Scalable SIRU™ Family

The Scalable SIRU™ family of products combines innovation and high reliability—with 100 percent mission success in more than 70 million on-orbit hours—for precision performance on space missions.

Description

The Hemispherical Resonator Gyro (HRG) sensor on the Scalable SIRU™ is composed of three simple machined quartz parts—an outer shell, a high-Q vibrating hemispherical resonator and an inner shell. The quartz construction of the HRG is inherently stable, impervious to aging effects, and naturally radiation hardened. Operating in a completely evacuated hermetically sealed case, the HRG sensor is the ideal gyro for space applications.

Applications

The Scalable SIRU™ is the spacecraft manufacturer's choice for sensor pointing/stabilization and spacecraft attitude control on demanding long-term space missions, including:

- Earth orbits at all altitudes/angles
- Interplanetary missions
- Deep space missions

Advantages

The HRG-based Scalable SIRU™ incorporates unmatched features:

- Proven high reliability and long life, due to the simple HRG sensor design
- Ultra-low angle random walk and inherent freedom from dead band
- Fault-tolerant, redundant system architecture with cross-strapped HRGs and electronics, helping to ensure the success of missions lasting 15 or more years
- Dual bus architecture (RS-422, 1553), including RS-422 rates up to 1000Hz with the potential to feed both the satellite bus and payload, resulting in significant weight and power savings compared with a two-inertial measurement unit (IMU) design
- Demonstrated gyro capability, providing an inertially stable, low noise, wide bandwidth reference
- Radiation hardened sensors and electronics that operate reliably when subjected to long-term radiation exposure in space

Performance

The Scalable SIRU™ features precision inertial rate measurements, characterized by extremely stable gyro bias, low noise and precise scale factor.

Additionally, the efficient and redundant architecture of the Scalable SIRU™ helps ensure high performance and minimizes subassembly count. It contains:

- Four HRGs and four (optional) accelerometers, with independent associated loop control/readout/thermal control electronics, and sensing along the octahedral-tetrad axes
- Highly reliable n+1 design that allows the IMU to be reconfigured to achieve probability of mission success of 0.997 for a 15-year mission
- In a compact 15.7 lb. standard package, the internally redundant Scalable SIRU™ provides significant size, weight and power savings over competitive systems.

Radiation Hardness

Radiation hardness can be scaled by selecting specific EEE parts and variable thickness bolt-on shielding for low total

NORTHROP GRUMMAN

northropgrumman.com

dose, high total dose, high dose rate [2E8 rad (Si/s)] and SEU/SEL tolerance.

Heritage

The space-qualified Scalable SIRU™ evolved from the heritage Core SIRU™. Together, these systems have operated in space since 1996 for over 70 million hours with 100 percent mission success. Our heritage systems have been launched more than 225 times for NASA, Department of Defense, Civil, Commercial and International space applications.

The Scalable SIRU™ includes low latency software, which was first introduced in 2012 and is now a standard implementation. This variant has the same overall hardware configuration as the standard Scalable SIRU™ but includes a specific RS422 message software implementation, which is driven by the user's timing reference. Sample rate and anti-aliasing filter is available in 100Hz and 200Hz options, but can also be tailored to user specs up to 1000Hz.

Scalable SIRU™-L Configuration

The Scalable SIRU™-L is a variant configuration that has the same hardware and associated reliability as the Scalable SIRU™. The Scalable SIRU™-L has streamlined calibration and test processes that lead to a shorter delivery schedule and lower cost compared with the standard Scalable SIRU™.

Scalable SIRU™-E Configuration

The Scalable SIRU™-E variant has the same overall hardware configuration as the standard Scalable SIRU™ with the low latency option. A nominal increase in a sensor electronics component value improves the signal to noise ratio, resulting in tripled improvement in Angle White Noise.

Performance			
	Scalable SIRU™	**Scalable SIRU-L™**	**Scalable SIRU-E™**
Gyro Bias Stability	<0.0015°/hr, 1σ over 12 hours (Typical <0.0005°/hr)	<0.0015°/hr, 1σ over 12 hours	<0.0005°/hr, 1σ over 12 hours
Gyro Noise			
– Noise Equivalent Angle	<3 arc sec pk-pk	<3 arc sec pk-pk	<1 arc sec, pk-pk
– Angle Random Walk	<0.00015°/√hr (Typical <0.00005°/√hr)	<0.0002°/√hr	<0.00005°/√hr
– Angle White Noise	<0.003 arc sec/√Hz	<0.009 arc sec/√Hz	<0.0015 arc sec/√Hz @1000Hz output rate <0.0010 arc sec/√Hz @200Hz output rate
Scale Factor short term stability	<5 ppm, 1σ over 12 hours	10 ppm, 1σ over 12 hours	<5 ppm, 1σ over 12 hours
Scale Factor Non-Linearity	<20 ppm, (1σ)	<40 ppm, (1σ)	<20 ppm, (1σ)
Scale Factor Non-Linearity -1 to +1°/sec	<0.1°/hr	<0.2°/hr	<0.1°/hr
High Accuracy Mode Rate Range	±7°/sec at gyro input axis	±7°/sec at gyro input axis	±3°/sec at gyro input axis

Characteristics	
Power	28 or 70 Vdc, 43 W max
Size	Length: 11.4 in. (28.9 cm) (Without Optical Cube) Width: 7.1 in. (18 cm) Height: 5.9 in. (14.9 cm)
Weight	15.7 lb (7.1 kg)
Temperature	-55°C (-67°F) to +85°C (185°F) (non-operational) -10°C to +60°C (full performance)
Altitude	Sea level to space
Shock (Pyrotechnic)	3000g peak
Cooling	Base-plate conduction
Interface	1553B and/or RS-422
Random Vibration	18.56g rms
Sine Vibration	20g pk
Radiation Hardness	Scalable up to >15-year GEO missions

Features
High reliability: Over 70 million on-orbit hours with 100 percent mission success
Lightweight, small size, low power
Four solid-state HRGs and cross-strapped electronics in a redundant architecture
Optional accelerometers
Optional one and two optical cube configurations

For more information, please contact:
Northrop Grumman
Navigation, Targeting and Survivability
21240 Burbank Boulevard
Woodland Hills, CA 91367 USA
1-866-NGNAVSYS (646-2879)

northropgrumman.com

NORTHROP GRUMMAN