Vibration Measurement Solution

Vol. VIB_2.24.10_EN

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1.Vibration Measurement & Predictive Maintenance

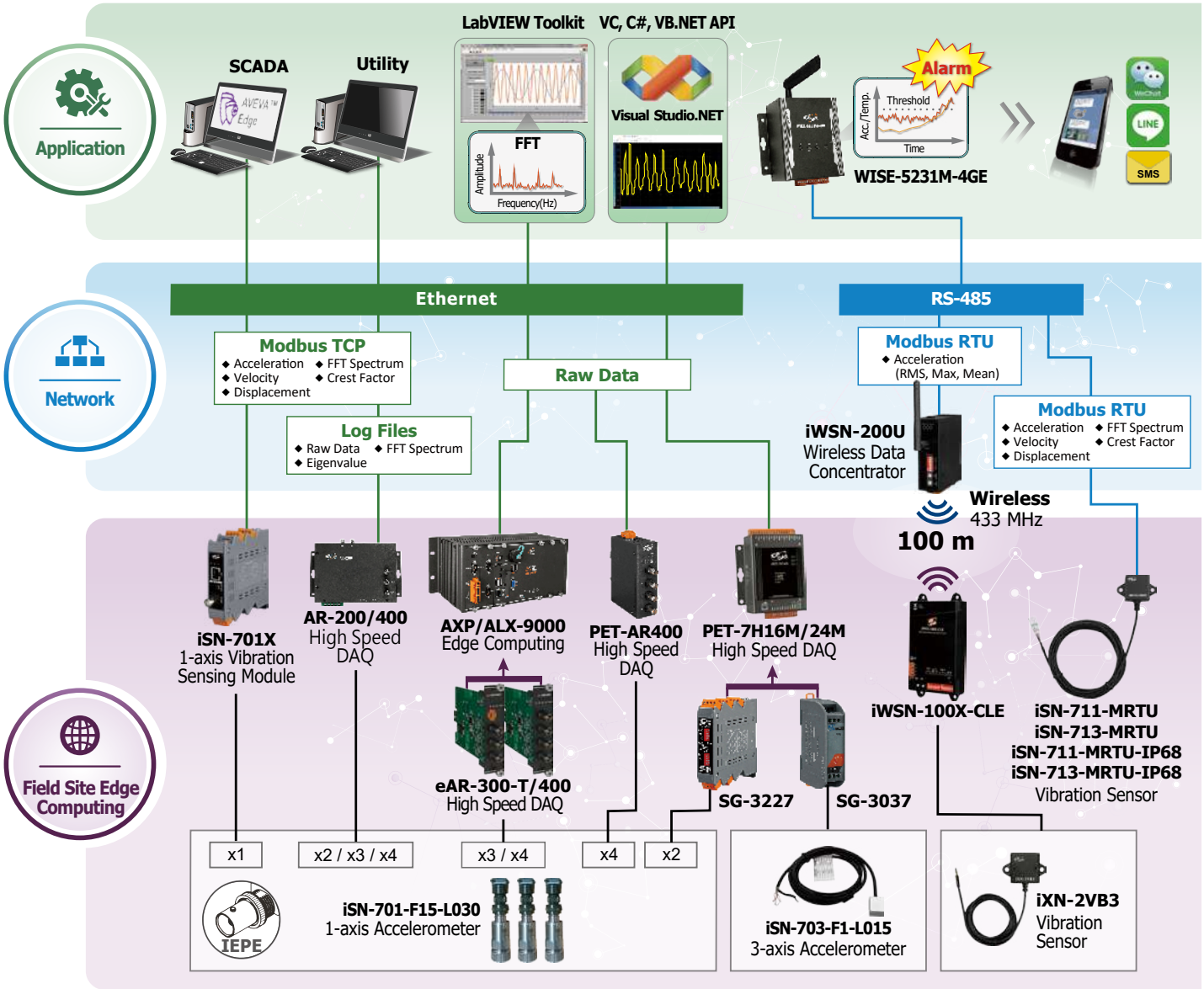
Overview:

In recent years, predictive maintenance has become more important. Quick diagnosis and maintenance of equipment can help prevent unexpected damage and safety issues. Vibration signals are key indicators, as most equipment generates vibrations during operation. By using vibration measurement technology to collect data, we can analyze the condition of equipment and its key components, allowing for proactive maintenance that extends equipment life and reduces unplanned downtime.

To support this, ICP DAS has introduced a range of vibration measurement products that offer wireless, wired, and high-speed data acquisition solutions. These products can measure and identify vibrations in various devices and assist in detecting anomalies and troubleshooting.

The iWSN/iSN vibration sensor series is designed for low-frequency rotor equipment. Their flagship products include the e-AR vibration data module, AR high-speed data logger modules, and signal conditioning modules, all capable of collecting high-rate vibration data.

Application Architecture of the Vibration Products



Applications Suitability Table

Application	Description	Solution
Measurement Analysis	Built with a vibration monitoring system, fixed sensing points, integrate measurement information, and vibration signals can be measured online automatically. The purpose of reducing labor costs can also be achieved by storing the original data to file records.	AR Series
Periodically Inspection	The vibration eigenvalues value measured in real time is used to determine which mechanical part is abnormal. System management personnel can repair damaged components and reduce costs.	iWSN Series AR Series iSN Series
Device Diagnosis & Predictive Maintenance	Using the eigenvalues of vibration caused by mechanical operation, frequency and amplitude, to show the operating status of device. When there is an unplanned change in vibration signal, it means that device is in an abnormal state during operation and needs to be maintained in advance.	AR Series e-AR Series

Maintenance Solutions:

Descriptions

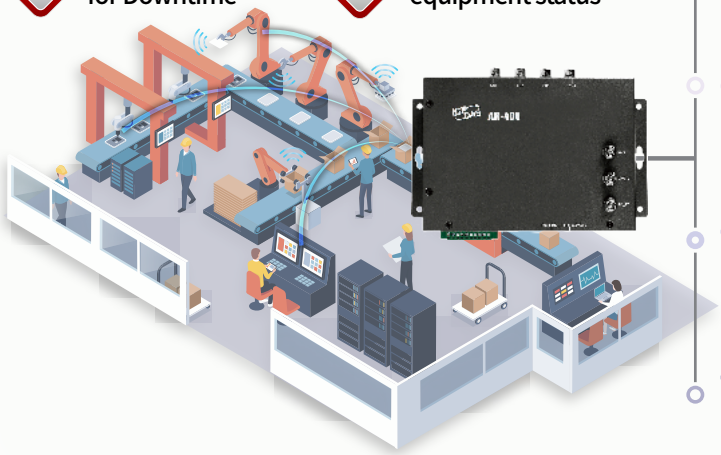
The guiding about applications of Industry 4.0 and the maintenance concept about process devices are constantly evolving. Effective maintenance can improve productivity and protect company from risk. Types of maintenance may include:

1. Damage Maintenance: Maintenance is performed only after device is damaged or malfunctioned. Core device may not be repaired in short time because of severe damage, and cause the production line to stop.

2. Preventive Maintenance: Periodic maintenance, regular oil and parts changes. However, the difference in the quality of the parts, is still a risk of equipments damage or failure.

3. Predictive Maintenance: Diagnose device through operating data such as device and environment, and plan maintenance in advance. It can prevent major damage and avoid excessive maintenance to the device, saving time and money for the factory.

The Importance of Monitoring Critical Equipment



Measuring equipment by accelerator
Measure high-resolution, high-frequency vibration data of rotating equipment and use it to analyze production line quality.

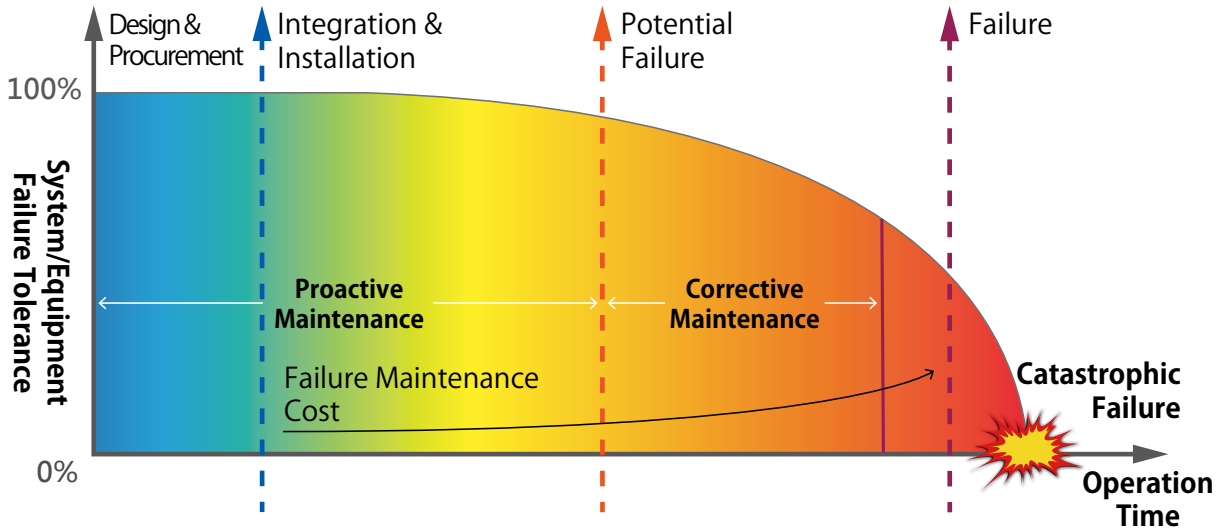
Ensure product yields by monitoring
Vibration monitoring can avoid production defects and unwarranted shutdowns when equipment is aging and deformed.

Early preparation & maintenance schedule
Diagnose the status of your equipment and plan maintenance schedules in advance.

IoT System for Data Integration
Real-time monitoring of equipment status can effectively shorten inspection and repair time and improve efficiency.

Maintenance Policy

Factories usually are equipped with power devices, host devices, and auxiliary devices. And if only one way is used to manage all kinds of devices, there will be problems. Even the same type of devices, such as power devices, boilers, air compressors, power distribution devices, etc., have different technical characteristics, so different sensors are required to collect different key data for analysis. The vibration measurement solution provided by ICP DAS can collect vibration data for different types of machinery, arrange preventive work, and reduce serious losses after functional failure.



Design	Precise Work	Preventive Work	Failure
1. Reliability design 2. Purchasing purpose	1. Commissioning 2. Installation 3. Defect correction 4. Calibration and balance 5. Workflow process 6. Cleaning and check 7. Reliability work	1. High frequency analysis 2. Vibration analysis 3. Periodically inspection 4. Electrical power analysis 5. Temperature analysis 6. Oil quality analysis 7. Pressure analysis	1. Function failure 2. Automatic shutdown 3. Catastrophic accident

Vibration Severity:

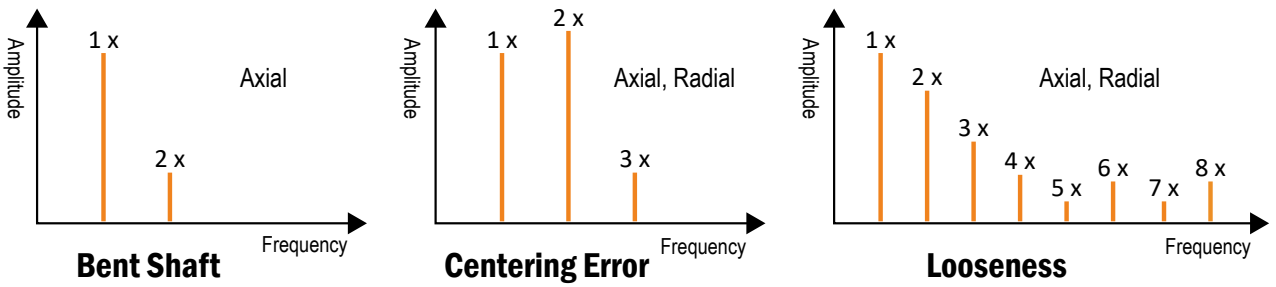
The three parameters commonly used to describe vibrational responses are displacement, velocity, and acceleration. In general, the vibration intensity at low frequency is measured by the displacement value; the vibration intensity at medium frequency is measured by the velocity value; the vibration intensity at high frequency is measured by the acceleration value. For most machines, velocity is the best indicator, which is one reason why many standards use this parameter.

The absolute value evaluation of vibration intensity based on ISO 10816-3 (as figure below) is one of the ways to judge whether a machine is in good or bad status according to the vibration value. In addition, based on normal time vibration values, relative judgment methods are also common, where 2 to 3 times are used as warning values and 5 to 6 times are used as abnormal values.

