Programmable Multi Axis Controller

PMAC Series

- World-beating* output speeds — Extremely precise motion control
- Flexible function development capability — More creative
- Multi-vendor compatibility — Create the right system for your application

*Refers to the motion control performance of 16.6 μs/1 axes or 50 μs/8 axes (Omron survey as of July 2016).
More flexible, more open —
Programmable Multi Axis Controller "PMAC"

Omron keeps believing in human potential

In order to satisfy diverse consumer needs and deal with short product life cycles, manufacturers need to boost both their productivity and their manufacturing quality. Omron is doing so by adopting the latest precision machining and robotics technologies.

More open technology will help customers turn their ideas into reality to flexibly respond to future changes —

That’s why Omron developed the Programmable Multi Axis Controller (PMAC).

The PMAC delivers world-beating* output speeds and flexibility that allows you to achieve your creative ideas.

Turn your ideas into a real machine, and enrich the lives of people around the world through products made by your machine.

The PMAC was originally created by Delta Tau Data Systems, Inc., which joined the Omron family in September 2015, and was further developed by adding Omron’s philosophy and technology. Its potential is unlimited — it’s up to you in how you use it.

* Refers to the motion control performance of 16.6 μs/1 axes or 50 μs/8 axes (Omron survey as of July 2016).

PMAC series
Programmable Multi Axis Controller

The controller meets the needs of the times.
Control innovation through ultra-high-speed calculations

The Programmable Multi Axis Controller (PMAC) is a controller designed specially for high-precision multi-axis motion control applications. Delivering world-beating* output speeds to perform precise linear motor drive control and nanometer positioning, the PMAC is appreciated by manufacturers of semiconductor manufacturing equipment and other products employing leading-edge technologies.

* Refers to the motion control performance of 16.6 μs/1 axes or 50 μs/8 axes (Omron survey as of July 2016).

Ultra-high-speed, high-precision

The PMAC achieves full closed loop control of position, velocity, torque, and current every servo cycle time of 16.6 μs per axis (50 μs/8 axes).

High-speed execution of motion programs, PLC programs, trajectory generation, and position compensation, improves positioning accuracy and velocity stability. The high-performance CPU centralizes the control of multiple axes to synchronize them precisely.

Flexible function development capability

The PMAC can be programmed in G-Code, ANSI C, or original programming language. This flexibility allows you to create your own control programs. You can use the servo algorithms that you designed using MATLAB®, add the program synchronized with PID control, and control your own mechanical system — Unlock your creativity.

Compatibility

You can configure a system to suit your application by connecting to both Omron devices and devices from other vendors. The PMAC can interface with virtually any type of motor including ultrasonic and voice coil motors, and can give position, velocity, and torque commands as well as commutation commands (two-phase analog commands and direct PWM commands) to the connected motors. Galvano scanner commands can also be put out.

It provides various input and feedback interface capabilities to accept the A/B phase signals, 1Vp-p sine wave signals from linear encoders, and parallel binary signals from serial data interfaces and laser interferometers.
Innovative control applications

The PMAC allows you to develop advanced systems that integrate your own technologies. It is used for various applications from manufacturing sites to advanced academic studies.

Processing machines

High-speed, high-precision processing for electric discharge machines, water jet machines, laser processing machines, plasma processing machines, and ultra-precision machining systems

Semiconductor/FPD manufacturing/inspection machines

Extremely precise motion for electron beam exposure machines, linear coaters, sealant dispensers, and wafer inspection machines

Robots

Complex mechanical control for machines using customized robots

Academic studies

Ultra-high-speed control functionality to control undulators and monochromators in synchrotron systems.
Versatile motion functions to create the best machine

Motor control

The PMAC has many modes for controlling motors: position-, velocity-, torque-, sinewave-, and direct PWM-mode drives. In addition to default servo algorithms, custom servo algorithms can be implemented. This enables motors to be fully synchronized even if many external devices are connected.

