Improve Your Application's Performance

By John Mazurkiewicz

Baldor Electric

Servomotors are used in applications requiring numerous starting, stopping, and reversals. Applications requiring precise control over position and speed – tight control that may not be possible with other motors.

Servomotor

The servomotor is designed to provide precise control and "performance" – i.e. drive a load and get it into position faster. This is important in typical applications as listed in Table 1, and of course many other applications exist. But what allows the servomotor to accomplish this, what makes the servomotor different than other motors?   The answer is in the servomotor's diameter, use of a feedback device, and in the manufacturing of the product.

Table 1 – Typical applications for servomotors

Laser cutting	Cheese machines	Woodworking
Pepperoni Dispensing	Margarine Slicing	Tool Changer
Electronic Pick & Place	Carton Cutting	Textile Manufacturing
Wood Cutting	Pull Wire to Length	Wrapping
Tire Manufacturing	Furniture Drilling	Glass Packaging
Sewing	Robots	Metal Cutting
Egg Handling	Wood carving	Silicon Wafer Handling
Chocolate Bar Collating	Textile Weaving	Medical Scanners
Form/fill/seal	Material Trimming	Automation
Frozen Food Packaging	Material Cutting	Wire Weaving
Paper Industry	Yogurt Dispensing	Meat Packaging
Pull to Length	Measurement	Printing Machines
Packaging Machine	X–Y Positioning	Dye Machines
Mixing/Dispensing	Glue Laying	Food Packaging
Camera Control	Machine Tool	Chicken Packaging
Laser Wood Trimming	Bacon Cutting	Confectionery
Envelop Manufacturing	Plastic Bag	XY Coordinate
CNC Machine	Industrial Sewing	Winding Equip

The servomotor has been designed specifically to have the rotor diameter reduced, while maintaining the same output hp or torque. The smaller diameter reduces the mass, or inertia of the rotor. As an example, typical sizes for a 1 horsepower motor would be as follows: AC induction motor 5.6 – 7.6″ OD; SCR rated motor 4.7″; and low inertia brushless servomotor 3.5″ sq. (See photo). Smaller rotors mean lower inertia which allows for faster acceleration and faster positioning. This reflects directly to the bottom line in an application – the number of parts produced per hour.

For example, in the time it takes a typical 1/3 hp vector motor to produce 1 part, a standard inertia brushless servo will produce 6 parts, and a low inertia brushless will produce 40 parts! See Table 2 for time to speed for other hp categories. Thus the servomotor with its' faster response rate, can produced more parts per hour, thus attaining higher productivity improvements.

Table 2 – Time to speed for variety of motor technologies

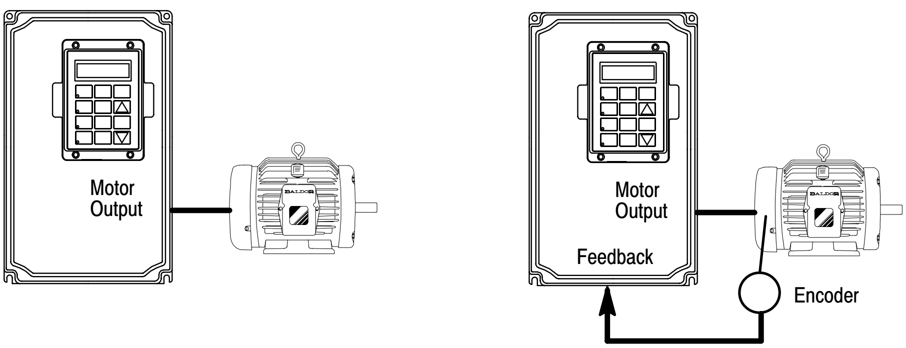
HP	Sensorless Vector	Flux Vector	PMDC Motor	Brushless Standard Inertia	Brushless Low Inertia
1/3	250	200	100	30	5
1	250	200	100	45	10
10	350	300	150	100	20

Time in Milliseconds

Closed loop

Secondly, servomotors are used with feedback in closed loop systems. A closed loop system is one in which there is a drive command and a feedback signal. See Figure 1 for a block diagram illustrating a closed loop. The feedback signal provides the means to monitor the process and perform complex tasks with greater precision – i.e. measures the task which the motor is doing. The command and feedback signals are compared and a correction signal is issued to fix any errors.

Figure 1 – Open loop vs closed loop



Open loop **Closed loop**

Examples of feedback devices include: tachometer, resolver and encoder. A tachometer provides speed information only. Both resolver and encoder provide position and speed information. The position feedback device selected depends upon factors such as dust, shock, and temperature. Coupled with a feedback device, the servomotor provides for greater accuracy in an application. This shows up in quality of the end product produced.

Servomotor design

Additionally, in the design and manufacturing of the servomotor, special care is taken in material selection and winding of the motor. Materials are carefully selected to allow operation at a higher winding temperature of 155 °C, whereas typical motors are designed to operate at 90–125 °C. Thus the servomotor delivers higher performances in a smaller package.

In manufacturing, a servomotor's slot fill is increased – more wire is wound onto the laminations. For example, a servomotor typically will have a slot fill of 75–80%, whereas most motors will only have a 65% fill. This higher slot fill presents production challenges, however it allows the servomotor to provide extra torque, and improves efficiency.

Servomotors have numerous design improvements/advantages over typical, traditional motors. Thus the servomotor provides precise control and application performance improvements.