# PACTECON Automation & Technology Life Vol. 79

# IoT Builds Smart Campus Security and Energy-Efficient Environment

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Wireless Monitoring to Enhance the Efficiency of Furnace Temperature Management

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### Not Only Reduce Carbon Emissions, but also Create Higher Value by Saving Energy! Full Analysis of ICP DAS ESG Smart Factory Forum

By Digiwin Software Co., Ltd (Translated by Lynn Tang)

#### Introducing into AI to eliminate all problems? Enterprises need to have a data ammunition library

Recently, rapid changes have caused enterprises to face AI waves, net-zero pressure, foreign supply chain shifts, and labor shortages, making digital upgrading crucial. At the July ICP DAS Seminar, experts from ITRI, Digiwin Software, and ICP DAS provided incisive analysis on these challenges.

Frank Zheng, General Manager of ICP DAS, highlighted the goal of industrial upgrading. Smart manufacturing involves IoT, AI, and cloud computing integration. Due to rising climate concerns, sustainable, efficient production methods are essential. ESG intelligent manufacturing is now a dual-axis transformation trend. ICP DAS offers networking solutions, power consumption monitoring, energy management, and various technologies to help enterprises optimize processes.

Many companies think AI will immediately fix production line problems, but AI needs data to train models for accurate analysis. Thus, data becomes the "ammunition" of the future, and enterprises must first accumulate significant data and integrate IT and OT for extraction.

Frank Zheng shared a customer case where a Thai palm oil plant faced uneven feeding and unstable maintenance cycles. Manual records and monitoring by employees consumed manpower, raised safety risks, and failed to improve efficiency.

ICP DAS offers IoT-based solutions to uncover real production problems and achieve accurate management. This approach has boosted production capacity by 28% and made human resources more efficient and flexible.



▲ Frank Zheng, ICP DAS GM, analyzed ESG trends, focusing on big data, supply chain transparency, energy management, and Al.

#### Do businesses really need net zero? Regardless of carbon emissions, orders come nowhere

Intelligence is the high-speed engine for enterprise upgrading, and another driving force for dual-axis transformation is lowcarbon and energy-saving.

ESG is costly for businesses, especially SMEs. Li Hongjun of ITRI stresses that, without addressing carbon emissions, companies may struggle to find customers, secure funds, or generate revenue in the future.

With the EU CBAM, US CCA, and upcoming domestic carbon fees, SMEs must meet supply chain requirements and reduce carbon emissions to avoid losing orders. The FSC's Green Finance 3.0 plan also ties sustainability standards to financing, impacting even companies with good credit. Global carbon tax and trading impact enterprise profits through regulations, capital, and market competition. Green transformation is essential for businesses to thrive.



▲ Analyst Li Hongjun highlighted the global trend of net-zero carbon regulations.

Li Hongjun suggests improving energy efficiency to reduce costs and carbon emissions. Introducing an energy management system can help identify usage patterns and hotspots, allowing companies



▲ Key Directions for Energy Efficiency-Process Improvement



▲ ITRI illustrates the industry observation of improving energy efficiency from energy management and process improvement.

to optimize work scheduling and equipment energy efficiency, creating a win-win situation.

"Don't just emphasise that businesses must save energy, but let customers know that energy savings can create more value! Li Hongjun further shared that Taiwan already has electricity trading, and if enterprises invest in energy management, the energy saved from energy conservation can be traded in the electricity market, adding value to the company. In addition, energy management will detect leaks, which not only reduces wear and tear, but also improves safety, and can negotiate with insurance companies to reduce premiums in the future.

## Data stability is key to energy monitoring

Dingxin Computer and ICP DAS have been cooperating in energy management

solutions for many years. Wu Yuxian, consultant of Dingxin's AloT Business Department, emphasized that only when enterprises have a clear "low-carbon management" thinking can they steadily embark on the implementation path of lowcarbonization: from carbon knowledge, carbon control, to final carbon reduction.

The first step is to know carbon, collect data, and grasp the cost and structure of electricity. In terms of equipment, smart meters are installed and energy management systems are introduced to monitor electricity consumption conditions and abnormalities. From an organizational point of view, it is necessary to take stock of the electricity consumption and carbon emissions of various departments.

The second step of carbon control is to make attribution judgments on

electricity consumption and production behavior. After mastering carbon data and carbon hotspot monitoring, the next step is to integrate and compare production information and carbon data through system integration tools and machine Internet of Things, so as to analyze which production behaviors are the culprits of high carbon emissions.

The third step is carbon reduction, changing production behavior to reduce carbon emissions. From an organizational point of view, it is possible to check the waste of each department and make improvements; From a process perspective, it is necessary to think about how to optimize processes and technologies.

#### Wu Yuxian emphasized that only with a data basis can there be scientific improvement methods.

The overdrive to save energy is to replace equipment, but this is often also a high capital expenditure. If the company has a complete data collection, it can further review whether to prioritize the process improvement, or set carbon reduction KPIs for various functions and departments to reduce the organization's carbon emissions.



