# Advantech EtherCAT Controller and I/O Solutions

/ EtherCAT Control Platforms

/ EtherCAT Programmable Edge Controllers

/ Motion Controllers and Software

/ EtherCAT I/O

/ Selection Guide

/ Case Studies

**MotionNavi**

CODESYS

intel partner
Titanium
IoT Solutions

EtherCAT®

**ADVANTECH**

*Enabling an Intelligent Planet*

# Advantech IIoT Automation Control Solutions

Traditional manufacturing companies face significant challenges as they transition between their conventional operations and the digital transformation of their factories. With increasing demand for customized production, customers now prioritize product yield. The condition of production equipment directly impacts efficiency and quality, making data from production and equipment the driving force behind digital upgrades. However, traditional digital solutions, such as integrating products like PLCs, PCs, gateways, data collection, and SCADA software into the same system, are complex, costly, and pose security risks. Software engineers encounter difficulties in programming and development, including higher costs and maintenance expenses.

Smart equipment, on the other hand, is rapidly advancing. Advantech's Industrial IoT Motion Control Solution combines PLC automation and PC IT technology, integrating various functions into a single control platform. This includes PLC controllers, PCs, gateways, motion control, data collection, communication protocols, machine vision, and equipment networking. This solution is suitable for motion control, machine vision, preventive maintenance, and data analysis. It enables intelligent production line control through data uploading to industrial cloud platforms, both at the edge and remotely.

| Overhead Travelling Crane | EV Charging Station | Semiconductor | Vehicle Electronics |
|---|---|---|---|

Machine Control — Local/Remote Visualization — SoftMotion Control — Domain-Focused Applications

**CODESYS**

CODESYS Edge Controller — Modular Control Platform — MotionNavi Designer — MotionNavi API

**Automation Control Platforms & Edge Controllers** — **Motion Controllers & Motion Control Cards**

**EtherCAT**

Couplers & Junction Modules — Terminal-Type I/O Modules — Slice I/O Modules — Pulse Modules — Trigger & Latch Modules — 4-in-1 Stepper Drive Modules — 3rd-Party Servo Drives & Motors

Dispensing Machine — Coil Winding Machine — SCARA Robot Control — LED Sorter — IC Test Handler — Laser Cutting

# Advantech - A Pioneer in Smart Automation

The key steps for realizing smart manufacturing require networking all devices, computing systems, machines, and equipment to enable data collection; next, import services and perform data integration in one step; lastly, initiate all manufacturing process integration. Advantech can help you realize your dream of network-connected smart machinery, advanced integration of machines and equipment, and the digital transformation at the core of a smart manufacturing operation.
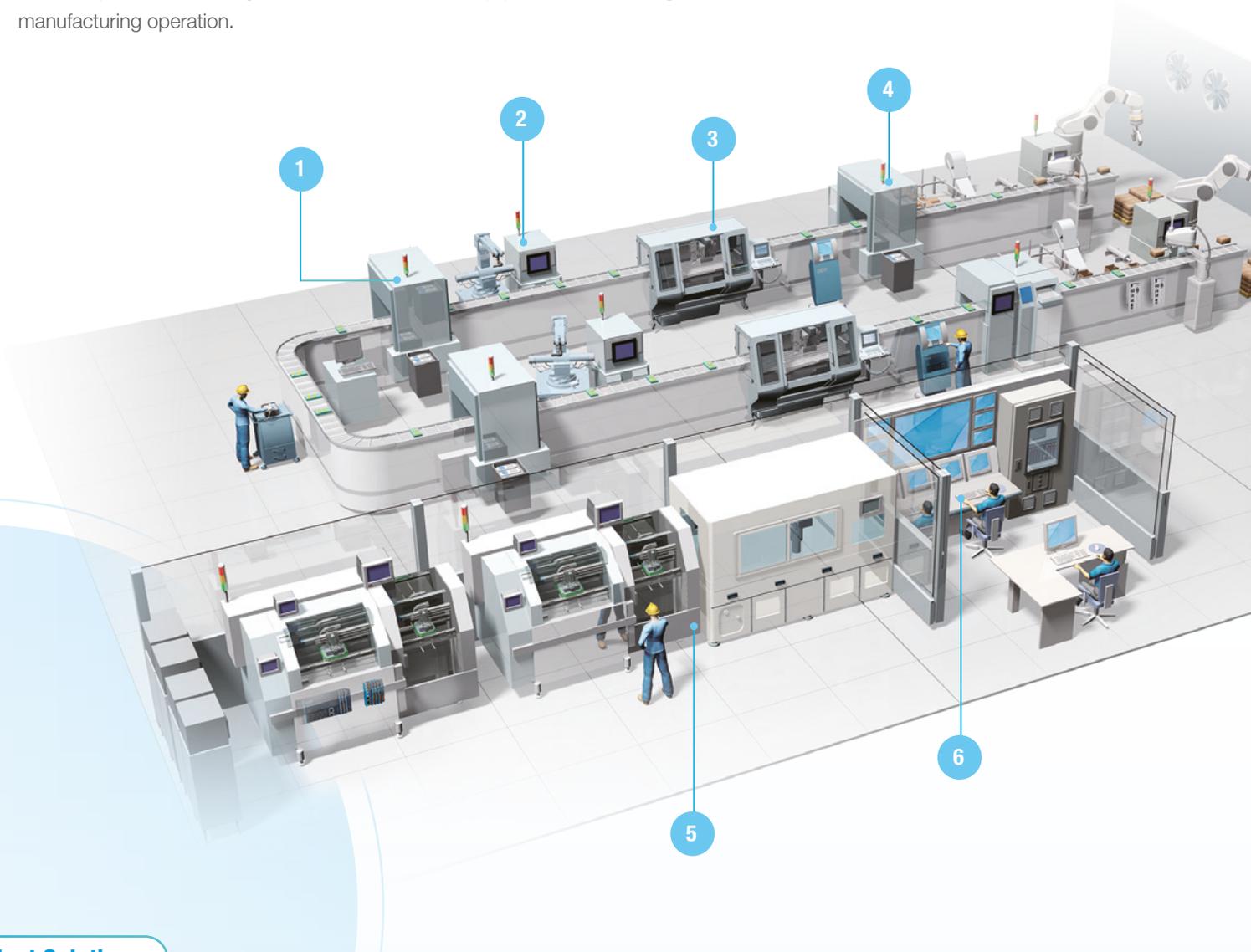
## Product Solutions

### Data Acquisition

• Provides a wide range of I/O devices with various interfaces and functions
• Reliable and accurate data acquisition hardware and graphical software tools

### Industrial Ethernet Switch & Wireless Network

• Wired & wireless network infrastructure

### Motion Control

MotionNavi

• Supports versatile EtherCAT servo/stepping motor
• Pulse train control via EtherCAT motion module

### Compact Edge Controller

• PC-based integrated solution for easy development
• Supports real-time dual fieldbus data acquisition (PROFINET and EtherCAT)

## 1. AI Automated Optical Inspection (AOI)

- AI defect inspection for multi-product line and multi-defect applications
- Manual inspection replacement
- Increased reliability and efficiency on the factory floor

## 2. Data Convergence and Transmission

- Supports various widely used industrial protocols such as PROFINET, EtherNET/IP, and EtherCAT
- Seamless conversion between each industrial protocol
- Efficiently connects to different protocol equipment with redundancy and management features

## 3. Predictive Maintenance

- Wide range of industrial data acquisition and control devices with various interfaces and functions
- Reliable, accurate, affordable, and suitable for diverse industrial automation applications
- Enables customers to seamlessly integrate data acquisition cards with the latest platforms for improved performance and reduced development times

## 4. Edge Computing, Analysis, and Visualization

- Modular design for PC-based controllers, industrial PCs, and panel computers
- High system configuration flexibility to meet the needs of various applications
- Minimize lead times with global CTOS capability

## 5. Automation and Control

- Unique SoftMotion kernel and innovative GigE Vision offload engine using FPGA, DSP and ARM as the core-computing platform
- Provides versatile solutions and optimum motion/vision performance for fulfilling the demands of OEM machine makers and system integrators

## 6. Industrial Connectivity

- Robust, reliable, and sophisticated connectivity from the network edge to the network core
- Transmit data over copper cables, fiber optics, and wireless connections
- Flexible access to network status via multiple industrial protocols

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### Machine Vision & AI AOI

- Easy multi-task configuration without programming
- Intuitive menu-driven GUI shortens the learning curve

### Modular IPC

- Comprises compact modularized systems
- Diverse selection of CPUs, flexible I/O expansion, and slot expansion for various applications

### Intelligent System

- High-performance fan-based system for motion and vision applications
- Diverse form factor options

### Server, GPU, and Storage

- Xeon® Scalable processor for high performance computing
- CPU/GPU hybrid technology for image analytic applications
- Supreme server DTOS for optimal customization

# EtherCAT Control Platforms

## AMAX-5000 Series

### AMAX-5580 + Slice I/O

6th Gen Intel®. Core™ i7/i5/Celeron Modular Controller with Multiple EtherCAT Slice I/O Expansion

### AMAX-5570 + Slice I/O

Intel® ATOM™ X Series Ultra Compact Controller with Multiple EtherCAT Slice I/O Expansion

### Real-Time Control Optimization

- BIOS optimization for stable processor clock
- Real-time core integration for Windows/Linux operating systems
- Robust and compact design meeting industrial-grade environmental requirements

### Embedded Operating System for Industrial Control

- Flexible hot-swap power for automation equipment system design
- Faster boot times compared to standard operating systems
- Long-term support to meet industrial-grade application requirements

### Wireless Communication Expansion Capability

- Host compatible with LTE/Wi-Fi modules, offering installation flexibility
- Support for up to 4 antennas to meet 5G communication needs

### AMAX-5000 EtherCAT I/O Expandability
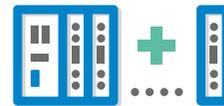
- Digital input/output modules
- Analog input/output modules
- Encoder/counter modules
- Communication modules

### PCIe Module Expandability
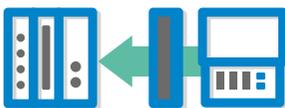
- PCIe expansion modules compatible with industrial aluminum rail mounting
- AMAX-5400 series expansion I/O modules
- DAQ-964 series high-speed I/O data acquisition modules

### Designed Specifically for Real-Time Control Software Developers

- The AMAX-5580/5570 is designed specifically for industrial real-time control software developers, with hardware and software integration expertise from globally renowned brands like CODESYS, Acontis, and Movensys.

## AMAX-5580 Modular Controller with Multiple EtherCAT Slice I/O Expansion



### iDAQ Card Expansion

| 10 KHz |
| 24-Bit Resolution |
| Internal Buffer |

### PCIe System I/O Expansion

| 4 x USB | 2 x LAN (PoE) |
| 2 x COM | 2 x CAN Bus |
| 1 x Profibus | 1 x mPCIe |

### EtherCAT I/O Expansion

| Width of 12 mm | 16-Bit Resolution |
| DI/DO Timestamp | Relay Output |
| Analog Temperature / Thermocouple | Encoder/Counter |

## AMAX-5570 Ultra-Compact Controller with Multiple EtherCAT Slice I/O Expansion

Internal mPCIe Expansion Slot for mSATA / NVRAM / Wi-Fi Modules

Internal M.2 B-Key Expansion Slot for LTE Wireless / SATA Storage



### Communication I/O Expansion

| 1 x mPCIe Slot |
| 1 x M.2 B-Key Slot |

### Industrial Fieldbus I/O Expansion

| 2 x COM Port |
| 2 x CAN Bus |
| EtherCAT I/O |

# EtherCAT Programmable Edge Controllers
## AMAX-600 Series



**AMAX-658**

6th Gen Intel® Core™ i7/i5/Celeron™ Modular Programmable Edge Controller with Multiple EtherCAT Slice I/O Expansion

**AMAX-657**

Intel® ATOM™ X Series Cabinet Programmable Edge Controller with Multiple EtherCAT Slice I/O Expansion

**AMAX-637**

Intel® ATOM™ E Series Cabinet Programmable Edge Controller with 1 x iDoor Expansion

## | Advantech CODESYS Software Structure |

### CODESYS Development Environment (IDE)

| Fundamental | Engineering | | Advantech Add-Ons | |
|---|---|---|---|---|
| CODESYS Application Composer | Debugger | CODESYS Fieldbus | APAX 5000 I/O Library | AMAX 5000 I/O Library |
| CODESYS Professional Develop. Edition | Compiler | CODESYS Visualization | ADAM 4000 I/O Library | AMAX 4/5xxx Application Template |
| | Project Configuration | CODESYS Motion+CNC | ADAM 6000 I/O Library | PCM/UNO Peripheral Mapping |
| CODESYS Library | IEC61131-3 Editors | IEC61131-3 Libraries | AMAX 42xx Motion Drive Library | 3rd Party Motion Drive Library |

### Windows Service

| Advantech CODESYS Agent | EdgeSync 360 |
|---|---|
| MQTT | EdgeLink |
| MQTT/SparkPlug | DeviceOn |
| WebAccess/SCADA | WebAccess |
| WISE-PaaS/DataHub | EdgeHub 2.0 |

### Advantech CODESYS Runtime Engine (RTE) Toolkit

| Fieldbus Support | | Advanced Motion | | Additional Products | |
|---|---|---|---|---|---|
| ModbusTCP (Server/Client) | ModbusRTU (Client) | SoftMotion | CNC & Robotics | OPC UA Server | CODESYS PLC Handler |
| EtherCAT MainDevice | CANopen Manager | Visualization | | Redundancy Control | Multi-Core |
| Profinet I/O-Controller | Profibus Master | Target Visu | Web Visu | CODESYS Safety SIL2/SIL3 | C-Integration |
| Ethernet/IP Scanner | | | | | |

**Add-On Selected Package**

**Advantech Developed Functions**

**CODESYS Base Package**

**CODESYS Expert Function**
(Not supported by Advantech)

# COSESYS Real-Time Software Solution

**CODESYS**

## Compatible with IEC 61131-3 Standard Programming Language Development

CODESYS Real-Time Control Software incorporates both native function blocks (FB) from CODESYS and additional function blocks developed by Advantech's application team, offering capabilities like high-speed I/O communication, logic control, and motion control. With Advantech's CODESYS Agent software service, you can seamlessly integrate parameter data from CODESYS programming into higher-level languages or third-party software for cloud-based control and monitoring. The CODESYS development environment provides a range of programming languages, from ladder logic (LADDER) to high-level graphical programming (UML), ensuring stability and integrity in industrial control logic, as recognized by global industrial control experts and engineers.

