Condition-Based Monitoring

Complete System-Level Solutions from Sensing to Artificial Intelligence

Condition-based monitoring (CbM), often referred to as condition monitoring, enables early detection and diagnosis of machine and system abnormalities in real time. Identifying and isolating these issues creates opportunities for optimizing replacement part inventories, scheduling downtime for planned maintenance, and making run-time process adjustments that can extend the useful life of the equipment.

The Impact of Condition Monitoring

- **Increased Productivity**
- **Increased Asset Life**
- **Reduced Maintenance Cost**
- **Reduced Downtime**

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AHEAD OF WHAT'S POSSIBLE™

Analog Devices Condition-Based Monitoring Technologies

Vibration, current, and temperature all provide key insights into the health of equipment ranging from motors and pumps to bearings and encoders. Vibration measurements are also a source of additional data by further isolating mechanical noise from electrical noise, improving machine diagnostics.

These machine health insights result in increased productivity, improved efficiency, and maximized uptime, accelerating the path to Industry 4.0. Data from a multitude of sensors are often fused to deliver cutting edge insights into asset health.

Condition-Based Monitoring Applications

Pharmaceuticals

Renewable Energy

Metal Processing

Wastewater Management

Petrochemical

Automotive Manufacturing

Sugar Refining

Condition-Based Monitoring Sensing Modalities

Vibration

Temperature

Voltage

Current

Pressure

Humidity

Sound

End-to-End Solutions for Condition Monitoring

Sensing Modalities

ADI's accelerometers and *i*Sensor® MEMS accelerometer subsystems provide accurate detection while measuring acceleration, tilt, shock, and vibration in performance driven applications.

Edge Processing

Maxim Integrated's ultra low power MCUs offer intelligence at the edge nodes for condition monitoring applications by enabling local decision making, thereby extending battery life.

Power Management

Analog Devices and Maxim Integrated low complexity power management solutions help our customers accelerate time to market while achieving high efficiency performance.

Artificial Intelligence at the Edge

ADI's artificial intelligence solution enables continuous real-time monitoring of any asset at the edge, using sound and vibrations, leveraging AI models designed with the ADI OtoSense visual toolkit.

Data Acquisition

ADI provides an unrivalled portfolio of precision converters that enable the detection of potential fault conditions earlier in their life cycle.

Wired/Wireless Connectivity

SmartMesh®, IO-Link®, Industrial Ethernet, and other wireless and wired connectivity options from Analog Device and Maxim Integrated enable seamless connectivity that delivers critical data with high reliability.

Asset Monitoring

Our asset monitoring solutions detect, measure, and communicate critical information to enable predictive maintenance for assets.

MEMS Sensing Technology

Analog Devices accelerometers accurately detect and measure acceleration, tilt, shock, and vibration in condition monitoring applications. ADI's portfolio leads the industry in power, noise, bandwidth, and temperature specifications, and it offers a range of MEMS sensor and signal conditioning integration on chip.