▲ Dingxin assists enterprises in energy management through carbon data integration tools, and ICP DAS is also an important partner.

However, in order to implement energy data collection, the quality of electricity meters and construction technology are extremely important. "One customer insisted on installing it himself, and it took a month to build five meters, and the meters burned down as soon as they were delivered," said Ng.

Professional topics also need to be solved by a professional team. In addition to the stable quality, more importantly, the lean technology of ICP DAS smart meters evaluates the number and location of installations according to customer needs and routes in the early stage, completes the most suitable monitoring, and continuously verifies the data in the later stage. "Dingxin uses a lot of ICP DAS I/O devices to assist customers in digital transformation. ICP DAS meters are also used in the energy management system, because data stability is the most important thing for us.

When smart manufacturing and ESG have become the direction of the industry's rapid catch-up, the key to AI application, energy management or low-carbon transformation lies in accurate data collection and analysis. If enterprises can grasp the data and use new technologies and new thinking, they will have the opportunity to break through the competition and achieve sustainable development.

#### Article source:

**DigiKnow** https://www.digiknow.com.tw/ knowledge/6699f2967c850

## The Internet of Things Builds a Safe and Energy-Saving Environment for Smart Campuses

A smart campus uses big data, IoT, and cloud technologies to digitalize teaching, management, community, energy, and security. This improves efficiency, records user habits, and promotes personalized services for better user interaction.

By Eugene Chen (Translated by Lynn Tang)

A smart campus, unlike traditional campuses, includes environmental perception, seamless connectivity, big data analysis, efficient resource use, and personalized services. ICP DAS integrates digital environmental control and energysaving applications into school systems, reducing paper waste, conserving energy, and automating tasks. This shift frees up manpower for more creative educational endeavors.

The system addresses safety, management, and energy-saving needs by enhancing equipment power consumption monitoring, campus safety inspections, and public facility utilization. It provides real-time data on people and equipment, ensuring

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teacher and student safety. Applications include ranging, human body sensing, air quality monitoring, power measurement, emergency distress systems, edge computing, and big data analysis to improve manpower load, energy control, and real-time issue handling.

## A description of existing problems on campus

#### Classroom lighting, air-conditioning and teaching equipment

After classes, forgetting to turn off devices such as lights, air conditioners, projectors, or TVs leads to energy wastage.

#### Parking lot occupancy and safety

Unclear basement parking availability and lack of scheduled ventilation reduce usage and increase equipment energy consumption.

#### Campus Safety

Unauthorized individuals hiding in

#### **Documentary of smart campus improvements**

bathrooms or staying can cause property damage and safety risks.

#### Conference room and auditorium environment

Air conditioning temperature, lighting brightness, and air quality affect attendees' concentration, leading to low meeting efficiency.

	Traditional Campus	Smart Campus
School administration	Scheduled inspections increase admin workload.	Digitized environmental info manages equipment based on actual conditions, reducing manual needs.
Analyticability	Manual or timed switches can't adapt to changes in climate, load, or usage patterns.	24/7 recording adjusts automatically based on climate, time, and usage analysis.
Abnormal reaction speed	Unresponsive to emergencies or anomalies.	Real-time alerts for anomalies notify relevant personnel to handle them.

#### Smart campus application field

#### Temperature monitoring in hazardous areas

- Non-contact temperature measurement
- · Central kitchen temperature monitoring
- · Laboratory hazardous chemicals monitoring
- **Energy Saving Analysis Appli**cations
- · Regional electricity consumption measurement
- · AC and lighting anomaly detection
- · Power demand analysis and cost control

#### Vacant Room Monitoring and Protection

- · Highly sensitive area human detection
- · Linked monitoring of vacant room status
- · Security at specific times/locations



- IAQ monitoring and recording
- Temp/humidity monitoring linked to AC
- Harmful gas monitoring in enclosed spaces
- · Wireless call-for-help system w/o wiring
- Safety protection for campus corners · Continuous proactive reporting system

### ment

- Non-contact distance measurement
- Personnel or parking space detection
- Waste collection/storage monitoring



# Energy-saving application solutions for smart classrooms

Smart classrooms use environmental control and network tech to meet teaching needs, providing assistance, interaction, and energy-saving, creating a digitalized campus.

The system optimizes classroom air conditioning by analyzing sensor data like temperature, humidity, gas indices, and electricity usage. It adjusts modes and shuts down inactive equipment automatically. Network connectivity allows monitoring by security or control rooms, reducing manual patrols and achieving convenience and energy savings.

ICP DAS Technology Import includes:

 The CL-203-E measures environmental parameters including temperature, humidity, carbon dioxide (CO2), and carbon monoxide (CO).

- 2. The PM-3114-100-MTCP meter captures the current electricity usage in each distribution panel area.
- 3. Multiple PIR-234L sensors detect classroom activity with no blind spots.
- 4. The IR-712-MTCP controls infrared devices like air conditioners and projectors.

The WISE-5231M edge controller integrates data for equipment management and alarms for remote anomalies. It shuts down unused equipment and adjusts temperature via infrared control, preventing power waste and reducing manual intervention.



