MEMS Inertial Measurement Units Digital Tilt Sensors

InertialLabs
Attitude is Everything

KERNEL-110
KERNEL-120

The **Inertial Labs MEMS KERNEL Inertial Measurement Units & Digital Tilt Sensors** are the second generation of the Inertial Labs KERNEL Miniature MEMS sensor-based family. Revolutionary due to its very compact, 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-110 and KERNEL-120** models are the breakthrough, fully integrated inertial solutions that combines the latest MEMS sensor technologies. **KERNEL-120** model utilizes two types of accelerometers: with ±40g and ±90g measurement ranges.

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.

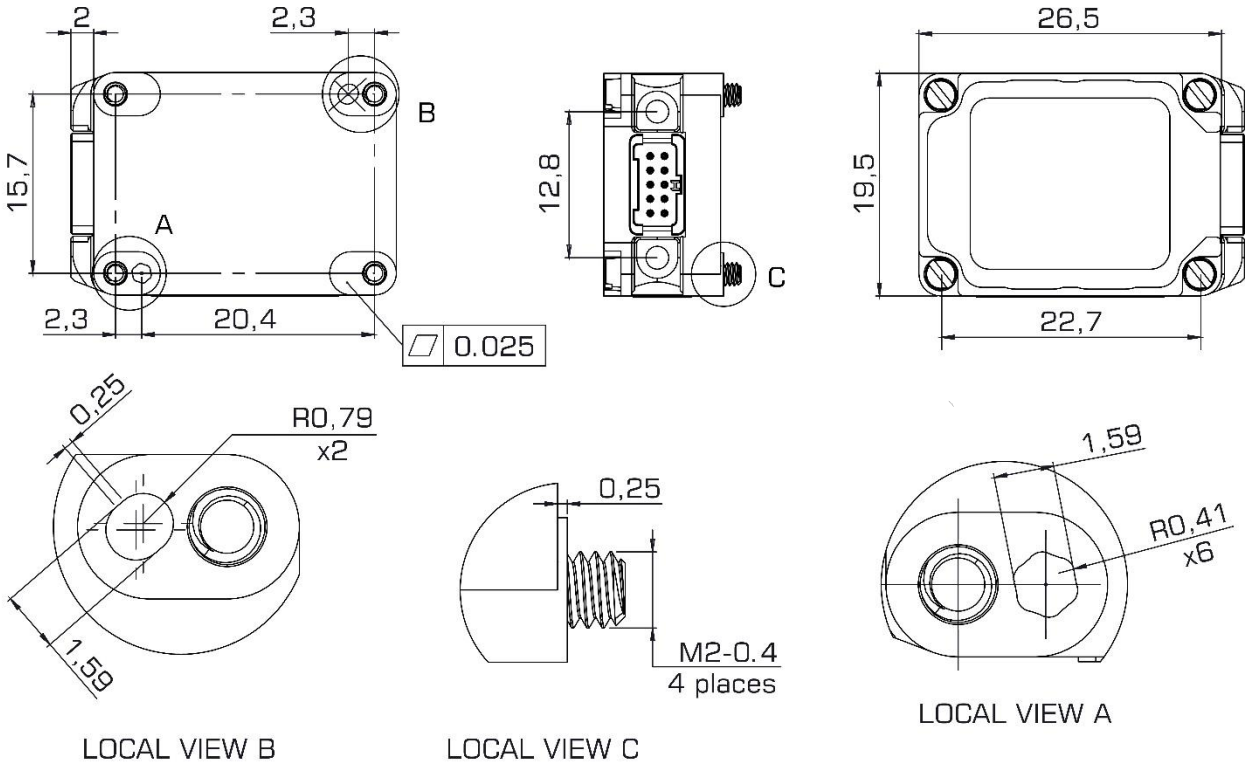
The **Inertial Labs KERNEL** models were designed for applications, like:

- Autonomous vehicles
- Antenna and Line of Sight Stabilization Systems
- Passengers trains acceleration / deceleration and jerking systems
- Motion Reference Units (MRU) and Motion Control Sensors (MCS)
- Gimbals, EOC/IR, platforms orientation and stabilization
- GPS-Aided Inertial Navigation Systems (INS)
- Attitude and Heading Reference Systems (AHRS)
- UAV & AUV/ROV navigation and control

