

# Sensors for Wind Turbines

# sensing your world™



#### Superior Performance & Reliability....

As a global designer and manufacturer of sensors and sensor-based systems Measurement Specialties provides support to wind engineers in both the development and operation of wind turbines. Our operations in the US, Europe and China provide resources close to our customers. This global footprint allows us to offer the lowest cost of ownership to OEMs.

We offer a broad range of sensing technologies to manufacturers, system integrators, wind farm operators, R&D labs and universities. Among others, they include vibration sensors for gear box monitoring, oil level sensors, tilt sensors for tower installation and accelerometers for tower sway and blade monitoring. There is significant interest in our piezo film sensors for energy harvesting, miniature pressure sensors for blade monitoring and our LVDTs for facilitating emergency prop feathering and shutdown. Our temperature sensors are found in hundreds of wind turbines throughout the world. All sensors are shipped with industry-standard warranties and extended warranties when required.





## **Position Sensors**

					A State	
	<b>DPL/DPN-Series</b>	<b>D-Series</b>	DC-SE		DT1 & SDT1	ACH01
Package	PCB board	AL housing IP 67	AISI-400 series stainless steel	Package	Unshielded element with twisted pair	Ceramic base, plastic cover, shielded cable
Туре	Inclination board module	Inclinometer	LVDT		with shielded cable	6 6 7 8 8 8
Range	±2° to ±30°	±5° to ±30°	0 - 0.1 to 0 - 6 inches	Туре	Flexible film, adhesive	Adhesive mount
Output	Voltage / RS 232 / SPI	RS232 / Voltage /	0 - 5 VDC (4 wire)		mount	9 9 9
		PWM / CAN open	1 - 6 VDC (3 wire)	Range	15 mV/µ□ up to 1% strain	±250 g (typical)
Unique Features	<ul> <li>High resolution</li> <li>Minimal temperature drift</li> <li>User configurable</li> </ul>	<ul> <li>High accuracy</li> <li>Rugged housing</li> <li>Programmable</li> <li>CE approved</li> </ul>	- CE mark     - Low current     consumption     (6 mA typical)     - Synchronous     demodulation	Unique Features	<ul> <li>Thin, flexible, robust</li> <li>Withstands up</li> <li>to 1% strain</li> <li>Ultra-low power</li> <li>(self generating)</li> </ul>	- Extremely high bandwidth - Low cost - Ultra-low power
			- Shielded cable	Accuracy	±20% (typical)	±20% (typical)
Accuracy	±0.05° to ±0.8°	±0.04° to ±0.8°	±0.25% of range	Operating Temp	-40°C to 70°C (up	-40°C to 85°C
Operating Temp	-40°C to 85°C	-40°C to 85°C	-25°C to 85°C		to 125°C available)	
Dimensions (mm)	45 x 45 x 14	84 x 70 x 46	19	Dimensions (mm)	Application dependent	18.80 x 13.21 x 6.10
Typical Apps	Tower leveling	Tower leveling	Monitor vibration to facilitate emergency prop feathering and shutdown	Typical Apps	Energy harvesting to power sensors	Gearbox condition monitoring

# Vibration Sensors

	20147	1
	201	43
Ingress Protection	IP65	IP6
Static/Dynamic Response	Static and Dynamic	Sta
Full Scale Range	±2g, 5g, 10g, 20g, 30g, 50g, 100g	±20
Full Scale Output	±2V	±2\
Unique Features	<ul> <li>High resolution</li> <li>Low current consumption</li> <li>2-pole filter</li> <li>Ruggedized cable</li> </ul>	- Tr - Lo - Te - Ri
Power Excitation	5 - 30 Vdc	5 -
Operating Temp.	-40°C to 125°C	-40
Dimensions (mm)	25.4 x 21.59 x 9.65	34.
Typical Apps	Tower sway	Sei



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# tatic and Dynamic

#### ±2g, 5g

- ±2V
- Triaxial (3-axis)
   Low noise
- Temperature compensated
   Ruggedized cable
- 5 30 Vdc
- -40°C to 125°C
- 34.5 x 34.5 x 31.2
- Seismic motion



#### 8011/8021-01

Hermetically Sealed Dynamic

±10g, 80g, 500g

- ±5V, 8V, 5V
- Voltage output
- Stainless steel housing
   MIL-5015C connector
   Thru-hole option: 8021
- 18 30 Vdc
- -55°C to 125°C
- 48.3 x 22.23
- Gearbox monitoring



Piezo Film Sensors

#### 8011/8021-AR/AP

- Hermetically Sealed Dynamic
- ±5g, 10g, 20g, 50g

#### 4 to 20mA RMS or Peak

- Current output
- Stainless steel housing - MIL-5015C connector
- Thru-hole option: 8021 12 - 30 Vdc
- -40°C to 85°C
- 48.3 x 22.23
- Gearbox monitoring