ISO 20816-3	Medium Machines		Large Machines	
Technical Guidance	Group 1		Group 2	
Speed	Rated Power			
RMS (mm/s)	15 kW ~ 300 kW		> 300 kW	
11.0	Machine Damage			
7.1				
4.5	Restricted operation			
3.5				
2.8	Normal operation			
2.3				
1.4				
0.7	New Adaptive Machines			
Comparison Basis	Strict	Flexibility	Strict	Flexibility

FFT Analysis

Based on the analysis of displacement, velocity, and acceleration of the time domain signal, the trend of the machine failure can be known, however, the cause of the machine failure maynot be known. FFT (Fast Fourier Transform) is a mathematical operation that converts time-domain signals into frequency-domain spectral graphs. The vibration spectrum can effectively analyze the cause of machine failures. Our products can provide up to 10 sets of spectral values (amplitude/frequency), and by measuring the radial and axial spectral information of the equipment, the root cause and severity problem of the equipment can be estimated. The faults that may be identified are as follows:



To Measure Time-domain Eigenvalues & FFT Spectrum

iSN-71X-MRTU

iSN-701X Series

AR Series

Application Types:

A. PET Ethernet High-speed Data Acquisition Module

- High-speed real-time data acquisition
- Provide raw data:
  .csv, .txt, .tdm file formats
- Choose either PET-7HxxM + SG-3000 or PET-AR400 to measure data.


PET-7HxxM


SG-3000

/


PET-AR400

+


iSN-701-F15-L030
iSN-703-F1-L015

B. Open System Controller + e-9K High-speed Vibration Data Acquisition Module

- Open development environment
- Built-in IEPE interface
- Provide raw data:
  .csv, .txt, .tdm file formats


AXP/ALX-9000

+


e-AR300-T
e-AR400

+


iSN-701-F15-L030
iSN-701-F15-L060

C. AR Accelerometer Data Logger Module

- Schedulable/offline data acquisition(.csv, .txt, .tdm file formats)
- Built-in IEPE interface
- Provide eigenvalues: Acceleration, velocity, displacement, FFT spectrum, etc.


AR-200/300-T/400

+


iSN-701-F15-L030
iSN-701-F15-L060

D. iSN Vibration Sensor Series

- Built-in Modbus RTU & Modbus TCP Protocol
- Provide eigenvalues:
  Velocity, RMS, P-P, Crest Factor, FFT, etc.


iSN-71x-MRTU


iSN-701X

+


iSN-701-F15-L030
iSN-701-F15-L060

E. iWSN Vibration Sensor Series

- Low sampling rate & time selectable (1/10/30/60 sec.)
- Provided eigenvalues (Velocity, RMS, etc.)
- Built-in MEMS Sensor


iWSN-100X/101X-CLE

+


iXN-2VB3

Type	Main Module	+Module	+Accelerometer	Raw Data	Eigenvalues	CHAN	Sampling (Max.)	Frequency	Comm.
A	PET-7H16M PET-7H24M	SG-3037	iSN-703-F1-L015	Y	N	3	128/200 kHz	-	Wired
		SG-3227	iSN-701-F15-L030 iSN-701-F15-L060			2			
	PET-AR400	-				4	128 kHz		
B	AXP-9000	e-AR300-T				3	200 kHz	-	
	ALX-9000	e-AR400				4			
C	AR-200 AR-300-T AR-400	-			Displacement, Velocity, Acceleration, FFT spectrum (up to 20 spectrum values)	2		-	
						3			
						4			
D	iSN-701X	-		N		1	64 kHz	6 Hz ~ 6.4 kHz	
	iSN-711-MRTU iSN-713-MRTU	-	Built-in MEMS sensor			1	-	6 Hz ~ 1KHz	
						3			
E	iWSN-100X-CLE iWSN-101X-CLE	iXN-2VB3			RMS/Max./ Vector value	3	-	10 ~ 500 Hz	Wireless

Monitoring Level and Analysis Period:

Monitoring Level	Analysis Method	Analysis Functions	Application
High	Physical Modeling	Vibration analysis Service life evaluation	AR Series, PET-7H Series + SG Series AXP-9000 + e-AR Series
Medium	State Identification	Vibration rate	AR Series, PET-7H Series + iSN Series
Low	Baseline Comparison	Amplitude & Acceleration	iWSN Series, iSN Series

Monitoring Level	Measuring Period	Measuring Object	Deployment	Data Type	Application
High	Real-time	Main Device	Wired	Raw data	PET-7H Series + SG Series AXP-9000 + e-AR Series
Medium	Real-time Periodic	Main Device	Wired	Raw data	PET Series + SG Series AR Series (Data Logger)
Low	Periodic	Auxiliary Device	Wireless	Amplitude	iWSN Series
			Wired		iSN Series

Equipment Early Warning Application:

In iron and steel plants, complex equipment is used in processes like raw material transport, coking, steelmaking, and rolling. Predictive maintenance is crucial to prevent unexpected shutdowns, but there are challenges:

1. Limited manpower and time for frequent testing.
2. Complex equipment and testing procedures that may affect accuracy.
3. Lack of predictive maintenance knowledge among staff, requiring cultural adaptation.

ICP DAS developed an intelligent online monitoring system, including HMI, signal acquisition, and I/O modules, with diagnostic software. It automates monitoring, diagnoses equipment issues using vibration signals (amplitude, frequency, velocity), and provides real-time alerts, improving accuracy and reducing downtime. The system can also be customized to meet specific equipment needs.




Features

❶ AR-400 :

- Provides various trigger modes to record data.
- Provides Acceleration, Velocity, Displacement, FFT Specturm, and Crest Factor values.
- Eigenvalue threshold setting and over-value alarm outoput function.

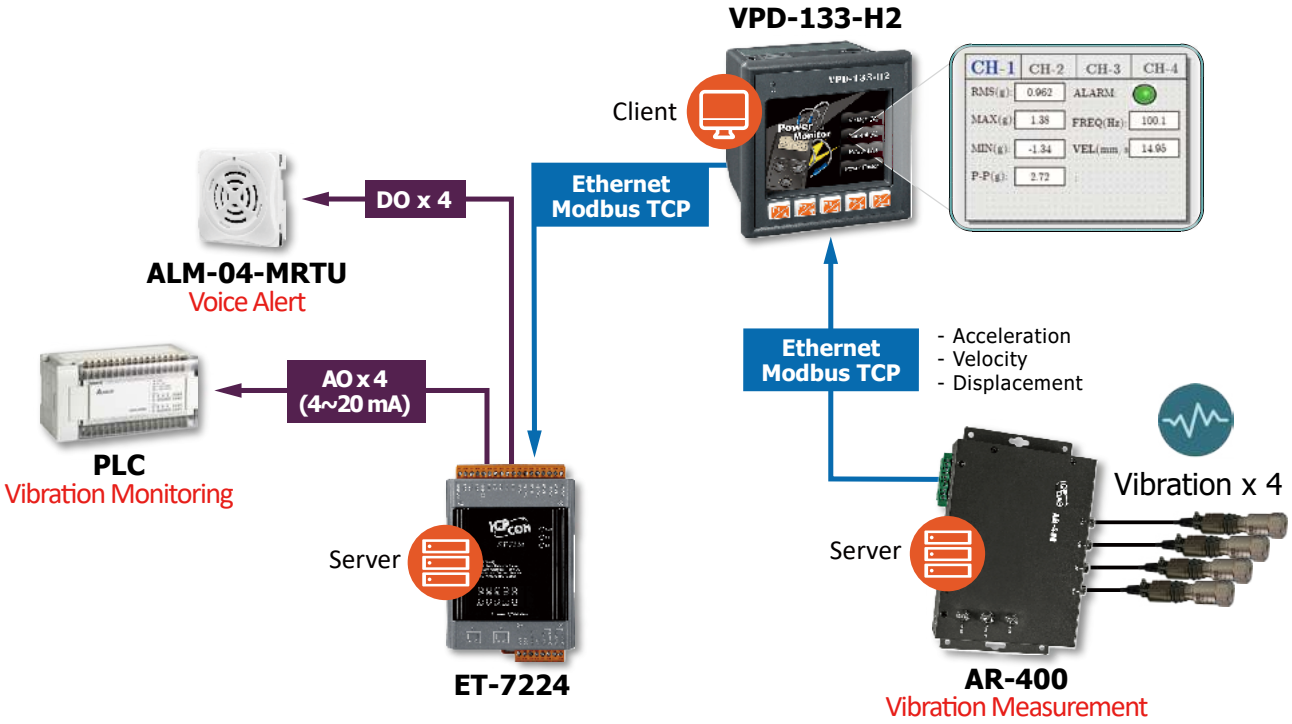
❷ ET-7224 :

- Output current according to VPD-130 Modbus command
- Eigenvalues threshold alarm function.

❸ VPD-130 :

- Convert eigenvalues to 4 ~ 20mA.
- Display and setting of eigenvalues.

Architecture:



Inspection Process

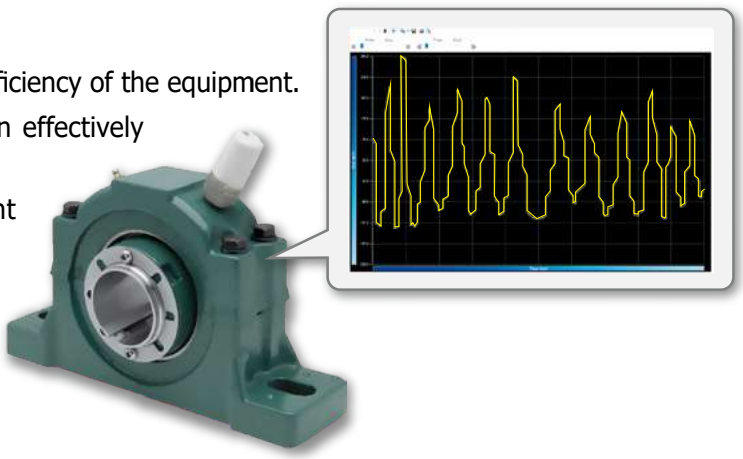
Solution Effects

Reduced Cost:

- Early warning and pre-processing can reduce the loss of equipment, production capacity and labor due to abnormal failure.
- Understand the operating status of equipment so that the number of equipment spare parts can be effectively planned, and reduce unnecessary spare parts inventory.
- Reduce fixed regular shift for periodic inspection.
- Integrate process and quality information to improve product yield (such as the reduction of roll marks in the steel process).

Increased Benefits:

- Improve troubleshooting and maintenance efficiency of the equipment.
- Data-based evaluation and improvement can effectively extend the equipment maintenance cycle.
- Effectively improve the reliability of equipment operation.



2. High-speed Vibration DAQ Scheme for Main Devices

AXP/ALX-9000
Edge Computing Controller

AR-200/300-T/400
High-Speed Vibration Data logger

PET-7H16M/7H24M
High-Speed Data Acquisition Module

High performance vibration signal acquisition modules include: **AR series**, **e-9K series**, **PET-7H series** (with SG signal conditioning module), and **PET-AR400**.

The AR and PET series modules can simultaneously convert A/D signals and store the captured signals on an SD card to avoid data loss and later analysis.

e-AR300-T/AR400
High-Speed Vibration Data Acquisition Module

PET-AR400
High-Speed Data Acquisition Module

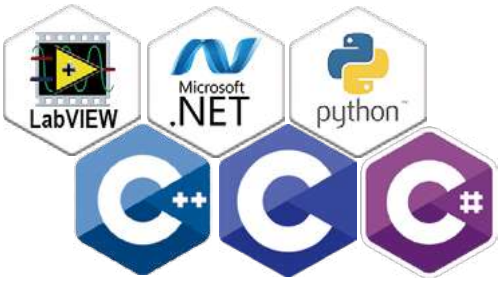
In addition, the AXP/ALX-9000 controller is a Windows 10 IoT / Linux operating system platform with e-9K series of vibration signal acquisition modules, allowing users to develop their own vibration signal acquisition and analysis system with up to 28 channels.

