

# RT2000

## Inertial and GPS Measurement System

### Features

- 2cm Position
- 0.1 km/h Velocity
- 10 mm/s<sup>2</sup> Acceleration
- Lateral Acceleration
- 0.05° Roll, Pitch
- 0.2° Slip Angle
- 0.02°/s Rates
- Other Measurements
- 100Hz/250Hz Updates
- Real-Time
- Low Latency
- CAN Output Option
- 2 GB Logging
- 5 min Installation
- Compact Size

### RT2500 Applications

- Vehicle Testing
- NHTSA ESC
- Lap timing/racing
- Acceleration/Braking

### RT2002/4 Applications

- Vehicle Testing
- ADAS Testing on proving grounds (in combination with RT-Range)
- Steering Robot

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# RT2000 Low-Cost Inertial and GPS Navigation Systems

The RT2000 Inertial and GPS Navigation Systems are advanced six-axis inertial navigation systems that blend GPS information to keep the measurements accurate.

The RT2000 products show our commitment to bring customer value to users where a balance between price and performance is necessary.

The RT2000 Inertial and GPS Navigation Systems include three angular rate sensors (gyros), three servo-grade accelerometers, the GPS receiver and all the required processing in one very compact box.

The RT2000 works as a stand-alone, autonomous unit and requires no user input before it starts operating.



The outputs from the RT2000 Inertial and GPS Navigation Systems are derived from the measurements of the accelerometers and gyros. Using the inertial sensors for the main outputs gives the RT2000 systems a fast update rate and a wide bandwidth. All the outputs are computed in real-time

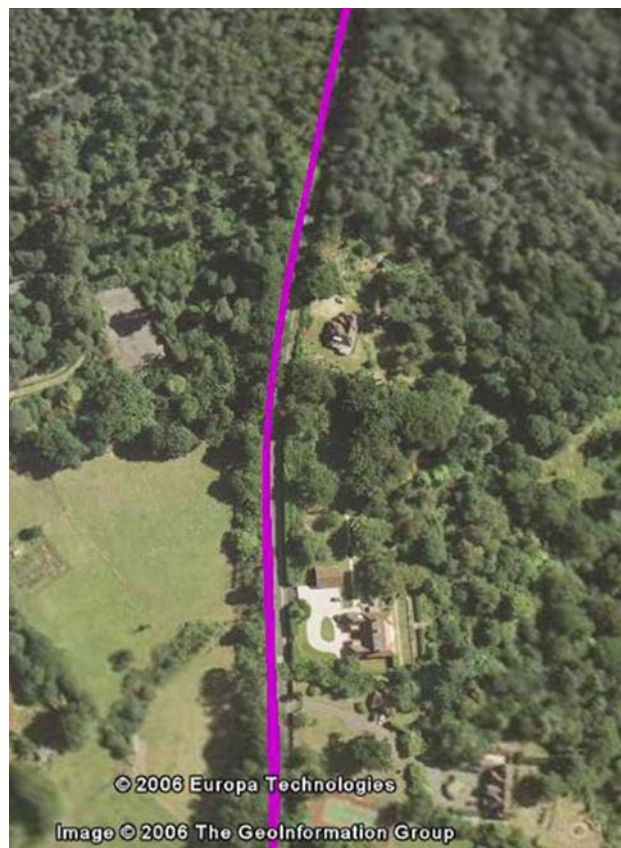
with a very low latency.

The RT2000 Inertial and GPS Navigation Systems output the real-time measurements over RS232, Ethernet and CANbus. Optional outputs can be made over Analogue.

The Analogue option includes 16 individually configurable channels of 16-bit resolution. Galvanic isolation on the analogue outputs ensures there are no ground loops.

The CAN bus output can be combined into a vehicle's CAN bus or captured using any CAN data acquisition system. The real-time nature allows the RT2000 family of products to be used for *hardware in the loop* and controller development. Connection to powerful tools like dSPACE is easy. CAN DBC files are provided.

The precision ADC in the RT2000 systems gives more than 20 bits of resolution. The resolution of the acceleration measurements is 0.12mm/s<sup>2</sup> (12µg). The ADC oversamples the analogue sensors and uses coning/sculling motion compensation algorithms to avoid aliasing of the signals.



