

NEXT-GENERATION CONDITION-BASED MONITORING

*Technologies and Solutions
for Industry 4.0*



Resonant
Frequency:
21 kHz

Vibration
Levels:
500 Hz

Acceleration:
200 g
Accelerometer
Status:
25 mV/g

-40°C
+125°C

Status: **Online**

Good decisions require good information.

Predicting and diagnosing a machine's health before it becomes problematic requires insights that can only come from having accurate and reliable data.

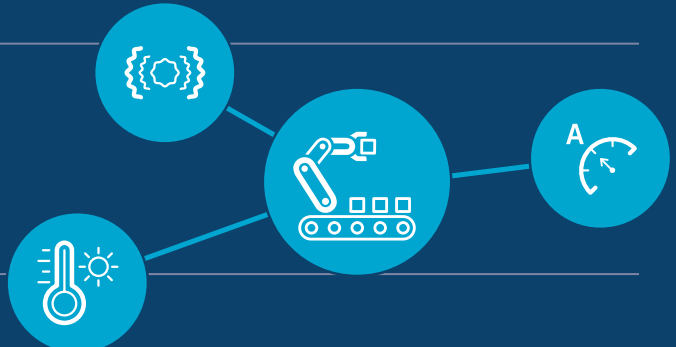
Analog Devices' focus on condition-based monitoring leverages next-generation technologies that enable effective and efficient monitoring of factory equipment, delivering high performance solutions that can lead to improvements in uptime, productivity, and quality.

Overview

Analog Devices, Inc. (ADI) is focused on delivering next-generation condition monitoring solutions that enable real-time monitoring of factory equipment. ADI's commitment to enabling condition monitoring and Industry 4.0 leverages decades of experience in MEMS sensor development, signal processing, and packaging techniques by helping our customers solve the most challenging problems. Deep signal chain and system design insights enable our customers to extract more value out of their system and improve their customers' processes.

Vibration, current, and temperature all provide key insights into the health of equipment ranging from motors and pumps to bearings and encoders.

Measuring vibration provides additional insights into machine health by further isolating mechanical noise from electrical noise, improving machine diagnostics.



Bearings

Initial signs of wear typically create high frequency noise that can only be detected with wide bandwidth, low noise vibration sensors or accelerometers. Wide bandwidths enable earlier detection of initial bearing wear caused by impacts created by small fragments of metal.



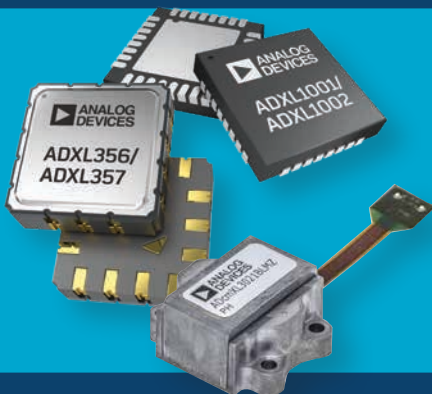
Misalignments and Imbalances

Small changes in shaft alignment or motor frame imbalances require low noise, stable accelerometers that detect subtle mechanical shifts that can impact motor performance.



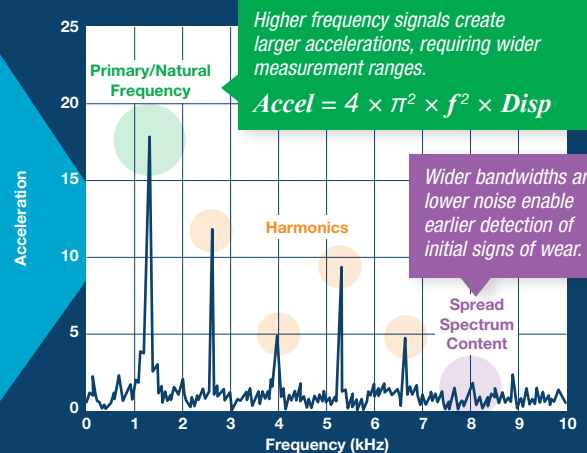
Machine Tools

Increased vibration levels during high speed activities such as production milling or cutting can damage critical materials and reduce precision. Wide bandwidth, low noise sensors that sense irregularities can provide real-time data for feedback and machine control.