## Advanced CODESYS Optional Features

**SoftMotion**
- Function Blocks Defined According to PLCopen Association's MotionControl - Part 1 Chapter
- Related Function Blocks for MC_Move
- Electronic Gear/CAM Switches
- Position Capture/Skip Abort (MC_TouchProbe, MC_AbortTrigger)

**CNC and Robotics**
- G-Code Conversion/Processing (Read Files and Execute CNC Trajectories)
- Interpolation Functions Including Override Handling
- Coordinate Axis/Polar Transformations
- 2D/3D Motion Control (H-portals or T-portals)
- Six-Axis Articulated Arm Robots
- Gantry Robots, Bipedal Robots, SCARA Robots

**Control Redundancy**
- SwitchOver Time: 50 ms
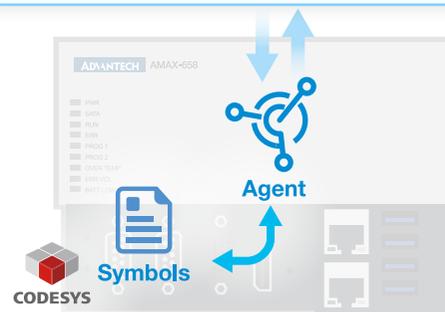- Support for Industrial Bus Communication Protocols: ModbusTCP/EtherCAT

**Multi-Core**
- Allocate Multi-Core Processors for Programming Task Scheduling and Management

Visualization

CODESYS RTE

SoftMotion

CNC Robotics

## Advantech CODESYS Agent

Advantech's CODESYS Agent facilitates data exchange between the CODESYS runtime engine and external environments, including third-party software and cloud backends. It oversees read and write permissions for CODESYS programming's declared variable points (symbols). Developers can use development API examples in C++ and C# to efficiently work with control program parameters, enabling IT and OT integration applications.

- ✓ Utilizing memory sharing (shared memory) for faster data exchange.
- ✓ Sharing the same declaration names and syntax for CODESYS internal variables.
- ✓ Managing data access permissions within the controller and enabling access by third-party software or cloud backend.

Cloud

MATLAB
python
Visual Studio
.NET
LabVIEW

3rd-Party
Application S/W

AMAX-658

Agent

Symbols

CODESYS

# PC-Based EtherCAT Motion Controller
## AMAX-300 Series

USB x 2

Ethernet x 2

HDMI x 1

AMAX-5000 Series
EtherCAT Slice I/O Expansion

EtherCAT Port for Connecting
Third-Party Servo/Stepper
Systems and I/O Modules

· Cycle Time: 500 µs
· 32-Axis Control
· 512-Byte I/O
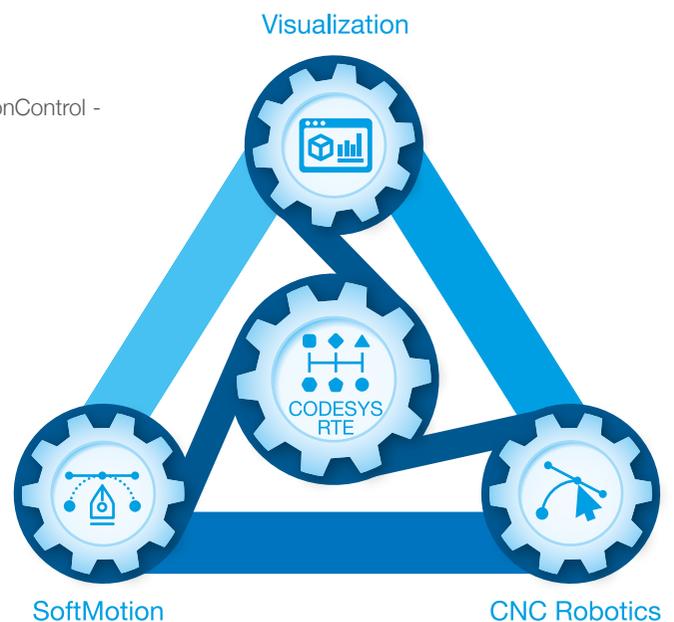
**AMAX-357**  |  **MotionNavi API**

Intel® ATOM™ Ultra-Compact PC-Based EtherCAT Motion Controller

Motion Control and Vision
Alignment Integration

3C Assembly Inspection and
Transfer Equipment

intel
partner
Titanium
IoT Solutions

## Compact Size, High-Efficiency Computing

AMAX-357, with its compact 100 x 70 x 48 mm size, offers space-saving advantages when paired with the AMAX-5000 slice I/O expansion module. It features dual processors: one for EtherCAT protocol and motion control algorithms, and the other, an Intel Atom quad-core CPU, capable of running Windows applications. This integration enhances overall reliability.
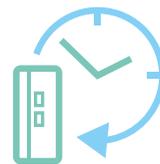
## Outstanding Real-Time Performance

AMAX-357 utilizes an SoC (System-on-a-Chip) processor for executing EtherCAT protocol, packet processing, and motion control algorithms. It operates independently, providing superior real-time performance compared to Windows. This unique design enables users to achieve 500 microseconds of real-time capability and control up to 32 axes of motion when connecting I/O and motion devices to the EtherCAT network.

## Flexible EtherCAT Topology Structure

AMAX-357 offers various EtherCAT SubDevice connection options. Users can expand I/O using the AMAX-5000 slice I/O system or choose any I/O modules as needed. Additionally, AMAX-357 provides an external EtherCAT port for expanding third-party servo/stepper drives and I/O systems.

## Convenient EtherCAT Tools

AMAX-357 is a PC-based, all-in-one EtherCAT motion controller. In addition to the new MotionNavi API library, users also have access to two helpful tools: one for EtherCAT ESI/ENI, which enables easy setup and management of EtherCAT network information, and the other for EtherCAT analysis, providing a graphical topology display and detailed network information for a quick understanding of network status.

## Powerful SoftMotion Kernel

With over 15 years of experience in equipment automation, Advantech offers a proven SoftMotion kernel. This kernel, validated and optimized through real-world applications, provides more than just basic motion control. It includes application-specific libraries for tasks like vision inspection, dispensing control, single-axis, and multi-axis continuous motion, electronic gear/cam functions, and more.

## Diverse PC-based Development Support
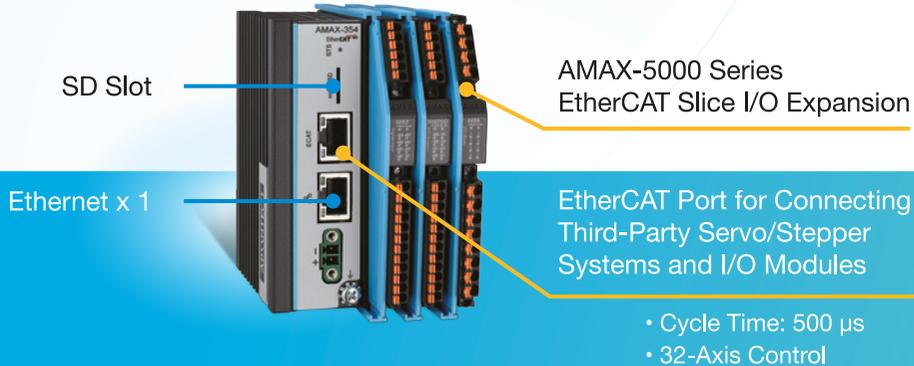
AMAX-357, based on the Wintel architecture, provides the MotionNavi API library for program developers to facilitate system integration, testing, and debugging. The MotionNavi library is compatible with C/C++ and Visual Studio .NET and offers VI controls for LabVIEW users. Upon driver installation, all development resources, including user manuals and sample programs, are readily available.

# ARM-Based EtherCAT Motion Controller

## AMAX-300 Series

SD Slot

AMAX-5000 Series
EtherCAT Slice I/O Expansion

Ethernet x 1

EtherCAT Port for Connecting
Third-Party Servo/Stepper
Systems and I/O Modules

• Cycle Time: 500 μs
• 32-Axis Control

Visual Processing PC and
MotionControl I/O
Dual System Architecture

**AMAX-354**     **MotionNavi Designer**

Modular Production
Line System

Dual-Core Cortex A9 Ultra-Compact ARM-Based EtherCAT Motion Controller

## Compact and Powerful Design

The compact AMAX-354, measuring 100 x 70 x 34 mm, is compatible with the AMAX-5000 slice I/O expansion module, reducing cabinet installation space. It utilizes a cost-effective SoC design with Cortex A9 performance for efficient EtherCAT communication and motion control. AMAX-354 also offers support for Modbus TCP and TCP/IP for device interfacing.

## Combining Efficiency and Utility

AMAX-354, powered by an SoC core processor, handles EtherCAT protocol, packet processing, and motion control. It ensures real-time I/O and motion device connectivity within the EtherCAT network with a 500 μs performance guarantee, supporting up to 32 motion control axes. With an I/O capacity of up to 1024 channels of DI/DO and 128 channels of AI/AO, AMAX-354 can connect directly to the AMAX-5000 slice I/O system, expandable up to 8 slots, with a 1-ampere power supply.

## Low-code Development Environment

MotionNavi Designer, which supports AMAX-354, is a low-code integrated development environment (IDE). It offers a visual user interface for programming similar to BASIC with low-code commands. It also provides auxiliary tools to assist developers, including tree view displays of EtherCAT network nodes, simplifying motion control debugging, system and VR variable management. 3D path displays and oscilloscopes help inspect motion curves.

## Flexible EtherCAT Topology Structure

AMAX-354 offers various EtherCAT SubDevice connection options. Users can expand I/O using the AMAX-5000 slice I/O system or choose any I/O modules as needed. Additionally, AMAX-354 provides an external EtherCAT port for expanding third-party servo/stepper drives and I/O systems.

## Convenient EtherCAT Tools

MotionNavi Designer facilitates EtherCAT network configuration with:
• EtherCAT ESI Configuration Tool: Import ESI files for ENI generation.
• EtherCAT Diagnostic Tool: Monitor network status and node communication quality.
• Dynamic PDO Configuration: Flexibly allocate PDO packet sizes, e.g., inserting SDO for synchronized communication with the EtherCAT MDevice.
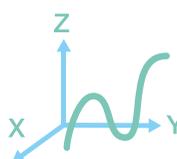
## Powerful SoftMotion Kernel

The SoftMotion algorithm on AMAX-354 operates on the system SoC, ensuring overall processing efficiency and real-time performance. In addition to basic motion control, SoftMotion provides application-oriented libraries, such as position comparison and trigger output for vision inspection and dispensing control, path table functions for single and multi-axis continuous motion, electronic gear/cam, and more.

# MotionNavi Designer Motion Control Software

**Tuning & Test Tool**
Point-to-point,
HOME, JOG test

**Offline Simulation**
Simulation without
hardware installation

**3D Path Display**
Visualized motion
trajectory by XYZ
dimension

**Coding Help**
No need to remember
all commands

**Motion**Navi Designer

**Status Monitoring**
Axis, I/O, system and
VR (variable) status

**Rapid Deployment**
EtherCAT configuration
tool – simple step to
initialize network

**BASIC Low-Code
Commands**
Easy-to-learn commands,
helpful for developing in a
short time frame

**Oscilloscope**
Monitor motion
status in real time

## Easy Development, Effortless Control Configuration

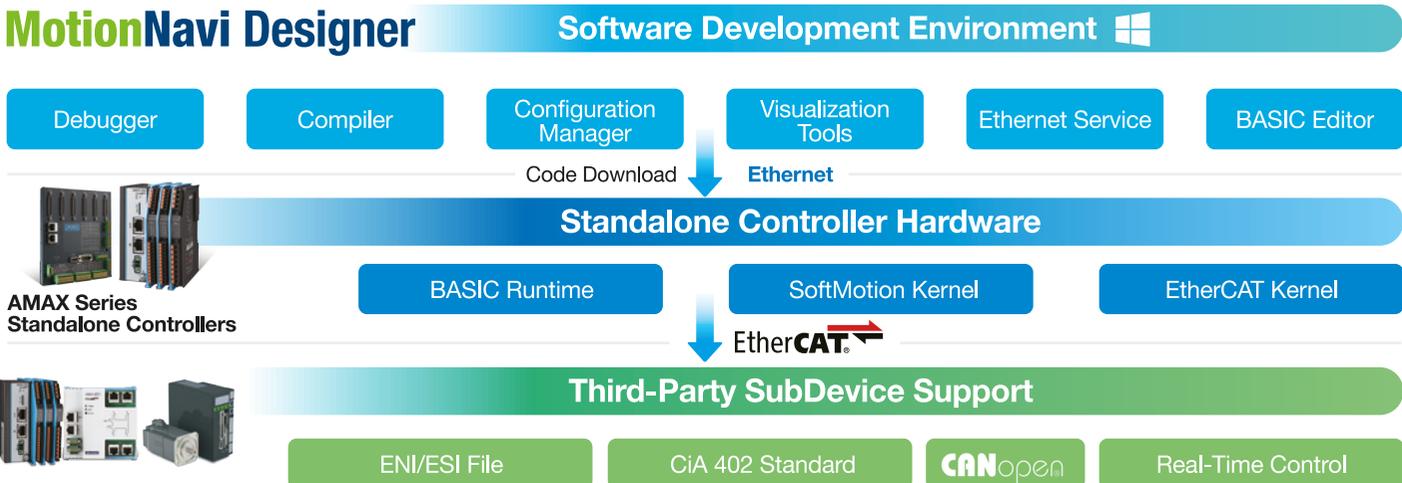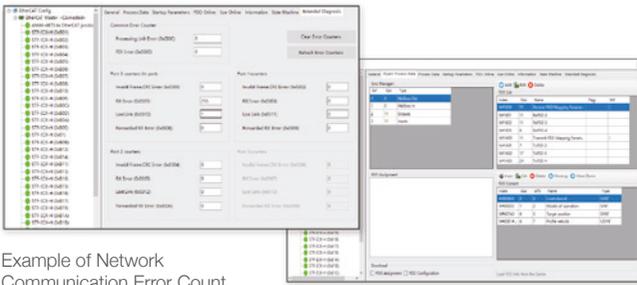MotionNavi Designer is a low-code integrated development environment (IDE) with a visual interface for Advantech's standalone motion controllers. It's compatible with Windows OS and enables tasks like EtherCAT SubDevice configuration, network communication diagnostics, motion control testing and debugging, and trajectory analysis. It streamlines application-specific code development. After coding and debugging, the compiled code can be downloaded and executed on standalone motion controllers.

