

ADVANTECH

PLCopen Solution for Vision Inspection: On-the-Fly High-Speed System

Enhanced Efficiency with Advanced
Flying Trigger Technology

PLCopen[®] **EtherCAT**[®] **OPC UA**[®]
for efficiency in automation



intel
partner
Titanium
IoT Solutions

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In industrial automation, efficiency and precision are paramount. Advantech's integration of cutting-edge technologies into its AMAX series enhances the PLCopen vision inspection system, allowing for real-time, on-the-fly image capture. This critical feature supports high-speed inspection processes without compromising accuracy. By streamlining manufacturing and reducing downtime, Advantech's solution boosts productivity and maintains consistent quality, embodying the future of intelligent automation in demanding environments.

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ADVANTECH

Enabling an Intelligent Planet

Est. **1983**

Headquarters: **Taipei, Taiwan**

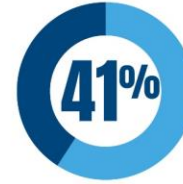
INDUSTRIES SERVED

Industry 4.0, Industrial IoT,
Embedded Computing,
Medical, Retail, Logistics



**WORLD'S LARGEST
IPC COMPANY**

Advantech IPC WW Market Share



● Advantech ● Other IPC Companies

Source: OMDIA – Market Share estimates for
Industrial PCs: World, 2022 Edition

\$2.07B 2023
REVENUE
(USD)

KEY ECO-SYSTEM PARTNERS



QUALITY SYSTEMS IN PLACE

- ISO9001
- ISO14001
- ISO13485
- ISO17025
- ISO27001
- ISO45001
- TL9000
- ISO50001
- RoHS
- WEEE
- SONY GP
- REACH

1.8 MILLION+ sq. ft.

MANUFACTURING PLANTS

Linkou, Taiwan



- 9 SMT lines, 16 system lines
- Engineering sample services
- Complex product lines
- Flexible & quick production

Kunshan, China



- 12 SMT lines, 13 system lines, 6 chassis lines
- Chassis design & production
- Mature product lines
- Cost-effective production



Nogata, Japan

- 4 SMT lines, 1 system line
- Japan design center, CTOS service, logistics center, repair center

\$10.61B MARKET
CAP (USD)
(Feb., 2024)



HONORS & AWARDS

- No.5 in Best Taiwan Global Brands
- No.17 in Top 50 Global Automation Vendors
- No.9 in Top 100 Industrial IoT Companies
- Red Dot Product Design Award
- iF Product Design Award



WORLDWIDE OFFICES



- Manufacturing 3
- On-site service 4
- Design centers 11
- CTOS centers 16
- Repair centers 17
- Logistics centers 20

More than 90 offices globally!

