Datasheet Rev 1.11

INS-NV

Programmable Inertial Navigation System Development Platform

Integrated solution combing Inertial Navigation System (INS), Attitude and Heading Reference System (AHRS), and Nvidia Jetson Compute Module. Delivering high performance development platform for machine vision algorithms and demanding guidance applications for alternative PNT.

Product Overview

Inertial Labs INS-NV integrates Nvidia Jetson compute module and Inertial Labs INS to deliver a modular high-performance development platform to host demanding navigation algorithms.

Built as development platform, the INS-NV enables rapid integration and significantly reduce integration time and time-to-market for product requiring robust real-time navigation and sensor fusion system, including machine vision, autonomy guidance system and for other demanding APNT algorithms.

By leveraging Inertial Labs' aiding data ecosystem, advance sensor fusion filters, calibration software, and state of-the-art navigation algorithms, the INS-NV delivers precise time, position, velocity, and attitude measurements and maintain accurate orientation in GNSS-denied environment.



Features

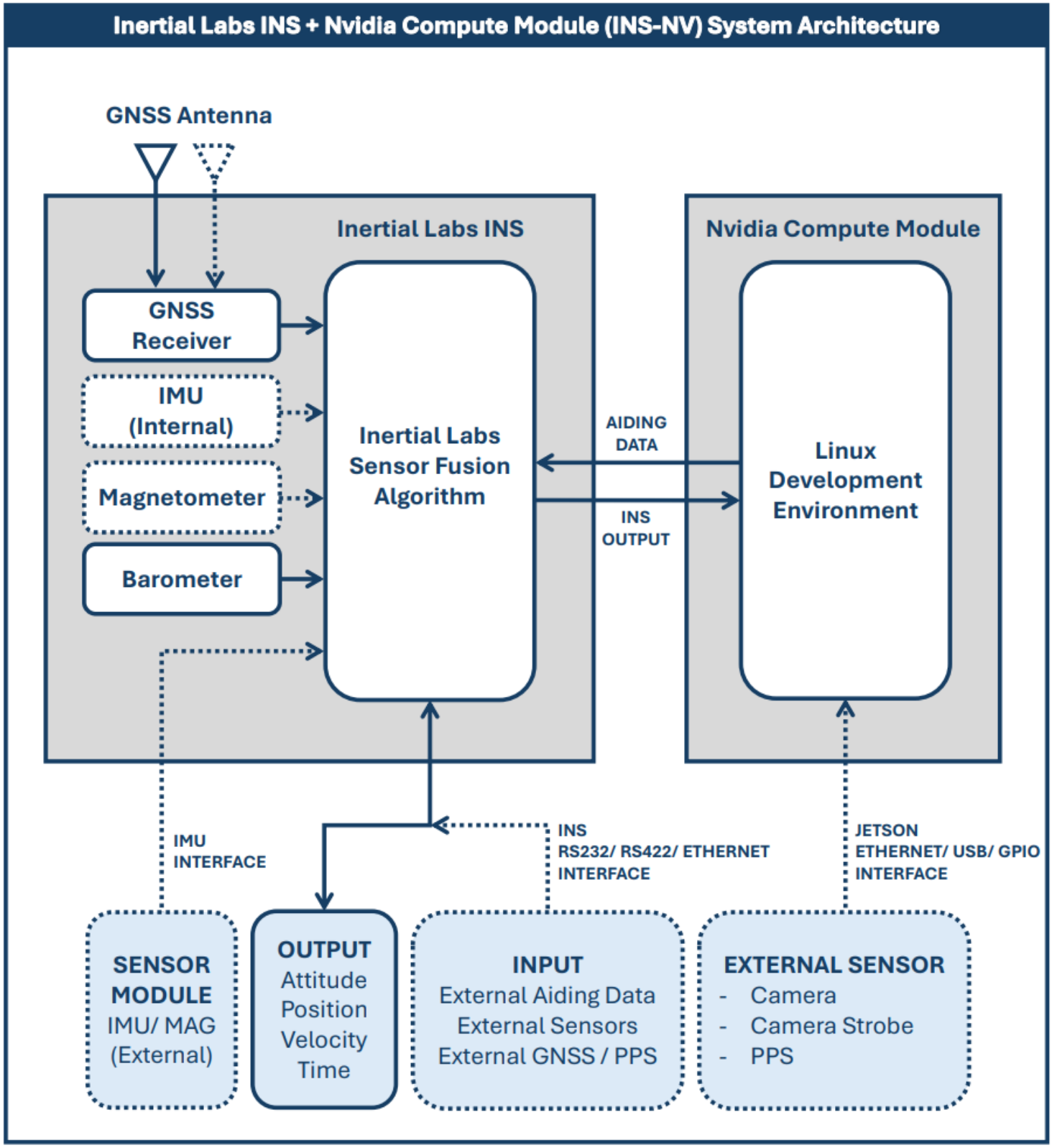
- Fully calibrated tactical-grade MEMS accel and gyros
- MIL-STD-810G compliant[1]
- Full-constellation GNSS receiver (GPS/ QZSS/ GLO/ GAL/ BDS/ NavIC)
- ASPN-compliant data interface (upon request)
- Embedded barometric altimeter
- Embedded in-flight magnetometers calibration

