

Galaxy Nav-2

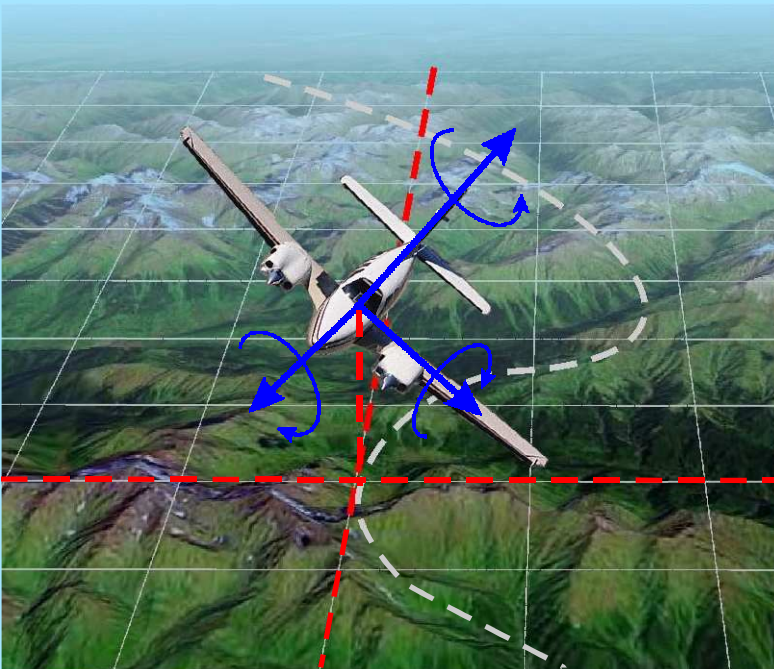
MEMS-based Integrated INS/GPS System for Aviation

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-2 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
- Attitude and Heading Determination
- Predictive Flight Guidance and Control
- Autonomous Flight Data Recording
- Motion Detection and Measurement
- Stand-by Avionics Instruments
- General Aviation
- Experimental Aviation
- Unmanned Air Vehicles
- Special Purpose Aviation
- Flight Testing and Analysis
- Commercial Aviation

Performance

During normal operation Nav-2 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 measurements at a 1-Hz rate. This reduces inertial sensor errors and results in a robust 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-2 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-2 will operate as an AHRS, providing accurate roll and pitch data, which is fully time- independent.

Accuracy

	Units	GNSS On	GNSS Gap 5 min	GNSS Off
Position	m RMS	6 (*)	500 (**)	Not available
Velocity				
X,Y Velocity	m/s RMS	0,3	5(**)	Not available
Z Velocity	m/s RMS	0,28	0,35	0,5
Pitch and roll				
Straight Horizontal Flight	deg RMS	0,2...0,3	0,2...0,3	0,3...0,5
Normal Maneuver (***)	deg RMS	0,4...0,6	0,5...0,7	0,7...1
Complex Maneuver (***)	deg RMS	1,3	1,5	2
Heading (****)	deg RMS	0,5	3	Not available
Altitude	m	2...4	2...4	6

Notes

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

(**) Assumes straight level flight prior to and during GPS gap.

(***) Normal is "pitch and roll less 45 deg", complex is "pitch and roll 45 deg...75 deg".

(****) Heading is calculated as deviation from the track angle value which is output by GNSS receiver immediately after CompaNav-2 initialization.

Dynamic Ranges

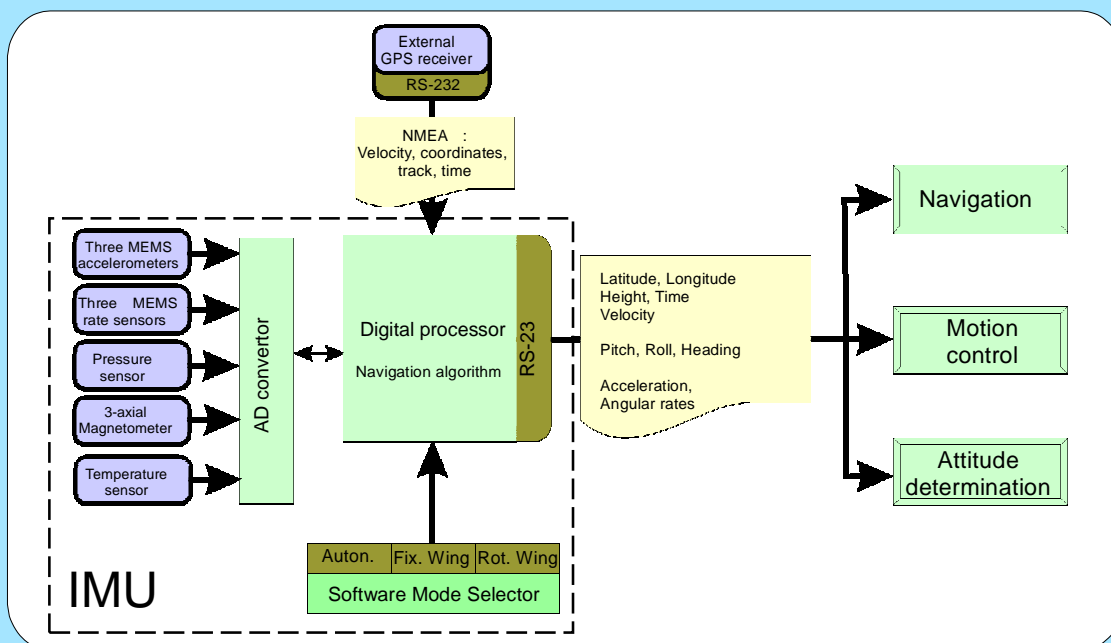
	Units	Range	Resolution
Roll, Pitch	deg	±180, ±90	0,05
Accelerations	g	±10	10 ⁻³
Heading	deg	0...360	0,1
Angular rate	deg/sec	±300	10 ⁻²
Max. calibrated altitude	m	6,000	0,2
(for barometric altimeter)	ft	18,000	1

