

AC Servo Amplifier (Single Axis Type with Internal Power Supply) / “Q Series” S Type

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1. Introduction

The servo system market requires higher performance and lower cost with each passing year. We have encountered some situations where our conventional products could not satisfy the customer application and we could see the opportunity for a new servo system product.

In addition, servo systems from our competitors began to enhance the ease of system start-up and tuning. These user-friendly features further increased the necessity of offering a product with the performance and the functions that are able to compete in the marketplace.

Our new “Q series” S type servo amplifier (analogue and pulse train I/F options) is designed with the above considerations and is introduced in this paper.

2. Functions and Performance

2.1 Model Lineup

The various models of the “Q series” S type servo amplifier are 15A, 30A, 50A, 100A, and 150A. These match-up and can be used to replace our conventional products, the “PY series” servo amplifiers (PY0/PY2).

2.2 Product Externals

The “Q series” S type servo amplifier is up to 50% smaller in volume than our conventional “PY” product. In particular, the larger power servo amplifiers (those greater than 30A) are the smallest of their kind in the industry. This is thanks to the continued refinement of hardware technology that has been used in our conventional products. Key results of this refined hardware technology is highly integrated control circuit, low-loss power module, and miniaturization of the switching power supply. Fig.1 shows a volume comparison between our new “Q Series” and the conventional product.

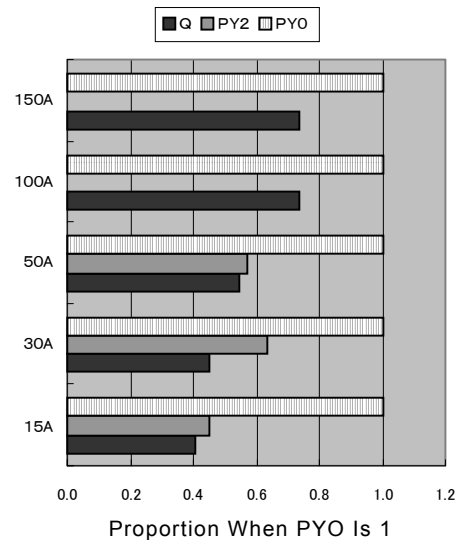


Fig.1 Comparison of Volume for Servo Amplifiers

2.3 Performance

In the “Q Series” S type servo amplifier, the control portion is completely changed as compared to our conventional product (both hardware and software). Our new servo control reaches a higher level of effectiveness. The main hardware is as follows.

- Dedicated ASIC for controlling the servo (including current control and interface for various sensors, etc.)
- Utilization of the latest 32-bit RISC type CPU. (62 MIPS, built-in flash ROM, etc.)

New software that contains the control algorithm was developed which results in the basic performance as follows (including the other innovations mentioned earlier).

- The sampling time of the position loop and the speed loop is 125 μ s.
- The sampling time of the current loop is 50% smaller than the conventional product.
- The complete d-q axis control was adopted for highly accurate torque control.
- Adoption of speed feedback filter to achieve smooth speed control.
- Performance improvement of torque sensor.
- Development of sensor for vibration control.

Table 1 is a summary of the performance improvement items.

Table 1 Performance Comparison of "PY Series" Servo Amplifier and "Q Series" Servo Amplifier

		PY Servo Amplifier	Q Servo Amplifier	Performance Improvement Value
1	Speed loop frequency response($J_L=J_M$)	400Hz	600Hz	1.5 times
2	Positioning stop settling time	5ms	< 1ms	> 5 times
3	Deviation of position during constant speed	Yes	0 control possible	Deviation minimum control
4	Practical position loop gain maximum value ($J_L=J_M$)	628 rad/s	942 rad/s	1.5 times
5	Tracking performance of position (practical use of FF gain)	50% max	100% max	2 times
6	Position command pulse frequency	2MHz	5MHz	2.5 times
7	Current loop response (with AC200V supply)	870Hz	1.7KHz	2 times
8	Motor current with no load	Yes	No	Decrease of motor heat
9	Accuracy of notch filter	13BIT	16BIT	8 times
10	Applicable frequency of notch filter	200Hz - 990Hz	100 - 1990Hz	2.4 times
11	Vibration control	No	Yes	Machine vibration control
12	Real-time auto tuning (with parameter updates)	speed control system	Speed & position control system	
13	Inertia ration range for real-time auto tuning	31 times	127 times	4.1 times
14	Frequency characteristic identification function	No	Yes	With separate PC

