



iNAT-M300/xLD-DA (x = T, R, S)

MEMS Based Inertial Navigation System with integrated INS/GNSS/ODO/xxx Sensor Data Fusion and accessible Memory Stick

The **iNAT-M300/xLD** 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, tracking and control systems on the market for applications on the ground, at 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 500 Hz.

- robust, compact, light weight system, ~850 grams
- based on high grade MEMS Gyro / Accel technology and up to all-frequency / all-constellation GNSS with RTK support and optional dual-antenna heading support
- integrated accurate GNSS engine, up to RTK all frequencies / all constellations (3 grades of GNSS engines available: /TLN, /SLN, /RLN)
- Options for high/low range angular rate (-HRR/-LRR) and high range acceleration (-HRA) available
- odometer / wheel sensor / CAN aiding capability
- output of angular rate, acceleration, attitude, true heading, CoG, velocity and position in realtime with up to 500 Hz outut rate (adjustable)
- several processing modes: Standard mode with 1 m position accuracy and RTK mode with 0.02 m position accuracy; PPP support
- 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")
- additionally accessible USB Memory stick / IP67 for fast post-mission data access
- easy to use, easy to configure; powerful GUI

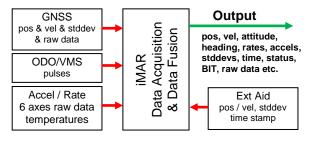
Depending on the use's application, environmental conditions and required realtime accuracy, the integrated sensor data fusion includes IMU, GNSS, VMS or any other external sensor providing position and/or velocity, standard deviation and time stamp.

In urban canyons often the number of observable satellites is quite limited and affected by multipath and therefore the iNAT-M300/TLD supports an all GNSS constellation sensor data fusion. The 42+ state extended 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, the radar data, the CAN data or any other is estimated automatically. The <u>iNAT-M300/TLD</u> provides system performance and system reliability which is required in standard tasks of navigation, guidance and control, mapping, vehicle motion dynamic stesting, trajectory surveying and platform control tasks for cars, trucks, naval vessels, civil and military aircrafts etc.



The **iNAT-M300/RLD** provides the same features, but containing a cheaper commercial grade multi-constellation RTK GNSS engine with less robust GNSS solution.



The iNAT-M300 is delivered with the configuration software <u>iXCOM-CMD</u>. 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, Graf-Nav). With <u>iREF-GNSS</u>, iMAR also provides a GNSS reference station to provide RTK corrections for centimeter level accuracy on demand.

A powerful postproc software <u>iPosCAL-SURV</u> 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[™].



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Technical Data iNAT-M300/TLD-DA and iNAT-M300/xLD (typical, rms):

