

# RT4000

## Inertial and GPS Measurement System

### Features

- 250 Hz Update Rate
- 2 cm Positioning
- 0.05 km/h Velocity
- 10 mm/s<sup>2</sup> Acceleration
- Dual Antenna GPS
- 0.1° Heading
- 0.03° Roll, Pitch
- 0.15° Slip Angle
- 0.01°/s Angular Rates
- Other Measurements
- Real-Time
- Low Latency
- CAN Output
- Wheel speed input
- 2 GB Logging
- 5 min Installation
- Compact Size

### Applications

- Photogrammetry
- Vehicle dynamics
- Autonomous vehicles
- AHRS
- Video correction
- Road survey
- Aerial survey
- LIDAR correction

Oxford Technical Solutions  
77 Heyford Park  
Upper Heyford  
Oxfordshire  
OX25 5HD  
England  
Tel: +44 1869 238 015  
Fax: +44 1869 238 016  
<http://www.oxts.co.uk>  
<mailto:info@oxts.com>

### North American Sales & Service

Brendel Associates Ltd.  
Brent Rijnovean  
Tel: (313) 729-9898

[info@brendelassociates.com](mailto:info@brendelassociates.com)  
[www.brendelassociates.com](http://www.brendelassociates.com)

# RT4000 High-Speed Inertial and Dual-GPS Navigation System

The RT4000 Inertial and Dual-GPS Navigation Systems are advanced six-axis inertial navigation systems, blended with precision GPS, to give high speed 250Hz, robust outputs of position, orientation and velocity. The second GPS improves heading accuracy.

The RT4000 Inertial and GPS Navigation System includes three angular rate sensors (gyros), three servo-grade accelerometers, two GPS receivers and all the required processing in one very compact box.

Six dual GPS antenna models in the RT4000 family allow us to offer very competitively priced products. The difference between the products is the positioning performance of the GPS receiver, with our most accurate model offering 2cm accuracy.



The RT4000 works as a stand-alone, autonomous unit and requires no user input before it starts operating.

The outputs from the RT4000 Inertial and GPS Navigation System are derived from the measurements of the accelerometers and gyros. Using the inertial sensors for the main outputs gives the RT4000 sys-

tem a fast update rate (250Hz) and a wide bandwidth. All the outputs are computed in real-time with a very low latency.

The two GPS receivers work together to measure true heading. Unlike inertial navigation systems corrected by single antenna systems, the heading accuracy is constant and not dependent on having high dynamics. It is possible for the RT4000 to initialise without motion.

The RT4000 Inertial and GPS Navigation System outputs its real-time measurements over RS232, Ethernet and CANbus.

The precision ADC in the RT4000 gives more than 19 bits of resolution. The resolution of the acceleration measurements is 0.24mm/s<sup>2</sup> (24µg). The ADC oversamples the analogue sensors and uses coning/sculling motion compensation algorithms to avoid aliasing of the signals.

The internal processing includes the strapdown algorithms (using a WGS-84 earth model), Kalman filtering and in-flight alignment algorithms. The internal Pentium-class

