iNAT-RQH-400x

Inertial INS/GNSS/ODO/xxx Navigation & Surveying System
for Advanced Applications on Land, at Sea and in the Air

iNAT-RQH is a member of the iNAT INS/GNSS product family for inertial navigation, timing, gyro compassing, surveying and dynamic motion measurement with ring laser gyros, that covers applications, which require high accuracy, reliability, a flexible interface and easy integration and usage.

- High performance inertial navigation and surveying system for airborne, naval, underwater, surface and railway applications; self gyro compassing.
- RLG technology with low angular random walk and much better bias stability and vibration / temperature gradient robustness than FOG based systems.
- Integrated time synchronization module and L1L2 up to all-frequencies / all-constellations GNSS / RTK / PPP engine with single or dual antenna. External atomic clock as option.
- High data rate, open interfaces: UART RS422 / RS232, Ethernet TCP/IP - UDP, CAN, ARINC429, ARINC825, NMEA 183.
- Integrated VMS / odometer interface.
- Internal 32 GByte non-volatile memory ("black-box"), up to 128 GByte as option
- Small size, low weight, low power; integrated surveying markers and aiding support points on the enclosure.

The iNAT-RQH consists of three high precision ring laser gyroscopes, three servo accelerometers, a powerful strapdown processor and an open and modular architecture with open interfaces.

The system contains an up to all-frequencies / all-constellations RTK / PPP capable GNSS receiver (GPS, GLONASS, GALILEO, Beidou), several Dig-I/Os (e.g. for odometer, laser altimeter, DVL) and DAC. Optional communication I/Os are Ethernet (TCP/IP, UDP), RS422/232 UART, CAN, ARINC429, ARINC 825 as well as internal data storage on non-volatile memory.

Data processing (strapdown navigation, gyro compassing, north keeping etc.) is performed inside of the iNAT-RQH, data transmission and storage of pure or corrected raw data is available.

A key feature is its high data rate of up to 300 Hz and its unique resolution (0.000'3 degree in roll/pitch/yaw) as well as its superior accuracy (e.g., for stabilization tasks). Customized algorithms can be provided as option. (e.g. for SAR or LIDAR applications).

The iNAT-RQH contains a sophisticated INS/GNSS/ODO/xxx based 42+ state extended

Kalman filter for data fusion incl. gyro compassing, free inertial or dead-reckoning navigation etc. The iNAT-RQH-400x family is available in several performance classes, down to 0.001 deg/sqrt(hr) angular random walk.

The user software iXCOM-CMD allows the user the full control of the system, data storing on the iNAT device as well as on the host computer (if any) and data visualization in real-time and playback mode. It also supports access via network (e.g. to download stored data). Furthermore, a powerful post-processing tool is available for advanced surveying applications. iNAT-RQH supports also multi-vehicle tracking operation to monitor several objects simultaneously.

The systems are covered by European dual-use export control regulations and partially by ITAR. With the family of iNAT-RQT a fit-function (FF) compatible system is provided which is not regulated by ITAR. With iNAT-FSSG-1 a compatible system with dual-antenna GNSS technology is provided, which even does not require any export license.

Technical Data of iNAT-RQH-400x (rms values)

Data Output:	Heading, Roll, Pitch, Angular Velocity, Velocity (Body and World), Position, Raw Data of INS / GNSS / VMS incl. time-stamp, Internal Status Information

True Heading [1]:

iNAT-RQH-4001:	< 0.015° [0.26 mils] sec(lat) free inertial; 0.01° with GNSS/motion, 0.008° post-proc RTK/motion
iNAT-RQH-4002:	< 0.020° [0.35 mils] sec(lat) free inertial; 0.01° with GNSS/motion, 0.008° post-proc RTK/motion
iNAT-RQH-4003:	< 0.028° [0.50 mils] sec(lat) free inertial; 0.01° with GNSS/motion, 0.008° post-proc RTK/motion
iNAT-RQH-4004:	< 0.057° [1.00 mils] sec(lat) free inertial; 0.01° with GNSS/motion, 0.008° post-proc RTK/motion

Attitude Accuracy [1]:

iNAT-RQH-4001:	< 0.012° (< 0.005° with GNSS/motion, 0.002° postproc with RTK aiding/motion)
iNAT-RQH-4002:	< 0.016° (< 0.005° with GNSS/motion, 0.003° postproc with RTK aiding/motion)
iNAT-RQH-4003:	< 0.023° (< 0.005° with GNSS/motion, 0.003° postproc with RTK aiding/motion)
iNAT-RQH-4004:	< 0.050° (< 0.008° with GNSS/motion, 0.003° postproc with RTK aiding/motion)

