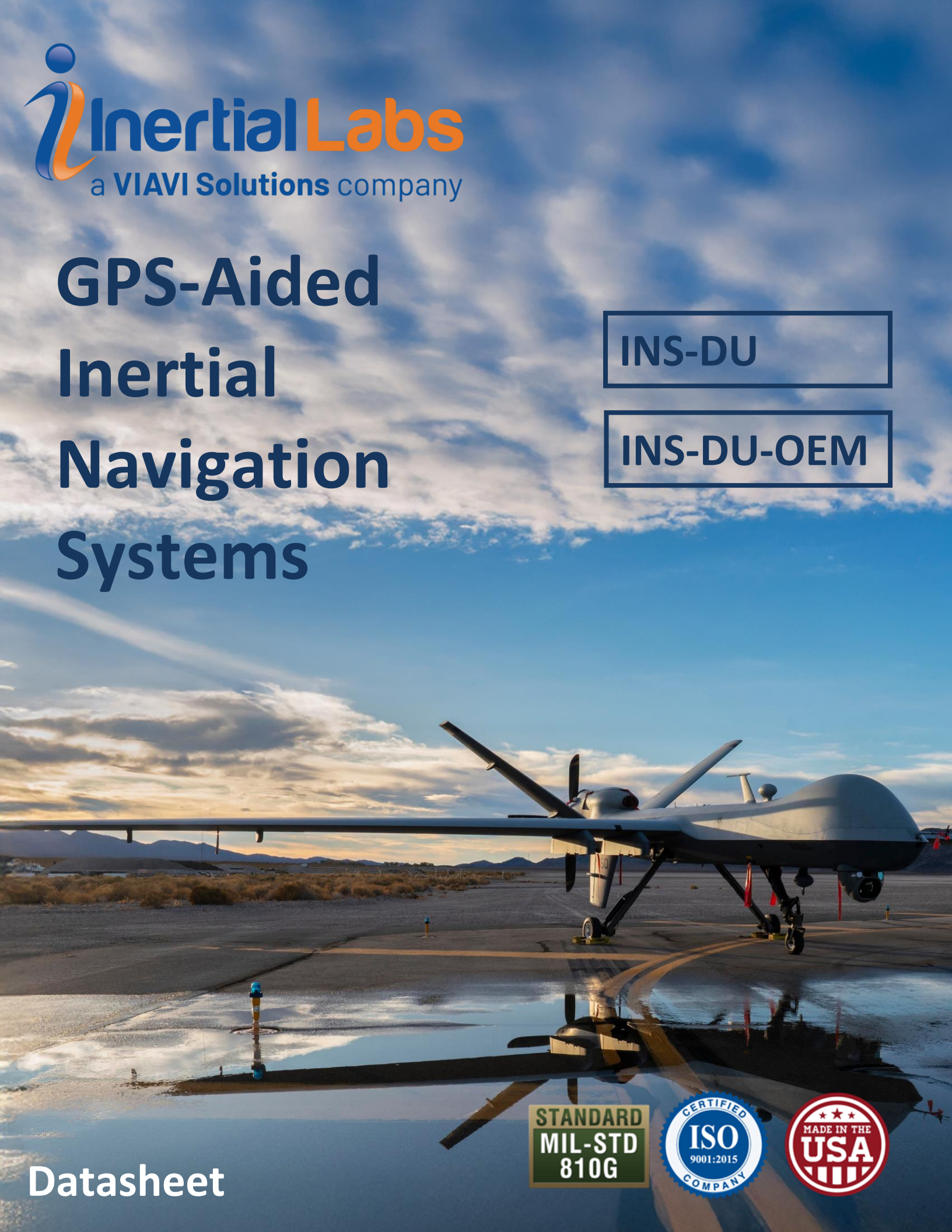
Inertial Labs
a VIAVI Solutions company

GPS-Aided Inertial Navigation Systems

INS-DU

INS-DU-OEM



STANDARD MIL-STD 810G

CERTIFIED ISO 9001:2015 COMPANY

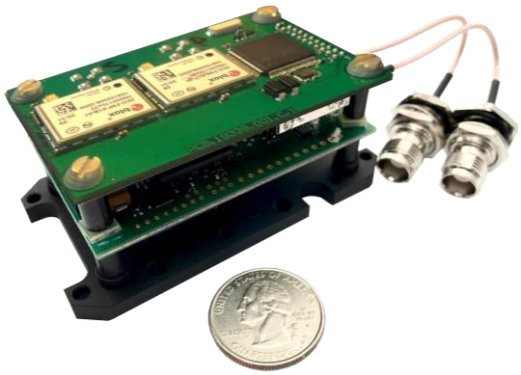
MADE IN THE USA

Datasheet

The **Inertial Labs Dual-Antenna GPS-Aided Inertial Navigation System (INS-DU, INS-DU-OEM)** is a new generation of fully integrated, combined GPS, GLONASS, GALILEO, QZSS, BEIDOU, and L-Band navigation and high-performance strapdown system, that determines position, velocity and absolute orientation (Heading, Pitch and Roll) for any device on which it is mounted. Horizontal and Vertical Position, Velocity and Orientation are determined with high accuracy for both motionless and dynamic applications.

INS-DU

INS-DU-OEM



The Inertial Labs **INS** utilizes an advanced dual-antenna GNSS receiver, barometer, 3-axes each of calibrated in full operational temperature range precision Accelerometers and Gyroscopes to provide accurate Position, Velocity, Heading, Pitch and Roll of the device under measure. **INS** contains Inertial Labs new on-board sensors fusion filter, state-of-the-art navigation and guidance algorithms and calibration software.

KEY FEATURES AND FUNCTIONALITY

- Excellent accuracy in GPS-Denied environments
- Support: ROS, LabVIEW, Waypoint Inertial Explorer, QINSy
- GPS, GLONASS, GALILEO, BEIDOU, SBAS, DGPS, RTK supported signals
- Fluxgate gyro-compensated compass to maintain free-inertial Heading (options)
- High-performance GNSS receivers
- Compatibility with LiDARs (Velodyne, RIEGL, FARO) and optical cameras
- Odometer, Wheel sensor, Airspeed sensor, Wind sensor aiding data
- Advanced, extendable, embedded Kalman Filter based sensor fusion algorithms
- State-of-the-art algorithms for different dynamic motions of Vessels, Ships, Helicopters, UAV, UUV, UGV, AGV, ROV, Gimbals and Land Vehicles
- Implemented ZUPT, ZARUPT, Tunnel Guide, GNSS tracking angle features
- Full temperature calibration, compact design, MIL-STD-810G/DO-160E
- Full integration with ArduPilot platform