Parameter	RT4202	RT4102	RT4022	RT4003	RT4052	RT4042
Position Accuracy	3.0 mCEP SPS	1.8mCEP SPS	1.8mCEP SPS	1.5mCEP SPS	1.8mCEP SPS	1.5mCEP SPS
	1.4mCEP SBAS	0.6mCEP SBAS	0.6mCEP SBAS	0.6mCEP SBAS	0.6mCEP SBAS	0.6mCEP SBAS
	1.0mCEP DGPS	0.4mCEP DGPS	0.4mCEP DGPS	0.4mCEP DGPS	0.4mCEP DGPS	0.4mCEP DGPS
			0.5mCEP VBS <sup>2</sup>	0.5mCEP VBS <sup>2</sup>	0.5mCEP VBS <sup>2</sup>	0.5mCEP VBS <sup>2</sup>
			0.2m 1 $\sigma$ L1	0.15mCEP XP <sup>2</sup>		0.15mCEP XP <sup>2</sup>
				0.1mCEP HP <sup>2</sup>		0.1mCEP HP <sup>2</sup>
				0.2m 1 $\sigma$ L1		
				0.02m 1 $\sigma$ L1/L2		
Velocity Accuracy	0.2 km/h RMS	0.1 km/h RMS	0.08km/h RMS	0.05km/h RMS	0.08km/h RMS	0.07km/h RMS
Acceleration						
– Bias	10 mm/s <sup>2</sup> 1 $\sigma$	10 mm/s <sup>2</sup> 1 $\sigma$	10 mm/s <sup>2</sup> 1 $\sigma$	10 mm/s <sup>2</sup> 1 $\sigma$	10 mm/s <sup>2</sup> 1 $\sigma$	10 mm/s <sup>2</sup> 1 $\sigma$
– Linearity	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
– Scale Factor	0.1% 1 $\sigma$	0.1% 1 $\sigma$	0.1% 1 $\sigma$	0.1% 1 $\sigma$	0.1% 1 $\sigma$	0.1% 1 $\sigma$
– Range <sup>1</sup>	100 m/s <sup>2</sup>	100 m/s <sup>2</sup>	100 m/s <sup>2</sup>	100 m/s <sup>2</sup>	100 m/s <sup>2</sup>	100 m/s <sup>2</sup>
Roll/Pitch	0.1° 1 $\sigma$	0.05° 1 $\sigma$	0.04° 1 $\sigma$	0.03° 1 $\sigma$	0.04° 1 $\sigma$	0.03° 1 $\sigma$
Heading	0.2° 1 $\sigma$	0.1° 1 $\sigma$	0.1° 1 $\sigma$	0.1° 1 $\sigma$	0.1° 1 $\sigma$	0.1° 1 $\sigma$
Angular Rate						
– Bias	0.02°/s 1 $\sigma$	0.01°/s 1 $\sigma$	0.01°/s 1 $\sigma$	0.01°/s 1 $\sigma$	0.01°/s 1 $\sigma$	0.01°/s 1 $\sigma$
– Scale Factor	0.2% 1 $\sigma$	0.1% 1 $\sigma$	0.1% 1 $\sigma$	0.1% 1 $\sigma$	0.1% 1 $\sigma$	0.1% 1 $\sigma$
– Range <sup>1</sup>	100°/s	100°/s	100°/s	100°/s	100°/s	100°/s
Track (at 50km/h)	0.2° RMS	0.15° RMS	0.1° RMS	0.07° RMS	0.1° RMS	0.08° RMS
Slip Angle (at 50km/h)	0.3° RMS	0.2° RMS	0.15° RMS	0.15° RMS	0.15° RMS	0.15° RMS
Lateral Velocity	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%

Note 1. 300m/s<sup>2</sup> and 300°/s options are available. Note 2. A subscription is required to use OmniStar VBS, XP and HP services.



*Inertial Sensors in RT4000 include servo-grade accelerometers and precision MEMS angular rate sensors. Powerful 40MHz floating point DSP takes care of coning, sculling and aliasing.*



*GPS antenna for RT4202, RT4102 and RT4022 systems*

processor runs QNX real-time operating system to ensure that the outputs are always delivered on time.

The Kalman filter monitors the performance of the system and updates the measurements using GPS and wheel speed. By using the measurements from GPS, the RT4000 system is able to maintain highly accurate measurements and correct its inertial sensor errors.

The RT4000 comes with acquisition software that displays the data on a PC or on Pocket PC devices. The PC software can be used to save tests in files, display real-time results and monitor the performance.

The internal logging enables the RT4000 to work stand-alone. Post-mission, data can be output in ASCII text format and loaded in to the software of your choice.

Simple configuration software allows the user to change the mounting angle; displace the measurement point to a virtual location; change the differential GPS options, etc.

#### Models

To choose the best model for your application, think about the positioning accuracy you require and what differential GPS corrections you can supply. OmniStar systems give excellent results over a wide area. The RT4003 can give

more accurate positioning in a local area where licence-free radios can be used to transmit the corrections.

The RT4000 products are also available as single antenna models. For road vehicles the single antenna system may provide equally accurate measurements at a lower cost.

For further information please contact Oxford Technical Solutions or your nearest local agent.

Parameter	RT4000
Power	9-18 V d.c. 20 W
Dimensions (mm)	234 x 120 x 80
Weight	2.4 kg
Operating Temperature	-10 to 50°C
Shock Survival	100 G, 11 ms
Update Rate	250 Hz
Calculation Latency	3.5 ms
Internal Storage	2 GB