Benefits

- High performance in dynamic and statis conditions.
- Accurate orientation and navigation in GNSS-denied environment
- Expandable sensor fusion with external aiding sources
- Compatible with Commercial Off-The-Shelf cameras or Inertial Labs Sensor Modules
- Rapid integration and reduced time-to-market development
- Raw GNSS measurements and IMU data for post processing

1. Please inquire with the Inertial Labs Sales team to request MIL-STD-810G compliance qualification test reports with respect to general minimum integrity vibration profile, 20g functional shock (sawtooth pulse) and operating temperature test from -25 to +75 °C.

System Architecture



1. Dotted boarders represent optional components
2. For dual GNSS antenna application, please contact Inertial Labs for availability.

IMU

Gyroscopes	**INS-NV-M1[6]**			**INS-NV-A1[6]**		
Measurement Range (°/s)	±2000					
Bias in-run Stability[1] (°/hr)	2			1		
Bias Instability[2] (°/hr, RMS)	72			30		
SF Accuracy[2] (ppm)	1000			750		
Noise (ARW)[3] (°/√hr)	0.38			0.2		
Accelerometers						
Measurement Range (g)	±8	±15	±40	±8	±15	±40
Bias in-run Stability[1] (mg)	0.01	0.03	0.05	0.005	0.01	0.02
SF Accuracy[2] (ppm)	500	700	850	150	300	500
Bias instability[2] (mg, RMS)	0.7	1.1	1.5	0.5	0.7	1.2
Noise (VRW)[4] (m/s/√hr)	0.02	0.045	0.06	0.015	0.035	0.045
Magnetometers	**miniAHRS**					
Measurement Range (nT)	±800,000			N/A		
Bias in-run Stability[2] (nT)	0.8			N/A		
PSD (nT/√Hz)	1.5			N/A		
SF Accuracy (ppm)	500			N/A		

GNSS Receiver

	u-Blox ZED-F9P	**Septentrio Mosaic-X5**	**NovAtel OEM719**
GNSS Constellations	GPS/QZSS, GLONASS, Galileo, BeiDou, NavIC		
GNSS Bands	L1C/A, L2C, L1OF, L2OF, E1B/C, E5b, B1I, B2a	L1C/A, L1C, L1PY, L2C, L2P, L3 L5, L6 B1I, B1C, B2a, B2I, B3, E1, E5a, E5b, E5, E6	L1 C/A, L1C, L2C, L2P, L5, L3, L2 C/A, L2P, E1, E5a, E5b, B1I, B1C, B2I, B2a, B2b, L1S, L5
GNSS Corrections	WAAS; EGNOS; MSAS; GAGAN; SBAS; DGPS; RTK	WAAS; EGNOS; MSAS; GAGAN; SBAS; DGPS; RTK	TerraStar-L/C PRO, RTK, DGPS, SBAS, GLIDE, SPAN, GRIT
GNSS Data Rate (Hz)	10	20	20
RTK Corrections	RTCM 3	RTCM 2, RTCM 3	RTCM 2, RTCM 3, CMR, CMR+
Initialization Time (s)	<30/ <10 (cold/ hot start)	<45/ <20 (cold/ hot start)	<34/ <20 (cold/ hot start)
Time Accuracy (ns)[5]	30	20	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
6. All performance specification are conducted with internal IMU/ AHRS. However, INS-NV-M1 performance are applicable with all INS-NV configuration paired with SM.
7. INS-NV without IMU (WOI) is available for purchase, please inquire this option with Inertial Labs sales.

