

Development of Large-capacity Models of Multi-axis Servo Amplifier "PQ"

Haruhiko Chino
Tetsuya Yamamoto

Hiroaki Koike
Tadamitsu Hasegawa

Akihiro Matsumoto

1. Introduction

These days, servo actuators are no longer limited to the fields of robots and machine tools. They have been extended to ordinary industrial machines. The result is an increasing number of cases where "single-axis" (with a built-in power converter) servo amplifiers are not enough to satisfy the wide-ranging market needs. Above all, demand is particularly strong for "multi-axis" (with a separate power converter) servo amplifiers. We have thus been developing and selling "PQ" series as multi-axis servo amplifiers.

Among the fields that call for multi-axis amplifiers, the market in one field is growing quickly these days. It is the field of "injection molding machines." Based on the aforementioned "PQ" servo amplifier, we have now developed multi-axis servo amplifiers designed mainly to increase the capacity and optimize the functions for injection molding machines. This paper gives an overview.

2. Background of the Development of PQ Large-capacity Models

2.1 Extension of Multi-axis Servo Amplifier "PQ"

The servo amplifiers "PQ" developed for "multi-axis" use are characterized by their space-saving and low-cost features of the system. These products also embody our "Multi-interface Statement."

[Fig. 1](#) shows a photo that gives an overview of the type M (modular) of the "PQ."

For the high-level interface, we have simultaneously developed (1) a control unit with an analog or pulse train input system and (2) a control unit with an RS-485 interface having fast (4Mbps) serial communications, in addition to the SERCOS interface developed in advance. The aim was to make it possible to mount them both on the existing multi-axis servo amplifier "PQ" and the newly developed "PQ" large-capacity model.

For the RS-485 interface with fast (4Mbps) serial communications, our supply of communications LSIs allows users to build fast, high-performance networks easily.

[Fig. 2](#) is a conceptual diagram of connections based on analog pulse train input.

2.2 Application to Injection Molding Machines

While environmental issues are taken up in every field, the industry of "injection molding machines", which used to depend on hydraulic pressure for most of its driving sources, has now inclined dramatically toward motor-driven servo actuators for the past few years. About a half of the production of the industry of "injection molding machines" in fiscal 1999 is said to have been replaced by equipment incorporating motor-driven servo actuators.

“Injection molding machines” generally consist of four axes (including the injection axis). However, as shown in robots and metal-working machine tools, it is rare that more than one axis should act at the same time. When seen chronologically, each axis acts almost independently.

The servo system therefore does not have to incorporate four axes worth of capacity of converter (AC/DC converter) designed to rectify the power supply. When one considers a multi-axis servo system with a separate converter (AC/DC converter), it is advantageous in that the system can be run by a converter with a relatively small capacity.

Another thing to be noted is that the sharing of a common DC main power supply, which is one of the advantages of the multi-axis servo system, has reduced the number of regenerative resistors. What is more, the shift to a power regenerative converter to save energy can be smoothly conducted by using a separate power supply unit.

With the quick growth of portable and other information equipment, “injection molding machines” are showing great growth. Particularly remarkable is the growth of small-size machines having a mold-clamping force of 100t or less. To drive them, mid- and large-capacity servo motors with capacities from a few to 30kW are used. The future electrification of mid- and large-capacity mold injection machines is projected to increase the effectiveness of this development project, which offers a line-up of products up to 75kW.

3. Characteristics of “PQ” Large-capacity Models

3.1 Line-up of Products

The line-up covers our “P6” servo motors ranging from 11kW to 75kW. Products for 45kW, 55kW, and 75kW, in particular, have been developed with an input supply voltage of 3 phases, 400V AC.

A typical combination is shown in [Table 1](#).

3.2 Characteristics

3.2.1 Control Unit

The control of this product uses elements identical with those of the “PY” series servo amplifier. It uses the high performance and high functions of the “PY” series servo amplifier.

3.2.2 Main Circuit

All five kinds of servo amplifiers in this series use an intelligent power module (IPM) incorporating an IGBT of the 3.5-th or the 4th generation. This has made it possible to simplify the main circuit and reduce labor for assembly wiring.

