

iNAT-U200/RLD-OEM-DA

Economic Miniature MEMS Based Inertial Navigation System with integrated MF/MC RTK Dual-Antenna INS/GNSS/ODO/xxx Data Fusion

iNAT-U200/RLD-DA is a member of the advanced iNAT series (iMAR Navigation and Timing) and one of the smallest powerful MEMS based INS/GNSS inertial navigation, measurement, surveying and control systems on the market for applications on the surface (land/sea) and in the air. It provides PNT (positioning, navigation & timing) relevant data as all kinematic measurements like acceleration, angular rate, attitude, true heading, velocity and position of the target vehicle in real-time incl. timestamp and standard deviation with a data update rate of up to 500 Hz.

iNAT-U200/RLD-OEM-DA is the open-frame version (OEM) and can also be provided with enclosure (**iNAT-U200/RLD-M**, **iNAT-U200/RLD-CB**). All versions support integrated single and dual antenna GNSS with RTK capability.

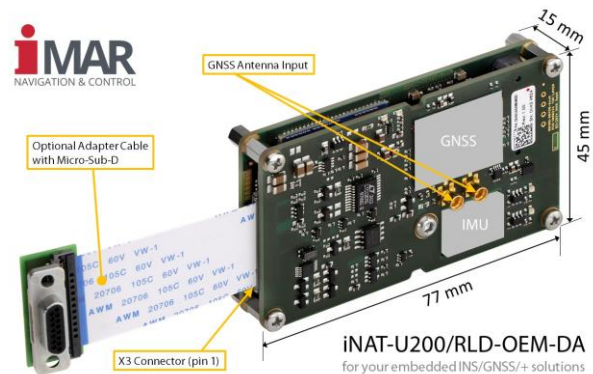
- robust, compact, light weight system, ~55 grams, excellent SWaP-C
- **Miniature size: ~77 x 45 x 15 mm³**
- **Low power consumption: typ. < 3.5 W**
- based on high grade MEMS Gyro, Accel technology with integrated multi-frequency / multi-constellation GNSS with dual-antenna heading and RTK support
- support of simultaneous GPS, GALILEO, GLONASS, BeiDou (other on request)
- Options for high/low range angular rate (-HRR/-LRR) and high range acceleration (-HRA) available
- odometer / wheel sensor aiding capability
- output of angular rate, acceleration, attitude, true heading, CoG, velocity, position, timestamp and standard deviations in realtime with up to 500 Hz (adjustable). Also raw data for post-proc available
- several processing modes: Standard mode with 1 m position accuracy and RTK mode with 0.02 m position accuracy
- interfaces: UART / CAN / Ethernet / USB / TRIG, PPS_OUT for realtime data output and DGPS/RTK correction input; odometer / VMS; connectivity to magnetometer, barometer / TAS via ARINC825-lite
- up to 128 GByte internal memory ("black-box")
- **no AI inside**; no measurement uncertainty due to possibly incomplete training data of an AI algorithm e.g. in corner cases
- easy to use, easy to configure; powerful GUI

Depending on the application, environmental conditions and required real-time accuracy, the data fusion includes INS, GNSS, VMS or any other external sensor, providing position and/or velocity, standard deviation and time stamp.

The internal 42+ state Extended Kalman Filter processing guarantees a significant better and

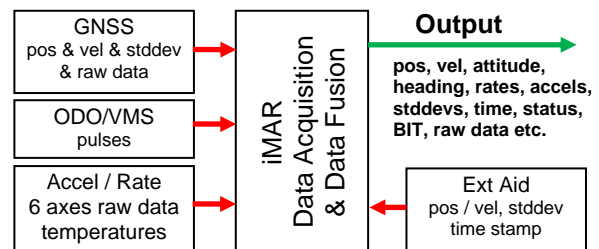
more robust position and velocity result compared to standard solutions.

For land vehicles an odometer aiding capability is available as an option, the scale factor of the



wheel sensor is estimated automatically. Use vibration isolation for implementation in harsh environment.