INS-NV General

Environmental		
Operating Altitude (m)	up to 15000	
Operating and Storage temperature (°C)	-25 to +75	
Environmental Protection	MIL-STD-810G	
EMI/EMC	Not Rated	
Electrical		
Supply Voltage (VDC)	9-36	
INS-NV+SM Power Consumption (W)[1]	<15[2]	
1 PPS Level (VDC)	3.3/ 5/ Differential	
Physical[3]	Encased	OEM
Dimensions (mm) (LxWxH)	111x75x89	107x68x92
Weight (g)	546	473
Interfacing		
Output Interface	RS-232/ RS-422/ RS-485 USB2.0/ GPIO/ Ethernet[4]	
Output Data Rate (INS) (Hz)	up to 200	
Output Data Format	Binary, NMEA 0183 ASCII characters	
Data Inputs[5]	Aiding data External sensors	

Nvidia Compute Module

Compute Module	
Processor (CPU/ GPU)	Jetson Orin NX 8 Cortex-A78AE (64-bit) 1024 CUDA Cores 32 Tensor Cores
RAM	16 GB (128-bit LPDDR5)
Storage	1TB M.2 NVMe SSD
Carrier Board	Connect Tech Hadron Carrier Board
AI Performance	157 TOPS

Sensor Module General

Imagery	Monochrome[6]		Infrared[7]	
	Encased	OEM	Encased	OEM
Spectrum	Visible Spectrum		Infrared (LWIR)	
Resolution (pixel)	2048x1536		640x512	
Horizontal FOV (°)	83		95	
Vertical FOV (°)	67		82	
Frame Rate	55		60	
Environmental				
Operating Altitude (m)	up to 15000			
Operating temp (°C)	-40 to +85			
Environmental Protection	MIL-STD-810G			
Electrical				
Supply Voltage (VDC)	9-36			
SM Power Consumption (W)[1]	<2		<2	
Physical[3]				
Dimensions (LxWxH) (mm)	88x 80x 100	63x 49x 68	83x 80x 100	56x 49x 62
Weight (g)	430	170	330	80
Interfacing				
Output Interface	RS-422/ USB			
Output Data Rate (IMU) (Hz)	up to 2000			
Output Data Format	Inertial Labs IMU Binary Image via USB			

1. Power consumption varies depending on hardware configuration. Contact Inertial Labs for details on specific hardware configuration.
2. INS-NV power consumption estimates is derived from operating INS-NV paired with Infrared SM and External ADC.
3. Weight and size are PN dependent. Contact Inertial Labs to obtain the most recent 2D/3D files before designing any interface hardware.
4. INS-NV ethernet ports includes Nvidia Jetson Module (1Gbs) and INS (100Mbs) for INS configured without SAMC.
5. Data input includes aiding data via INS-COM1/ external ADC/ Digital Wind Speed Sensor/ GNSS receiver.
6. BFS-U3-31S4M-BD2 - FA 4mm Machine Vision 1/1.8" Fixed Focus Lens.
7. BOSON+ 640 X 512 4.9mm Short Lens 95° HFOV – LWIR.

Performance

Position, Velocity, and Timestamps	INS-NV-M1[4]	INS-NV-A1[4]
Horizontal Position Accuracy (SP/SBAS/DGPS/PPK) (m)	1.5 / 0.6 / 0.4 / 0.005	
Horizontal Position Accuracy (RTK)[2] (m + 1ppm CEP[3])	0.01	
Vertical Position Accuracy (m, RMS)	0.01	
Velocity Accuracy (m/s)	0.03	
Heading		
Range (°)	0-360	
Angular Resolution (°)	0.01	
Heading (INS) (°)	0.15	
Heading (GNSS, 1m/2m baseline) (°)	0.15 / 0.08	
Heading (Magnetic) (°)	0.6	N/A
Heading (Free Inertial) (°\hr)[1]	5	2
Pitch and Roll		
Range (Pitch, Roll) (°)	±90, ±180	
Angular Resolution (°)	0.01	
Pitch/ Roll Static Accuracy (°)	0.08	
Pitch/ Roll Dynamics Accuracy (°)	0.05	

