

## 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

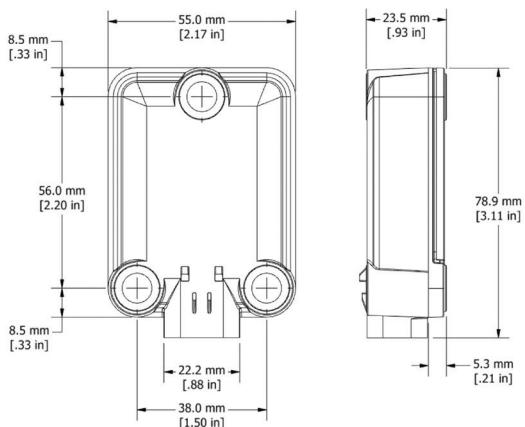
## APPLICATIONS

- 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
<b>Measurement range</b>	±8 g	±1000°/sec
<b>Output range</b>	±320 m/s <sup>2</sup>	±250°/sec
<b>Non-linearity</b>	±0.08% fs	±0.06% fs
<b>Resolution*</b>	1.0 mg	<0.003°/sec
<b>Bias instability</b>	±0.08 mg	8°/hr
<b>Initial bias error</b>	±0.008 g	±0.1°/sec
<b>Scale factor stability</b>	±0.08%	±0.05%
<b>Noise density</b>	120 µg/√ Hz	0.0075°sec/√Hz
<b>Alignment error</b>	±0.1%	±0.05°
<b>Bandwidth</b>	40 Hz	40 Hz
<b>Offset error over temperature</b>	0.2% (typ)	0.1% (typ)
<b>Gain error over temperature</b>	0.1% (typ)	0.1% (typ) 0.4% (max)
<b>Scale factor non-linearity (@ 25°C)</b>	0.1% (typ) 0.2% (max)	0.04% (typ) 0.15% (max)
<b>IMU data output rate</b>	100 Hz default (1 – 100 Hz selectable)	
Communication Options		
<b>J1939</b>	Order p/n 6283-4790	
<b>CANopen</b>	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	
<b>Integrated sensors</b>	Triaxial accelerometer, triaxial gyroscope
<b>Data outputs</b>	Pitch, Roll, Angular Rate, Acceleration
Attitude (pitch and roll) Outputs	
<b>Accuracy</b>	±0.5° RMS roll and pitch
<b>EKF update rate</b>	500 Hz
<b>Pitch</b>	±90°
<b>Roll</b>	±180°
<b>Resolution*</b>	0.05°
<b>Repeatability</b>	0.5°
<b>Max Data output rate</b>	100 Hz default (1 – 100 Hz selectable)
Attitude (pitch and roll) Outputs	
<b>Dimensions</b>	L 78.9 mm × W 55.0 mm × H 23.5 mm
<b>Weight</b>	110.5 grams
<b>Power source</b>	+4.5 V Min, 12/24 V Nominal, +36 V Max
<b>Power consumption</b>	360 mW Nominal
<b>Operating temperature</b>	–40°C to +85°C
<b>Enclosure material</b>	PBT Thermoplastic, Reinforced
<b>Ingress protection</b>	IP68 (Immersion), IP69K (Pressure Wash)
<b>Vibration (random)</b>	MIL-STD-202G, Method 214A, Test Condition 1-B, 24 hrs/axis
<b>Vibration (sweep)</b>	SAE J1455 Appendix A 10 –2000 Hz, 10 g Peak, 10hr/octave/axis
<b>Thermal shock</b>	SAE J1455 4.1.3.2
<b>Salt spray</b>	MIL-STD-202G, Method 101E Condition A (96 hours)
<b>Hot dunk</b>	5X, 30 mins @ 85°C, 30 mins @ ice bath, operating
<b>Mechanical shock drop</b>	SAE J1455 4.11.3.1; 1 m onto concrete surface
<b>Mechanical shock operating</b>	MIL STD 202, M213B; 50 g, 11 ms 1/2sine, 3x each axis; 18 total
<b>MTBF</b>	826,440; Telcordia SR332 (issue 3)
<b>Connectors</b>	AMPSEAL 16 gold plated 4-pin, 4 position, gold plated pins
<b>Mounting</b>	3 × M8, installation torque 20 Nm ±2 Nm
<b>Regulatory compliance</b>	RoHS, REACH, CE, UKCA