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WISE-5231M IIoT Edge Controller

iWSN-200R Wireless Concentrator

iKAN-116 Industrial LED Display

## Smart parking and safety management

In smart parking management, "parking spaces" are key for IoT, enabling real-time monitoring of availability. Ensuring air quality and addressing security blind spots in parking areas is vital for campus safety, protecting the well-being of teachers and students.

This project uses sensor tech and edge computing for campus parking management and environmental quality monitoring. Includes:

- The iSN-301H uses Time-of-Flight (ToF) ranging technology to detect the parking status of each space and controls the indicator lights via relay output.
- The CL-203-E measures the environmental quality in real-time, including temperature, humidity, carbon monoxide (CO), and carbon dioxide (CO2) levels.

 The iSOS-100 emergency button, paired with the iWSN-200R concentrator, uses wireless communication for quick deployment in security corners throughout parking areas within the wireless signal coverage.

The WISE-5231M edge controller integrates the aforementioned sensor data and displays parking space status on the iKAN-116 display. When air quality is poor, it activates the tM-R5 relay module to ventilate. In emergencies, the system alerts the security office via internet, SMS, or Line. This system manages parking, energy-saving ventilation, and ensures environmental safety.

#### Summary

ICP DAS integrates sensing, communication, and monitoring into a smart campus platform, improving safety, optimizing energy use, and achieving carbon reduction.

## Harnessing Sub-GHz 433MHz Perfectly Overcome Communication Difficulties

The Sub-GHz 433MHz RFU-433 wireless modem solves 2.4GHz band issues in concert halls, ensuring stable temperature/humidity/power data transmission. Integrated with IoTstar cloud software, it provides data visualization and real-time alerts for optimal instrument storage.

By Evanna Lin (Translated by Eva Li)

"Sub-GHz" and "2.4GHz" are the most common frequency bands in RF wireless communication. The 2.4GHz band, crowded with Wi-Fi, Bluetooth, and ZigBee devices, was initially planned for the concert hall but had frequent communication issues.

After on-site testing, the ICP DAS team chose the self-developed Sub-GHz 433MHz modem, RFU-433, for its strong signal penetration and noise resistance. It can switch to relay mode to extend signals in weak areas, transmit temperature and humidity data to the control room, and resolve 2.4GHz issues. The customer found the system simple and stable. Later, they used RFU-433 to monitor power across different areas and added IoTstar cloud management software for data visualization and other solutions.

#### **Concert Hall Instrument Preservation Monitoring**

## Temperature and Humidity Control Needs

Temperature and humidity are key for preserving instruments. The ideal range is 18-24°C with 40%-60% humidity, stabilizing components and extending lifespan. Traditional methods, like air conditioning and dehumidifiers, may still cause moisture-related maintenance issues, especially for large instruments like organs and pianos.

#### Harsh Communication Environment

This case is not only for temperature and humidity data collection. The concert hall includes many performance areas and instrument storage rooms with soundproof walls and metal doors. Wirings are difficult to install, and wireless communication like 2.4GHz Wi-Fi has short range, high signal loss, and weak penetration issues due to soundproofing.

#### Helping Concert Halls Conduct Visual Management of Temperature and Power

ICP DAS went to the concert hall to conduct on-site inspections and specific needs and proposed a wireless data management solution.

1. Each site has a remote data logger

DL-302 to collect temperature and humidity, and on-site staff can check the values easily on its touch screen.

- The RFU-433 wireless modem can remotely transmit data from each area to the control room. It features 433MHz Sub-GHz RF technology, long-range transmission, strong penetration, and minimal signal loss, to overcome obstacles like soundproof walls and metal doors.
- 3. The control room uses a PMC-5231 controller to record temperature and humidity data from each area. Integrated with IoTstar cloud software, IT staff can visualize data on a dashboard and monitor real-time conditions across areas. The system will auto-send alerts via Line to the mobile phone if there are anomalies. This helps maintain consistent conditions, reduce risks, and ensure optimal preservation of high-value instruments.



In addition to temperature measurement, ICP DAS supports power monitoring by transforming consumption data into a visual interface. Charts and comparison tools help customers quickly understand power usage and analyze differences across areas over the same period.

## RSSI Received Signal Strength Detection

RSSI is an indicator value that measures the signals wirelessly. Signal quality is measured in dBm (decibels mill watts) and displayed as a negative value. A signal value closer to 0 indicates higher quality, and a larger negative value indicates poorer signal quality.

RSSI is affected by distance, building

materials, objects, interference, etc. The best way is to conduct on-site testing in different environments with different wireless signal coverage. For RFU-433 testing, the communication quality should be at least better than -71dBm.

Since Sub-GHz cannot be used with common Wi-Fi signal testing software. ICP DAS provides two ways for customers to test the quality of their communication.