8800+
EMPLOYEES

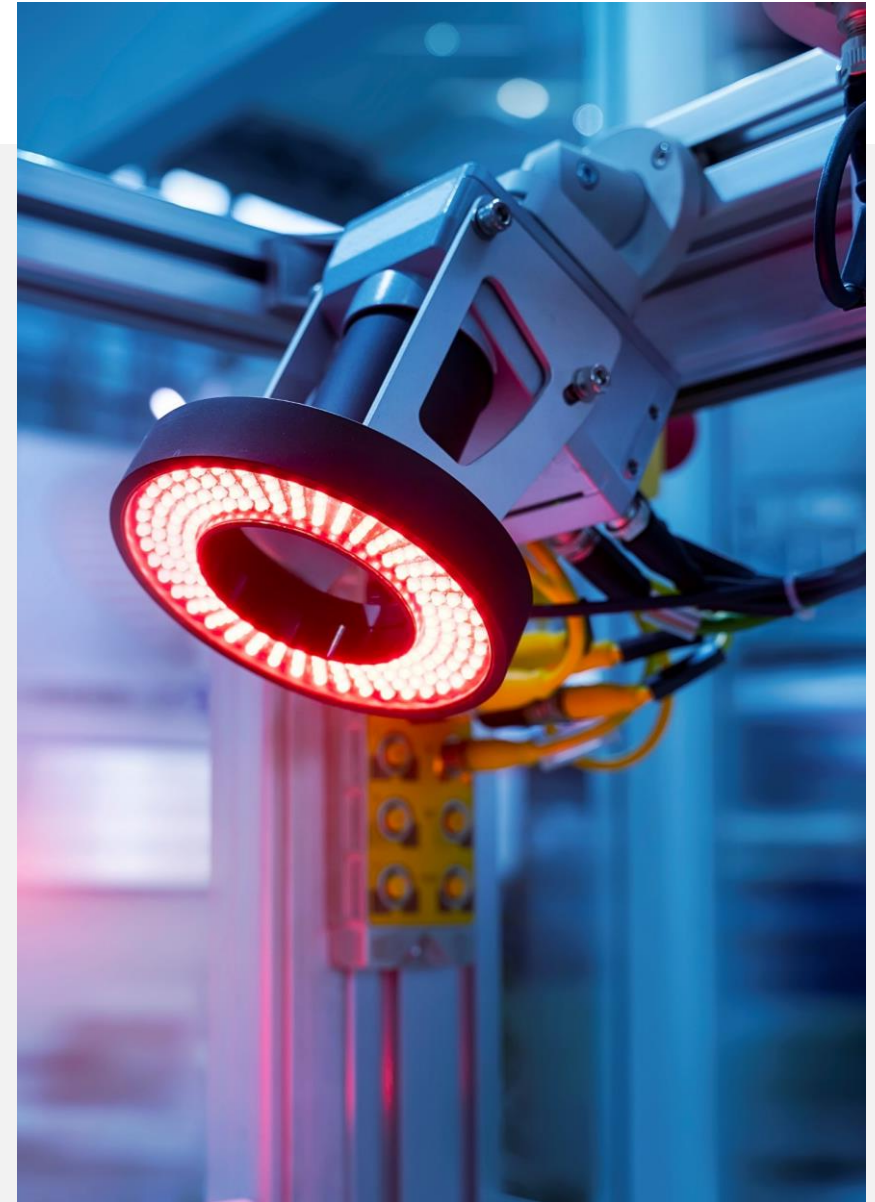


Elevate Manufacturing Agility with On-the-Fly AI Inspection Solutions

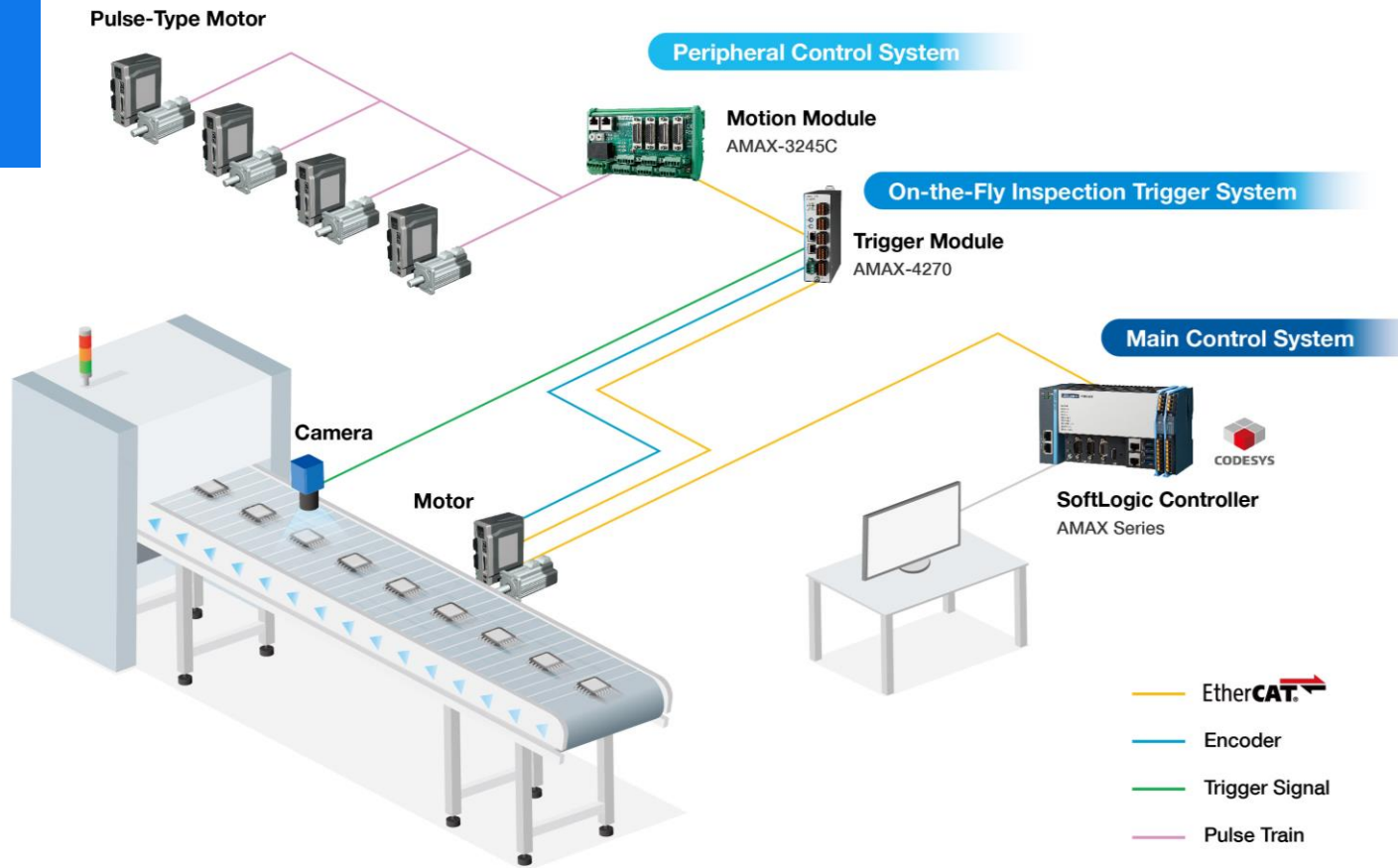
The Covid-19 pandemic has accelerated the transformation of manufacturing industries toward advanced automation and digitization, driven by the necessity to mitigate supply chain disruptions and labor shortages. This shift, coupled with the rise of diversified, small-batch production, has increased the reliance on precision technologies such as **Automated Optical Inspection (AOI)**.

AOI is critical in the precision manufacturing of high-tech electronics, including flat-panel displays, semiconductors, and PCBs, where precision and micro-component integration are key. With technological advancements leading to smaller, more intricate designs, the limitations of manual quality control are evident. **Traditional AOI systems often yield high false-positive rates and suffer from rigidity, leading to inefficiencies and increased operational costs.**

To counter these challenges, Artificial Intelligence (AI) is revolutionizing AOI. Unlike conventional systems that rely on fixed algorithms, **AI-enhanced AOI** harnesses deep learning, enabling adaptive and experiential analysis akin to human judgment. This not only minimizes false positives but also categorizes products, identifying manufacturing errors and facilitating process optimization.



Building upon the AI-driven inspection capabilities, **Advantech's integrated system comprises three primary components** that further elevate the manufacturing process:



- The core of the control system features a **CODESYS-equipped controller** that adheres to the PLCopen standards for motion control, seamlessly orchestrating complex automated tasks with precision and reliability.
- At the heart of the on-the-fly inspection capabilities is the **AMAX-4270, 4-channel EtherCAT trigger and position latch module**, which is specifically designed for high-speed, real-time image capture. This enables the system to conduct rapid inspections at an exceptional rate, ensuring quality control without compromising on efficiency.
- Complementing the setup is the peripheral control system, which includes the **motion module AMAX-3245C**. Compatible with the standard EtherCAT CiA-402, it effectively converts EtherCAT communications into pulse signals for the control of pulse-type stepper and servo motors, thus providing a flexible and precise control solution crucial for the diverse needs of modern automated systems.

Advantech's components work together to redefine intelligent motion control, delivering the **precision, speed, and flexibility** essential for advanced smart manufacturing.

Overcoming Inspection Hurdles with Advantech On-the-Fly Innovation

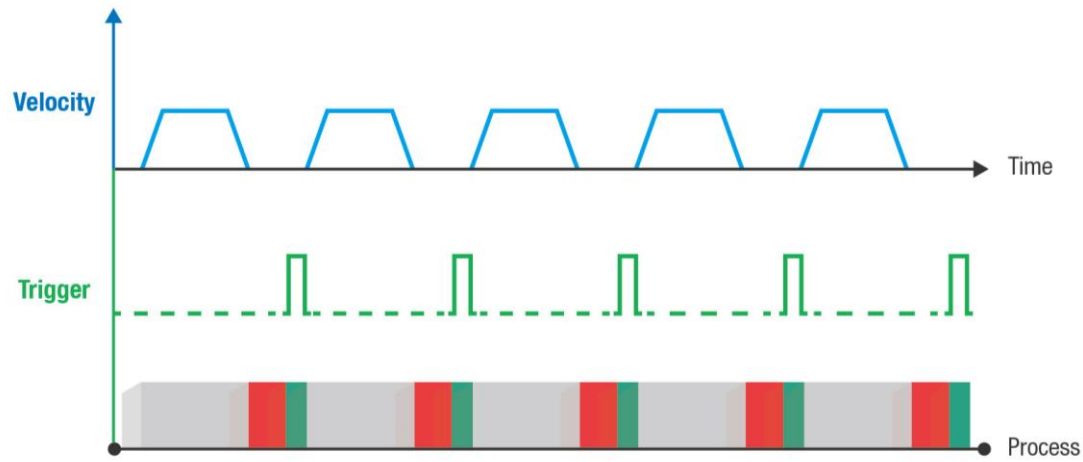
In the realm of AOI, traditional devices face significant challenges that hamper efficiency and accuracy. One major bottleneck is **the slow pace of image capture, necessitated by the requirement for components to be completely stationary**. This not only lengthens the inspection cycle significantly as the number of components increases but also introduces delays that are incompatible with the demands of high-speed manufacturing lines.

