

## PRODUCT DATA

# ML5-AR: Economical, Compact, Ruggedised CAN Bus Vertical Reference Unit and IMU

The ML5-AR gyro-stabilised inclinometer delivers low-cost precision measurements of dynamic inclination, acceleration, and angular rate in challenging environments such as those encountered by heavy-duty construction, off-highway, agriculture, and trucking vehicles.

The ML5-AR utilises the power of a sophisticated AutoAdaptive Extended Kalman Filter (EKF) to remove errors associated with vibration, sudden linear motions, and quake, resulting in a true reading of inclination under all conditions.

The ML5-AR's state-of-the-art temperature compensation and calibration assures error-free performance over the full operational temperature range.

The compact size, wide 4.5 to 36 V power range, IP68/IP69K rating, and CAN J1939 or CANopen communications protocol make the ML5-AR a single part solution for a full range of vehicle sizes and applications.



## MEASUREMENT PERFORMANCE

- 6 DOF gyro-stabilised inclinometer
- Full accuracy over the entire operational temperature range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Auto-adaptive EKF provides superior dynamic accuracy
- Based on MicroStrain by HBK's proven 5th generation industrial/aerospace solid-state MEMS gyro technology

## RUGGEDISED FOR OFF-HIGHWAY USE

- Compact and rugged reinforced PBT housing is fully sealed for immersion, pressure wash (IP68/IP69K)
- Low-cost, rugged, reliable AMPSEAL 16 connector
- Optional metal guard plate protects sensor and connector and allows connector insertion and removal

## FLEXIBLE DEPLOYMENT OPTIONS

- CAN J1939 or CANopen communication
- Simple sensor to vehicle alignment, install in any orientation
- Wide power input range (4.5 Vdc – 36 Vdc)
- User-settable parameters

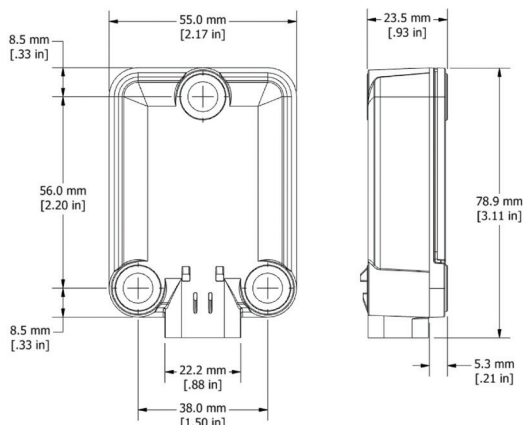
## APPLICATIONS

- Auto-steer and terrain compensation
- Dynamic incline detection (roll, pitch, rotation)
- Vehicle stability and levelling
- Platform control, alignment and stabilisation
- Bucket/Stick/Boom angle
- Impact detection
- Operator feedback
- Precision navigation

## MICROSTRAIN ML5-AR SPECIFICATIONS

Inertial Measurement Unit (IMU) Sensor Outputs		
	Accelerometer	Gyroscope
Measurement range	±8 g	±1000°/sec
Output range	±320 m/s <sup>2</sup>	±250°/sec
Non-linearity	±0.08% fs	±0.06% fs
Resolution*	1.0 mg	<0.003°/sec
Bias instability	±0.08 mg	8°/hr
Initial bias error	±0.008 g	±0.1°/sec
Scale factor stability	±0.08%	±0.05%
Noise density	120 µg/√ Hz	0.0075°sec/√Hz
Alignment error	±0.1%	±0.05°
Bandwidth	40 Hz	40 Hz
Offset error over temperature	0.2% (typ)	0.1% (typ)
Gain error over temperature	0.1% (typ)	0.1% (typ) 0.4% (max)
Scale factor non-linearity (@ 25°C)	0.1% (typ) 0.2% (max)	0.04% (typ) 0.15% (max)
IMU data output rate	100 Hz default (1 – 100 Hz selectable)	
Communication Options		
J1939	Order p/n 6283-4790	
CANopen	Order p/n 6283-4792	
CAN 250 kb/s, custom baud rates available.		

*\*NOTE: Communications protocol may impose resolution limits beyond those of the measuring device. Refer to product manual for details.*



General	
Integrated sensors	Triaxial accelerometer, triaxial gyroscope
Data outputs	Pitch, Roll, Angular Rate, Acceleration
Attitude (pitch and roll) Outputs	
Accuracy	±0.5° RMS roll and pitch
EKF update rate	500 Hz
Pitch	±90°
Roll	±180°
Resolution*	0.05°
Repeatability	0.5°
Max Data output rate	100 Hz default (1 – 100 Hz selectable)
Attitude (pitch and roll) Outputs	
Dimensions	L 78.9 mm × W 55.0 mm × H 23.5 mm
Weight	110.5 grams
Power source	+4.5 V Min, 12/24 V Nominal, +36 V Max
Power consumption	360 mW Nominal
Operating temperature	–40°C to +85°C
Enclosure material	PBT Thermoplastic, Reinforced
Ingress protection	IP68 (Immersion), IP69K (Pressure Wash)
Vibration (random)	MIL-STD-202G, Method 214A, Test Condition 1-B, 24 hrs/axis
Vibration (sweep)	SAE J1455 Appendix A 10 –2000 Hz, 10 g Peak, 10hr/octave/axis
Thermal shock	SAE J1455 4.1.3.2
Salt spray	MIL-STD-202G, Method 101E Condition A (96 hours)
Hot dunk	5X, 30 mins @ 85°C, 30 mins @ ice bath, operating
Mechanical shock drop	SAE J1455 4.11.3.1; 1 m onto concrete surface
Mechanical shock operating	MIL STD 202, M213B; 50 g, 11 ms 1/2sine, 3x each axis; 18 total
MTBF	826,440; Telcordia SR332 (issue 3)
Connectors	AMPSEAL 16 gold plated 4-pin, 4 position, gold plated pins
Mounting	3 × M8, installation torque 20 Nm ±2 Nm
Regulatory compliance	RoHS, REACH, CE, UKCA