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ServoLoc 3 **Model 700-SL3**

Digital Brushless Servo Controller

Operation Manual May 1999

Introl Design, Inc.

48 North Street

Lockport, NY 14094

Important

This control has been designed as a component intended to be implemented in a control system. Introl Design, Inc. has no control over the numerous control schemes, therefore it is the responsibility of the user to install this device in a system with the safeguards in place to prevent personal injury or equipment damage. The user should comply with the National Electrical Code as well as any local or other applicable codes. Although every effort has been made to assure the accuracy of the information contained in this manual, Introl Design, Inc. accepts no liability whatsoever with respect to the information provided herein. There are no implied warranties of merchantability or fitness for a particular purpose that apply to the control described in this manual.

Introduction

ServoLoc 3 **Digital Brushless Servo Controller**

The Introl ServoLoc 3 is a digital controller designed to control the speed and torque of a motor in a fast responsive servo loop. The ServoLoc 3 is capable of controlling DC/AC brushless servo motors, as well as DC brush motors with encoder or resolver feedback. This drive accepts DC or AC power input.

The ServoLoc series of controls offer a variety of selectable/programmable options through the furnished PC software. Even though the drive is designed for servo control type applications, it also offers a unique acceleration/deceleration with coast or ramp to stop option which could be used for spindle drive applications. All drive parameters can be changed while in operation (on the fly) through the RS485 serial communication port, which lends itself to a multi-axis control environment.

The drive can be configured for velocity or torque mode operation with a programmable current limit in the velocity mode, or programmable current output at full input analog command input.

Please take a few minutes to read through this manual and familiarize yourself with the drive. Also, please copy the drive model number and serial number below. You will need these numbers any time you call for questions or service.

Drive Serial Number _____

Drive Model Number _____

Specifications

- Power Input Requirements - 85 VAC to 240 VAC rms line to line. Three phase/single phase at 15 Amps.
- Single phase power can be used for motor rms currents under 7 Amps.
- DC power source can also be used, 100 to 350 VDC at 20 Amp max.
- Output Power - For brushless servo motors, 3 phase sinusoidal current, 0 to input line voltage rms, up to 15 Amps continuous and 30 Amps peak for one second.
- For DC brush motors, 0 to 1.4 times the input line voltage, up to 15 Amps continuous and 30 Amps peak for one second.
- (ServoLoc 2: 10 Amps continuous and 20 Amps peak for one second)
- Discrete Inputs - Three optically isolated inputs, 5 to 24 VDC at 5 to 25 mA.
Drive Enable
Future Use
Motor Thermal Switch
- Discrete Outputs 1 - Fault relay contact output, normally closed held open, rated at 24 VDC at 0.5 Amp.
2 - Open collector transistor output, capable of sinking to drive common 50 mA at 24 VDC, to indicate current limit (overload) condition.
3 - Three open collector transistor output, to simulate encoder channels A, B, and reference in quadrature format when resolver is used as the drive feedback.
- Analog Inputs - Three software configurable analog inputs, 0 to ± 10 VDC primary input, 0 to 5 VDC auxiliary input, and 0 to 20 mA or 4 to 20 mA input.
- Analog Output information - Optional : one 0 to 20 mA or 4 to 20 mA output configurable to output various when the positioning software is used.
- Drive Faults - Based on the following conditions, the drive will automatically shut OFF the output power to the motor, the Fault LED on the face of the drive will illuminate, and the fault relay contact output will close.
1 - Motor/motor wiring/output power transistor short, or overcurrent condition.
2 - Low DC bus voltage.
3 - High DC bus voltage.
4 - AC power interrupt.

- Environment - The drive is designed to operate safely in a non-corrosive atmosphere of 0 to 60°C ambient temperature, with the heatsink temperature not to exceed 85°C.
- Serial Comm. - RS485/RS232 with PC software for set-up provided. Up to 32 drives can be linked, each with a unique programmed address.
- Physical Dimensions - Footprint 10.1" H x 3.3" W
- Size 10.1" H x 3.3" W x 6.0" Deep, including mating connector.

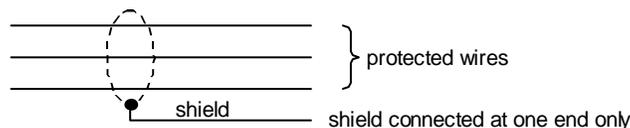
Installation and Set-Up

The installation of this equipment should be performed by qualified electrical personnel and should conform to all applicable local and national electric codes.

Warning: Use extreme caution during installation and start-up. Hazardous potentials exist on some drive terminals. Familiarize yourself with the drive terminals before installation. Stop and read the manual fully and study the appropriate connection diagram. Have all your questions answered before installation. After unpacking, check for any type of physical damage. Do Not install a damaged drive; return for repair or replacement.

Disconnect power and safety lock-out at the power source before installation, and any time service is needed.