## Quick Start, Flexible, and Feature-Rich Applications

MotionNavi Designer simplifies low-code development with a BASIC-like syntax, ideal for developers with basic PC experience. It supports multi-tasking with up to 10 processes on AMAX-354. Users can share data via the main program, subprograms, and variables for flexible control. The software includes tools for analyzing EtherCAT network quality, motion control, parameter tuning, and VR variables.

**Motion**Navi Designer — Software Development Environment

| Debugger | Compiler | Configuration Manager | Visualization Tools | Ethernet Service | BASIC Editor |

Code Download — Ethernet

**Standalone Controller Hardware**

| BASIC Runtime | SoftMotion Kernel | EtherCAT Kernel |

**AMAX Series
Standalone Controllers**

EtherCAT

**Third-Party SubDevice Support**
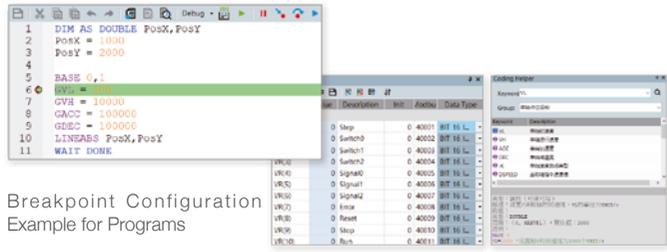
| ENI/ESI File | CiA 402 Standard | CANopen | Real-Time Control |

## ✓ EtherCAT Assistant Tool



Example of Network Communication Error Count Monitoring and Analysis

Example of PDO Data Configuration

- **ESI (EtherCAT SubDevice Information) Configuration**

  Import ESI pages and generate ENI (EtherCAT Network Information) to support third-party SubDevices using standard EtherCAT protocol.

- **EtherCAT Network Topology**

  Visualize and display the topology of SubDevices connected to the EtherCAT master in a tree-like structure, allowing easy identification of connection issues.

- **EtherCAT Network Connection Quality Analysis**

  Monitor error connection counts for each SubDevice, identifying unstable connections or those affected by signal interference, thus reducing debugging time.

- **PDO Data Configuration**

  Map SDO data that requires real-time updates, such as motor current, torque, or temperature, to PDO packets through this tool for periodic data updates.

## ✓ Controller Assistant Tool



Selection Screen for Offline Simulation Example

Search for Controllers in the Same Domain Example

Automatic Program Backup Example

- **Support for Offline Motion Control Simulation**

  Users can perform offline motion control development and simulation using MotionNavi Designer, offering flexibility during development.

- **Automatic Domain Controller Discovery**

  Automatically scans and lists controllers within the same network domain along with their information.

- **Automatic Program Backup**

  MotionNavi Designer periodically and automatically backs up information to prevent program loss due to system crashes or forgetting to save files.

- **System Real-Time Clock (RTC) Configuration**

  Users can manually set the date and time or synchronize it with the date and time of the development computer, facilitating timestamping in log records for reference.

## ✓ Programming Assistant Tool



Breakpoint Configuration Example for Programs

Example of VR Variable Table Display Format

Example of Program Assistant

- **Configurable Program Breakpoints**

  Users can set breakpoints in the program to execute the code step by step, facilitating error troubleshooting.

- **Custom Variable Display**

  Users have the flexibility to define variable names and add them to the Watch Window. This allows them to observe the correctness of variable values during program debugging.
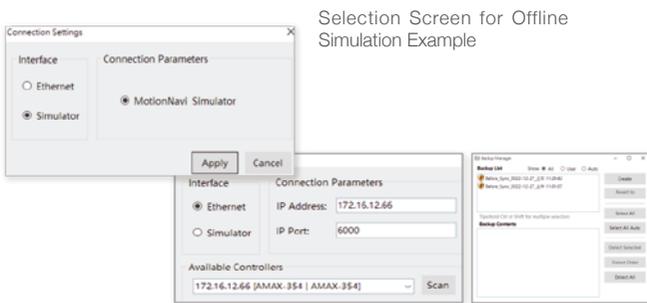
- **VR Variable List Presentation**

  MotionNavi Designer treats VR (Virtual Registers) as global variables, enabling Modbus address mapping for data exchange, ensuring an organized variable list.

- **Program Assistant**

  MotionNavi Designer provides in-program explanations for easy information retrieval using keywords, parameter explanations, and direct execution of application examples during debugging.

## ✓ Status & Monitor Tool

Controller Status Example

3D Motion Path Display Example



Example of Tabular Presentation of Motion Status Information for Each Axis

- **Controller Status Overview**

  Presented in a tabular format, it displays the number and status of controller tasks, error codes, firmware information, system time, etc.

- **Motion Control Axis Status**

  Presented in a table, it provides data on mechanical I/O status for each motion axis, including limit signals, home signals, EZ markers, motor warning signals, position, speed, and operational status.

- **Controller I/O Status and Control**

  Presented in tabular form, but separated into digital and analog signals.

- **Motion Control Trajectory Display**

  Visualizes motion trajectories, allowing users to choose between 2D or 3D representations for easy verification of path accuracy.

# EtherCAT I/O Expansion Module

## AMAX-4800 & 5000 Series

**EtherCAT**

Advantech's AMAX-4800 Distributed I/O and AMAX-5000 Slice I/O both utilize the latest industrial automation technology, EtherCAT, to provide high stability and versatility in solutions, catering to a wide range of user needs. Advantech offers the economically efficient and reliable AMAX-4800 Distributed EtherCAT Remote I/O series for various use cases, as well as the compact, highly flexible, and expandable AMAX-5000 EtherCAT Slice I/O series.

## AMAX-5000 Series Coupler Modules

### # Stable and Flexible Communication Protocol Conversion

✓ Offers EtherCAT cable redundancy to enhance overall system reliability.

✓ Paired with high-density and versatile function I/O modules, it offers extremely flexible topology configuration and expansion capabilities.

✓ The underlying I/O all utilize the standard EtherCAT communication protocol, enhancing stability and system setup efficiency.

✓ It interfaces with widely used communication protocols, making it compatible with controllers from various manufacturers.

**AMAX-5070**

Modbus TCP Coupler

**Modbus TCP**

**EtherCAT**

**AMAX-5072**

EtherNet/IP Coupler

**EtherNet/IP**

**EtherCAT**

**AMAX-5074**

EtherCAT Coupler

**EtherCAT**

**EtherCAT**
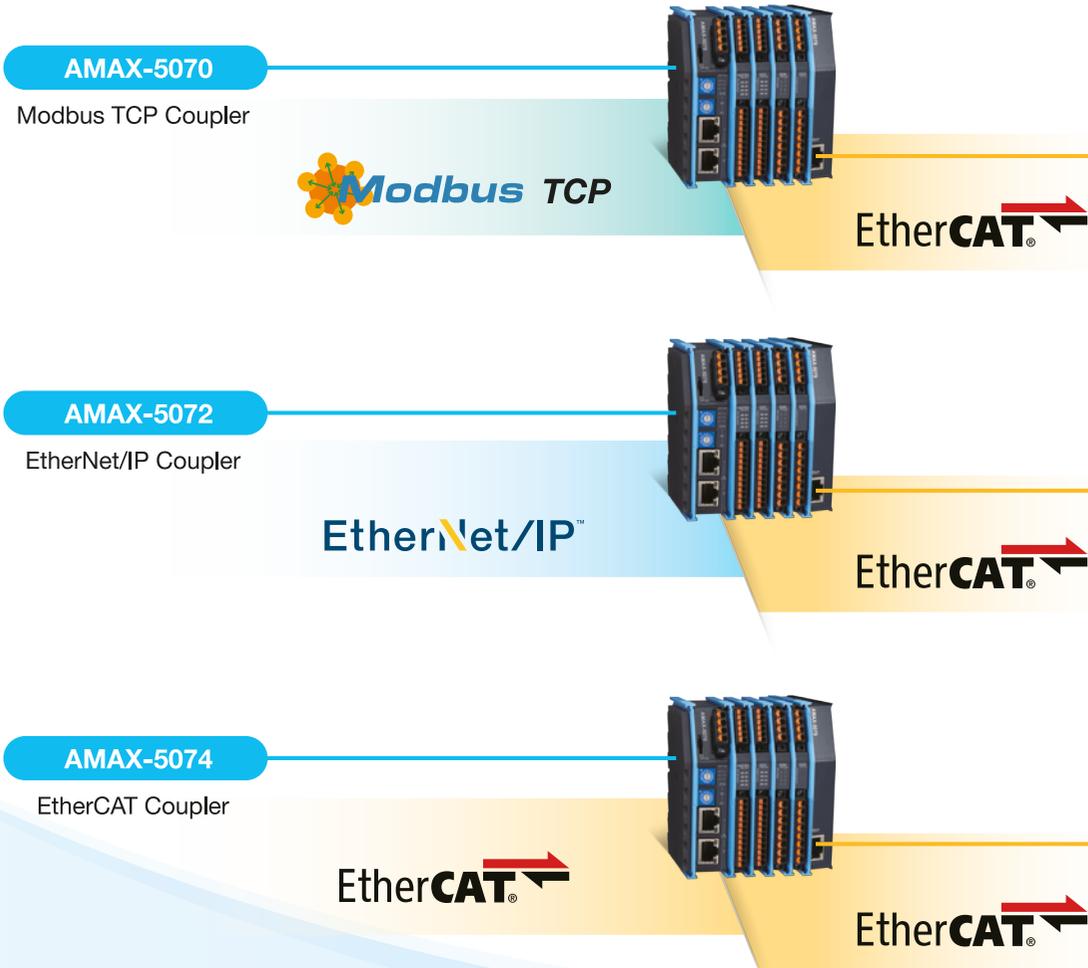
## AMAX-5000 Series Slice I/O Modules

# High Flexibility  # High Scalability

☑ Modular design allows flexible configuration of various I/O based on different needs.

☑ Unique screw-in terminal design prevents blocking of I/O indicator lights.

☑ All use EtherCAT standard communication, reducing setup time.

☑ Compared to conventional modules, slice-type modules can provide higher density and a variety of I/O functions within the same unit area.

☑ All modules are equipped with minimum 1500 $V_{DC}$ isolation protection.

| AMAX-5001 | AMAX-5079 | AMAX-5000 Slice I/O Module |

Dual-Channel Power Input Module

EtherCAT Expansion Module

• 8-channel/16-channel digital input/output
• 4-channel relay output
• 6-channel thermistor/thermocouple
• 6-channel analog input
• 4-channel high-speed analog input
• 4-channel analog output
• Absolute/incremental encoder/decoder
• Timestamped digital input/output

EtherCAT®

| AMAX-4800 Remote I/O Module |

• 16-channel/32-channel digital input/output
• 4-channel/8-channel analog input/output
• 6-port star topology hub

| AMAX-4870 |

EtherCAT Star Topology Hub Module

## AMAX-4800 Remote I/O Modules

# High Stability  # Cost-Effective

☑ All modules have dual power inputs and I/O isolation protection.

☑ A variety of basic I/O function modules: digital/analog input and output, topology hub modules.

☑ Distributed high-density I/O provides cost-effectiveness and stability.

☑ Prominent I/O status indicator lights for clear and easily distinguishable operational status.

☑ Compatible with controllers using various EtherCAT standard communication protocols from different manufacturers.

# EtherCAT Control Platforms
## AMAX-5000 Series



| Model | AMAX-5570 | AMAX-5580 |
|---|---|---|
| Description | Intel® ATOM™ X Series Cabinet Control Platform with EtherCAT Slice I/O Expansion | Intel® Core™ i7 / i5 / Celeron Modular Control Platform with EtherCAT Slice I/O Expansion |
| **System Hardware** — BIOS | AMI EFI 128Mbit Flash BIOS | AMI EFI 128Mbit Flash BIOS |
| Watchdog Timer | Programmable 255-level timer interval, from 1 to 255 sec | Programmable 255-level timer interval, from 1 to 255 sec |
| Processor | Intel® Atom™ x6413E 1.5GHz | Intel® Core™ i7-6600U 2.6GHz, Dual Core  Intel® Core™ i5-6300U 2.4GHz, Dual Core  Intel® Celeron 3955U 2.0GHz, Dual Core |
| Memory | DDR4 2666MHz, 4GB | "DDR4 2666MHz, 4GB for Celeron™ / 8GB for i5/i7 (two socket support up to 16G)" |
| Graphics Engine | 10th Gen Intel® UHD Graphics | 9th Gen Intel® LP GT2 |
| Ethernet | Realtek 8119I GbE, IEEE 802.3/802.3u/802.3ab | Intel® i210-IT GbE, 802.1Qav, IEEE1588/802.1AS, 802.3az |
| LED Indicators | LEDs for Power, Run(Programmable), LAN (LINK, ACT) | LEDs for Power, Storage, Run(Program) and Abnormal status, LAN (LINK, ACT) |
| Storage | 1 x 64GB eMMC on board | 1 x  M.2 2280 M-Key slot for SATA storage |
| Expansion | 1 x Full-size mPCIe (PCIe / USB 2.0 / SATA signal)  1 x M.2 2242 B-Key (USB 3.0 / SATA signal) | 1 x Full-size mPCIe (PCIe / USB 2.0 signal)  AMAX-5400 PCIe expansion modules, optional for left side (max.4)  AMAX-5000 EtherCAT slice I/O modules, optional for right side |
| **I/O Interfaces** — Serial Ports | 1 x RS-232/422/485 (terminal), 50 ~ 115.2kbps  1 x 485 (terminal), 50 ~ 115.2kbps  Isolated voltage 2500V$_{DC}$ | 2 x RS-232/422/485 (DB9), 50 ~ 115.2kbps |
| CAN ports | 2 x CAN Bus (terminal), adjustment up to 1Mbps (terminal block)  Hardware support CAN 2.0 A/B, Linux support Socket CAN, advCAN  Isolated voltage 2500V$_{DC}$ | NA |
| LAN Ports | 2 x RJ-45, 10/100/1000 Mbps 1000BASE-T Fast Ethernet | 2 x RJ-45, 10/100/1000 Mbps 1000BASE-T Fast Ethernet |
| USB Ports | 2 x USB ports (USB 3.2 compliant) | 4 x USB ports (USB 3.0 compliant ), 1 x internal USB |
| Display | 1 x HDMI, support up to 1920 x 1080 @60Hz | 1 x VGA, support up to 1920 x 1200 @60Hz  1 x HDMI, support up to 4096 x 2160 @24Hz |
| Isolation | CAN & serial port isolation (2500Vdc) | - |
| Grounding Protection | Chassis grounding | Chassis grounding |
| Power Connector | 1 x 2 Pins | 1 x 7 Pins, dual power input with alarm output |
| **General** — Power Requirement | 24 V$_{DC}$ ± 20% | 24 V$_{DC}$ ± 20% |
| Power Consumption | 15.8W (typical), 35W (max.), 60W (Slice I/O local supply) | 15 W (Typical), 42 W (Max) |
| OS Support | Support Microsoft® Windows 10 64-bit  Adv Ubuntu 20.04 | Support Microsoft® Windows 10 64bit, WES 7 32-/64-bit  Adv Ubuntu Linux 18.04/20.04 |
| Enclosure | Aluminum housing | Aluminum alloy and ziny alloy housing |
| Mounting | DIN-rail | DIN-rail |
| Weight (Net) | Approx. 0.7 kg | Approx. 1.3 kg |
| Dimensions (W x H x D) | 48.8 x 100 x 70 mm | 139 x 100 x 80 mm |
| Certification | CE, FCC, UL61010-1, BSMI(pending) | CE, FCC, UL, CCC, BSMI |
| **Environment** — Operating Temperature | -20 ~ 60°C (-4 ~ 140°F) @ 5 ~ 85% RH with 0.7 m/s airflow | -10 ~ 60°C (14 ~ 140°F) @ 5 ~ 85% RH with 0.7m/s airflow |
| Storage Temperature | -40 ~ 85°C (-40 ~ 185°F) | -40 ~ 85°C (-40 ~ 185°F) |
| Relative Humidity | Operating, 95% RH@40°C, Non-Condensing  Non-Operating, 95% RH@60°C, Non-Condensing | 95% RH @ 40°C, non-condensing |
| Shock Protection | Operating, IEC 60068-2-27, 50G, half sine, 11 ms | Operating, IEC 60068-2-27, 10G, half sine, 11 ms |
| Vibration Protection | Operating, IEC 60068-2-64, 2 Grms, random,  5 ~ 500 Hz, 1hr/axis (eMMC) | Operating, IEC 60068-2-64, 1 Grms, random,  5 ~ 500 Hz, 1hr/axis (M.2) |