1. Prepare two RFU-433 with 1 computer to read RSSI packet values.

Enable the RSSI test mechanism by RFU-433 utility, the RSSI data is in the wireless data packet, which ranges from 0x00 to 0xFF, where 0xFF is the best value of the signal. Users can read this data and convert it to dBm using

0.01 0.02 0.02 0.04

Rx			UX	0x75
Tx RS-232 RFU-433 (RSSI Data Disable)			Ox	RFU-433 PC (RSSI Data Enable) 01, 0x02, 0x03, 0x04, 0x63, 0x75
	<b>RSSI Data</b>	dBm	lcon	Strength Description
	0 ~ 89	< -85	¥))	Unable to connect or invisible
	90 ~ 119	-85 ~ -71	((1-	Most of the connects are disabled, visible
	120 ~ 159	-71 ~ -53	((t-	Connectable, unstable
	160 ~ 199	-53 ~ -35	((	Normal use
	200 ~ 255	> -35	((1-	Strong signal, best experience

•RSSI Data To dBm Formula : dBm=-123+(RSSI Data \* 0.457)

▲ Enable the RSSI test mechanism by RFU-433 utility

the following formula to judge the signal quality.

2. Prepare two RFU-433 and RF signal measurement modules, and check the signal strength by mobile phone.



The tWF-RF-Sniffer, developed by ICP DAS, tests RF communication quality. It automatically interprets RFU-433's RSSI data and converts them to dBm. With Wi-Fi connectivity and a built-in web server, it displays live signal strength intuitively using standard icons. Users can check RF quality via a mobile phone or any Wi-Fi-enabled device.

#### RFU-433 Module, The Ideal Choice for Efficient Wireless Communication

ICP DAS offers comprehensive industrial control solutions for monitoring analog and digital signals, including power, vibration, and environmental data. These solutions support remote monitoring, controllers, and system integration across various industries.

RFU-433 converts RS-232 and RS-485 into wireless communication using transparent transmission. It offers a LOS range of up to 500 meters at 9600bps, with strong signal penetration, anti-noise, and interference immunity for IoT, smart home, smart city, and industrial control applications. RFU-433 reduces system construction time and maintenance costs, making it a reliable solution for wireless communication in harsh environments.

ICP DAS						
tWF-RF-Sniffer Tiny WiFi RF Device RSSI Sniffer						
IP:192.168 Location:	3.77.1 MAC:00:0D:E0:A4:5F:C4 RSSI: -25dBm Not Set!!					
(i)	6					
	RF RSSI					
	RSSI Master	(((•	-33.5dBm			
	RSSI Slave	<b></b>	-45.5dBm			
	Polling		Polling RSSI			
	Init Config Device					
	Device	RFU-400	O LRA-900			
	Channel	00				
	Power	15				
	Init Mode Action	RSSI Enable	RSSI Disable			

▲ tWF-RF-Sniffer web operation screen

## Wireless Monitoring to Enhance the Efficiency of Furnace Temperature Management

Effective furnace temperature monitoring is crucial in modern factories. ICP DAS's wireless solution, using the iWSN module and GRP-540M-4GE gateway, enables real-time data transmission, automated measurement, and remote monitoring. It improves safety and efficiency and reduces wiring costs, with 4G expansion offering future scalability.

By Bao Huang (Translated by Carol Hsu)

In steel plants, monitoring equipment is important for maintaining product quality in dangerous environments with high temperatures, heavy machinery, and dust. Semi- or fully automated systems ensure safe, consistent production while reducing workplace risks. Real-time updates to the control room enable timely maintenance, extending equipment life and preventing downtime.

#### The operation of plant equipment is a key issue that cannot be ignored

Effective furnace temperature monitoring is crucial in steel production. Failure to do so can lead to issues like improper hardness and toughness, resulting in substandard steel quality. Overheating wastes energy increases costs, accelerates furnace wear, and raises maintenance needs, reducing productivity. In extreme cases, it may cause explosions or molten metal leaks, leading to accidents and injuries.

#### Breakthrough Ways! Wireless Temperature Monitoring Solutions

ICP DAS offers a wireless temperature monitoring solution for steel plants, compatible with 4~20mA signal temperature sensors. This system, combined with a wireless data concentrator and data logger, transmits temperature data to the control room, reducing wiring costs, automating measurement and logging, and enabling problem and product history tracking. Following is an overview of its application in steel plants.

#### Challenging customers' complex needs for furnace temperature testing

In a traditional steel plant, furnace temperatures are measured and recorded by staff, then entered into a computer, which is inefficient and prone to errors. The customer requests a solution using 4~20mA temperature sensors for automatic measurement, wireless data transmission, real-time remote monitoring, and data logging.

The client's plant has two furnace temperature measurement points: one on the second floor and one in the basement. The furnace temperatures must be centralized on the first floor for easier transmission to the control room.



 Diagram of Furnace Temperature Measurement Points

#### How ICP DAS Revolutionized Furnace Temperature Monitoring

ICP DAS offers a solution combining the iWSN wireless module with the GRP-540M-4GE data logger to meet customer needs. The iWSN-1310-mA-ME supports three 4–20mA input channels for temperature sensor signals, which are transmitted every second via 433MHz to the iWSN-200U for temporary storage. The GRP-540-4GE reads the data from the iWSN-200U using Modbus RTU and records it on an SD card. A control room PC can then read the data from the GRP-540-4GE via Modbus TCP and convert it into furnace temperature readings.

