# 3DM-RQ1™ -45

Ruggedized Tactical Grade GPS-Aided Inertial Navigation System

The **3DM-RQ1™** -45 Ruggedized Tactical Grade GPS-Aided Inertial Navigation System (GPS/INS) combines a MEMS inertial sensor core with a high sensitivity GPS receiver, and a sophisticated Extended Kalman Filter to generate optimal position, velocity, and attitude (PVA) estimates. Time aligned raw GPS outputs and IMU measurements are also available to the user. The 3DM-RQ1™ -45 has been designed to meet the needs of applications that require tactical grade performance in a harsh operating environment while simultaneously demanding low cost and a small package size.
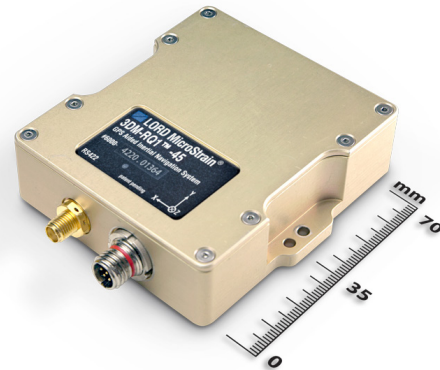
Features & Benefits

Best in Class
- precise position, velocity & attitude estimates
- fully configurable data outputs
- high immunity to shock and vibration
- compact, low profile, & light weight
- galvanically isolated
- -55 to 80 °C operation (-40 to 80 °C with heaterless model)
- designed to DO-160G for deployment in harsh environments

Easiest to Use
- simple integration supported by SDK & comprehensive API
- robust, forward compatible MIP™ packet protocol

Cost Effective
- reduced cost and rapid time to market for customer's applications
- aggressive volume discount schedule

Applications

Accurate navigation and attitude under dynamic conditions such as:

- camera stabilization
- satellite dish, radar, & antenna pointing
- platform stabilization, artificial horizon
- primary and/or secondary GPS-aided navigation system
- unmanned vehicle navigation
- health and usage monitoring of vehicles
- reconnaissance, surveillance, & target
- robotic control
- personnel tracking

System Overview

The advanced GPS/INS Kalman Filter embedded in the 3DM-RQ1™ -45 provides high accuracy position, velocity and attitude & heading outputs. A full set of supporting data quantities are also available including: PVA uncertainties, estimated gyro and accel bias and scale factor errors, filter status and gravity-free linear acceleration.

All data is transmitted using LORD MicroStrain's robust MIP™ packet protocol. This allows the user to fully configure the data stream to meet the needs of the application. It ensures forward and backward software compatibility.

The 3DM-RQ1™ -45 utilizes the LORD **MicroStrain®** IMU7 inertial sensor core which rovides tactical grade performance. All inertial measurements are fully temperature compensated and are mathematically aligned to an orthogonal coordinate system. The angular rate quantities are further corrected for g-sensitivity and scale factor non-linearity. The hardware architecture has been carefully designed to substantially eliminate common sources of error. Onboard coning and sculling compensation allows for use of lower data output rates while maintaining the performance of a fast internal sampling rate.

The 3DM-RQ1™ -45 is housed in a compact, low profile enclosure. It is designed to meet a comprehensive set of DO-160G Environmental requirements for airborne equipment including: altitude, temperature, humidity, shock, vibration, water proofness, voltage pike and EMI/EMC.

LORD MicroStrain®
SENSING SYSTEMS
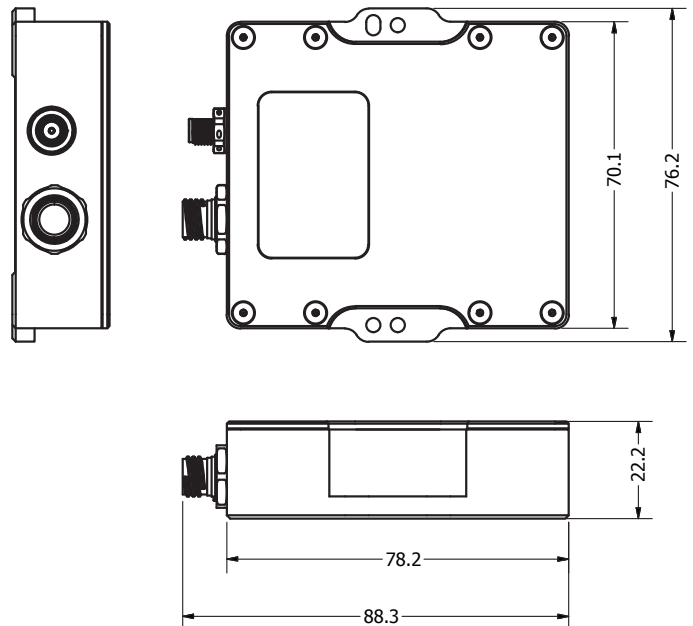
Specifications

INS Specifications

Performance	
Typical position accuracy	±2.5 m RMS horizontal, ±5 m RMS vertical
Typical velocity accuracy	±0.1 m/s RMS
Typical attitude accuracy	±0.1 deg RMS roll & pitch ±0.5 deg RMS heading
Typical attitude repeatability	0.1°
Attitude resolution	<0.01°
Attitude, heading range	360° about all axes
Navigation filter update rate	500 Hz
Features	vehicle dynamics mode selection, user-defined sensor to vehicle frame transformation and offset, antenna offset, bias enable/disable, external GPS and heading input support, WGS84 gravity model, WMM 2010 geomagnetic model
Output quantities	LLH position, NED velocity, attitude (Euler angles, orientation matrix or quaternion), acceleration, angular rate, deltaTheta, deltaVelocity, GPS time, filter status, PVA uncertainties, gravity-free linear acceleration, bias-compensated angular rate, estimated accel and gyro bias and scale factors
Data output rate	1 Hz to 500 Hz