# EtherCAT Programmable Edge Controllers
## AMAX-600 Series



| Model | AMAX-637 | AMAX-657 | | AMAX-658 | | |
|---|---|---|---|---|---|---|
| Description | Intel® ATOM™ X Series Cabinet Controller with 1 x iDoor Expansion | Intel® ATOM™ X Series Cabinet Controller with EtherCAT Slice I/O Expansion | | Intel® Core™ i7 / i5 / Celeron Modular Controller with EtherCAT Slice I/O Expansion | | |
| Part Number | AMAX-637-E1CW00A | AMAX-657-E2CW00A | AMAX-657-E2CW0RA | AMAX-658-6CCW00A | AMAX-658-65CW00A | AMAX-658-67CW00A |
| **SoftLogic** — Runtime | CODESYS Control RTE V3.5 SP18 | | | | | |
| Visualization | Target Visualization (Local HMI), Web Visualization (Web Browser) | | | | | |
| Advances Motion Control | SoftMotion & CNC Robotics (Optional-Upgrade from Advantech Marketplace) | | | | | |
| Industry Ethernet | EtherCAT MainDevice, PROFINET I/O-Controller, EtherNet/IP Scanner (IEC/CIFX), MODBUS/TCP Server and Client, MODBUS/RTU Client (Master)PROFIBUS Master & CANopen Manager | | | | | |
| Uplink | OPC UA Server, MQTT (Sparkplug), ODBC for Database (by Advantech developed SW functions) | | | | | |
| Motion Control Capability | 32-axis，1ms cycle time | 64-axis，1ms cycle time | | 64-axis，1ms cycle time | 128-axis，1ms cycle time | 256-axis，1ms cycle time |
| **Sysem Hardware** — Processor | Intel® Atom™ 1.2GHz | Intel® Atom™ 1.5GHz | | Intel® Celeron™ 2.0GHz | Intel® Core™ i5 2.4GHz | Intel® Core™ i7 2.6GHz |
| Memory | 8GB | 4GB | | 4G | 8G | 8G |
| Storage | 128GB SSD | 64GB eMMC | | | | |
| Retained Memory | 4MB | - | 4MB | 4MB | | |
| Expansion | 1 x 2.5" SSD/HDD slot | 1 x mPCIe 1 x M.2 B-Key AMAX-5000 Slice I/O module | 1 x M.2 B-Key AMAX-5000 Slice I/O module | AMAX-5400 PCIe module (max.4) AMAX-5000 Slice I/O module | | |
| **I/O Interfaces** — Local Digital Input/Output | 8 x Digital Input (Wet/Dry), 8 x Digital Output (Sink) | - | | - | | |
| Serial Ports | 2 x RS-232/422/485 (terminal) | 1 x RS-232/422/485, 1 x RS-485 (terminal) 2 x CAN Bus (terminal) | | 2 x RS-232/422/485 (DB9) | | |
| LAN Ports | 2 x RJ-45, 10/100/1000 Mbps IEEE 802.3u 1000BASE-T | 2 x RJ-45, 10/100/1000 Mbps IEEE 802.3u 1000BASE-T | | 2 x RJ-45, 10/100/1000 Mbps IEEE 802.3u 1000BASE-T | | |
| USB | 3 x USB ports, 1 x USB port | 2 x USB ports | | 4 x USB ports, 1 x internal USB | | |
| Display | 2 x DP 1.2 | 1 x HDMI | | 1 x VGA, 1 x HDMI | | |
| Isolation | DI & DO & Serial Ports (2500V$_{DC}$) | CAN & Serial Port isolation (500V$_{DC}$) | | - | | |
| Grounding Protection | Chassis grounding | Chassis grounding | Chassis grounding (common electrical ground with the board end) | Chassis grounding | | |

\* 4MB only supported for CODESYS versions newer than SP18

# PCI/PCIe EtherCAT Motion Control Cards

| Model | | PCI-1203 | PCIE-1203IO | PCIE-1203L | PCIE-1203 | PCM-26R1EC |
|---|---|---|---|---|---|---|
| Interface (Bus) | | PCI | PCIe | PCIe | PCIe | Mini PCIe (iDoor) |
| Axes | | 6/10/16/32 | - | 64 | 64 | - |
| Motion Function | PTP | v | - | v | v | - |
| | LINE | v | - | v | v | - |
| | Trajectory | v | - | - | v | - |
| | Synchronization | v | - | - | v | - |
| Local Motion I/O | General Purpose DI Channels | 8 | - | - | 4 | - |
| | General Purpose DO Channels | 4 | - | - | 2 | - |
| | Encoder In | - | - | - | 2 | - |
| | MPG | - | - | - | 1 | - |
| | Compare Trigger | - | - | - | 2 | - |
| | Position Latch | - | - | - | 2 | - |
| I/O Expansion | Remote I/O | 1024-CH DI and 1024-CH DO | | | | |
| | | 128-CH AI and 128-CH AO | | | | |
| Connectors | | 2 x RJ-45, D-sub 15 | 2 x RJ-45 | 2 x RJ-45 | 2 x RJ-45, D-sub 26 | 1 x RJ-45 |

# EtherCAT Motion Controllers
## AMAX-300 Series

| Model | | PC-Based | | ARM-Based | |
|---|---|---|---|---|---|
| | | **AMAX-357-32AE** | **AMAX-357-00AE** | **AMAX-354-32AE** | **AMAX-354-00AE** |
| Software | SDK/IDE | MotionNavi API | | MotionNavi Designer | |
| | Language | C/C++, C#, LabVIEW, VB.Net | | Advantech BASIC | |
| System | CPU | Atom®x6413E, 4C, 1.5GHz | | Cortex A9 | |
| | USB | 2 | | - | |
| | Serial | - | | - | |
| | SD Slot | - | | 1 | |
| | Ethernet LAN | 2 x RJ-45 | | 1 x RJ-45 | |
| | Display | 1 x HDMI | | - | |
| EtherCAT | Port | 1 | | | |
| | Axis | 32 | - | 32 | - |
| | I/O | 1024-CH DI and 1024-CH DO, 128-CH AI and 128-CH AO | | | |
| Local Expansion I/O | Slice I/O | AMAX-5000 Series I/O (Up to 8pcs) | | | |
| Dimensions | W x H x D (mm) | 48 x 100 x 70 | | 34 x 100 x 70 | |

# Infrastructure Modules

## AMAX-5000 Series Slice I/O

| Model | AMAX-5001 | AMAX-5074 | AMAX-5070 | AMAX-5072 | AMAX-5079 |
|---|---|---|---|---|---|
| Description | 2-ch Power Input with 4-ch Digital Input EtherCAT Slice I/O Module | EtherCAT Coupler with ID Switch Slice I/O Module | Modbus TCP Coupler with ID Switch Slice I/O Module | EtherNet/IP Coupler with ID Switch Slice I/O Module | EtherCAT Extension Slice I/O Module |
| Power Requirement | 24 $V_{DC}$ ± 20% | 24 $V_{DC}$ ± 20% | 24 $V_{DC}$ ± 20% | 24 $V_{DC}$ ± 20% | - |
| Dual Power Input | Supported | Supported | Supported | Supported | |
| Max Current on Bus | 2A (provides power for approx. 10pcs AI/O modules or 20pcs DI/O modules) | | | | |
| Diagnosis Function | Over/Under voltage for input 1&2 Over current output on bus | | | | |
| Input Channels | 4-ch. (Digital Input) | - | - | - | - |
| Rating | **Wet Contact** Rated voltage: 24 $V_{DC}$ Logic level 1: 10~30 $V_{DC}$ and Logic level 1: -30~-10 $V_{DC}$ Logic level 0: -3~3 $V_{DC}$ | | | | |
| Input/Output Delay | From logic level 0 to 1: 4 ms From logic level 1 to 0: 4 ms | | | | |
| Digital Filter | 3 ms | | | | |
| Function | - | Coupling EtherCAT I/O modules to 100 BASETX EtherCAT network | Coupling EtherCAT I/O modules to Modbus TCP network | Coupling EtherCAT I/O modules to EtherNet/IP network | - |
| Cable | | Ethernet/EtherCAT cable (min. Cat. 5), shielded | | | |
| Distance Between Stations | | Max. 100 m (100BASETX) | | | |
| Bus Interface | | 2 x RJ-45 (1 x Input, 1 x Output) | 2 x RJ-45 (1 x Input, 1 x Output) | 2 x RJ-45 (1 x Input, 1 x Output) | 1 x RJ-45 |
| LED Indicator | PWR, RUN / ERROR, Power Diagnosis LED | | | | - |
| Interface | 100Mbps EtherCAT | | Modbus TCP | EtherNet/IP | 100Mbps EtherCAT |
| Power Consumption | 2W @ 24$V_{DC}$ | 2.5W @ 24$V_{DC}$ | 3W @ 24$V_{DC}$ | 3W @ 24$V_{DC}$ | No power from bus |
| Isolation | 2,000 $V_{DC}$ | LAN Port 1,500 $V_{DC}$ | | | |
| Weight (Net) | Approx. 84 g | Approx. 97 g | Approx. 167 g | Approx. 167 g | Approx. 71 g |
| Dimensions (W x H x D) | 12 x 106 x 95 mm | 27 x 106 x 95 mm | 29 x 106 x 95 mm | 29 x 106 x 95 mm | 27 x 106 x 95 mm |
| Certification | CE, FCC class A, cTUVus | | | | |
| Operating Temperature | -25 ~ 60°C (-14 ~ 140°F) | | | | |
| Storage Temperature | -40 ~ 85°C (-40 ~ 185 °F) | | | | |
| Relative Humidity | 95% RH @ 40°C, non-condensing | | | | |

# EtherCAT Digital I/O Modules
## AMAX-5000 Series Slice I/O

| Model | AMAX-5051 | AMAX-5052 | AMAX-5056 | AMAX-5057 | AMAX-5056SO | AMAX-5057SO | AMAX-5060 |
|---|---|---|---|---|---|---|---|
| Description | 8-ch Digital Input EtherCAT Slice I/O Module | 16-ch Digital Input EtherCAT Slice I/O Module | 8-ch Sink-type Digital Output EtherCAT Slice I/O Module | 16-ch Sink-type Digital Output EtherCAT Slice I/O Module | 8-ch Source-type Digital Output EtherCAT Slice I/O Module | 16-ch Source-type Digital Output EtherCAT Slice I/O Module | 4-ch Relay with 2-ch Digital Input EtherCAT Slice I/O Module |
| Input Channels | 8-ch | 16-ch | - | - | - | - | 2-ch |
| Output Channels | - | - | 8-ch | 16-ch | 8-ch | 16-ch | 4-ch (Relay) |
| Rating | **Dry Contact** Logic level 1: close to Iso.GND Logic level 0: open **Wet Contact** Rated voltage: 24 $V_{DC}$ Logic level 1: 10~30 $V_{DC}$ and -30~-10 $V_{DC}$ Logic level 0: -3~3 $V_{DC}$ **Typical Input Current** Logic level 1: 1.3mA~4.3mA (10V~30V) | | **Rated Voltage** 10~30 $V_{DC}$ **Rated Current Output** Logic level 1: 0.3 A per channel Logic level 0: 25 µA per channel (leakage current) | | **Rated Voltage** 10~30 $V_{DC}$ **Rated Current Output** Logic level 1: 0.5 A per channel Logic level 0: 10 µA per channel (leakage current) | | **Relay** Type: Form A (SPST) Contact Rating: 250 VAC @ 5 A, 30 $V_{DC}$ @ 5 A Breakdown Voltage: 500 VAC (50/60 Hz) **Wet contact** Rated Voltage: 24 $V_{DC}$ Logic level 1: 10~30 $V_{DC}$ Logic level 0: 0~3 $V_{DC}$ |
| Input/Output Delay | From logic level 0 to 1: 4 ms From logic level 1 to 0: 4 ms | | From logic level 0 to 1: 10 µs From logic level 1 to 0: 100 µs | | From logic level 0 to 1: 150 µs From logic level 1 to 0: 2 ms | | **Relay** Turn on delay: 6 ms Turn off delay: 3.5 ms Switch delay: 9.5 ms **Digital Input** Logic level from 0 to 1: 6 µs Logic level from 1 to 0: 45 µs |
| Digital Filter | 3 ms | 3 ms | - | - | - | - | Selectable |
| LED Indicator | PWR, RUN, ERROR, DI/O status | | | | | | |
| Interface | 100Mbps EtherCAT | | | | | | |
| Power Consumption | 2W @ 24$V_{DC}$ | 2W @ 24$V_{DC}$ | 2W @ 24$V_{DC}$ | 2.5W @ 24$V_{DC}$ | 2W @ 24$V_{DC}$ | 2.5W @ 24$V_{DC}$ | 2.5W @ 24$V_{DC}$ |
| Isolation | 2,000 $V_{DC}$ | | | | | | |
| Weight (Net) | Approx. 81 g | Approx. 80 g | Approx. 80 g | Approx. 80 g | Approx. 80 g | Approx. 81 g | Approx. 92 g |
| Dimensions (W x H x D) | 12 x 106 x 95 mm | 12 x 106 x 95 mm | 12 x 106 x 95 mm | 12 x 106 x 95 mm | 12 x 106 x 95 mm | 12 x 106 x 95 mm | 12 x 106 x 95 mm |
| Certification | CE, FCC class A, cTUVus | | | | | | |
| Operating Temperature | -25 ~ 60°C (-14 ~ 140°F) | | | | | | -20 ~ 55°C (-4 ~ 131°F) |
| Storage Temperature | -40 ~ 85°C (-40 ~ 185 °F) | | | | | | |
| Relative Humidity | 95% RH @ 40°C, non-condensing | | | | | | |