- 1** - Select an appropriate location. A good location is a dust-free, non-corrosive atmosphere with an ambient temperature within 0 to 60° C, non-condensing (no moisture). Use the dimensions provided at the end of this manual to locate holes for installation.
- 2** - Select a large enough enclosure to allow for cooling.
 - For totally enclosed enclosures, use approximately 2 cubic feet of space per horsepower.
 - For ventilated enclosures with a circulation blower, the volume can be reduced to about one cubic foot per horsepower.
- 3** - Select a connection diagram that applies to your application and connect accordingly.
 - Be careful with shielded cables. More than likely, the feedback shielded cables have been furnished as a part of the package. The shielded cable is a set of wires surrounded by a layer of braided wire or a foil wrapping which shields the signal wires within from electrical noise pick-up or prevents radiation of electrical noise energy.



Please note the shield connection. In some cases the shield only connects at one end, and the other end must be isolated from contact to any other wiring or the body of the conduit or junction box. There are other cases when the shield needs to be connected at both ends.

- 4** - Motor and power wires should be selected based on the motor nameplate rating, or the expected current draw and wiring length. It is not recommended to use wires smaller than 18 AWG.

<u>Current Rating</u>	<u>Wire Size</u>
up to 5 Amp	18 AWG
5 to 10 Amp	16 AWG
10 to 15 Amp	14 AWG

These wiring sizes are suitable for up to 50 feet. For wire lengths of 50 feet to 200 feet, increase the wire size to avoid wire heating and degraded performance.

Warning: Check the supply voltage and make sure that it is within the drive's acceptable input power range.

5 - Initially make sure that the drive will not be enabled at power up until all drive settings have been verified. Also at this point, you should connect your PC with the furnished software installed, to establish a communication link for set-up parameter verification.

6 - While observing the indicator lights on the drive, turn the power **ON**. The Current Limit light should illuminate for a short period of time and then should shut OFF, and the Power indicator light should stay **ON**. The Fault indicator light may turn **ON** momentarily.

7 - Through the PC, running the furnished software, select "Read" and then accept the default ID# at the prompt.

8 - If the wires connecting the PC to the ServoLoc 3 are correct, all the factory setting parameters will be transferred to the screen of your PC. Otherwise, an error message will be displayed.

9 - Everything on the PC screen is self-explanatory, and we will discuss here the effect of each setting on the performance. **All of the factory settings will provide good performance with the PID (Proportional, Integral, Derivative) settings.**

10 - Since the drive is already set up, you may choose to skip the tuning procedure and continue by enabling the drive and applying the reference to initiate motion.

11 - Based on the nature of the application, you can select the torque or velocity control mode.

- Velocity Control Mode: In this mode the drive will compare the actual velocity of the motor to the commanded velocity reference input and then it will increase/decrease current in to the motor to maintain a zero velocity error.

- Torque (Current) Mode: In this mode the drive will use the velocity/torque command reference input and scale it based on the current limit setting to provide the programmed current at the full command input.

Tuning

1 - From your PC, reset the following parameters to start-up settings.

Proportional Gain	2
Integral Gain	0
Derivative Gain	0
Accel Time	0
Decel Time	0
Current Limit	to match motor, each 10% = 1.5 Amp

Now select "Send" on the PC screen to send information to the drive.

2 - With zero velocity reference applied to the drive, enable the drive. The green Run indicator light should illuminate. The motor now should be without any motion.

3 - Increase velocity reference to force motor rotation. Continue increasing the velocity reference to its maximum.

4 - Disconnect the reference and reconnect (step function) and observe the response to the instantaneous velocity changes. Increase the proportional gain and repeat this procedure until erratic performance is attained. Erratic performance would be: overshooting, harsh metallic noise from the motor, excessive chatter and vibration in motion (not very smooth motor rotation). Once the erratic behavior is encountered, reduce the proportional gain until smooth operation is established.

Please remember, after each change of gain you must send the parameters to the drive.

Proportional gain refers to: the velocity reference input is subtracted from the actual velocity to develop a velocity error. This error is then scaled and multiplied by the proportional gain setting, and then summed with the integral and derivative terms, and then used as a direct current command to power the motor.

As is obvious, the higher the difference between the command and the feedback, the larger the current command. Also, the lower the difference, the lower the current. Therefore, with a zero velocity command and a slow motor movement by the load, there will be no torque produced. In order to correct this problem the integral term is introduced.

5 - With the drive enabled and velocity reference at zero or disconnected, increase the integral gain from zero. As soon as the integral gain is applied, the motor will develop full torque at zero speed. Reconnect

and disconnect the velocity reference input to the drive and observe the response. Increase the proportional gain to a point that when the velocity reference is disconnected, the motor overshoots, then backs up. This overshoot and back up should be very small and very quick. After the overshoot is observed, reduce the integral gain until the overshoot is eliminated.