The ADI MEMS Advantage

Wide Bandwidth, Low Noise

Stability Over Temperature, Life

Small Form Factor

Wide Range of Measurement

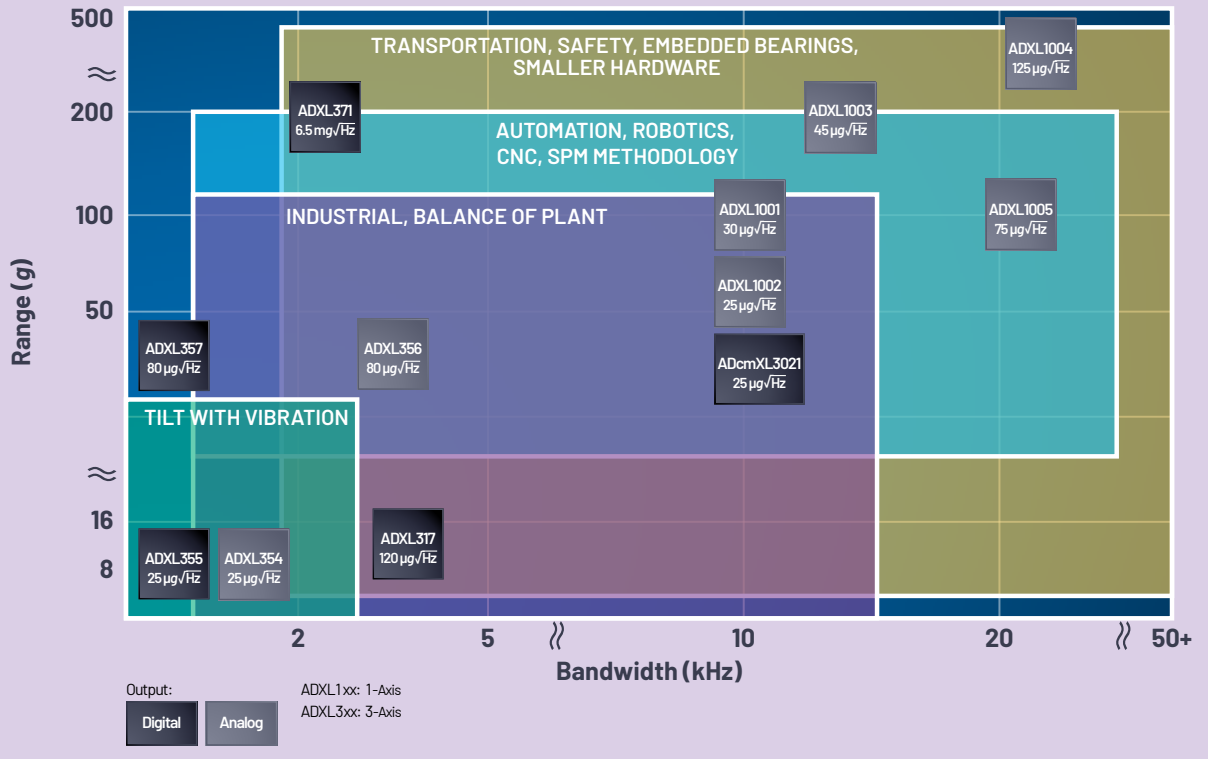
Multiaxis Products

Cost-Effective

MEMS Enabling New and Improved CbM Capabilities

Performance improvements over piezoelectric sensors:

- Compact and low power consumption
- Multiaxis measurement
- Improved performance
- Low frequency response
- Long-term reliability
- Easy MEMS conversion with IEPE/4 mA to 20 mA infrastructure



Precision Converters

Analog Devices provides an unrivaled portfolio of precision converters that enable the detection of potential fault conditions earlier in their life cycle. Extend the life of equipment and maximize operational efficiency with precision technology from ADI.

ADI Precision Products

AD7768-1	1-channel, 24-bit, 255 kSPS, simultaneous sampling ADC with power scaling
AD7768-4	4-channel, 24-bit, 255 kSPS, simultaneous sampling ADC with power scaling
AD4008	1-channel, 16-bit, 500 kSPS, pseudo differential SAR ADCs
ADAQ7768-1	1-channel, 24-bit 256 kSPS, µModule® data acquisition system
ADAQ7988	1-channel, 16-bit, 500 kSPS, µModule data acquisition system

The ADI Advantage

Repeatability and Stability

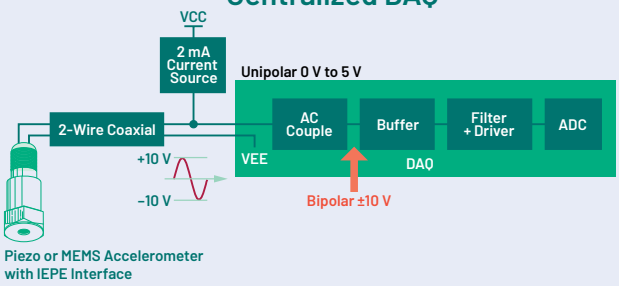
Small Footprint

Low Power

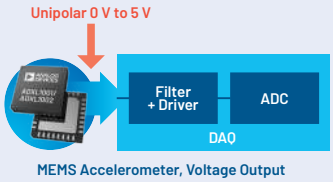
Wide Resolution Range

Data Acquisition—System Architecture Options

Centralized DAQ



Edge Node

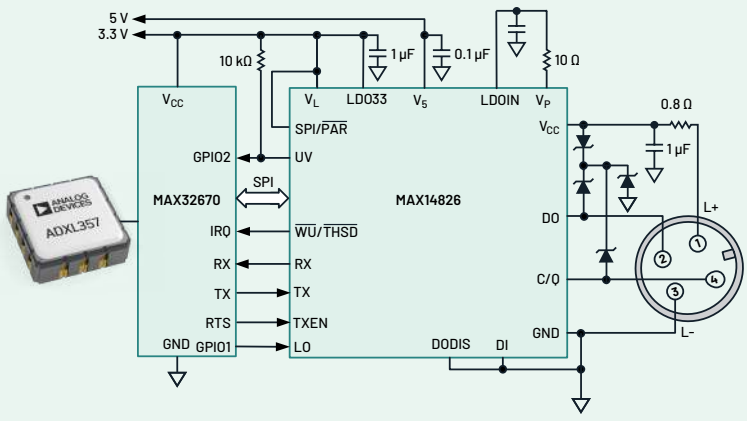


IO Link and Low Power Processing

IO-Link combines with low power processing to simplify communication to smart CbM sensors in smart manufacturing. By joining signaling power over-cable technology, IO-Link also eases installation. Analog Devices and Maxim Integrated provide solutions for both device PHY and master PHY interfaces.