Automatically calculates position and velocity

Dynamic Lookahead
Algorithmically evaluates trajectories in advance of their execution. This optimized trajectory maximizes speed, acceleration and smoothness, reducing cycle time and improving path accuracy.

Positional Compensation
Table-based position compensation for imperfections in the mechanics enables more accurate motion.

Forward / Inverse Kinematics
Write a kinematics calculation as a subroutine to control user-developed mechanical systems (e.g. robots). In addition to mechanical control, it can also convert the travel distance (velocity) of the laser scanning header into the laser pulse amount.

Precisely synchronizes axes

Motion Spectral Decomposition
A single trajectory is divided into separate components that the standard (e.g. XY stage) and fast-tool actuators (e.g. galvano actuator) execute in coordinated fashion.

Ultra-fast Position-Compare
A hardware circuit creates an output pulse (response time: < 100 ns) when an exact encoder position is reached. Because it uses an actual position instead of a command, servo following errors do not affect the accuracy.

Cross-Coupled Gantry Control
Monitors in real time the positions of two gantry motors that have a tight mechanical linkage and corrects the skew between the motors to precisely synchronize the motion.
Executes motion program in synchronization with external input

PVT Mode Contouring
Enables direct control over the trajectory profile created by combining trapezoidal and S-curve velocity profiles, achieving cycle time reduction and stability.

Spline Move Mode
Generates very smooth but complex profiles and contours. The time profiles are guaranteed to be continuous in position, velocity, and acceleration, even at move boundaries. Multi-dimensional paths are guaranteed continuous in position, direction, and curvature, even at move boundaries.

Move/Path Blending
Permits smooth transitions in centripetal acceleration when the radius/curvature changes, rather than the step change of unblended tangent moves. Linear-, circle-, and PVT-mode moves can be blended.

Suppresses disturbance

Torque Compensation
Provides velocity corrections by compensating for cyclic disturbances such as motor cogging torque.

Trajectory Pre-Filter
Suppresses the occurrence of vibration by removing the resonant frequency with a trajectory pre-filter when sending a command.

Adaptive Control
Automatically compensates for the load inertia changes to reproduce the intended motion.

Executes motion program in synchronization with external input

Dual Feedback
Simultaneously uses velocity feedback from a servo and position feedback from a linear encoder or other device, providing extremely precise control (e.g. Bottom dead center control for high precision pressing machines).

Cascaded Servo Loops
The output of one servo loop is used as an input to another servo loop, bringing the capabilities of both loops to bear on a single actuator. The coupling of the loops permits easy switching between control modes, e.g. from position control to load control when the target position is reached.

External Time Base Control
An electronic cam function can be created by executing a motion program, without using a cam table. The motion program is synchronized to an external axis, not to time. Multiple axes can be synchronized with workpiece feeding controlled by another controller, which is useful for thread cutting and pipe bending work.
PMAC Series Product lineup

Motion controller plus PC - in one box
Industrial Box PC
NY51□-A

2 in 1
Multi-axis motion controller equipped with Windows Operating System

Reliability
Hypervisor software for uninterrupted control even if Windows is down
Simplicity eliminates problem generation and improves reliability

High performance
Controls up to 128 synchronized axes via EtherCAT® while running applications for creating high-resolution graphics and data handling

Saving space in machines
Compact Controller
CK3E

Saving space
Slim design of 28.6 mm saves space in machines and control panels

Cost effective
High-speed multi-axis control at an affordable cost - fastest cycle time of 250 μs

Reduced wiring
One connection of servo drives, I/Os, and other devices via EtherCAT

System configuration using CK3E

<table>
<thead>
<tr>
<th>IDE (Integrated Development Environment)</th>
<th>Ethernet</th>
<th>CK3E Programmable Multi Axis Controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZW</td>
<td>Vision System</td>
<td>NX1P Machine Automation Controller</td>
</tr>
<tr>
<td>Confocal Fiber Displacement Sensor</td>
<td>AC Servo System</td>
<td>NX2-V1 Multi-function Compact Inverter 3G3MX2-V1</td>
</tr>
<tr>
<td>NA</td>
<td>NX I/O NX Safety</td>
<td></td>
</tr>
</tbody>
</table>
Powerful and scalable flagship controller