# EtherCAT Analog and Temperature I/O Modules
## AMAX-5000 Series Slice I/O

| Model | Analog Module | | | | Temperature Module | |
|---|---|---|---|---|---|---|
| | **AMAX-5017C** | **AMAX-5017V** | **AMAX-5017H** | **AMAX-5024** | **AMAX-5015** | **AMAX-5018** |
| Description | 6-ch Current Analog Input EtherCAT Slice I/O Module | 6-ch Voltage Analog Input EtherCAT Slice I/O Module | 4-ch High Speed Analog Input EtherCAT Slice I/O Module | 4-ch Analog Output EtherCAT Slice I/O Module | 4-ch RTD Input EtherCAT Slice I/O Module | 6-ch Thermocouple Input EtherCAT Slice I/O Module |
| Input Channels | 6-ch. (Differential) | 6-ch. (Differential) | 4-ch. (Differential) | - | 4-ch. (2 or 3 wire) | 6-ch. |
| Output Channels | - | - | - | 4-ch. | - | - |
| Input Type | mA | V, mV | V, mA | V, mA | - | V, mV |
| Input/Output Range | ±20 mA, 0 ~ 20 mA, 4 ~ 20 mA | ±150 mV, ±500 mV, ±1 V, ±5 V, ±10 V | ±10 V, 0~10 V 0~20 mA | 0~5 V, 0~10 V, ±5 V, ±10 V, 4~20 mA, 0~20 mA | 0 ~ 65535 (Pt 100, Pt 1000, Balco 500, Ni 518) | ±50 mV, ±100 mV, ±500 mV, ± 1 V, ± 2.5 V, 0 ~ 65535 (Type J 0~760°C, Type K 0~1370°C, Type T -100~400°C, Type E 0~1000°C, Type R 500~1750°C, Type S 500~1750°C, Type B 500~1800°C, Type N -200~1300°C) |
| Input Impedance | >120 Ω | >1 MΩ | 800 KΩ (V) 500 Ω (mA) | - | >10 MΩ | >2 MΩ |
| Resolution | 16-bit ±0.2% FSR accuracy @25°C | 16-bit ±0.1% FSR accuracy @25°C | Voltage: 16-bit ±0.1% FSR accuracy @25°C Current: 16-bit ±0.2% FSR accuracy @25°C | 16-bit ±0.01% FSR accuracy @25°C | 16-bit ±0.1% FSR accuracy @25°C | 16-bit ±0.1% FSR accuracy @25°C |
| Sample Rate | 100 sample/s (per channel) | 100 sample/s (per channel) | 10k sample/s (per channel) | - | 100 sample/s (per channel) | 100 sample/s (per channel) |
| Burn-Out Detection | Supported | - | - | Supported | Supported | Supported |
| Slew Rate | - | - | - | Selectable | - | - |
| Current Load Resistor | - | - | - | Max. 500 Ω | - | - |
| Voltage Load Resistor | - | - | - | Min. 1 KΩ | - | - |
| LED Indicator | PWR, RUN, ERROR | | | | | |
| Interface | 100Mbps EtherCAT | | | | | |
| Power Consumption | 2W @ 24V$_{DC}$ | 2W @ 24V$_{DC}$ | 2.5W @ 24V$_{DC}$ | 3.5W @ 24V$_{DC}$ | 2W @ 24V$_{DC}$ | 2W @ 24V$_{DC}$ |
| Isolation | 2,000 V$_{DC}$ | | | | | |
| Weight (Net) | Approx. 82 g | Approx. 82 g | Approx. 87 g | Approx. 86 g | Approx. 82 g | Approx. 87 g |
| Dimensions (W x H x D) | 12 x 106 x 95 mm | | | | | |
| Certification | CE, FCC class A, cTUVus | | | | | |
| Operating Temperature | -25 ~ 60°C (-14 ~ 140°F) | | | | | |
| Storage Temperature | -40 ~ 85°C (-40 ~ 185°F) | | | | | |
| Relative Humidity | 95% RH @ 40°C, non-condensing | | | | | |

# EtherCAT Timestamped Digital Input and Output I/O Modules

## AMAX-5000 Series Slice I/O

| Model | AMAX-5051T | | AMAX-5056T |
|---|---|---|---|
| Description | 8-ch Digital Input (2-ch Timestamp & 6-ch without Timestamp) EtherCAT Slice IO Module | | 2-ch Sink-type Digital Output Timestamp EtherCAT Slice IO Module |
| Input Channels | 2-ch. (Timestamp) | 6-ch. | - |
| Output Channels | - | - | 2-ch. (Timestamp) |
| Rating | **Wet Contact**<br>Logic level 1: 11~30 $V_{DC}$<br>Logic level 0: -3~5 $V_{DC}$<br>(similar to EN 61131-2, type 3) | **Dry Contact**<br>Logic level 1: Close GND<br>Logic level 0: Open<br>**Wet Contact**<br>Logic level 1: 11~30 $V_{DC}$<br>Logic level 0: -3~5 $V_{DC}$<br>(similar to EN 61131-2, type 3) | **Rated Voltage**<br>10~30 $V_{DC}$<br>**Rated Current Output**<br>Logic level 1: 0.3 A per channel<br>Logic level 0: 25 µA per channel (leakage current) |
| Input/Output Delay | < 0.5 µs | < 10 µs | < 0.5 µs |
| Resolution Timestamp | 1 ns | - | 1 ns |
| DI Latch / DO Sync | Rising Edge & Falling Edge DI Latch | N/A | DO Sync. |
| LED Indicator | PWR, RUN, ERROR, DI status | | PWR, RUN, ERROR, DO status |
| Interface | 100Mbps EtherCAT | | |
| Power Consumption | 2W @ 24$V_{DC}$ | | |
| Isolation | 2,000 $V_{DC}$ | | |
| Weight (Net) | Approx. 80 g | | Approx. 79 g |
| Dimensions (W x H x D) | 12 x 106 x 95 mm | | |
| Certification | CE, FCC class A, cTUVus | | |
| Operating Temperature | -25 ~ 60°C (-14 ~ 140°F) | | |
| Storage Temperature | -40 ~ 85°C (-40 ~ 185°F) | | |
| Relative Humidity | 95% RH @ 40°C, non-condensing | | |

# EtherCAT Counter, Encoder, PWM, and Serial Communication I/O Modules

## AMAX-5000 Series Slice I/O

| Model | AMAX-5080 | AMAX-5081 | AMAX-5082 | AMAX-5086 | AMAX-5090 |
|---|---|---|---|---|---|
| Description | 2-ch 24V HTL Incremental Encoder/Counter EtherCAT Slice I/O Module | 1-ch TTL/RS-422 Incremental Encoder/Counter EtherCAT Slice I/O Module | 1-ch SSI Absolute Encoder EtherCAT Slice I/O Module | 2-ch PWM with 2-ch Digital Input EtherCAT Slice I/O Module | 1-port Isolated RS-232/422/485 Communication EtherCAT Slice I/O Module |
| Encoder Type | Incremental | Incremental | Absolute | - | - |
| Input/ Output Channels | 2-ch. | 1-ch. | 1-ch. | 2-ch PWM Output, 2-ch DI Input | 1-ch Serial Port |
| Counting Range | 32-bits | 32-bits | ST: 0~16-bits, MT: 0~16-bits | - | - |
| Function | **Counter Mode:**<br>Encoder x4<br>Pulse/ Dir.<br><br>**Features:**<br>Overflow/underflow detection and reload counter<br>Latch counter value<br>Reset counter value<br>Set counter value<br>Counter frequency measurement Input Filter | **Counter Mode**<br>Position Measure - Encoder x4<br>Position Measure - Pulse/Dir.<br>Position Measure - CW/CCW<br>Position Measure - Pulse/Gate<br>Pulse Train Output<br>**Features**<br>Overflow/underflow detection<br>Latch counter value<br>Reset counter value<br>Set counter value<br>Input filter<br>Position compare output<br>Reversion of A/B phase Input<br>Frequency measurement<br>(Pulse Input) | **Counter Mode**<br>SSI signal with Binary or Gray code<br><br>**Features**<br>Latch Counter Value<br>Compare trigger Output *2 | **PWM**<br>Maximum Output Current 0.5 A<br>Duty Cycle 0 ~ 100%<br><br>**Load Type**<br>Ohmic, Inductive, Lamp Load<br><br>**Resolution**<br>Up to 300 Hz：15 bits<br>Up to 600 Hz：14 bits<br>Up to 1.2 kHz：13 bits<br>Up to 2.4 kHz：12 bits<br>Up to 4.8 kHz：11 bits<br>Up to 9.6 kHz：10 bits<br>Up to 19.2 kHz：9 bits | **Interfaces**<br>RS-232/422/485, Modbus RTU<br><br>**Data Transfer Channels**<br>TxD, RxD Full/Half Duplex<br><br>**Data Buffer**<br>1,000 bytes receive/ transmit buffer<br><br>**Termination Resistor**<br>Typ. 120 Ω, default turn off |
| Auxiliary I/O | - | Digital Input (Latch) x 1 Digital Output (Pulse) x 1, 5V TTL | Digital Input (Latch) x 1 Digital Output (Source) x 2, 10 ~ 30V$_{DC}$, 0.3A | Digital Input x 2<br>**Wet contact**<br>Rated Load Voltage: 24 V$_{DC}$<br>Logic level 1: 10~30 V$_{DC}$<br>Logic level 0: 0~3 V$_{DC}$<br>**Input Delay**<br>From logic level 0 to 1: 25 μs<br>From logic level 1 to 0: 45 μs | - |
| Encoder Power Supply | - | 5 V, 100 mA | +12 V, 80 mA | 24 V$_{DC}$, 1A (Require External Power Input) | - |
| Signal Input | Logic level 0: 0~5 V$_{DC}$ Logic level 1: 11~30 V$_{DC}$ | 5V single-ended RS-422 differential | RS-422 Differential | - | RS-232/422/485, Modbus RTU |
| Input/Output Frequency | 1 MHz x 4 | 10 MHz x 4 | 2 MHz (Selectable) | Output 1 ~ 125KHz | 1,200 ~ 115,200 bps |
| LED Indicator | PWR, RUN / ERROR, A+, A-, B+, B-, Z+, Z-, L+, L- | PWR, RUN / ERROR, A, B, Z, IN, OUT | PWR, RUN/ERROR, CLK, Data, DO0, DO1, L | PWR, RUN/ERROR PWM1, PWM2, DI1, DI2 | PWR, RUN/ERROR TxD, RxD |
| Interface | 100Mbps EtherCAT | | | | |
| Power Consumption | 2W @ 24V$_{DC}$ | 3W @ 24V$_{DC}$ | 3W @ 24V$_{DC}$ | 3W @ 24V$_{DC}$ | 2W @ 24V$_{DC}$ |
| Isolation | 2,000 V$_{DC}$ | | | | |
| Weight (Net) | Approx. 78 g | Approx. 92 g | Approx. 92 g | Approx. 80 g | Approx. 80 g |
| Dimensions (W x H x D) | 12 x 106 x 95 mm | 12 x 106 x 95 mm | 12 x 106 x 95 mm | 12 x 106 x 95 mm | 12 x 106 x 95 mm |
| Certification | CE, FCC class A, cTUVus | | | | |
| Operating Temperature | -25 ~ 60°C (-14 ~ 140°F) | | -25 ~ 45°C (-14 ~ 113°F) | -25 ~ 55°C (-14 ~ 131°F) | -25 ~ 60°C (-14 ~ 140°F) |
| Storage Temperature | -40 ~ 85°C (-40 ~ 185°F) | | | | |
| Relative Humidity | 95% RH @ 40°C, non-condensing | | | | |

