

Galaxy Nav-2T

MEMS-based Integrated INS/GPS System for Land

Galaxy has developed a family of Guidance, Navigation, and Control (GN&C) products that use low-cost solid-state inertial sensor technology integrated with external Global Navigation Satellite System (GNSS) receivers - GPS, GLONASS or future systems.

Nav-2T is an integrated INS/GPS system designed specifically for aviation applications. This ultra-compact low-power system works in any type of fixed-wing or rotor air vehicle (manned or unmanned) providing a total navigation solution with outstanding characteristics at a competitive total cost of ownership. It requires only DC power supply and any device capable of accepting RS232 data.



High-Performance Low-Cost Solution for Navigation, Flight Control and Guidance



Applications

- 3-D Navigation and Positioning
- Precise Inertial Heading Determination
- Attitude Determination
- Autonomous Motion Data Recording
- Motion Detection and Measurement
- Autonomous Navigation in Tunnels
- INS/GPS aided positioning in city canyon
- Simplified map matching
- INS/GPS Aided Urban Positioning
- Experimental Vehicle
- Unmanned Ground Vehicles (UGV)
- Special Purpose Vehicles
- Car Testing and Motion Analysis

Advanced Driving Assistance Systems:

- Car autopilot
- Sleeping detection
- Dynamic pitch and roll indication
- Adaptive cruise control
- Instant heading determination
- High position resolution

Performance

During normal operation **Nav-2T** computes a three-dimensional navigation solution (including attitude and heading) based on integrated inertial data. This inertial solution is corrected using a Kalman filter, which processes GNSS rate. This reduces measurements at a 1-Hz results in a robust sensor errors and navigation solution. The navigation solution remains accurate during periods of GNSS signal loss due to satellites obscuration (for example, during complex maneuvers) and high dynamics. **Nav-2T** must complete both inertial system alignment and GNSS signal acquisition to output the integrated navigation solution with specified characteristics. If powered up

with GNSS off, **Nav-2T** will operate as an AHRS, providing accurate roll and pitch data, which is fully time-independent.

Key system features:

- Complete navigation/motion data output
- More accurate positioning compared to inertial GNSS
- Fast cold start
- Low size, low power, low cost
- Fully digital output
- Consistent navigation data
- High responsive heading information
- Dynamic attitude indication
- Easy to integrate implementation

Accuracy

	Units	GNSS On	GNSS Gap			
			10 sec	40 sec	1 min	5 min
Position	m RMS	5 (*)	6~10	20~40	50~70	200
Velocity						
X,Y Velocity	m/s RMS	0,3	0,4	0,8	1,0	1,5
Z Velocity	m/s RMS	0,2	0,3	0,3	0,3	0,3
Pitch and roll	deg RMS	0,4...0,5	0,5...0,6			
Heading	deg RMS	0,5	4 (10 min GNSS off)			
Attitude	m	2	3			

Notes

(*) Applies to a standard configuration with GPS receiver Garmin GPS35 (positioning accuracy of 15 m RMS).

