

# Intelligent Positioning Modules for Programmable Logic Controllers

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Factory automation systems are being used to manage more varied and complicated tasks. Intelligent modules are a key to implementing these systems because they extend and complement the functions of programmable logic controllers (PLCs). Intelligent modules offer such functions as analog-to-digital (AD) and digital-to-analog (DA) conversion, high-speed counting, temperature input and positioning control. This article introduces the AD75 Series positioning modules.

## Description

The AD75 Series offers dramatic enhancements over the previous AD71 Series in performance, functionality and versatility. Use of a 32b RISC processor with peripheral circuits implemented in custom LSIs gives the series high performance and compact dimensions. A programming software package for the series supports creation of positioning data, monitoring of module operating status, and other programming and maintenance tasks.

## Lineup

The AD 75 Series offers 1- to 3-axis control modules for MELSEC A, QnA and A1S series PLCs. All modules consume only a single slot, which contributes to reduced equipment size and cost. Fig. 1 shows the A1SD75P3 and AD75P3 three-axis positioning modules.

## Functions and Performance

Three-axis independent control, two-axis linear interpolation, two-axis circular interpolation and continuous positioning control functions are supported. These functions can be combined for continuous positioning control and are thus capable of supporting up to 600 points, which supports extremely complicated control functions.

External signal inputs for startup and speed-position switching reduce scanning demands on the sequencing program and the associated response delays. The PLC processing time required for positioning control is reduced by 75% compared to previous positioning units, which leads to shorter tact times for controlled equip-



Fig. 1 The positioning modules.

ment.

Six functions for origin recovery when activated support a wide variety of applications.

Step and S-curve acceleration patterns may be selected to minimize impacts associated with axis start and stop operations.

Open collector and differential pulse train motor drive interfaces support a wide variety of motor drives. The differential interface can output pulses at rates up to 400kHz to support high-speed motor control. Table 1 summarizes the AD75 Series functions and performance.

## Programming

Positioning statements use the table positioning scheme of the AD71 Series for backward compatibility and easy upgrading.

The AD75 Series has internal parameters controlling movement conditions and simultaneous start conditions for other-axis start,

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Table 1 Specifications of the AD75 Series Positioning Modules

Parameters\Products		AD75P1, A1SD75P1	AD75P2, A1SD75P2	AD75P3, A1SD75P3
I/O points		32		
Control capability		1 axis	2-axis simultaneous, 2-axis independent	3-axis simultaneous, 3-axis independent
Pulse output		Open collector, differential driver		
Control method		Point-to-point control, continuous control (linear or circular), speed control, speed-position control		
Interpolation		None	2-axis liner/circular interpolation	
Positioning	Language	Table method		
	Position pattern	600 patterns per axis		
	Memory	Battery-less flash EEPROM program storage		
	Absolute position limits	-214,748,364.8 ~ 214,748,364.7 $\mu$ m, -21,474.83648 ~ 21,474.83647 inches, 0 ~ 359.99999 degrees, -2,147,483,648 ~ 2,147,483,647 pulses		
	Increment limits	-214,748,364.8 ~ 214,748,364.7 $\mu$ m, -21,474.83648 ~ 21,474.83647 inches, -21,474.83648 ~ 21,474.83647 degrees, -2,147,483,648 ~ 2,147,483,647 pulses		
	Speed instruction range	0.01 ~ 6,000,000.00mm/min, 0.001 ~ 600,000in./min, 0.001 ~ 600,000°/min, 1 ~ 1,000,000 pulses/s		
	Acceleration processing	Automatic step acceleration, automatic S-curve acceleration		
	Acceleration time	1.0 ~ 65,535ms, four patterns each for acceleration and deceleration		
	Startup time	Less than 20ms		
Compensation		Electronic gear Backlash compensation Error compensation function		
		0 ~ 65,535 x position instruction unit 0 ~ 65,535 x position instruction unit Compensates for systematic mechanical errors (includes electronic gear support)		
Origin recovery functions		Near-point dog, count (2), stopper (3), external signal (2)		
Manual operation		Supports one manually operated rotary encoder for each axis		
Error and I/O display		Provided by 2.5 digit LED display		

which reduces sequence programming requirements and provides high-precision positioning that is not dependent on sequence program scan time. Parameter setting is performed using an optional positioning module software package.

Positioning data is stored in flash memory, eliminating battery-related maintenance requirements.

### Monitor Functions

The module has a 2.5 digit LED display that can be used to monitor zero-point signal inputs and mechanical inputs such as near-point dog and upper/lower limits for quicker equipment installation and adjustment. The display also outputs error codes to facilitate troubleshooting.

### Positioning Module Software Package

This software package, which operates under the Mitsubishi Electric A7PHP/A7HGP peripheral unit or a personal computer, offers edit, monitor and test modes, with simple switching from editing to online monitoring or testing. Fig. 2 shows the top-level edit-mode screen, and Fig. 3 the screen for positioning data editing. Positioning data editing is assisted by auxiliary windows for displaying menus and setting ranges.

The test and monitor modes permit detailed monitoring of the module's current status and operation history. The user can select monitoring of current feed position and feed speed for each axis as well as error history, warning history, external I/O signals and the state of the