



# GPS-based Space Weather Monitoring from Moving Platforms

## Designed for Remote Autonomous Operation & CubeSat Applications

### FEATURES

Low power requirement and small form factor

Near real-time space situational awareness from moving platforms

Remote re-programmability

Full control of receiver behavior, products, and cadences

Superior performance in severe scintillation environments

Flexible Communication Interfaces

Availability of precise Total Electron Content & GPS scintillation parameters

Robust tracking loops to track through events of interest

GAMMA is operable from a broad array of platforms, including ocean buoys and remote unmanned sites.

**GAMMA**, ASTRA's 5<sup>th</sup> generation dual-frequency GPS receiver, provides accurate TEC and simultaneous scintillation measurements in real-time. The GAMMA GPS receiver is a light-weight, low power, fully-autonomous system capable of operating from remote locations.\* The software architecture enables optimization of receiver performance for an array of platforms, including CubeSats, aircraft, and ocean buoys. The small form factor and low power requirement of the receiver allow integration on CubeSat platforms for ionospheric monitoring and GPS radio occultation.

\*using ASTRA's Standalone System Support Module in locations where power and communication infrastructure is not available

### Proven Unparalleled Tracking Performance

The GAMMA GPS receiver uses proven processing techniques that enable monitoring of ionospheric TEC and scintillations.

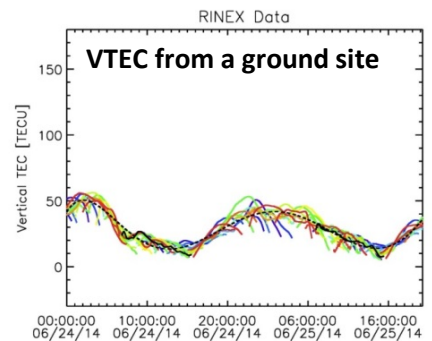
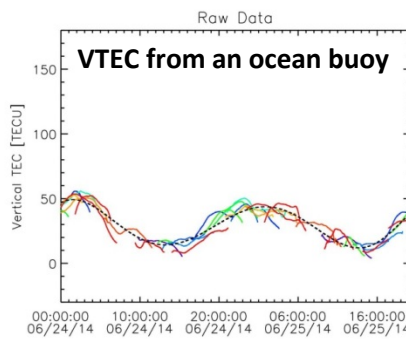
VTEC from ocean buoys has been validated against ground measurements. The figures below show vertical TEC measurements from an ocean buoy (left), and the corresponding VTEC from a ground site (right).



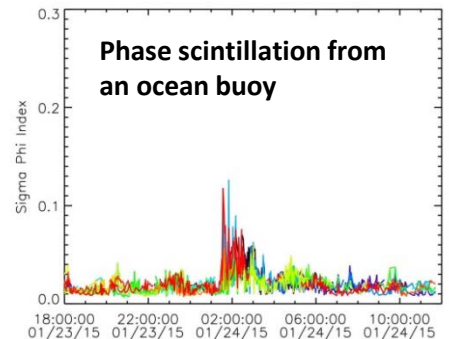
GAMMA OEM

Phase scintillation from an ocean buoy after motion correction is also shown.

### Representative Data Products



**GAMMA GPS is the only receiver available that can provide scintillation parameters from moving platforms**





# GAMMA Data Sheet

## Performance

### Channel Configuration

40 Channels

### Signal Tracking

GPS: L1 and L2C

### Configurable Data Rate

High Rate at 50 or 100 Hz

Low Rate at 1 Hz or less

Scintillation Parameters at user defined interval

### Time to First Channel Lock

Cold Start ~60s

Hot Start ~15s

## Physical and Electrical

Dimensions 4x3.75x1.25 (inches)

Weight Approx. 200 g

### Power

Supply Voltage +5V

Power Consumption 5 W (typical)

## Environmental

Operating Temperature 0-70°C

## Communication Interfaces

One USB Host Port

One  $\mu$ SDHC Port

One USB Debug Port

One RJ45 Ethernet Port

One UART Aux Port

Bluetooth

802.11 b/g Wifi (Wifi version only)

## Included Accessories

USB Cable

Power Cable

Manual and Quick Start Guide

## Optional Accessories

L1/L2 GPS Patch Antenna

L1/L2 GPS Choke Ring Antenna

RF Cables

High-Stability External OCXO

Storage Media

## Programmable Parameters

### Selected Parameters

- Number of tracking channels
- Low rate data cadence
- Scintillation parameters
- High rate data availability & cadence
- Data storage options
- EML chip spacing
- PLL loop order
- PLL bandwidth
- PLL discriminator type
- DLL bandwidth
- FLL bandwidth
- FLL weak bandwidth
- Code generation type
- Navigation smoothing parameters
- SPR threshold for non-scintillating channel
- Window length for scintillation calculations
- Frequency resolution for SPR calculation
- Scintillation threshold for triggering selective availability of high rate data
- Elevation mask for scintillation triggering

*For full list of parameters, see the CASES User Manual*

## Data Products

Data Type	Per Channel High Rate Data	Per Channel Low Rate Data	Per Channel Scint Params	Other
Default Data Rate	100 Hz	1 Second	60 Seconds	1 Second
Configurable Rate?	Yes, 50 or 100 Hz	Yes, $\geq 1$ Second	Yes	Yes, $\geq 1$ Second
Available Parameters	<ul style="list-style-type: none"> <li>• Integrated Carrier Phase</li> <li>• In-Phase Accumulation</li> <li>• Quadrature Accumulation</li> <li>• GPS Time</li> <li>• Receiver Time</li> </ul>	<ul style="list-style-type: none"> <li>• Pseudorange-based TEC</li> <li>• Phase-based delta TEC</li> <li>• Pseudorange</li> <li>• Integrated Carrier Phase</li> <li>• GPS Time, Receiver Time</li> <li>• Doppler Frequency</li> <li>• SV Elevation, SV Azimuth</li> <li>• C/N0</li> </ul>	<ul style="list-style-type: none"> <li>• <math>S_4</math></li> <li>• <math>\sigma_\phi</math></li> <li>• <math>\tau_o</math></li> <li>• Scint Power Ratio</li> <li>• GPS Time</li> <li>• Reference Channel Status</li> <li>• PRN</li> </ul>	<ul style="list-style-type: none"> <li>• Receiver X/Y/Z Position</li> <li>• Receiver X/Y/Z Velocity</li> <li>• GPS Time</li> <li>• Receiver Time</li> <li>• Receiver Clock Error</li> <li>• Receiver Clock Error Rate</li> </ul>