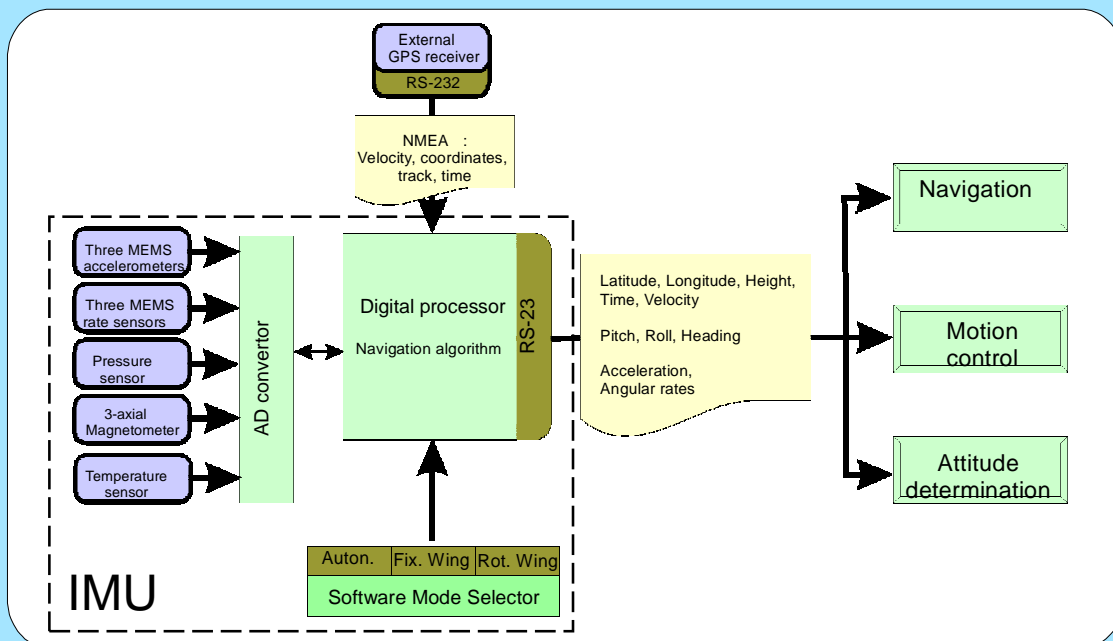
Dynamic Ranges

	Units	Range	Resolution
Roll, Pitch	deg	±180, ±90	0,05
Accelerations	g	±10	10 ⁻³
Heading	deg	0...360	0,1
Angular rate	deg/sec	±150	10 ⁻²
Max. calibrated altitude	m	6,000	0,2
(for barometric altimeter)	ft	18,000	1

Architecture

Nav-2T is a MEMS-GPS integrated system intended for land vehicle navigation, heading and attitude determination. Combining GPS data with inertial sensors measurements the system provides the user with complete set of continuous information about position, height, attitude angles, accelerations and angular rates under any environment and motion conditions. Tiny enough to be fitted into the pocket, **Nav-2T** offers the complete performance of inertial navigation, attitude determination and motion sensing, introducing the genuine aviation technology in conventional land applications.

Nav-2T consists of MEMS angular rate sensors and accelerometers, magnetometers, temperature sensors, and barometric altimeter. Proprietary sensor fusion and navigation software runs on a high-speed microprocessor. It implements Galaxy-developed inertial strap-down system algorithm, which employs special quaternion algebra, time series analysis and proprietary optimal filtering mechanization. GNSS is integrated with IMU using loosely coupled technique to provide flexibility in the choice of GNSS receivers (NMEA interface is required).



Note: in the standard configuration magnetometer is not used in the navigation algorithm. In order to include it in calculations, a special procedure of deviation compensation must be implemented for each installation type (contact Galaxy for details).

Electronics and Mechanical Design

Nav-2T hardware is built entirely from commercial off-the-shelf electronic and mechanical components. Its high reliability was proven in multiple flight tests and many hours of in-service operation.

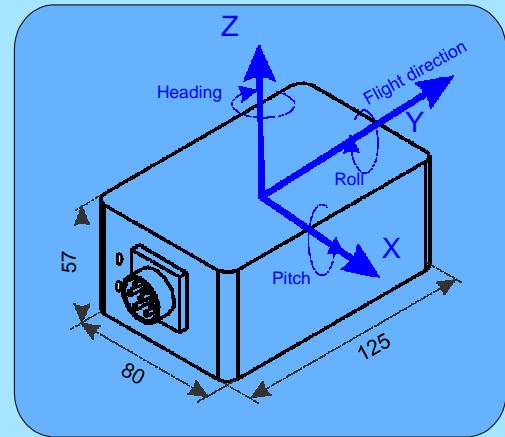
The electronics (except GNSS receiver) are housed in a metal chassis that is hermetically sealed and ruggedized, forming a compact, robust package.



