



502-PD-001-00

# ***PosiDrive*<sup>™</sup> Servo Motor Control OPERATION AND SERVICE MANUAL**



**WARNING - Read this manual before any installation, maintenance or operation.**



**FORCE CONTROL INDUSTRIES, INC.**

**MANUFACTURERS OF MECHANICAL AND  
ELECTRICAL POWER TRANSMISSION EQUIPMENT**

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# Section 1

## DESCRIPTION and OPERATION

Force Control Industries manufactures a variety of complete, pre-engineered, servo systems built around our *PosiDrive* family of servomotors and servoamplifiers. Some of these systems are designed for general-purpose servo applications. Others are highly customized.

### 1-1 SCOPE OF THIS MANUAL

*PosiDrive* Servo Packages are customized to fit specific applications. We add or remove features to suit the job at hand, and the different packages vary widely from one another.

This manual is intended to cover the general features common to most *PosiDrive* Servo Control Packages. It supplements the schematics or other detailed documentation that we provide for each specific system.

This manual was written for revision 1.0.7 of the HMI software.

This manual does not cover the mechanical components that are sometimes included with a servo package. Mechanical components are documented separately.

### 1-2 HOW TO USE THIS MANUAL

Read the Section(s) that applies to the particular application needed. The general content of each section is described below.

**Section #1** contains general descriptive material about servo systems and how they work.

**Section #2** contains technical specifications for some of the components used in most *PosiDrive* servo packages.

**Section #3** contains general installation tips.

**Section #4** discusses the operators' controls in a general way. The physical buttons and switches are usually self-explanatory.

**Section #5** describes how to operate the servo on a day to day basis using the HMI touchscreen's Main Menu, Run, and Status screens.

**Section #6** describes how to configure the servo system using the Setup Menu on the HMI touchscreen.

**Sections #7 and 8** both pertain to troubleshooting and maintenance issues.

### 1-3 GENERAL DESCRIPTION

A typical servo package includes one or more servomotors, a control box, operators' station(s), connecting cables, and perhaps mechanical components.

*PosiDrive* Servomotors feature a brushless design with permanent magnet rotors. We offer a wide variety of speeds, power ratings, and frame sizes. The servomotor needs to be correctly sized to guarantee good performance on your machine. Contact our applications department for assistance.

A *PosiDrive* control box is usually a complete industrial control built in to a NEMA-12 enclosure. The size and complexity of the control depends on the specific application. We offer small control boxes that operate a single servomotor. We also offer large cabinets designed to run multiple servomotors.

In general, the control box houses at least one servoamplifier along with a power supply, fuses, contactors, and other auxiliary equipment. The operators' controls can be located on the door of the main control enclosure, or they can be remote-mounted on a separate console. The operators' console typically includes an industrial touchscreen HMI (Human Machine Interface) plus a few other buttons.

The HMI touchscreen interface is an important feature of *PosiDrive* control package. The interface is designed to replace the complex and proprietary software usually associated with servo systems, and to eliminate the need for connecting up an external laptop computer. You can use the touchscreen to easily change the motion of the servomotor and to read out diagnostic information. Some *PosiDrive* servo packages come with factory default settings stored in the touchscreen that you simply download to the servoamplifier. This provides a "plug-and-play" approach for commissioning the servo system on your machine.

Mechanical components are sometimes included with the servo package. These could be off-the-shelf items like couplings or mounting hardware; or they could be custom designed components like special gearboxes or adapter plates.

## 1-4 MAJOR COMPONENTS OF A TYPICAL SYSTEM

Servomotors are specially designed electrical motors that are capable of very precisely controlled motion. Servomotors are not intended to run by themselves like ordinary motors; instead they require sophisticated electronic controllers to operate them. These controllers are usually called "servo drives" or "servoamplifiers".

Figure 1.1 shows the pieces of a typical *PosiDrive* Servo Motor and Control Package ("Servo Package" for short). All the components working together make a servo system. The elements of the servo system are described below.

1. **Servomotor** - The purpose of the servo system is to operate a machine in a precisely controlled manner. Servomotors are capable of very accurate movements. *PosiDrive* servomotors are specialized DC motors that have permanent magnet rotors and wound stators. Since there are no windings in the rotor these motors do not need commutators or brushes. The brushless design reduces maintenance and improves performance. Since they do not have commutators, these motors must be "electronically commutated" by the servoamplifier.

2. **Resolver** – Servo control systems require a feedback signal that tells the controller the machine's position. *PosiDrive* servomotors have built in resolvers that monitor the rotational position of the motor shaft and transmit it to the servoamplifier. This is the most rugged and reliable method of providing the feedback. Resolvers are much more durable than encoders because they do not contain fragile glass disks.
3. **Servoamplifier** – (Also called a servo drive). The servoamplifier controls the electrical power fed to the servomotor. By adjusting the amperage, frequency, and phasing of the motor current, the servoamplifier can control the motion of the machine the motor is driving. Meanwhile, the servoamplifier monitors the position and speed of the motor using the feedback signal from the resolver. By comparing the motor's actual position and speed to the desired position and speed, the servoamplifier can correct for any errors as it goes along. This technique, where the servoamplifier constantly checks the movement of the motor and makes corrections, is called closed loop control.