SPECIFICATIONS

	Parameter	Units			
General	Output signals		Positions, Heading, Dual-antenna Heading, Pitch, Roll, Velocity, Accelerations, Angular rates, Barometer, PPS Direct AT_ITINS message with Position, Heading, Pitch & Roll to COBHAM AVIATOR UAV 200 Direct Navigation Support for ArduPilot/PX4-based Flight Controllers		
	Input signals		Marine application: DVL (Doppler Velocity Log) Land application: Odometer, Wheel sensor, Encoder, DMI Aerial application: Wind sensor, Air Speed Sensor All: External Stand-Alone Magnetic Compass (SAMC/AHRS)		
	Main features		High precision dual antenna heading		
	Compatible with		ArduPilot/PX4 Autopilot; Embention Autopilot; COBHAM AVIATOR UAV 200		
	Data rate	Hz	Up to 200 (INS data); Up to 2000 (IMU data)		
	Internal Data Logger (storage) - optional	GB	64		
	Start-up time	sec	<1		
Navigation	**Positions and Velocity**				
	Horizontal position accuracy (GPS L1)	meters, RMS	1.5		
	Vertical position accuracy (GPS L1)	meters, RMS	<2		
	Horizontal position accuracy (GPS L1/L2)	meters, RMS	1.2		
	Horizontal position accuracy (SBAS) [1]	meters, RMS	0.6		
	Horizontal position accuracy (DGPS)	meters, RMS	0.4		
	Horizontal position accuracy (TerraStar-L) [2]	meters, RMS	0.4		
	Horizontal position accuracy (TerraStar-C PRO) [2]	meters, RMS	0.025		
	Horizontal position accuracy (TerraStar-X) [2]	meters, RMS	0.02		
	Horizontal position accuracy (post-processing) [3]	meters, RMS	0.005		
	Horizontal position accuracy (RTK)	meters, RMS	0.01 + 1 ppm CEP		
	Vertical position accuracy (RTK)	meters, RMS	0.02 + 1ppm CEP		
	Position accuracy (free inertial, land vehicles) [4]	%, DT	1 (using Tunnel Guide positional aiding references)		
	Velocity accuracy, RMS	m/s RMS	0.05		
Orientation	**Heading**		**NovAtel OEM7720 / Septentrio mosaic-H**		**u-blox dual ZED-F9P**
	Range	deg	0 to 360		
	Static Accuracy [5]	deg RMS	0.15 (1 meter baseline), 0.08 (2 meters baseline)		0.4 (1 meter baseline), 0.2 (2 meters baseline)
	Dynamic accuracy (GNSS) [6]	deg RMS			
	Post processing accuracy [3]	deg RMS	0.1		
	Pitch and Roll				
	Range: Pitch, Roll	deg	±90, ±180		
	Angular Resolution	deg	0.01		
	Static Accuracy in the whole Temperature Range	deg RMS	0.08		
	Dynamic Accuracy [6]	deg RMS	0.05		
	Post processing accuracy [3]	deg RMS	0.03		
IMU	**Gyroscopes**				
	Type		Tactical-grade		
	Measurement range	deg/sec	±2000		
	Bias in-run stability (RMS, Allan Variance)	deg/hr	2		
	Bias error over temperature range (RMS)	deg/hr	72		
	Angular Random Walk	deg/√hr	0.38		
	Accelerometers				
	Type		Industrial-grade		
	Measurement range	g	±8	±15	±40
	Bias in-run stability (RMS, Allan Variance)	mg	0.01	0.03	0.05
	Bias error over temperature range (RMS)	mg	0.7	1.1	1.5