Moreover, the quest for impeccable image quality often hits a roadblock due to **premature image capture**. In instances where the motor and mechanical parts have not fully settled, the resulting images are marred by blurriness and inaccuracies, undermining the very purpose of quality control. Compounding these issues is **the critical synchronization mismatch between the lighting system and the camera's triggering mechanism**. Without precise alignment, the camera may either pre-empt or lag behind the optimal lighting condition, leading to recognition errors. These errors result in missed defects or false positives, severely impacting the reliability of the inspection process.

Addressing these challenges with traditional solutions typically involves integrating **high-speed PLCs for triggering direct outputs** at predetermined intervals for image capture, coupled with a separate light source controller. This approach not only escalates costs but also adds layers of complexity to the control architecture, presenting a daunting task for engineers faced with intricate programming requirements.

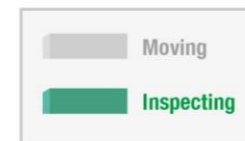
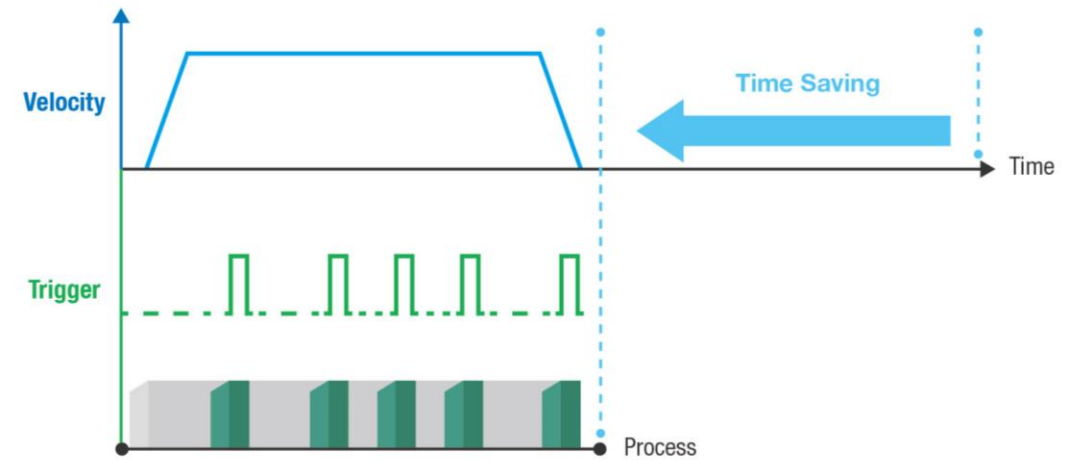
Traditional AOI

Stops equipment for each item image, leading to longer inspection times.



Advantech On-the Fly AOI

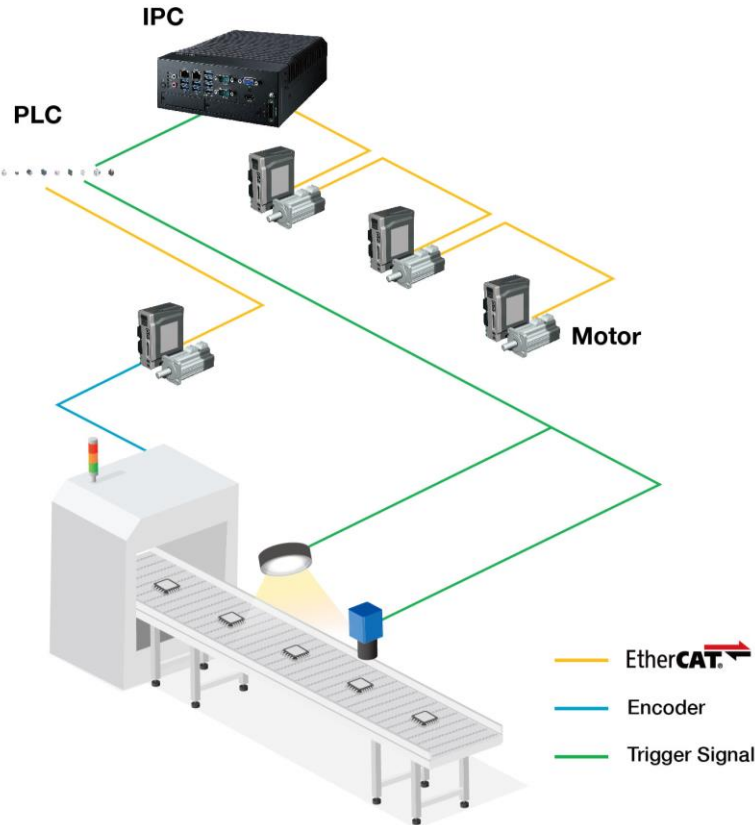
Images are taken of items in motion, significantly reducing the time needed for the same number of inspections.



Enter the transformative Advantech AMAX-4270 solution, a beacon of efficiency for on-the-fly applications. This ingenious EtherCAT module eliminates the need for multiple ancillary devices, seamlessly integrating into existing setups. It features advanced **four-channel compare trigger functionality**, streamlining the process by allowing precise position inputs through the EtherCAT MainDevice. As components pass the designated trigger points, the AMAX-4270 ensures instantaneous imaging, capturing components in motion with unparalleled clarity.

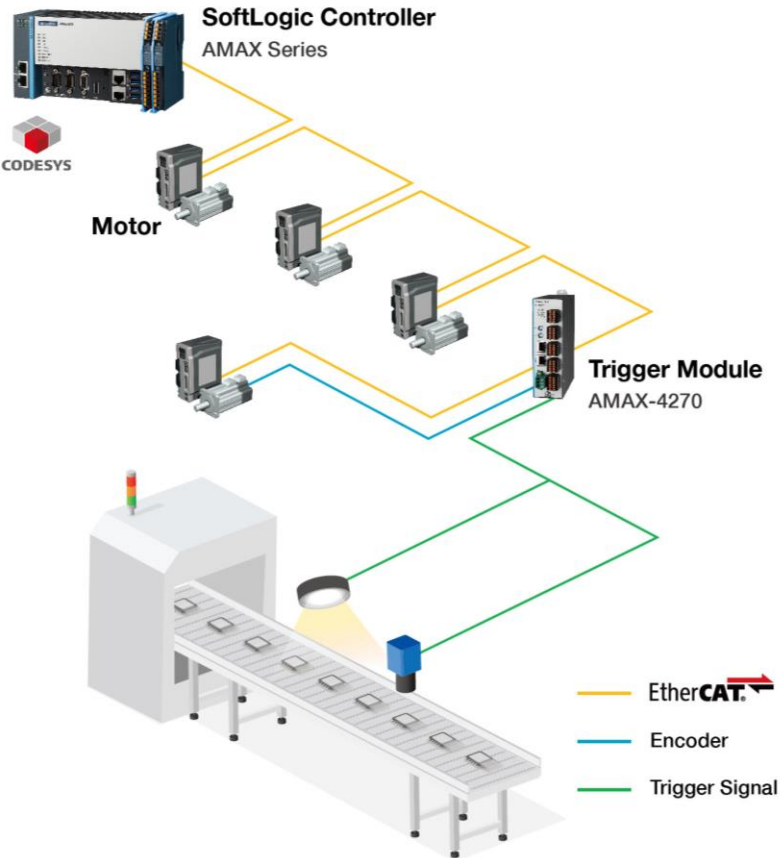
Furthermore, its **trigger delay output functionality** empowers users to fine-tune the synchronization between lighting and camera triggers, dramatically enhancing image recognition accuracy. By significantly reducing developmental hurdles, hardware costs, and programming complexity, **the AMAX-4270 elevates inspection speed, quality, and operational throughput**, marking a new era in manufacturing efficiency.