Prooducts / Functions	AXP/ALX-9000 + e-AR300-T/e-AR400	AR-200 AR-300-T AR-400	PET-7H16M/7H24M + SG-3037/SG-3227	PET-AR400
Data Acquisition	Centralized	Distributed		
Signal Type	IEPE		IEPE (SG-3227) Voltage (SG-3037)	IEPE
Channels	3 / 4 CH	2 / 3 / 4 CH	2 / 3 CH	4 CH
Concentrator Slots /Channels	Support extended slots: 1/2/3/6/7	-	Support input channels: 8 CH (PET-7H16M)/ 4 CH (PET-7H24M)	-
Accelerometer	iSN-701-F15-L030 iSN-701-F15-L060		iSN-701-F15-L030 iSN-701-F15-L060 (Only SG-3227)/ iSN-703-F15-L015 (Only SG-3037)	iSN-701-F15-L030 iSN-701-F15-L060
Data Transmission	Acquisition followed by transmission, Continuous real-time transmission	Acquisition followed by transmission	Acquisition followed by transmission, Continuous real-time transmission	
Data storage	Support (SSD/Cfast)	Support (MicroSD)	-	
Software SDK	**Windows:** VC, C#, VB.NET SDK and Demo, Python Demo, NI LabVIEW Toolkit and Demo **Linux:** C/C++ library and Demo, .NET library and Demo, Python Demo			

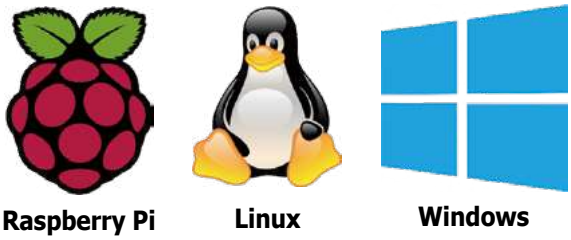
High Speed Module Applications:

On-line Mode

► Software SDK



► OS platform



❶ AXP/ALX-9000 with e-ARx00 series

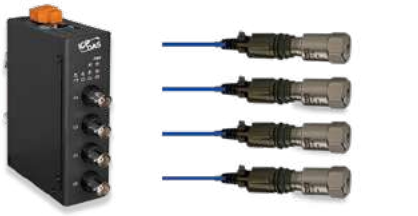
DAQ Controller + IEPE Module
AXP-9251-IoT
e-AR300-T / e-AR400

Triaxial Accelerometers
iSN-703-F15-L030
/Thermistor

❷ PET-AR400

IEPE Module
PET-AR400

Triaxial Accelerometers
iSN-703-F15-L030



❸ PET-7H16M/7H24M with SG series

DAQ Module
PET-7H16M/7H24M

IEPE Signal Conditioner
SG-3227

IEPE Accelerometers
iSN-701-F15-L030

Off-line Mode

- **AR-200/AR-300-T/AR-400**

IEPE Accelerometers
iSN-701-F15-L030

IEPE DAQ Module
AR-200/AR-300-T/AR-400

AR_Tool Utility

AXP/ALX-9000 Edge computing Controller

AXP-9x51-IoT / AXP-9x91-IoT / ALX-9x51 / ALX-9x91

Features:

- OS: Intel Core i5/E3950
- Built-in VGA & HDMI
- 64-bit Hardware Serial Number
- I/O Expansion Slots (RS-232/485, USB, Ethernet)
- Dual Watchdog
- Various solutions of software
- Edge computing applications

The new AXP/ALX-9000 series ICP DAS released is the latest flagship controller with a rugged compact design (3U). It uses all-metal shell to achieve stronger anti-interference capability. The new AXP/ALX-9000 series offers a variety of CPU, OS, and software development tools to meet different needs of customers. The AXP/ALX-9000 series is with excellent cost performance. It can be widely used in most harsh environments, for example, factory automation, building automation, equipment automation, laboratory automation, chemical industry, environmental monitoring, M2M, IIoT, Industry 4.0, etc.

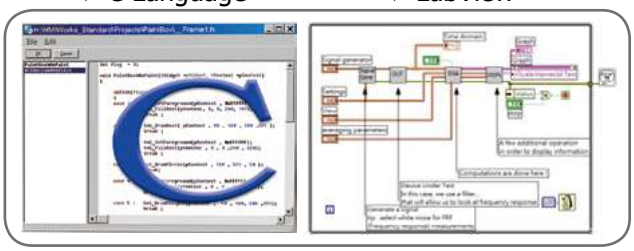
OS selection

Windows 10 IoT

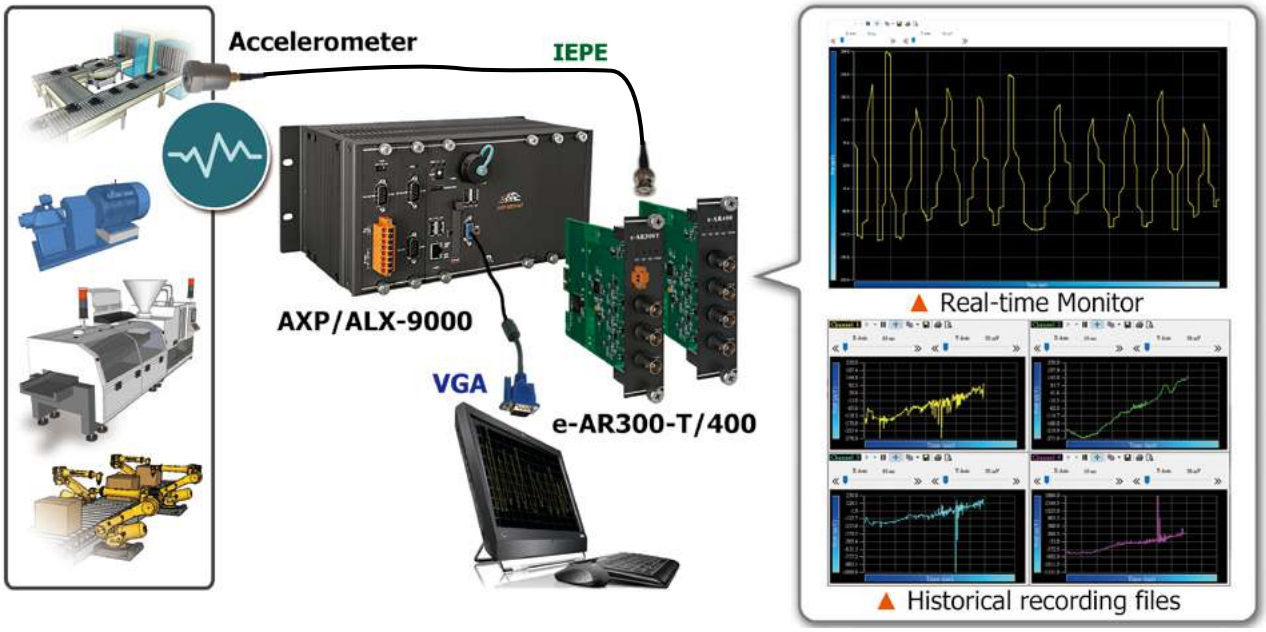
Linux Kernel 4.14

Software Development Toolkit

▼ C Language ▼ LabView



Application Architecture

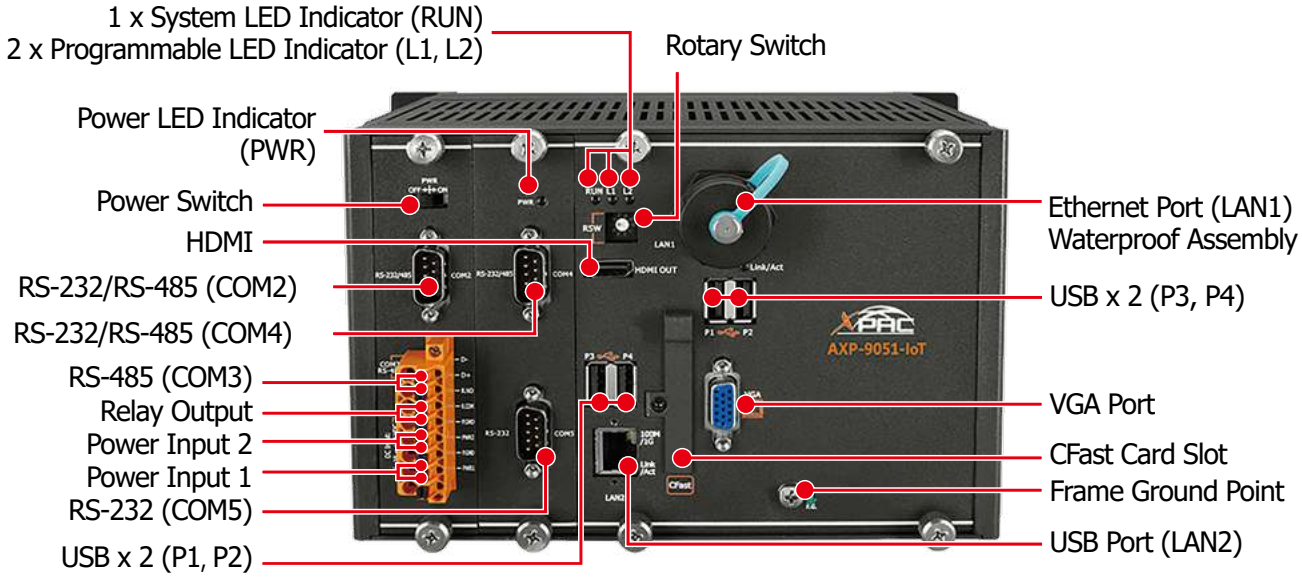


Selection Guide:

AXP-9xxx-IoT (Windows 10 IoT OS)						
Model	**CPU**	**RAM**	**Flash**	**Memory Card**	**USB**	**I/O Slots**
AXP-9251-IoT	I5-8365UE (1.6 ~ 4.1 GHz, 4C8T)	16 GB	128 GB (mSATA)	32 GB CFast	2 x USB 2.0 2 x USB 3.0	2
AXP-9651-IoT						6
AXP-9191-IoT	E3950 (1.6 ~ 2.0 GHz, 4C4T)	8 GB				1
AXP-9391-IoT						3
AXP-9791-IoT						7

ALX-9xxx (Linux OS)						
Model	**CPU**	**RAM**	**Flash**	**Memory Card**	**USB**	**I/O Slots**
ALX-9251	I5-8365UE (1.6 ~ 4 .1 GHz, 4C8T)	16 GB	128 GB (mSATA)	32 GB CFast	2 x USB 2.0 2 x USB 3.0	2
ALX-9651						6
ALX-9191	E3950 (1.6 ~ 2.0 GHz, 4C4T)	8 GB				1
ALX-9391						3
ALX-9791						7

Appearance:



Communication Interfaces	
Ethernet	2 x RJ-45 10/100/1000M Base-TX (Auto-negotiating, Auto MDI/MDI-X, LED Indicator)
USB	2 x USB 2.0, 2 x USB 3.0
COM1	Used to expand I-97K series
COM2	RS-232/485 (RS-232: RxD, TxD, GND/RS-485: Data+, Data-); 3000 VDC isolation
COM3	RS-485 (Data+, Data-); 3000 VDC isolation
COM4	RS-232/485 (RS-232: RxD, TxD, CTS, RTS, GND; RS-485: Data+, Data-); 3000 VDC isolation
COM5	RS-232 (RxD, TxD, CTS, RTS, DSR, DTR, CD, RI, GND); 3000 VDC isolation

e-AR High-speed Vibration Data Acquisition Module

e-AR300-T

e-AR400

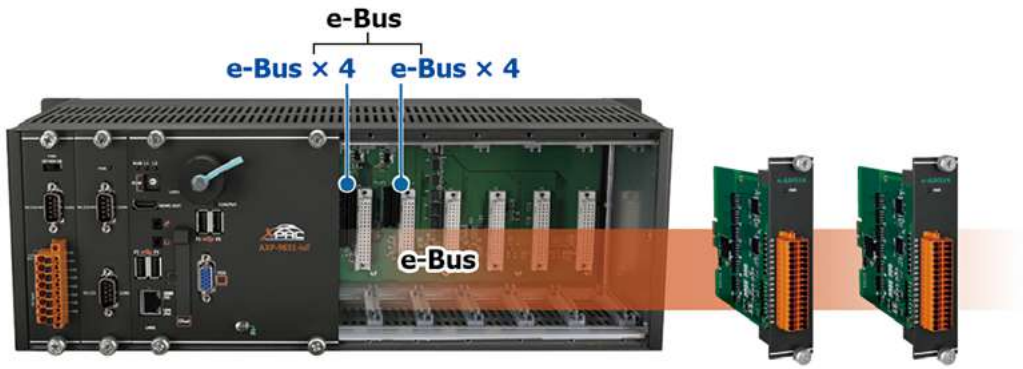
Features:

- 3, 4 channels IEPE Input; 16-bits resolution
- Dynamic Range: ±10 V, driving current: 4 mA
- 4 kV ESD Protection

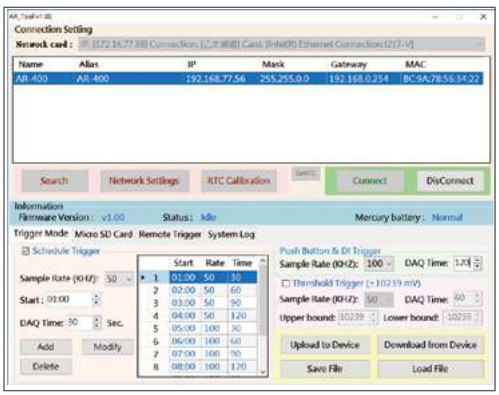
e-AR300-T / e-AR400 is High-speed dynamic data acquisition module. It provides synchronous sampling up to 200 kHz for each channel. It is built-in with 3 mA excitation current and 16-bits analog/digital converter. The signal acquired can be stored on CFast card, and can be used for analysis. Users can configure various trigger modes, sampling rate and sampling time by utility software. It could implement data acquisition applications for vibration measurement efficiently.