# PCIe Expansion Modules
## AMAX-5000 Series

| Model | AMAX-5400E | AMAX-5410 | AMAX-5410P | AMAX-5490 | AMAX-5495 | AMAX-5493M |
|---|---|---|---|---|---|---|
| Description | Mini PCIe Card Expansion Module | 2-port GigE Vision Frame Grabber Module | 2-port PoE Vision Frame Grabber Module | 2-port Isolated RS-232/422/485 Communication Module | 2-Port CAN Module | 1-port PROFIBUS DP Master Module |
| Communication | **Mini PCI Card**<br>**Interface**<br>Full size mini PCI express 2.0<br>**SIM card slot**<br>Nano SIM card<br>**Antenna**<br>2x SMA hole on the top and bottom | **Ethernet**<br>**Compatibility**<br>IEEE 802.3,<br>IEEE 802.3u,<br>IEEE 802.3ab,<br>IEEE 802.3x,<br>IEEE 802.3af<br>**Speed**<br>10/100/1000 Mbps<br>**No. of Ports**<br>2 Gigabit Ethernet Media Access Control (MAC) and physical layer (PHY) ports.<br>**Input Voltage**<br>24 V$_{DC}$ direct from AMAX-5000 controller | **Ethernet**<br>**Compatibility**<br>IEEE 802.3,<br>IEEE 802.3u,<br>IEEE 802.3ab,<br>IEEE 802.3x,<br>IEEE 802.3af<br>**Speed**<br>10/100/1000 Mbps<br>**No. of Ports**<br>2 Gigabit Ethernet Media Access Control (MAC) and physical layer (PHY) ports.<br>**Input Voltage**<br>24 V$_{DC}$ direct from AMAX-5000 controller Output PoE Power 48 V$_{DC}$ PoE Power output, 15.4W per port, total Max. 20W | **Serial Communication**<br>**Data Bits**<br>5, 6, 7, 8<br>**Stop Bits**<br>1, 1.5, 2<br>**Parity**<br>None, even, odd<br>**Baud Rate**<br>50 bps ~ 230.4 kbps<br>**Data Signals**<br>RS-232: TxD, RxD, GND<br>RS-422: Tx+, Tx-, Rx+, RX<br>RS-485: Data+, Data-<br>**FIFO**<br>256 bytes<br>**Flow Control**<br>Xon/Xoff | **CAN**<br>**Protocol**<br>CAN2.0 AB<br>**Max. Speed**<br>1Mbit/s<br>**Signal Support**<br>CAN_H, CAN_L | **PROFIBUS DP**<br>**Controller**<br>Hilscher netX100<br>**Protocol**<br>PROFIBUS DP V1<br>**Signal interface**<br>Iso. RS-485, RxD/TxD-P, RxD/TxD-N<br>**Speed**<br>9.6 kbps ~ 12 Mbps |
| LED Indicator | PWR, Standby | | | PWR, Standby, TX1, RX1, TX2, RX2 | | PWR, Standby |
| Enclosure | Aluminum Alloy housing | | | | | |
| Interface | PCIe x1 | - | - | PCIe x1 | - | PCIe x1 |
| Power Consumption | 0.5W@24V$_{DC}$ | 2.5W@24V$_{DC}$ | 2.5W@24V$_{DC}$ | 2W@24V$_{DC}$ | 3W@24V$_{DC}$ | 3W@24V$_{DC}$ |
| Isolation | - | | | | | |
| Weight (Net) | Approx. 189 g | Approx. 195 g | Approx. 235 g | Approx. 200 g | Approx. 199 g | Approx. 199 g |
| Certification | CE, FCC class A | | | | | |
| Operating Temperature | -10 ~ 60°C (14 ~ 140°F) | | | | | |
| Storage Temperature | -40 ~ 85°C (-40 ~ 185°F) | | | | | |
| Relative Humidity | 95% RH @ 40°C, non-condensing | | | | | |

# AMAX-4800 Remote I/O Modules

## Digital I/O Modules
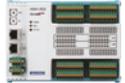
| Model | | AMAX-4830 | AMAX-4830SO | AMAX-4833 | AMAX-4834 | AMAX-4856 |
|---|---|---|---|---|---|---|
| Description | | 16-ch Isolated Digital Input and 16-ch Isolated Digital Output (Sink) EtherCAT Remote I/O Module | 16-ch Isolated Digital Input and 16-ch Isolated Digital Output (Source) EtherCAT Remote I/O Module | 32-ch Isolated Digital Input EtherCAT Remote I/O Module | 32-ch Isolated Digital Output (Sink) EtherCAT Remote I/O Module | 32-ch Isolated Digital Input and 32-ch Isolated Digital Output (Sink) EtherCAT Remote I/O Module |
| I/O | Input Channels | 16-ch. | | 32-ch. | - | 32-ch. |
| | Output Channels | 16-ch. | | - | 32-ch. | 32-ch. |
| | Digital Input | Input Voltage Logic 0: 3 $V_{DC}$ max. Logic 1: 10 ~ 30 $V_{DC}$ | | Input Voltage Logic 0: 3 $V_{DC}$ max. Logic 1: 10 ~ 30 $V_{DC}$ | - | Input Voltage Logic 0: 3 $V_{DC}$ max. Logic 1: 10 ~ 30 $V_{DC}$ |
| | Digital Output | Load Voltage 5 ~ 40 $V_{DC}$ Load Current 350 mA/ch (sink) @ 25°C 250 mA/ch (sink) @ 60°C Opto-Isolator Response Time 100 µs | | - | Load Voltage 5 ~ 40 $V_{DC}$ Load Current 350 mA/ch (sink) @ 25°C 250 mA/ch (sink) @ 60°C Opto-Isolator Response Time 100 µs | |
| General | LED Indicator | PWR, RUN, ERROR | | | | |
| | Interface | 100Mbps EtherCAT | | | | |
| | Power Consumption | 85 mA @ 24 $V_{DC}$ (Typical) | | | | |
| | | 110 mA @ 24 $V_{DC}$ (Max) | | | | 130 mA @ 24 $V_{DC}$ (Max) |
| | Isolation | 2,500 $V_{DC}$ (IO) | | | | |
| | Weight (Net) | Approx. 250 g | | | | Approx. 350 g |
| | Dimensions (W x H x D) | 120 x 120 x 40 mm | | | | 168 x 120 x 40 mm |
| | Certification | CE, FCC Class A | | | | |
| Environment | Operating Temperature | -20 ~ 60°C (-4 ~ 140°F) | | | | |
| | Storage Temperature | -40 ~ 70°C (-40 ~ 158 °F) | | | | |
| | Relative Humidity | 5~ 95% RH @ 40°C, non-condensing | | | | |

## Digital Input + Relay Output Modules

| Model | | AMAX-4862 |
|---|---|---|
| Description | | 16-ch IDI & 16-ch Relay EtherCAT Remote I/O module |
| I/O | Input Channels | 16-ch. |
| | Output Channels | 16-ch. |
| | Digital Output | Relay Type Form A Contact Rating (resistive) 2A @ 250 VAC, 2A @ 30 $V_{DC}$ Max. Switching Power 500VA, 60W Max. Switching Voltage 270 VAC, 125 $V_{DC}$ Resistance 30mΩ max. Operating Time Max. 10 ms Releasing Time Max. 5 ms Life Expectancy Mechanical 2 x 107 ops. at no load. Electrical 3 x 104 ops. @2A/250VAC |
| General | LED Indicator | PWR, RUN, ERROR |
| | Interface | 100Mbps EtherCAT |
| | Power Consumption | 85 mA @ 24 $V_{DC}$ (Typical) |
| | | 130 mA @ 24 $V_{DC}$ (Max) |
| | Isolation | 2,500 $V_{DC}$ (I/O) |
| | Weight (Net) | Approx. 350 g |
| | Dimensions (W x H x D) | 168 x 120 x 40 mm |
| | Certification | CE, FCC class A |
| Environment | Operating Temperature | -20 ~ 60°C (-4 ~ 140°F) |
| | Storage Temperature | -40 ~ 70°C (-40 ~ 158°F) |
| | Relative Humidity | 5~ 95% RH @ 40°C, non-condensing |

# AMAX-4800 Remote I/O Modules

## Analog I/O Modules

| Model | AMAX-4817 | AMAX-4820 |
|---|---|---|
| Description | 8-ch, 16-bit Isolated Analog Input EtherCAT Remote I/O Module | 4-ch, 16-bit Isolated Analog Output EtherCAT Remote I/O Module |
| I/O — Input Channels | 8-ch. | - |
| I/O — Output Channels | - | 4-ch. |
| I/O — Input/Output Type | V | V, mA |
| I/O — Input Impedance | 120 Ω | - |
| I/O — Common Voltage Range | ±275V | - |
| I/O — Input/Output Range | ±10 V, 0~10 V | 0~5 V, 0~10 V, ±5 V, ±10 V, 4~20 mA, 0~20 mA |
| I/O — Resolution | 16-bit with ±0.1% FSR accuracy @25°C | 16-bit with ±0.1% FSR accuracy @25°C |
| I/O — Sample Rate | 10k sample/s (per channel) | 10k sample/s (per channel) |
| I/O — Bandwidth (-3dB) | 1.375 kHz/ch | 1.375 kHz/ch |
| I/O — Current Load Resistor | - | < 625 Ω |
| I/O — Voltage Load Resistor | - | > 1 kΩ |
| General — LED Indicator | PWR, RUN, ERROR | |
| General — Interface | 100Mbps EtherCAT | |
| General — Power Consumption | 160 mA @ 24 V$_{DC}$ (Typical) / 190 mA @ 24 V$_{DC}$ (Max) | 160 mA @ 24 V$_{DC}$ (Typical) / 190 mA @ 24 V$_{DC}$ (Max) |
| General — Isolation | 2,500 V$_{DC}$ (I/O) | |
| General — Weight (Net) | Approx. 250 g | Approx. 350 g |
| General — Dimensions (W x H x D) | 120 x 120 x 40 mm | |
| General — Certification | CE, FCC class A | |
| Environment — Operating Temperature | -20 ~ 60°C (-4 ~ 140°F) | |
| Environment — Storage Temperature | -40 ~ 70°C (-40 ~ 158°F) | |
| Environment — Relative Humidity | 5~ 95% RH @ 40°C, non-condensing | |

## Infrastructure Modules

| Model | AMAX-4870 |
|---|---|
| Description | 6-port EtherCAT Junction Module |
| EtherCAT Junction — Ports | 1 x Inport, 5 x Outports |
| EtherCAT Junction — Cable | Ethernet CAT 5E |
| General — LED Indicator | PWR, RUN, ERROR |
| General — Interface | 100Mbps EtherCAT |
| General — Power Consumption | 140 mA @ 24 V$_{DC}$ (Typical) |
| General — Power Consumption | 190 mA @ 24 V$_{DC}$ (Max) |
| General — Weight (Net) | Approx. 250 g |
| General — Dimensions (W x H x D) | 120 x 120 x 40 mm |
| Environment — Certification | -20 ~ 60°C (-4 ~ 140°F) |
| Environment — Storage Temperature | -40 ~ 70°C (-40 ~ 158°F) |
| Environment — Relative Humidity | 5~ 95% RH @ 40°C, non-condensing |

# EtherCAT Control I/O Solutions Enhance the Performance and Efficiency of Wire Winding Machines

Advantech's EtherCAT Control I/O Solution brings excellent performance and flexibility to electric wire winding machines. With efficient positioning control, remote I/O management, and convenient diagnostic tools, this solution enables wire winding machines to easily adapt to various application scenarios, improving production efficiency while ensuring product quality and stability.

## Project Requirements

In modern industry, electric wire winding machines play a critical role, primarily used for winding in the manufacturing of electrical motors, transformers, inductors, and reactors, among other equipment. These winding machines are also widely employed in various wire winding, welding, and bonding processes. **To enhance production efficiency and ensure product quality, customers require an efficient and precise positioning control system**.
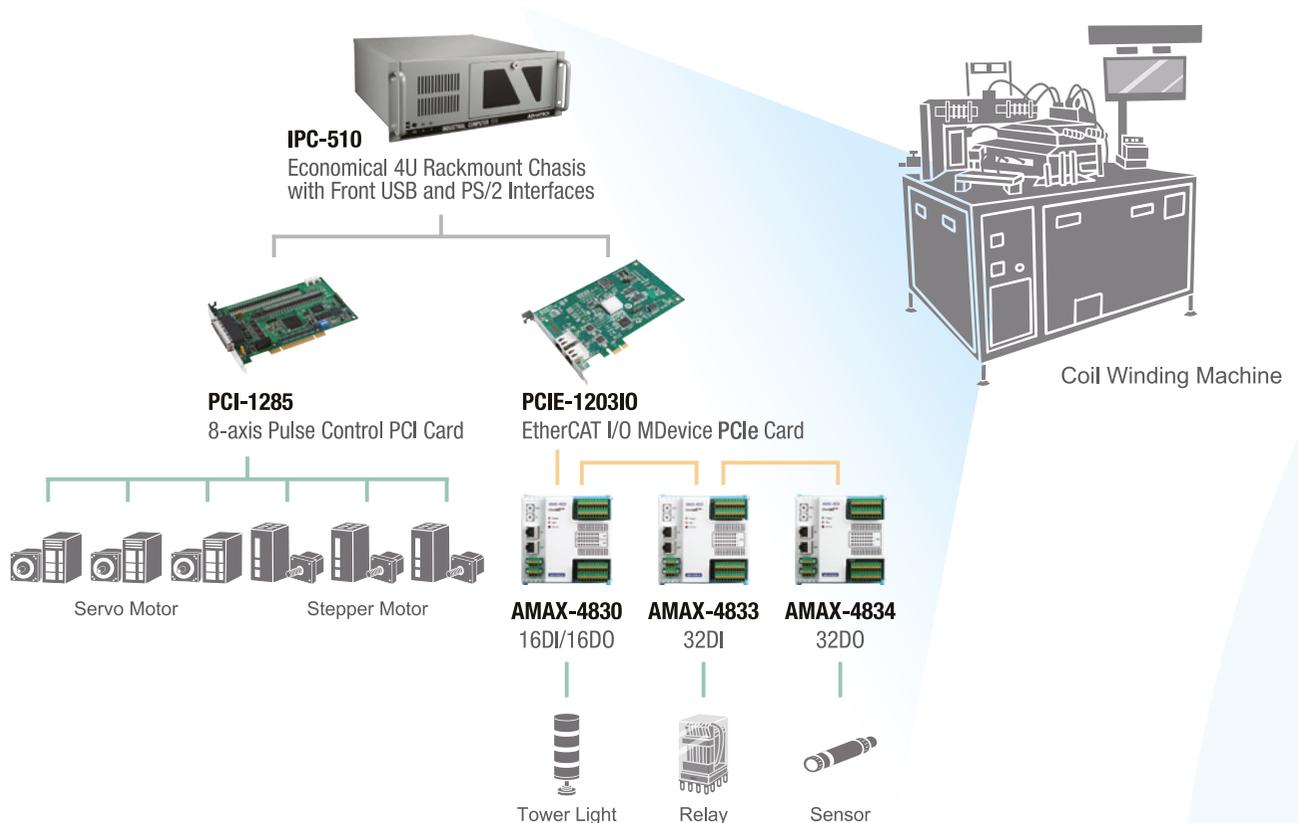
## System Description

For precise positioning control, we integrated the **PCI-1285 8-axis motion control card**, connecting the winding machine to pulse-type servo/stepper motors. Traditional I/O control methods consume space and complicate troubleshooting. Thus, we sought a **remote I/O control solution** for strategic device distribution, reducing wiring complexity and improving equipment maintenance.