Before



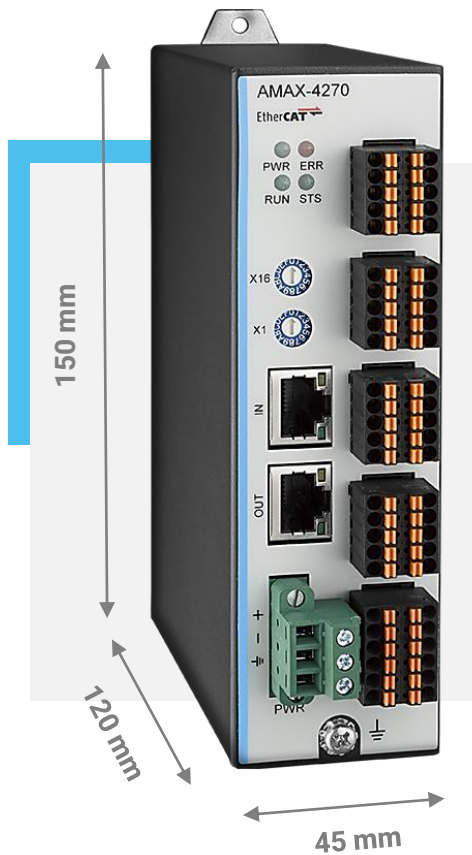
After

The system is simplified and empowered by AMAX-4270



AMAX-4270

4-Ch EtherCAT Trigger & Latch SubDevice



■ EtherCAT Standard

- Supports 3rd-party EtherCAT MDevices



■ Space Saving

- Compact size, smaller than a motor drive

■ CODESYS Function Blocks and Examples

- AMAX-4270 provides CODESYS libraries including structure, function blocks, and examples.
- 2 simple steps to completing an AMAX-4270 project.

Step 1. Import Library

Library

Structure

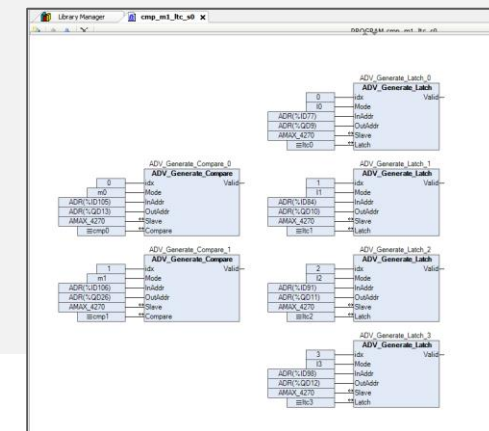
FB

FB Description

ADV_COMPARE_FORCE_TRIGGER

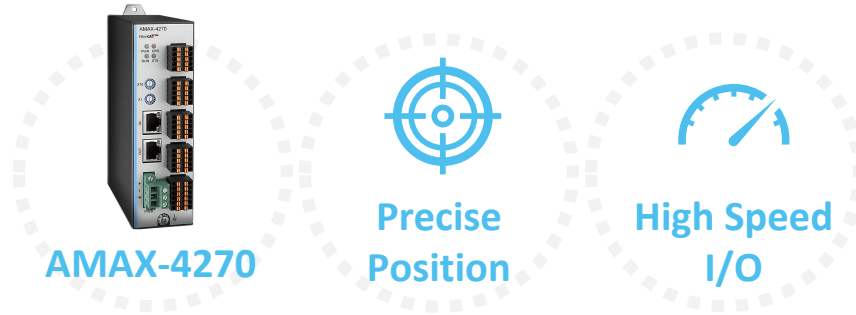
Execute — Done
compareIn — CompareChannel — Busy
Error
ErrorID

Step 2. Select Example to Develop



AMAX-4270

4-Ch EtherCAT Trigger & Latch SubDevice



AOI

Dispensing

Measurement

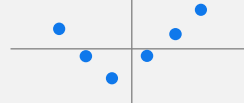
Laser

Supports 1D & 2D PSO

1D PSO



2D PSO



PSO Type

Pulse



Toggle

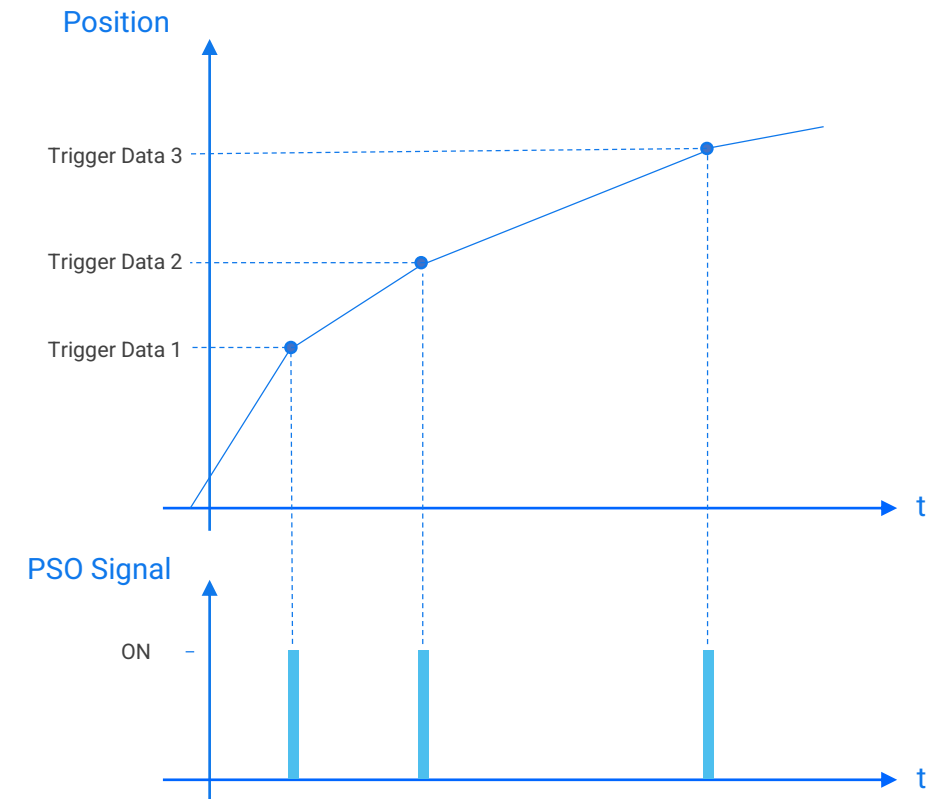


Encoder	
Encoder Channel	4
Encoder Input	CW/CCW, P/D, AB
Encoder In Frequency	2.5 MHz@CW, P/D
	10 MHz@4xAB
Trigger	
Trigger Output Channel	4-Ch
Trigger Out Freq.	10 kHz
Output Type	NPN/PNP, TTL
Sink Current	500 mA
Trigger Type	1&2- Dimension Position Trigger
Trigger Mode	Table
Trigger Signal	Pulse/Toggle
Trigger Delay Time	0 ~ 65 ms (Interval: 1 μ s)
Latch	
Latch Input Channel	4-Ch
Latch In Frequency	10 kHz
Latch Mode	Rising/Falling/Both
General	
EtherCAT Cycle Time	500 μ s (Min.)
Dimensions (W x H x D)	150 x 45 x 120 mm

PSO - Position Synchronized Output

■ What is PSO?

