



iCOMOX: Condition Based Monitoring Development Platform

Open Embedded Sensor-to-Cloud Building Blocks for Prototyping and Quick Deployment

Unplanned equipment downtime causes significant disruption to operations and productivity which directly impacts a company's bottom line. This problem is further compounded with legacy equipment that is prone to frequent failures. Current inspection methods mainly involve maintenance personnel physically checking equipment on a periodic basis. This approach is resource intensive and cannot be scaled easily. Further, complexity and cost of repairs increases after equipment failures occur, compared to preventive measures.

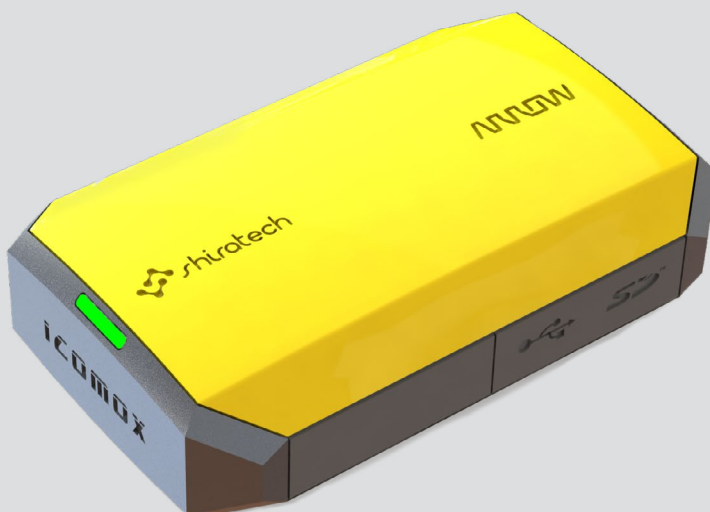
iCOMOX (Intelligent Condition Monitoring Box) – is a portfolio of sensor and backhaul devices that combined with software and cloud capabilities create a development platform for Condition Based Monitoring (CBM) of industrial equipment, assets, and structures. iCOMOX monitors operating conditions from the surface of the equipment to identify potential faults and reduce risks associated with equipment operation and maintenance. This extends the lifetime of the equipment, reduces unplanned downtime, cuts maintenance costs, and unlocks potential for energy savings.

Benefits of the iCOMOX Platform

- > **Serves multiple use cases** – As a rapid prototyping and development platform for Original Equipment Manufacturers (OEMs) or as a starting point for end-users looking to deploy iCOMOX in their applications
- > **Seamless out-of-the-box experience** – Demos, software and application support for testing functionality. CE and FCC certified
- > **Reliable and accommodates a wide range of monitored equipment** – Small form-factor and options for mounting adapters
- > **Quick customization services** – Add new functionality, lower BOM cost, or have the complete product designed

Newly released versions offer three options for backhaul connectivity – NB-IoT, Power over Ethernet (PoE) or SmartMesh IP™

