Inertial Labs
a VIAVI Solutions company

MADE IN USA

# IRINS-DM

## LOW EARTH ORBIT (LEO) AND GNSS AIDED INERTIAL NAVIGATION SYSTEM



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Fully integrated solution combining an Inertial Navigation System (INS), an Attitude and Heading Reference System (AHRS), an Iridium Satellite Timing and Location (STL) service, a Low Earth Orbit (LEO) satellite signals service alternative to GNSS, and an RSR Transcoder.

### Product Overview

IRINS-DM is a result of fusion of the Novatel OEM7 GNSS receiver, LEO STL-2600 receiver, Tactical-grade MEMS Inertial Measurement Unit (IMU), embedded gyro-compensated fluxgate magnetic compass, Barro-Altimeter and embedded Air Data Computer.




Optional onboard RSR transcoder [1] converts the navigation solution into a simulated GPS (L1/L2) RF signal that can be accepted by any GNSS receiver.

The IRINS uses Inertial Labs' sensor fusion filter, state-of-the-art navigation and guidance algorithms, and battle-proven jamming and spoofing algorithms to provide precise Time, Position, Velocity and Attitude measurements in challenging GNSS-denied environments.

### Features

- Assured Position, Navigation and Time (A-PNT) Solution
- LEO-Aided INS with embedded AHRS and GNSS receiver
- Low drift in GNSS and LEO denied environments
- Jamming and Spoofing mitigation
- Optionally embedded Transcoder GPS (L1/L2) RF signal output

### Applications

- Medium and Long-range Unmanned Airial Vehicles (UAV)
- Loitering Munitions
- Unmanned Surface Vessels (USV)
- Manned and Unmanned Ground Vehicles (UGV)
- Navigation, Battle Management and Blue Force Tracking Systems
- Maritime Navigation and Dynamically Positioning Systems

1. The IRINS-DM variant displayed in this image contains the optional RSR transcoder (interface J2).

## MEMS IMU

| Gyroscopes | | |
|---|---|---|
| Measurement Range (°/s) | ±2000 | |
| Bias in-run Stability[1] (°/hr) | 1 | |
| Bias Instability[2] (°/hr, RMS) | 30 | |
| SF Accuracy[2] (ppm) | 750 | |
| Noise (ARW)[3] (°/√hr) | 0.2 | |
| **Accelerometers** | | |
| Measurement Range (g) | ±8 | ±40 |
| Bias in-run Stability[1] (mg) | 0.005 | 0.02 |
| SF Accuracy[2] (ppm) | 150 | 500 |
| Bias instability[2] (mg, RMS) | 0.5 | 1.2 |
| Noise (VRW)[4] (m/s/√hr) | 0.015 | 0.045 |

## GNSS Receiver

| NovAtel OEM719 | |
|---|---|
| GNSS Constellations | GPS, GLONASS, Galileo, BeiDou, QZSS, NavIC |
| GNSS Bands | L1 C/A, L1C, L2C, L2P, L5, L3, L2 C/A, L2P, E1, E5a, E5b, B1I, B1C, B2I, B2a, B2b, L1S, L5 |
| GNSS Corrections | TerraStar-L/C PRO, RTK, DGPS, SBAS, GLIDE, SPAN, GRIT |
| GNSS Data Rate (Hz) | 20 |
| RTK Corrections | RTCM 2, RTCM 3, CMR, CMR+ |
| Initialization Time (s) | <34/ <20 (cold/ hot start) |
| Time Accuracy (ns)[5] | 5 |

1. Allan Variance, 12-hour measurement
2. In the temperature range
3. Angular Random Walk
4. Velocity Random Walk
5. Time accuracy does not include biases due to RF or antenna delay