2.4 Product Specifications

Other improvements have been achieved in the "Q Series" S type servo amplifier in addition to the improvements as described in the preceding section. These additional improvements are as follows.

- The motor sensor uses a high-speed serial interface to reduce wires between the sensor and drive (2.5Mbps start stop synchronous specification).
- The interface for the personal computer has been improved.
- Up to 15 servo amplifiers can be connected to one personal computer.
- A scrolling function for the monitor waveform, useful for system start-up and maintenance, is included with the personal computer I/F.
- A 1 pulse movement is now possible with the JOG function.
- The I/F with host controller can be user defined for 8 inputs and 8 outputs (however, there are default values defined). The command interface remains specific for torque, velocity, or position.
- A built-in touch pad is provided with four buttons and five LEDs to set any of the drive parameters. The touch pad screen can also be used for various types of monitor functions.

All of these improvements have resulted in a servo system that is easier to operate and maintain as compared to conventional products. This includes improved alarming that results in easier diagnosis of any problems or defective parts.

Additionally, expanded "warning" messages have been added so that user may take preventive measures to avoid eventual alarm conditions.

The complete list of specifications for this servo amplifier is on the next page.

3. Conclusion

We are confident that the new "Q Series" servo system meets the requirements of our customers and offers many advantages as compared to competitive products. We will continue to monitor customer needs and the direction of the competition so that we can develop new products that build on our technology and that offer new advantages for our customers.

Table 2 List of Specifications

	Specification · Function	"Q Series" Amplifier	
Basic Specifications	Voltage Series	AC200V (AC100V is also possible with 15A and 30A)	
	Phase of power supply	3 ϕ 1 ϕ	
	Main power supply / Control power supply	Independent Inputs	
	Amplifier output capacity	15 / 30 / 50 / 100A 150A / 300A	
	Adapting motor capacity	30~15000W	
	Motor maximum rotation speed	5000min ⁻¹ (Q motor)	
	Control mode	Position / speed / torque control	
	Feedback	Incremental Type	5000×4 P/R (parallel) *1 and 131072 separate serial encoder
		Absolute Type	
	System requirements	Usable temperature	0~55°C
		Usable humidity	<90% (without dewing)
		Vibration resistance	4.9m / S ²
Shock resistance		19.6m / S ²	
Structure		Tray type with built-in power supply	
Dimension of externals (15A, without mounting stay) :W×H×D		45×168×130	
Installation method		Front side / rear side	
Performance	Frequency characteristics (JL=JM)	600Hz	
	Highest command pulse frequency	5Mpulse / s	
	Settling time	<1ms	
New Control	Deviation minimum control	○	
	Vibration control	○	
	Disturbance torque observer	○ (performance improvement)	
Built-in Functions	Regeneration process	Built-in	
	Dynamic brake	○	
	Gain switching function (depends on speed or position deviation etc.)	○	
	JOG function	○ (single pulse possible)	
	Control mode switching	Position·speed / position·torque / speed·torque	
	Real-time auto tuning	○ (load inertia ratio improved)	
	Programmable filter	○ (2 nd order notch filter+LPF)	
	Full closed loop support	○ (no external change)	
	Parameter change	Built-in touch pad and personal computer	
	Frequency characteristic identification function using PC	○	
	Personal computer interface	Number of axes	up to 15 axes
Communication rate		9600~57.6kbps selectable	
Real-time scrolling waveform display		○	
Others	Safety standard	CE·UL	
		*1 Support 500~65535×4 P/R Serial encoder can support up to 400 million P/R	

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