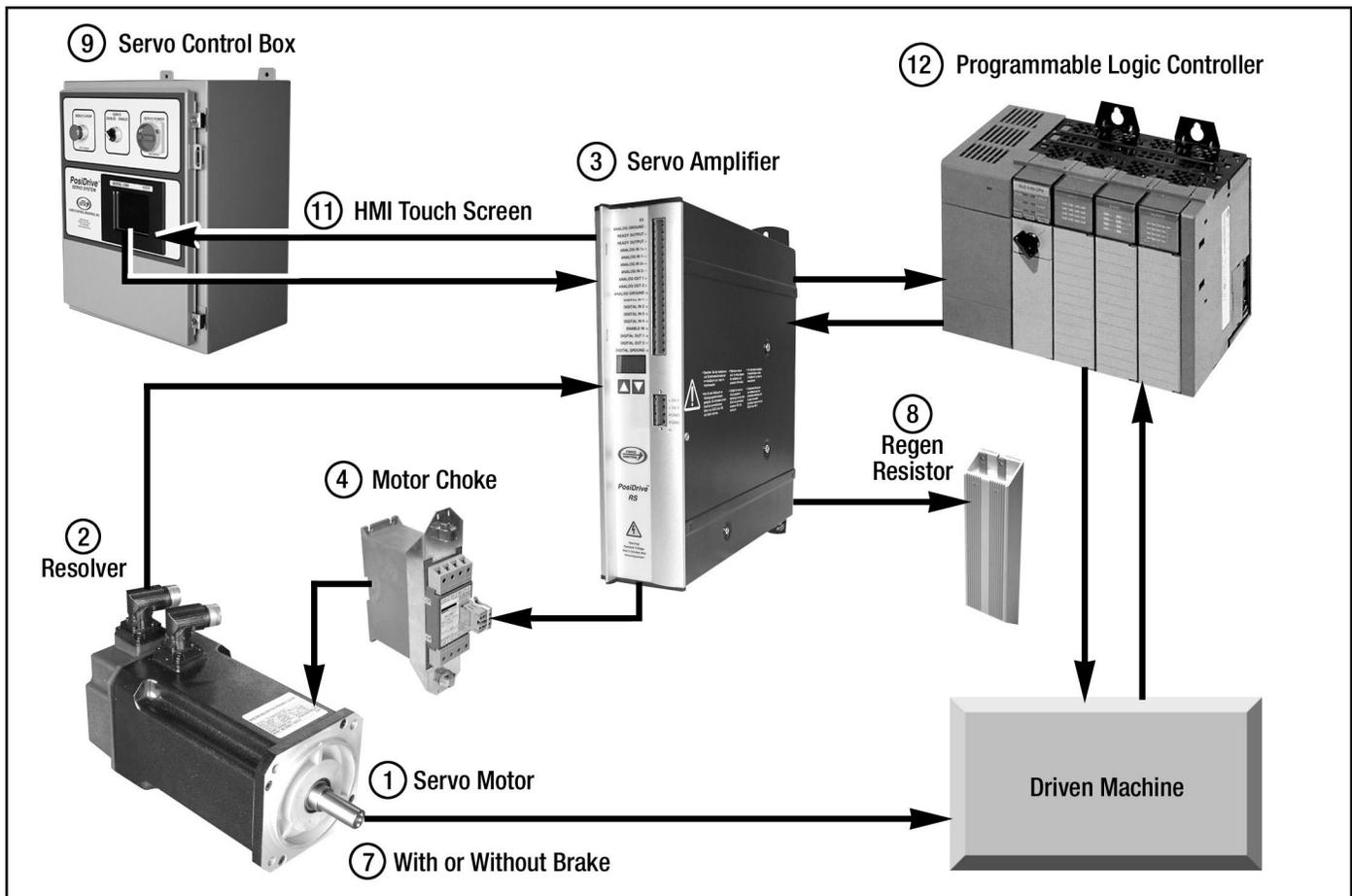


Figure 1.1 - PosiDrive Servo System Diagram

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4. **Motor Choke** – (Also called an AC reactor). The motor choke is only required if the wiring to the motor will be longer than 25 meters (82 feet). The motor choke suppresses high frequency switching noise in the servoamplifiers output waveform. This may reduce vibration in the motor. For long motor leads the choke reduces problems arising from electrical harmonics and reflected voltage waves.
  5. **Motor Cable** – This cable connects the power output stage of the servoamplifier to the stator windings of the servomotor.
  6. **Resolver Cable** – This cable transmits the resolver feedback signal from the servomotor to the servoamplifier.
  7. **Motor Brake** – Some servomotors come equipped with a build-in mechanical brake that is used to lock the motor shaft whenever the motor is not powered. This can keep the machine from drifting when electrical power is turned of. These brakes are usually engaged by a spring and require electrical power to disengage.
  8. **Regeneration Resistor** – (Often referred to as a braking resistor, or by the slang term "regen resistor"). The regeneration resistor helps the servoamplifier slow down fast moving or massive machinery. Moving machine parts possess kinetic energy because of their mass and velocity. This kinetic energy is converted into electrical energy by the servomotor as it slows the machine. There is no good place in the circuit to store this surplus electrical energy, so it has to be dissipated as heat using a resistor. The servoamplifier has an internal resistor that can be used if the amount of waste heat is not too large. Otherwise an external regeneration resistor must be added to the system.
  9. **Servo Control Box**- (Also called a "control cabinet", a "control enclosure", or a "servo control"). This is a control enclosure with most of the electrical components of the servo system mounted inside it and wired together. It is usually a NEMA-12 type enclosure, which means that dirt and dripping oil or water will not leak in to it.
  10. **Operators' Control Station** – The operators' controls can be mounted on the servo control enclosure door or they can be installed at a remote location. Operator controls allow a human being to run the servo system using buttons, switches, and the HMI (Human Machine Interface).
  11. **Touchscreen HMI** – "HMI" stands for "Human Machine Interface". This is an LCD graphics display terminal with a touchscreen surface. It provides most of the operators' controls for the servo system, such as manual index and jog functions. The HMI touchscreen is also used for configuring the system, tuning the servoamplifier, and monitoring faults, etc.
  12. **PLC** – (Programmable Logic Controller). Usually a servo system is part of a larger machine that has many other functions and moving parts. In these cases the servoamplifier will be just one control element within a larger control system. Although there are many kinds of control systems, PLC based ones are very common. Most *PosiDrive* servo packages are designed to connect to the PLC or other controls of a larger host machine. Some *PosiDrive* servo packages include a PLC of their own.

## Section 2 SPECIFICATIONS

This section supplements the information in your system's schematics and is subject to change with product development

### 2-1 SERVOAMPLIFIER SPECIFICATIONS

At this time all *PosiDrive* servomotor and control packages utilize our *PosiDrive* Series RS servoamplifiers. This family of servo drives are available in six different

current ratings and can be operated from 3-Phase voltage supplies between 208VAC and 480VAC nominal.