Parameter	KERNEL-110	KERNEL-120	
GYROSCOPES			
Measurement range	±2000 deg/sec	±2000 deg/sec	
Gyroscopes Bias in-run stability	2 deg/hr	2 deg/hr	
Gyroscopes Bias instability (over temp. range)	72 deg/hr	72 deg/hr	
Gyroscopes Noise - Angular Random Walk	0.3 deg/√hr	0.3 deg/√hr	
ACCELEROMETERS			
Measurement range	±8g (15g/40g)	±40 g and	±90 g
Accelerometers Bias in-run stability	0.01 mg	0.05 mg	1 mg
Accelerometers Bias instability over temperature range	0.7 mg	1.5 mg	200 mg
Accelerometers Noise (Velocity Random Walk)	0.02 m/sec/√hr	0.06 m/sec/√hr	15 m/sec/√hr
PITCH & ROLL	0.05 deg	0.05 deg	

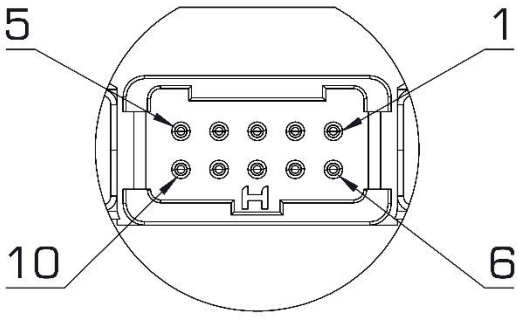
	Parameter	Units	KERNEL-110	KERNEL-120	
GENERAL	Output signals		Pitch, Roll, Accelerations, Angular Rates, Temp., Synch	Pitch, Roll, Accelerations, Angular Rates, Temp., Synch	
	Color of Enclosure		Aurum (Gold)	Aurum (Gold)	
	Update rate (IMU data)	Hz	2000	2000	
	Update rate (Pitch & Roll data)	Hz	2000	2000	
	Start-up time	sec	<0.02	<0.02	
	Full Accuracy Data (Warm-up Time)	sec	<0.05	<0.05	
	Latency	milli sec	<2.4	<2.5	
	Pitch & Roll	**Units**	**KERNEL-110**	**KERNEL-120**	
PERFORMANCE	Data rate	Hz	2000	2000	
	Range: Pitch	deg	±90	±90	
	Range: Roll	deg	±180	±180	
	Angular Resolution	deg	0.01	0.01	
	Static Accuracy, RMS	deg, 1σ	0.05	0.05	
	Dynamic Accuracy, RMS	deg, 1σ	0.08	0.08	
	Gyroscopes	**Units**	**KERNEL-110**	**KERNEL-120**	
	Measurement range	deg/sec	±2000	±2000	
	Bandwidth (-3dB)	Hz, 1σ	260	260	
	Data update rate	Hz	2000	2000	
	Bias in-run stability (Allan Variance, RMS)	deg/hr, 1σ	2	2	
	Bias instability (over temp. range, RMS)	deg/hr, 1σ	72	72	
	SF accuracy (over temperature range)	ppm, 1σ	1000	1000	
	Noise. Angular Random Walk (ARW)	deg/√hr, 1σ	0.3	0.3	
	Non-linearity	ppm, 1σ	350	350	
	Axis misalignment	mrad, 1σ	0.5	0.5	
	Accelerometers	**Units**	**KERNEL-110**	**KERNEL-120**	
	Measurement range	g	±8 / ±15 / ±40	±40	and ±90
	Bandwidth (-3dB)	Hz, 1σ	260	260	260
	Data update rate	Hz, 1σ	2000	2000	2000
	Bias in-run stability (RMS, Allan Variance)	mg, 1σ	0.01 / 0.03 / 0.05	0.05	1
	Bias instability (in temperature range, RMS)	mg, 1σ	0.7 / 1.1 / 1.5	1.5	200
	Bias one-year repeatability	mg, 1σ	1.5 / 2.0 / 2.5	2.5	200
	SF accuracy (over temperature range)	ppm, 1σ	500 / 700 / 850	850	2000
	SF one-year repeatability	ppm, 1σ	800 / 1400 / 1700	1700	2000
	Noise. Velocity Random Walk (VRW)	m/sec/√hr, 1σ	0.02 / 0.045 / 0.06	0.06	15
	Non-linearity	ppm, 1σ	340 / 800 / 1000	1000	3000
	Axis misalignment	mrad, 1σ	0.5	0.5	0.5
	Environment	**Units**	**KERNEL-110**	**KERNEL-120**	
ELECTRICAL & MECHANICAL	Mechanical shock	g, msec	400 g, 0.1 ms	400 g, 0.1 ms	
	Vibration	g RMS, Hz	8, 10 – 2000	8, 10 – 2000	
	Operating temperature	deg C	-40 to +85	-40 to +85	
	Storage temperature	deg C	-50 to +90	-50 to +90	
	Low pressure	Pa, min	1750, 30	1750, 30	
	Humidity	%	up to 95	up to 95	
	MTBF (G_M @+65degC, operational)	hours	100,000	100,000	
	Life time (operational)	years	10	10	
	Life time (storage)	years	17	17	
	Electrical	**Units**	**KERNEL-110**	**KERNEL-120**	
	Supply voltage	V DC	5.4 - 36	5.4 - 36	
	Power consumption	Watts	0.4 – 0.6	0.4 – 0.6	
	Output Interface	-	RS422 + discrete IOs	RS422 + discrete IOs	
	Output data format	-	Binary, ASCII, KERNEL-100	Binary, ASCII, KERNEL-100	
	Physical	**Units**	**KERNEL-110**	**KERNEL-120**	
	Size	mm	28.38 x 19.5 x 10.5	28.38 x 19.5 x 10.5	
	Weight	grams	10	10	