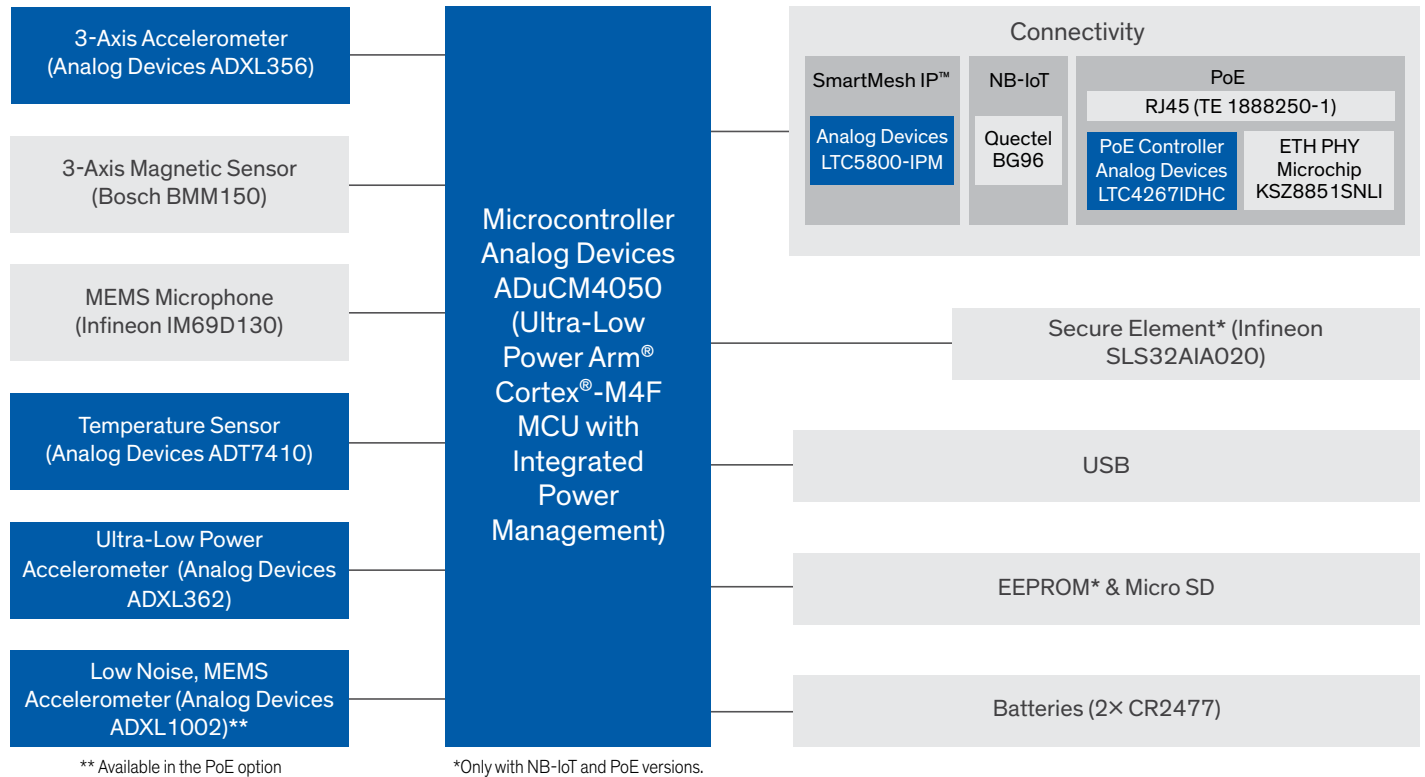
Multi-sensing condition monitoring solution:
Vibration, magnetic field, temperature, and sound sensors



Target Applications

- > Manufacturing facilities: Motors, pumps, gearboxes, etc.
- > Construction facilities: Drills, motors, heavy equipment
- > Buildings: Elevators, moving walkways, escalators, refrigeration, HVAC systems
- > Healthcare: Large medical equipment with motors
- > Oil & gas: Pumps, drills
- > Transportation: Fleet management
- > Structures: Bridges, towers, pipelines

iCOMOX Block Diagram



Hardware Features

- > Multi-sensing: Vibration, magnetic field, temperature, and sound sensors
- > Three options for backhaul communication - cellular (NB-IoT), Power over Ethernet (PoE) or the highly reliable SmartMesh IP™ protocol
- > Compact form-factor and various mounting adapters to accommodate a wide range of monitored equipment
- > CE and FCC certified with an IP66 enclosure

Software Features

- > Embedded intelligence for early detection of machine failures
- > Ability to configure warning and alarm levels and timestamp events for each sensor
- > Seamless integration into existing systems and to the portal
- > AI enables predictive and smart preventive maintenance

Portal Features

- > Centralized management of all assets and related maintenance processes
- > Real-time reporting and dashboards for visualization
- > User-friendly interface that can be accessed from anywhere, via a computer or a mobile device