ICP DAS High-speed Bus

ICP DAS roll out the new flagship controller (AXP/ALX-9000), which fully supports the new high-speed bus interface (e-Bus). Its speed is up to 2 GB/s (e-Bus x4) and 500 MB/s (e-Bus x1), and it also supports DMA (Direct Memory Access) data transfer without the intervention of the CPU. With the same-level processor, DMA is a fast data transmission method which provides a large amount of data transmission and high-speed data comparison of expansion modules. It improves the work efficiency of the controller.



Software Toolkit

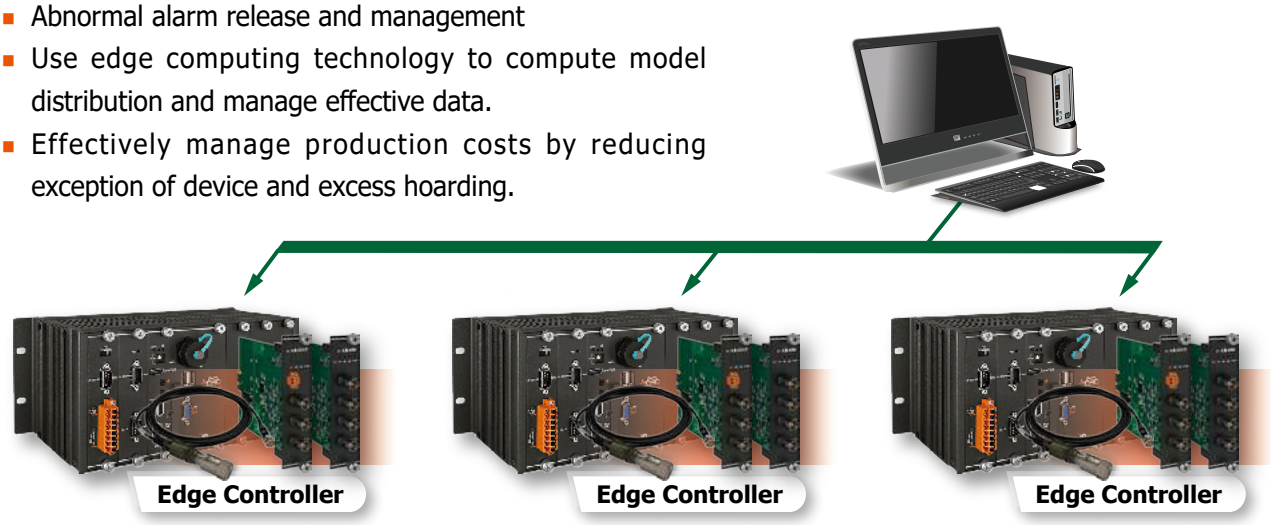


- Support AR-200/300-T/400, e-AR300-T, e-AR400
- Provide device search function
- Support trigger mode configuration
- Support RTC calibration
- Provide recording file type: .xls / .csv / .txt
- Support utility remote trigger mode
- Show system event log

Application:

Equipment monitoring and early warning system are applied to equipment diagnosis and continue to develop rapidly. For steel industry, petrochemical industry, and power plants, both of them are indispensable maintenance strategies. For automated production lines, it can provide vibration monitoring, fault warning and precision diagnosis of rotor equipment. To reduce unwarranted failures and achieve planability.

- Automatic / real-time data monitoring (local, remote)
- Abnormal alarm release and management
- Use edge computing technology to compute model distribution and manage effective data.
- Effectively manage production costs by reducing exception of device and excess hoarding.



Supplies Section	Processing Section	Products Warehouse
Fans	Fans	Crown Blocks & Reducers
Pumps	Pumps	Counterpoint IO
Machines & Reducers	Machines & Reducers	Statuse of Devices
	Mills	

Selection Guide:

Model	e-AR300-T	e-AR400
Analog Input		
Channels	3 (Synchronous sampling)	4 (Synchronous sampling)
ADC Resolution	24-bit	
Sampling Rate	50 / 100 / 200 kHz	50 / 100 / 125 kHz
Dynamic Range	±10 V	
IEPE	4 mA	
Trigger mode	Software Trigger	
Connector	BNC	
Temp. Measurement (Thermistor)	1 (0°C ~ 80°C)	-
Mechanism/Environment		
Consumption	2 W	
Dimensions (W x L x H)	31 mm x 134 mm x 144 mm	
Operation Temp.	-25°C ~ +75°C	
Humidity	10 ~ 90% RH, Non-condensing	

AR High-speed Vibration Data Logger Module

AR-200 AR-300-T AR-400

Features:

- 2/3/4 simultaneous, 16-bit resolution ADC
- Support IEPE input and built-in 3 mA excitation current
- Dynamic range: ±10 V
- Adjustable sampling rate (Max. 30m@5kHz)
- Data Format: Acceleration, Velocity, Displacement, FFT spectrum, etc.
- Supports 4 to 32 GB microSD card
- Log File: Raw Data, Eigenvalues

Introduction:

AR-200 / AR-300-T / AR-400 is a high-performance vibration signal acquisition module equipped with 2, 3 and 4 analog input channels, providing simultaneous sampling up to 200/125 kHz per channel. With the built-in high-precision 3 mA excitation current and 16-bit analog-to-digital converter, all captured signals will be stored in the SD card or read the vibration characteristics via Modbus TCP for user analysis. It also supports flexible trigger modes, sampling rates, and recording time span, making it ideal for signal measurement in vibration applications.

Vibration waveform display function

1. Real-time waveform display

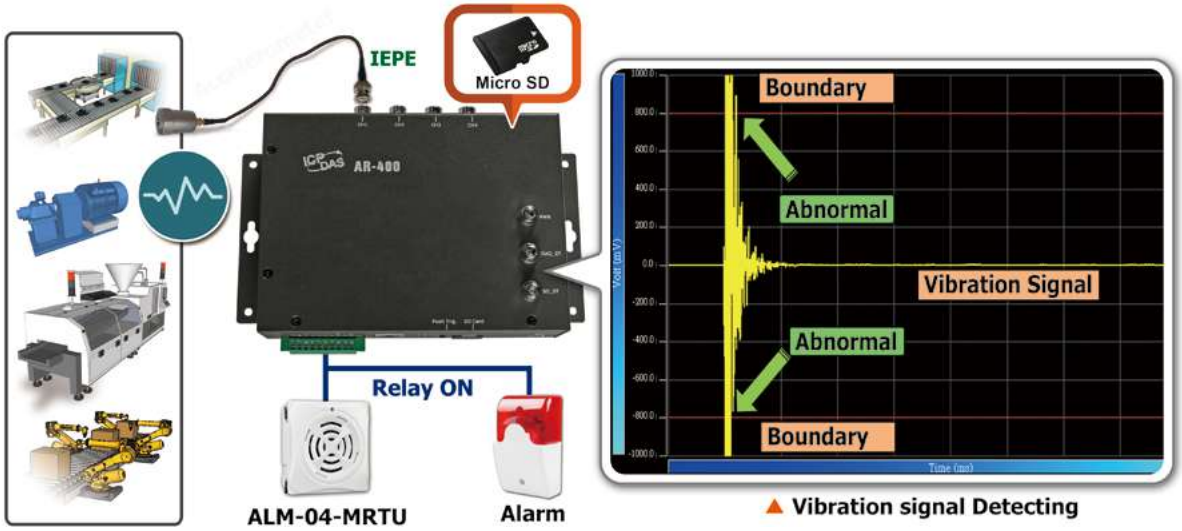
The user can monitor the machine's vibration status through the utility software, which is convenient for the on-site staff to debug and diagnose at the first time.

2. Historical waveform recording files playback

The vibration signal can be recorded and stored in the flash card of the AR-200/AR-400 module. The user can download the recorded file back to the computer and play it through the utility software, and convert the vibration signal into a waveform display with ease. The difference between the signal and the signal between the channels is observed to facilitate further vibration analysis and processing.

3. Signal abnormal alarm function

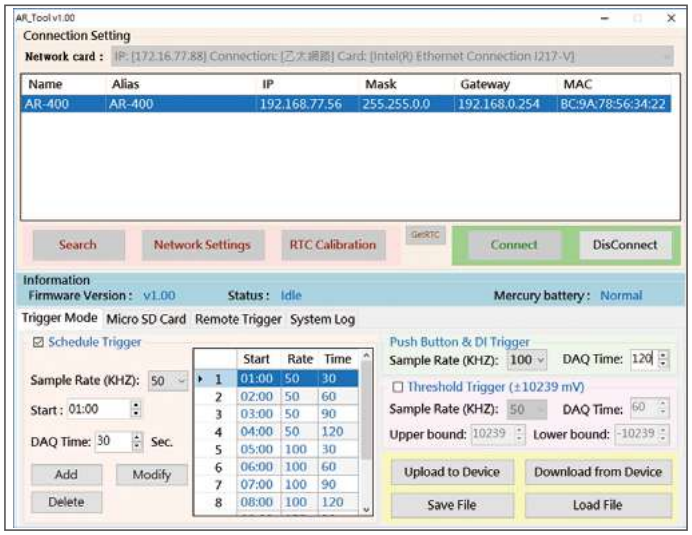
The ALM-04-MRTU or the alarm connected to the relay will be activated, so that the field staff can immediately react to the machine abnormality, and then the recording file playback function can be used to check the abnormal vibration.



▲ Vibration signal Detecting

Utility:

- Provide device search function
- Support trigger mode configuration
- Support RTC calibration
- Show system event log
- Support utility remote trigger mode
- Provide recording file (*.ar) convert to various file type (*.xls, *.csv, *.txt, *.tdm)



Selection Guide:

Model	AR-200	AR-300-T	AR-400
Vibration Data Format	Options: File/Vibration Data (Acceleration, Velocity, Displacement, FFT Spectrum, Peak Factor)		
Analog Input			
Channels	2	3	4
ADC Resolution	16-bit		
Sampling Rate	5 / 10 / 20 / 50 / 100 / 125 kHz		
Dynamic Range	±10 V		
IEPE	3 mA		
Trigger Mode	Push Button, Schedule, Analog Threshold, Digital Input and Utility Remote		
Connector	BNC		
Temp. Measurement	-	1 (0°C ~ 80°C)	-
Digital Input			
Channels	1 (Dry Contact / Wet Contact)		
Wet Contact	OFF Voltage Level: +4 VDC max. / ON Voltage Level: +10 VDC ~ +50 VDC		
Digital Output			
Channels	1 (Form A Power Relay)		
Contact Capacity	AC : 125 V @ 0.6 A ; DC : 30 V @ 2 A / 110 V @ 0.6 A		
Communication			
Ethernet	10/100 Base-TX Ethernet Controller (Auto-negotiating, Auto_MDIX)		
SD Expansion Slot	Micro SDHC (Support 4 ~ 32 GB)		
Others			
Input Voltage Range	Unregulated +10 ~ +30 VDC		
Consumption	4.3 W		
Dimensions (mm)	197 x 139 x 57 (L x W x H)		
Operation Temp.	-25°C ~ +75°C		
Humidity	10 ~ 90% RH, Non-condensing		