KERNEL-110 and KERNEL-120 Mechanical/Electrical Interface Description



HARWIN G125 SERIES GECKO CONNECTOR

1	POWER	POWER SUPPLY INPUT
2	BOOT	DO NOT CONNECT
3	1PPS	1PPS INPUT
4	RS422-A	RS-422 NON-INVERTING INPUT
5	RS422-B	RS-422 INVERTING INPUT
6	GROUND	POWER SUPPLY RETURN
7	TOV	TIME OF VALIDITY OUTPUT
8	EXTRIG	EXTERNAL TRIGGER INPUT
9	RS422-Y	RS-422 NON-INVERTING INPUT
10	RS422-Z	RS-422 INVERTING INPUT

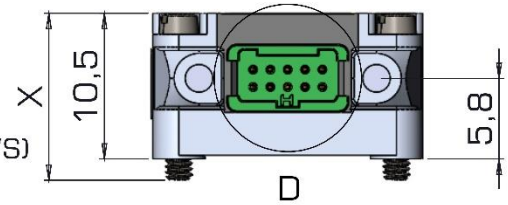


LOCAL VIEW D

NOTE 1: X VALUE IS PRODUCT CODE DEPENDENT:
X = 13.5 FOR C12 OPTION (12.0mm SCREWS)
X = 12.0 FOR C42 OPTION (10.5mm SCREWS)

NOTE 2: SCREW HEAD IS PRODUCT DEPENDENT:
HEX SOCKET (1.3mm) FOR C12 OPTION (12mm SCREWS)
STRAIGHT SLOT FOR C42 OPTION (10.5mm SCREWS)

NOTE 3: RECOMMENDED MAXIMUM TORQUE 2.5 IN-LBS.



KERNEL-110 and KERNEL-120 Product Codes structure

Model	Gyroscope	Accel	Calibration	Connector	Color	Version	Interface
KERNEL-110	G2000	A8 A15 A40	TGA	C12	A	V1	2
Model	**Gyroscope**	**Accel**	**Calibration**	**Connector**	**Color**	**Version**	**Interface**
KERNEL-120	G2000	A40A90	TGA	C12 C42	A	V1	2

Example:
KERNEL-110-G2000-A15-TGA-C12-A-V1.2
KERNEL-120-G2000-A40A90-TGA-C12-A-V1.2

Product code details:

- 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
- A40A90: Accelerometers measurement range = ±40 g and ±90 g
- TGA: Gyroscopes and Accelerometers are calibrated over temperature range
- C12: Aluminum case (with 12mm captive screws)
- C42: Aluminum case (with 10.5mm captive screws)
- A: Color of enclosure: Aurum (Gold)
- V1: Version 1
- .2: RS-422 interface