The customer also seeks handheld devices from other manufacturers, allowing on-site personnel to connect to the nearest Ethernet device during abnormal conditions and access GRP-540M-4GE data records for analysis and troubleshooting.

#### Features and Advantages of iWSN-1310-mA-ME



#### WSN-1310-mA-ME iWSN Current Sensing Modules

◆The built-in lithium battery powers the device without wiring. The first 4-20mA channel charges the battery from the signal with 3mA or more input. This enables

long-term use of the module by balancing power consumption and charging.

 You can set it to return a signal every
 1, 10, 30, or 60 seconds. For real-time monitoring, it sends a signal per second.  Communication range: Transmits up to 100 meters, allowing easy installation adjustment based on the environment.

#### How the iWSN-200U iWSN Data Concentrator Efficiently Integrates and Stores Data



◆ The iWSN-200U supports multiple iWSN-1310-mA-MEs to store data temporarily. In this case, the iWSN-1310-mA-ME transmits one signal to the iWSN-200U in a second, so one iWSN-200U can temporarily store the signals of 4 iWSN-1310-mA-

MEs. In addition, since one iWSN-1310-mA-ME supports three 4~20mA input channels, one iWSN-200U can temporarily store up to 12 4~20mA signals  Up to 31 Modbus Slave stations can be set, with each iWSN-200U storing 12 signals, allowing 31 iWSN-200Us to store 372 signals.



#### GRP-540M-4GE 4G Gateway customized firmware and expansion features

This case uses customized firmware to provide Modbus RTU Master on the RS-485 end

and Modbus TCP Server on the Ethernet end. This allows the control room PC to read back 4-20mA signals and convert them to temperature using Modbus TCP.



- It supports logging one data per second on an SD card, which can record RTC time, 4~20mA signal, iWSN wireless signal strength, iWSN wireless packet serial number, etc. In case of Ethernet disconnection, data can be recovered once reconnected.
- It supports 4G communication with optional remote camera monitoring, allowing customers to control the site in real time.

For more details, visit the ICP DAS website (https:// www.icpdas.com/index\_tw.php) and search the module name to access its page.

#### The Future of Wireless Temperature Monitoring

ICP DAS provides comprehensive solutions and customizable firmware to meet needs in automatic temperature measurement, wireless data transmission, remote temperature monitoring, and data recording. The iWSN module draws power from the 4-20mA signal, cutting extra power and communication cable costs. It also enhances installation flexibility and allows for future 4G-based remote camera monitoring, allowing customers to monitor via video even if they are not on-site.



## From Data to Security, U-7500M Enables Comprehensive Factory Upgrade

The U-7500M provides an all-in-one factory upgrade solution, supporting OPC UA, RESTful APIs, and MQTT for cloud integration (e.g., Azure, AWS). It enables real-time data recording, and report generation, and improves alarm message management and system maintenance, helping factories enhance efficiency and security.

Cloud

B

POWER B

By Tim Chen (Translated by Carol Hsu)

In today's smart environment, the integration of IoT and manufacturing is an unstoppable trend. As smart factories become a reality, businesses focus on improving efficiency and safety. The U-7500M provides a reliable solution for companies moving toward intelligent transformation.

#### The Key to Factory Integration

The U-7500M supports OPC UA communication protocol and RESTful APIs, enabling seamless integration with SCADA,

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MES, and ERP systems. The high flexibility and unified data model of OPC UA, combined with its security mechanisms, allow for crossplatform, cross-device, and cross-network data exchange, significantly enhancing the interoperability, reliability, and security of industrial automation.

In practical applications, the U-7500M collects analog signals, like temperature and pressure, from factory equipment and sends them to the BRK-2841M (IIoT MQTT Communication Server) for data storage and processing. The data can also be transmitted to the AVEVA Edge system for further analysis using its built-in features.

#### **Cloud Platforms**

The U-7500M supports MQTT protocol for easy data upload to major cloud platforms like Microsoft Azure, IBM Bluemix, Amazon AWS, and Google Cloud, enabling smart upgrades through cloud services.

The U-7500M can integrate with IoTstar, an IoT cloud management software developed by ICP DAS. IoTstar can be installed on a PC for private cloud systems or a public cloud VM. System setup requires no programming and can be easily completed through a web interface.

By using the U-7500M to obtain analog or digital signals from the factory, and transmitting this data to ICP DAS's



#### **Seamless Integration with**

loTstar loT cloud management software, the built-in functions can be utilized to achieve factory upgrades.

## Alarm message and historical data management

Public safety incidents such as fire, smoke, and water leakage in large commercial centers must be dealt with promptly to prevent damage. Combined with the U-7500M's Event Log function, the fire protection system can significantly enhance fire safety and rescue efficiency

The fire protection system, combined with the event log application solution, can achieve the following functions:

- Real-time event data recording: including occurrence time, trigger messages, and equipment status.
- Log File Download: Compile event data into complete logs for query and analysis.
- Report and Chart Generation: Generate reports and charts via Excel for

management decision-making.