The two following Tables show some of the more important specifications for the RS Series Servoamplifiers. Detailed information is available in our manual #502-PD-RS-001 "Installation Manual for *PosiDrive* Series RS Digital Servo Motor Control & Amplifier".

**Table 2.1 - *PosiDrive* Series RS Servoamplifier Technical Data**

Rated data	DIM	<i>PosiDrive</i>					
		RS-01	RS-03	RS-06	RS-10	RS-14	RS-20
Rated supply voltage	V~ V~	3 x 230V-10% ... 480V+10%, 50 Hz 3 x 208V-10% ... 480V+10%, 60 Hz					
Rated installed load for S1 operation	kVA	1	2	4	7	10	14
Rated DC-link voltage	V=	260 to 675					
Rated output current (rms value, ± 3%)	Arms	1.5	3	6	10	14	20
Peak output current (max. ca. 5s, ± 3%)	Arms	3	6	12	20	28	40
Clock frequency of the output stage	kHz	8					
Technical data for regen circuit	—	(See page 19 in Installation Manual #502-PD-RS-001-00)					
Overvoltage protection threshold	V	450 to .900					
Form factor of the output current (at rated data and min. load inductance)	—	1.01					
Bandwidth of subordinate current controller	kHz	> 1.2					
Residual voltage drop at rated current	V	5					
Quiescent dissipation, output stage disabled	W	15					
Dissipation at rated current (incl. power supply losses, without regen dissipation)	W	30	40	60	90	160	200
<b>Internal fusing</b> (See next page for External Fusing)							
Auxiliary supply 24V	—	internal 3.15 AT					
Regen resistor	—	internal, electronic					
<b>Inputs</b>							
Setpoint 1/2, resolution 14bit/12bit	V	±10					
Common-mode voltage max.	V	±10					
Input resistance	kW	20					
Digital inputs	V	low 0 to 7 / high 12 to 36					
	mA	7					
Digital outputs, open collector	V	max. 30					
	mA	10					
Ready Output, relay contacts	V	DC max. 30, AC max. 42					
	mA	500					
Aux. power supply, electrically isolated without brake	V	24 (-0% +15%)					
	A	1					
Aux. power supply, electrically isolated with brake (consider voltage loss!)	V	24 (-0% +15%)					
	A	3					
Max. output current, brake	A	2					
<b>Connections</b>							
Control signals	—	Combicon 5.08 / 18 pole , 2.5mm					
Power signals	—	Power Combicon 7.62 / 4x4 + 1x6-pole, 4mm					
Resolver input	—	SubD 9pole (socket)					
Sine-cosine encoder input	—	SubD 15pole (socket)					
PC-interface, CAN	—	SubD 9pole (plug)					
Encoder emulation, ROD/SSI	—	SubD 9pole (plug)					
<b>Mechanical</b>							
Weight	kg	4			5		7.5
Height without connectors	mm	275					
Width	mm	70			100		120
Depth without connectors	mm	265					

**Table 2.2 - PosiDrive Series RS Servoamplifier External Fusing**

Fusible cutouts or similar (Fuse UL time delay)	PosiDrive RS-01/RS-03	PosiDrive RS-06/RS-10	PosiDrive RS-14/RS-20
AC supply FN1/2/3	6 AT (FRx-R-6)	10 AT (FRx-R-10)	20 AT (FRx-R-20)
24V supply FH1/2	max. 16 AF (FRx-R-16)		
Regen resistor FB1/2	4 A (FRx-R-4)	6 A (FRx-R-6)	6 AF (FRx-R-6)

(x = S for 480V applications)

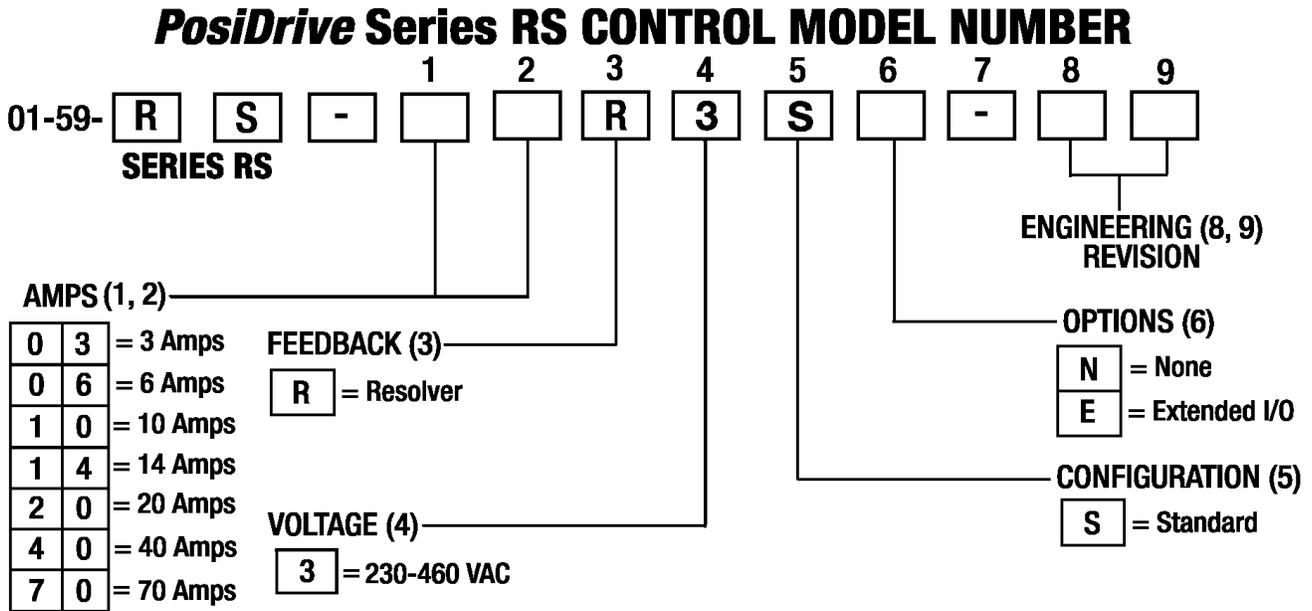
x = N for 230V applications

**2-2 SERVOAMPLIFIER NAME PLATE & MODEL NUMBERS**



This Name Plate is located on the L.H. side of the Servoamplifier.

