iNAT-RQT-4001 / -4002 / -4003

Inertial INS/GNSS Navigation System for Advanced Applications

iNAT-RQT-400x is part of the IMS product family of systems for inertial navigation and guidance, gyro compassing, stabilization, true heading determination and for dynamically motion analysis with ring laser gyros, that covers applications, which require accuracy, reliability, an flexible interface and easy usage.

- High performance ring laser gyro based inertial navigation and surveying system for airborne, naval, underwater, surface and railway applications; self gyro compassing. Additional dual-antenna GNSS heading setup as option (iNAT-RQT-400x-DA)
- Integrated time synchronization module and GPS / RTK-GNSS engine with single or dual antenna. Integrated atomic clock as option. SAASM GNSS as option.
- High data rate, open interface: UART RS422 / RS232, Ethernet TCP/IP - UDP, CAN, ARINC429, ARINC825, NMEA 183.
- Integrated VMS / odometer interface.
- Internal 32 GByte non-volatile memory ("black-box")
- Optional Dual-Antenna GNSS Heading
- Small size, low weight, low power; integrated surveying markers and aiding support points on the enclosure (to support also advanced surveying applications).

The iNAT-RQT consists of three high precision ring laser gyroscopes, three servo accelerometers, a powerful strapdown processor and an open and modular architecture, which allows also adaptations to customer's demands.

The system contains an up to L1L2 RTK capable GNSS receiver (GPS, GLONASS, GALILEO, Beidou) with optional SAASM capability, several Dig-I/Os (e.g. for odometer, laser altimeter, DVL). Optional communication I/Os are Ethernet (TCP/IP, UDP), RS422/232 UART, CAN, ARINC429, ARINC825 as well as internal data storage on non-volatile memory.

Data processing (strapdown navigation, gyro compassing or motion monitoring) is performed inside of the iNAT-RQT, and also data transmission and storage of pure or corrected raw data is available.

A key feature is its high data rate of up to 400 Hz and its unique resolution (0.001 degree in roll/pitch/yaw) as well as its superior accuracy (e.g., for stabilization tasks). As an option, special designed algorithms and features are

available, e.g. the Multi-Vehicle-Tracking Mode (MVT), which allows an exchange of information between several iNAT systems without the need of any additional computation power. iNAT-RQT can also operate as PTP time server as an option.

The iNAT-RQT contains a tightly or loosely coupled INS/GNSS based data fusion, using iMAR's highly sophisticated 42+ state Kalman filtering incl. gyro compassing, free inertial or dead-reckoning navigation etc.

iNAT-RQT is usually operated in online mode, however, it also provides the possibility of post-processing, e.g. to perform additional reverse Kalman filtering and smoothing.

The systems iNAT-RQT are <u>not</u> ITAR controlled. The systems iNAT-RQT-4002 / -4003 are only covered by standard European dual-use export control. With iNAT-Rx/Fx several fit-function (FF) compatible systems are provided on RLG, HRG and FOG technology. With iNAT-FSSG-1-DA a compatible system with dual-antenna GNSS technology is provided, which even does not require any export license.




Technical Data of iNAT-RQT-4001 / -4002 / -4003 (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	iNAT-RQT-4001:	0.040° [0.7 mils] sec(lat) free inertial; < 0.01° with GNSS[1], < 0.008° post-proc[2] RTK
	iNAT-RQT-4002:	0.057° [1.0 mils] sec(lat) free inertial; < 0.01° with GNSS[1], < 0.008° post-proc[2] RTK
	iNAT-RQT-4003:	0.086° [1.5 mils] sec(lat) free inertial; < 0.01° with GNSS[1], < 0.008° post-proc[2] RTK
	option: Dual-Antenna Setup with 0.2 °/L[m] with L = antenna baseline; e.g. 0.02 ° @ 10 m baseline (iNAT-RQT-400x-DA)	
Attitude Accuracy:	< 0.025° [0.5 mils] (< 0.01° with GNSS, < 0.0025° postproc with RTK aiding)	
Position Accuracy	iNAT-RQT-4002/1:	< 1.0 nm/hr free inertial [CEP][3]; typically < 1.6 m GPS (S/A off) and < 10 cm RTK[1] online
	iNAT-RQT-4003:	< 1.5 nm/hr free inertial [CEP][3]; typically < 1.6 m GPS (S/A off) and < 10 cm RTK[1] online
	< 0.6 m [rms] SBAS (WAAS/EGNOS), < 0.1 m DGPS / TerraStar and 2 cm RTK/INS (post-proc.)	
	< 0.1 % distance travelled [CEP] (with odometer and GPS, application dependant)	
	< 0.2 % distance travelled [CEP] on underwater vehicles (with RDI DVL aiding)	
Velocity Accuracy:	5 mm/s (aided with L1/L2 RTK GPS, < 3 mm/s postproc RTK)	