Ethernet High-speed DAQ Module + Signal Conditioning module

PET-7HxxM/PET-AR400

High-speed DAQ Module

SG-3037/SG-3227

Vibration Signal Conditioning module

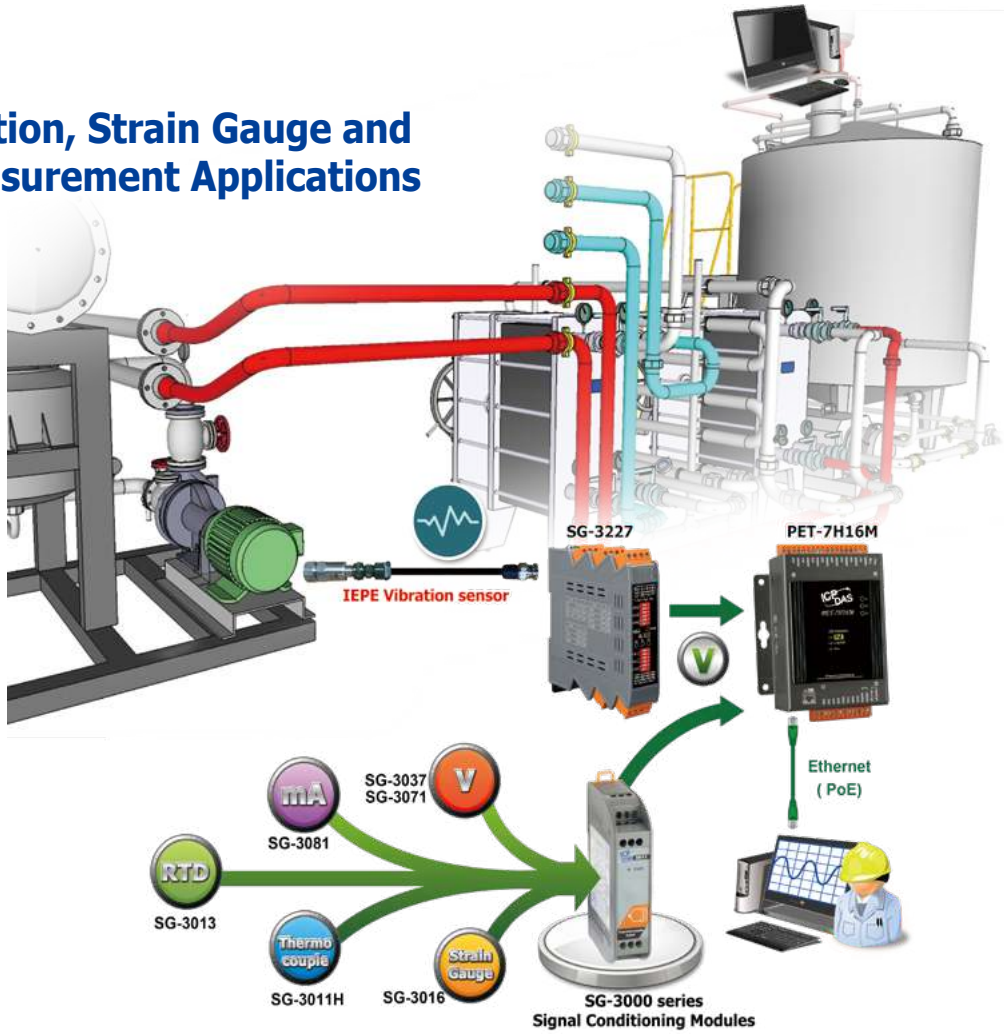
The **PET-7H16M/PET-7H24M/PET-AR400** are high speed data acquisition devices with built-in POE Ethernet communication port for data transfer over network. PET-7H16M includes 8 high-speed 16-bit singleended Analog Input channels, and PET-7H24M includes 4 highspeed 24-bit differential Analog Input channels. PET-7H16M/PET-7H24M allow A/D signal conversion simultaneously on each channel, and provide the programmable input range on all Analog Input channels. In addition to Analog Input, the modules also provides Digital Input/Digital Output/Counter/Encoder with different combinations and numbers of channels, and 4 kV ESD protection as well as 2500 VDC intra-module isolation.

The **SG-3037** & **SG-3227** are vibration signal conditioning modules for vibration measurement. SG-3037 has 3 Analog Input channels to connect to voltage output accelerometer (3-axis of iSN-703-BALT-F1-L015). SG-3227, with 2 channel IEPE interface, is suitable for IEPE accelerometer (1-axis of iSN-701-BALTF15-L030). SG-3037/SG-3227 can convert signal measured from accelerometer into analog voltage output. It collects the vibration data through PET-7H16M, and then send them via highspeed Ethernet to the data center for processing and analysis.

Application:

High Speed Vibration, Strain Gauge and Temperature Measurement Applications

With the **PET-7H16M** and **SG-3000** series signal conditioning modules, users can easy to implement remote sensing applications for measuring multiple analog input signals such as voltage, current, temperature (thermocouple, RTD), vibration (IEPE sensor) and strain gauge based on an Ethernet network, and collect data from various fields for advanced analysis.



Features:

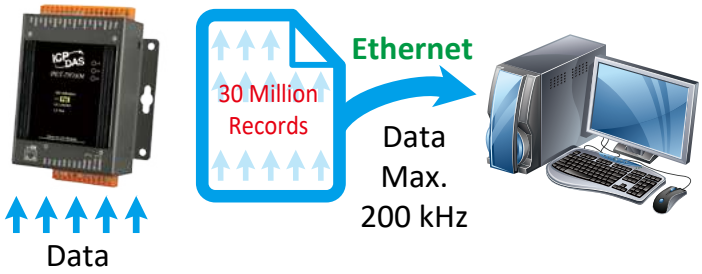
❶ Data transmission mode

1. Continuous Transmission

After starting A/D acquisition, data is continuously transmitted to the Host PC.

2. After collecting N data samples, the data is transferred to the Host PC

After starting A/D acquisition, the data will be temporarily stored in the memory, and wait until a command is received from the Host PC to transfer the collected data to the Host PC. The memory capacity allows temporary storage of up to 30 million data samples.



❷ External Digital Signal Event Trigger mode

A/D acquisition is performed in external digital event trigger mode (triggering the electrical signal is the falling edge trigger). The maximum sampling rate per channel is 200 kHz, and A/D acquisition of N data samples is performed.

1. Pre-Trigger (Acquisition of N data samples)

The A/D data is continually collected and is temporarily stored in the memory on the PET-7H16M until the trigger signal is received. Once the trigger signal is received, the collected N data samples are then transferred to the Host PC.

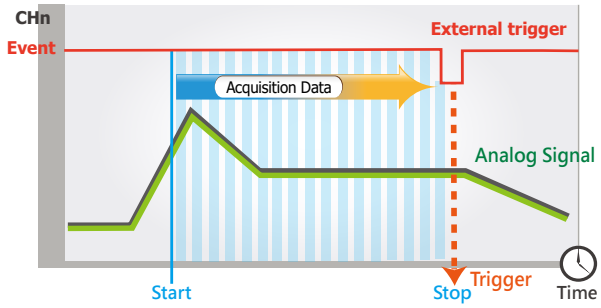
2. Post-Trigger (Acquisition of N data samples)

In this mode, the A/D acquisition of the N data samples is started once the trigger signal is received.

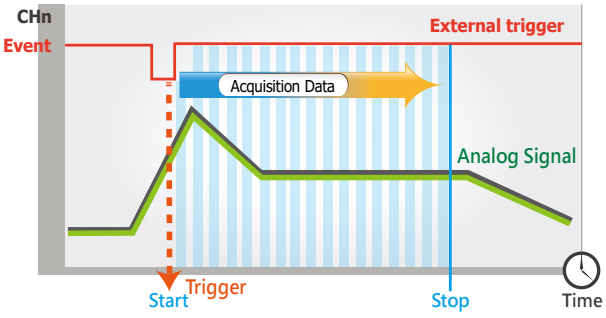
3. Delay-Trigger (Acquisition of N data samples)

The A/D acquisition of the N data samples is started once the programmed delay period from the trigger has elapsed.

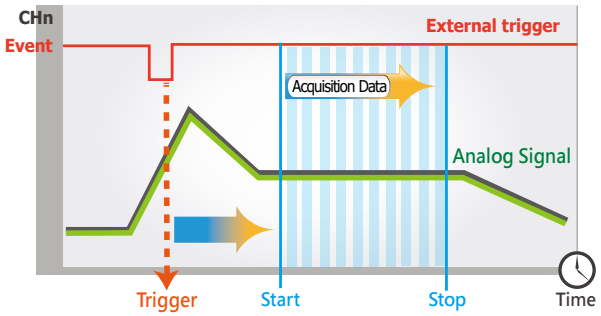
Pre-Trigger



Post-Trigger



Delay-Trigger



❸ A/D trigger mode

1. Software AD Data Acquisition mode

The A/D acquisition parameters are configured via a command from the Host PC. The continuous A/D acquisition or the acquisition of N data samples begins after the command is triggered.

2. External Digital Signal Event Trigger mode (*Only for PET-7H16M)

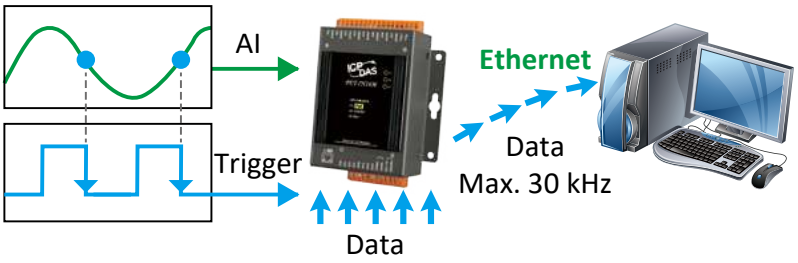
The A/D acquisition parameters are configured via a command from the Host PC, and then triggered via an external electrical signal. The A/D acquisition of the N data samples is then started.

3. Analog Input Trigger mode

The A/D acquisition parameters are configured via a command from the Host PC. When the analog input value is higher or lower than the set specific voltage value, the A/D acquisition of the N data is started.

4. External Clock Signal synchronization A/D Acquisition mode (*Only for PET-7H16M)

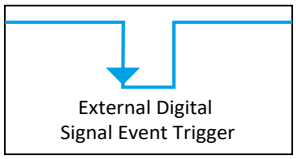
The speed of the A/D acquisition and the amount of data acquired are controlled by external electrical signals. A falling edge for each output waveform triggers an AD conversion.

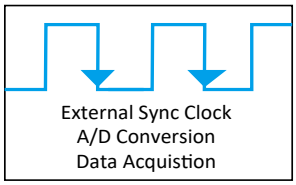


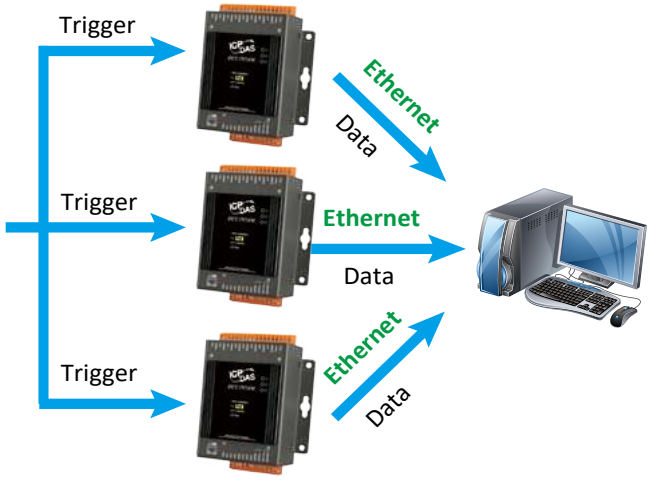
External Clock Signal Synchronization A/D Acquistion Mode

❹ A/D synchronization trigger between multiple modules

The A/D acquisition parameters are configured via a command from the Host PC, and are triggered by an external digital signal event, the A/D acquisition of N data samples, or A/D acquisition via the synchronization of an external clock signal.