	Bias one-year repeatability	mg	1.5	2.0	2.5
	Velocity Random Walk	m/s/√hr	0.02	0.045	0.06
	Pressure				
	Measurement range	hPa	300 – 1100		
	Bias in-run stability (RMS, Allan Variance)	Pa	2		
	Noise density	Pa/√Hz	0.8		
General	**Environment**				
	Operating temperature	deg C	-40 to +75		
	Storage temperature	deg C	-50 to +85		
	MTBF (G_M @ +65degC)	hours	100000		
	Environmental protection [7]	-	IP67, MIL-STD-810G		
	EMC/EMI	-	MIL-STD-461F		
	Electrical				
	Supply voltage	V DC	9 to 36 (26±10 for MIL-1275 protection)		
	Power consumption		5 (6 with datalogger)		
	Protection (optional)		MIL-STD-1275		
	Output data format		Binary, NMEA 0183 ASCII characters		
	Physical		**INS-DU**		**INS-DU-OEM**
	Size [8]	mm	120.5 x 53.2 x 49.3		85.5 x 47.7 x 40.2
	Weight [8]	gram	320		174

Specifications subject to change without notice

[1] GPS only. [2] Requires a subscription to a TerraStar data service. [3] RMS, incremental error growth from steady state accuracy. Post-processing results using third party software. [4] Under ideal conditions that include proper static alignment and in-field dynamic motions during loss of GNSS signal. [5] Calibrated in whole operational temperature range, in homogeneous magnetic environment, for latitude up to ±65 deg. [6] Dynamic accuracy may depend on the type of motion. [7] The environmental protection ratings apply only to the device in its protective case. The OEM version may not meet these standards. [8] Weight and size are PN dependent. Customers should obtain the most recent 2D/3D files before designing any interface hardware.

	Parameters	Units	NovAtel	Septentrio	u-blox
GNSS Specifications	Model	-	OEM7720	mosaic-H	ZED-F9P
	Number of GNSS Antennas	-	Dual	Dual	Dual
	GNSS Constellations	-	GPS (L1 C/A, L1C, L2C, L2P, L5) Galileo (E1, E5 AltBOC, E5a, E5b) GLONASS (L1 C/A, L2 C/A, L2P, L3, L5) BeiDou (B1I, B1C, B2I, B2a, B2B) QZSS (L1 C/A, L1C, L1S, L2C, L5) NavIC (L5); L-Band	GPS (L1C/A, L2P(Y), L2C) Galileo (E1, E5b) GLONASS (L1C/A, L2C/A) BeiDou (B1I, B2I, B3I) QZSS (L1C/A, L1C/B, L2C) NavIC (L5)	GPS (L1C/A, L2C) Galileo (E1B/C, E5b) GLONASS (L1OF, L2OF) BeiDou (B1I, B2I) QZSS (L1C/A, L2C)
	GNSS Corrections	-	SBAS (WAAS, EGNOS, GAGAN, MSAS, L1, L5); DGPS; RTK; PPP TerraStar	SBAS (WAAS, EGNOS, GAGAN, MSAS, SDCM (L1)); DGPS; RTK	WAAS; EGNOS; MSAS; GAGAN; SBAS L1C/A; DGPS; RTK
	Channel Configuration [1]	Channels	555	448	184
	GNSS Data Rate	Hz	5 / 20 / 100	100 (max)	10 / 20
	RTK Corrections	-	RTCM v2, RTCM v3		RTCM v3
	Velocity Accuracy	m/s RMS	0.03		0.05
	Initialization Time	s	<34 (cold start), <20 (hot start)	<45 (cold start); <20 (hot start)	<30 (cold start), <10 (hot start)
	Time Accuracy (clock drift) [2]	ns RMS	20		30