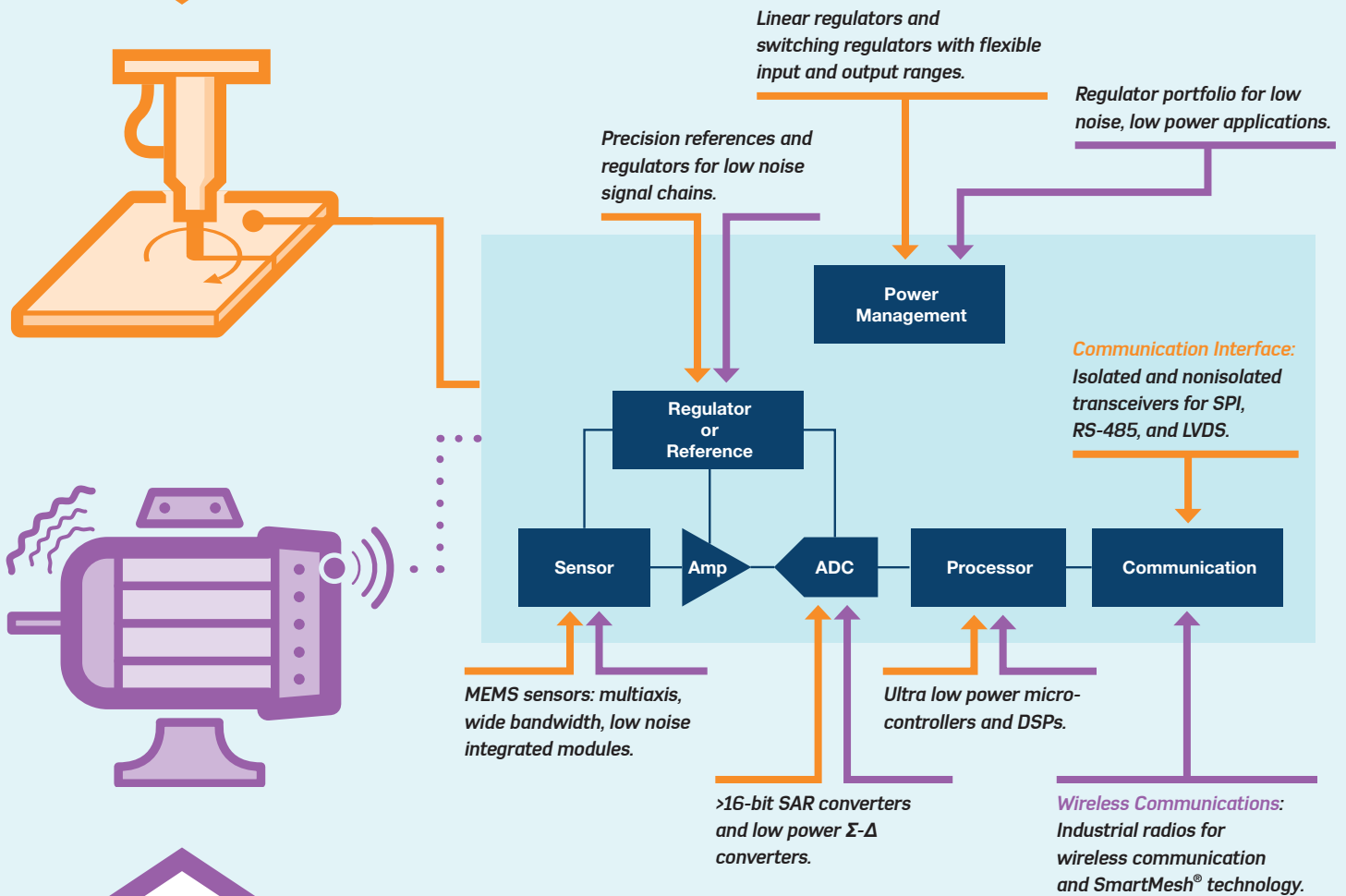
Features

- ▶ Wide Bandwidth
- ▶ Wide Measurement Range
- ▶ Low Noise
- ▶ Stability Over Temperature and Life
- ▶ Multiaxis
- ▶ Small Form Factor



Wired Signal Chain Example for Machine Tools

Critical applications that require higher bandwidth data for vibration monitoring, real-time feedback, and control require a robust, wired solution suitable for industrial environments. Reduced sensor size and overall form factors allow sensors to be placed closer to the vibration source, enabling more reliable measurements, which result in improved diagnostics and real-time machine control.



