

iATTHEMO/TLN-1

Precise MEMS Based Inertial Navigation System for marine / naval applications
with integrated INS/GNSS/xxx Data Fusion

iATTHEMO/xLN¹ 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 marine and naval applications. 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 500 Hz.

- robust, compact, light weight system, ~850 grams
- based on high grade MEMS Gyro, Accel technology and multi-frequency / multi-constellation GNSS with RTK capability and optional dual-antenna heading; gyros highly resistant against vibration impacts
- integrated GNSS engine, (3 types of engines available: /TLN, /SLN, /RLN)
- options for high/low range angular rate (-HRR/-LRR) and high range acceleration (-HRA) available
- DVL and LiDAR aiding capability
- output of angular rate, acceleration, attitude, true heading, CoG, velocity and position in realtime with up to 500 Hz (adjustable)
- 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 UART for DGPS/RTK correction input; DVL
- 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
- iATTHEMO/TLN-1: version with standard accels
- easy to use, easy to configure; powerful GUI

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

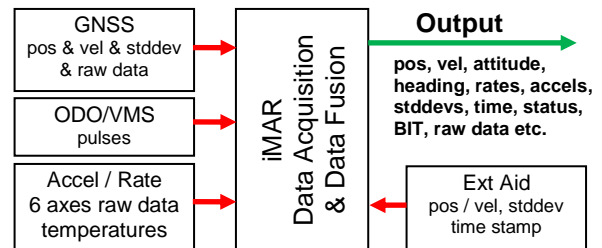
In difficult environment often the number of observable satellites is quite limited and therefore the iATTHEMO/xLN supports an all GNSS constellation data fusion. The 42+ state Kalman filter processing provides a significant better and more robust position and velocity result compared to standard solutions.

For marine / naval applications a DVL aiding capability is available as an option, the scale factor of the sensor is estimated automatically.

The [iATTHEMO/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 **iATTHEMO/RLN** provides the same features, but containing a cheaper commercial RTK grade GNSS engine with less robust GNSS solution in difficult



environment.

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

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™.

¹ Meaning of „x“: the iATTHEMO/xLN can be delivered with 4 classes of integrated GNSS engines. Standard device is





Technical Data iATTHEMO/TLN-1 and iATTHEMO/xLN-1 (typical, rms):

	Rate	Acceleration	Attit./Heading	Position	Velocity	Height
Range ¹ :	± 400 °/s	± 10 g (opt. 30 g)	unlimited	unlimited	515 m/s	unlimited
Bias Stability (AV):	< 0.5 °/h	< 0.06 mg			(without export control)	
Bias (filtered ²):	3 °/h	< 0.8 mg				
Bias day-to-day ³ :	< 0.07 °/s	< 6 mg				
Angles (Attitude, Hdg.):	0.04° / 0.1° RP/Y (INS / GNSS) ⁵ 0.05° / 0.12° RP/Y (after 10 s GNSS outage) ⁵ 0.1 deg heading for 2 m baseline in dual-antenna setup (/SLN-DA) ² 0.3° Roll/Pitch without any initial aiding after power-on at standstill					
Position (horizontal plane) ⁴ :	for iATTHEMO/TLN : +/- 0.1 m CEP (INS/GNSS RTK real-time) ⁵ +/- 0.03 m CEP (INS/GNSS RTK post-proc) ⁵ +/- 0.4 m CEP (INS/GNSS with SBAS) +/- 1.8 m CEP (INS/GNSS) 0.2 % of DT CEP (with DVL, during short GNSS outages) ⁶ +/- 1.8 m CEP (INS/GNSS) for iATTHEMO/RLN : 1 % of DT CEP (with DVL, during GNSS outages) ⁶					
Velocity:	0.02 m/s (INS / RTK GNSS)					
Noise:	0.15 % / √hr	60 µg/√Hz	0.03 °	< 0.01 m	< 0.01 m/s	
Resolution:	< 0.0001 °/s	< 10 µg	0.001 °	< 0.001 m	< 0.001 m/s	
Linearity error:	< 0.01 %	< 0.05 %	< 0.1 %			
Scale factor error:	< 0.1 %	< 0.1 %	< 0.1 %			
Non-orthogonality:	< 0.5 mrad	< 0.5 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)					
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:	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 / DVL or any other speed log (A or A/B at RS422 level) as an option					
Data Latency:	< 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, optional up to 128 GByte (lasts for several days continuous data sampling as "black-box")					
Graphical User Interface:	MS Windows or LINUX or MacOS based software iXCOM-CMD for configuration, visualization, data recording, data converting and playback operation					
Power Supply:	10...34 V DC, two independent and isolated inputs available; reverse 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)					
Qualification:	designed to meet MIL-STD-810G, MIL-STD-461G, MIL-STD-704F and partially DO160G					
Shock, Vibration, Altitude:	60 g, 11 ms, 10...2'000 Hz 5 g rms (endurance); 10...2'000 Hz 2 g rms (operational); 60'000 ft					
g / g ² dependent gyro drift:	< 1 °/h/g / 0.06 °/h/g ² [at 5 g / 1'000 Hz] (internally compensated)					
Mass, size; IP:	approx. 900 grams, approx. 102 x 65 x 122 mm; IP67 environmental protection					
Operational Support:	Sea, Subsea, Airborne, Ground (with and without velocity aiding); 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 - iXCOM-CMD MS Windows or LINUX or MacOS based GUI / HMI software - ROS-2 node, Python driver, SDK for C++					
PartNumber:	standard version: P/N 00193-05001-xx2x [for advanced accuracy see the "advanced" version iATTHEMO/TLN-2]					
Options:	- dual-antenna GNSS based true heading (iATTHEMO/TLN-1-DA) allows heading determination even at standstill conditions -> typ. 0.2° at 1 m baseline - odometer (DVL or others) interface for velocity aiding during longer GNSS outages (position error is then correlated to speed sensor performance, typically 0.1 % longitudinal error of distance travelled) - interface to iMAR's iDMN Dynamic Mesh Network for Swatm Communication & Control - specific algorithms (also customized solutions)					

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¹ Option: **iATTHEMO/TLN-HRR** for high rate range tasks: up to 1'200 deg/s
 Option: **iATTHEMO/TLN-HRA** for high range acceleration tasks: up to 30 g [then it might require an export license]
 Option: **iATTHEMO/TLN-HRS** for high range speed tasks: > 515 m/s (requires an export license)
² after algorithm converging under motion with GPS aiding at const. temperature
³ values without sufficient INS/GNSS data fusion conditions; the bias are estimated / compensated during GNSS aiding under motion automatically (Kalman filter); iATTHEMO-TLN provides 10 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 dependent on trajectory and satellite constellation; in challenging environments (e.g. urban canyons) use iATTHEMO/TLN-2
 Hint: Under best GNSS and motion conditions the accuracy is 2 cm CEP.
⁶ 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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