## Solution Description

To meet customer needs, **Advantech offers an efficient EtherCAT control I/O solution known for high-speed transmission and real-time performance**. This advanced protocol ensures synchronized data exchange for precise winding machine control during high-speed movements, enhancing production efficiency.

**The PCIE-1203IO EtherCAT I/O MDevice PCIe card facilitates remote I/O control**, strategically placing I/O devices on the winding machine through the EtherCAT network. This saves space, reduces wiring complexity, and includes **diagnostic tools for EtherCAT communication monitoring**. This streamlines issue identification, cuts troubleshooting time, boosts equipment throughput, and enhances production line stability and reliability.



**IPC-510**
Economical 4U Rackmount Chasis with Front USB and PS/2 Interfaces

**PCI-1285**
8-axis Pulse Control PCI Card

**PCIE-1203IO**
EtherCAT I/O MDevice PCIe Card

Servo Motor          Stepper Motor

**AMAX-4830**
16DI/16DO

**AMAX-4833**
32DI

**AMAX-4834**
32DO

Tower Light      Relay       Sensor

Coil Winding Machine

# High-Performance Solution with EtherCAT System Improves Precision and Efficiency in EDM Machines

Advantech's EtherCAT technology solution provides robust support for the upgrade and transformation of EDM (Electrical Discharge Machining) machines. By offering **high-performance real-time transmission, low latency features, and flexible topology configurations**, this advanced system ensures accuracy, efficiency, and reliability in the machining process. It helps manufacturers maintain a competitive edge in a highly competitive market.

## Project Requirements

Electrical Discharge Machining (EDM) is a non-traditional metal manufacturing process that involves shaping materials using sparks generated by electrical discharges. This technology is widely used for cutting, drilling, and engraving metal workpieces and other products. For mechanical manufacturers, transforming and upgrading equipment is a necessary step to improve manufacturing precision and optimize equipment structures.
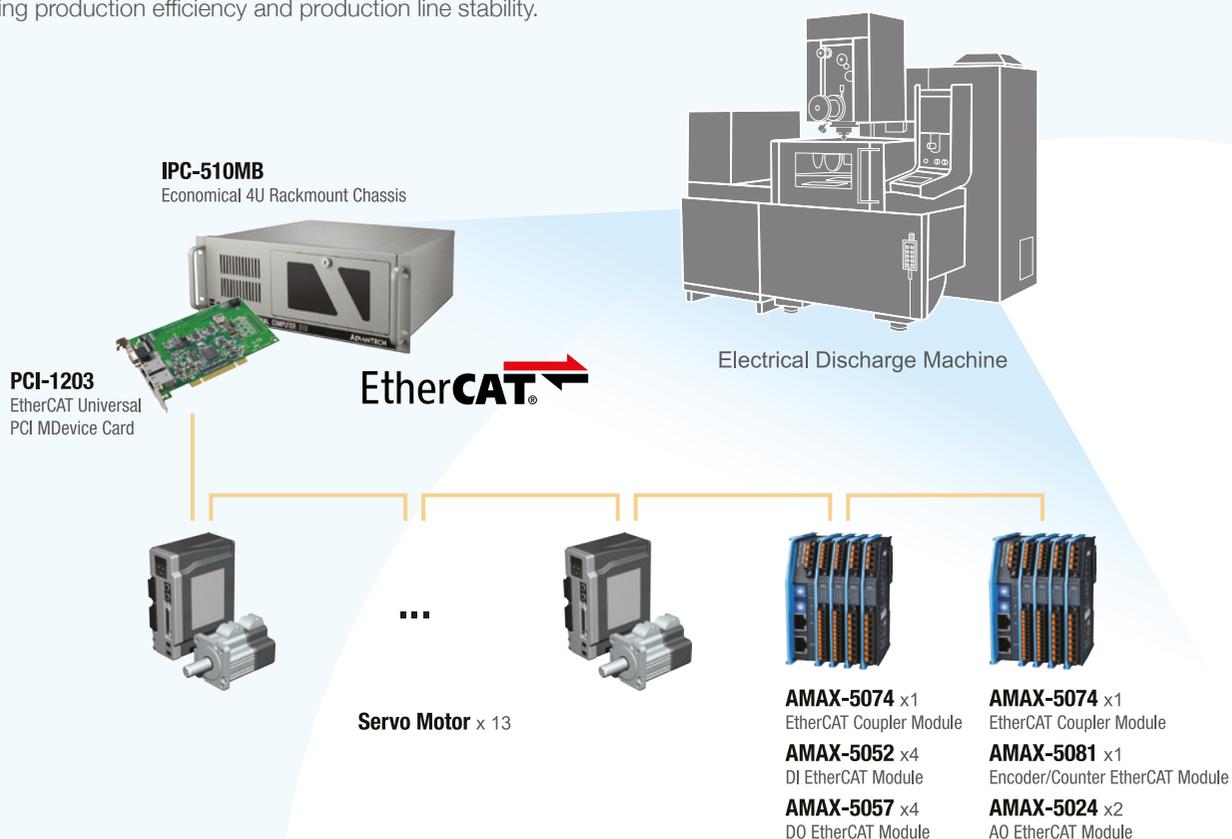
## System Description

To meet this requirement, **Advantech provides a high-performance industrial fieldbus system based on EtherCAT technology**. The system includes the PCI-1203 MDevice card and the AMAX-5000 Slice I/O modules. EtherCAT's real-time transmission and low latency capabilities ensure that the output signals match the machining trajectory perfectly. Additionally, its topological flexibility accelerates the deployment of wiring and speeds up on-site troubleshooting.

## Solution Description

Advantech's EtherCAT solution provides a range of advantages for electrical discharge machining (EDM) machines. Firstly, **EtherCAT's high-performance real-time transmission ensures fast feedback of control signals, guaranteeing precision and stability in the machining process**. This is crucial for precise cutting and engraving of metal materials, leading to improved product quality and reduced manufacturing defects.

Secondly, **the use of the PCI-1203 I/O MDevice card and AMAX-5000 Slice I/O modules gives the entire system exceptional topological flexibility**. The ability to configure and wire various I/O devices flexibly saves space and simplifies equipment construction. Simultaneously, on-site troubleshooting becomes more efficient, reducing maintenance and repair times significantly and further enhancing production efficiency and production line stability.

**IPC-510MB**
Economical 4U Rackmount Chassis

**PCI-1203**
EtherCAT Universal
PCI MDevice Card

EtherCAT®

Electrical Discharge Machine

**Servo Motor** x 13

**AMAX-5074** x1
EtherCAT Coupler Module

**AMAX-5052** x4
DI EtherCAT Module

**AMAX-5057** x4
DO EtherCAT Module

**AMAX-5074** x1
EtherCAT Coupler Module

**AMAX-5081** x1
Encoder/Counter EtherCAT Module

**AMAX-5024** x2
AO EtherCAT Module

# EtherCAT Solution Boosts Precise Control and Efficiency in High-Speed LED Sorting Processes

In this case, **the torque limit table significantly reduces the equipment's motion cycle time** (0.15 seconds per chip, achieving up to 24,000 chips per hour). PT/PVT functionality allows user-defined S-curve profiles based on machine characteristics and vibration suppression. Additionally, **PCI-1203 supports synchronized control of up to 13 axes**. Advantech's **SoftMotion API** enables efficient development of all machine behaviors, ensuring robust control, precision, and efficiency in high-speed dispensing processes.

## Project Requirements

In the later LED sorting stage, blue tape removal from the LED chip bottoms is essential. The bottom pins need repositioning onto the top film for upper nozzle removal. High-speed motion can cause excessive upper pin force, risking LED chip damage. **To expedite the process, the swing arm must move rapidly, including quick acceleration and deceleration**. Many machines lower speed to withstand these vibrations, but this extends the picking cycle time.

## System Description

In such high-speed applications, to ensure that the rapid sorting process does not damage the LED chips, **the PCI-1203 provides a torque limit table feature**. The preconfigured torque limit table provides the maximum torque parameters for each position, and the maximum torque value is sent to the servo drive for each cycle. Additionally, the PCI-1203 also offers **PT/PVT** functionality, which provides smooth and continuous motion trajectories and acceleration.

## Solution Description

Designing precision machining machines requires selecting the right components. The PCI-1203 is a 2-port EtherCAT PCI universal card, serving as a plug-and-play EtherCAT development platform for PC-based industrial automation. It offers extremely short cycle times for motion and I/O applications, supporting up to 32 servo motors. **The PCI-1203 ensures real-time, high-precision capabilities**.

**Advantech's motion controllers share a common Motion API framework, offering a unified user interface and graphical development tools**. The AMAX-4833/34 is an industrial EtherCAT SubDevice with 32 digital inputs and outputs, compact design, DIN Rail mounting, European terminal blocks, and LED indicators for easy maintenance. All digital input channels are protected with 2500 $V_{DC}$ isolation.

**IPC-510MB**
Economical 4U Rackmount Chassis

**PCI-1203**
EtherCAT Universal PCI MDevice Card

EtherCAT

**Servo Motor** x 13

**AMAX-4833** x 2
DI EtherCAT Remote I/O Module

**AMAX-4834** x 2
DO EtherCAT Remote I/O Module

# Integration of EtherCAT Solution for High-Performance and High-Precision IC Packaging Machines

Advantech's EtherCAT technology solution provides robust support for the upgrade and transformation of EDM (Electrical Discharge Machining) machines. By offering **high-performance real-time transmission, low latency features, and flexible topology configurations**, this advanced system ensures accuracy, efficiency, and reliability in the machining process. It helps manufacturers maintain a competitive edge in a highly competitive market.

## Project Requirements

In this scenario, the PCI-1203 achieves synchronized control for 31 motors, including 2-axis gantry control, alongside dependable I/O control. The AMAX-3285IO connects the EtherCAT master device to pulse-type servo/stepper motors, delivering high-speed compare triggering and position latching. Advantech provides a powerful SoftMotion API, versatile visual products, and efficient computing platforms to meet rapid development needs.
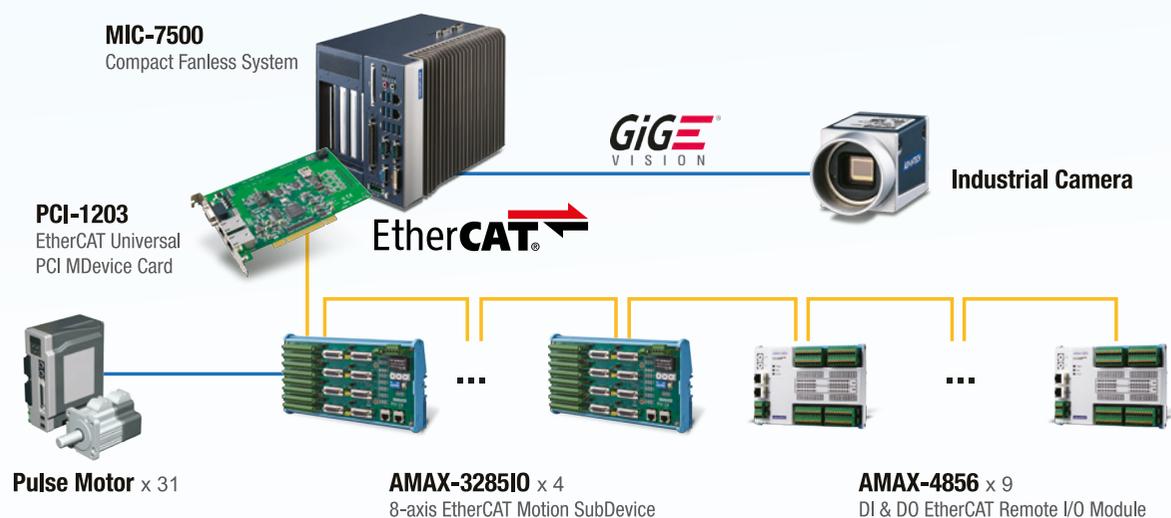
## System Description

With semiconductor product diversity, back-end processing must consolidate tasks into single machines, reducing equipment variety and shortening production cycles. Integrated machines require higher speeds and optical inspections for error reduction and cost savings. **Space constraints necessitate efficient control setup, impacting setup time, costs, and maintenance**. Multi-axis synchronized motion control with optical inspection enables integrated applications in semiconductor manufacturing, from laser marking to inspection and packaging.

## Solution Description

In precision machining equipment design, component choice is critical. **The PCI-1203, a 2-port EtherCAT PCI card, offers a plug-and-play solution for PC-based industrial automation**. It autonomously executes the EtherCAT protocol, handling two EtherCAT networks with short cycle times, suitable for motion and pure I/O applications. EtherCAT motion ports feature sub-500 μs cycle times, connecting up to 32 servo motors, while fast I/O ports support sub-250 μs cycle times for real-time, high-precision capabilities.

**The AMAX-3285IO, an 8-axis EtherCAT motion SubDevice module, connects to pulse-type servo/stepper motors, providing high-speed comparison triggering and position latch functions**. It integrates seamlessly into an EtherCAT network under Advantech's EtherCAT master PCI-1203 control. With a horizontally mounted open design and on-board interface connectors, it conveniently connects to Mitsubishi J3/J4, Yaskawa Sigma V/7, and Panasonic A4/A5 servo motors via transmission cables to the servo drives.

AMAX-4856 is a compact 32DI/32DO industrial EtherCAT SubDevice module with the EtherCAT protocol. Its small size and DIN rail mounting kit simplify installation in control cabinets. Featuring European terminal blocks and LED indicator lights for maintenance and system setup, all digital input channels are safeguarded with 2500 $V_{DC}$ isolation. **Advantech designs and tests its EtherCAT devices for noise immunity, making AMAX-4856 an excellent choice for industrial automation setups, providing fast, precise data transmission and effortless remote configuration**.