Architecture

Nav-2 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).

For optimal performance in the main aviation applications (aircraft or helicopter), Galaxy introduced corresponding algorithm modes, which account for specific motion characteristics and are included in every navigation software. The default mode setting is stored in non-volatile memory and is activated at power-up. The third mode - autonomous - is used in laboratory for unit testing and main performance characteristics verification.

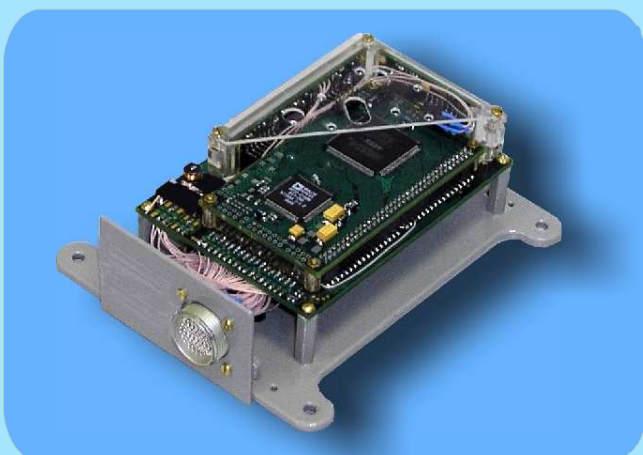


Note: in the standard configuration magnetometer is not used in the navigation algorithm. In order to include it in calculations, a special procedure of deviation compensation must be implemented for each installation type (contact Galaxy for details).

Electronics and Mechanical Design

Nav-2 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.

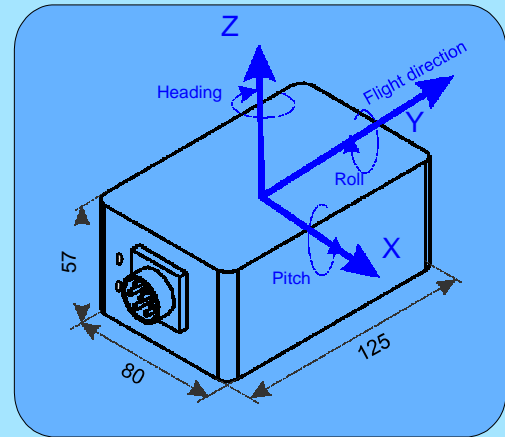
The electronics (except GNSS receiver) are housed in a metal chassis that is hermetically sealed and ruggedized, forming a compact, robust package.



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

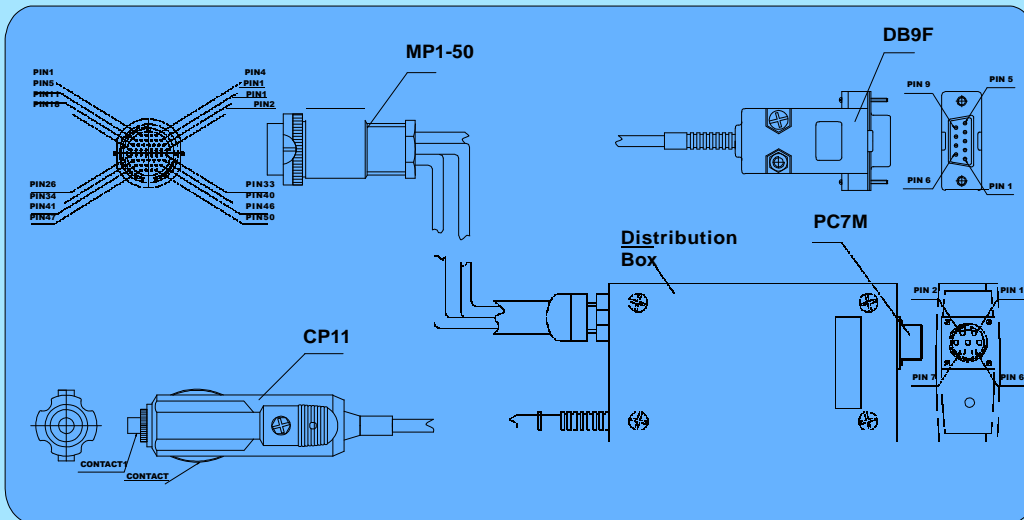
PC7M - GPS

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, Dat;
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