# iSULONA/TLE-LN1-D

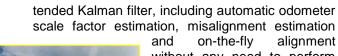## Dead Reckoning INS/GNSS System for Tactical Grade Position Determination

Dead Reckoning is the way to make (D)GNSS more accurate and reliable when tracking or steering vehicles or when surveying their trajectories. iSULONA is a hybrid INS/GNSS system, complemented by vehicle motion sensor (VMS) input. It provides reliable information of position and heading also during GNSS outages.

- Used to provide orientation & position of support, supply and logistics ground vehicles
- Robust, compact, light
- MEMS gyro technology
- integrated multi-frequency / all constellation GNSS engine
- Output of all navigation data, like position, heading, attitude and many more, also during GNSS outages
- Position accuracy typ. 2 m
- Interfaces: UART RS232 & 422 / CAN / Ethernet / USB for real-time data output and RS232 for DGPS correction input; NMEA 0183 / iXCOM
- 32 GByte internal memory
- Vibration hardened, low noise

All iSULONA navigation systems contain a full triade of each gyros and accelerometers and an integrated RTK capabe GNSS receiver to detect position, velocity, true heading, roll and pitch. An interface to odometer / VMS is available to measure the vehicle velocity.

Due to the robust internal sensor data fusion, iSULONA continues to provide position, heading and attitude with high data rate also during GNSS signal blockages or disturbances, such as in tunnels, in urban canyons as well as in case of GNSS loss due to temporary jamming, if an odometer is connected (automatic dead-reckoning mode).

**iSULONA/TLE-LN1-D**

The sesor data fusion is based on a 42+ state extended Kalman filter, including automatic odometer scale factor estimation, misalignment estimation and on-the-fly alignment without any need to perform any "calibration drives". **iSULONA provides an automatic initialization, calibration and operation.**

Besides using its internal GNSS receiver, iSULONA can be made operable with nearly all common available GNSS receivers incl. military receivers like ERGR, NavHub, TopStar etc. (SAASM, M-Code, …)

The "stored heading / stored position" feature is a standard feature in the iSULONA and allows a fast start-up even if GNSS is not available during power-up.

The **leading motion detection feature** allows suer sufficient zero velocity (ZUPT) updates for automatic performance improvements. The iSULONA is delivered with the configuration software iXCOM-CMD, which is available under MS Windows, Linux and MacOS. All output data can be displayed and stored online on the user's notebook, tablet or mission computer.

iSULONA / iNAT-M300 can also be used without odometer aiding for UAV applications.

Versions with higher and lower grade (iPRENA, iCOMBANA, iSULONA) performance are also available with compatible data interface.

The iSULONA is **free of any export control or ITAR regulations.**

# Technical Data iSULONA/TLE-LN1, iSULONA/TLE-LN1-D

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|---|---|---|
| System performance: (PE and CEP): | **Heading accuracy:** | ● 2 mil [RMS], on the move with GNSS [1] <br> ● 4 mil / L[m] [RMS] with <u>integrated</u> dual-antenna GNSS engine (L = antenna baseline in [m] <br> i.e. 2 mil at 2 m baseline (for iSULONA/TLD-D version) <br> ● ~10 mil with magnetometer (option iMAG) <br> ● 0.04 mil/sec heading drift during short term GNSS outages |
| | **Attitude accuracy:** | ● 0.5 mil [RMS] (after sufficient GNSS aiding) [1] <br> 2 mil [RMS] (static alignment, without any GNSS) |
| | **Position accuracy:** | ● 0.2 % of distance traveled during short GNSS outages [2] <br> ● 1…8 m (typ. 2 m) with GNSS (S/A off), 2 cm with RTK GNSS |
| | **Altitude accuracy:** | ● 0.5 % of distance travelled <br> ● typ. 3 m with GNSS (S/A off), typ. 6 cm with RTK GNSS |

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|---|---|
| Data Output & Rate: | Position, velocity, heading, roll/pitch, standard deviations, status via UART RS232/ RS422, NMEA 0183, CAN, Ethernet (TCP/IP, UDP), USB; integer divisor of 500 Hz |
| Alignment Time: | not required (stored heading/pos.) or < 1 minute for first GPS acquisition (warm start) |
| Gyroscopes: | $\pm$450 °/s \| **iSULONA/TLE-LN1 is low noise version: ARW = 0.06 °/$\sqrt{hr}$** \| > 180 Hz |
| Accelerometers: | $\pm$10 g all axes \| noise density 60 µg/$\sqrt{Hz}$ \| bandwidth > 160 Hz |
| Integrated GNSS receiver: | iSULONA/TLE-LN1: all frequencies / all constellations GPS/GALILEO/GLONASS/BEIDOU/ SBAS / RTK / PPP etc. (see ICD) <br> iSULONA/TLE-.-D: multi frequencies / multi constellations – dual-antenna capabilty <br> iSULONA/SLE-LN1 capability depends on extra charged options (from L1 GPS to all features) <br> iSULONA/SLE-.-D multi frequency / multi constellation – dual-ant. (features on extra charge) <br> iSULONA/RLE-LN1 multi frequencies / multi constellations / SBAS / RTK (commercial grade) <br> iSULONA/RLE-.-D multi frequencies / multi constellations / SBAS / RTK (commercial grade) <br> with -D = dual antenna for heading determination even at standstill condition |
| Odometer Interface / VMS: | one (A) or two (A/B) lines for odometer counts (RS422 level); <br> mode selection (e.g. usage of forward/backward signal) by software |
| Communication Interfaces: | Ethernet (TCP/IP, UDP), 2 x UART RS422/232, 2 x CAN, PPS (RS422 level), 2 x SYNC-IN, SYNC-OUT, USB, UART RS232 for GNSS correction data input |
| Data Input: | iMAG-DMC-LS (option), external MIL grade GNSS receiver (option) |
| Power Supply: | 10...34 V DC / approx. 8.5..10 W (depending on version) |
| Temperature range: | -40°C to +71°C operating, -56 °C to +85 °C storage |
| Shock; Vibration: | 10 g / 11 ms half-sine (op.); 1'000 g / 0.5 ms h.-s. / 20g, 10-2'000 Hz vib. (endurance) |
| Environment: | per MIL-STD-810G (vibration, shock, temp., humid.) and MIL-STD-461G (EM/EMC) |
| MTBF / MTTR: | 35'000 hrs (estimated) / 5 min. |
| Built-In-Test: | Power up and continuous (PBIT, CBIT) |
| Dimensions, Weight: | approx. 102 x 112 x 65 mm³ (WxDxH) ; approx. 800 grams |
| Additional Features: | Stored Heading/Position after Power-Off/On etc. |
| Signal Processing: | iMAR's advanced extended Kalman filter based SD/DR-algorithms |
| Parameter Setup: | For most accurate measurements, beside of other parameters the lever arms between the system and the odometer and the GNSS antenna and the user definable virtual reference point can be stored via a Windows™ or Linux based tool iXCOM-CMD or via command interface on the iSULONA hardware. |
| GUI / HMI software: | iXCOM-CMD software; SDK and Python scripts and ROS 2 node available |
| Part Number: | 00190-040C2-0u1i (u= type of GNSS engine, i=6: single / i=7: dual antenna GNSS) |

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[1] under sufficient motion dynamics and GNSS aiding; ask for "iSULONA/TLN-2-advanced" for higher attitude accuracy
[2] only applicable, if the system is aided with odometer (wheel sensor)