Characteristics

Physical		
Size	in cm	4,9x3,1x2,2 12,5x8,0x5,7
Weight	lbs kg	<1,4 <0,6
Environmental		
Operating temperature	deg C	-40 to +85
Non-operating temperature	deg C	-60 to +85
Humidity	%	<98
Atmospheric pressure	kPa	20-113
Operating vibration (50-2000 Hz, 11 msec)	g	+/- 4
Operating shock	g RMS	+/- 40
Electrical		
Input voltage	VDC	10-30VDC
Input current (at 12 VDC)	A	0,17
Power consumption (at 12 VDC)	W	<1,5
Data		
Update rate	Hz	50
Fully stabilized data	sec	<30
Output signal type		RS-232
Data format		Galaxy proprietary or NMEA

Dimensions and Orientation



Electrical Interface

CP1 - power cable

Connect 1 + Power
Connect 2 "Ground" Power

MP1-50 - VITANS connector

1-4 Factory use
5, 6, 7 + Power
8, 9, 10 - Ground
11-17 - Factory use
18-21 COM4 (RS232)
22-25 COM3 (RS232)
26-29 COM2 (RS232)
30-33 COM1 (RS232)
34-50 Factory use

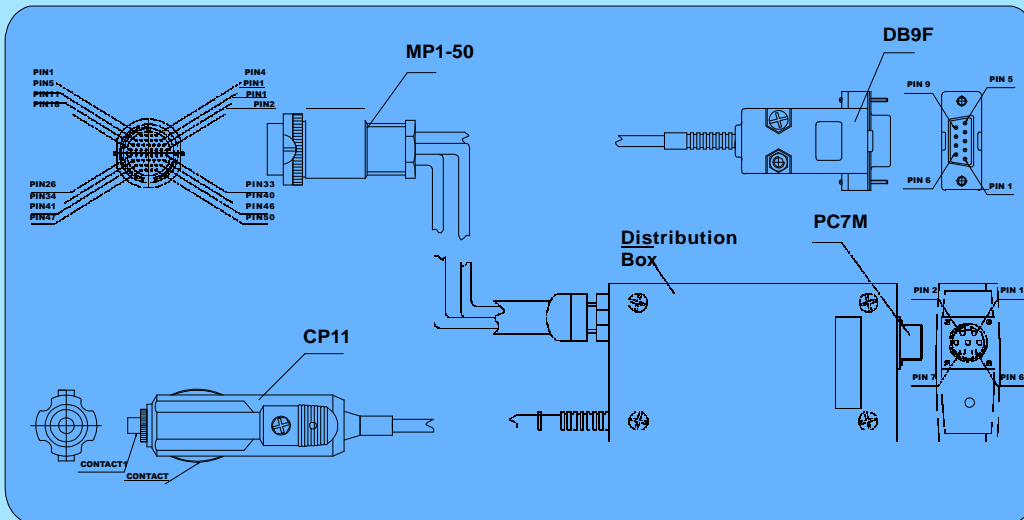
PC7M - GPS

1,2 + Power
3-5 RS232
6,7 - Ground

DB9F - data output (RS232)

1 Data carrier detect
2 Receive data
3 Transmit data
4 Data terminal ready
5 Signal ground
6 Data set ready
7 Request to send
8 Clear to send

Optional Interconnect Cable



Output Data

INS/GPS data 50 Hz

Latitude, Longitude
Pitch, Roll, Heading, Magnetic heading
Ground speed, Vertical speed
Altitude, Barometric altitude
G-load
Specific force (XYZ)
Angular velocity (XYZ)
Velocity components (Eastern, Northern)
Time in navigation mode
Time after power-on
Checksum

GPS data 1 Hz

(NMEA GGA,GSA,RMC, GSV messages)
Latitude, Longitude
Ground speed
Course
UTC Time, Date;
Altitude
NMEA GSA HDOP, VDOP, PDOP
NMEA GSV satellites data
NMEA GGA satellites data

Status flags 50 Hz

No usable GPS data
Motion detection (Stop/Move)
NMEA RMC valid
NMEA GGA quality
INS mode
NMEA calculation mode