Key Components

- > **Analog Devices ADuCM4050:** Ultra-low power Arm® Cortex®-M4F MCU with integrated power management
- > **Analog Devices ADXL356:** 3-axis accelerometer serves as a vibration sensor
- > **Analog Devices ADXL362:** Ultra-low power, low-g accelerometer
- > **Analog Devices ADXL1002:** Low noise, high frequency +/-50g MEMS accelerometer
- > **Analog Devices ADT7410:** Temperature sensor with $\pm 0.5^\circ\text{C}$ accurate with 16-bit resolution
- > **Analog Devices LTC5800-IPM:** SmartMesh IP™ 2.4 GHz, 802.15.4e SoC as either a wireless mote, e-manager, or access point mote in a SmartMesh IP™ network
- > **Analog Devices LTC4267IDHC:** Power over Ethernet IEEE 802.3af PD interface with integrated switching regulator
- > **Infineon SLS32AIA020:** OPTIGA TRUST X turn key high-end cryptography and security controller
- > **Microchip KSZ8851SNLI:** Single-Port Ethernet MAC controller with 8/16-bit or 32-bit non-PCI interface
- > **Quectel BG96:** LTE Cat M1/NB1/EGPRS Module with maximum data rates of 375Kbps downlink and uplink

Autonomous Mode Operation with Built-In AI

For the SRT-ICOMOX-POE-SEC-AI Version

Autonomous mode anomaly detection algorithms allow users to configure a single preset state to be learned by the algorithm. Once a machine learning program learns a preset state, any deviations of observed behavior relative to the preset state can be easily detected and reported automatically. Autonomous mode finds particular application in selecting sensors for AI systems and in training AI algorithms. Algorithms can be configured for a wide training duration (1 to 65535 minutes) and the learning result can be stored in non-volatile memory.

The benefits of the autonomous mode include:

- > Compared to the demo mode operation running on all other iCOMOX versions, the autonomous mode has four times more internal (hidden) substates that augment learning in a single state
- > Storage of the learned model in a non-volatile memory (in external flash)
- > Ability to run learning mode for an extended period allowing learning of the machine behavior for several hours and automatically switching inference mode
- > Ability to control sensors involved in the learning/inference mode

iCOMOX Integration with Siemens MindSphere®

MindSphere® is a cloud-based, open IoT operating system from Siemens that connects real things to the digital world and enables powerful industry applications and digital services to drive business success. MindSphere's open platform as a service (PaaS) enables a rich partner ecosystem to develop and deliver new applications.

iCOMOX uses the strengths of MindSphere® for connecting devices and data analysis (vibration, magnetic field, temperature, and noise sensors) to enable a high dynamic range and an extraordinary signal-to-noise ratio (SNR) for the vibration analysis. With MindSphere®, customers can configure warnings and alarm levels as well as time stamp events for each sensor, which offers comprehensive analysis functions in the device (edge of the network) and in the cloud. With the specially developed integrated software and analysis stack, machine errors in a MindSphere® application can be detected at an early stage.

Ordering Information

Part #	Description
<u>SRT-ICOMOX-POE-SEC</u>	Monitoring module with Power over Ethernet wired backhaul to gateway
<u>SRT-ICOMOX-POE-SEC-AI</u>	PoE version with advanced AI capabilities
<u>SRT-ICOMOX-NBIOT-SEC</u>	Monitoring module with NB-IOT and a secure element (contains mounting hardware)
<u>SRT-COMOX-SM</u>	Monitoring module with SmartMesh wireless backhaul to gateway
<u>SRT-ICOMOX-KIT</u>	iCOMOX module, Wireless SmartMesh USB Dongle, mounting kit, USB cable, Monitor Software
<u>SRT-SMARTMESH-USB-DONGLE</u>	SmartMesh Dongle only
<u>SRT-MOUNTING-KIT</u>	Mounting hardware only

Arrow Electronics is a
MindSphere® Platinum
Partner

As a member of the
MindSphere® partner
program, Arrow can offer
market-ready solutions,
including retrofitting, to help
companies migrate and
integrate old industrial plants
into new ones — smart cities
and end-to-end tracking of
assets.



Watch Video:

[iCOMOX Condition
Based Monitoring Box](#)

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Getting Started Documentation

github.com/ArrowElectronics/iCOMOX/wiki

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