

# TSPI

## High Accuracy GPS

### Time and Space Position Information System



NAVSYS has developed an extremely accurate and affordable Time and Space Position Information (TSPI) System for aircraft and automotive performance envelopes, temperature and vibration environments. The NAVSYS TSPI System allows the user to rapidly perform developmental, acceptance, and qualification testing at levels not achievable through other means. The system enables a "rangeless" testing capability to the user. The NAVSYS TSPI provides the user with dynamic position accuracy of 1.0 ft, velocity of 0.1 ft/sec, acceleration of 100 micro g's, heading of 1.5 milliradians, and pitch/roll of 0.75 milliradian. The extended Kalman filter outputs these variables along with estimates of their uncertainties.

The NAVSYS TSPI was developed to first fly in the newest Lockheed Martin F-16 through all flight envelopes. It consists of a high accuracy GPS receiver, coupled with an IMU. There are also automated GPS ground stations (number required varies depending on the area of operation) that provide precise GPS reference data. The system's small size enables it to fit into a variety of existing small and restrictive enclosures.

TSPI data can also be synchronized and combined with other available vehicle performance sensors to enable precise modeling and analysis of the vehicle's dynamics.

The NAVSYS TSPI consists of both an in-vehicle system and a stationary ground system. The in-vehicle equipment contains the integrated GPS receiver, IMU, processor, power supply, required I/O, and data storage capability. The ground system includes several ground stations (exact number of ground stations is dependant on the area of coverage desired by the user) Each station is self powered autonomous system that contains its own GPS receiver, data storage capability, communications link, and power supply.

The in-vehicle and ground systems work independently of each other, but the recorded data from both systems is used to perform the post-processing analysis required to achieve the desired accuracies.



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### In-Vehicle System Major Components:

#### IMU:

- $0.3^{\circ}/\text{rt-hr}$
- $0.065 \text{ ft/sec/rt-hr}$  (85 mG/rt-Hz)

#### GPS:

- 12-channel L1/L2

#### Data Storage:

- 720 hours continuous

#### Power

- 50W, 28 VDC

#### Environmental

- Temperature:  $-40$  to  $+185^{\circ}\text{F}$
- Altitude:  $>50,000 \text{ ft}$

### Ground System Major Components:

#### GPS:

- 12-channel L1/L2
- Data logger

#### Data Storage:

- 76 days continuous

#### Communications:

- Wireless Modem
- Landline Modem

#### Power:

- Solar cells & stands
- Battery & Universal VAC

### Accuracy

#### Position:

- $< 1 \text{ ft}$  vertical,
- $< 0.5 \text{ ft}$  horizontal

#### Velocity:

- $< 0.1 \text{ ft/sec}$

#### Acceleration:

- $< 0.02\text{g}$  (Navigation Frame)
- $< 100\mu\text{g}$  (Body Frame)

#### Attitude:

- $< 1.5 \text{ mrad}$  heading
- $< 0.75 \text{ mrad}$  pitch, roll

#### Attitude Rate:

- $< 45 \text{ mrad/sec}$

#### Post Processed Data Rate:

- User selectable up to 100 Hz

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