The [iNAT-U200/RLD](#) provides system performance and system reliability which is required in standard tasks of navigation, guidance and control, mapping, vehicle motion dynamics testing, trajectory surveying and platform control tasks for cars, trucks, naval vessels, civil and military aircrafts etc. (UAV, UGV, USV, RPV, AUV).



The iNAT-U200 is delivered with the MS Windows (or LINUX or MacOS alternatively) based configuration software [iXCOM-CMD](#). This software allows to configure the output interfaces. Furthermore, all output data can be displayed and stored online on the user's notebook, tablet or process computer. It also allows powerful playback capabilities and provides data export in many formats (csv, xml, GoogleEarth, iPosCAL InertialExplorer). With [iREF-GNSS](#), iMAR presents a GNSS reference station to provide RTK corrections for centimeter level accuracy on demand.

A powerful postproc software is available for post-mission processing, including a direct visualisation of the results in Google Earth™.



Technical Data iNAT-U200/RLD-OEM-DA (typical, rms):

	Rate	Acceleration	Attit./Heading	Position	Velocity	Height
Range ¹ :	± 500 °/s	± 8 g	unlimited	unlimited	515 m/s	unlimited
Bias Stability (AV) ¹ :	< 2.5 °/h	< 0.1 mg			(without export control)	
Bias (filtered ²):	< 5 °/h	< 1 mg				
Bias day-to-day ³ , ¹ :	< 0.2 °/s	< 2 mg				
Angles (Attitude, Hdg.):	0.1° / 0.3° 0.05° / 0.15° RP/Y (INS / GNSS, w/o with RTK) 0.15° / 0.35° 0.1° / 0.2° RP/Y (after 10 s GNSS outage, w/o with RTK) 0.1 deg heading for 2 m baseline in dual-antenna setup (/RLD-DA) ²					
Position (horizontal plane) ⁴ :	+/- 0.03 m CEP (INS/GNSS RTK real-time) +/- 0.02 m CEP (INS/GNSS RTK post-proc) +/- 0.4 m CEP (INS/GNSS with SBAS) +/- 1.8 m CEP (INS/GNSS) 2 % of DT CEP (with VMS, during GNSS RTK outage) ⁵ 0.02 m/s (INS / RTK GNSS)					
Velocity:						
Noise:	0.15 °/sqrt(hr)	23 µg/√Hz	0.02 °	< 0.01 m	< 0.01 m/s	
Resolution:	< 0.0001 °/s	< 20 µg	0.001 °	< 0.001 m	< 0.001 m/s	
Linearity error:	< 0.2 %	< 0.5 %	< 0.2 %			
Scale factor error:	< 0.3 %	< 0.1 %				
Scale factor (filtered):	< 0.1 %	< 0.07 %	< 0.1 %			
Axes Orthogonality:	< 0.5 mrad	< 0.5 mrad				
g / g ² dependent gyro drift:	< 32 °/h/g / 1.8 °/h/g ² (internally compensated)					
INS / GNSS / ODO proc.:	integrated advanced 42+ state INS/GNSS/+ extended Kalman filter data fusion					
Internal GNSS Engine:	multi-frequency / multi-constellation GPS / GLONASS / GALILEO / BeiDou, SBAS, QZSS, RTK; > 150 channels					
Data Processing Rate:	up to 500 Hz; PPS timing accuracy better 10 ns					
Data Output Rate:	integer divisor of 500 Hz; all data available in real time, latency < 3 ms, jitter < 1 ms					
Synchronisation:	1 x PPS_OUT (LVTTTL level, latency < 1 µs); 1x EVENT_IN (LVTTTL level, latency < 3 ms)					
Output (options):	1 x USB, 1 x CAN, 1 x UART (LVTTTL), 1 x UART (RS232 or RS422), Ethernet 100 Mbit/s (TCP/IP, UDP, NTRIP caster with RTCM 104 rev 3 (can serve as a GNSS reference station); NTP Time Server)					
Inputs:	Odometer (A or A/B opto-coupler; 3.5 ...30 V, 5 mA)					
Data Latency:	< 1 ms (sampling accuracy better 1 µs, time-stamped according to PPS; jitter < 1 ms) in RTK mode					
Connectors:	OEM-Version: Power & Interfaces: HIROSE Connector FH52-40S-0.5SH(99) recommended flat flexible cable: FFC with 40P 0.5MM PITCH R/A SMT, AU GNSS Antenna: T&R U.FL straight surface mount jack					
Integrated Data Storage:	32 GByte (option: 128 GByte); lasts for several days continuous data sampling as "black-box"					