1. Dependent on several factors. Contact Inertial Labs to discuss expected performance in your application.
2. Measured using 1 km baseline and patch antennas with good ground planes. Does not account for possible antenna phase center offset errors. ppm limited to baselines up to 20 km.
3. Circular Error Probable (CEP)
4. All performance specification are conducted with internal IMU/ AHRS. However, INS-NV-M1 performance are applicable with all INS-NV configuration paired with SM.
5. INS-NV without IMU (WOI) is available for purchase, please inquire this option with Inertial Labs sales.

INS-NV
Mechanical Interface

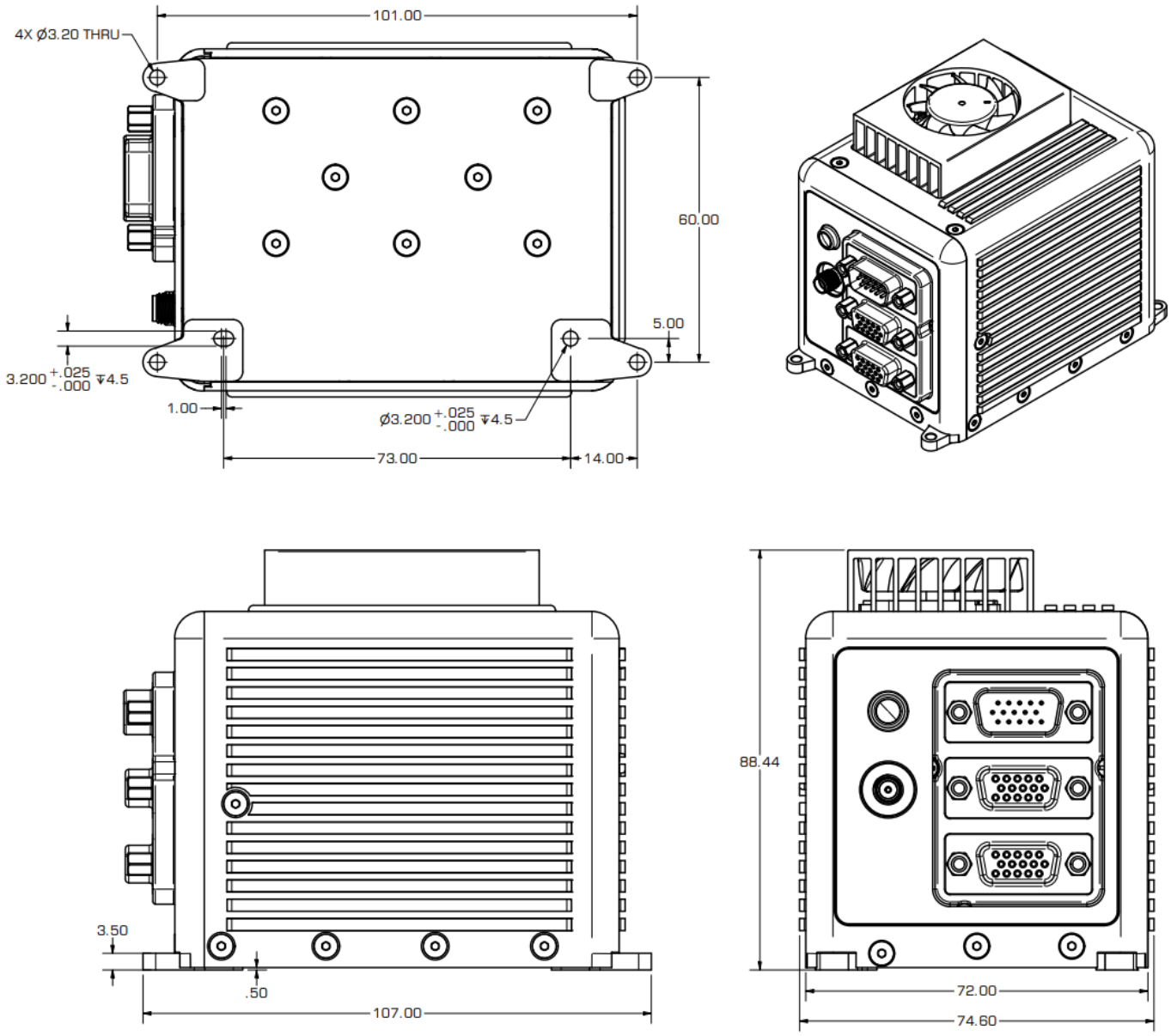


Figure 1 : *INS-NV mechanical drawing*[1]

1. Weight and size are PN dependent. Contact Inertial Labs to obtain the most recent 2D/3D files before designing any interface hardware.
2. All measurements units are in millimeters (mm).