#### 8011/8021-VR/VP

- Hermetically Sealed Dynamic
- 0.5, 1.0, 3.0, 5.0 in/sec

#### 4 to 20mA RMS or Peak

- Velocity transmitter
- Stainless steel housing
   MIL-5015C connector
- Thru-hole option: 8021
- 12 30 Vdc
- -40°C to 85°C
- 48.3 x 22.23
- Gearbox monitoring



## **Temperature Sensors**

		At the second	10	
	Surface Mount Probe	Embedment Probe	Bolt-On Probe	Transformer Probe
Package	Silicone rubber or kapton laminated element	- Stainless steel or tin plated copper case - Four case styles	- Threaded bolt, tube style, flat rectangular style	<ul> <li>Pt element embedded into Ceramic tube and cover with PTFE shrinkable sleeve</li> </ul>
Туре	<ul> <li>Flat, flexible, rectangular sensor</li> <li>Variety of designs available</li> </ul>	- Miniature design	- Quick response time	- Push-in probe
Sensor Range	RTD: Pt, Ni, Cu Thermocouple: J, K, T, E	RTD: Pt, Ni Thermocouple: J, K, T, E	RTD: Pt, Ni	RTD: Pt100
Unique Features	<ul> <li>Surface sensing for \round</li> <li>or uneven surfaces</li> <li>Noninvasive, simple installation</li> <li>Adhesive backing option</li> </ul>	<ul> <li>For use where space is limited</li> <li>Simple installation</li> <li>Custom designs</li> <li>Feedthrough options</li> </ul>	<ul> <li>For use where space is limited</li> <li>Retro fitting</li> <li>Simple installation</li> <li>Custom designs</li> </ul>	<ul> <li>Dielectric strength 3KV</li> <li>4 wires measurement</li> <li>Various length of cable</li> </ul>
Accuracy	RTD: ± 0.06%, ± 0.12% and ± 0.5% at 0°C	RTD: ± 0.12%, ± 0.36% and ± 0.5% at 0°C	DIN Class B (IEC 75) and ± .5% at 0°C	CI.B according to IEC 751
Operating Temp.	Varies by design Standard: -50°C to 200°C (-58°F to 392°F) Available up to 220°C	-50°C to 250°C (-58°F to 482°F)	-50°C to 250°C (-58°F to 482°F)	-40°C to 250°C (-40°F to 482°F)
Dimensions (mm)	Custom dimensions available	Case specific dimensions	Case specific dimensions	ø5mm Lg 50mm (Custom cable lengths available)
Typical Apps	Monitor end windings of stator coils	Bearing monitoring	Generator	Temperature monitoring in low voltage Transformer's windings





## Fluid Property Sensors

	HTM2500B3C4 OIL	FP52802
Package	Fully integrated, stand-alone module combines sensor and processing electronics for in-situ monitoring	Fully integrated, stand-alone module combines sensor and processing electronics for in-situ monitoring
Туре	Water content in oil and temperature sensor	Gear oil quality sensor in high viscosity conditions
Operating Range	0 to 1 aw (aw, activity = water content / water content in saturated oil)	Viscosity up to 10,000 mPa-S
Operating Temp	-40°C to 85°C	-40°C to 150°C
Unique Features	<ul> <li>Full interchangeability</li> <li>High reliability and demonstrated long term stability in oil</li> <li>Ratiometric to voltage supply</li> <li>Sensitive elements with unique mechanical and chemical robustness</li> </ul>	<ul> <li>Rugged construction for high pressure and high flow environments</li> <li>Proprietary corrosion and contaminant resistant coating for wetted parts</li> <li>On-board microprocessor for real-time data analysis with 12-24 volts supply</li> <li>High reliability and long term stability</li> </ul>
Calibration	Factory calibrated and tested	Factory calibrated and tested
Dimensions (mm)	76.2 x 30 x 30	81 x 30 x 30
Typical Apps	Gearbox oil	Gearbox oil

## Level Sensor



Housing Material Nylon 6.6 Float Material Glass filled Nylon 6.6 **Contact Material** Ruthenium 0.74 Float SG -30°C to 110°C Operating Temp Medium Fuel / Oil Housing Color Blue Float Color Blue Shock 50 g for 11mS duration Vibration 35 g up to 500 Hz Maximum Pressure 4.7 Bar Float Diameter 22 mm IP IP65 Typical Apps Gearbox oil level

