

# Precision Machinery Research and Development Center (PMC)

## BACKGROUND

Precision Machinery Research and Development Center (PMC) is a Taiwan-based company created in 1993 by the government and the Association of Machinery Industry (TAMI). PMC has teams of engineers from all fields related to machinery, including mechanical engineering, electrical engineering, control engineering, and information technologies. PMC conducts research and development in association with universities, and not only transfers newly developed technologies to Taiwanese machinery companies, but also helps train their engineers. This approach allows the Taiwanese machinery industry to be a leader in performance and quality.

In recent years the economics of the machine industry have pushed companies toward the use of industrial robots.

Although many machine building companies have built and demonstrated robots throughout achieving the required precision and performance has proven difficult.

With expertise in both mechanical engineering and control engineering, PMC set out to build a wide range of quality industrial robots to match the different use cases in the industry. PMC needed the right tools and technologies to build not only a single robot controller, but also a total solution that can control multiple robots and the components used in combination with those robots, like machine vision or conveyor control.

## CHALLENGES AND REQUIREMENTS

PMC's search for the technologies that would offer such flexibility led them to PC-based control and network-based real-time protocols. These technologies allow you to use the same program for multiple types of robots or other controllers. The only adjustments required are matching the processor and memory to each application. Network protocols are also very important for this kind of flexibility, because they allow you to change the motion and sensor hardware without changing or adding boards to the control computer.

Numerous Taiwan companies use PMC's machine technology and each has its own hardware preference, such as motor drives or input cards. For this reason PMC chose to use the EtherCAT network protocol. EtherCAT, originally developed by Beckhoff, is now an open standard widely used in the

industry, and most hardware vendors have an EtherCAT version of their hardware. As PMC develops the technology and control based on a standard, the various companies in the industry can use it while still maintaining flexibility in their hardware choices.

But hardware flexibility comes at a cost. EtherCAT requires a complex configuration, which differs for each hardware component. Testing and learning how to use each hardware component is time consuming. Additionally, battling protocol issues is not the purpose of PMC, which sought a way to maintain the hardware flexibility, while overcoming the testing, learning and protocol challenges.



## ● Partnership in a Mature Platform

After testing multiple EtherCAT solutions, PMC chose KINGSTAR EtherCAT as the best way forward.

A pioneer in PC-based control, KINGSTAR and its parent company IntervalZero, develop RTX64 and RTX hard real-time software, which extend the capabilities of the Windows operating system to deliver hard real-time functionality. Symmetric multiprocessing-enabled RTX64/RTX provide a separate real-time scheduler independent of the Windows scheduler. RTX64/RTX, Windows, x64/x86 multicore multiprocessors and EtherCAT are all key components of the KINGSTAR Soft Motion Platform.

As the demand increased throughout Asia for a simpler interface to use EtherCAT, KINGSTAR responded with its KINGSTAR EtherCAT product: a plug-and-play software interface for EtherCAT which detects the machine hardware, eliminating the need for complicated, time-consuming hardware testing and configuration.

While developing their technology and working with their partner companies, PMC had new demands for EtherCAT options and hardware support. The KINGSTAR team is working together with PMC to add the new functionalities to the platform and test any new hardware that was required

As part of the partnership, the KINGSTAR team visited multiple companies, working with them to make sure the hardware they used would work properly. While performing tests and learning more about market needs, the KINGSTAR team has developed relationships with many of the EtherCAT drive and input/output module vendors and shared the technical requirements of the Taiwanese machine builders. These relationships help ensure that PMC's technology can be used with a wide range of hardware without requiring many modifications in the control algorithms.

KINGSTAR and PMC have also begun working on ways to enhance PMC's solution with other components such as real-time vision control.

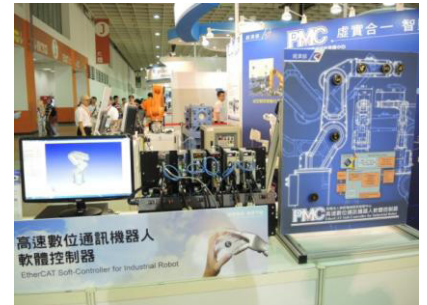


● Streamlined, Sophisticated Motion Control

PMC showed the results of their work during the Taiwan Automation Intelligence and Robot show (TAIROS) in 2014. They deployed multiple types of robots and solutions with a wide range of functionality and exceptional performance.

THE ABILITY TO INTEGRATE ANY HARDWARE

One of the demonstrations showed the ability to integrate hardware from different vendors on a 6-axis robot arm controller using various EtherCAT drives. The motors followed the moves of the simulated arm even though they each had different specifications.



THE CHALLENGE OF 6-AXIS ROBOT ARMS

At TAIROS, PMC demonstrated the popular 6-axis robot arm. A challenge of this architecture is that with bigger sizes and heavier loads, the load-variation can be significant and difficult to handle. PMC successfully showed their expertise with a bigger model, similar to those used in the automotive industry.



MULTIPLE ROBOTS IN ONE CONTROLLER

PMC also showed that its architecture allowed for a total solution with Delta type robots, SCARA type robots and machine vision synchronized with one conveyor belt. The demonstration used three controller computers in combination, but PMC also has the ability to put all the robots in one controller.



DUAL ARM ROBOT, SINGLE COMPUTER

The most impressive demonstration was two 7-axis robot arms linked together and controlled by a single computer. The 7 axes allow the robot arm to have the same degrees of liberty as a human arm. With this architecture, they can co-work on a single piece just like a human would with two arms. Thanks to KINGSTAR EtherCAT and the available power of recent processors, the whole control can be done in a single, relatively small, and fanless computer.

