Advantech EtherCAT Solutions

- Real Time
- Precision
- Simplicity
- Integration

Product Portfolio
Software Tools
Application Cases

Torque limitation table
3-axis arc interpolation
Gantry control
EtherCAT

www.advantech.com
Powerful embedded motion control software SoftMotion Core

■ Advantech EtherCAT Solution Features

Real Time
- Up to 64 synchronized axes control and communication cycle time = 250us (min.)
- High speed I/O communication cycle time = 200us

Precision
- Embedded RTOS, satisfying real-time motion control requirements
- Basic script programming allows motion and logic control to run on hardware core

Simplicity
- Dedicated API that satisfies rapid development requirements
- Powerful SoftMotion functions designed specifically for vertical industry applications

Integration
- Supports 3rd party EtherCAT servo/stepping motors
- Connect EtherCAT slaves automatically, without ESI files

■ EtherCAT Product Offerings

<table>
<thead>
<tr>
<th>Master</th>
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<tbody>
<tr>
<td><em>Supports up to 64 axes synchronized control</em></td>
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<tr>
<td><em>Powerful embedded SoftMotion engine</em></td>
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<tr>
<td><em>Basic script language for deterministic control</em></td>
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<table>
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<tr>
<th>Motion Slaves</th>
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<tr>
<td><em>4/8-axis EtherCAT to pulse module connecting to pulse-type servo/stepping motors</em></td>
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<tr>
<td><em>32DI / 32DO / 16DIO / 8AI / 4AO modules</em></td>
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<tr>
<td><em>Terminal board (DIN-Rail)</em></td>
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<td><em>Compact design</em></td>
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<th>I/O Slaves</th>
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<tr>
<td><em>4-slot high-speed I/O control system</em></td>
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<tr>
<td><em>Supports high density DI/DO/AI/O and counter modules</em></td>
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</table>

■ Structure

PCI/PCIE-1203
EtherCAT Universal PCI Master Card

EtherCAT servo/stepping motors
EtherCAT linear motors
AMAX-3245/3285
EtherCAT pulse module
AMAX-4830/33/34/17/20
EtherCAT remote I/O module
ADAM-5000/ECAT
4-slot distributed high speed I/O system
Pulse Type Servo Motors
Advantech Common Motion Software Tool Supports EtherCAT

SoftMotion technology, a solution for all types of motion control

Aligned with PC-based control to provide the latest processors, mainstream Ethernet fieldbus, Advantech intelligent motion control product division provides flexible solutions to OEM Machine Makers and System Integrators. The core technologies are based on state-of-the-art DSP/FPGA/SoC processors, Advantech's own SoftMotion kernel for trajectory and control, EtherCAT motion bus, and a configuration utility. Advantech provides a universal software development environment, called Common Motion, in which users do their development. All Advantech motion controllers are applied in "Common Motion API" architecture. The programmer can benefit from integrating any Advantech SoftMotion controller, without large-scale changes to the application code, to save effort on application maintenance and upgrades.
EtherCAT Master Card: PCI-1203/PCIE-1203

- Dual Core ARM
  - SoftMotion Engine
  - EtherCAT Stack
  - Linux OS

ARES
- Real-time Stored Procedure for real-time motion & IO processing
- No need for real-time OS

Common Motion
- Unified API
- Seamless working with pulse train type solution

Dual Master
- Motion master
  - Cycle Time: 250us
  - Up to 64 axes
- I/O master
  - Cycle Time: 200us

PCI-1203 / PCIE-1203
Software Introduction: Advantech Real-time Enhanced Script (ARES)

ARES is a very powerful, embedded motion control Basic language that can be operated in the PCI-1203/PCIE-1203 hardware core, providing stable and predictable timing for deterministic motion control. The simple program development environment satisfies the requirements for rapid development.

Satisfies high accuracy trajectory planning and synchronized I/O control

Supports mathematical functions, loops, and operators for logic control and programming

Supports multi-thread program development

- **Rapid development environment**
  An intuitive control interface including program commands, status monitoring, and step by step debugging function; linking top-layer user program by global variables

- **Simple coding language**
  Realize motion functions through one instruction, without any type declaration

- **Multi-thread processing**
  Store 10 program sets on the hardware core, and run 6 processing sets at any one time

- **Conditional judgment**
  Supports For-Loop, While-Loop and If-Else loop structures and various operators for logic control

- **Monitor Window**
  User can define variable names and descriptions and monitor them in a variable table

- **Trial Run**
  Provides user-friendly interface for rapid verification

**Powerful ARES software function, enhanced motion control capability**

Real-time motion trajectory plan and conditional logic control

Guaranteed multi-axis synchronized trajectory accuracy and speed stability

Open project

- Click on FILE \ New \ Project, choose the required route and enter the project name
- After the project is set up, the project filename and variable address record (address.adr) can be seen in the Project Explorer

Loop

ARES supports IF-ELSE / FOR-LOOP / WHILE-LOOP
Software Introduction: Advantech Real-time Enhanced Script (ARES)

**Instruction coding**
- “Right-click on the project’s title in the Project Explorer, choose “Add New Item…” enter the file name and save it.
- Write the ARES program to realize the motion control.

- Click on FILE \ New \ Project, choose the required route.
- After the project is set up, the project filename and enter the project name.
- Right click on Progress in the Controller
- After the coding is completed, ARES
- Program link
- Finally use the
- Program Download
  - Download ARES procedure by API
  - Compile the process into a .aobj binary file within the ARES IDE
  - Use the Acm_DevDownloadAres to download the file to the PCI-1203/PCIE-1203
  - Then use Acm_DevLoadAresProgram to load the execution file into the ARES process, and finally use the Acm_DevRunAres to enable the process.