- Real-time monitoring and notification: When an event occurs, the system can send LINE messages to notify the personnel to deal with it.
- System Maintenance and Troubleshooting: When a fault occurs, you can view the event log to understand the cause of the problem and take appropriate action.

In summary, the application of fire protection systems and event logs can effectively improve fire safety and rescue efficiency, and provide a strong guarantee for the safe operation of the enterprise.

#### Conclusion

The efficient integration and flexible application of U-7500M promote the intelligent upgrading of factories and improve safety and management efficiency. With the advancement of technology and the expansion of applications, U-7500M will play a greater role in the industrial field, adding value and security for enterprises.



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## Stable Power and Green Energy: The Dual Challenge for Enterprises

As environmental awareness grows, enterprises focus more on power stability. With the rise of green energy, a stable power supply and energy storage are crucial. Factories rely on energy storage systems to prevent production disruptions and equipment damage, making them a key enterprise choice.

By Chris Yen (Translated by Eva Li)

#### Power Supply Stability in Green Energy Development

In recent years, companies worldwide have increasingly discussed power stability alongside growing environmental awareness. While many countries invest in green energy like solar and wind, they face supply instability. This has driven growth in the power stability and energy storage industries, which are essential for protecting equipment and ensuring factory production.

Energy storage cabinets are often placed

in areas without network access, making management difficult, lowering efficiency, and increasing maintenance costs. Safety is also a major concern, as fire incidents are common. To address this, developers use Energy Management Systems (EMS) to monitor battery status, but without network connectivity, real-time monitoring remains challenging.

ICP DAS has launched a 4G communication integration solution (4G communication + MQTT protocol) for these problems. The UA-2241MX-4GE is a 4G IoT

#### **Products Column**

communication server that integrates IT and OT systems, accessing factory I/O modules and controllers. It converts data to OPC UA and MQTT for cloud, database, and SCADA connectivity.

#### Convenience of Remote Maintenance/Management

Remote maintenance is crucial after system setup. The UA-2241MX-4GE offers dynamic DNS (DDNS) to convert 4G IP addresses into readable domain names, simplifying remote management.

(Note: To use UA-2241MX-4GE's DDNS feature, ensure the SIM card provides a public IP. Contact your network provider.)

In the 4G integration solution, UA-2241MX-4GE transmits controller Modbus data via 4G to a data center. Paired with AVEVA Edge, it visualizes cloud data for easy analysis.

## UA-2241MX-4GE Cloud Solution Advantages

#### Integrating Facilities and Data Management Centers

Most controllers (machines, devices, etc.) communicate using the Modbus protocol. The UA-2241MX-4GE converts Modbus data into MQTT protocol for transmission, reducing integration troubles.

Advantages of using the MQTT protocol in 4G communication :

- Less network bandwidth usage
- Good reliability (supports setting QoS for transmission quality)
- High expandability (supports a large



number of IoT devices)

Strong security

#### Unified Energy Storage Data Management

In remote areas, disjointed device management complicates data analysis and increases costs. The UA-2241MX-4GE helps consolidate data, improve integration, simplify maintenance, and reduce management burdens.

#### **Cloud Data Visualization**

The UA-2241MX-4GE uses Modbus-to-

MQTT to convert data and display them on SCADA AVEVA Edge for decision analysis.

#### **Simplified Data Integration Process**

The UA-2241MX-4GE integrates data without coding, using a web interface for setup. It supports OPC UA, MQTT, and Modbus protocol conversion, enabling seamless data transfer. Modbus data can be recorded to remote databases, local microSD cards, or cloud platforms, reducing development time and costs. It is the best partner for the IIoT cloud system and Industry 4.0 system.



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### Precision Position Measurement Relies on It ECAT-2074A Absolute Encoder Master

The ECAT-2074A is a high-efficiency absolute encoder master supporting EtherCAT communication with SSI and BiSS-C interfaces up to 10 MHz. It features four independent channels for 48-bit data transmission and automatic compensation of cable delays. The module supports various pulse frequencies, Binary Code, and Gray Code encoding, with non-volatile memory to preserve settings and data during outages.

#### By Nick Wang (Translated by Carol Hsu)

As industrial automation becomes more precise, the demand for high-resolution encoders is growing. Absolute encoders are widely used in robotics and processing machines, as they eliminate the need for zeroing operations. In the future, more incremental encoders are expected to shift to absolute encoders. The ECAT-2074A was developed to meet this demand, providing accurate data transmission to controllers via the EtherCAT interface for precise motion control.

#### ECAT-2074A Features

The ECAT-2074A is an EtherCAT slave module designed to acquire absolute encoder data via SSI and BiSS-C modes, supporting transmission frequencies up to 10 MHz and 48-bit data processing. In BiSS-C mode, it compensates for cable delays up to 70 m. With four independent channels, it can connect up to four encoders simultaneously, meeting diverse needs.