IO-Link in condition monitoring applications enables simplified installation by removing the need for control cabinets and extensive wiring while providing accurate asset health data with automated alerts to monitor the health of assets.

MAX14824	IO-Link main transceiver scalable up to 16 channels
MAX14826	SPI and pin programmable IO-Link device transceiver
MAX32670	High reliability, ultra low power microcontroller powered by Arm® Cortex®-M4 processor with FPU



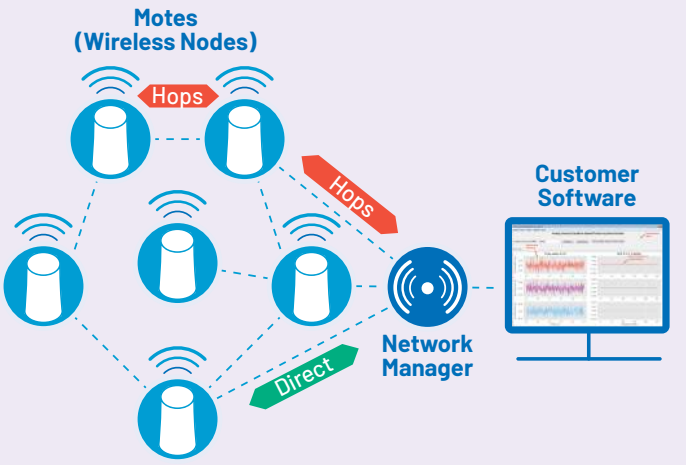
Wireless

ADI's SmartMesh® technology enables highly scalable, self-forming mesh networking for sensors in a tough Industrial Ethernet of Things environment.

- >99.999% data reliability in the most challenging RF environments.
- >10-year battery life, so sensors can be placed anywhere with the lowest cost.
- Encryption, authentication, and message integrity checks for a secured network.
- A complete wireless mesh solution, so no network stack development is required.

LTC5800-WHM	SmartMesh WirelessHART mote-on-chip
LTP5901-WHM	SmartMesh IP Wireless 802.15.4e PCBA module with antenna connector

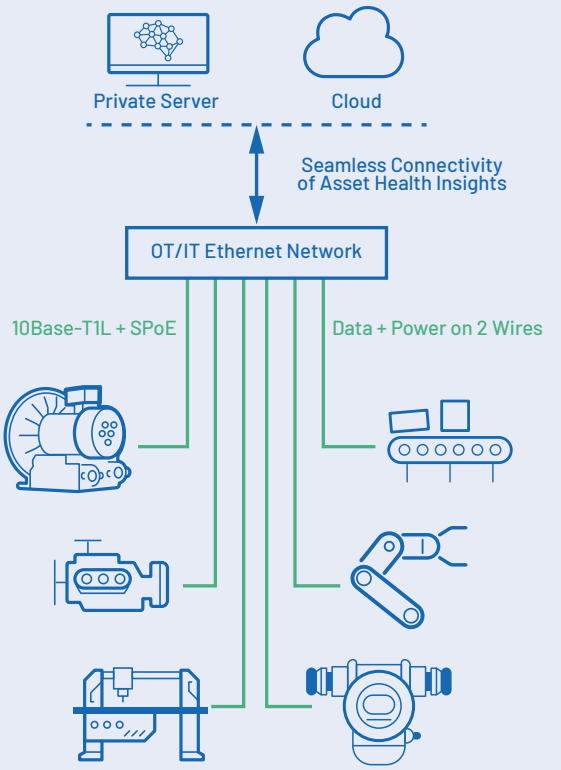
SmartMesh Network with Voyager 3 Motes



Industrial Ethernet

Robust Ethernet connectivity will dramatically change the automation industry by significantly improving operational efficiency through seamless Ethernet connectivity to field-level assets. Ethernet will enable new asset health insights that were previously unavailable and seamlessly communicate them to the control layer and to the cloud/private server.

These new insights will awaken new possibilities for data analysis, operational insights, and productivity improvements through a converged Ethernet network from the field assets to the cloud or private server.



Physical Layer Devices

	Bandwidth (Mbps)	Interface	Typical Power Consumption (mW)
ADIN1110	10	SPI	42
ADIN1100	10	MII/RMII/RGMII	39
ADIN1200	10/100	MII/RMII/RGMII	139

Power Management

Our high performance power management solutions meet stringent power requirements with leading-edge design and packaging technologies, including unmatched power densities, ultralow noise technology, and superior reliability.

