Bias Factory Set	≤2.0°/sec*	<±8 mg
Bias Variation over Temperature (Max Deviation from 22°C)	≤2°/sec from 22°C*	≤70 µg/°C
Long Term Bias Stability (1 year)	<0.2°/sec*	<1200 µg
G Sensitivity	≤0.02°/sec/g	—
Start-Up Time	<1.0 sec	
Bandwidth (-90°)	>60 Hz	>300 Hz
Non-Linearity	≤0.05% of F.R.	<50 µg/g²
Threshold/Resolution	≤0.004°/sec*	≤10 µg
Output Noise (DC to 100Hz)	≤0.01°/sec/√Hz*	≤7.0 mV
Environments		
Operating Temperature	-40°C to +80°C	
Storage Temperature	-55°C to +100°C	
Vibration Survival	10 g _{rms}	20 Hz to 2 kHz random, 5 hour duration
Shock	200 g	
Weight	900 grams	

*Values indicated are for ±100°/sec range.

**Other Rate Ranges Available - Consult Factory

Other Information:

1. Part number based on ranges, options and number of channels specified.
2. Rate channel options - High Performance, Low Noise, Wide Bandwidth, Special Ranges.
3. Acceleration Channel Option - Current output



DIVISION HEADQUARTERS

Systron Donner Inertial
 355 Lennon Lane, Walnut Creek, CA 94598
 Tel: 1-925-979-4500
 Fax: 1-925-979-9827
 E-mail: sales@systron.com
 World Wide Web: <http://www.systron.com>

EUROPEAN HEADQUARTERS

Systron Donner Inertial
 c/o FDS House, 94-104 John Wilson Park
 Whitstable, Kent, England CT5 3QZ
 Tel: +44 (0) 7770 268698
 Fax: +44 (0) 1227 363289
 E-mail: bei.tech@ukonline.co.uk

MotionPak® II

Multi-Axis Inertial Sensing System

DESCRIPTION

The MotionPak II is a "solid state" MEMS six degree of freedom inertial sensing system used for measuring linear accelerations and angular rates in instrumentation and control applications. It is a highly reliable, compact, and rugged package providing both analog and digital (RS-232) outputs. With three orthogonally mounted micromachined quartz angular rate sensors and three silicon based accelerometers, the MotionPak II is a fully self-contained motion measurement package utilizing internal power regulation and signal conditioning electronics.



FEATURES

- "Solid State" Sensors
- Dual Level Analog Outputs
- RS-232 Digital Output
- Single Supply Feature
- Compact, Rugged Package
- Wide Bandwidth
- Long Operating Life
- Fast Start-Up
- Low Cost
- Fully Self-Contained System

OPERATION

The MotionPak II may be directly powered by a + and - 15 Vdc input voltage which will provide 12 analog signal outputs (6 high signal outputs and 6 low signal outputs) and a digital (RS-232) output at a Data Transfer Rate of 32 Hz maximum. For applications requiring a +12 Vdc input voltage the Single Supply Feature will provide a low signal output and RS-232 digital output. The package contains internal power regulation and an additional temperature sensor output for high performance applications.

For applications assistance or more information on any of Systron Donner Inertial's micromachined inertial sensors, Call 1-800-227-1625.

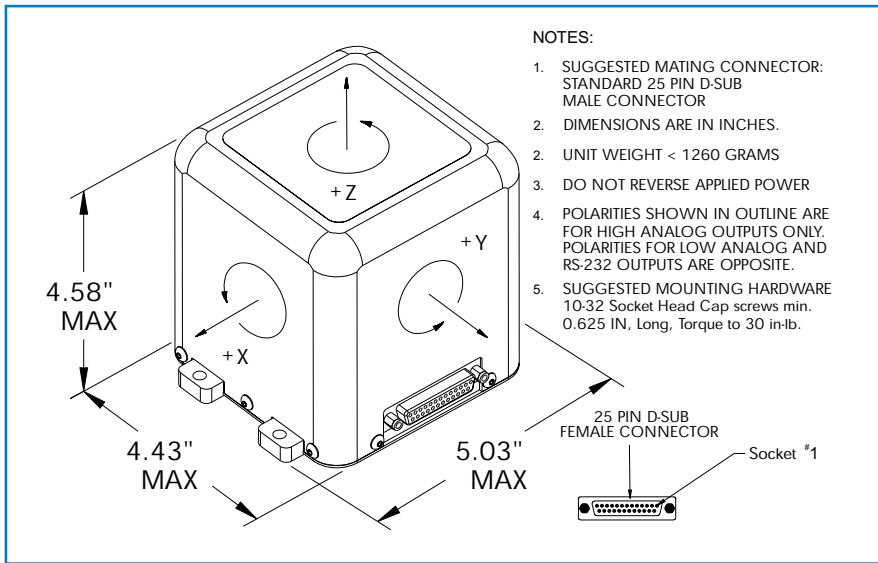
APPLICATIONS

- Vehicle Instrumentation
- Robotics
- Automotive Testing
- Attitude Reference Systems
- Control Systems
- Dead Reckoning Aiding GPS
- Flight Testing
- Buoy Instrumentation