### The transmission modes of SSI and BiSS-C encoders are fully supported

The ECAT-2074A supports the mainstream protocol transmission modes of SSI and BiSS-C absolute encoders.

#### SSI mode:

The master transmits a periodicity pulse to the encoder. The encoder transmits the data according to the rising edge of the



BiSS-C Bidirectional Synchronous Serial C-mode

pulse, and the master captures the data on the falling edge. After the whole transmission process is completed, the master holds high, and the encoder turns high after a timeout and is ready for the next transmission.

♦ BiSS-C mode:

The master sends a periodicity pulse to the encoder, which responds with an acknowledgment (Ack) on the second rising edge. The slave holds low until the encoder is ready and sends a high start bit.

The encoder then transmits a low '0' bit, followed by the position data, an Error bit, and a Warn bit, and finishes with a CRC check code. After the transmission, the master module holds high and the slave module returns to high after a timeout.

Note: The Error bit and Warn bit are both active low.

#### **Flexible Bit Number Options**

The ECAT-2074A supports two parameters, multiturn bit and singleturn bit, each with a maximum of 32 bits, but the total number of bits cannot exceed 48 bits. In BiSS-C mode, the error, warning and CRC bits also belong to this limitation. If the encoder only supports singleturn mode, the multiturn bit can be set to 0.

#### Variety of Pulse Frequency Options

The encoder master sends pulses and simultaneously acquires position data. Since encoders support different pulse frequencies, knowing their frequency range is important to ensure correct data acquisition. The ECAT-2074A offers seven optional frequencies.

Clock Frequency number	Clock Frequency
0	10MHz
1	5MHz
2	2.5MHz
3	1.25MHz
4	625KHz
5	312.5KHz
6	156.25KHz

#### Options for Data Encoding: Binary and Gray Code

After reading the encoder position data, decode it based on the encoder's encoding mode. ECAT-2074A supports two encoding modes: Binary code and Gray code. The key difference is that Gray code changes only one bit when moving to the next position, reducing the chance of incorrect readings and minimizing errors.

#### **CRC** generator polynomial

In BISS-C mode, the encoder will add a CRC check code at the end of the data, and this check code is generated according to the CRC generator polynomial. The encoder master needs to know this CRC generator polynomial to verify the data. The common CRC generator polynomial is  $x^6 + x^{1} + x^{0}$  (CRC-6), represented as 1000011 in binary or 67 in decimal. ECAT-2074A uses this as the default.

### Automatically compensates for delays to ensure data accuracy

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The signal transmitted between the encoder master and the encoder is delayed due to the length of the cable, the longer the cable length the larger the measured value. At high transmission frequencies, this delay can lead to incorrect data readings. ECAT-2074A measures the cable delay and automatically sets a compensation value to ensure correct data reading.

#### Non-volatile memory storage settings, enabling seamless recovery after power loss

The absolute encoder also has a feature that stores the original position data after the system is powered off and restored. However, if the settings of the encoder master are lost, the user still needs to reset the parameters, the ECAT-2074A has a non-volatile memory device that can store the parameters set by the user.

## ECAT-2074A Multi-Use Scenario

ICP DAS EtherCAT master ECAT-M801 can be used to control ECAT-2074A.



ECAT-M801 also provides ECAT\_Utility. exe utility for users to test the ECAT-2074A module. The following example uses ECAT-M801 ECAT\_ Utility.exe to control the ECAT-2074A module.

EtherCAT provides the CANopen communication mechanism called CANopen over EtherCAT (COE) at the application layer, providing objects such as SDOs, PDOs, etc. to enable network initialization and periodic data transfer.

## SDO Object Configuration and Application

The SDO object initializes module parameters, as shown in the diagram below. Under the 0x8000 object (channel 0), you can set parameters like CRC Generator Polynomial, Transmission Frequency, Multiturn Singleturn Bits, and Transmission

#### 📘 SDO LIST

#### PDO Object Transmission and Management

It is used to transmit data periodically, as shown in the diagram below, you can read the singleturn and multiturn position information in the PDO.

PDO					
Input (TxPdo) Offset:					
ByteSize:			An	alysis	
Name		size(bit)	Value(DEC)	Туре	
▼ 0.0 ENC Status Ch.0					
BiSS Warning bit (nV	Varning)	1	0	BOOL	
BiSS Error bit (nError	7)	1	0	BOOL	
Ready		1	1	BOOL	
CRC Error		1	0	BOOL	
		4	0		
Input cycle counter		8	143	USINT	
Multiturn Position		32	1	UDINT	
Singleturn Position		32	1192	UDINT	
<ul> <li>10.0 ENC Status Ch.1</li> </ul>					