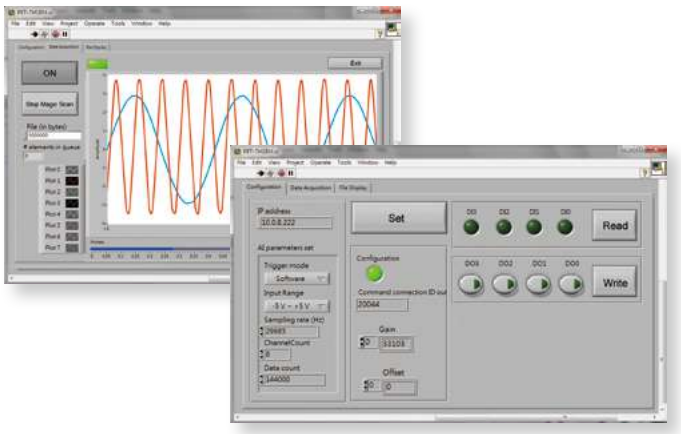
❺ Software support

1. Microsoft VC, C#, VB.NET SDK API and Demo

2. LabVIEW Toolkit and Demo

3. C/C++, .Net Library and Demo for Linux

4. Support Python Demo



PET Series Selection Guide:

Model	PET-7H16M	PET-7H24M	PET-AR400
Analog/IEPE Input			
Channels	8 (Single-ended)	4 (Differential)	4
Input Range	±10 V、±5 V	±10 V、±5 V、±2.5 V、±1.25 V、±0.625 V、±300 mV、±150 mV、±75 mV、±40 mV、±20 mV	±10 V
Resolution/ Sampling Rate	16-bit / 200 kS/s	24-bit / 128 kS/s	
AD Trigger Mode	Software/Analog Input/ External Clock Trigger/ Digital Trigger	Software / Analog Input Trigger	
Excitation Current	N/A	N/A	4 mA (Configured by Jumper) (IEPE: 24 V)
Input Coupling			AC / DC Coupling (Configured by Jumper)
Analog Output			
Channels	2	N/A	N/A
Type	±10 V、±5 V、0 ~ 5 V、0 ~ 10 V		
Encoder Input			
Encoder Mode (Max.)	Quadrant Counting: 2 MHz; CW/CCW: 6 MHz; Pulse/Dir: 6 MHz	N/A	N/A
Counter	32-bit		
Digital Input/Output			
DI Channels/Type	3 x DI (Wet Contact)	4 x DI (Wet Contact)	N/A
DO Channels/Type	4 x DO (Sink)		
Other			
Comm. Interface	1 * RJ-45 · 10/100 Base-TX PoE		
Input Voltage Range/ Consumption	+12 ~ +48 VDC / 2.6 W		
Dimensions (mm)	76 x 120 x 38 (L x W x H)		

SG-3037 / SG-3227 Selection Guide:

Model	SG-3037	SG-3227
Analog Input for Accelerometer		
Channels	3	2
Wiring	5 wires	Differential
Signal	Voltage	IEPE
Type	0 ~ 24 V	0 ~ 28 V
Gain	-	x1 / x10 / x100
Bandwidth	50 kHz	x1 / x10 Gain : 80 kHz x100 Gain : 50 kHz
Accuracy	±5% of FSR	
Excitation Voltage	24 V	-
Supported Accelerometer	iSN-703-F1-L015 (3-Axis) x 1	iSN-701-F15-L030 (1-Axis) x 2
Analog Output		
Channels	3	2

Accelerometer

iSN-701-F15-L030
iSN-701-F15-L060
1-Axis accelerometer

iSN-703-F1-L015
3-Axis accelerometer

iSN-701-Mbase01
Magnetic Base

iSN-703-Mbase01
Magnetic Base

Introduction:

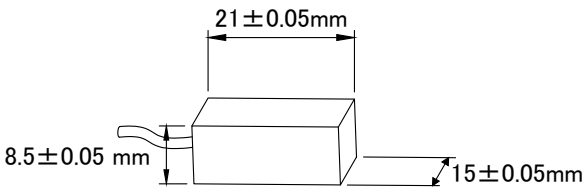
iSN-701-F15-L030 and **iSN-703-F1-L015** are high sensitivity accelerometer sensors. iSN-701-F15-L030 is 1-axis IEPE accelerometer, and iSN-703-F1-L015 is a triaxial accelerometer that simultaneously measures vibration in three orthogonal axes. These sensors are designed primarily for vibration analysis applications.

Selection Guide:

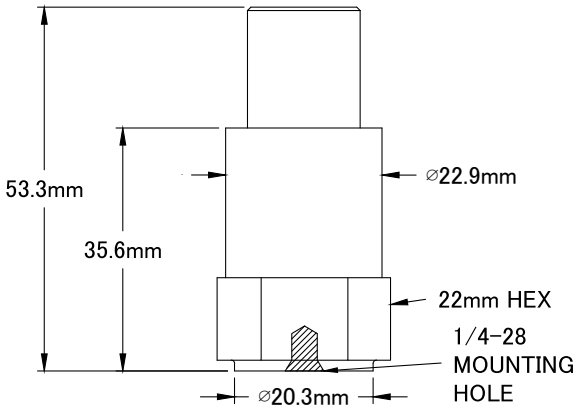
Model	iSN-701-F15-L030 iSN-701-F15-L060	iSN-703-F1-L015
Type	1-Axis (IEPE)	3-Axis
Sensitivity	100 mV/g	400 mV/g
Frequency Response	0.5 Hz ~ 15 KHz	10 Hz ~ 1 KHz
Measuring range	±80 g	±18 g
Bias Voltage	10 ~ 14 VDC	10 ±0.5 VDC
Power		
Voltage	18 ~ 30 VDC	22 ~ 26 VDC
Current	2 ~ 10 mA	3 mA
Mechanism		
Cable Length	3 M / 6 M	1.5 M
Magnetic Base	iSN-701-Mbase01 (Optional)	iSN-703-Mbase01 (Optional)

Dimensions:

iSN-703-F1-L015



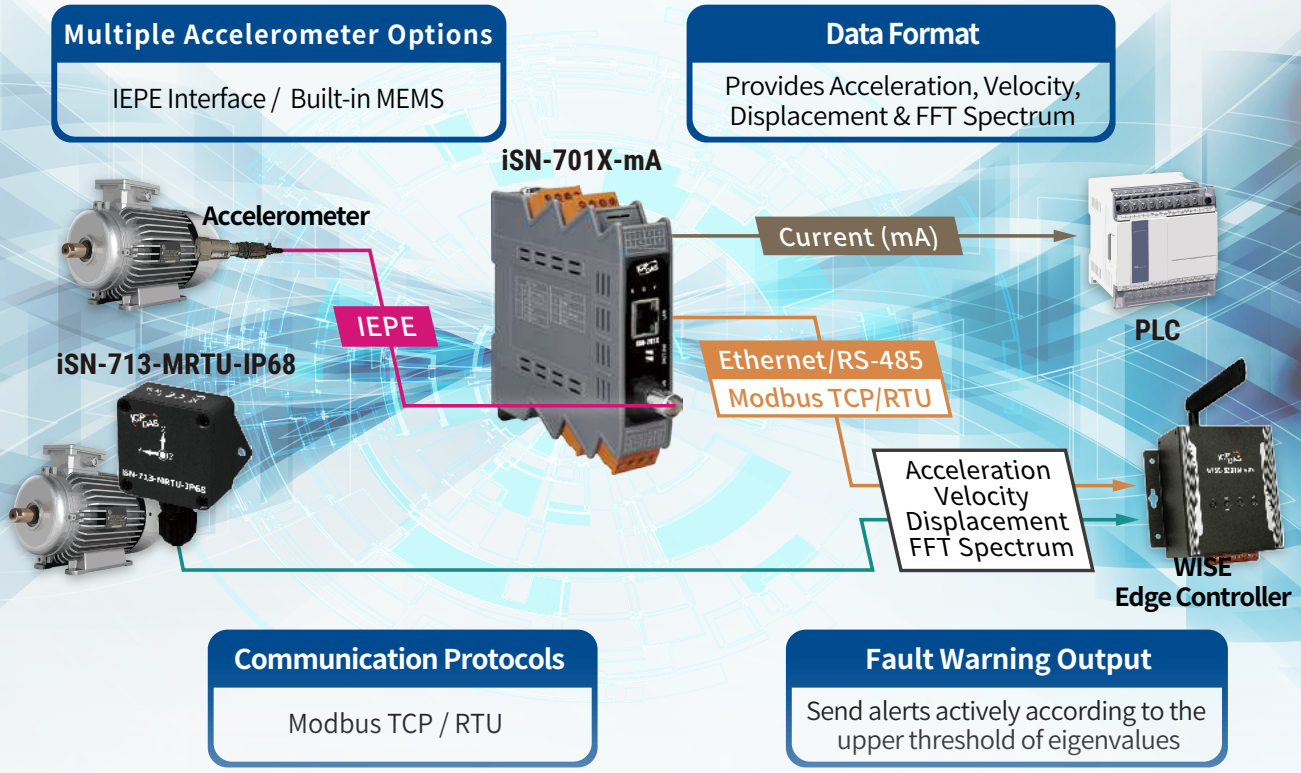
iSN-701-F15-L030
iSN-701-F15-L060



3. Wired Vibration Measurement of Auxiliary Equipment

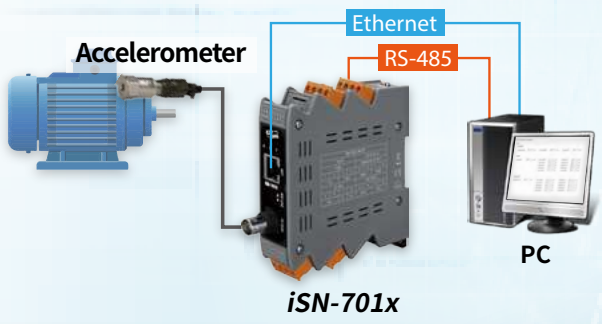
Features:

The iSN-700 series is a vibration detection device that allows users to monitor the vibration status of their equipment by selecting either an external IEPE accelerometer or an built-in MEMS accelerometer, depending on their needs. The modules support Modbus RTU or Modbus TCP protocols that can be used to read the computed Eigenvalues and FFT spectral values through Modbus commands for subsequent vibration data analysis.



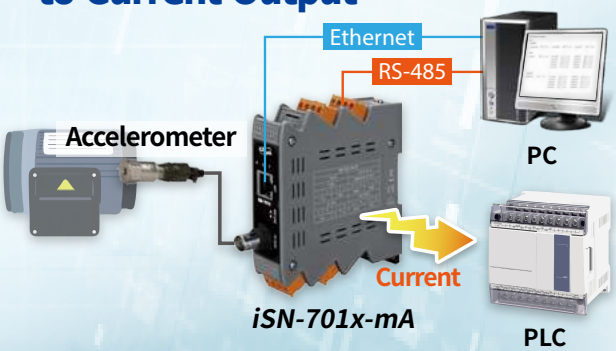
Architecture:

❶ Single-Channel Data Acquisition



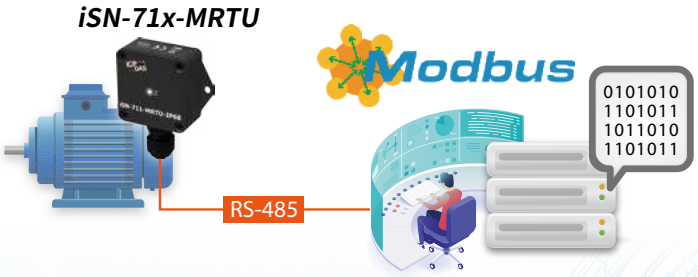
- Single-channel high-speed (64 kHz) data acquisition.
- Supports IEPE accelerometer with high accuracy and excellent interference immunity.

❷ Convert Vibration Eigenvalues to Current Output



- Vibration signal value can be converted to current signal output.
- Integration of conventional analog control devices.

❸ Vibration Communication Integration

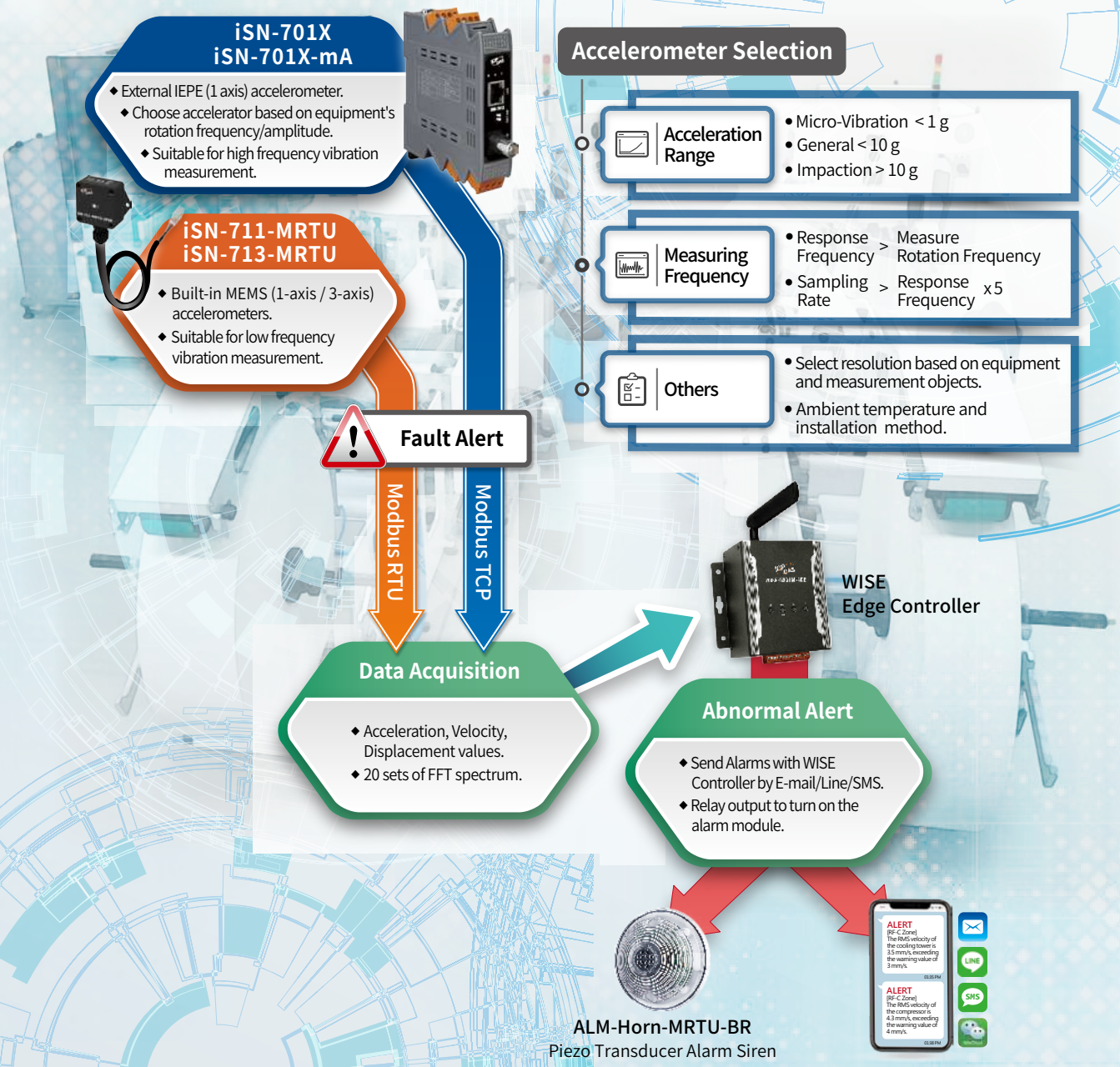


▲ Real-time vibration data acquisition

▲ Trend Chart & Spectrum Analysis

- Vibration measurement module with built-in MEMS accelerometer for easy installation.
- Read the vibration eigenvalues and FFT spectrum via the Modbus RTU protocol.