Figure 2.1 - Servoamplifier Name Plate



## 2-3 PosiDrive SERVOMOTOR SPECIFICATIONS

At this time all *PosiDrive* servomotor and control packages utilize our *PosiDrive* Series RA servomotors.

The Tables below show some of the more important specifications for the RA Series Servomotors.

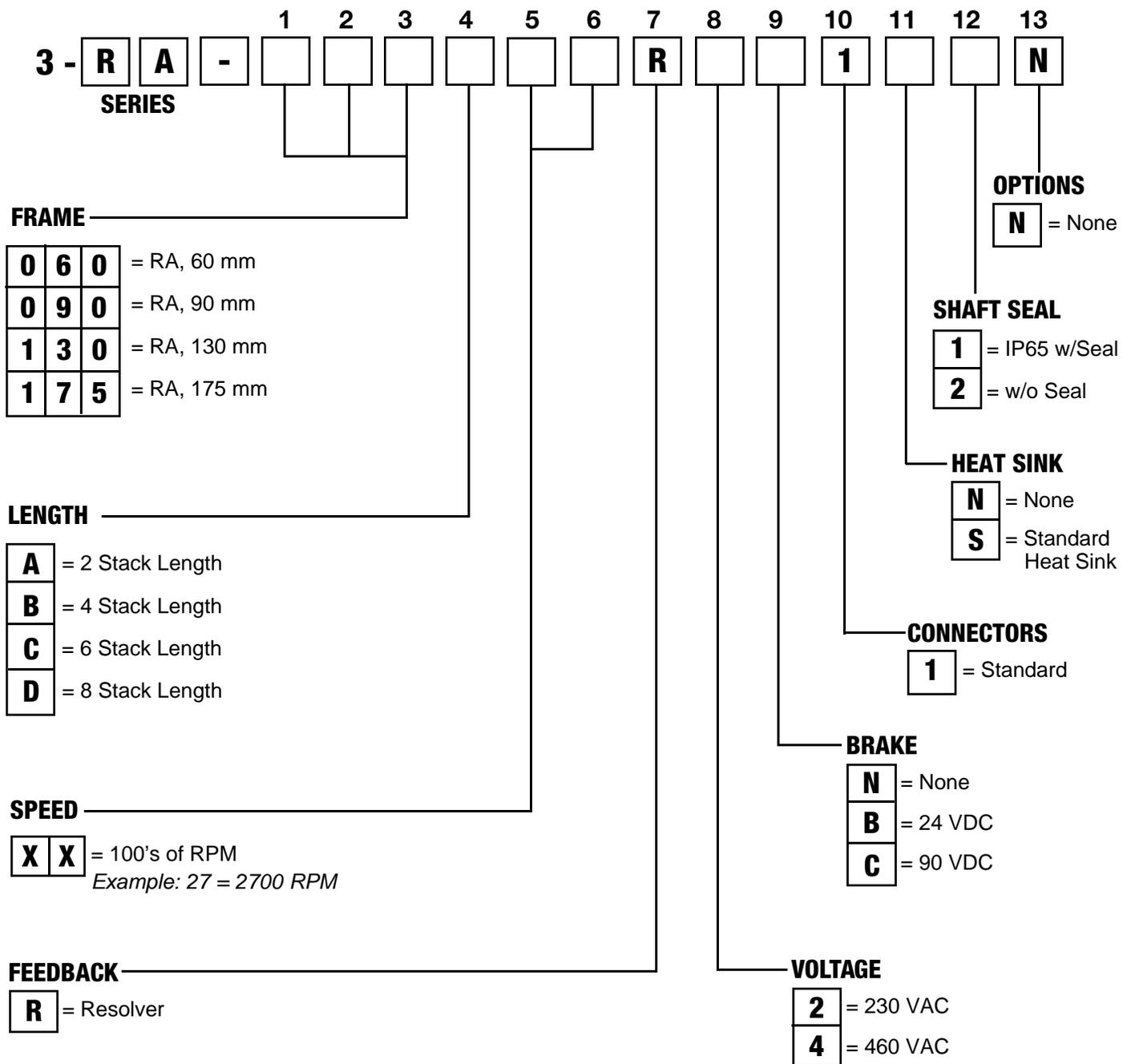
**Table 2.3 - 230 Volt Servomotors**

Model Number	Frame (mm)	Stack Length	Speed (RPM)	Volts	Continuous Stall Torque Lb. Ft. (Nm)	Peak Torque Lb. Ft. (Nm)	Continuous Power HP (kW)
3-RA-060A60R2x	60	2	6000	230	0.32 (0.44)	0.92 (1.25)	0.31 (0.23)
3-RA-060B60R2x	60	4	6000	230	0.55 (0.74)	1.50 (2.03)	0.50 (0.37)
3-RA-060C60R2x	60	6	6000	230	1.00 (1.35)	2.80 (3.80)	0.90 (0.67)
3-RA-090A45R2x	90	2	4500	230	0.95 (1.29)	1.75 (2.37)	0.79 (0.59)
3-RA-090A60R2x	90	2	6000	230	1.00 (1.35)	2.20 (2.98)	1.02 (0.76)
3-RA-090B30R2x	90	4	3000	230	1.86 (2.52)	3.62 (4.91)	0.95 (0.71)
3-RA-090B60R2x	90	4	6000	230	1.81 (2.45)	3.78 (5.13)	1.80 (1.30)
3-RA-090C25R2x	90	6	2500	230	2.49 (3.50)	4.93 (6.69)	1.10 (0.82)
3-RA-090C46R2x	90	6	4600	230	2.45 (3.32)	4.96 (6.73)	2.00 (1.50)
3-RA-090D15R2x	90	8	1500	230	3.72 (5.04)	8.70 (11.8)	0.95 (0.71)
3-RA-090D30R2x	90	8	3000	230	3.53 (4.79)	7.21 (9.77)	1.70 (1.30)
3-RA-130A24R2x	130	2	2400	230	2.40 (3.30)	4.60 (6.20)	1.10 (0.80)
3-RA-130A40R2x	130	2	4000	230	2.40 (3.30)	5.00 (6.80)	1.60 (1.20)
3-RA-130B24R2x	130	4	2400	230	4.80 (6.50)	9.20 (12.4)	1.90 (1.40)
3-RA-130B40R2x	130	4	4000	230	4.90 (6.60)	9.50 (12.9)	2.50 (1.90)
3-RA-130C23R2x	130	6	2300	230	8.00 (10.9)	17.8 (24.1)	3.00 (2.20)
3-RA-130C40R2x	130	6	4000	230	7.20 (9.70)	13.1 (17.7)	4.20 (3.10)
3-RA-175A22R2x	174	2	2200	230	16.5 (22.3)	35.6 (48.3)	5.20 (3.90)
3-RA-175A33R2x	174	2	3300	230	16.2 (22.0)	41.4 (56.1)	6.20 (4.60)
3-RA-175B20R2x	174	4	2000	230	24.2 (32.8)	41.2 (55.9)	6.30 (4.70)
3-RA-175B30R2x	174	4	3000	230	22.1 (30.0)	56.2 (76.2)	8.00 (6.00)
3-RA-175C20R2x	174	6	2000	230	32.5 (44.0)	85.1 (115)	8.20 (6.10)
3-RA-175C30R2x	174	6	3000	230	32.5 (44.0)	85.1 (115)	9.00 (6.70)