Modular Rack System

Power UMAC

Customizable
Allows you to create a customer control system with exactly what you need for your application

Modular
Allows you to expand into multiple configurations for your control system and maintain commonality of hardware for each machine option

Flexible
Provides flexible connectivity and multiple communication methods, enabling you to take advantage of the most powerful and versatile machine control technology available

Integrated multi-axis motion controller and amplifiers

Intelligent Amplifier

Power Brick LV/AC

Integrated
A highly integrated package combining both the controller, amplifier and I/O

Convenient
Minimizes and simplifies your hardware and wiring in one system solution

Packaged
Integrated design allows for reduced cabinet space in a small, convenient package

System configuration using Power UMAC: Laser marking machine

Note: Consult your Omron representative for details.
PMAC Series family

Specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>Industrial Box PC (IPC Programmable Multi Axis Controller)</th>
<th>Compact Controller (CK3E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>NYS12-A600-1XX11391X</td>
<td>NYS12-A600-1XX21391X</td>
</tr>
<tr>
<td>Appearance</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image1.png" alt="Industrial Box PC" /></td>
<td><img src="image2.png" alt="Compact Controller" /></td>
</tr>
</tbody>
</table>

| Motion control        |                                                            |                           |
| Max. no. of controlled axes | 528                                                         | 8, 16, 32                 |
| Motion control period | 250 μs or more                                             |                           |
| Control method        | Issuing control commands using EtherCAT communications     |                           |

| Interface             |                                                            |                           |
| Ethernet port         | ![Ethernet port](image3.png)                               |                           |
| EtherCAT port          | ![EtherCAT port](image4.png)                               |                           |
| MACRO port            | ![MACRO port](image5.png)                                  |                           |
| Analog I/O            | ![Analog I/O](image6.png)                                  |                           |
| Digital I/O           | ![Digital I/O](image7.png)                                 |                           |
| Feedback              | ![Feedback](image8.png)                                    |                           |

| Memory                |                                                            |                           |
| RAM                   | 8 GB                                                       | 1 GB                      |
| Flash                 | —                                                          | 1 GB                      |
| Storage               | 64 GB (SSD)                                                | —                         |

| Windows OS            |                                                            |                           |
| Windows Embedded Standard 7 32 bit | ![Windows Embedded Standard 7](image9.png)               | Windows Embedded Standard 7 64 bit |

| Manufacturer          | OMRON Corporation                                         |                           |

Software

<table>
<thead>
<tr>
<th>Name</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power PMAC IDE</td>
<td>Computer software to be used in configuring the controller, creating user programs, and debugging the programs.</td>
</tr>
<tr>
<td>EC Engineer</td>
<td>Computer software to be used in configuring and monitoring the EtherCAT network by using the controller as the EtherCAT master. Bundled with Power PMAC IDE.</td>
</tr>
<tr>
<td>Power PMAC NC16-SDK</td>
<td>Computer software to be used in controlling machine tools and other CNC machines with the controller and customizing HMI screens. Extension source codes used for customization are included.</td>
</tr>
<tr>
<td>Power PMAC NC16</td>
<td>Computer software to be used in controlling machine tools and other CNC machines with the controller. Use this software when you do not customize the HMI screen.</td>
</tr>
<tr>
<td>Power PMAC Development Kit (PDK)</td>
<td>A collection of .Net Components and functions to be used in creating a .Net-based application program (HMI) that communicates to the controller.</td>
</tr>
</tbody>
</table>

Accessories for modular rack system (Power UMAC)