Graphical User Interface:	MS Windows or LINUX or MacOS based GUI / HMI software iXCOM-CMD for configuration, visualization, data recording, data converting and playback operation					
Power Supply:	4.75...5.25 V DC or 5 ... 30 V DC (factory set), reverse polarity protection; no galvanic insulation of power supply for OEM version (only available for enclosed version) Power consumption: ~ 3...4.1 W (dep. on options; ~3 W @ 5 V and 50 % CPU load, ~4.1 W @ 12 V and 100 % CPU load) -40...+71 °C (outer case temperature) operating, -40...85 °C storage; >50'000 hrs (AUC, Airborne Uninhabited Cargo, 25 °C)					
Temperature; MTBF:						
Shock, Vibration, Altitude:	60 g, 11 ms, 10...2'000 Hz 5 g rms (endurance); 10...2'000 Hz 1.2 g rms (operational) [vibration isolation recomm.]; 60'000 ft					
Mass, size; IP:	55 grams; ~77 x 45 x 15 mm ³ ; IP00 (OEM version, open-frame, no environmental protection)					
Operational Support:	Airborne, Ground (with and without odometer), Sea, Subsea; ZUPT (auto or on demand), open interface to feed in application specific aiding information (position, velocity, attitude, heading, standard deviations, time stamp)					
Part Number:	00190-00504-0427 (iNAT-U200/RLD-OEM-DA with standard range +/- 500 deg/s, +/- 8 g)					
Deliverables:	<ul style="list-style-type: none"> - MEMS based INS with integrated GNSS receiver, GNSS antenna, cable set - dual-antenna GNSS based true heading (iNAT-U200/RLD-OEM-DA) allows heading determination even at standstill conditions → typ. 0.2° at 1 m baseline; this feature is default delivery for standard purchases - odometer (VMS) interface for velocity aiding during longer GNSS outages (position error is then correlated to wheel sensor performance, typically 0.1 % longitudinal error of distance travelled) - iXCOM-CMD MS Windows or LINUX or MacOS based GUI software; drivers für ROS-2, Python and C++ SDK - integration set with adapter cable (to Micro-Sub_D) and distribution lab cable (from Micro-Sub-D to RJ45, DSUB 9...) - see system ICD for integration details about iNAT-U200 (DOC210121069) 					
Options:	<ul style="list-style-type: none"> - SW-Development Kit with DLL available (with SDK under Qt / C) - EMI shield or IP67 enclosure to wrap the iNAT-U200/RLD-OEM for partial EMI/EMC and general environmental protection - interface to iMAR's iDMN Dynamic Mesh Network for Swarm Communication & Control - version with aviation certified operational system (OS) on request - specific algorithms (also customized solutions) 					

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¹ Option: **iNAT-U200/RLD-LRR/HRR** for low range and high range rate tasks: ±120 °/s (0.15 °/sqrt(hr)), ±2000 °/s (0.3 °/sqrt(hr)) [factory set, can also be combined with -DA option]
Option: **iNAT-U200/RLD-HRA** for high range acceleration tasks: ±40 g °/s (100 µg/sqrt(Hz)), 3 mg bias day-to-day [factory set, can also be combined with -LRR or -HRR]
Option: **iNAT-U200/RLD-HRS** for high range speed tasks: > 515 m/s (requires an export license)
² after algorithm converging under sufficient motion excitation with sufficient GPS aiding conditions
³ values without sufficient INS/GNSS data fusion conditions; the bias are estimated / compensated during GNSS aiding under motion automatically (Kalman filter); iNAT-U200/SLD provides 20 deg/hr bias stability for several hours duration at const. temperature
⁴ GNSS based altitude deviation is about 1.5 times of GNSS based horizontal error
⁵ position error in relation to distance travelled (DT) during GNSS outages (requires a vehicle motion sensor / wheel sensor) – after suffic. GNSS