Position Accuracy [1]:	free inertial: -4001: < 0.2 nm/hr; -4002: < 0.5 nm/hr; -4003: < 0.8 nm/hr; < 1 m GNSS (S/A off) and < 10 cm RTK online, < 0.5 m with ground based ref station / SBAS / TerraStar and 2 cm with RTK/INS < 0.1 % distance travelled (with odometer and GPS, application dependant) < 0.2 % distance travelled on underwater vehicles (incl. RDI DVL interface)
Velocity Accuracy [1]:	< 20 mm with standard GNSS, 5 mm/s aided with RTK GNSS, < 3 mm/s postproc RTK

Alignment Duration:

On-shore Alignment Duration to achieve true heading of (static):

Class of System	Gyroscopes	Accelerometer		0.25°	0.1°	0.05°	0.028°	0.013°
iNAT-RQH-4001:	< 0.0010 °/√h 0.0020 °/hr	< 8 µg/√Hz	25 µg	2 min	2 min	3 min	5 min	19 min
iNAT-RQH-4002:	< 0.0015 °/√h 0.0027 °/hr	< 10 µg/√Hz	25 µg	2 min	2 min	4 min	7 min	
iNAT-RQH-4003:	< 0.0020 °/√h 0.0036 °/hr	< 12 µg/√Hz	50 µg	2 min	3 min	5 min	9 min	
iNAT-RQH-4004:	< 0.0030 °/√h 0.0050 °/hr	< 12 µg/√Hz	50 µg	2 min	4 min	7 min		

Off-shore Alignment Duration = On-shore Alignment Duration + 15 minutes

Resolution:	0.000'3 ° (1,2"), < 0.001 °/s	< 5 µg (depends on data rate)
Scale/Linearity Error:	< 5 ppm / < 5 ppm	< 100 ppm / < 20 µg/g²
Axis Misalignment:	< 25 µrad	< 25 µrad
Sensor Range:	± 800 °/s (no angle limitation)	± 20 g
Bias Instability (AllanVar):	< 0.002 °/hr (const. temp.)	< 10 µg
GNSS Receiver (integrated):	up to all-frequencies / all-constellations GPS+GLONASS+GALILEO+BEIDOU, RTK / PPP, L-Band; high speed range version (< 515 m/s) available as option (iNAT-RQH-HRS, requires export license)	
Input Interfaces (options):	external GNSS receiver (standard: integrated GNSS receiver); event trigger (PPS / SYNC, RS422 level), odometer (opto-coupler input up to 32 V, A/B quadrature or counts & direction, RS422 level compliant)	
Output Interfaces (options):	UART RS232/422, Ethernet TCP/IP / UDP, CAN, ARINC429, ARINC825, HDLC/SDLC, PPT (Pulse Per Time), PPS, SYNC, PTP / NTP Server (since HW rev. 4); NTRIP caster; PPD (Pulse-per Distance)	
Data Output Rate:	integer divisor of 300 Hz, internal data rate 1'800 Hz	
Data Latency:	< 2 ms (sampling accuracy better 1 µs, time-stamped according to PPS; jitter < 1 ms)	
Data storage:	32 GByte on internal non-volatile memory, 128 GByte available as option	
Atomic Clock TimeRef. (opt.):	External high precision clock, drift < 100 ps/s (= 90 µs / 10 days) for -15…+55 °C ambient temperature	
Connectors:	MIL-C-38999 Series III for signals and power, TNC for antenna	
Temperature, rel. Humidity:	-40...+71°C operating (case), -55...+85°C storage; 8...100%; IP67	
Magnetic. insensitivity:	< 300 µTesla (3 Gauss) [1]	
MTBF / MTTR:	40,600 hrs (estimated for surveying applications) / < 30 minutes	
Shock, Vibration, Altitude:	25 g / 11 ms, 60 g / 5 ms (operating); 20…2'000 Hz, 3 g rms; 60'000 ft	
Qualification:	MIL-STD-810G, MIL-STD-461G, MIL-STD-704F, DO160G	
Power:	10...35 V DC, < 25 W (incl. GNSS); 50 ms hold up time according to DO160G; continuous overvoltage protection up to 60 V	
Weight / Size:	approx. 7.9 kg / approx. 187 x 128 x 296 mm³ (w/o connectors);	
Installation:	Installation in all arbitrary orientations allowed	
Software:	iXCOM communication protocol; iXCOM-CMD GUI software under MS Windows and Linux available; Python scripts available for easy access; INS/GNSS post-proc available	

iMAR Navigation manufactures and designs inertial navigation, surveying, guidance, control and stabilization systems for defence, airborne, industrial, automotive, agriculture, mining, drilling, surveying and many other applications. All systems are manufactured and maintained by iMAR Navigation in Europe / Germany.

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[1] values with GNSS or RTK aiding are given under the condition of sufficient GNSS availability and sufficient motion