[1] Tracks up to 60 L1/L2 satellites. [2] Time accuracy does not include biases due to RF or antenna delay.

PRODUCT CODE STRUCTURE

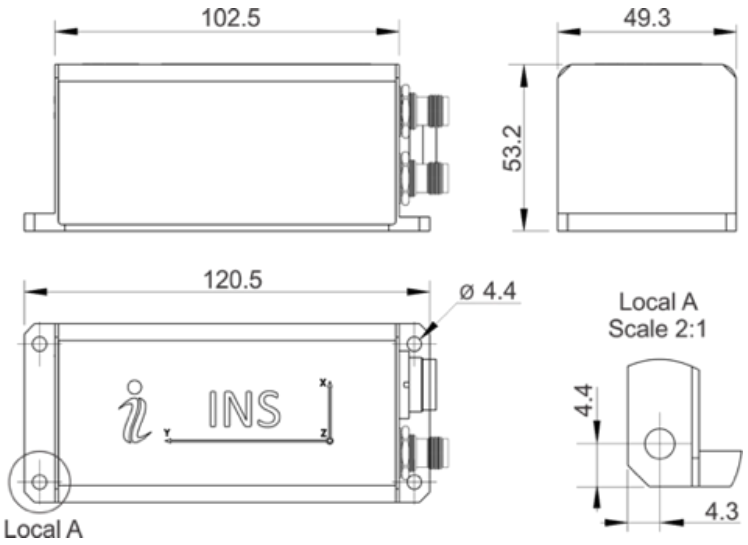
Model	Gyro	Accel	Calibration	Connector & Enclosure	Encoder support	Color	External Compass	Data Logger	GNSS receiver	Version	Interface
INS-DU	G2000	A8	TGA	C3 (default)	E (optional)	B	SAMC (optional)	S64 (optional)	O7720	VD9	124
INS-DU-OEM		A15	TMGA (optional)	C37					DMH		145
		A40		C4 (OEM)					ZD9P		1234
				C8 (OEM)							1245

Examples:
INS-DU-G2000-A8-TGA-C3E-B-S64-O7720-VD9.145
INS-DU-OEM-G2000-A40-TGA-C4-B-SAMC-O7720-VD9.1234

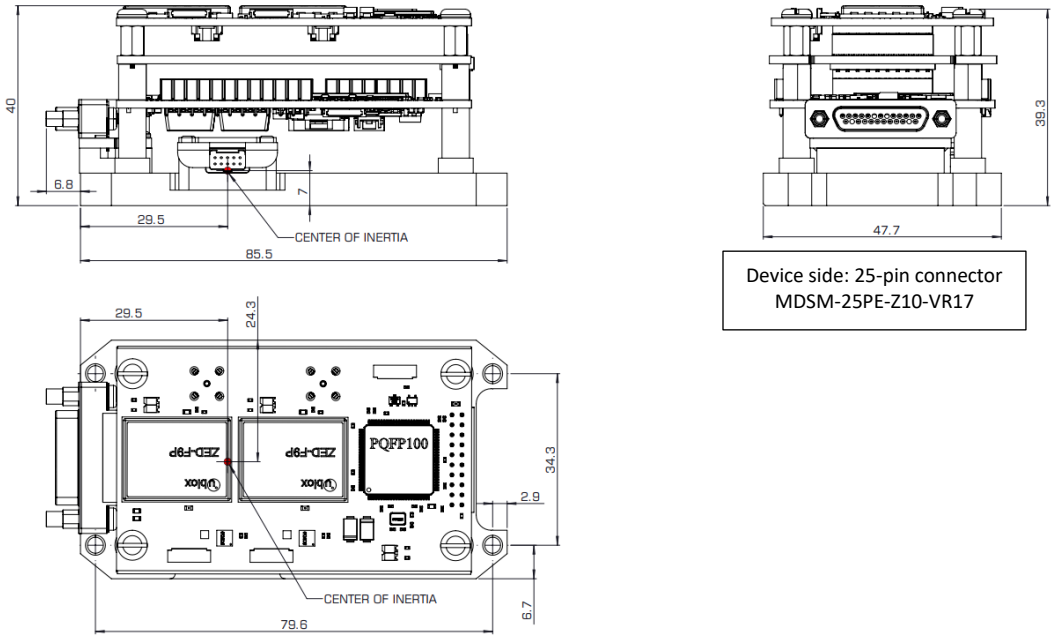
Product code details:

- INS-DU: Enclosed IP67 rated version of the GPS-aided Inertial Navigation System
- INS-DU-OEM: OEM version of the GPS-aided Inertial Navigation System
- G2000: Gyroscopes measurement range = ±2000 deg/sec
- A8: Accelerometers measurement range = ±8 g
- A15: Accelerometers measurement range = ±15 g
- A40: Accelerometers measurement range ±40 g
- TGA: Gyroscopes and Accelerometers
- TMGA: Magnetometers, Gyroscopes and Accelerometers (optional)
- C3: 24-pin connector
- C37: C3 with MIL-STD-1275 protection
- C4: Aluminum base plate with 26-pin header and ribbon cable (20021121-00026T4LF by Amphenol) (OEM only)
- C8: Aluminum base plate with 25-pin micro D-SUB connector with screw lock (MDSM-25PE-Z10-VR17 by ITT Cannon) (OEM only)
- E: Encoder support (optional)
- B: Black color
- SAMC: External Stand-Alone Magnetic Compass support (optional) (can only be used with VX.1234)
- S64: 64GB embedded Data Logger (optional)
- O7720: NovAtel OEM7720: GPS+GAL+BDS+QZSS, L1/L2/L5/E1/E5a/E5b/AltBOC/B1/B2I/B2a/B2b, NavIC L5, SBAS L1/L5 Dual Antenna Activation, RTK+PPP+Single Point+DGPS PNT, ALIGN Heading, 20 Hz Data Output Rate, Base Station Corrections + Measurements, GRIT Interference Mitigation and Spoofing Detection Includes GLIDE & RAIM
- DMH: Septentrio mosaic-H: GPS+GLO+BDS+GAL+QZSS, L1C/A/L2P(Y)/L2C/L1CA/L2CA/B1I/B2I/B3I/E1/E5b/L1C/A/L1C/B/L2C, SBAS, RTK, Dual Antenna GNSS Heading, AIM+ anti-jamming, anti-spoofing Advanced Interference Monitoring and Mitigation
- ZD9P: Dual u-blox ZED-F9P-02B: GPS+GLO+GAL+BDS+QZSS, L1C/A/L2C/L1OF/L2OF/E1B/C/E5b/B1I/B2I/L1C/A/L1S/L2C/L5, SBAS, RTK, Dual Antenna GNSS Heading, Active CW detection and removal, Onboard bandpass filter, Advanced anti-spoofing algorithms
- VD9: Dual-antenna GNSS receiver
- .124: RS-232, RS-422 and CAN interface
- .145: RS-232, CAN and Ethernet interface (w/ Encoder support)
- .1234: RS-232, RS-422, RS-485 (to be used when connecting to a Stand-Alone Magnetic Compass), and CAN interface
- .1245: RS-232, RS-422, CAN and Ethernet interface

INS-DU Mechanical Interfaces Description (standard configuration)



INS-DU-OEM Mechanical Interfaces Description (standard configuration)



Device side: 25-pin connector
MDSM-25PE-Z10-VR17

Notes:
1. All dimensions are in millimeters.
2. All dimensions within these drawings are subject to change without notice. Customers should obtain final drawings before designing any interface hardware.
3. GNSS antenna connector type: TNC – Female.
4. Weight and size are PN dependent. Customers should obtain the most recent 2D/3D files before designing any interface hardware.
5. Please contact Inertial Labs, Inc. if you need the INS unit to be delivered in a custom configuration with customized connector and output data.