## Performance

| Attitude | |
|---|---|
| Range (Heading, Pitch, Roll) (°) | 0-360, ±90, ±180 |
| Angular resolution (°) | 0.001 |
| Heading (INS) (°) | 0.15 |
| Heading Free Inertial (°/hr) | 1 |
| LEO-Aided Heading (°) | <2 |
| Pitch/Roll (Static) (°) | 0.05 |
| Pitch/Roll (INS) (°) | 0.03 |
| LEO-Aided Pitch/Roll (°)[6] | <0.15 |
| **Navigation** | |
| Horizontal Position (m, RMS) (SP/SBAS/DGPS/RTK) | 1 / 0.6 / 0.4 / 0.01 |
| Vertical Position (m, RMS) | 1 |
| Velocity (m/s) | 0.03 |
| LEO-Aided Horizontal Position (CEP50, m)[6,9,12] | 50 |
| LEO-Aided Velocity (RMS, m/s)[6,10,12] | <0.9 |
| Free Inertial (% DT)[11] | 0.2 |
| Jamming and Spoofing detection | Yes |
| **STL Receiver** | |
| Antenna Power (V) | 3.3 (built in) |
| Tracking (dBm)[7] | -120 |
| **Clock oscillator** | **MEMS OCXO** |
| Frequency (MHz) | 10 MHz |
| Holdover (μs)[8] | <2 |
| **Transcoder** | |
| RF Output Format | GPS L1, L2, P, C/A-code (at -100 to -125 dBm) |
| Spectral Purity (dBc) (1MHz to 13.2 GHz) | < -33 in-band (L1, ±20 MHz)<br>< -80 out-of-band |
| Harmonics (dBm) (L1 1.57542 GHz) | < -150 |

6. Land & Aerial Vehicle Applications
7. 25 dB antenna LNA gain assumed
8. Over 8 hours with rugged OCXO
9. Circular Error Probable at 50% Confidence (CEP50)
10. Root Mean Square (RMS)
11. Land Vehicle Applications
12. Performance is conditional to observability of Iridium SVs.