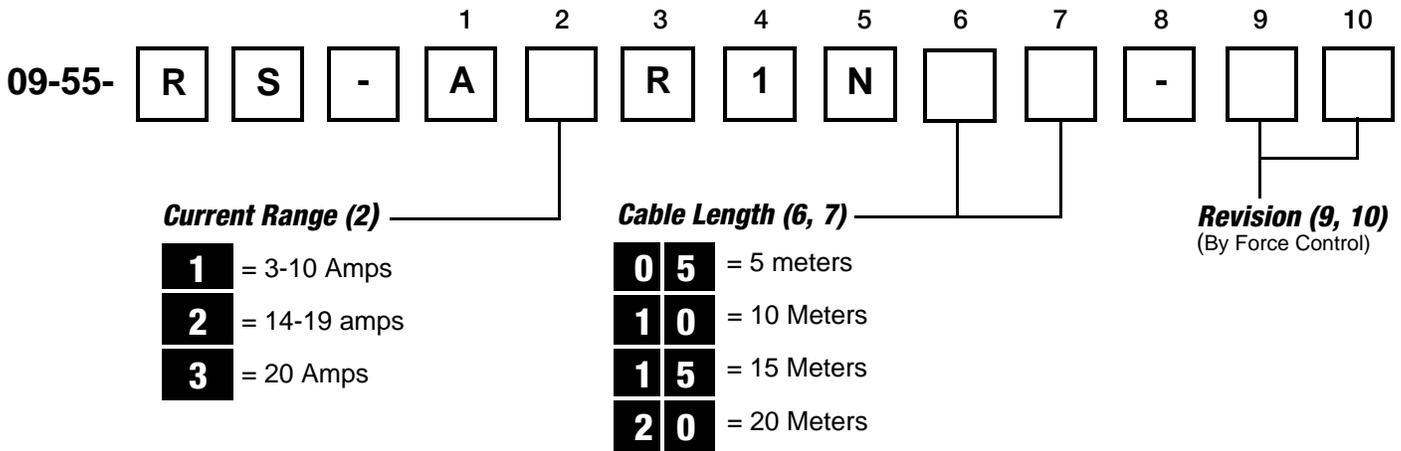
**Table 2.4 - 460 Volt Servomotors**

Model Number	Frame (mm)	Stack Length	Speed (RPM)	Volts	Continuous Stall Torque Lb. Ft. (Nm)	Peak Torque Lb. Ft. (Nm)	Continuous Power HP (kW)
3-RA-090A60R4x	90	2	6000	460	0.89 (1.21)	2.39 (3.24)	.91 (.68)
3-RA-090B60R4x	90	4	6000	460	1.70 (2.31)	5.47 (7.41)	1.65 (1.23)
3-RA-090D30R4x	90	8	3000	460	3.14 (4.26)	13.78 (18.68)	1.21 (.90)
3-RA-090D50R4x	90	8	5000	460	3.25 (4.41)	13.78 (18.68)	1.59 (1.19)
3-RA-130A40R4x	130	2	4000	460	2.40 (3.30)	7.50 (10.20)	1.60 (1.19)
3-RA-130B23R4x	130	4	2300	460	4.68 (6.30)	16.00 (21.70)	1.90 (1.42)
3-RA-130B40R4x	130	4	4000	460	4.63 (6.30)	16.00 (21.70)	2.90 (2.16)
3-RA-130C27R4x	130	6	2700	460	7.92 (10.70)	33.20 (45.10)	3.20 (2.39)
3-RA-130C36R4x	130	6	3600	460	7.91 (10.70)	33.50 (45.40)	3.90 (2.91)
3-RA-175A24R4x	174	2	2400	460	16.20 (22.00)	45.90 (62.20)	5.16 (3.85)
3-RA-175A30R4x	174	2	3000	460	16.30 (22.10)	45.90 (62.20)	5.60 (4.18)
3-RA-175B22R4x	174	4	2200	460	23.30 (31.60)	66.80 (90.60)	6.95 (5.18)
3-RA-175C23R4x	174	6	2300	460	35.2 (47.70)	106.20 (143.90)	9.23 (6.88)

## 2-4 PosiDrive SERVOMOTOR MODEL NUMBERS



**2-5 PosiDrive CONTROL CABLE SET MODEL NUMBER**



**NOTE** - Use the Model Number above to order a correct Set of Cables. A complete set of Cables includes (1) Servo Motor Cable and (1) Resolver Cable as shown in *Figure 9.1* below.