Index	Name	Flags	Current Value	Default Value	Тур
▶ 6000	ENC Inputs Ch.0		>18<	>18<	DT6
▶ 6010	ENC Inputs Ch.1		>18<	>18<	DT6
▶ 6020	ENC Inputs Ch.2		>18<	>18<	DT6
▶ 6030	ENC Inputs Ch.3		>18<	>18<	DT6
▼ 8000	ENC Settings Ch.0		>10<	>10<	DT8
8000:01	CRC Invert	RW	0x01(1)	0x01(1)	BOC
8000:03	CRC Polynomial	RW	0x0043(67)	0x0043(67)	UIN
8000:04	Clock Frequency	RW	3:"1.25MHz"	0x00(0)	DTO
8000:05	Coding	RW	0:"Binary code active"	0x00(0)	DTO
8000:06	Multiturn [Bit]	RW	0x0C(12)	0x00(0)	USI
8000:07	Singleturn [Bit]	RW	0x0D(13)	0x20(32)	USI
8000:08	Mode	RW	1:"SSI mode"	• 0x00(0)	DTO
8000:09	Measured Delay Time	RO	0x00(0)	0x00(0)	USI
8000:0A	Latch Delay Time	RO	0x00(0)	0x00(0)	USI
▶ 8010	ENC Settings Ch.1		>10<	>10<	DT8

#### **Technical: Examples of API Operations**

ICP DAS provides a libecatdevice(. dll) library to enable users to use EtherCAT Master series devices under the Windows operating system.

The library provides easy development and powerful functions for users to get started quickly, the shared library architecture is shown in the following diagram.



The following example uses the API library to control the ECAT2074A module.

Use the ECAT\_SetSlaveSdoObject API to set the SDO object. The following program demonstrates how to set the value of 0x8000:04 (Clock Frequency) of the ECAT-2074A SDO object.

```
int32_t ret;
uint16_t DeviceNo = 0;
uint16_t SlaveNo = 0;
uint16_t Index = 0x8000; //ENC
Settings Ch.0
uint8_t SubIndex = 0x04; //Clock
Frequency
uint16_t DataSize = 2; //2 byte
uint32_t ObjectVal = 1;
uint32_t AbortCode = 0; //AbortCode
ret = ECAT
SetSlaveSdoObject(DeviceNo, SlaveNo,
Index, SubIndex,
DataSize, ObjectVal, &AbortCode);
```

```
if (ret < 0)
printf("Failed to set sdo object:%d)
n", ret);
else
printf("Set sdo object
successfully!in");</pre>
```

 Use the ECAT\_GetSlaveTxPdoData API to read TxPdo data. The following program demonstrates how to read the ECAT2074A PDO Singleturn Position value.

```
int32_t ret;
uint16_t DeviceNo = 0, SlaveNo = 0,
OffsetByte=6, DataSize=4;
union position (
      uint32_t Singleturn;
      uint8_t Data[4];
)position;
ret = ECAT
GetSlaveTxPdoData(DeviceNo, SlaveNo,
OffsetByte,
DataSize, position.Data);
if (ret < 0)
      printf("Failed to get TxPdo
data:%d)n", ret);
else
      printf("Singleturn: %d)n",
```

```
position.Singleturn);
```

#### Conclusion

As an absolute encoder master, ECAT-2074A has the advantages of fast transmission speed, multiple transmission modes (SSI, BiSS-C), multiple independent channels (4 in total), and easy operation, which makes it an excellent choice for use with absolute encoders.

For more details about ECAT-2074A, please refer to the website: https://www.icpdas.com/tw/product/ECAT-2074A



## **iSN-104-Е**

4-channel Liquid Leak Detection Module (Ethernet version)

#### Edit by Eva Li

The iSN-104-E Liquid Leak Detection Module is a low-cost, intelligent device that directly controls triggers and alarms without needing a conversion module. It integrates easily with various monitoring systems for remote alarms and device control. It monitors up to 500 meters of double-core leader cable, works with extended and included detection cables, and connects seamlessly with networked collection hosts.

The iSN-104-E is ideal for real-time leak detection in critical locations like server rooms, warehouses, museums, and industrial sites, as well as for monitoring air handling units, refrigeration systems, liquid containers, or pump tanks. It supports Modbus TCP/UDP communication with configurable addresses via hardware. With Ethernet and PoE, the iSN-104-E integrates easily into existing HMI or SCADA systems, ensuring smooth maintenance in distributed control setups.

#### Features:

- 4-ch Liquid Leak Detection
- Water Leakage and cable break detection triggers and audible alarm
- A mute button to silence the audible alarm
- Five LED indicators to display the status of the power and the alarm
- Liquid Leak Detection Cable and Extended Cable can be up to 500 meters
- Sensitivity adjustable detection
- Supports Modbus TCP/UDP, MQTT
- Redundant Power Inputs: PoE and DC Input

Leak detection is used for water pipes, fire lines, sewage, and electrical equipment to conserve water and ensure safety. The iSN-104-E detects leaks, sends alarms, and integrates with WISE IoT Edge Controller, TPD/VPD Touch HMI, and mobile apps.

For more details about the iSN-104-E Liquid Leak Detection Module, please visit: https://www.icpdas.com/en/product/iSN-104-E

# Seamless IT - OT Integration Connect Devices to the Cloud