## Air Data Computer

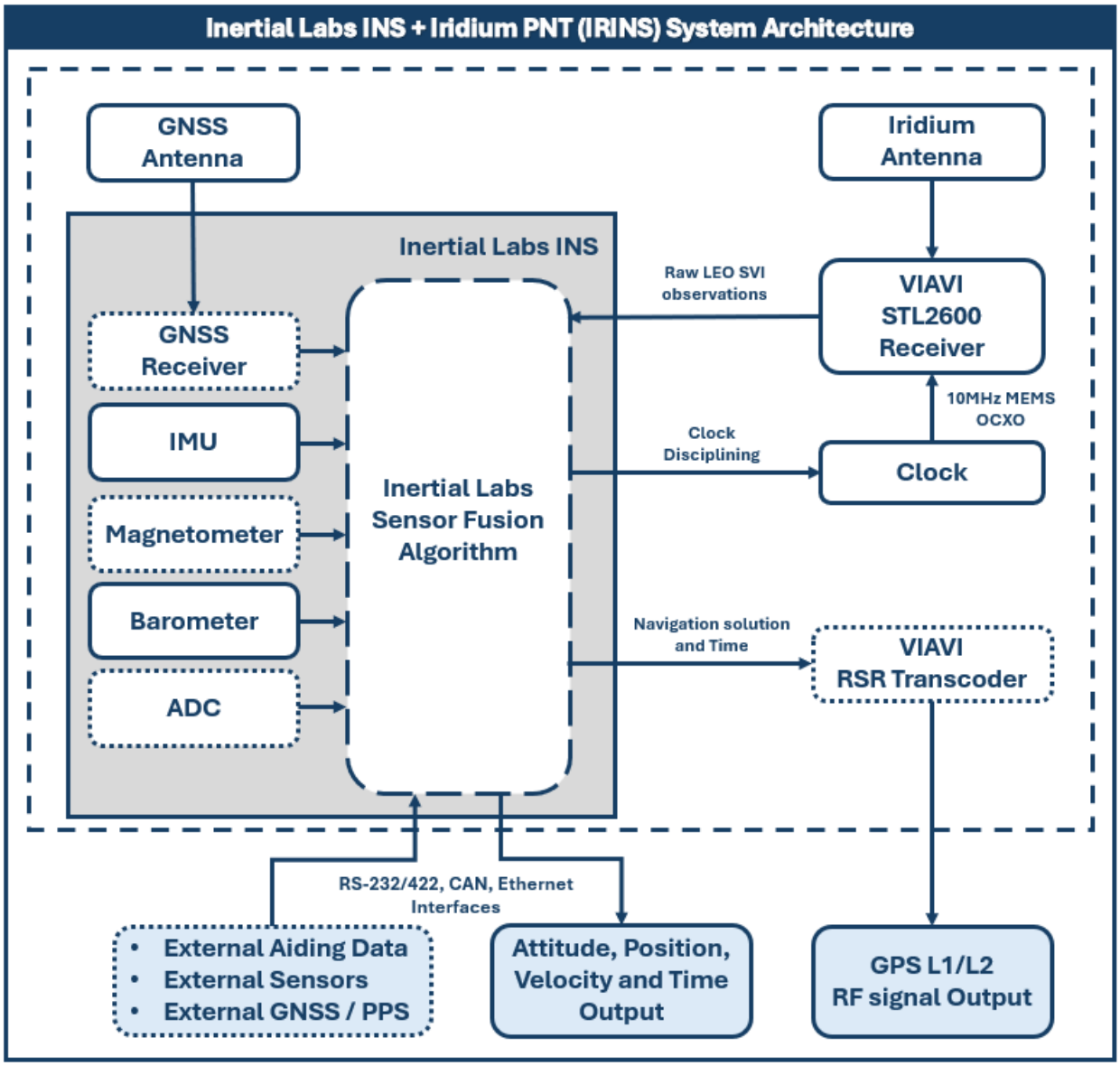
| Model | 2P | 2PEX | 2PMAX |
|---|---|---|---|
| Measurement Range (mbar) | ±25 | ±600 | ±4000 |
| **Static Pressure** | | | |
| Range (hPa) | 300 to 1100 | | |
| Accuracy (% FSS) | ±0.1 | | |
| **Dynamic Pressure** | | | |
| Range (hPa) | 0.15 to 25 | 0.15 to 600 | 0.15 to 4000 |
| Accuracy (% FSS) | ±0.25 | | |
| **Pressure Altitude** | | | |
| Range (m) | -500 to 9000 | | |
| Accuracy (m) | 1 | | |
| **Airspeed** | | | |
| Range (m/s) | 5 to 64 | 5 to 310 | 5 to 800 |
| Accuracy (m/s) | 0.5 | | |
| **Mach-Number** | | | |
| Range (M) | 0.01 to 0.2 | 0.01 to 0.99 | 0.01 to 2.5 |
| Accuracy (M) | 0.001 | 0.002 | 0.002 |
| **Static Pressure Over Total Pressure** | | | |
| Range | 0.97 to 1 | 0.63 to 1 | 0.2 to 1 |
| Resolution (ppm) | 1 | | |
| **Air Density** | | | |
| Range (kg/m3) | 0.3 to 1.6 | | |
| Accuracy (kg/m3) | 0.002 | | |
| **Outside Air Temperature (OAT)** | | | |
| Range (°C) | -40 to +85 | | |
| Resolution (°C) | 0.01 | | |

## GENERAL

| Environmental | |
|---|---|
| Operating Altitude (m) | up to 18000 |
| Operating temperature range (°C) | -40 to +80 |
| Storage temperature range (°C) | -50 to +85 |
| Environmental Protection | IP67, MIL-STD-810G |
| EMI/EMC | MIL-STD-461F |
| MTBF (GM) (h) | 100000 |
| **Electrical** | |
| Supply Voltage (VDC) | 9-36<br>26±10 (MIL-STD-1275) |
| Power Consumption (W)[1] | <10 |
| Input power protection | MIL-STD-1275 (optional) |
| 1 PPS Level (VDC) | 3.3/ 5 / Differential |
| **Physical[2]** | |
| Dimensions (mm) | 160.0 x 141.2 x 61.3 |
| Weight (g) | 1400 |
| **Interfacing** | |
| Output Interface | RS-232/RS-422/CAN/ Ethernet/RF[3] |
| Output Data Rate (INS) (Hz) | up to 200 |
| Output Data Format | Binary, NMEA 0183 ASCII characters |
| Data Inputs[4] | Aiding data<br>External sensors<br>External GNSS |

1. Power consumption varies depending on hardware configuration. Contact Inertial Labs for details
2. Contact Inertial Labs to obtain the most recent 2D/3D files before designing any interface hardware
3. GPS RF signal output available with a RSR transcoder configuration only
4. Refer to the ICD for the complete list of supported aiding data types and external sensors.