MotionPak® II

Multi-Axis Inertial Sensing System



PIN ASSIGNMENT	
PIN NO.	DESCRIPTION
1	+15Vdc INPUT (or) +12Vdc INPUT
2	-15Vdc INPUT
3	PWR GND
4	CASE GROUND
5	X RATE OUT - HIGH ANALOG
6	HIGH ANALOG RETURN
7	Y RATE OUT - HIGH ANALOG
8	RS-232 TD (TRANSMIT DATA)
9	Z RATE OUT - HIGH ANALOG
10	RS-232 RD (RECEIVE DATA)
11	X ACCEL OUT - HIGH ANALOG
12	RS-232 GND
13	SPARE
14	Y ACCEL OUT - HIGH ANALOG
15	SPARE
16	Z ACCEL OUT - HIGH ANALOG
17	SPARE
18	X RATE OUT - LOW ANALOG
19	Y RATE OUT - LOW ANALOG
20	Z RATE OUT - LOW ANALOG
21	LOW ANALOG RETURN
22	Y ACCEL OUT - LOW ANALOG
23	TEMP SENSOR OUT
24	X ACCEL OUT - LOW ANALOG
25	Z ACCEL OUT - LOW ANALOG

Labels on the right side of the table indicate: HIGH ANALOG OUTPUT (pins 5-16), LOW ANALOG OUTPUT (pins 18-25), RS-232 (pins 8, 9, 10, 12), and Temperature Sensor (pin 23).

STANDARD OUTPUTS (HIGH, LOW & RS-232 OUTPUTS)

INPUT POWER

Input Voltage
Input Current

DUAL SUPPLY (BIPOLAR)

+ and - 15 Vdc ± 1 Vdc
Plus Supply < 125 milliampere
Minus Supply < 35 milliampere

SINGLE SUPPLY FEATURE (LOW OUTPUT & RS-232 ONLY)

SINGLE SUPPLY
+ 12.0 Vdc ± 1 Vdc
< 125 milliampere

PERFORMANCE

Standard ranges
Full Scale HIGH Analog Output
Full Scale HIGH Analog Output
Scale Factor HIGH-nominal
Scale Factor LOW-nominal
Sensitivity (Error) -40 to +85 °C
Offset HIGH -nominal
Offset LOW -nominal
Offset (-40 to +85 °C)
Output noise
Start-up time
Bandwidth
Non-linearity

RATE CHANNELS

± 75 °/sec
 ± 10 Vdc
+0.5/+4.5 Vdc
0.133 V/°/sec
0.027 V/°/sec
 $\pm 6\%$ (1)
0 Vdc
2.5 Vdc
 ± 5.0 °/sec (2)

ACCELEROMETER CHANNELS

± 1.5 g
 ± 10 Vdc
+0.5/+4.5 Vdc
6.66 V/g
1.2 V/g
 $\pm 5\%$
0 Vdc
2.5 Vdc
 ± 125 mg
< 5 mV RMS (DC - 4KHz)
< 1.0 second
-3dB@50 ± 30 Hz
 ± 40 mg

RATE CHANNELS

± 75 °/sec
--
+0.5/+4.5 Vdc
--
0.027 V/°/sec
 $\pm 6\%$ (1)
2.5 Vdc
 ± 5.0 °/sec (2)

ACCELEROMETER CHANNELS

± 1.5 g
--
+0.5/+4.5 Vdc
--
1.2 V/g
 $\pm 5\%$
2.5 Vdc
 ± 125 mg
< 5 mV RMS (DC - 4KHz)
< 1.0 second
-3dB@50 ± 30 Hz
 ± 40 mg

ENVIRONMENTS

Operating temperature -40 TO +85 °C
Storage temperature -40 TO +85 °C
Vibration survival 4 g RMS (20 - 2 KHz)
Shock 200 g PK 2 mSec $\frac{1}{2}$ sine pulse

-40 TO +85 °C
-40 TO +85 °C
4 g RMS (20 - 2 KHz)
200 g PK 2 mSec $\frac{1}{2}$ sine pulse

(1) Sum of 3% Set and 3% Linearity, worst case
(2) Sum of 1.8°/sec Set and 3.2°/sec TC, worst case

RS-232 FEATURE

Data Transfer Rate 32 Hz maximum (measuring 7 "12 BIT" WORDS)
LSB = 1.2 millivolt (Least Significant BIT)

TEMPERATURE SENSOR

10 millivolt/°K -40 °C (233.15 *K) = 2.33 Vdc +85 °C (358.15 *K) = 3.58 Vdc

Specification subject to change without notice



Division Headquarters

Systron Donner Inertial
355 Lennon Lane, Walnut Creek, CA 94598
Tel: 1-925-979-4500 or 1-800-227-1625
Fax: 1-925-979-9827
E-mail: sales@systron.com
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European Headquarters

Systron Donner Inertial Division
c/o FDS House, 94-104 John Wilson Park
Whitstable, Kent, England CT5 3QZ
Tel: ++44 (0) 7770 268698
Fax: ++44 (0) 1227 363289
E-mail: bei.tech@ukonline.co.uk