**MIC-7500**
Compact Fanless System

**Industrial Camera**

**PCI-1203**
EtherCAT Universal
PCI MDevice Card

**Pulse Motor** x 31

**AMAX-3285IO** x 4
8-axis EtherCAT Motion SubDevice

**AMAX-4856** x 9
DI & DO EtherCAT Remote I/O Module

# Comprehensive EtherCAT Control Solution Enhances Precision Printing Quality and Efficiency

Advantech provides a complete control solution for screen printing machine manufacturers, implementing a phased approach for the migration process. The first step involves replacing the EtherCAT I/O system, with compatibility testing to ensure it works alongside the customer's existing XFC system. **The AMAX-5000 series from Advantech not only seamlessly integrates with the customer's control system but also offers superior performance compared to the previous solution**. The robust technical support provided to customers plays a key role in the successful transition.

## Project Requirements

The customer is a prominent Taiwanese screen printing machine manufacturer, specializing in high-speed automatic cylindrical screen printing equipment. They sought a dependable EtherCAT I/O system to replace their existing setup, aiming for compatibility with Beckhoff's XFC architecture. The customer opted for Advantech due to **the suitability of the AMAX-5000 series, featuring timestamp and encoder modules**, and the robust technical support provided.

## System Description

The customer's screen printing machine requires **precise control, accurate positioning, and the seamless integration of the I/O system with various components** such as doctor blades, paper sensors, and encoders to improve print quality and productivity. Since a complete control system replacement is time-consuming, the initial focus was on upgrading the existing I/O system. Advantech successfully integrated the AMAX-5000 I/O system to meet these requirements.

## Solution Description

In a control system based on EtherCAT distributed architecture, various motors and sensors are interconnected via EtherCAT for precise position data and control output through EtherCAT I/O. To ensure printing precision, Advantech integrated the **AMAX-5051T timestamp DI module**, which accurately determines paper feeding timing and converts it to positional data. This information is then utilized by the **AMAX-5081 encoder module** to precisely trigger the doctor blade. Ink distribution is initiated through the **AMAX-5056T timestamp DO module**. The system's remarkable 1 ns-level precise timestamping guarantees fast and accurate machine control, resulting in high-quality printing. The addition of a 10 MHz encoder reading further enhances response times, maximizing machine productivity and efficiency.

**The AMAX-5000 series, serving as standard EtherCAT SubDevices**, smoothly integrated into the customer's existing EtherCAT master system with the assistance of Advantech's technical support. These EtherCAT slice I/O modules feature a compact form factor similar to the previous I/O solution. Following customer testing, **the AMAX-5000 system effectively replaced the original solution, resulting in enhanced print quality**.

AMAX-5580
EtherCAT Controller

CODESYS
IEC-61131-3 Control SW

EtherCAT
I/O

EtherCAT

Inverter

Servo Driver

Stepper Driver

Total 20 axes

AMAX-5000 Series
EtherCAT Slice I/O Module

AMAX-5051T
Timestamp DI Module

AMAX-5056T
Timestamp DO Module

AMAX-5081
TTL Encoder Module

Workpiece
Detection Sensor

Squeegee Blades

TTL Encoder

# Smart Factory Control Solution Facilitates Smart Manufacturing Transformation for Zinc Alloy Faucet Manufacturer

A global leader in zinc alloy faucet component manufacturing achieved a successful transformation into intelligent manufacturing using Advantech's AMAX-5000 control system. **This solution offered a flexible control architecture that seamlessly integrated with existing controllers and robotic arms, delivering real-time execution status feedback and substantially enhancing production efficiency**. Besides space savings, the solution provided significant competitive advantages in intelligent manufacturing, supported by effective training and assistance.

## Project Requirements

In recent years, one of the world's largest manufacturers of zinc alloy faucet components invested significantly to establish an intelligent factory in Taichung, Taiwan, marking a transition from an OEM to an ODM service provider. They sought **a flexible control system that seamlessly integrated with existing controllers and robotic arms, offered real-time feedback to the management system, and fit within space constraints**. To meet these needs, they selected Advantech's AMAX-5000 controller.
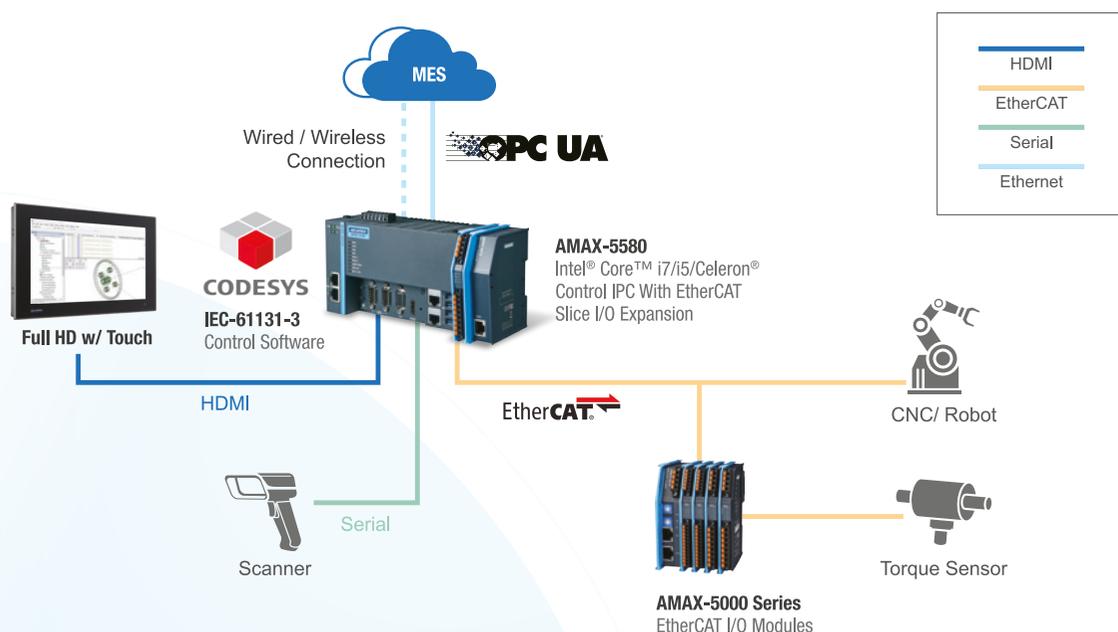
## System Description

In traditional manufacturing, industrial PCs were space-intensive and lacked flexibility. Standard controllers couldn't meet the data and bandwidth requirements of smart factories. To overcome these challenges, the customer sought a new integrated control system that combined the advantages of PCs with flexible I/O expansion while seamlessly integrating with existing controllers. **This new architecture incorporated open-standard communication protocols like Fieldbus and EtherCAT, used the IEC-61131-3 Softlogic standard for control, and adopted open protocols like ODBC or OPC UA for upper-level communication**. This approach ensured independence from specific manufacturers and retained control of essential technologies.

## Solution Description

**The core controller in this system is the AMAX-5580, based on an EtherCAT distributed architecture with CODESYS Softlogic**. It collects production data and communicates it to the central controller through local HMI and a web interface. The CODESYS RTE, the primary real-time control software, is embedded in the AMAX-5580.

Advantech provides additional software components for upstream communication and uses the AMAX-5000 EtherCAT slice I/O series for remote I/O expansion, which includes AMAX-5001, AMAX-5052, and AMAX-5056. Their extensive support ensures a smooth transition for the customer. **Advantech offers comprehensive training for customers to quickly master CODESYS (IEC-61131-3 standard Softlogic) and provides sample solutions for testing, along with exclusive CODESYS training courses**. The AMAX-5580 simplifies maintenance with its easy installation, plug-in terminal design, slide-in mechanism, and convenient component upgrades. It's also designed for future expandability, featuring PoE/USB 3.0 interfaces for potential optical vision inspection system upgrades.



MES

Wired / Wireless Connection

OPC UA

HDMI
EtherCAT
Serial
Ethernet

CODESYS
IEC-61131-3
Control Software

Full HD w/ Touch

HDMI

AMAX-5580
Intel® Core™ i7/i5/Celeron®
Control IPC With EtherCAT
Slice I/O Expansion

EtherCAT

CNC/ Robot

Serial

Scanner

AMAX-5000 Series
EtherCAT I/O Modules

Torque Sensor

# Intelligent Logistics Control Solution: Optimizing AGV Forklift System Efficiency and Stability

As land and labor become more costly, enterprises are facing challenges for the development and profitability of warehousing and logistics management. Smart logistics systems are increasingly becoming the choice of large enterprises. **One of the key components of an AGV (Automated Guided Vehicle) logistics system is the stability of its control system and its connection with other key systems**, which is a crucial component to the efficiency, security, and stability of the overall logistics solution.

## Project Requirements

- The AGV forklift system needed EtherCAT bus to connect to the servo drives to control the extension of the forklift arm, and it also needed to support CAN bus to connect to the vehicle's power system. It also needed to connect to a wireless client through the serial port.

- The AGV system needed a powerful processing capability and an operating system for processing and computing the scheduling system path instructions, and a 3D interface display capability.

- The controller needed a compact low-voltage DC power supply and low power consumption to meet the body size and battery requirements.

## System Description

- Controller: Integrated CODESYS-enabled controller AMAX-5570
- I/O Modules: AMAX-5000 EtherCAT plug-in I/O modules
- Control Software: CODESYS V3.5
- Operating System: Windows 7 64-bit

## Solution Description

- AMAX-5570 supports EtherCAT, CAN bus, Modbus TCP, and serial interfaces, providing all necessary peripherals for AGV forklifts.

- It is compatible with both Windows environments and SoftPLC CODESYS real-time core, and its x86 processor enables various data and display functions.

- With dimensions of only 48.8 x 100 x 70 mm and a power supply range of 10-36VDC, it meets the requirements of AGV forklifts.

- Its embedded fanless design and rail mounting ensure stable, long-term system operation, enhancing the stability and efficiency of the overall logistics system.

# 3C Inspection Solution Integrating Motion Control, Machine Vision, and MES

The customer is a domestic company that specializes in AOI filter inspection algorithms, who, with the increase in market automation and intelligentization, needs **a comprehensive AOI solution that includes materials storage, collection, inspection, sorting, and information which must be uploaded to a database and integrated with an MES**.

## Project Requirements

Currently, manufacturers in this market face a range of problems. Since multiple key processes such as motion control, visual inspection, and databases are involved, the realization of a filter inspection and control system requires industrial control computers and multiple PLCs. Programmers knowledgeable in two different programming languages are also necessary. Projects face delays due to due to time spent on integrating multiple systems. When there's a significant amount of communication between the controllers, it is necessary to sacrifice a portion of the equipment processing efficiency. At the same time, multiple controllers and large data transmission volumes also present hidden dangers that may reduce system stability and inspection accuracy.

## System Description

- Hardware: As the main control system, AMAX-5580 controls the 39 servos and electric cylinders on site through EtherCAT, and the field sensor signals are accessed through distributed I/O;

- Software: CODESYS implements the motion control function and seamlessly connects with the C# program developed by the customer through shared memory, both of which run on the AMAX-5580;

## Solution Description

- The split-core and sub-system architecture integrates the Windows core and the CODESYS real-time core while keeping each CPU independent of each other so that the Windows core does not affect the immediacy of the PLC core.

- The shared memory connects IT and OT seamlessly.

- The CODESYS programming method is flexible, making it suitable for PLC programmers and high-level language programmers. The whole system uses CODESYS and C# programming flexibly.

- Decentralized I/O and multiple communication interfaces are suitable for production lines and large equipment.
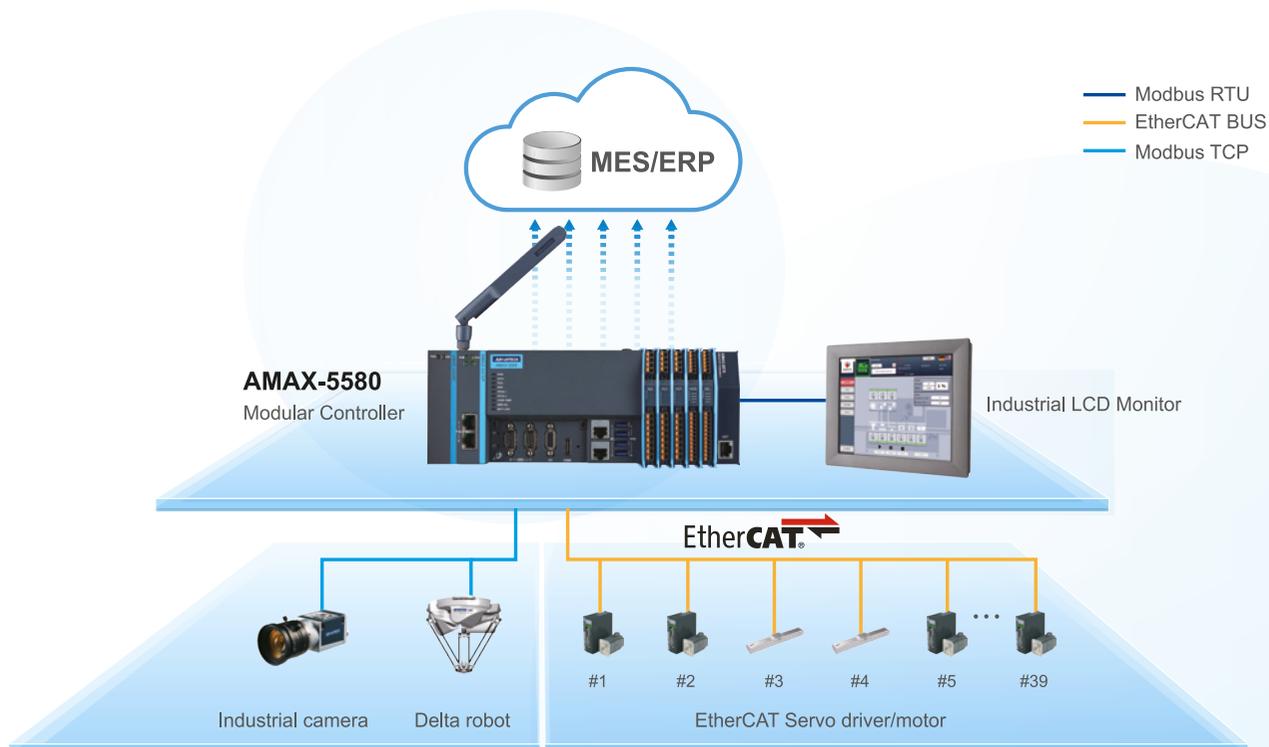
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