

# DIGITAL TILT SENSOR



# INERTIAL MEASUREMENT UNIT



The **Inertial Labs MEMS KERNEL-110M Inertial Measurement Units & Digital Tilt Sensors** is ruggedized version of the KERNEL-110 Miniature MEMS sensor-based IMU. Revolutionary due to its ruggedized design, self-contained strapdown, industrial-grade Inertial Measurement Systems that measures linear accelerations and angular rates with three-axis MEMS accelerometers and three-axis MEMS gyroscopes. Angular rates and accelerations are determined with low noise and very good repeatability for both motionless and dynamic applications.



The **Inertial Labs KERNEL-110M** is the breakthrough, IP-67 sealed, fully integrated inertial solutions that combines the latest MEMS sensor technologies.

Fully calibrated, temperature compensated, mathematically aligned to an orthogonal coordinate system, the IMU contains up to 2 deg/hr Bias in-run stability gyroscopes and 0.01 mg Bias in-run stability accelerometers with very low noise and high reliability.

Continuous Built-in Test (BIT), configurable communications protocols and flexible input power requirements make the **Inertial Labs KERNEL** easy to use in a wide range of higher order integrated system applications.



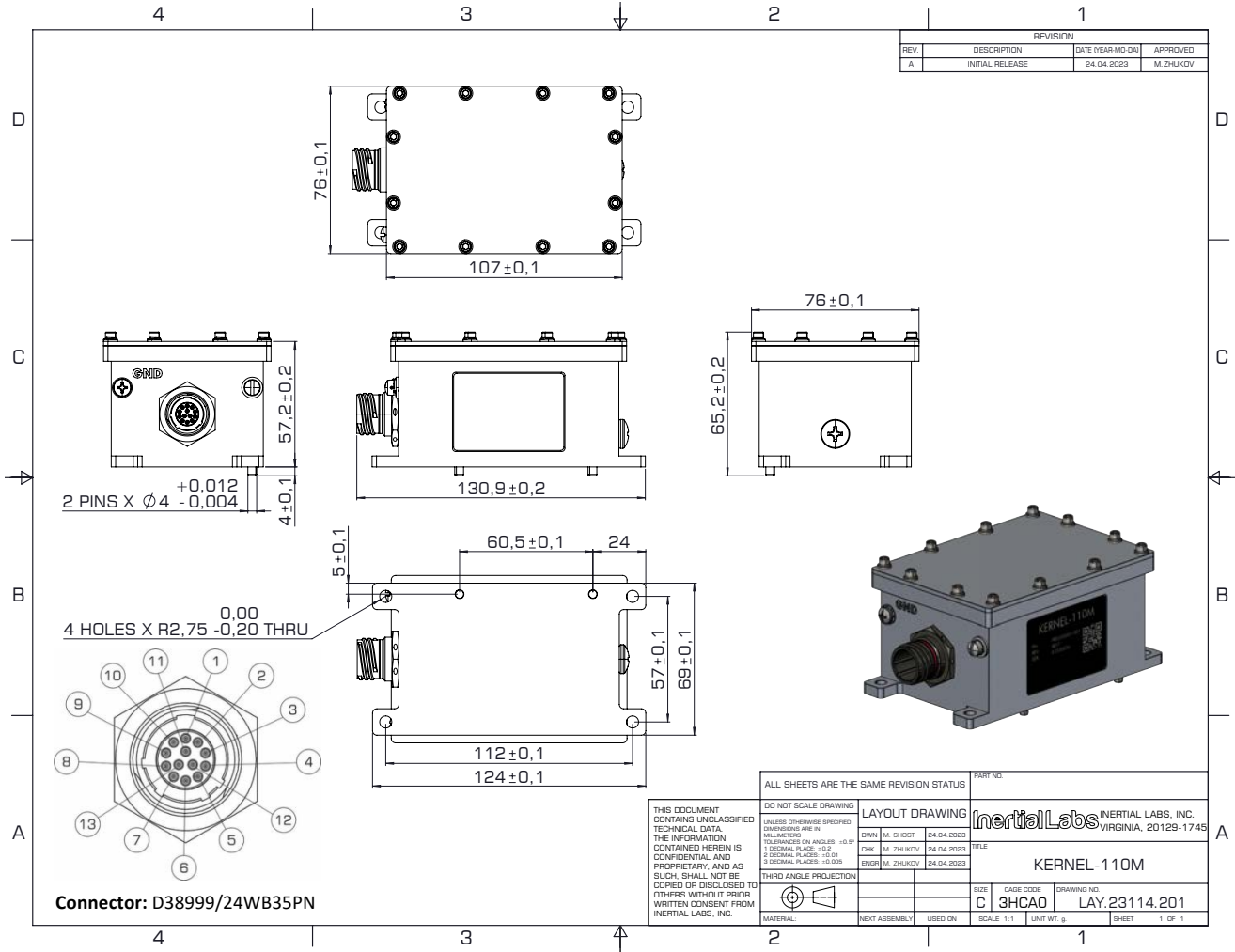
The **Inertial Labs KERNEL** models were designed for applications, like:

- ❖ Construction Vehicles Critical Attitude Control Systems
- ❖ Autonomous Ground Vehicles (AGV)
- ❖ Mining Trucks Motion and Safety Control Systems
- ❖ Autonomous Haulage Systems (AHS)
- ❖ Passengers trains acceleration / deceleration and jerking systems
- ❖ GPS-Aided Inertial Navigation Systems (INS)
- ❖ Attitude and Heading Reference Systems (AHRS)