	Rate	Acceleration	Attit./Heading	Position	Velocity	Height	
Range ¹ :	\pm 500 °/s	± 8 g	unlimited	unlimited	515 m/s	unlimited	
Bias Stability (AV) ¹ :	< 2.5 °/h	< 0.1 mg			(without		
Bias (filtered ²):	< 5 °/h	< 1 mg			export		
Bias day-to-day ^{3,1} :	< 0.2 °/s	< 2 mg			control)		
ngles (Attitide, Hdg.):			0.1° / 0.3° 0.05° / 0 0.15° / 0.35° 0.1° /	0.15° RP/Y		S, w/o with RTK) ⁵ iNSS outage, w/o with RTK) ⁵	
			0.1 deg heading for		`	0, 1, ,	
) anitian (harizantal plan	(a) 4:		0 0			• • •	
Position (horizontal plan	ie) ::			+/- 0.03 m CF	EP (INS/GNSS P (INS/GNSS F	RTK post-proc) ⁵	
					P (INS/GNSS w		
				+/- 1.8 m CE		, ,	
/ - I ite				0.5 % of DT C	EP (with VMS,	during GNSS RTK outage)6	
/elocity:			0.00.0			S/RIK GNSS)	
Noise: Resolution:	0.15 ° /√hr < 0.000'1 °/s	23 µg/√Hz < 20 µg	0.02 ° 0.001 °	< 0.01 m < 0.001 m	< 0.01 m/s < 0.001 m/s		
	< 0.2 %	< 0.5 %	< 0.2 %	< 0.001 11	< 0.001 11/5		
₋inearity error: Scale factor error:	< 0.2 % < 0.3 %	< 0.1 %	< U.Z /0				
Scale factor (filtered)	< 0.1 %	< 0.07 %	< 0.1 %				
NS / GNSS / ODO proc	· integrated a	advanced 42+ state IN	S/GNSS/+ extended K	alman filter data	fusion: extende	ed motion detector	
nternal GNSS Engine:						ngle & dual antenna available)	
9 .						S engine (single or dual antenn	
	version /RL	D: commercial multi fr	equencies / multi cons	tellation RTK GN	NSS engine (sin	gle & dual antenna available)	
Data Processing Rate:	•	Iz; PPS timing accurac					
Data Output Rate:			of 500 Hz; all data ava				
Synchronisation:			< 1 µs); 2x EVENT_IN /422, Ethernet 100 Mbi				
Dutput (options):							
		caster with RTCM 104 rev 3 (can serve as a GNSS reference station); integrated real-time-clock (RTC) w/o battery NTP Time Server; furthermore accessible environmental protected USB stick for storing of mission data					
	INTP TIME 3	Server, furthermore at	cessible environmenta	al protected USB	stick for storing	g of mission data	
nputs:	DGPS/RTK	correction data from l	base station, if availabl	•	stick for storing	g of mission data	
	DGPS/RTK odometer (/	correction data from I A or A/B at RS422 leve	base station, if availabl el) as an option	e (RS232);		g of mission data	
Data Latency:	DGPS/RTK odometer (/ < 1 ms (sar	correction data from I A or A/B at RS422 leve npling accuracy better	base station, if availabl el) as an option 1 μs, time-stamped ac	e (RS232); ccording to PPS;	jitter < 1 ms)	-	
Data Latency: Connectors:	DGPS/RTK odometer (/ < 1 ms (sar MIL-C-3899	Correction data from I A or A/B at RS422 level npling accuracy better 99 III (data) [all typical	base station, if availabl el) as an option 1 μs, time-stamped ac platings availabe], SM	e (RS232); ccording to PPS; A (antenna), M12	jitter < 1 ms) 2 (Ethernet); op	tion: LEMO connectors	
Data Latency: Connectors: ntegrated Data Storage	DGPS/RTK odometer (/ < 1 ms (sar MIL-C-3899 32 GByte (d	correction data from I A or A/B at RS422 leve npling accuracy better 99 III (data) [all typical option: 128 GByte); las	base station, if availabl el) as an option 1 μs, time-stamped ac platings availabe], SM sts for several days cor	e (RS232); ccording to PPS; A (antenna), M1 ntinuous data sa	jitter < 1 ms) 2 (Ethernet); op mpling as "blac	otion: LEMO connectors k-box"	
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Data Latency: Connectors: ntegrated Data Storage Graphical User Interface	DGPS/RTK odometer (/ < 1 ms (sar MIL-C-3899 e: 32 GByte (c e: MS Window visualization 934 V DC approx. 8.5	correction data from I A or A/B at RS422 leve npling accuracy better 39 III (data) [all typical option: 128 GByte); las vs or LINUX or MacOS n, operation, data reco c, two independent and 10 W (dep. on optio	base station, if availabl el) as an option 1 μs, time-stamped ac platings availabe], SM sts for several days cor δ based GUI / HMI soft ording, data converting d isolated inputs availa ons); < 14 W for < 1 se	e (RS232); ccording to PPS; A (antenna), M1: ntinuous data sai ware <u>iXCOM-CM</u> and playback op ble; reverse and c after power-on	jitter < 1 ms) 2 (Ethernet); op mpling as "blac <u>AD</u> for configura beration overvoltage pro	otion: LEMO connectors k-box" ation, otection;	
