

## Section 1. INTRODUCTION

### 1.1. THE COMPUMOTOR PLUS TECHNOLOGY (PATENTED)

Conventional DC servo systems are being replaced by brushless servo motors and digital control systems. Brushless motors are thermally efficient and require no periodic maintenance. While they are somewhat more complicated to control, the decreasing price of digital control electronics has made these systems attractive. Brushless servo motors and digital control systems are still more expensive than conventional systems, however, and there is little standardization between manufacturers. Feedback devices, such as Hall effect devices, tachometers, encoders, and resolvers must be added to control the motor.

An ideal brushless servo motor would be physically compatible with industry standard frame sizes, have a high torque-to-inertia ratio (for fast accelerations and short move times), and have an integral high-resolution position sensor. This ideal motor should also have a sinusoidal torque-angle characteristic (for smooth operation) and be reasonably priced.

Compumotor began a motor development program in 1986 to design a low-cost, high efficiency brushless servo motor with an integral brushless resolver.

After evaluating many motor technologies, Compumotor determined that the conventional 1.8 degree hybrid step motor, when controlled properly, makes a very good servo motor. It has a high theoretical torque-to-inertia ratio (and hence high acceleration capability) that cannot normally be used when run 'open loop' because of the potential to stall. The step motor has a high theoretical torque for its size because of its efficient magnetic structure, but this torque can only be fully used when the motor is run closed loop. This motor is extensively tooled and inexpensive to manufacture.

A brushless resolver made of the same rotor and stator components used in the motor was developed. This patented resolver is magnetically similar to the motor itself, and is manufactured as an integral part of the motor. The result is a sensor with the same number of poles as the motor (which makes control easy) that is always properly aligned with the motor and can operate in high noise, high temperature environments. Three motor/resolver combinations are currently being manufactured: Industry standard NEMA sizes 23, 34, and 42.

The new Compumotor Plus servo system is a brushless, digital, closed-loop positioning system based on this new motor and drive technology. It offers many innovative features, including:

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- o New motor technology with integral brushless resolver
  - High torque/inertia ratio for high acceleration rates and short move times
  - ideal for point-to-point positioning applications
  - Industry standard NEMA 23, 34, and 42 stepper-compatible torques
    - Size 23: 130 Oz.-in.
    - Size 34: 370 Oz.-in.
    - Size 42: 1,100 Oz.-in.
  
- o Digital velocity and position loops with simple PID<sup>1</sup> tuning
  - Front-panel, push-button tuning with LED diagnostic indicators
  - A standard RS-232C interface, which provides online setup assistance
  - Velocity Monitor output, which provides real-time performance data
  
- o Interface options
  - A step and direction interface, which is compatible with all Compumotor indexers (CPL, CPH)
  - A +/- 10V velocity input version for DC servo retrofit applications (CPLA, CPHA)
  
- o An integrated controller/amplifier has built-in power supply, low EMI filtered amplifier outputs, full optical isolation on all user connections, two-digit LED diagnostic display.

Compumotor has joined each motor with a new digital control system designed specifically to take advantage of the performance characteristics of the motor. Each drive is fully packaged with an integral power supply, filtered power amplifier (for low EMI and low motor heating), and controller card. The controller is based on a 68000 16-bit microprocessor, which digitally closes the position and velocity loop. Loop gains (specified as

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<sup>1</sup> PID refers to proportional, integral, and derivative gain settings.

proportional, integral, derivative, and velocity gains) are factory preset for stability with moderate frictional and inertial loads. These gains may be adjusted with either hidden front-panel push buttons (assisted by a two-digit LED display) or with the unit's standard RS-232C interface. Using the RS-232C interface allows the user to query the servo system about performance data such as following error, average and peak currents, setpoints, and gains. Each drive also has an Analog Velocity Monitor output, which is a synthesized tachometer signal that can be used with an oscilloscope.

## 1.2. PERFORMANCE

The Compumotor Plus system provides high accelerations (typically 10 times higher than open loop stepper systems) and high torques in each frame size. The torque profiles have been chosen to provide high torques at low to moderate speeds. This makes the Compumotor Plus system ideal for point-to-point positioning applications where increased throughput is important.

Because the Compumotor Plus system runs closed loop, current is only produced when torque demands require it. The Compumotor Plus system runs much cooler than comparable open loop steppers. This can be important in applications (such as stage drives) where motor heating is an important factor.

Because the Compumotor Plus system runs as a servo, the motor cannot stall in the same way that conventional open loop steppers can. If torque demands exceed the capability of the system, the motor just slows down and tries to keep moving. If the load absolutely prohibits the motor from moving, the drive can be programmed to indicate a fault to the operator or control system.

## 1.3. INTERFACE OPTIONS

Both the Analog and Step/Direction versions of the Compumotor Plus system have push-button and RS-232C tuning, Velocity Monitor and Fault outputs, hardware Enable input, and a CW/CCW display that indicates setup and fault information. The exact nature of any fault (e.g., excess average current, excess following error, loss of resolver signal, etc.) is displayed as a unique two digit number as an operator aid.

The Step and Direction version is designed to be compatible with all Compumotor indexers and is operated just like other Compumotor servos and microsteppers. The drive moves the motor one increment in the specified direction for each step pulse received. The optically isolated Step and Direction inputs can be provided by the user, as well. The Compumotor Plus has programmable resolution, so that any convenient user units may be specified.

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The Analog Input version functions as a velocity servo (no positioning), rotating the motor at a velocity proportional to a +/-10V control input. This version is useful for applications where a Plus system is replacing a conventional brushed DC servo motor and amplifier. Full digital tuning and the digital diagnostics are maintained, however, for easy system setup and maintenance.

For information in the Compumotor Plus Indexer version, refer to that product's user guide.

## Section 2. INSTALLATION

### 2.1. WHAT YOU SHOULD HAVE

You should inspect your Compumotor Plus system upon receipt for obvious damage to its shipping container. Report any such damage to the shipping company as soon as possible. Parker Compumotor cannot be held responsible for damage incurred in shipment. The Compumotor Plus should be carefully unpacked and inspected for the following items to be present and in good condition:

1. Drive unit
2. Motor with drive and resolver cables
3. This manual
4. The following models are provided with an input step-down transformer:
  - CPL: 57-120
  - CPL: 83-150

The 106-220 is provided with an AC power cord instead of a transformer. The part number, description, and quantity shipped are listed below.

<u>Part Number</u>	<u>Description</u>	<u>Quantity</u>
43-007483-01	8-Position Plug	2
43-007484-01	12-Position Screw Terminal Plug	1
71-007547-01	AC Power Cable (high-power only)	1
47-007386-01	36VAC Transformer (low-power only)	1
71-007819-10	10-Foot Motor Cable (for 57-120 and 83-150 motors)	1
71-007817-10	Motor Cable (for 106-220)	1
71-007811-10	Resolver Cable (for all models)	1
52-006007-01	Mounting Bracket	2

### 2.2. DRIVE MOUNTING

This section outlines installation guidelines with the safety of the operator and the equipment in mind. You should become familiar with this section and with local and national codes that pertain to the installation of electrical equipment to ensure the safest possible installation.