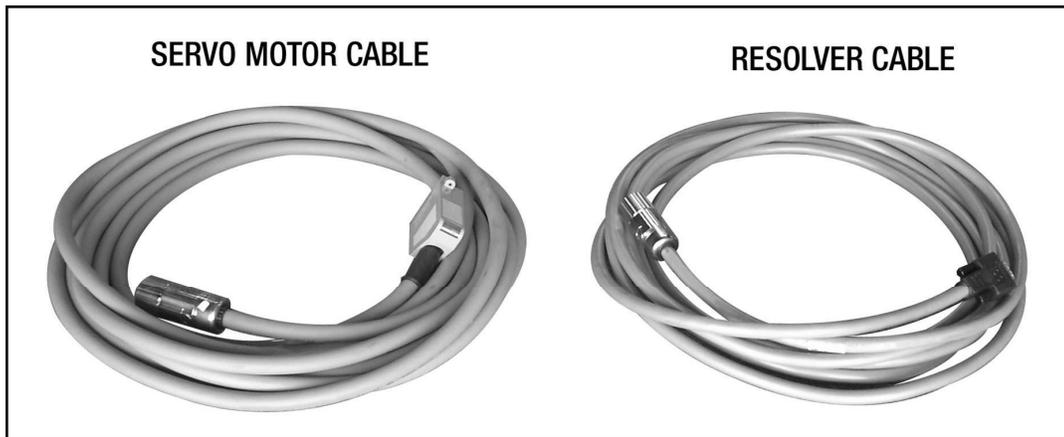


Figure 2.1 - PosiDrive Control Cable Set

**2-6 PosiDrive CONTROL PANEL NAME PLATE**

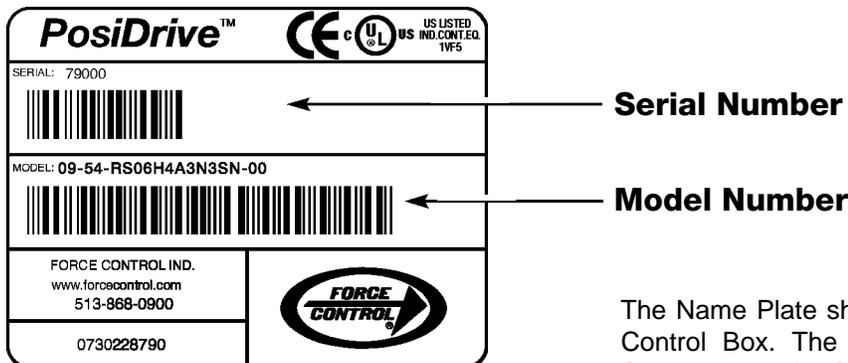
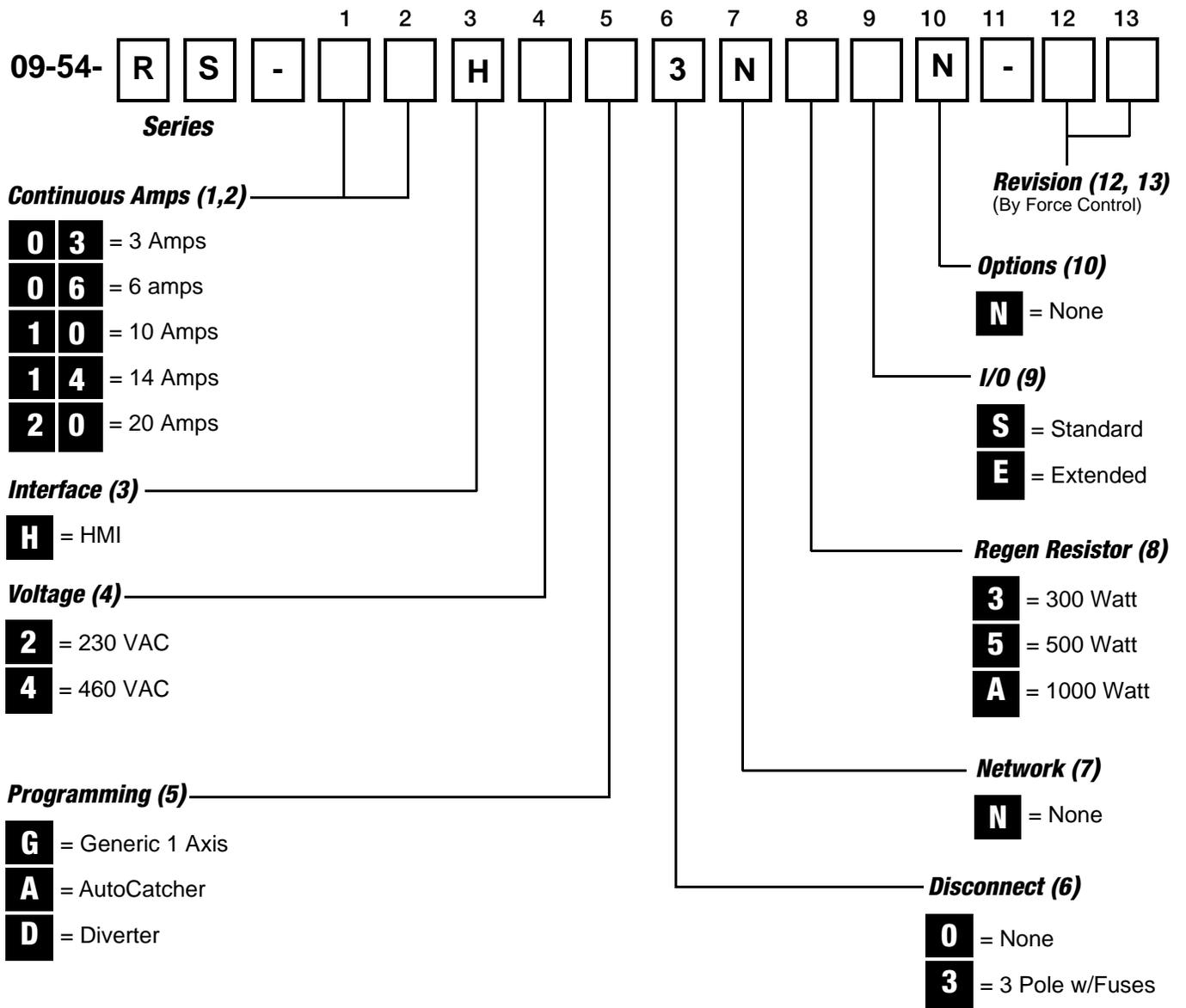


