

THE VALUE OF PERFORMANCE.

**NORTHROP GRUMMAN**

## **LN-200S**

*Inertial Measurement Unit (IMU)*

**T**he LN-200S inertial fiber-optic gyro for space applications offers outstanding accel/gyro bias and random walk performance.

### **Description**

The LN-200S is a small, lightweight, highly reliable, state-of-the-art fiber-optic inertial measurement unit (IMU). The LN-200S comprises three solid-state fiber-optic gyros and three solid-state silicon Micro Electro-Mechanical Systems accelerometers in a compact package that measures velocity and angle changes in a coordinate system fixed relative to its case. Digital output data of incremental velocity and angle are provided to user equipment over a digital serial data bus.

The LN-200S has the performance of the LN-200 family, with additional screening and utilization of radiation-tolerant components for space environments. Additionally,

the LN-200S has the same form factor as the standard LN-200.

The LN-200S can be installed with software variations that include selectable data rate outputs from delta thetas and delta velocities.

### **Applications**

Designed for short- to medium-term space missions, the LN-200S provides highly reliable attitude reference and acceleration data for moderate performance demands, including:

- Earth and heliocentric orbits
- Missions lasting up to six years
- Moderate three-axis inertial reference

### **Advantages**

Adapted from Northrop Grumman's medium accuracy IMU, the LN-200S maintains performance, even in demanding environmental conditions. The unit is hermetically

sealed, which is advantageous for planetary and asteroid probes. The non-dithered, low-voltage inertial sensors ensure long, reliable usage life and low noise. The LN-200S IMU has been utilized and is still performing on the NASA Mars rovers after more than 10 years. The LN-200S has the lowest gyro and accelerometer white noise in the medium accuracy IMU class.

With full IMU functionality, the LN-200S performs critical functions in a spacecraft attitude control system. Its wide dynamic range makes it ideal for attitude determination and high maneuvers such as spacecraft slewing, despinning and thrust measurements. Its accelerometers provide inertial data useful for delta-V and other specific force measurements.

## Heritage

The LN-200S is part of the LN-200 product line, which has been in high-rate production since 1994 with more than 25,000 units produced. Northrop Grumman has a broad, strong business base for this family of systems and can ensure its availability and support for even the most demanding production quantities. Benefiting from the production line, the low-cost LN-200S unit is highly attractive to missions for flight demonstration, sensor redundancy and multiple phases.

The first prototype LN-200S was qualified for space flight onboard the Clementine spacecraft. Many spacecraft now depend on the IMU to provide reliable inertial data for low-earth orbit and space probe missions. Additional spacecraft that use the LN-200S include the following:

- BATSAT (Teledesic I)
- Deep Space I
- TSX-5
- MightySat II
- Space Station Interim Control Module
- Shuttle/SAFER
- VCL
- OrbView-3
- GRACE
- QuikTOMS
- Muses-C
- Coriolis
- Mars Rover (Spirit, Opportunity, and now, Curiosity)

Performance	
Accelerometer (1 $\sigma$ )	
Bias Repeatability	300 $\mu$ g, 1 $\sigma$
Noise	35 $\mu$ g/ $\sqrt{\text{Hz}}$
Scale Factor Accuracy	300 ppm, 1 $\sigma$
Input Axis Alignment	0.1 mrad
Max Input Accel	40 g
Gyro (1 $\sigma$ )	
Bias Repeatability	1°/hr, 1 $\sigma$
Bias Stability (60 min)	<0.1°/hr
Scale Factor Stability	100 ppm
Angle Random Walk	<0.07°/ $\sqrt{\text{hr}}$
Input Axis Alignment	0.1 mrad
Dynamic Range (max)	1,000°/sec
Bandwidth	200 Hz @ 400 Hz data rate

Characteristics	
Power	12w nominal, regulated at $\pm 5$ Vdc and $\pm 15$ Vdc
Dimensions	Diameter: 3.5 in. (8.89 cm) Height: 3.35 in. (8.51 cm) (plus connector)
Weight	1.65 lb (748 g)
Volume	35 in <sup>3</sup>
Temperature Range	-54°C (-65.2°F) to +71°C (+159.8°F)
Survival Temp Range	-62°C (-79.6°F) to 85°C (+185°F) Perf
Shock	400 g/100 Hz; 1,500 g/1,000 Hz
Vibration (survival)	15 g rms random
Radiation Tolerant	10 Krad
Electrical Interface Protocol	RS-422/485 serial data
Enclosure	Hermetically sealed

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