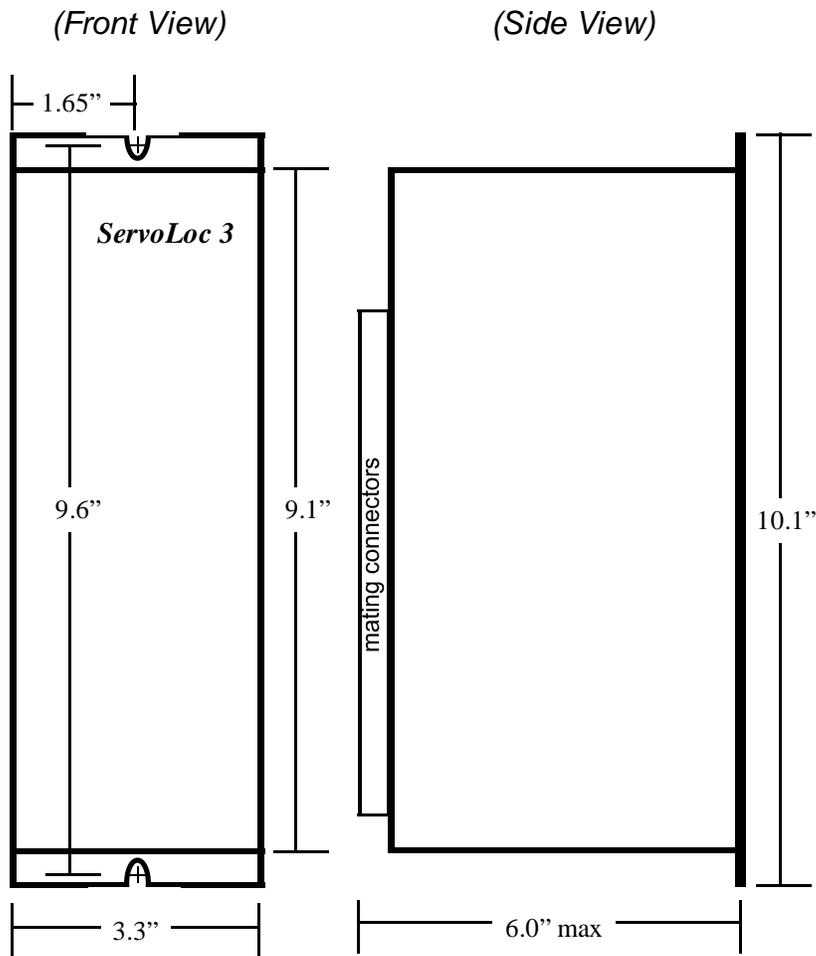
Integral gain refers to: the velocity reference input is subtracted from the actual velocity to develop a velocity error. This error is then accumulated each sample time and then scaled and multiplied by the integral gain setting to reduce the error to zero. In other words, the quickness at which the velocity error is reduced to zero is controlled by the integral term. The integral term is then summed with the proportional and derivative term, and then used as the current command to the motor.

Derivative gain only is needed if a sluggish response cannot be compensated for by the proportional and the integral terms.

Derivative gain refers to: the velocity reference input is subtracted from the actual velocity to develop a velocity error. This error is then subtracted from the previously sampled error to develop a rate of change of error. The calculated error is then scaled, and then multiplied by the derivative gain. The derivative term is summed with the proportional and integral terms, and this is used as the current command to the motor.

Note: The derivative term is usually not needed unless a high dynamic response is desired. Too large of a derivative gain will cause overshoot, excessive motor current, motor heating, and metallic noises from the motor.

Mounting Dimensions



Warranty Policy

Introl Design, Inc. guarantees its products against defects in workmanship and materials for a period of twelve (12) months from date of purchase, not to exceed twenty-four (24) months from date of manufacture. Final determination of whether a device is defective rests with Introl Design. Introl Design must be notified about any alleged defects, and will provide the customer with shipping instructions. If inspection reveals defects caused by faulty materials or workmanship, Introl reserves the right either to rebuild the device using new or refurbished and warranted parts or to replace the device with a new device, returning to the buyer a device meeting full factory standards for new performance. Any repairs necessary due to customer modification will be considered non-warranty and billed by the factory at current rates. Buyer will bear costs of transportation to and from the factory, risk of loss for goods not at the factory, and costs required to remove or prepare for shipment and to reinstall equipment after repair. Introl Design, Inc. assumes no responsibility for injuries or damages to persons or property arising out of improper use of this device, and Introl Design's liability arising out of the device or its use, whether on warranty or otherwise, shall not exceed the cost of correcting defects. There are no expressed or implied warranties of merchantability or fitness for a particular purpose that apply to this device. Introl Design, Inc. reserves the right to make changes or improvements in its products without incurring any obligation to make such changes or improvements in the similar products previously purchased.

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