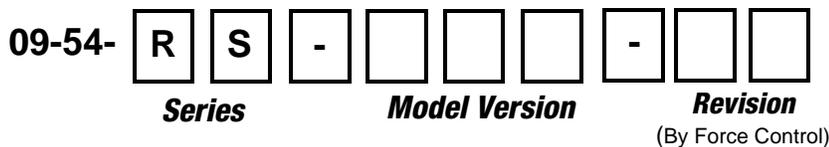
Figure 2.3 - Control Panel Name Plate

The Name Plate shown is located on the inside of the Control Box. The Model Number System shown in Section 2-7 is for Standard Control Panels and the one shown in Section 2-8 is for Custom or Special Control Panels.

**2-7 PosiDrive CONTROL PANEL MODEL NUMBER FOR STANDARD UNITS**



**2-8 PosiDrive CONTROL PANEL MODEL NUMBER FOR CUSTOM OR SPECIAL UNITS**



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## Section 3

# INSTALLATION

### 3-1 RECEIVING AND UNPACKING PARTS

Upon receipt of your *PosiDrive* servo package the following steps should be taken:

1. Inspect all items for possible shipping damage. If you find damage then you should contact the freight carrier immediately and file a claim.
2. Verify that the model numbers and quantities of items received match the purchase order. Contact Force Control Industries if there is a question or problem.

*PosiDrive* servo packages come in many variations. Most components are usually supplied by Force Control Industries, but can be supplied by the customer instead. Also, some of the components may already be assembled (i.e. servomotor already mounted to a gearbox). A basic checklist follows:

1. Servomotor
2. Servo Control Box
3. Motor Cable – This cable may already be connected to the servo control box.
4. Resolver Cable – This cable may already be connected to the servo control box.
5. Operators' Control Station – The operators' controls might be mounted on the servo control enclosure door or they may be a separate piece.
6. Mechanical Components

### 3-2 MOUNTING THE SERVO CONTROL BOX

*PosiDrive* servo control boxes are usually "Hoffman style" NEMA-12 enclosures. The larger panels will be free standing types. Smaller panels will be wall-mounted types, or may be outfitted with floor stand kits.

1. NEMA-12 Enclosures can be located in indoor factory environments where there may be dust, falling dirt, or dripping, noncorrosive liquids.
2. NEMA-4 Enclosures can be located outdoors where there may be windblown dust and rain, splashing water, hose directed water, and ice formation.
3. NEMA-4X Enclosures can be located in the same sort of places as NEMA-4 enclosures and they are also corrosion resistant.
4. Avoid excessive heat. Operating temperature should be from 32deg to 100deg Fahrenheit. Avoid direct sunlight since it tends to heat the panel.
5. Leave clearance for the regeneration resistor heat

sink. If your *PosiDrive* control package is equipped with an external regeneration resistor then there will probably be a large aluminum heat sink with fins installed on one side of the control box. You should leave a little bit of room (4") for air to circulate around the fins. Avoid putting the heat sink near equipment or materials that could be damaged by heat.

6. Avoid excessive vibration.
7. *PosiDrive* Servo controls are not safe for explosive environments.
8. Maintain a clear workspace in front of the control box. The National Electrical Code requires 3 feet of clear distance in front of the control enclosure as long as there are not exposed live electrical parts behind a maintenance worker when he faces the control box. If the control box is located where a maintenance worker would be between the box and some other hazard, then the clearance should be increased to four feet. See article 110.26 of NEC-2002. (Most *PosiDrive* servo controls use either 230 or 480 VAC, 3-phase).
9. If the operators' controls are on the door of the servo control box, then it will need to be located where your machine operators can easily reach them.
10. Try to locate the servo control box so that the motor cable will be less than 80 feet long.

### 3-3 MOUNTING THE SERVMOTOR

Please refer to the mechanical documentation for mounting the servomotor.

### 3-4 MOUNTING THE HOME SENSOR

Most servo systems have a Home Position Sensor that is used to calibrate the controls to the mechanical position of the machine. This sensor should be located where it will pick up the home (or starting) position of the machine for each cycle by detecting a suitable target. For rotating machinery the target could be on the output shaft of a reducer, or the head shaft of a conveyor. For translating machinery the target might be the slide of a ball screw driven motion. For some applications the home sensor will be factory-installed into a gearbox or similar component.

It will not always be convenient or practical to locate the home sensor at the exact starting position of the machine cycle. For these situations, most *PosiDrive* servo controls provide a Home Offset feature that allows the servo to move away to a pre-programmed home position after finding the physical home sensor.

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### 3-5 ELECTRICAL CONNECTIONS

There are numerous wiring connections to be made, some of which will be completed at our factory before shipping and others that will need to be completed during installation at your facility. Also note that there may be optional items which will not be used in all applications.

**IMPORTANT: It is critical that the correct wiring type and wiring paths be followed for maximum performance and a minimum of electrical noise related problems.**

Electrical noise is any electrical disturbance that can cause erroneous operation of the control. Transients and line to ground spikes can be generated by load switching, starting of motors, and the actuating of solenoids.

The servoamplifier can also be a significant source of electrical noise. Although *PosiDrive* servoamplifiers have been tested and conform to a number of EC (European Community) Directives on EMC (Electromagnetic Compatibility), it is still necessary to install them properly to prevent noise-related problems. On the input side, the servoamplifier will produce troublesome electrical harmonics in the power circuits that feed it. On the output side, the cabling from the servoamplifier to the motor will be a noise source.