PSO stands for Position Synchronized Output, which allows users to input the positions that need to be compared into the module and output control values such as dispensing valve switch position or camera imaging position. The real-time encoder feedback position is compared with the set position data, when the compared position synchronizes with the actual position, it triggers a digital output, thus achieving high-speed and high-precision switch control.



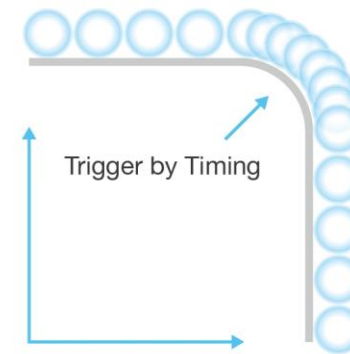
PSO - Position Synchronized Output

■ Why do we need PSO?

In dispensing applications, rounded shapes are commonly encountered during actual processing, from the corners of mobile phones to the chamfers of PCB boards. In traditional dispensing solutions, the dispensing valve is typically triggered by pulses at a fixed time frequency. Common processing paths include both straight lines and corners. Due to mechanical limitations, the speed needs to be reduced at corners to avoid equipment vibration or noise. If the triggering frequency at curved positions remains the same as that at straight-line positions, it can lead to adhesive overflow, thereby reducing dispensing quality.

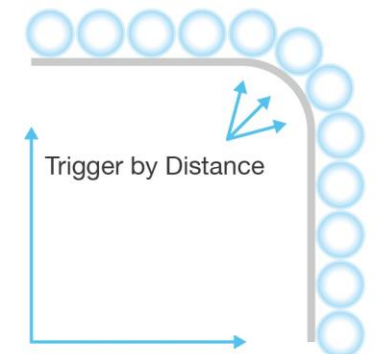
To address this issue, we need to adjust the processing method so that the dispensing valve triggers at consistent intervals along the entire motion trajectory. Using PSO (Position Synchronized Output), the triggering condition is set based on position. This avoids changes in speed and acceleration that may affect dispensing quality, ensuring that the spacing between each adhesive dot remains consistent.

Timing Domain Output



Non-uniform distribution of trigger pulses in acceleration and deceleration process at the corner

PSO



Guaranteed uniform distribution of trigger pulses which are triggered by the fixed position

AMAX-3245C

CiA402 Device Profile 4-Axis EtherCAT Motion Module

■ Supports 4-Axis Servo/Stepper Motor

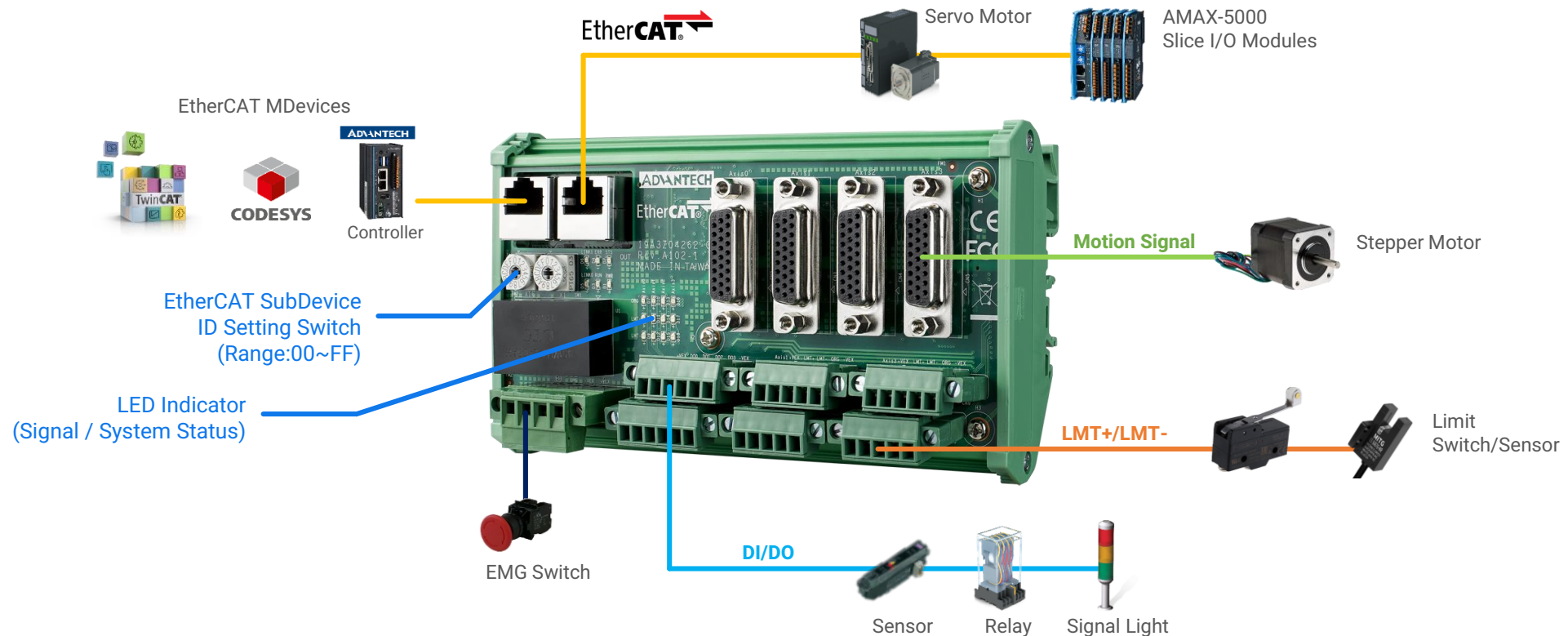
- High-speed motion I/O (Pulse in/out, CW/CCW)
- 26P D-Sub & terminal for motion signals