## **Pressure Sensors**

M5100, U5100M7100, U7100EPIHPackageIndustrial stainless steel housing with a large selection of threaded fittings, electrical connectors, cable options and customized housings for mid to low volume applicationsAutomotive grade, stainless steel hermetic pressure ports and integral electrical connector for high volume, OEM applicationsVarious housings: cylindrical 1.27 to 2.36 mm, low profile I M4x0.7, M5x0.8, 6-32UNC, 1TypeGage (M5100) Gage, sealed gage, absolute (U5100)Gage, absoluteGage, sealed gage, absolute0 - 50 psi thru 0 - 30K psi (M5100) 0 - 1 psi thru 0 - 5K psi (U5100)0 - 15 psi thru 0 - 43K psi0 - 5, 10, 15, 25, 50, 75, 100,Output / Span0.5 - 4.5 Vdc, 1 - 5 Vdc, 0 - 5 Vdc, 0 - 10 Vdc, 4 - 20 mA0.5 - 4.5 Vdc12 mV to 75 mVUnique Features- MicrofusedT <sup>M</sup> technology (M5100) - UltraStableT <sup>M</sup> technology (M5100) - UltraStableT <sup>M</sup> technology (U5100) High performance at a low cost Solid state reliability - 1% total error band ( -20°C to 85°C) - 2% total error band ( -20°C to 85°C) - 1% total error band ( -20°C to 85°C cill - 1% total error band ( -20°C to 85°C cill - 1% total error band ( -20°C to 85°C cill - 1% total error band ( -20°C to 85°C cill - 1% total error band ( -20°C to 85°C cill - 1% total error band ( -20°C to 85°C cill - 1% total error band ( -20°C to 15°C cill - 1% total error band ( -20°C to 15°C cill - 1% total error band ( -20°C to 15°C cill - 1% total error band ( -20°C to 15°C cill - 1% total error band ( -20°C to 15°C cill - 1% total error band ( -20°C to 15°C cill - 1% total e					
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TypeGage (M5100) Gage, sealed gage, absolute (U5100)Gage, absoluteGage, absoluteGage, absolutePressure Range0 - 50 psi thru 0 - 30K psi (M5100) 0 - 1 psi thru 0 - 5K psi (U5100)0 - 15 psi thru 0 - 43K psi0 - 5, 10, 15, 25, 50, 75, 100,Output / Span0.5 - 4.5 Vdc, 1 - 5 Vdc, 0 - 5 Vdc, 0 - 10 Vdc, 4 - 20 mA0.5 - 4.5 Vdc12 mV to 75 mVUnique Features- Microfused™ technology (M5100) - UltraStable™ technology (U5100) High performance at a low cost Solid state reliability - 1% total error band ( -20°C to 85°C) - 2% total error band ( -20°C to 125°C) - 2% total error band ( -20°C to 125°C) - UltraStable™ technology (U5100) - 0.75% total error band ( -20°C to 85°C call possible errors combined) (U5100) - 0.75% total error band ( -20°C to 85°C call possible errors combined) (U5100) - 0.75% total error band ( -20°C to 85°C call possible errors combined) (U5100) - 0.75% total error band ( -20°C to 85°C all possible errors combined) (U5100) - 0.57% total error band ( -20°C to 85°C call possible errors combined) (U5100) - 0.57% total error band ( -20°C to 85°C all possible errors combined) (U5100) - 0.57% total error band ( -20°C to 85°C - 40°C to 125°C+High frequency response (total error band ( -20°C to 85°C call - 40°C to 125°COperating Temp0.25% FSO (M5100), 0.1% FSO (U5100) US100: 22.23 x 22.23 x 80.77 US100: 22.23 x 22.23 x 80.40.25% FSO.(M7100), 0.5% FSO (U7100) - 40°C to 120°C	ylindrical body w profile housir 32UNC, 10-320	Various housings: cylindr 1.27 to 2.36 mm, low pro M4x0.7, M5x0.8, 6-32UN	Automotive grade, stainless steel hermetic pressure ports and integral electrical connector for high volume, OEM applications	Industrial stainless steel housing with a large selection of threaded fittings, electrical connectors, cable options and customized housings for mid to low volume applications	Package