We also believe that the optimization of the snubber circuit and imagination used for the copper bar in the main circuit have made it possible to reduce the switching surge voltage of the main IGBT and are expected to inhibit noises generated. (EMI data is in the process of being obtained.)

4. Conclusion

“PQ” large-capacity models inherit the concept of multi-axis servo amplifiers “PQ” and aim to achieve larger capacities and enhanced interfaces.

We are scheduled to provide a line-up of power regenerative converter as part of this series, thus proceeding further with our eco-friendly policy.

We intend to aim to develop user-friendly products to meet increasingly diverse market needs and to achieve more "customer satisfaction."

Haruhiko Chino

Joined company in 1983
Servo Systems Division, 2nd Design Dept.
Worked on development and design of servo amplifiers

Hiroaki Koike

Joined company in 1988
Servo Systems Division, 2nd Design Dept.
Worked on development and design of servo amplifiers

Akihiro Matsumoto

Joined company in 1990
Servo Systems Division, 2nd Design Dept.
Worked on development and design of servo amplifiers

Tetsuya Yamamoto

Joined company in 1993
Servo Systems Division, 2nd Design Dept.
Worked on development and design of servo amplifiers

Tadamitsu Hasegawa

Joined company in 1998
Servo Systems Division, 2nd Design Dept.
Worked on development and design of servo amplifiers

table 1 Combination of servo amplifier and motor in a "PQ" large-capacity servo system

Motor output capacity (kW)		11	15	20	25	30	37	45	55	75	
Line-up of PQ large-capacity servo amplifiers	200V input	300A	●	●							
		600A			●	●	●				
		900A					●	●			
	400V input	600A							●		
		800A								●	●



fig. 1 "PQ" type M, modular

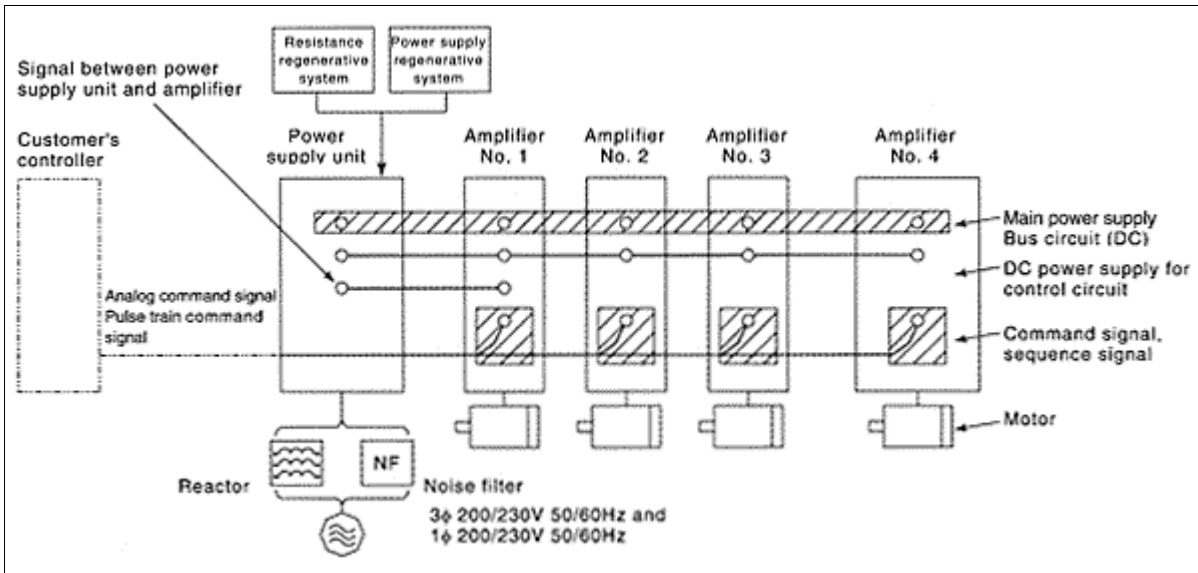


fig. 2 Conceptual diagram of connections based on analog or pulses signal input system (200V line)