Data Latency: Connectors: Integrated Data Storage Graphical User Interface Power Supply:	DGPS/RTK odometer (/ < 1 ms (sar MIL-C-3899 e: 32 GByte (c e: MS Window visualization 934 V DC approx. 8.5 -40+71 °C	correction data from I A or A/B at RS422 leve npling accuracy better 39 III (data) [all typical option: 128 GByte); las vs or LINUX or MacOS n, operation, data reco c., two independent and 10 W (dep. on optio C (outer case temperat	base station, if availabl el) as an option 1 µs, time-stamped ac platings availabe], SM sts for several days cor 8 based GUI / HMI soft ording, data converting d isolated inputs availa ons); < 14 W for < 1 se ture) operating, -408	e (RS232); ccording to PPS; A (antenna), M1: ntinuous data sai ware <u>iXCOM-CM</u> and playback op ble; reverse and c after power-on 5 °C storage; 49	jitter < 1 ms) 2 (Ethernet); op mpling as "blac <u>AD</u> for configura beration overvoltage pro b'000 hrs (AUC,	otion: LEMO connectors k-box" ation, otection; Airborne Uninhabited Cargo, 2	
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Data Latency: Connectors: ntegrated Data Storage Graphical User Interface Power Supply: Femperature; MTBF: Shock, Vibration, Altitud g / g ² depenent gyro drif Qualification: Mass, size; IP: Dperational Support: Part-Number: Deliverables:	DGPS/RTK odometer (/ < 1 ms (sar MIL-C-3899 2: 32 GByte (c 2: MS Window visualization 934 V DC approx. 8.5 -40+71 °C designed to approx. 850 Airborne, G application 00193-000 - MEMS ba - iXCOM-CL - drivers for ons: - L1L2L5	correction data from I A or A/B at RS422 leve npling accuracy better 39 III (data) [all typical option: 128 GByte); las ws or LINUX or MacOS n, operation, data reco c, two independent and 10 W (dep. on option C (outer case temperat s, 102'000 Hz 5 g rm / 1.8 °/h/g² (internally o meet MIL-STD-810G 0 grams , ≈102 x 122 x round (with and withou specific aiding informa x4-0Y1Z (X = sensor sed INS with integrate MD MS Windows or L ROS-2, Python, C++/ all frequency RTK acc	base station, if availabl el) as an option 1 µs, time-stamped ac platings availabe], SM sts for several days cor 5 based GUI / HMI soft bording, data converting d isolated inputs availa ons); < 14 W for < 1 se ture) operating, -408 us (endurance); 102'(compensated) , MIL-STD-461G, NIL-3 compensated) , MIL-3 compensated) , MIL-3 compensated , MIL-3 comp	le (RS232); ccording to PPS; A (antenna), M1: ntinuous data sai ware <u>iXCOM-CM</u> and playback or ble; reverse and c after power-on 5 °C storage; 49 000 Hz 2 g rms (STD-704F and p m. protection osea; ZUPT (aut, attitude, headin ℓ = GNSS engine SS antenna, cabi d GUI software d GNSS receiver	jitter < 1 ms) 2 (Ethernet); op mpling as "blac <u>AD</u> for configura beration overvoltage pro 2000 hrs (AUC, operational); 60 bartially DO1600 bo or on demand bg, standard dev ba, Z = single/du le set	otion: LEMO connectors k-box" ation, otection; Airborne Uninhabited Cargo, 2 0'000 ft G d), open interface to feed in <i>v</i> iations, time stamp) µal-antenna GNSS)	
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Data Latency: Connectors: ntegrated Data Storage Graphical User Interface Power Supply: Femperature; MTBF: Shock, Vibration, Altitud g / g ² depenent gyro drif Qualification: Mass, size; IP: Dperational Support: Part-Number: Deliverables:	DGPS/RTK odometer (/ < 1 ms (sar MIL-C-3899 2: 32 GByte (c 2: MS Window visualization 934 V DC approx. 8.5 -40+71 °C designed to approx. 850 Airborne, G application 00193-000 - MEMS ba - iXCOM-Cl - drivers for ons: L1L2L5 - dual-anter allows hea	correction data from I A or A/B at RS422 level npling accuracy better 99 III (data) [all typical option: 128 GByte); las we or LINUX or MacOS n, operation, data reco c, two independent and c, two independent and c (outer case temperat s, 102'000 Hz 5 g rm / 1.8 °/h/g² (internally o meet MIL-STD-810G 0 grams, \approx 102 x 122 x round (with and withous specific aiding informat X4-0Y1Z (X = sensor sed INS with integrate MD MS Windows or L ROS-2, Python, C++/ all frequency RTK acc nna GNSS based true ading determination ev	base station, if available all as an option 1 µs, time-stamped ac platings availabe], SM sts for several days cor based GUI / HMI soft ording, data converting disolated inputs availa bons); < 14 W for < 1 se ture) operating, -408 is (endurance); 102'(compensated) , MIL-STD-461G, NIL- compensated) , MIL-STD-461G, MIL- compensated) , MIL-S	le (RS232); ccording to PPS; A (antenna), M1: ntinuous data sai ware <u>iXCOM-CM</u> and playback op ble; reverse and c after power-on 5 °C storage; 49 000 Hz 2 g rms (STD-704F and p m. protection bsea; ZUPT (auti, attitude, headin ℓ = GNSS engine S antenna, cabi d GUI software d GNSS receiver applications whe ons → typ. 0.2° a	jitter < 1 ms) 2 (Ethernet); op mpling as "blac <u>AD</u> for configura peration overvoltage pro- v000 hrs (AUC, operational); 60 partially DO1600 o or on demand g, standard dev a, Z = single/du le set	otion: LEMO connectors k-box" ation, otection; Airborne Uninhabited Cargo, 2 0'000 ft G 1), open interface to feed in <i>v</i> iations, time stamp) Ial-antenna GNSS)	