Application:



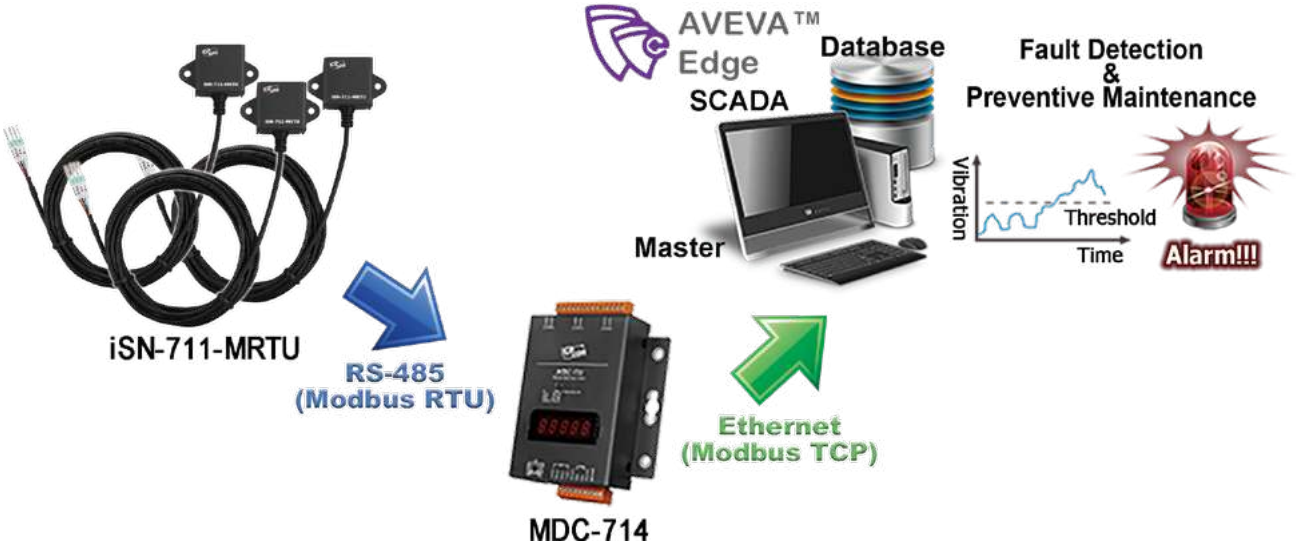
Modbus RTU Vibration Sensor

Features:

- 1-axis/3-axis vibration measurement
- Frequency range: 10 Hz to 1K Hz
- Data Format: Acceleration, Velocity, Displacement, FFT spectrum, etc.
- Supported Modbus RTU Slave protocol

iSN-71X-MRTU/iSN-71X-MRTU-IP68

Model	iSN-711-MRTU	iSN-711-MRTU-IP68	iSN-713-MRTU	iSN-713-MRTU-IP68
Vibration Measurement				
Data Format	Acceleration (RMS, Max, P-P) / Velocity (RMS) / Displacement (P-P) / FFT spectrum value / Crest Factor			
Sensor Type	1-axis MEMS		3-axis MEMS	
Amplitude Range	±8 g			
Frequency Range	10 ~ 1000 Hz			
COM Ports				
Ports	1 x RS-485 (D+ / D-)			
Baud Rate	2400、4800、9600、19200、38400、57600、115200 bps，N81			
Protocol	Modbus RTU			
Power				
Input Range	+10 ~ +30 VDC			
Consumption	0.3 W			
Mechanism				
Dimensions (mm)	51 x 30 x 19 (W x L x H)			
Protection	IP30	IP68	IP30	IP68
Installation	Wall/Magnetic mounting			
Environmental				
Temperature	Operating: -25 ~ 75 °C / Storage: -30 ~ 80 °C			
Humidity	10 ~ 95% RH, Non-condensing			



iSN-701X/iSN-701X-mA

Features:

- Dynamic range: ±10V
- Built-in 4 mA excitation current
- Support multiple sampling rate
- Data Format: Acceleration, Velocity, Displacement, FFT spectrum, etc.
- Support Modbus TCP/RTU slave protocol

Model	iSN-701X	iSN-701X-mA
Analog Input		
Vibration Measurement	Acceleration (RMS, Max, P-P) / Velocity (RMS) / Displacement (P-P) / FFT spectrum value / Crest Factor	
Channel	1	
Resolution	24 bit	
Sampling Rate	32 / 64 kHz	
Dynamic Range	±10 V	
IEPE	4 mA	
Connector	BNC or 4 pin terminal (IEPE+, IEPE-, RAW+, RAW-)	
COM Ports		
Interface	1 x RS-485, 1 x Ethernet 10/100 Base-Tx	
Baud Rate	Up to 115200 bps	
Protocol	Modbus TCP server / Modbus RTU slave	
Analog Output		
Current	N/A	4 ~ 20 mA; 0 ~ 20 mA
LED		
LED Indicator	PWR, IEPE, DAQ	
Power		
Input Range	+10 ~ +30 VDC	
Consumption	4.3 W	
Mechanism		
Dimensions (mm)	25 x 120 x 117 (W x L x H)	
Installation	Wall-mounting	
Environmental		
Temperature	Operating: -25 ~ 75 °C / Storage: -30 ~ 80 °C	
Humidity	10 ~ 95% RH, Non-condensing	

Accessories:

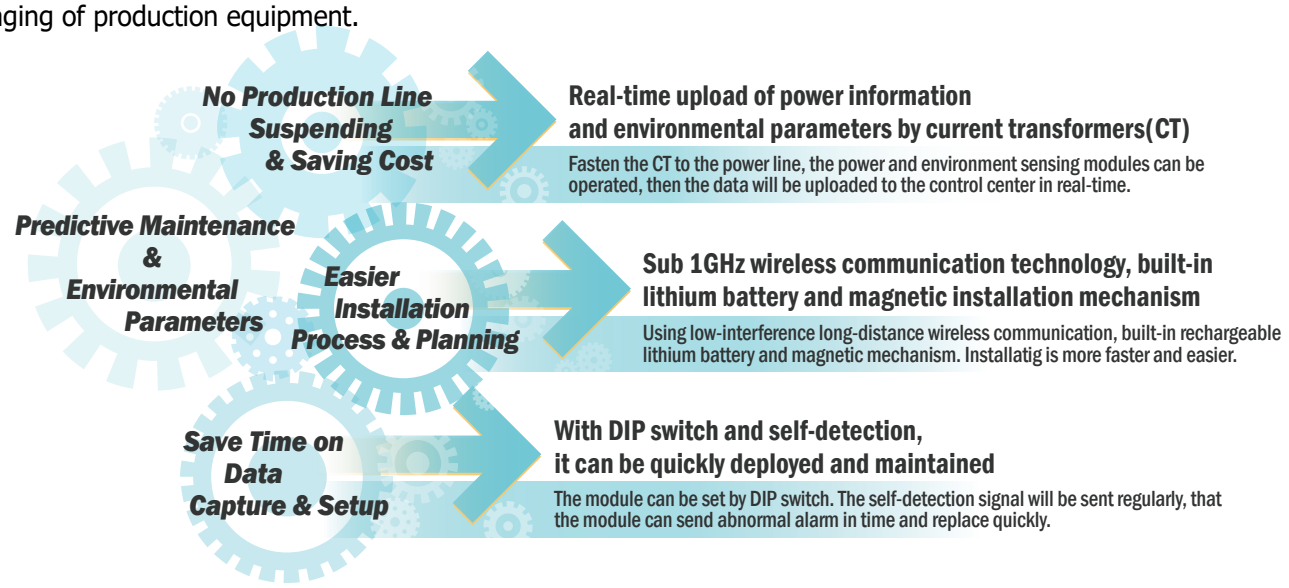
iSN-701-F15-L030

1-Axis MEMS

3. Vibration Measurement of Auxiliary Equipment

Overview:

With the trend of smart manufacturing and flexible manufacturing, the production process is becoming more and more sophisticated, and each production stage is interlinked. Adopting the concept of predictive maintenance, the health status of the equipment can be estimated to maintain the smooth operation of the production line. To meet the needs of Internet of Things, big data analysis, Industry 4.0 and energy saving, ICP DAS developed the "Industrial Wireless Sensor Data Network Solution". In addition to integrating vibration, temperature measurement, and wireless transmission functions into a single module, it features low power consumption and can be used with current transformer (CT) inductive charging function. The supply and demand of working power are balanced to achieve continuous and uninterrupted power data measurement. The settings can be completed by using a DIP switch, so that the production process will not be interrupted, and can greatly save system construction time and reduce maintenance costs. By monitoring equipment vibration status, performing predictive maintenance and equipment temperature monitoring, it is helpful for maintaining production line, avoiding accidents and unexpected shutdowns caused by mechanical aging of production equipment.



Comparison Table of Measurement Methods

Item	High speed vibration DAQ module	iXN series
Functions	Measured Vibration Parameter (IEPE)	Measured Vibration Parameter (MEMS). Expand temperature, humidity, CO2e, TVOC, CO, thermal imaging and other data.
Frequency	5 ~ 200 kHz	10 ~ 500 Hz
Power	DC requires additional transformer	CT charging, battery storage or external power supply
Power consumption	100% (4.3 W)	0.3% (20 mW)
Parameter Settings	Utility / Built-in setting program	DIP switch
Cost	Normal	Low
Disadvantage	Takes a long time, the system needs to be powered off.	Simple functions, low data update rate.
Applications	High speed vibration monitoring system, equipment operation quality analysis	Big data analysis, system monitoring, trend analysis, predictive maintenance

Advantage of iWSN Wireless Series:

Wireless Sensing Data Acquisition Solution proposed by ICP DAS integrates wireless transmission functions and various data measurement, such as current, vibration, temperature and humidity, thermal imaging, into one module. The ultra-low power consumption of this series of products can be matched with CT inductive charging. When the power supply is appropriate, the supply and demand balance is achieved, and the data is continuously measured. Then, transmit the data with low frequency and low interference manner.

Key Technology

Predictive Maintenance

Now a day most maintenance in a factory can fall into two groups: run-to-failure maintenance or planned maintenance. Run-to-failure is where an asset is allowed to run until it breaks before repair or replace. However, the losses caused by downtime or production stoppages may exceed the cost of maintenance. For planned maintenance, the cycle of maintenance is set based on previous experience or performed at scheduled time, however, the environmental differences (such as extreme weather) and the yield factor of replaced equipment cannot be taken into account. Also the different production line utilization rate may result in waste of unnecessary maintenance.