## IRINS-DM architecture




## Product Code Structure

| Model | IMU | Gyro | Accel | Connector | ADC | SAMC | GNSS | LEO | Transcoder | Interface |
|---|---|---|---|---|---|---|---|---|---|---|
| IRINS-DM | A1 | G2000 | A8 | C73 | 0P | SAMC | O719 | STL2600 | RSR2 | .12345 |
| | | | A40 | C76 | 2P | | | | | .1245R |
| | | | | | 2PEXT | | | | | |

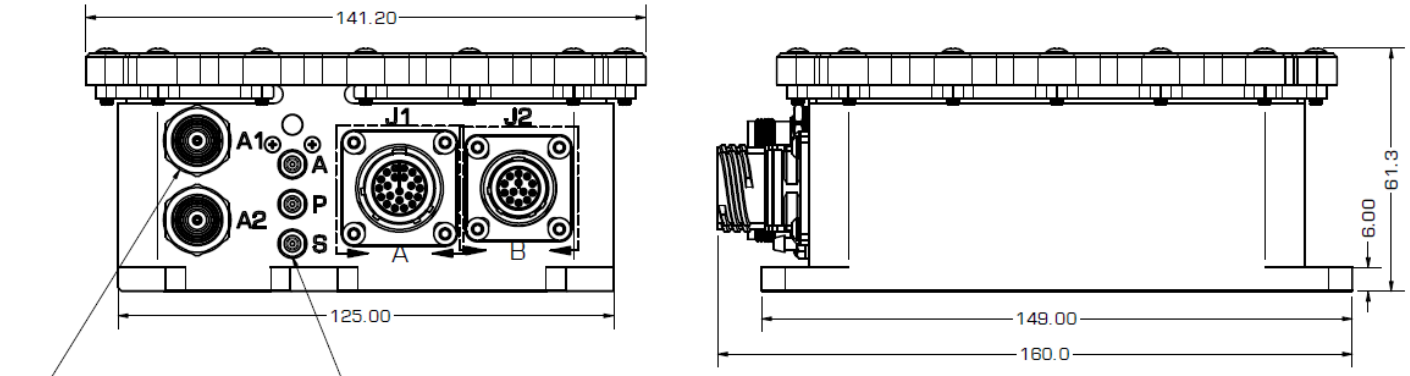
**Product code details:**

**IRINS-DM:** Inertial Navigation System
**A1:** Inertial Labs KERNEL-210 IMU
**G2000:** Gyro measurement range ±2000 deg/sec
**A8:** Accel measurement range ±8 g
**A40:** Accel measurement range ±40 g
**C73:** Two connectors (22-pin main; 13-pin auxiliary) with MIL-STD-1275 power protection
**C76:** Two connectors (22-pin main; TNC RF output) with MIL-STD-1275 power protection

**0P:** No ADC (Baro-altimeter only)
**2P:** ±25 mbar differential pressure sensor
**2PEX:** ±600 mbar differential pressure sensor
**SAMC:** External Stand-Alone Magnetic Compass (not available with transcoder)
**O719:** NovAtel OEM719 GNSS Receiver (optional)
**STL2600:** STL-2600 STL LEO Receiver
**RSR2:** RSR GNSS transcoder v2.0 (optional, *to be released*)
**.12345:** RS232, RS-422, RS-485 (SAMC), CAN, Ethernet
**.1245R:** RS232, RS-422, CAN, Ethernet, RF (RSR2 only)