Data Latency: Connectors: ntegrated Data Storage Graphical User Interface Power Supply: Femperature; MTBF: Shock, Vibration, Altitud g / g ² depenent gyro drif Qualification: Mass, size; IP: Dperational Support: Part-Number: Deliverables:	DGPS/RTK odometer (/ < 1 ms (sar MIL-C-3895 2: 32 GByte (d 2: MS Window visualization 934 V DC approx. 8.5 -40+71 °C designed to approx. 850 Airborne, G application 00193-000 - MEMS ba - iXCOM-CI - drivers for ourses for - dual-anter allows hea - odometer	correction data from I A or A/B at RS422 level npling accuracy better 29 III (data) [all typical option: 128 GByte); las we or LINUX or MacOS n, operation, data reco c, two independent and 10 W (dep. on option (unter case temperation) to wet MIL-STD-810G 0 grams, \approx 102 x 122 x foround (with and without specific aiding informat X4-0Y1Z (X = sensor sed INS with integrate MD MS Windows or L ROS-2, Python, C++/ all frequency RTK acc na GNSS based true ading determination ev (VMS) interface for ve	base station, if available al) as an option 1 µs, time-stamped ac platings availabe], SM sts for several days cor based GUI / HMI soft ording, data converting disolated inputs availa ons); < 14 W for < 1 se ture) operating, -408 is (endurance); 102'(compensated) , MIL-STD-461G, NIL- compensated) , MIL-STD-461G, NIL- compensated) , MIL-STD-461G, NIL- dometer), Sea, Sub tition (position, velocity, measurement range, Y d GNSS receiver, GNS INUX or MacOS base SDK available curacy of the integrated heading for dedicated	le (RS232); ccording to PPS; A (antenna), M1: ntinuous data sat ware <u>iXCOM-CM</u> and playback op ble; reverse and c after power-on 5 °C storage; 49 000 Hz 2 g rms (STD-704F and p m. protection bsea; ZUPT (auti, attitude, headin ζ = GNSS engine S antenna, cabid d GUI software d GNSS receiver applications whe ons \rightarrow typ. 0.2° a ger GNSS outage	jitter < 1 ms) 2 (Ethernet); op mpling as "blac <u>AD</u> for configura beration overvoltage pro- y'000 hrs (AUC, operational); 60 partially DO1600 o or on demand g, standard dev e, Z = single/du le set pere required (iN at 1 m baseline ges (position ern	otion: LEMO connectors k-box" ation, otection; Airborne Uninhabited Cargo, 2 0'000 ft G d), open interface to feed in <i>v</i> iations, time stamp) al-antenna GNSS)	
Data Latency: Connectors: ntegrated Data Storage Graphical User Interface Power Supply: Temperature; MTBF: Shock, Vibration, Altitud g / g ² depenent gyro drif Qualification: Mass, size; IP: Dperational Support: Part-Number: Deliverables:	DGPS/RTK odometer (/ < 1 ms (sar MIL-C-3899 e: 32 GByte (c e: MS Window visualization 934 V DC approx. 8.5 -40+71 °C le: 60 g, 11 ms t: < 32 °/h/g / designed to approx. 85C Airborne, G application 00193-000 - MEMS ba - iXCOM-Cl - drivers for - dual-anter allows hea - odometer then corre - interface t	correction data from I A or A/B at RS422 level mpling accuracy better 99 III (data) [all typical option: 128 GByte); las vs or LINUX or MacOS , two independent and 10 W (dep. on optic C (outer case temperat s, 102'000 Hz 5 g rm / 1.8 °/h/g² (internally o meet MIL-STD-810G 0 grams, ≈102 x 122 x fround (with and withou o specific aiding informat X4-0Y1Z (X = sensor sed INS with integrate MD MS Windows or L ROS-2, Python, C++/ all frequency RTK acc nana GNSS based true ading determination ev (VMS) interface for ve lated to wheel sensor o iMAR's <u>iDMN</u> Dynar	base station, if available al) as an option 1 µs, time-stamped ac platings availabe], SM sts for several days cor & based GUI / HMI soft fording, data converting d isolated inputs availa ons); < 14 W for < 1 se ture) operating, -408 (endurance); 102'(compensated) , MIL-STD-461G, NIL-4 (compensated) , MIL-STD-4	le (RS232); ccording to PPS; A (antenna), M1: trinuous data sai ware <u>iXCOM-CN</u> and playback or ble; reverse and c after power-on 5 °C storage; 49 000 Hz 2 g rms (STD-704F and p m. protection bsea; ZUPT (auti, attitude, headin ζ = GNSS engine SS antenna, cabi d GUI software d GNSS receiver applications whe ons \rightarrow typ. 0.2° a ger GNSS outag 0.1 % longitudin Swafm Commun	jitter < 1 ms) 2 (Ethernet); op mpling as "blac <u>AD</u> for configura beration overvoltage pro- b'000 hrs (AUC, operational); 60 partially DO1600 o or on demand g, standard dev e, Z = single/du le set rere required (iN at 1 m baseline ges (position ern ial error of dista ication & Contro	otion: LEMO connectors k-box" ation, otection; Airborne Uninhabited Cargo, 2 0'000 ft G d), open interface to feed in <i>v</i> iations, time stamp) ial-antenna GNSS) (AT-M300/xLD-DA) ror is ince travelled) of	
Inputs: Data Latency: Connectors: Integrated Data Storage Graphical User Interface Power Supply: Temperature; MTBF: Shock, Vibration, Altitud g / g ² depenent gyro drif Qualification: Mass, size; IP: Operational Support: Part-Number: Deliverables: Further Features / Optio	DGPS/RTK odometer (/ < 1 ms (sar MIL-C-3899 2: 32 GByte (c 2: MS Window visualization 934 V DC approx. 8.5 -40+71 °C le: 60 g, 11 ms t: < 32 °/h/g / designed to approx. 856 Airborne, G application 00193-000 - MEMS ba - iXCOM-Cl - drivers for som - L1L2L5 - dual-anter allows hea - odometer then corre - interface t - specific al	correction data from I A or A/B at RS422 leve npling accuracy better 39 III (data) [all typical option: 128 GByte); las we or LINUX or MacOS , two independent and 10 W (dep. on option C (outer case temperat a, 102'000 Hz 5 g rm / 1.8 °/h/g² (internally o meet MIL-STD-810G) grams , ≈102 x 122 x round (with and withou specific aiding informa X4-0Y1Z (X = sensor sed INS with integrate MD MS Windows or L ROS-2, Python, C++/ all frequency RTK acc na GNSS based true ading determination ev (VMS) interface for ve lated to wheel sensor o iMAR's <u>iDMN</u> Dynar gorithms (also custom	base station, if available al) as an option 1 µs, time-stamped ac platings availabe], SM sts for several days cor based GUI / HMI soft ording, data converting d isolated inputs availa bons); < 14 W for < 1 se ture) operating, -408 is (endurance); 1020 compensated) , MIL-STD-461G, NIL-1 compensated) , MIL-STD-461G, NIL-1 compensated) , MIL-STD-461G, NIL-1 compensated) , MIL-STD-461G, NIL-1 compensated) , MIL-STD-461G, NIL-1 compensated) , MIL-STD-461G, NIL-1 compensated , MIL-STD-461G, MIL-1 compensated , MIL-STD-461G, MIL-1 compensated , MIL-STD-461G, MIL-1 compensated , MIL-1 Compen	le (RS232); ccording to PPS; A (antenna), M1: tinuous data sai ware <u>iXCOM-CM</u> and playback op ble; reverse and c after power-on 5 °C storage; 49 000 Hz 2 g rms (STD-704F and p n. protection bsea; ZUPT (aut; , attitude, headin ℓ = GNSS engine SS antenna, cabil d GUI software d GUSS receiver applications whe ons \rightarrow typ. 0.2° a ger GNSS outage 0.1 % longitudin Swatm Commun	jitter < 1 ms) 2 (Ethernet); op mpling as "blac <u>AD</u> for configura- beration overvoltage pro- brook (AUC, operational); 60 brook or on demand or or on demand g, standard dev e, Z = single/du le set rere required (iN at 1 m baseline ges (position ern al error of dista- ication & Contro features in relea	otion: LEMO connectors k-box" ation, otection; Airborne Uninhabited Cargo, 2 0'000 ft G d), open interface to feed in viations, time stamp) ial-antenna GNSS) (AT-M300/xLD-DA) ror is ince travelled) of ase 2023/12)	

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¹ Option: iNAT-M300/xLD-LRR/HRR for low range and high range rate tasks: ¹ Option: iNAT-M300/xLD-HRA for high range acceleration tasks: ² Option: iNAT-M300/xLD-HRS for high range speed tasks: 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-M300/TLD provides 20 deg/hr bias stability for several hours duration at const. temperature ⁴ GNSS based altitude deviation is abut 1.5 times of GNSS based horizontal error ⁵ dependent on trajectory and satellite constellation; in challenging environments (e.g. urban canyons) use iNAT-M300/TLD (RTK not available for iNAT-M300/MLD) Hin: Under best GNSS and motion conditions the accuracy is 2 cm CEP with RTK. 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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