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital I/O board</td>
<td></td>
</tr>
<tr>
<td>ACC-64E</td>
<td>24 inputs/24 outputs, self-protected (overcurrent etc.) 12-24 VDC/PNP type/isolated Terminal block</td>
</tr>
<tr>
<td>ACC-66E</td>
<td>48 outputs, sourcing, self-protected (overvoltage by Zener diode) 12-24 VDC/isolated Terminal block</td>
</tr>
<tr>
<td>ACC-67E</td>
<td>24 inputs/24 outputs, self-protected (overcurrent etc.) 12-24 VDC/PNP type/isolated Terminal block</td>
</tr>
<tr>
<td>ACC-68E</td>
<td>48 outputs, self-protected (overcurrent etc.) 12-24 VDC/PNP type/isolated Terminal block</td>
</tr>
</tbody>
</table>

Option D-Sub 15 pin (female)
## Modular Rack System (Power UMAC)

### Intelligent Amplifier (Power Brick LV/AC)

<table>
<thead>
<tr>
<th>Low voltage type (LV)</th>
<th>High voltage type (AC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>256</td>
<td>4, 8</td>
</tr>
<tr>
<td>4, 8</td>
<td>4, 6, 8</td>
</tr>
</tbody>
</table>

- **Available output accessories**
  - Analog (single-phase ±10 V)
  - Pulse (pulse/direction)
  - Two-phase analog (120° phase difference, ±10 V)
  - Three-phase direct PWM

- **Built-in motor amplifiers**

- **Available feedback accessories**
  - ABZ phase
  - Sine wave
  - Parallel binary
  - Serial encoders

- **Available feedback options**
  - ABZ phase
  - Sine wave
  - Parallel binary
  - Serial encoders

### Available output accessories

#### Analog (single-phase ±10 V)

- **Pulse (pulse/direction)**
- **Two-phase analog (120° phase difference, ±10 V)**
- **Three-phase direct PWM**

### Available feedback accessories

#### ABZ phase
- **Sine wave**
- **Parallel binary**
- **Serial encoders**

### Available feedback options

#### ABZ phase
- **Sine wave**
- **Parallel binary**
- **Serial encoders**

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### Delta Tau Data Systems, Inc

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### Analog I/O board

<table>
<thead>
<tr>
<th>ACC-59E3</th>
<th>ACC-72EX</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 inputs 16-bit A/D converter</td>
<td>16 inputs 16-bit A/D converter</td>
</tr>
<tr>
<td>Input range: ±10 V, 4-20 mA</td>
<td>Input range: ±10 V, 4-20 mA</td>
</tr>
<tr>
<td>8 inputs 16-bit DAC</td>
<td>8 inputs 16-bit DAC</td>
</tr>
<tr>
<td>Output range: ±10 V</td>
<td>Output range: ±10 V</td>
</tr>
</tbody>
</table>

### Special field bus communication board

<table>
<thead>
<tr>
<th>ACC-24E3</th>
<th>ACC-24E3A</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 or 4 axis digital amplifier (PWM) interface</td>
<td>2 or 4 axis analog amplifier (±10 V) interface</td>
</tr>
<tr>
<td>TB connector or DB-15 connector</td>
<td>TB connector or DB-15 connector</td>
</tr>
</tbody>
</table>

### Axis interface board

<table>
<thead>
<tr>
<th>ACC-51E</th>
<th>ACC-84E</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 axis 4096x high-resolution analog encoder interpolator board</td>
<td>UMAC universal serial encoder interface</td>
</tr>
</tbody>
</table>

### Special encoder feedback

<table>
<thead>
<tr>
<th>ACC-51E</th>
<th>ACC-84E</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 axis 4096x high-resolution analog encoder interpolator board</td>
<td>UMAC universal serial encoder interface</td>
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</tbody>
</table>

### MACRO board

<table>
<thead>
<tr>
<th>ACC-5E3</th>
<th>ACC-E1</th>
</tr>
</thead>
<tbody>
<tr>
<td>For Power Series</td>
<td>115/230 VAC input UMAC power supply</td>
</tr>
</tbody>
</table>

### Power supply

<table>
<thead>
<tr>
<th>ACC-F1</th>
<th>ACC-E1</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 VDC input UMAC power supply</td>
<td>115/230 VAC input UMAC power supply</td>
</tr>
</tbody>
</table>