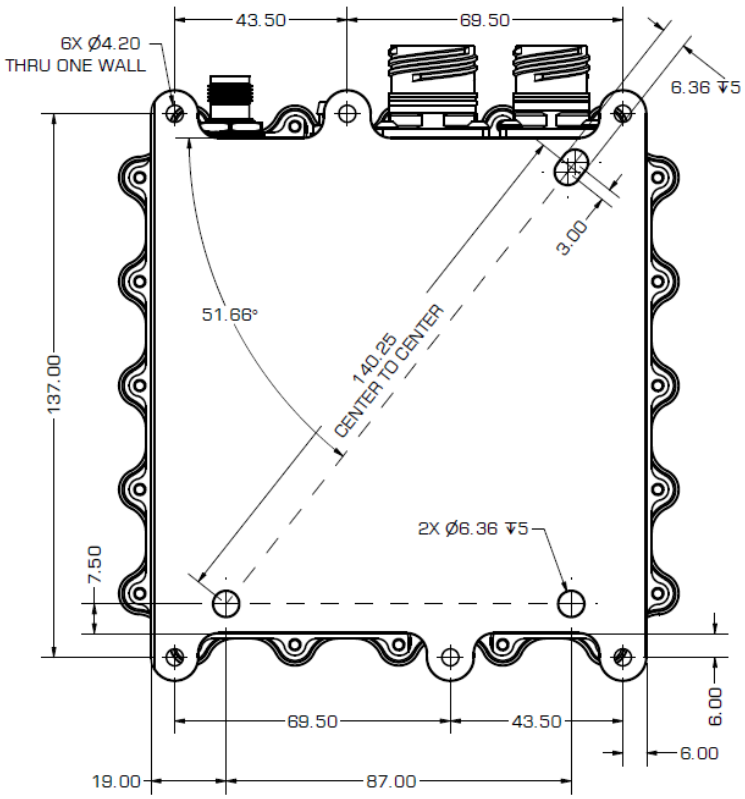
**Example:** IRINS-DM-A1-G2000-A40-C73-2P-SAMC-O719-STL2600-RSR2.12345

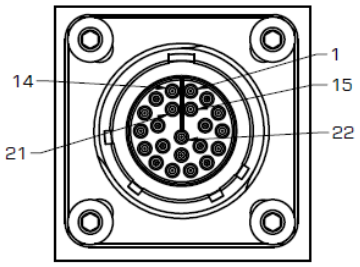
# IRINS-DM Mechanical and Electrical Interface



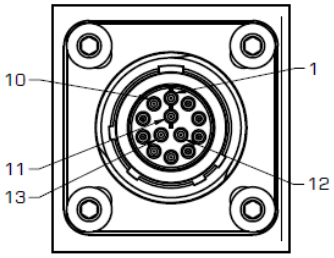

| | |
|---|---|
| A1 | GNSS ANTENNA TNC FEMALE |
| A2 | STL ANTENNA TNC FEMALE |

| | |
|---|---|
| A | ALTIMETER (STATIC) PRESSURE |
| P | AIRSPEED TOTAL (DYNAMIC) PRESSURE |
| S | AIRSPEED (STATIC) PRESSURE |




J1 PINOUT




J2 PINOUT

| | |
|---|---|
| 1 | POWER INPUT |
| 2 | POWER RETURN |
| 3 | RS232-RX1 |
| 4 | RS232-TX1 |
| 5 | RS232-RX2 |
| 6 | RS232-TX2 |
| 7 | RS232-RX3 |
| 8 | RS232-TX3 |
| 9 | RX4/CAN1-LOW |
| 10 | TX4/CAN1-HIGH |
| 11 | COMMON GND |

| | |
|---|---|
| 12 | RS422-RX1+ |
| 13 | RS422-RX1- |
| 14 | RS422-TX1+ |
| 15 | RS422-TX1- |
| 16 | 1 PPS OUT |
| 17 | MARK INPUT |
| 18 | ETHERNET TX+ |
| 19 | ETHERNET TX- |
| 20 | ETHERNET RX+ |
| 21 | ETHERNET RX- |
| 22 | COMMON GND |

| | |
|---|---|
| 1 | 5V OUTPUT |
| 2 | COMMON GND |
| 3 | ENC. PHASE A |
| 4 | ENC. PHASE B |
| 5 | RS485-A |
| 6 | RS485-B |
| 7 | RESERVED |
| 8 | RESERVED |
| 9 | AUX. RS232-TX4 |
| 10 | AUX. RS232-RX4 |
| 11 | CAN2 HIGH |
| 12 | CAN2 LOW |
| 13 | COMMON GND |



J2 (RSR Transcoder Option)
*To be released*

Inertial Labs, Inc a VIAVI Solutions Company
Address: 39959 Catoctin Ridge Street, Paeonian Springs, VA 20129 U.S.A.
Phone: +1 (703) 880-4222
E-mail: il.Sales@viavisolutions.com
Website: www.inertiallabs.com

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