INS-NV OEM
Mechanical Interface

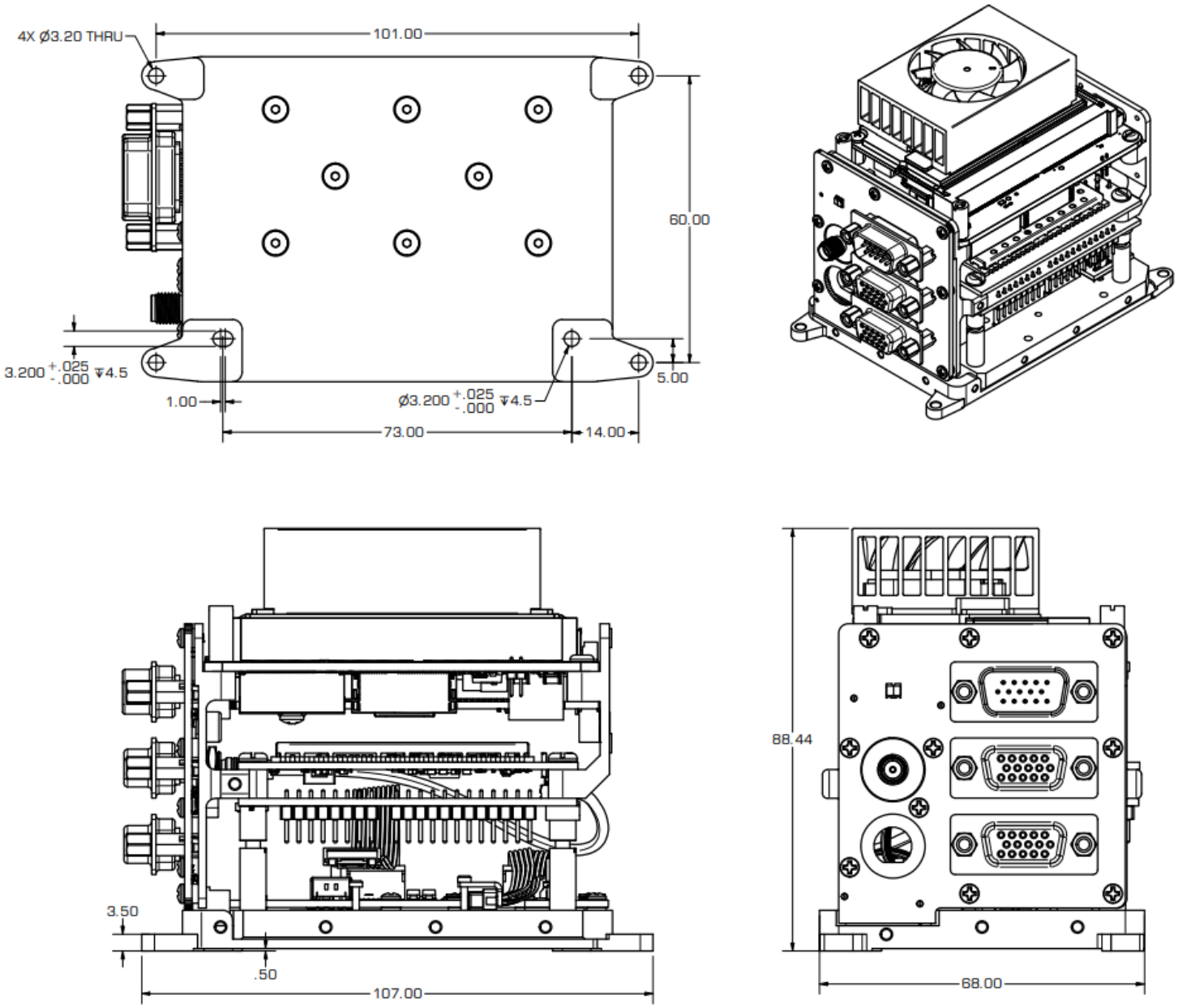


Figure 2 : *Caseless (OEM) INS-NV mechanical drawing*[1]

1. Weight and size are PN dependent. Contact Inertial Labs to obtain the most recent 2D/3D files