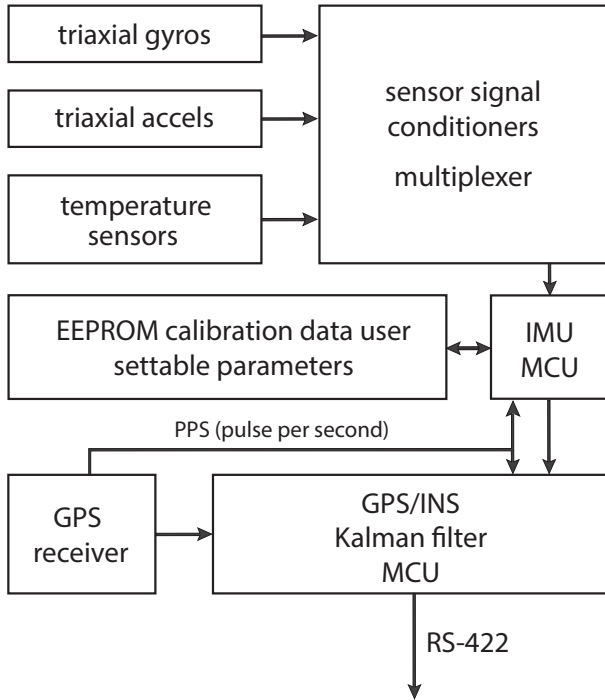| General	
Interface	RS422
Baud rate	9,600 bps to 230,400 bps (115,200 bps default)
Power supply voltage	+10 to +28 volts DC
Power consumption	**low temp model**: 2.5 W at 0 to 80 °C case temp; up to 6 W at -55 to 0 °C case temp; 25 W during pre-heat (up to 1 min at startup if case temp is below -25 °C) **standard model (heaterless)***: 2.5 W at -40 °C to 80 °C case temp
Connector	Glenair series 801 "Mighty Mouse" 7 pin circular
Operating temperature (case temp)	low temp model: -55 to 80 °C; standard (heaterless) model*: -40 to 80 °C
Vibration	6g RMS 10-2000 Hz
Shock	750 g half sine 2 msec powered any axis
Dimensions	88.3 mm x 76.2 mm x 22.2 mm 3.48 in x 3.00 in x 0.87 in
Weight	205 grams
Standards	ROHS Compliant, DO-160G
Software utility	CD in starter kit (XP/Vista/Win7/Win8 compatible)
Software development kit (SDK)	complete data communications protocol and sample code
API	MIP™ Packet Protocol

*contact factory for availability of standard (heaterless) model

Sensor Specifications

General		
	Accels	Gyros
Measurement range	±5 *g*	±300°/sec
Non-linearity	±0.03 % fs	±0.03 % fs
In-run bias stability	±0.02 m*g*	5°/hr
Initial bias error	±0.001 *g*	±0.05°/sec
Scale factor stability	±0.05 %	±0.05 %
Noise density	50 µg/√Hz	0.002°/sec/√Hz
Alignment error	±0.05°	±0.05°
Bandwidth (maximum)	250 Hz	160 Hz
Sampling rate	10 kHz	10 kHz
Resolution	<0.04m*g*	<0.0025°/sec
Vibration rectification error (Typical)	0.025%	0.001°/s/$g2$ rms
Vibration induced noise	—	0.06°/srms/$g2$ rms
4 Stage Filtering	analog low pass filter, digital sigma-delta anti-alias filter, user adjustable low pass filter, coning & sculling at 1000 Hz	

Options	
Gyroscopes	±75°/sec, ±150°/sec, ±900°/sec

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triaxial gyros →

triaxial accels →

temperature sensors →

sensor signal conditioners

multiplexer

EEPROM calibration data user settable parameters ↔ IMU MCU

PPS (pulse per second)

GPS receiver → GPS/INS Kalman filter MCU

RS-422

GPS Specifications

GPS Receiver	
GPS receiver type	50 Channels, L1 frequency, GPS C/A Code SBAS: WAAS, EGNOS, MSAS, GAGAN
GPS solution update rate	Up to 4Hz
Time-to-First-Fix	Cold Start (Autonomous): 36 sec Warm Start (Autonomous): 36 sec Hot Start: < 1 sec
GPS tacking and navigation sensitivity	-159 dBm
GPS reacquisition sensitivity	-159 dBm
GPS cold start (autonomous) sensitivity	-141 dBm
GPS velocity accuracy	0.1 m/sec
GPS heading accuracy	0.5°
GPS horizontal position accuracy	< 2.5 m Autonomous < 2.0 m SBAS (CEP, stationary 24 hours, SEP 3.5 m)
GPS timepulse signal accuracy	30 nsec RMS < 60 nsec 99%
GPS acceleration limit	≤ 4 g
GPS altitude limit	no limit
GPS velocity limit	500 m/sec (972 knots)
GPS antenna connector	SMA type
Data output rate	1 Hz to 4 Hz