**Conditional Statement**
ARES-supported operators and their priorities as follows in descending order of priority:

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<th>Level</th>
<th>Operators</th>
<th>Associative</th>
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<tr>
<td>Paren</td>
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<td>L</td>
</tr>
<tr>
<td>Unary</td>
<td>+ - ! ~</td>
<td>R</td>
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<tr>
<td>Multiplicative</td>
<td>* / %</td>
<td>L</td>
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<tr>
<td>Additive</td>
<td>+ -</td>
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<td>Shift</td>
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<td>Relation</td>
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<td>Bitwise OR</td>
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<tr>
<td>Logical And &amp;&amp;</td>
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<tr>
<td>Logical Or</td>
<td></td>
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<tr>
<td>Assignment =</td>
<td>R</td>
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</table>

**Open device**
After the project is set up, click on the tool bar’s button and choose to initiate the controlled device.

**Program Compiler**
- Click on the Compile All button on the toolbar (or hotkey F6) to compile all ARES files within the project.
- The result will be shown in the Console window to confirm the compile is successful.

**Program link**
- After the coding is completed, ARES must still link the file onto Progress for it to be executed.
- Right click on Progress in the Controller window, choose Link ARES, and a window will pop up allowing the user to choose the ARES file.

**Monitor Window**
Shown through the Axes Status window
- Home, Limit and other I/O signals
- Parameter values such as speed, acceleration, and jerk
- Command, Feedback locations

**Operation**
- Write the ARES program to realize the motion control
- Compile the process into a .aobj binary file
- Download ARES procedure by API
- Finally use the

**Operators**

- Multiplicative: *, /, 
- Additive: +, -
- Shift: <<, >>
- Relation: >, <, >=, <=
- Equality: !=, ==
- Bitwise: &, |, ~
- Logical: &&, ||
- Assignment: =

**Level**
- Parentheses
- Unary
- Multiplicative
- Additive
- Shift
- Relation
- Equality
- Bitwise
- Logical
- Assignment
Application Cases

■ LED Chip Sorter

Back-end LED sorting process. There are two methods of sorting LEDs: the first is chip sorting, the second is packaged LED sorting. In this sample case, LED chip sorting was used. Chip testing and sorting are completed by two different types of equipment: the testing machine records each chip's location and bin code, and transmits these data to the sorting machine, which uses the data to perform rapid sorting. The advantage of this method is that it is fast; its shortcoming appears during the process when the blue tape that is stuck beneath the LED chip is peeled off, because the bottom pin needs to be re-positioned to the film on top to allow the LED chip that is to be sucked away to be removed by the upper suction pod. During high-speed movement, the impact strength of the upper pin may be too strong, causing the LED chip to crack. In addition, to shorten the motion cycle period, the swing arm must conduct short, high-speed movements, which involve rapid acceleration/deceleration. To ensure that the mechanism can endure these vibrations, most machines decrease the speed and consequently decrease throughput.

System Instruction

In this high speed pick & place application, to ensure that rapid pick and place processes did not cause the eject needle to damage the LED dies, PCI-1203 provided a "Torque Limit Table" function. The "Torque Limit Table" was set up preemptively, giving a location list in which the maximum torque parameter of the motor at every location was designated; maximum torque value was sent to the servo drive at every DDA cycle. PCI-1203 also provides a "PT/PVT" function to smooth the continuous trajectory and acceleration/deceleration characteristics by planing position, velocity, and time.

Conclusion

In this case, the "Torque Limit Table" functions enabled the equipment motion cycle to be greatly shortened (Period = 0.15 sec/chip; UPH = 24,000ea/hr); the "PT/PVT" function fulfilled the user-defined S-curve according to the machine's characteristics, and vibration suppression was also achieved. In addition, the PCI-1203 also supports 13-axis synchronized control. All machine behavior can be efficiently developed using Advantech’s powerful and flexible SoftMotion API.

■ Integrated IC Packaging Machine

To deal with faster and more powerful chip technology, semiconductor process linewidth technology has continued to evolve down to the nano level, and the backend of semiconductor processes also needs to provide a shorter production cycle, in order to increase production throughput per unit of time. With the diversification of semiconductor end products, including flash memories, logic chips, analog chips etc., the backend of a semiconductor process has to integrate multiple processes into a single machine, reducing the variety of machines required on the production line and thereby greatly shortening the production cycle. The integrated machine itself also has to be able to provide for faster production, complemented with optical inspection to decrease the rate and cost of manual errors, which is also a very important factor. Due to limited space, the size of the machine itself is not allowed to increase due to integrated functions, so the setup of the control is a key factor to be considered. Not only does it affect the time and cost of on-site setup, but also influences the maintenance effort required. Multi-axis synchronized motion control complemented with optical inspection can be used for a vendor’s integrated applications, from laser inscription, to inspection, to packaging.

System Instruction

PCI-1203 provides accurate, 31-axis, synchronized motion control by connecting pulse-type servo drives/motors through AMAX-3285. PCI-1203 is also equipped with error protection in gantry motion. A high speed I/O system, ADAM-5000/ECAT, satisfies high density I/O requirements.

Advantech vision solutions including vision software and industrial camera s realize high accuracy vision inspection and positioning on highly efficient computing platform MIC-7500 series.
# Regional Service & Customization Centers

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<td>Ireland</td>
<td>Oranmore</td>
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#### Greater China
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  - **Ottawa**: 1-815-434-8731

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