Pressure Range0 - 50 psi thru 0 - 30K psi (M5100) 0 - 1 psi thru 0 - 5K psi (U5100)0 - 15 psi thru 0 - 43K psi0 - 5, 10, 15, 25, 50, 75, 100, 0 - 5, 10, 15, 25, 50, 75, 100, 12 mV to 75 mVOutput / Span0.5 - 4.5 Vdc, 1 - 5 Vdc, 0 - 5 Vdc, 0 - 10 Vdc, 4 - 20 mA0.5 - 4.5 Vdc12 mV to 75 mVUnique Features- Microfused™ technology (M5100) - UltraStable™ technology (U5100) High performance at a low cost Solid state reliability - 1% total error band (-20°C to 125°C) - Solid state reliability - 1% total error band (-20°C to 85°C all possible errors combined) (M5100) - 0.75% total error band (-20°C to 85°C all possible errors combined) (U5100) - 0.75% total error band (-20°C to 85°C all possible errors combined) (U5100) - 0.25% FSO (M7100), 0.5% FSO (U7100)±1.0% FSOOperating Temp-40°C to 125°C U5100: 22.23 x 22.23 x 80.77 U5100: 22.23 x 22.23 x 98.0426.7 x 26.7 x 50.0Accuracy 26.7 x 50.0Application dependent	, absolute	Gage, sealed gage, abso	Gage, absolute	Gage (M5100) Gage, sealed gage, absolute (U5100)	Туре
Output / Span0.5 - 4.5 Vdc, 1 - 5 Vdc, 0 - 5 Vdc, 0 - 10 Vdc, 4 - 20 mA0.5 - 4.5 Vdc12 mV to 75 mVUnique Features- Microfused™ technology (M5100) - UltraStable™ technology (U5100) High performance at a low cost 	, 75, 100, 200,	0 - 5, 10, 15, 25, 50, 75,	0 - 15 psi thru 0 - 43K psi	0 - 50 psi thru 0 - 30K psi (M5100) 0 - 1 psi thru 0 - 5K psi (U5100)	Pressure Range
Unique Features- Microfused™ technology (M5100) - UltraStable™ technology (U5100) High performance at a low cost Solid state reliability 		12 mV to 75 mV	0.5 - 4.5 Vdc	0.5 - 4.5 Vdc, 1 - 5 Vdc, 0 - 5 Vdc, 0 - 10 Vdc, 4 - 20 mA	Output / Span
Accuracy         0.25% FSO (M5100), 0.1% FSO (U5100)         0.25% FSO (M7100), 0.5% FSO (U7100)         ±1.0% FSO           Operating Temp         -40°C to 125°C         -40°C to 125°C         -40°C to 120°C           Dimensions (mm)         M5100: 22.23 x 22.23 x 80.77 U5100: 22.23 x 22.23 x 98.04         26.7 x 26.7 x 50.0         Application dependent	aphragm with a d shapes availa outside diamete sponse(to 1.7 N	<ul> <li>Diffused silicon diaphra variety of sizes and sha as small as 0.05" outsic</li> <li>High frequency respons</li> </ul>	<ul> <li>1% total error band ( -20°C to 85°C)</li> <li>2% total error band ( -20°C to 125°C)</li> <li>Solid state reliability</li> <li>Survives high vibration and immersion</li> <li>Microfused<sup>™</sup> technology (M7100)</li> <li>UltraStable<sup>™</sup> technology (U7100)</li> </ul>	<ul> <li>Microfused<sup>™</sup> technology (M5100)</li> <li>UltraStable<sup>™</sup> technology (U5100)</li> <li>High performance at a low cost</li> <li>Solid state reliability</li> <li>1% total error band ( -20°C to 85°C all possible errors combined) (M5100)</li> <li>0.75% total error band ( -20°C to 85°C all possible errors combined) (U5100)</li> </ul>	Unique Features
Operating Temp         -40°C to 125°C         -40°C to 125°C         -40°C to 120°C           Dimensions (mm)         M5100: 22.23 x 22.23 x 80.77 U5100: 22.23 x 22.23 x 98.04         26.7 x 26.7 x 50.0         Application dependent		±1.0% FSO	0.25% FSO (M7100), 0.5% FSO (U7100)	0.25% FSO (M5100), 0.1% FSO (U5100)	Accuracy
Dimensions (mm)         M5100: 22.23 x 22.23 x 80.77 U5100: 22.23 x 22.23 x 98.04         26.7 x 26.7 x 50.0         Application dependent		-40°C to 120°C	-40°C to 125°C	-40°C to 125°C	Operating Temp
	ent	Application dependent	26.7 x 26.7 x 50.0	M5100: 22.23 x 22.23 x 80.77 U5100: 22.23 x 22.23 x 98.04	Dimensions (mm)
Typical Apps         Hydraulic and oil pressure measurement         Hydraulic and oil pressure measurement         Dynamic pressure measurement	neasurement o	Dynamic pressure meas	Hydraulic and oil pressure measurement	Hydraulic and oil pressure measurement	Typical Apps
Agency Approvals CE, UL 508 CE			CE	CE, UL 508	Agency Approvals

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measurement ••



which they are embedded. Accordingly, our customers rely on MEAS sensors to operate accurately, every time. At MEAS, we place the highest emphasis on quality in terms of design standards, process control and customer feedback/integration and back up our products with an industry leading warranty.

MEAS maintains the highest quality certifications, including:

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