Combining Inertial Sensors and GPS gives smooth trajectories, free from jumps, even in difficult GPS environments.

| Parameter              | RT2500/<br>RT2500-250         | RT2502/<br>RT2502-250         | RT2002/<br>RT2002-250  | RT2004/<br>RT2004-250   |
|------------------------|-------------------------------|-------------------------------|--|---|
| Positioning            | SPS / SBAS                    | SPS / SBAS                    | L1/L2  | L1 + GLONASS RTK  |
| Position Accuracy      | 3.0m CEP SPS<br>2.0m CEP SBAS | 3.0m CEP SPS<br>2.0m CEP SBAS | 1.5m CEP SPS<br>0.6m CEP SBAS<br>0.4m CEP DGPS<br>50cm CEP VBS<br>15cm CEP XP<br>10cm CEP HP<br>20cm 1σ L1<br>2cm 1σ L1/L2 | 1.8m CEP SPS<br>0.6m CEP SBAS<br>0.4m CEP DGPS<br>50cm CEP VBS<br>20cm 1σ L1<br>2cm 1σ GG-L1 <sup>2</sup> |
| Velocity Accuracy      | 0.2 km/h RMS                  | 0.2 km/h RMS                  | 0.1 km/h RMS   | 0.1 km/h RMS  |
| Acceleration           |                               |                               |  |   |
| – Bias                 | 10 mm/s <sup>2</sup> 1σ       | 10 mm/s <sup>2</sup> 1σ       | 10 mm/s <sup>2</sup> 1σ  | 10 mm/s <sup>2</sup> 1σ   |
| – Linearity            | 0.01%                         | 0.01%                         | 0.01%  | 0.01%   |
| – Scale Factor         | 0.1% 1σ                       | 0.1% 1σ                       | 0.1% 1σ  | 0.1% 1σ   |
| – Range                | 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             | 0.15° 1σ                      | 0.15° 1σ                      | 0.05° 1σ   | 0.05° 1σ  |
| Heading                | 0.3° 1σ <sup>1</sup>          | 0.2° 1σ <sup>1</sup>          | 0.1° 1σ <sup>1</sup>   | 0.1° 1σ <sup>1</sup>  |
| Angular Rate           |                               |                               |  |   |
| – In-run Bias          | 2 deg/hr                      | 2 deg/hr                      | 2 deg/hr   | 2 deg/hr  |
| – ARW                  | 0.2 deg/√hr                   | 0.2 deg/√hr                   | 0.2 deg/√hr  | 0.2 deg/√hr   |
| – Range <sup>1</sup>   | 100°/s                        | 100°/s                        | 100°/s   | 100°/s  |
| Track (at 50km/h)      | 0.25° RMS                     | 0.25° RMS                     | 0.1° RMS   | 0.1° RMS  |
| Slip Angle (at 50km/h) | 0.4° RMS                      | 0.4° RMS                      | 0.2° RMS   | 0.2° RMS  |
| Lateral Velocity       | 0.5%                          | 0.4%                          | 0.2%   | 0.2%  |

Note 1. On land vehicles using Advanced Slip. Note 2: the GG-L1 mode requires a suitable base-station. See user manual for details.



*Inertial Sensors in the RT2000 product family include servo-grade accelerometers and precision MEMS angular rate sensors. Powerful 40MHz floating point DSP takes care of coning, sculling and aliasing.*



*Magnetic GPS antenna for vehicle mounting. Other types available.*

The internal processing includes the strapdown algorithms (using a WGS-84 earth model), Kalman filtering and in-flight alignment algorithms. The internal Pentium-class 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. By using the measurements from GPS, the RT2000 systems are able to maintain highly accurate measurements and to correct inertial sensor errors.

The RT2000 Inertial and GPS Systems come with acquisition software that collects the data on a PC or on Pocket PC devices. The software can be used to save tests in files, display real-time results and monitor the performance.

The internal logging enables the RT2000 range of products

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 and many more.

To obtain the best position accuracy, the RT2500 systems are able to use SBAS correc-

tions such as WAAS and EGNOS.

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

| Parameter             | RT2000                          |
|-----------------------|---------------------------------|
| Power                 | 9-18 V d.c. 15W                 |
| Dimensions (mm)       | 234 x 120 x 76                  |
| Weight                | 2.3 kg                          |
| Operating Temperature | -10 to 50°C                     |
| Vibration             | 0.1 g <sup>2</sup> /Hz 5-500 Hz |
| Shock Survival        | 100G, 11ms                      |
| Update Rate           | 100 Hz / 250 Hz                 |
| Calculation Latency   | 3.5 ms                          |
| Internal Storage      | 2 GB                            |