■ Supports 3rd-Party EtherCAT MDevices

- Supports EtherCAT Fieldbus
- Supports COE/FOE/PDO/SDO

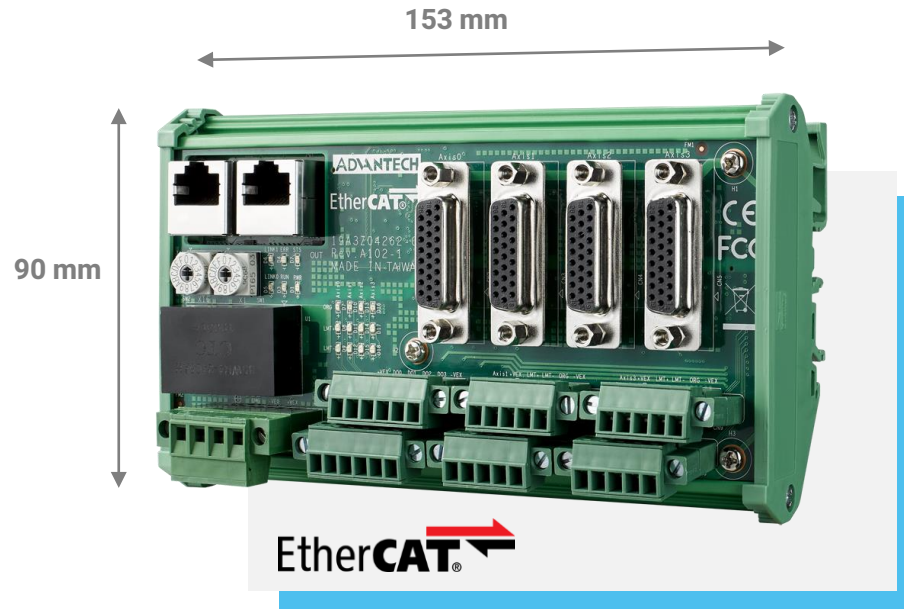
■ Provides CiA402 CSP/HM Mode

- 500 μ s/1 ms cycle time for 4-axis
- Supports 32 homing methods




AMAX-3245C

CiA402 Device Profile 4-Axis EtherCAT Motion Module




Field Wiring
Reduction


Easy & Fast Upgrade
Traditional Machines


Enhanced System
Productivity & Quality

Pulse Control & Local I/O

Axes	4
General DI/O	4DI/4DO
Motion Input	EMG, ORG, LMT+, LMT-
Motion Output	SVON, RALM, ERC
Encoder In	A/B phase, CW/CCW
Pulse In/Out Count Range	±2,147,483,648
Pulse Output Type	Pulse/Direction, CW/CCW
Max. Output Speed	5 Mpps
Pulse Input Type	A/B phase, CW/CCW
Max. Input Frequency	10 MHz @ 4xAB

EtherCAT

Port	2
Cycle time	500 µs/1 ms
Bus Type	CIA402 CSP, HM mode

Other

Input Voltage	24 V _{DC} ± 10%
Operating Temperature	0 ~ 60°C
Dimensions (W x H x D)	153 x 90 x 53 mm

AMAX-5570/5580 Series

IEC 61131-3 SoftLogic Controller

AMAX-5580 Series
Modular EtherCAT
SoftLogic Controller



EtherCAT®



intel
partner
Titanium
IoT Solutions

AMAX-5570 Series
Ultra-Compact EtherCAT
SoftLogic Controller

■ IEC 61131-3 For Automation Efficiency

- Standardization and interoperability
- Improved efficiency and productivity
- Enhanced flexibility and scalability

■ CODESYS Real-Time Kernel

- Motion control libraries compatible with CiA402 standard for drive integration
- Includes ready-to-use CODESYS RTE for efficient control and visualization
- Enables real-time automation for EtherCAT, ProfiNet, and Ethernet/IP

■ Flexible Expansion & Data Connection

- Easy plug-in expansion for EtherCAT Slice I/O modules
- Fastest EtherCAT cycle: 100 μ s for module scanning
- Windows API to access variables of CODESYS
- Capability for data streaming with MQTT and other third-party cloud servers

AMAX-5081

EtherCAT Slice I/O, 1-Ch RS-422/TTL Encoder Input Module with PSO Function



- Supports up to 10 MHz encoder input
- 32-bit counter with PWM and PSO function
- Supports 5 V output for encoder power input
- Supports frequency and pulse width measurement
- Compact size with wide operating temperature range

EtherCAT®

CiA402 in Industrial Automation

■ What is CiA402?

CiA402, known as the CANopen profile for drives and motion control, is an established communication protocol in the automation industry. Developed by CAN in Automation (CiA), this protocol standardizes the way in which various motion devices like motors and actuators communicate, ensuring seamless operation across different systems.

■ The Benefits of CiA402

This protocol outlines the essential parameters, communication objects, and services that facilitate the integration and management of motion devices within the CANopen framework. **It includes features for velocity, position control, and homing procedures that are key to precise and synchronized motion in automated setups.**

■ Standardization and Compatibility

One of CiA402's greatest strengths is its **uniform communication standard**. It ensures that motion control devices, regardless of manufacturer, can be easily managed using a unified programming model. This uniformity simplifies engineering workflows, shortens development timelines, and assures compatibility between diverse devices and control systems.

■ Enhanced Communication with EtherCAT

Combined with EtherCAT, CiA402 employs Process Data Objects (PDOs) for the cyclic transfer of essential motion data, ensuring synchronized control. Service Data Objects (SDOs) enable on-demand device configuration, allowing for adjustments to motion settings on the fly. This integration enhances system commissioning efficiency and high-performance operation, boosting productivity and engineering agility.



Overview:

The conventional dispensing solution regulates the valve according to speed over time, requiring complex paths to reduce overflow at corners. With increasing demands for production efficiency, there is a need to seek faster and more precise solutions.

Challenges/Requirements:

- Avoiding adhesive overflow at corners.
- Requires high-speed 2D comparison trigger.

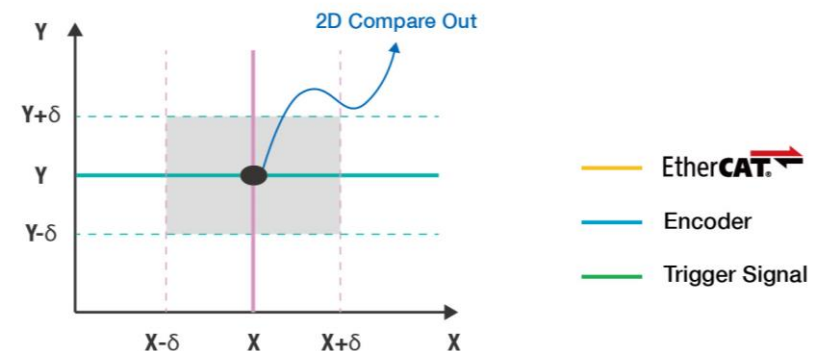
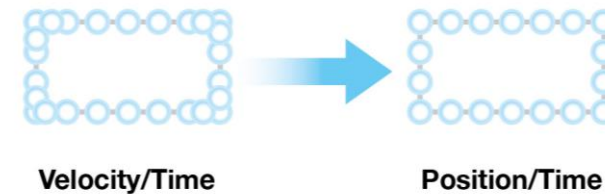
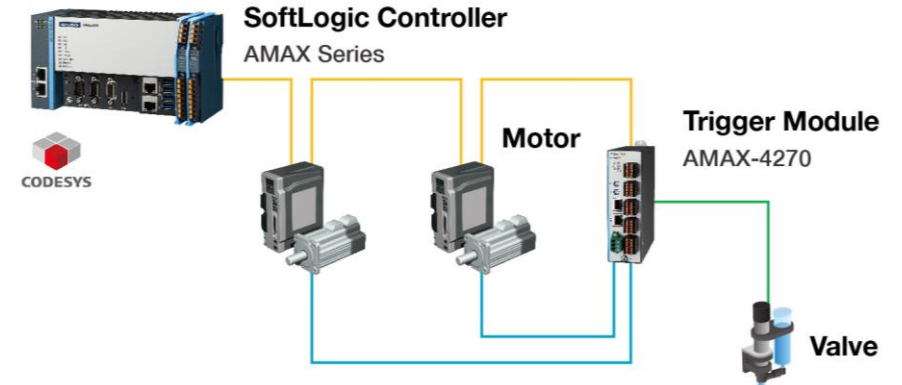
Solution:

- Advantech's AMAX-4270 provides a 4-channel encoder input and trigger output solution to achieve the 2D comparison trigger for the process trajectory.
- With the PSO function, users input the positions that need to be compared to realize the position/time control to avoid overflow at corners.