These features ensure systems operate at their optimal efficiency, speed, and power levels, while increasing feature density and reducing cost of ownership.

ADI and Maxim Integrated's low complexity power management solutions help our customers accelerate time-to-market while delivering best-in-class performance.

- Battery Management
- Linear Regulators
- PMIC
- Switching Regulators
- Charge Pumps
- µModule Devices
- Energy Harvesters

Your Trusted Power Solutions Partner

Quality and Reliability

Meeting our customers' requirements and exceeding their expectations with robust and reliable solutions.

Performance

Compact footprint, high efficiency conversion to deliver premium performance at unmatched value.

Customer Support

Unique field service and quality web presence for unmatched customer support.

Circuit Notes and LTspice® simulation ease the design process.

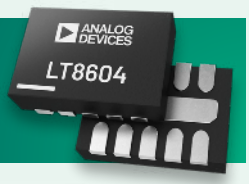
Longer Life Cycle

Long life cycle products ensure availability and reduce redesigns.

Feature Power Products

LT8604

High Efficiency, 42 V/120 mA Synchronous Buck



ADP5054

Quad Buck Regulator Integrated Power Solution

ADP7118

20 V, 200 mA, Low Noise, CMOS LDO Linear Regulator

LT3502

1.1 MHz, 500 mA Step-Down Regulator in a 2 mm × 2 mm DFN Package

Condition-Based Monitoring Development Platforms Ecosystem

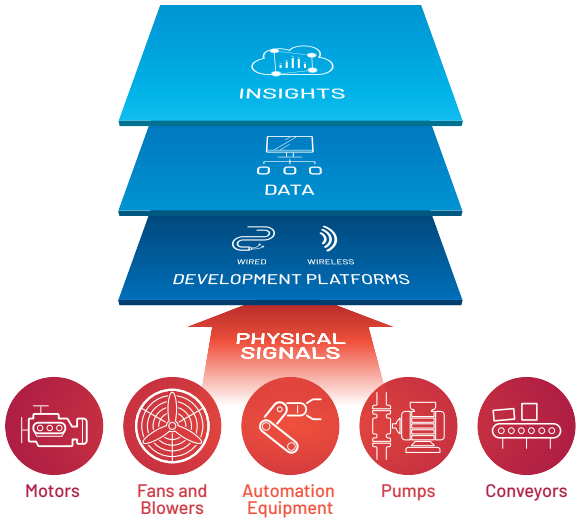
Condition-based monitoring reference designs and development platforms combine the necessary technologies with the tools and software required to quickly collect data, perform analysis, and customize solution designs for specific applications.

Development

Hardware design files and firmware/software source code is made available, enabling customized development based on the underlying evalution system.

Support

All the supporting documentation, including hardware and software files, is available from Analog Devices. Alternatively, you can reach out to us via EngineerZone®.



ADI CbM Reference Designs and Platforms

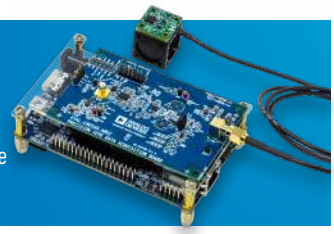
	Sensor	Signal Chain	Signal Processing	Communications	Mechanical Sensor Attach	System Enclosure Rating	Machine Learning/ Algorithms	AI	Design Files
CN0533	ADXL1002	✓	✓	4 mA to 20 mA					✓
CN0549—CbM Vibration Development Platform	ADXL1002	✓	✓	IEPE	✓				✓
EVAL-CN0532-EBZ	ADXL1002	✓		Wired—EPE					✓
EVAL-CN0540-ARDZ	IEPE Type	✓		Wired—IEPE, SPI					✓
EV-CBM-VOYAGER3	ADXL356	✓	✓	Wireless—SmartMesh	✓				✓
EV-CBM-PIONEER1-1Z	ADcmXL3021	✓	✓	Wired—RS-485	✓				✓
ADI OtoSense SMS	ADXL1002			Wireless—WiFi	✓	✓	✓	✓	

EV-CBM-VOYAGER3

MEMS-based wireless vibration monitoring kit for accelerating asset monitoring and solution development.

CN0549

CN0549 provides a high performance sensor and data acquisition system for real-time data analysis.



EV-CBM-PIONEER1

The platform provides a complete plug and play solution for operating the ADcmXL3021 on an RS-485 network.

ADI OtoSense SMS

ADI OtoSense Smart Motor Sensor (SMS) detects anomalies and defects in motors by analyzing the real-time data, thereby reducing unplanned downtime.

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