

**IMPROVED**

# iNAT-M200/TLN • iNAT-M200/xLN

Precise MEMS Based Inertial Navigation System with  
integrated INS/GNSS/xxx Data Fusion

**iNAT-M200/xLN<sup>1</sup>** 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 all kinematic measurements like acceleration, angular rate, attitude, true heading, velocity and position of the target vehicle in real-time with an data update rate of up to 250 Hz.

- robust, compact, light weight system, ~850 grams
- based on high grade MEMS gyro & accel technology and up to all frequency GNSS with optional dual-antenna heading and RTK support; gyros highly resistant against vibration impacts
- integrated GNSS engine, up to RTK all frequ./const. (4 types of engines available: /TLN, /SLN, /RLN, /MLN)
- 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 and position in realtime with up to 250 Hz (adjustable) with minimum latency
- several processing modes: Standard mode with 1 m position accuracy and RTK mode with 0.02 m position accuracy
- interfaces: UART RS232 & RS422 / CAN / Ethernet / USB for realtime data output and RS232 for DGPS/RTK correction input; odometer / VMS
- up to 128 GByte internal memory ("black-box")
- several versions with surveying grade GNSS, economic grade GNSS, standard noise as well as low-noise inertial sensors are available
- high angular rate range (1200 °/s) as option: -HRR
- easy to use, easy to configure; powerful GUI

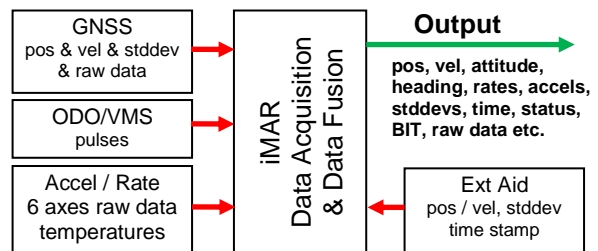
Depending on the application, environmental environment and required realtime accuracy, the data fusion includes INS, GNSS, VMS or any other external sensor providing position and/or velocity, standard deviation and time stamp.

The system is available with four different integrated GNSS engines (iNAT-M200/TLN, /RLN, /SLN, /MLN). The version /TLN is for most difficult environment and RTK aiding, and the version /MLN for economic applications.

In urban canyons often the number of observable satellites is quite limited and therefore the iNAT-M200/TLN supports an all GNSS constellation data fusion. The 42+ state Kalman filter processing provides a significant better and more robust position and velocity result compared to standard solutions.

For land vehicles additionally an odometer aiding capability is available as an option, the scale factor of the wheel sensor is estimated automatically.

The [iNAT-M200/TLN](#) 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.



The iNAT-M200 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, Iner-



tialExplorer, GrafNav). With [iREF-GNSS](#), iMAR also provides a GNSS reference station to provide RTK corrections for centimeter level accuracy on demand.

The "improved" version (this datasheet) contains advanced accelerometers (dual-use items regarding export control). A powerful postproc software [iPosCAL-SURV](#) for batch processing is available to allow post-mission processing including a multi station GNSS correction data solution and a direct visualisation of the results in Google Earth™.

<sup>1</sup> Meaning of „x“: the iNAT-M200/xLN can be delivered with 4 classes of integrated GNSS engines. Standard device is