Benefits:

- Up to 10 kHz jetting speeds to improve equipment productivity.
- Position-triggered for precise control of adhesive dispensing locations.

System Diagram





Overview:

As the market demand for passive components continues to grow, meeting this demand presents challenges not only in increasing production output but also in quality control management. Consequently, there is a growing trend toward AI-based automatic optical inspection.

Challenges/Requirements:

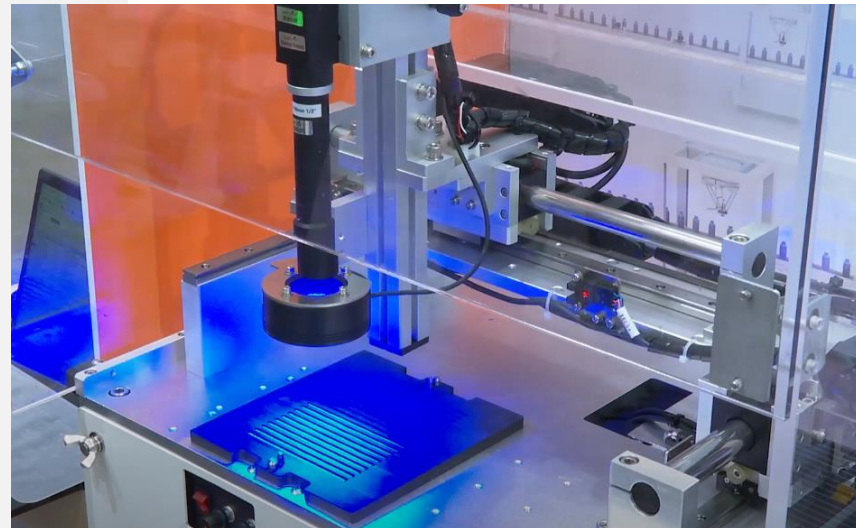
- Improve image acquisition speed.
- Enhance image quality.

Solution:

- Advantech's AMAX-4270 is able to achieve on-the-fly image capture.
- The AMAX-4270's built-in FIFO comparison trigger for real-time output.

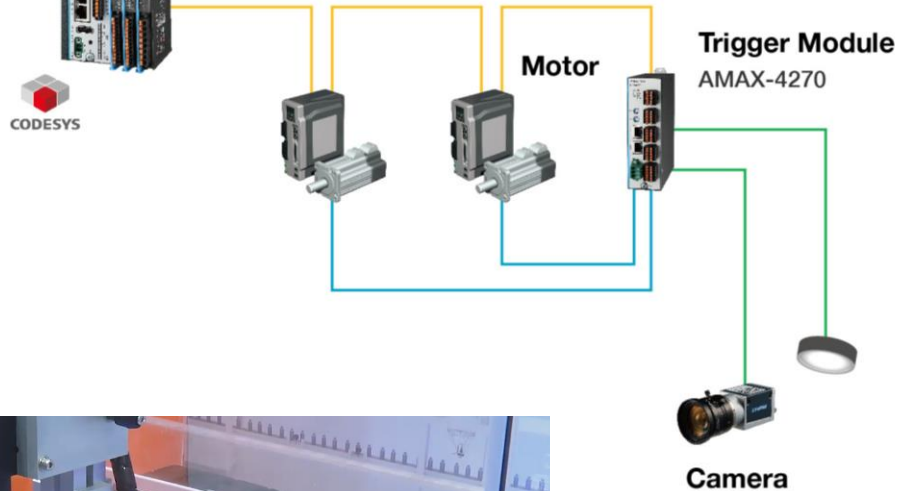
Benefits:

- Processing speed of up to 12,000 pieces per minute.
- Simple control system and wiring which amounts to cost savings.



System Diagram

SoftLogic Controller AMAX Series





Overview:

A Taiwanese company produces its own AGV application with an IPC and battery management system. The AGV utilizes communication technologies such as Wi-Fi, CANopen, and RS232/RS485. This technology is used for data storage and transmission via OPC UA to local HMI to facilitate efficient operations in industrial environments.

Challenges/Requirements:

- **Real-Time Communication:** Seamless communication between the AGV's Control IPC and peripheral devices is essential for optimal performance.
- **Integration Complexity:** Integrating multiple communication protocols and devices poses challenges in system configuration and maintenance.

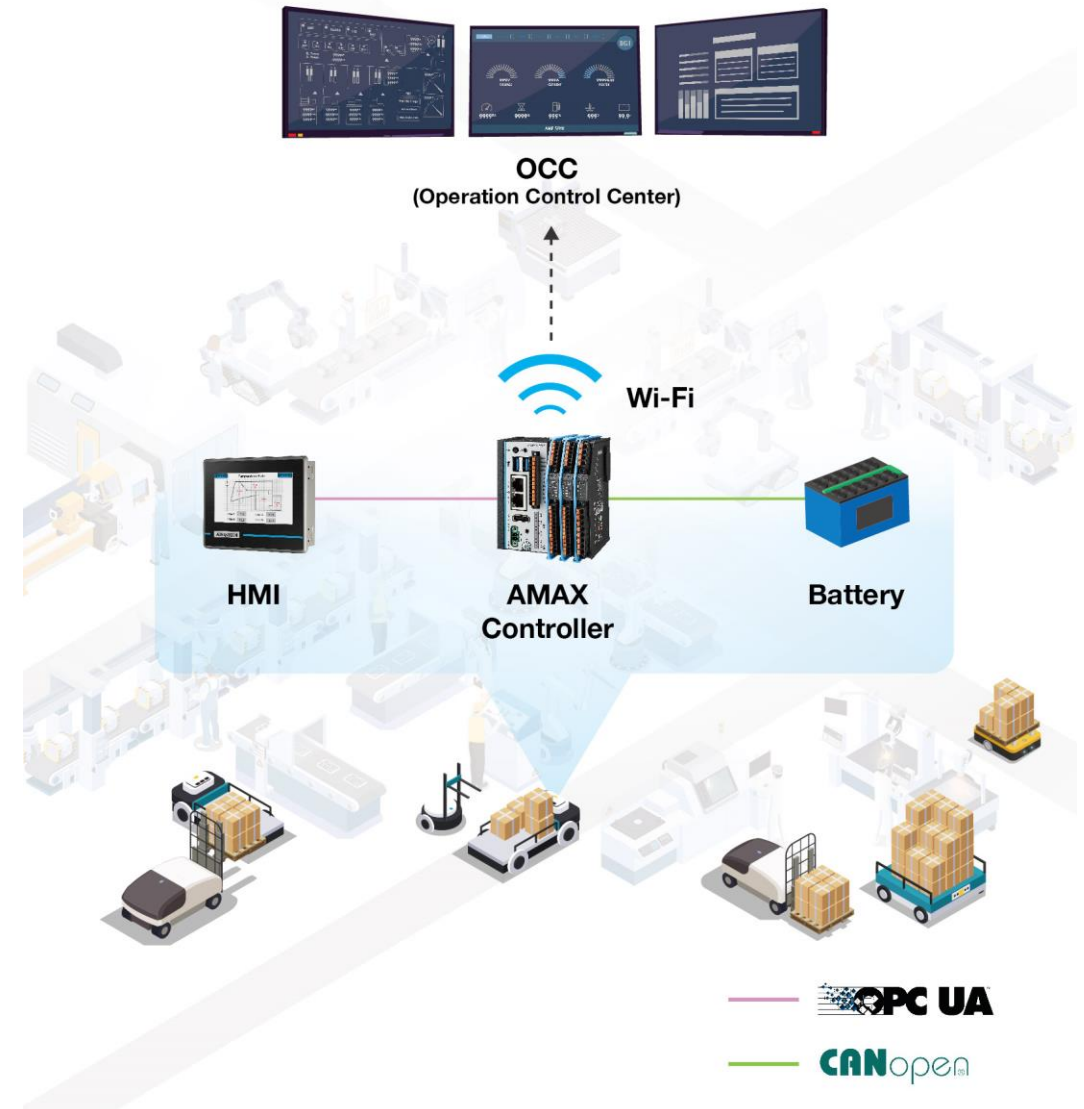
Solution:

- The AMAX controller serves as the central control unit, leveraging its robust processing capabilities and real-time application based on the PLCopen IEC 61131-3 standard.
- CANopen communication for managing battery usage and monitoring battery health. Data is transmitted through Wi-Fi to the control room to manage all vehicle usage.
- OPC UA data is exchanged with the HMI and is shown on the screen.

Benefits:

- Easy modular plug-in application of function blocks in CODESYS makes the architecture more adaptable.
- Low latency for data transmission and large-scale data acquisition thanks to the EtherCAT analog module.

System Diagram



Product Offerings

EtherCAT SubDevice



AMAX-4270

4-Ch Trigger & Latch Module

- Application I/O for inspection and measurement
- 4-ch encoder, 4-ch position trigger, & 4-ch position latch
- Max trigger frequency: 10 kHz (supports 1D & 2D triggers)
- Max latch frequency : 10 kHz (edge rising/falling/both)

[Learn More](#)

AMAX-3245C

CiA402 Device Profile 4-Axis Motion Module

- Supports 4-axis servo/stepper motor
- High-speed motion I/O (pulse in/out, CW/CCW)
- Provides CiA402 CSP/HM mode
- Compact size & EtherCAT to pulse solution
- Supports 3rd-party EtherCAT Mdevice
- Supports COE/FOE/PDO/SDO

[Learn More](#)

AMAX-5081

1-Ch RS-422/TTL Encoder Input Module with PSO Function

- Supports up to 10 MHz encoder input
- 32-bit counter with PWM and PSO functions
- Supports 5V output for encoder power input
- Supports frequency and pulse width measurement
- Compact size and wide operating temperature range

[Learn More](#)

AMAX-5000 Series I/O

Compact Modular EtherCAT Slice I/O

- Removable push-in I/O terminal
- Smart power quality diagnosis
- Dual power inputs
- 2000 V_{DC} isolation
- Supports isolated DI/DO, analogue (V/mV/mA, RTD, thermal couple), AO (V/mA), counter/encoder, timestamp module
- DC mode selectable

[Learn More](#)

CODESYS-Ready Controller

CODESYS-Compatible IPC



AMAX-5570 Series

AMAX-5580 Series

UNO-148 V2

MIC-770 V3

IPC-240

Ultra-Compact EtherCAT SoftLogic Controller with Slice I/O Expansion

Modular EtherCAT SoftLogic Controller with Slice I/O Expansion

Fanless DIN-Rail IPC with Intel® Core™ Processors (13th Gen)

Compact Fanless System with Intel® Core™ Processors (14th/13th/12th Gen)

Compact Industrial Computer System with Intel® Core™ Processors (14th/13th/12th Gen)

- | | | | | |
|--|--|---|--|--|
| <ul style="list-style-type: none"> • Intel Atom® X Series x6413E® processor • CODESYS control Real Time Engine (RTE) & Visualization (target & web) • Supports IEC 61131-3 programming languages (FBD, LD, IL, ST, and SFC) and PLCopen automation specification • Upstream connectivity facilitates IT/OT integration (MQTT, OPC UA, and ODBC) • CODESYS software control redundancy supported • CANopen communication supported with CODESYS runtime | <ul style="list-style-type: none"> • Intel® Core™ (6th Gen) / Intel® Celeron® processors • CODESYS control Real Time Engine (RTE) & visualization (target & web) • Supports IEC 61131-3 programming languages (FBD, LD, IL, ST, and SFC) and PLCopen automation specification • Upstream connectivity facilitates IT/OT integration (MQTT, OPC UA, and ODBC) • Supports flexible AMAX-5000 slices I/O and AMAX-5400 LAN/CAN/COM I/O expansion • CODESYS software control redundancy & cable redundancy supported | <ul style="list-style-type: none"> • Intel® Core™ processors (13th Gen) • Comes with 8GB DDR5 memory • Port isolation for 8 x DI, 8 x DO, 4 x COM • Supports 2 x M.2 M-Key 2280 NVMe SSD and 1 x M.2 B-Key 2242 storage • Supports 1 x M.2 E-Key 2230 Wi-Fi module and 1 x mini PCIe with Nano SIM card slot for LTE • Dual 2500BASE-T Ethernet supports Time-Sensitive Network (TSN) technology • Modular design for optional iDoor expansion | <ul style="list-style-type: none"> • Intel® Core™ processors (14th/13th/12th Gen) • CPU type: LGA1700 socket • Chipset: Intel® Q670E/H610E • Operating temperature range: -20~60°C / -4~140°F • VGA/HDMI output, NVMe M.2 • 2 x GigaLAN, 2 x USB 3.2 (Gen2) and 6 x USB 3.2 (Gen1) • 2 x DDR5 ECC/Non-ECC SO-DIMM, up to 64GB | <ul style="list-style-type: none"> • Intel® Core™ processors (14th/13th/12th Gen) • CPU type: LGA1700 socket • Chipset: Intel® Q670E/H610E • Up to 4 x expansion slots (PCIe/ PCI) • 2 x GbE, 1 x NVMe M.2, 2 x SATAIII, 2 x RS-232/422/485 serial ports • Supports 5V/12V power output (max. 2A) • Compatible motherboard : PCE-2033/ 2133 |
|--|--|---|--|--|

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Worldwide Offices

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1-408-519-3800

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