Parameter	KERNEL-110M
<b>GYROSCOPESS</b>	
Measurement range	±2000 deg/sec
Gyroscopes Bias in-run stability	2 deg/hr
Gyroscopes Bias instability (over temp. range)	72 deg/hr
Gyroscopes Noise - Angular Random Walk	0.3 deg/vhr
<b>ACCELEROMETERS</b>	
Measurement range	±40g
Accelerometers Bias in-run stability	0.05 mg
Accelerometers Bias instability over temperature range	1.5 mg
Accelerometers Noise (Velocity Random Walk)	0.06 m/sec/vhr

	Parameter	Units	KERNEL-110M		
	Output signals		Pitch, Roll, Accelerations, Angular Rates, Temp., Synch		
	Update rate	Hz	2000		
	Start-up time	sec	<1		
	<b>Pitch &amp; Roll</b>	<b>Units</b>	<b>KERNEL-110M</b>		
	Data rate	Hz	2000		
	Range: Pitch	deg	±90		
	Range: Roll	deg	±180		
	Angular Resolution	deg	0.01		
	Static Accuracy, RMS	deg, 1σ	0.05		
	Dynamic Accuracy, RMS	deg, 1σ	0.08		
<b>PERFORMANCE</b>	<b>Gyroscopes</b>	<b>Units</b>	<b>KERNEL-110M</b>		
	Measurement range	deg/sec	±2000		
	Bandwidth (-3dB)	Hz, 1σ	260		
	Data update rate	Hz	2000		
	Bias in-run stability (Allan Variance)	deg/hr, 1σ	2		
	Bias repeatability (turn-on to turn-on, room temp.)	deg/hr, 1σ	20		
	Bias residual error (over temp. range, RMS)	deg/hr, 1σ	72		
	SF accuracy (over temperature range)	ppm, 1σ	1000		
	Noise. Angular Random Walk (ARW)	deg/vhr, 1σ	0.38		
	Non-linearity	ppm, 1σ	350		
	Axis misalignment	mrad, 1σ	0.5		
	<b>Accelerometers</b>	<b>Units</b>	<b>KERNEL-110M</b>		
	Measurement range	g	±40		
	Bandwidth (-3dB)	Hz, 1σ	260		
	Data update rate	Hz, 1σ	2000		
	Bias in-run stability (RMS, Allan Variance)	mg, 1σ	0.05		
	Bias residual error (over temperature range)	mg, 1σ	1.5		
	Bias one-year repeatability (room temp.)	mg, 1σ	2.5		
	SF accuracy (over temperature range)	ppm, 1σ	850		
	SF one-year repeatability	ppm, 1σ	1700		
Noise. Velocity Random Walk (VRW)	m/sec/vhr, 1σ	0.06			
Non-linearity	ppm, 1σ	1000			
Axis misalignment	mrad, 1σ	0.5			
	<b>Environment</b>	<b>Units</b>	<b>KERNEL-110M</b>		
	Mechanical shock	g, msec	>1000 g, 0.1 ms		
	Vibration	g RMS, Hz	20, 10 – 2000		
	Operating temperature	deg C	-40 to +85		
	Storage temperature	deg C	-50 to +90		
	Low pressure	Pa, min	1750, 30		
	Humidity	%	up to 95		
	MTBF (G <sub>M</sub> @+65degC, operational)	hours	100,000		
	Life time (operational)	years	10		
	Life time (storage)	years	17		
<b>ELECTRICAL &amp; MECHANICAL</b>	<b>Electrical</b>	<b>Units</b>	<b>KERNEL-110M</b>		
	Supply voltage	V DC	18 to 32 V DC		
	Power consumption	mW	525 @ 18V	620 @ 28V	665 @ 32V
	Output Interface	-	RS422 + discrete IOs		
	Output data format	-	Binary, ASCII, KERNEL-100		
	EMC/EMI		MIL-STD-461E		
	Protection		MIL-STD-1275		
	Connector		D38999/24WB35PN		
	<b>Physical</b>	<b>Units</b>	<b>KERNEL-110M</b>		
	Size	mm	107 x 76 x 61		
	Weight	grams	< 525		

**KERNEL-110M Mechanical Interface Descriptions**



**Pinout (mating side view)**

PIN	Name	Type	Direction	Source	Destination	Notes
1	EXTRIG	Discrete	Input	Host	IMU	Internally pulled to 4VDC via 100K
2	RS422_RXN	RS422	Input	Host	IMU	
3	1PPS*	Discrete	Input	Host	IMU	Internally pulled to 4VDC via 100K
4	RS422_RXP	RS422	Input	Host	IMU	
5	RS422_TXN	RS422	Output	IMU	Host	
6	RS422_TXP	RS422	Output	IMU	Host	
7	Reserved					
8	Reserved					
9	BOOT**	Discrete	Input	Host	IMU	Internally pulled to 4VDC via 10K. Pull down for firmware update. Leave floating if not used.
10	Reserved					
11	TOV	Discrete	Output	IMU	Host	Internally pulled down via 10K. Output logic low – 0V Output logic high – SUPPLY_IN
12	SUPPLY_RTN	Power	Return	Host	IMU	
13	SUPPLY_IN	Power	Input	Host	IMU	

\* 1PPS is optional, confirm availability before ordering

\*\* Pulling BOOT pin down prior to powering up puts the device to the firmware update mode. Leave floating for normal operation.

**KERNEL-110M Product Code structure**

Model	Gyroscope	Accel	Calibration	Connector	Color	Version	Interface
KERNEL-110M	G2000	A40	TGA	C3	W	V1	2