Wireless Signal Chain Example for Motor Monitoring

Monitoring of factory equipment in difficult to access locations requires wireless solutions that eliminate the need for extra cables while providing critical information over a robust wireless link. Low power components coupled with high performance sensors in compact form factors create new condition monitoring opportunities for a wide variety of factory applications, while minimizing the complexities of integrating into existing and new factory equipment.

Recommended Products

Integrated Vibration Monitoring Modules

Integrated modules combine ADI's high performance MEMS sensors with an optimized signal chain and embedded signal processing into a mechanically optimized package, enabling predictive maintenance solutions.

- ▶ On-board pre-processing
- ▶ User configurable operating modes



Part Number	Axis	Range (g)	Resonance (kHz)	Noise ($\mu\text{g}/\sqrt{\text{Hz}}$)	Temp Range ($^{\circ}\text{C}$)
ADcmXL3021*	3	50	21	25	-40 to +105

* Digital Output

Sensors

High performance sensors provide precision, stability, and flexibility for a variety of applications.

- ▶ MEMS accelerometers
- ▶ Temperature



Part Number	Axis	Range (g)	Resonance (kHz)	Noise ($\mu\text{g}/\sqrt{\text{Hz}}$)	Temp Range ($^{\circ}\text{C}$)
ADXL1001	1	100	21	30	-40 to +125
ADXL1002	1	50	21	25	-40 to +125
ADXL1003	1	200	28	45	-40 to +125
ADXL1004	1	500	45	125	-40 to +125
ADXL1005	1	100	42	75	-40 to +125
ADXL356	3	40	5.5	80	-40 to +125
ADXL357*	3	40	5.5	80	-40 to +125

*Digital Output

Amplifiers and Converters

High performance sensors demand precision measurement. ADI's amplifiers and converters are optimized for sensor measurement.

- ▶ High resolution
- ▶ Simultaneous sampling
- ▶ Low noise



Part Number	Channel	Bits	Sample Rate (kHz)	Power (mW)	Temp Range ($^{\circ}\text{C}$)
AD4008	1	16	500	2.5	-40 to +125
LTC2344	4	16 to 18	400	81	-40 to +125
ADAQ7980	1	16	1000	21	-40 to +125
AD7768-1	1	24	204	<37	-40 to +125

Wireless Radio

Enabling wireless industrial applications requires a robust, low power wireless interface. SmartMesh[®] technology supports operation in harsh environments and simplifies network accessibility.

- ▶ Proven reliability
- ▶ Stable
- ▶ Robust
- ▶ Small footprints



Part Number	Band (GHz)	Upstream Data Throughput (Max Packets/sec)	Temp Range ($^{\circ}\text{C}$)
LTP5902	2.4	24	-40 to +125

Processors

Converting information into insights requires powerful processors that enable efficient processing at the node, reducing wireless bandwidth requirements.

- ▶ Ultra low power
- ▶ Flexibility



Part Number	Core	Max Speed (MHz)	Flash/SRAM (Max kB)	Hibernate Current (nA)	Temp Range ($^{\circ}\text{C}$)
ADuCM3027	M3	26	128/64	750	-40 to +85
ADuCM3029	M3	26	256/64	750	-40 to +85
ADuCM4050	M4F	52	512/128	680	-40 to +85

Isolated Digital Interface

Harsh industrial environments require robust, isolated signals to drive long cable lengths and minimize interference.

- ▶ iCoupler[®] technology reduces board space requirements
- ▶ Industrial operating temperature ranges
- ▶ Support long cable lengths



Part Number	Channel	Data Rate (Max Mbps)	Insulation Rating (kV rms)	Temp Range ($^{\circ}\text{C}$)
ADM2486	1	20	2.5	-40 to +85
ADuM4150	6	40	5	-40 to +125
ADN4651	2	600	5	-40 to +125

Power Management

Maintaining system performance is only as good as the power supplies that support the system. Power by Linear[™] provides efficient and flexible solutions to support a wide breadth of applications.

- ▶ Low noise
- ▶ Stable
- ▶ Small footprints



Part Number	Type	V _{IN} Range (V)	V _{OUT} (V)	Max Out Current (mA)	Temp Range ($^{\circ}\text{C}$)
LTC1928	Doubler	2.7 to 4.4	5	30	-40 to +85
ADP5300	Switch	2.15 to 6.5	0.8 to 5	500	-40 to +125
LTC3499	Switch	1.8 to 5.5	2 to 6	750	-40 to +85
ADP7118	LDO	2.7 to 20	1.8 to 5	200	-40 to +125

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