**Technical Data iNAT-M200/TLN and iNAT-M200/xLN (typical, rms):**

	Rate	Acceleration	Attit./Heading	Position	Velocity	Height
Range <sup>1</sup> :	± 400 °/s	± 10 g (opt. 30/80 g)	unlimited	unlimited	515 m/s	unlimited
Bias Stability (AV):	< 0.3 °/h	< 0.005 mg			(without export control)	
Bias (filtered <sup>4</sup> ):	< 3 °/h	< 0.3 mg				
Bias day-to-day:	< 0.07 °/s	< 2 mg				
Angles (Attitude, Hdg.):	0.03° / 0.1° RP/Y (INS/GNSS) [under best conditions 0.01° / 0.03° RP/Y] <sup>5</sup> 0.05° / 0.12° RP/Y (after 10 s GNSS outage) [best cond. 0.02° / 0.04° RP/Y] <sup>5</sup> 0.1 deg heading for 2 m baseline in dual-antenna setup (/SLN-DA) <sup>2</sup>					
Position (horizontal plane) <sup>2</sup> :	for <b>iNAT-M200/TLN</b> : +/- 0.1 m CEP (INS/GNSS RTK real-time) <sup>3</sup> +/- 0.03 m CEP (INS/GNSS RTK post-proc) <sup>5</sup> +/- 0.4 m CEP (INS/GNSS with SBAS) +/- 1.8 m CEP (INS/GNSS) 0.15 % of DT CEP (with VMS, during GNSS outages) <sup>4</sup> +/- 1.8 m CEP (INS/GNSS) for <b>iNAT-M200/MLN</b> : 1 % of DT CEP (with VMS, during GNSS outages) <sup>5</sup>					
Velocity:	0.02 m/s (INS / RTK GNSS)					
Noise:	0.15 °/sqrt(hr)	25 µg/√Hz	0.03 °	< 0.01 m	< 0.01 m/s	
Resolution:	< 0.0001 °/s	< 2 µg	0.001 °	< 0.001 m	< 0.001 m/s	
Linearity error:	< 0.002 %	< 0.02 %	< 0.1 %			
Scale factor error:	< 0.05 %	< 0.06 %	< 0.1 %			
Non-Orthogonality:	< 0.2 mrad	< 0.2 mrad				
INS / GNSS / ODO proc.:	integrated advanced 42+ state INS/GNSS/+ extended Kalman filter data fusion (GPS, GALILEO, GLONASS, BEIDOU)					
Internal GNSS Engine:	version /TLN: high performance all frequencies / all constellation RTK GNSS engine (single & dual antenna available) version /SLN: performance up to all frequency / constellation geodetic class RTK GNSS engine (single or dual antenna) version /RLN: commercial multi frequencies / multi constellation RTK GNSS engine (single & dual antenna available) version /MLN: economic grade L1 GPS+GLONASS, SBAS, Beidou, QZSS engine					
Data Processing Rate:	up to 250 Hz; PPS timing accuracy better 10 ns					
Data Output Rate:	integer divisor of 250 Hz; all data available in real time, latency < 3 ms, jitter < 1 ms					
Synchronisation:	PPS_OUT (RS422 level, latency < 1 µs); 2x EVENT_IN (RS422 or TTL level, latency < 2 ms)					
Output (options):	USB, 2 x CAN, 4 x UART RS232/422, Ethernet 100 Mbit/s, NMEA183, ARINC825, TCP/IP, UDP, NTRIP cas- ter with RTCM104 rev 3 (can serve as a GNSS reference station); NTP Time Server (since HW rev. 5)					
Inputs:	DGPS/RTK correction data from base station, if available (RS232); odometer / VMS (A or A/B at RS422 level) as an option					
Data Latency and Jitter:	< 11.3 ms (sampling accuracy better 1 µs, time-stamped according to PPS; jitter < 1 ms)					
Connectors:	MIL-C-38999 III (data), SMA (antenna), M12 (Ethernet)					
Integrated Data Storage:	32 GByte non-volatile memory, option 128 GByte (lasts for several days continuous data sampling as "black-box")					
Graphical User Interface:	MS Windows or LINUX or MacOS based software <b>iXCOM-CMD</b> for configuration, visualization, data recording, data converting and playback operation					
Power Supply:	9...34 V DC, two independent and isolated inputs available; reverse an overvoltage protection; approx. 8.5 ...11 W (dep. on options); < 14 W for < 1 sec after power-on					
Temperature; MTBF:	-40...+71 °C (outer case temperature) operating, -40...85 °C storage; 49'000 hrs (AUC, Airborne Uninhabited Cargo, 25 °C)					
Shock, Vibration, Altitude:	60 g, 11 ms; 1'000 g, 0.5 ms; 10...2'000 Hz 5 g rms (endurance); 10...2'000 Hz 2 g rms (operational); 60'000 ft					
g / g <sup>2</sup> deponent gyro drift:	< 1 °/h/g / 0.06 °/h/g <sup>2</sup> [at 5 g / 1'000 Hz] (internally compensated)					
Mass, size; IP:	approx. 900 grams, approx. 102 x 138 x 65 mm; IP67 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)					
Deliverables:	- MEMS based INS with integrated GNSS receiver, GNSS antenna, cable set - Python scripts for easy interfacing - iXCOM-CMD MS Windows or LINUX or MacOS based GUI / HMI software (if ordered)					
PartNumber:	improved version: P/N 00190-00001-xxxx (rev. 3A) [this datasheet] standard version: P/N 00190-00001-xxxx (rev. 3)					
Options:	- SW-Development Kit with DLL (with SDK under Qt / C) - L1 up to all-frequency / all constellations RTK / PPP accuracy of the integrated GNSS receiver - dual-antenna GNSS based true heading ( <b>iNAT-M200/xLN-DA</b> , iATHEMO-C) allows heading determination even at standstill conditions -> typ. 0.2° at 1 m baseline - 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) - interface to iMAR's <b>iDMN</b> Dynamic Mesh Network for Swarm Communication & Control - specific algorithms (also customized solutions)					

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<sup>1</sup> Option: **iNAT-M200/xLN-HRR** for high rate range tasks: up to 1'200 deg/s (requires export license)  
Option: **iNAT-M200/xLN-HRA** for high range acceleration tasks: up to 80 g (requires an export license)  
Option: **iNAT-M200/xLN-HRS** for high range speed tasks: > 515 m/s (requires an export license)  
<sup>2</sup> GNSS based altitude deviation is about 1.5 times of GNSS based horizontal error; position error of iNAT-M200/MLN: < 2 m (CEP)  
<sup>3</sup> after algorithm converging under sufficient motion / trajectory and multiple heading changes with GNSS aiding  
<sup>4</sup> Position error in relation to distance travelled (DT) during GNSS outages (requires a vehicle motion sensor / wheel sensor), after suffic. GNSS  
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