ARW and bias / Alignment Time:	Gyroscopes		Accelerometer		On-shore Alignment Duration: 0.25°	0.15°	0.10°	0.086°	0.06°	
iNAT-RQT-4001:	< 0.0020 °/√h	0.004 °/hr	< 12 µg/√Hz	50 µg |	2 min	2 min	2 min	2 min	3 min	@ lat 0°
					2 min	2 min	2 min	3 min	8 min	@ lat 50°
iNAT-RQT-4002:	< 0.0025 °/√h	0.007 °/hr	< 12 µg/√Hz	75 µg |	2 min	3 min	4 min	5 min	7 min	@ lat 0°
					4 min	5 min	6 min	9 min	35 min	@ lat 50°
iNAT-RQT-4003:	< 0.0050 °/√h	0.010 °/hr	< 12 µg/√Hz	100 µg |	2 min	4 min	8 min	10 min	45 min	@ lat 0°
					4 min	8 min	35 min	75 min		@ lat 50°

Off-shore Alignment Duration = On-shore Alignment Duration + 15…60 minutes (depends on v-aiding)

Range:		± 395 °/s	± 20 g
Bias Stability	iNAT-RQT-400x:	< 0.0015 °/hr	< 12 µg (AllanVar)
Resolution:		0.00033 ° (1,2"), < 0.001 °/s	< 5 µg (depends on data rate)
Scale/Linearity Error:		< 15 ppm / < 10 ppm	< 100 ppm / < 30 µg/g²
Axis Misalignment:		< 30 µrad	< 50 µrad

GNSS Receiver (integrated):	up to L1L2 GPS+GLONASS+GALILEO+BEIDOU, SBAS, RTK/PPP; SAASM capability as hardware option
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 on Ethernet as option
Data Output Rate:	1…400 Hz, internal data rate 3'200 Hz
Data Latency:	< 5.3 ms (sampling accuracy better 1 µs, time-stamped according to PPS; jitter < 1 ms)
Data storage:	32 GByte on internal non-volatile memory
Atomic Clock TimeRef. (opt.):	External high precision clock, drift < 100 ps/s (= 90 µs / 10 days) for -15…+55 °C ambient temperature
Dual-Antenna GNSS (opt.):	Additionally providing independent heading from dual-antenna GNSS setup: Accuracy = 0.2 deg/L[m] where L is the baseline between both antennas (example: 0.02 deg @ 10 m baseline)
Connectors:	MIL-C-38999 Series III for signals and power, TNC for antenna
Temperature (case):	-30...+65°C operating, (-40…+71°C degraded), -55...+85°C storage
Rel. Humidity:	8...100%, IP67
Magnetic. insensitivity:	< 500 µTesla (5 Gauss)
MTBF / MTTR:	> 25,000 hrs (estimated for surveying applications) / < 30 minutes
Shock, Vibration, Altitude:	6 g, 20 ms (operating); 10…2'000 Hz, 3.4 g rms; 60'000 ft
Qualification:	MIL-STD-810G, MIL-STD-461G, MIL-STD-704F, DO160G
Power:	10...35 V DC, < 20 W (incl. GNSS); 50 ms hold up time according to DO160E; continuous overvoltage protection up to 60 V
Weight / Size:	approx. 6.9 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; INS/GNSS post-proc iWP+ / iIP+; integrated real-time Kalman filter (42+ states); on request customized applications can be integrated

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] Assuming that sufficient GNSS observations as well as sufficient motion dynamics are available
[2] post-processing, depends on environment
[3] Smaller values achievable, if the iNAT-RQT is aided sufficiently with GNSS before switching to free inertial mode