before designing any interface hardware.
2. All measurements units are in millimeters (mm).

Monochrome Sensor Module Mechanical Interface

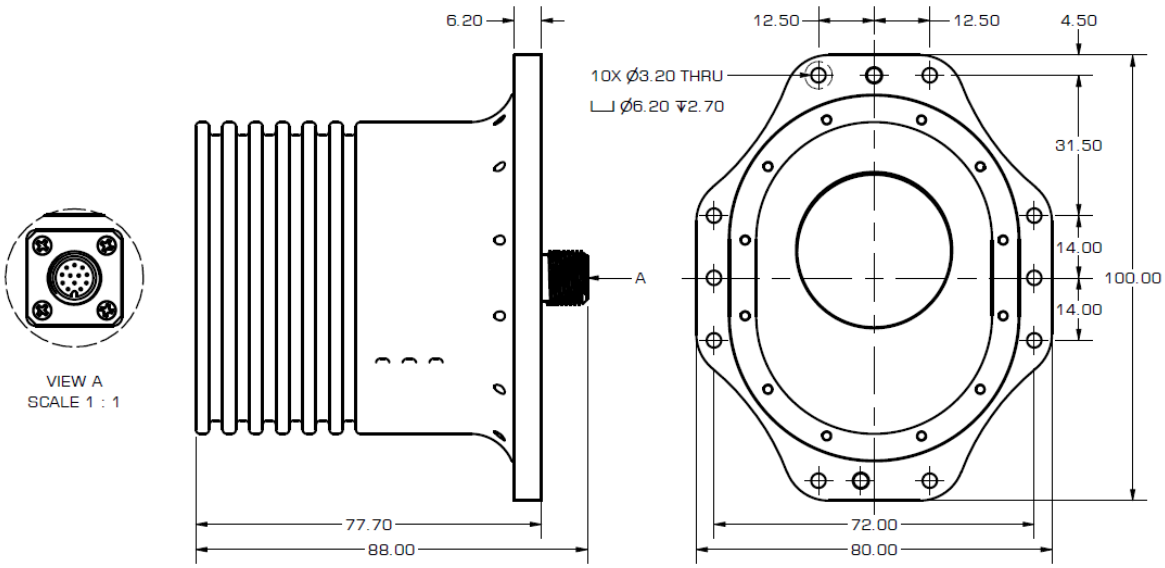


Figure 3: *Monochrome Sensor Module Drawing*[1]