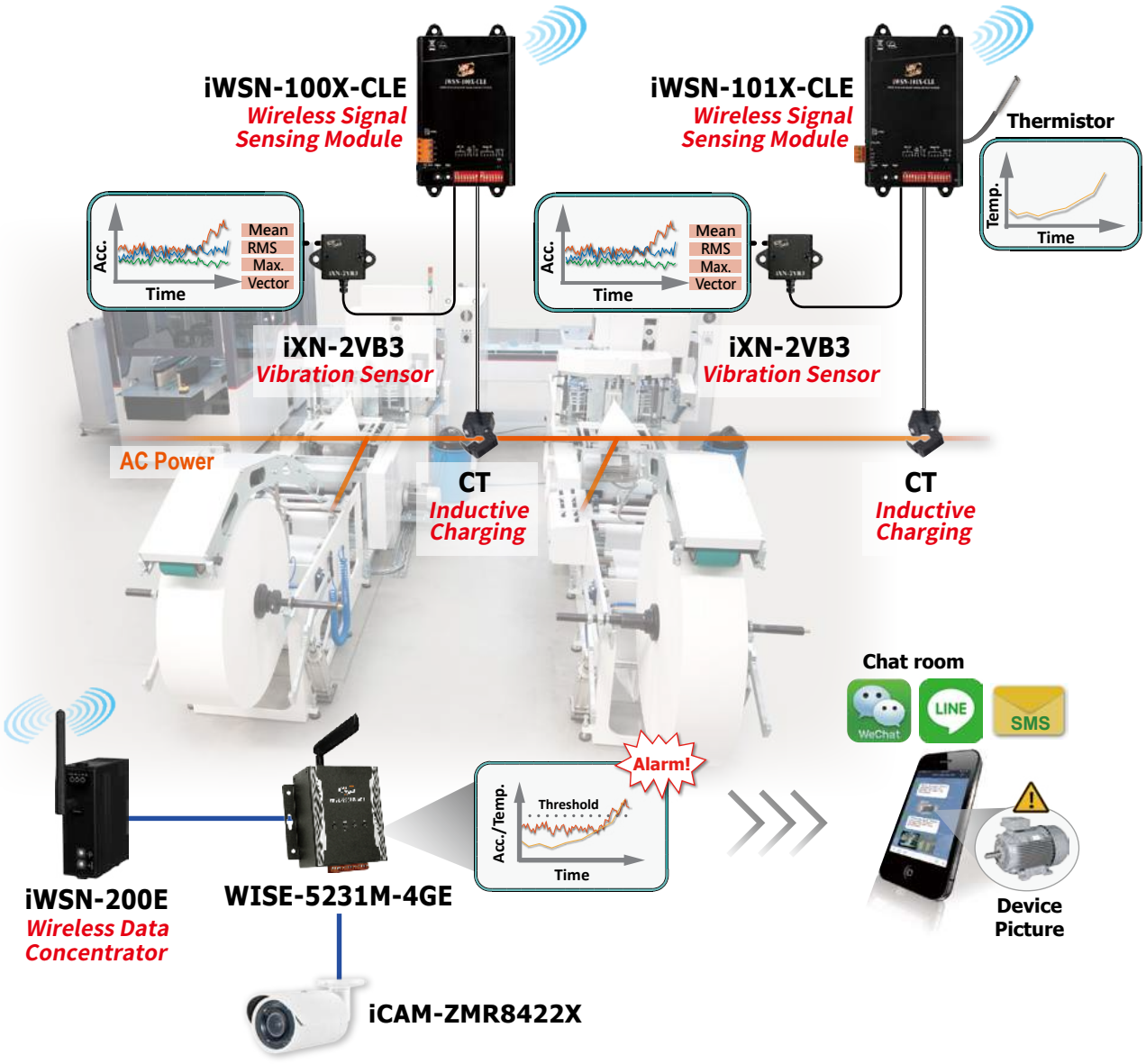
Predictive maintenance has been gaining significant attention over recent years. The main purpose is to prevent equipment failure due to component fatigue, personnel factor or equipment wear before the maintenance being performed. In the early stage of the introduction of the predictive maintenance system, most of them will first introduce analysis technologies in data of vibration, power, and ambient temperature & humidity, etc. It is because solutions can be quickly found through the above basic data when encounters problems in equipment or processes. Through the front-end sensors, with analytics software we can predict when a machine will fail, understand where the damage is, and schedule maintenance at most appropriate time.

1. **Estimate the time of equipment damage and avoid resource waste and unnecessary downtime.**
2. **Arrange the most suitable maintenance time.**
3. **Avoid unexpected downtime, identify the damage location.**

Applications:

In order to maintain normal production operations in factories, regular maintenance must be performed on important equipment. In the past, the vibration data is obtained by on-site inspection; the equipment is regularly checked one by one in a regular route. The data is manually recorded on papers which is labor-intensive, time-consuming and error-prone. The data is not easy to retrieve and analyze, and duplicate measurements or inappropriate inspections may occur.

iWSN Vibration Sensor Series uses **iWSN-100X-CLE/iWSN-101X-CLE** and **iXN-2VB3** with thermistor for measuring vibration of the device and temperature detection. The data of vibration/temperature can be long-term recorded and then effectively solve the reliability issue that on-site inspection may involve. Its self-powered wireless design makes it easy to be installed and maintained. The onsite personnel can also set the limit range via WISE series IIoT Edge Controller so that when the collected data exceeds the range of the limit, the alarm message or image of the device can be sent via SMS or LINE/WeChat groups immediately. The control center or related personnel can be notified in real time and estimate or arrange when maintenance should be performed.



Wireless Data Concentrator

iWSN-200x

Antenna Base:
ANT-Base-02

External Cable:
3S001-1

Features:

- 433 MHz Radio Frequency
- 16 RF Channels
- Support Modbus TCP/RTU Protocol
- Temporary storage for 31 sets of iWSN wireless signal sensing modules
- ESD Protection: +/- 4 kV Contact
- Isolation: 3000 VDC for DC-to-DC, 2500 Vrms for photo-couple

Model	iWSN-200U	iWSN-200R	iWSN-200E
RF Interface			
Radio Frequency	433 MHz		
RF Channels	0 ~ 15 (Configured by DIP switch)		
Transmission Distance	LoS 100 M		
Connectivity	Supports up to 31 iWSN wireless signal sensing modules		
Communication			
Interface	RS-232 or RS-485 x 1 (Cannot be used simultaneously)	RS-485 * 1	Ethernet * 1
Protocol	Modbus RTU		Modbus TCP
Relay Output			
Channels	-	1 (Form A)	-
Contact Rating	-	5A @ 250 VAC / 30 VDC	-
Others			
Input Voltage Range	10 ~ 30 VDC		
Dimension (mm)	108 mm x 84 mm x 33 mm (Without antenna)		
Installation	DIN-Rail Mounting		
Operation Temp.	-25°C ~ +75°C		

Wireless Signal Sensing Module

The iWSN wireless environment sensing module is suitable for measuring various signals, such as temperature, humidity, CO2e, TVOC, CO and vibration. In addition, it can also be widely used in energy saving, big data analysis and predictive maintenance applications.

Features:

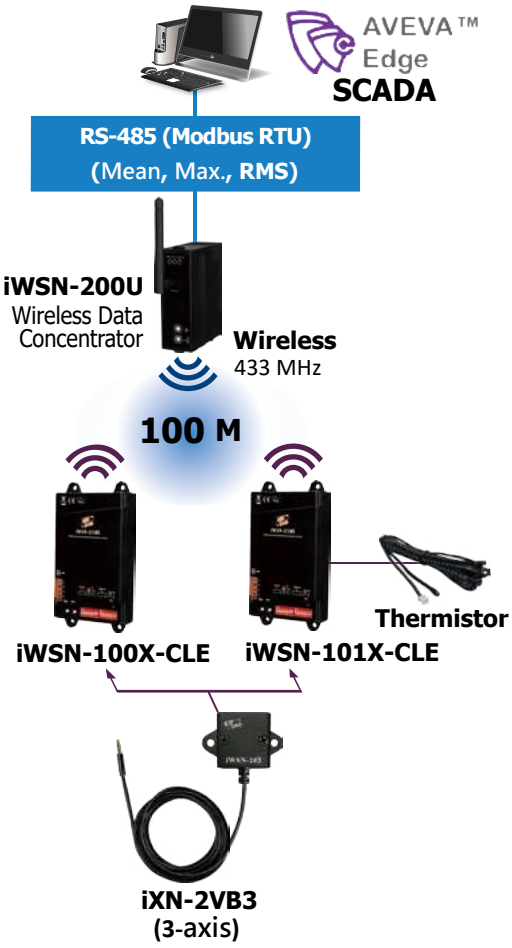
- Built-in a chargeable Li-ion battery, and energy harvest from the CT induced electricity
- Split-core CT for easy installation
- Uses 433 MHz RF communication
- CT induced current or DC power supply
- Wall-mount mechanism and magnet for installation

iWSN-100X-CLE / iWSN-101X-CLE

Model		iWSN-100X-CLE	iWSN-101X-CLE
RF Interface			
Radio Frequency		433 MHz	
RF Channels		0 ~ 15 (Configured by DIP switch)	
Transmission Distance		LoS 100 M	
Working Duty		1 / 10 / 30 / 60 sec., and 3 / 5 / 10 / 30 min. (Configured by DIP switch)	
Temperature Measurement			
Channels		-	1
Range			0 ~ + 80°C
Accuracy			±2°C
Power			
Split-Core CT	Channel	1	
	Input Voltage	50Hz/60Hz, under 500V	
	Input Type	Φ16mm (100A); Φ24mm (200A); Φ36mm (400A); For charging only	
DC Power Supply		1 ~ 3 VDC · 1 A	
Mechanism			
Dimension (mm)		152 x 85 x 25 (L x W x H)	152 x 94 x 21 (L x W x H)
Installation		Wall / Magnetic mounting	
Others			
Battery		Li-ion battery (Compliant with UL1642) charged by CT induced current	
Operation Temperature		0°C ~ +45°C	
Expansion Interface		Y (Support iXN-0TH, iXN-0VOC, iXN1CO, iXN-2VIB1, iXN-2VIB3)	

iXN Vibration Sensor

Model	iXN-2VB3 3-axis Vibration Sensor
Product Picture	
Sensing Parameter	
Type	3-Axis MEMS
Rate	10 Hz ~ 500 Hz
Range	±8 g
Output Interface	
Data Type (g)	X, Y, Z axes of the RMS, Maxumum, triaxial vector value
Mechanism	
Dimension (mm)	51 x 30 x 15 (L x W x H)
Installation	Wall/Magnetic mounting
Cable Length	1.5 M
Others	
Operation Temperature	-25°C ~ +75°C



PAC 9000 Series

- AXP/ALX-9000 Series
- XP-9000-WES7/ XP-9000-IoT/ LX-9000/LP-9000 Series
- e-9K Series Module
- I-9K Series Module
- 2000 Series PAC
- iBPC Series BoxPC
- Touch Monitor

IIoT Product

- IIoT Cloud Management Software (IoTstar)
- IIoT Edge Controller (WISE-5231 Series)
- IP Camer (iCAM Series)
- IIoT Communication Server (UA-5200 Series)
- MQTT I/O Module (MQ-7200 Series)
- Stack Light Monitoring Module (tSL S eries)

Energy Management Solution

- InduSoft SCADA
- Power Meter Concentrator
- IIoT PMC with Display
- Three-phase Smart Power Meter
- Single-phase Smart Power Meter
- Multi-circuit Smart Power Meter
- True RMS Input Module
- Smart Power Meter with LED Display

IIoT Cloud Solution - UA SERIES : IIoT Communication Server

- Built-in OPC UA Server Service
- Built-in MQTT Broker Service
- Support Logic Control IFTT
- Support IoT Cloud Platforms
- Connection and IoTstar Cloud Management
- IIoT Factory Application of MES
- Pumping Station IoT Application
- BA Smart BuildingIoT Application
- Robotic Arm Co-operation Application

Intelligent IIoT Edge Controller & I/O Module

- WISE IIoT Edge Controller & I/O Module
- Cloud Management
- Applications
- Product Specifi cation
- Intelligent Surveillance Solution

Smart Building, Smart Home Automation

- Video Intercom & Access Control
- Touch HMI - TouchPAD Series
- Smart Lighting Control
- Energy Saving - PM/PMC Series
- Environmental - DL/CL Series
- Motion Detector - PIR Series
- Wi-Fi Wireless - WF Series
- Infrared Wireless - IR Series
- ZigBee Wireless - ZT Series
- IIoT Server & Concentrator
- LED Display - iKAN Series

TouchPAD HMI Solutions

- TPD/VPD Products Series
- Video Intercom & Access Control Series
- TPD/VPD Application

Wireless Solution

- WLAN Products
- Radio Modems
- 3G/4G Products
- NB-IoT Solution
- GPS Products
- Bluetooth LE Converters
- ZigBee Products
- Infrared Wireless Modules
- Wireless Modbus Data Concentrators
- WLS (Wireless Locating System)

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