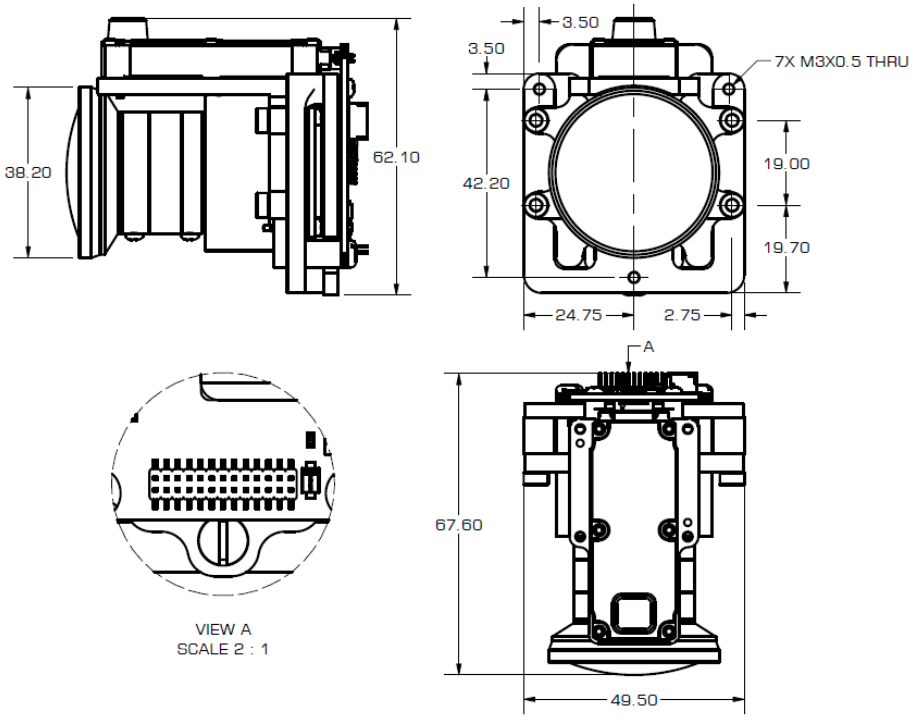


Figure 4: *Monochrome Sensor Module OEM Drawing*[1]

1. Weight and size are PN dependent. Contact Inertial Labs to obtain the most recent 2D/3D files before designing any interface hardware.
2. All measurements units are in millimeters (mm).

Infrared Sensor Module Mechanical Interface

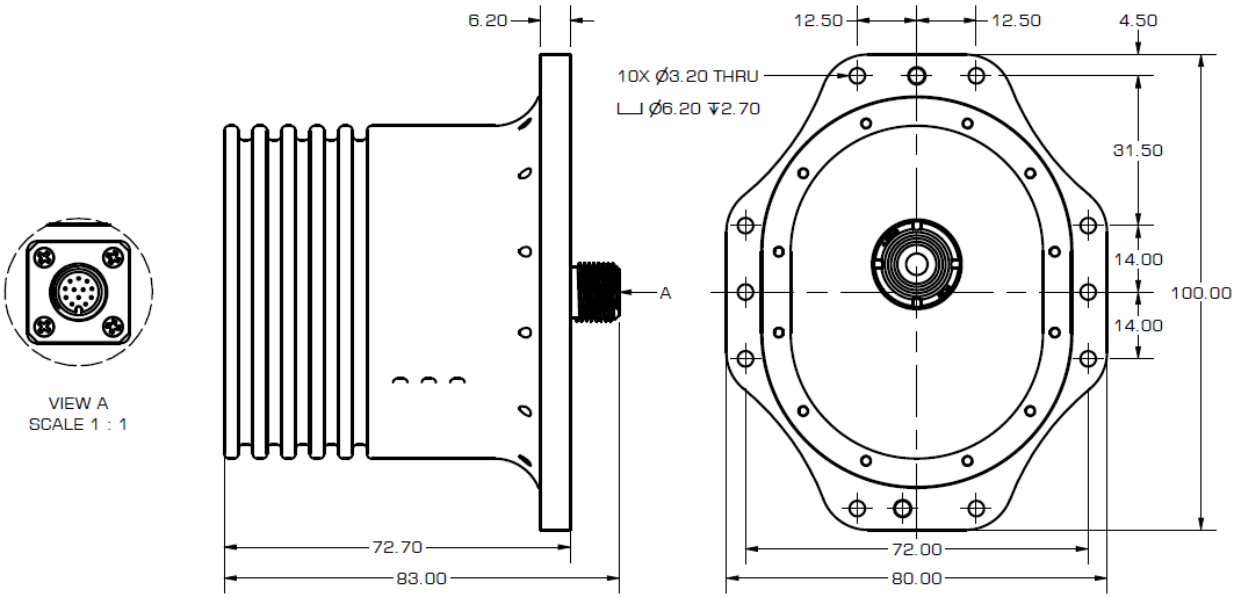


Figure 5: *IR Sensor Module Drawing*[1]

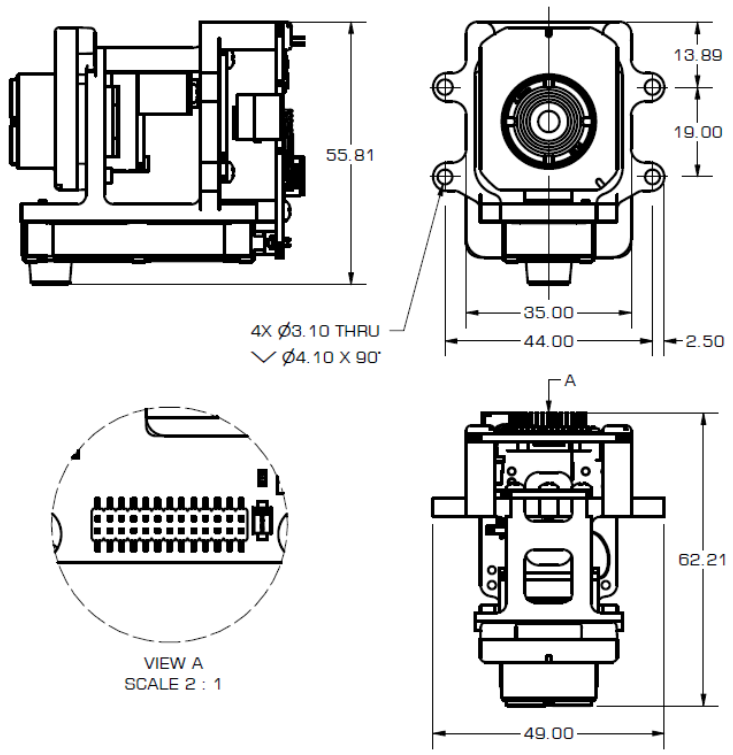


Figure 6: *IR Sensor Module OEM Drawing*[1]

1. Weight and size are PN dependent. Contact Inertial Labs to obtain the most recent 2D/3D files before designing any interface hardware.
2. All measurements units are in millimeters (mm).

Product Code Structure

Model	IMU	Gyro	Accel	Enclosure	GNSS Receiver	SAMC	Version	Interface
INS-NV	A1	G2000	A8	C25	O7500	SAMC	V9	.123
	M1		A15	C46	SMX5			.125
	WOI		A40		ZF9P			

Example[1]: INS-NV-A1-G2000-A15-C46-O7500-V9.12345

Product code details:

INS-NV: Nvidia INS Product Family
A1: Inertial Labs Kernel-210 IMU
M1: Inertial Labs miniAHRS
WOI: Without IMU
G2000: Gyro measurement range ±2000 deg/sec
A8: Accel measurement range ±8 g
A15: Accel measurement range ±15 g
A40: Accel measurement range ±40 g

C25: Caseless (OEM) device with three DB16 connector
C46: Encased[3] device with three DB16 connector
O7500: NovAtel OEM7500 GNSS Receiver
SMX5: Septentrio Mosaic-X5 GNSS Receiver
ZF9P: u-blox ZED-F9P GNSS Receiver
SAMC: External Stand Along Magnetic Compass (Optional)
V9: Single antenna GNSS receiver
.123: RS-232, RS-422, RS-485[2]
.125: RS-232, RS-422, Ethernet

Model	Gyro	Accel	Enclosure	Color	Camera	Version	Interface
VINS-SM	G2000	A8	C44	S	R1	V1	.29
		A15	C45		D1		
		A40					

Example: VINS-SM-G450-A8-C44-S-R1-V1.29

Product code details:

VINS-SM: VINS Sensor Module Product Family
G2000: Gyro measurement range ±2000 deg/sec
A8: Accel measurement range ±8 g
A15: Accel measurement range ±15 g
A40: Accel measurement range ±40 g

C44: Ruggedized enclosure with 12-pin connector
C45: Caseless (OEM) device with 26-pin connector
S: Chromated silver finish
R1: Infrared camera (LWIR)
D1: Day camera (monochrome)
V1: Version 1
.29: RS-422 and USB interfaces

1. Product configuration is flexible. Contact Inertial Labs to check compatibility or discuss other desired options.
2. RS-485 can only be utilized by Inertial Labs IMU: Kernel and miniAHRS.
3. Encased device is not ingress protection (IP) rated.