1. Only qualified electricians or engineers should work on the electrical wiring. The power supply for a *PosiDrive* servo control is usually a 240VAC or 480VAC, 3-phase electrical circuit. These voltages can be lethal. Make sure that electrical power is disconnected, locked out, and tagged out per OSHA requirements.
2. The power supply section of the servoamplifier can be damaged if it is connected to an ungrounded or asymmetrically grounded 480 V, three phase power system. The servoamplifier is designed to handle the 277 V (nominal) that is present from line to ground in a 480 Y / 277 V grounded, three or four wire electrical service. The servoamplifier is not able to tolerate the higher line to ground voltages that are present in asymmetrically grounded systems, or that might occur accidentally in an ungrounded system. If your plant's electrical system has this problem then you will need to install a drive isolation transformer with a wye type secondary winding to power the *PosiDrive* Servo System.

If the *PosiDrive* Servo System is to be powered from a 208-240 volt, three phase source, then these grounding issues are not a problem since the highest possible line to ground voltage is 240 volts.

Section 7-3 of this manual gives a procedure you can use to run a quick check if you are unsure of how the electrical system is grounded in your plant.

3. The servo motor power cable should be a 600 volt shielded cable with a capacitance of less than 150pF/m. Force Control Industries provides the correct cable as part of a *PosiDrive* servo package. The maximum length for these cables is 100 meters (328 feet). If these cables are longer than 25 meters (82 feet) then a motor choke should be installed in the circuit.
4. The resolver feedback cable should be a twisted-pair, shielded cable with a capacitance of less than 120 pF/m. Force Control Industries provides the correct cable as part of a *PosiDrive* servo package. The maximum length for these cables is 100 meters (328 feet).
5. The resolver feedback cable should be routed over a different path than the servo motor power cable so that electrical noise from the power cable will not corrupt the low-level feedback signal. If these cables must run over the same path, then keep them separated as far as possible or run them in separate conduits.
6. The motor power and resolver cables are sheathed with a durable polyurethane insulation. They can be routed over the surface of most machines if there is no danger of mechanical damage from forklifts, cutting torches, etc. Installing the cables in conduit or wireway is obviously a better, but more expensive approach. Take care not to lay cables across sharp edges that will cut into the cable.
7. All high speed or low voltage wiring from encoders, home switch, operators buttons, etc. should be routed away from high voltage cables, AC power lines, or other wiring carrying rapid switching transients. If it is necessary for low voltage wires to cross over high voltage wires, then it is best for them to cross at a 90-degree angle.
8. Wire colors: The usual wire colors for industrial installations in the United States are listed below. Color-coding shows electricians what kind of voltage level to expect on a given wire, making their jobs safer and easier. Machinery that was built in Europe or the Orient will probably not conform to the American standards.
  - **Green (or Green with Yellow Stripe):** Equipment grounding conductors.
  - **Black:** Ungrounded conductors at line voltage (usually 240 or 480VAC).
  - **Red:** Ungrounded AC conductors at less than line voltage (120VAC).
  - **Blue:** Ungrounded DC control conductors (usually 24VDC or less).
  - **Yellow:** Ungrounded conductors and interlock wiring that may remain energized when the main disconnect switch is in the OFF position.

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- **White:** Grounded circuit conductors (usually AC neutrals).
  - **White with Blue Stripe:** Grounded dc circuit conductors (DC neutrals). This color code is less common than the others, in many cases this will be Blue like other DC wires
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## Section 4

# GENERAL OPERATION

The operators' controls of most *PosiDrive* Servo Systems are straight forward and self explanatory. This section covers the physical switches and buttons, but not the touchscreen. The touchscreen HMI is documented in sections #5 and #6.

Since there is such a variety of *PosiDrive* servo packages, this section may describe features that your particular system does not possess.

### 4-1 MAIN DISCONNECT SWITCH

The main disconnect switch connects the servo control system to its electrical power source. Opening the main disconnect switch shuts off nearly all of the electrical power to the control panel, rendering it safe for qualified electricians to work on.

**IMPORTANT: There are a couple of cases where the main disconnect switch will not kill all electrical power in a control panel. The first case occurs where there is an auxiliary power circuit in the panel for lighting, a convenience receptacle, or for PLCs and computers. A circuit like this will usually be a 120VAC circuit, and should be wired with yellow conductors to alert electricians to its presence. The second case occurs when there is interlock wiring entering the control panel from some other machine that has its own power source. Once again, these sorts of circuits should be wired with yellow conductors.**

There are only a few *PosiDrive* servo control designs that do not include a main disconnect switch. These exceptions tend to occur where the servo control panel will be part of a larger control system that already has its own main disconnect switch. This is especially true if the host control system provides the power distribution (branch circuit) fusing for multiple servoamplifiers. In these cases the servo control panel will either have a

lock on the door, or it will be a type of enclosure that requires tools to open.

There are two general types of disconnect switches: Flange mounted and Door mounted.

**Flange Mounted** disconnect switches usually have a large operating handle located to the right of the enclosure door. Some two-door enclosures have the handle located on the centerpost between the two doors. The operating handle swings vertically like a lever. The raised position closes the switch to energize the panel and the lowered position shuts power off. Since the handle is mounted on a flange rather than the door, it is permanently attached to the switch inside the enclosure.

**Door Mounted** disconnect switches have an operating handle located on the enclosure door. The operating handle rotates clockwise and counterclockwise. Some handles have a long grip; other handles look like a large red knob set into a yellow plastic base. There will be legends on the handle to show which positions are "on" and "off". Some handles will also have a separate "open" position, which releases the door so you can open it. Since the handle is mounted on the door, it must separate from the switch inside the enclosure when the door opens. The switch has a rotating shaft that extends to the back of the handle on the door. When you close the door this shaft must reengage with the handle.

Most disconnect switches are mechanically interlocked with the enclosure door so that the door is locked shut if the disconnect switch is on. This is a safety precaution. Flange mounted disconnect switches nearly always have an override that allows you to open the door while the switch is on. This override will require a tool to operate, usually a screwdriver. Some door mounted disconnect switches are also equipped with a screwdriver override.

The main disconnect switch will always have provisions for locking out the electrical power using a pad lock or a

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safety lockout device. Most disconnect switches can only be locked in the off position, although there are exceptions for control panels that must not be turned off (like fire pumps or traffic lights).

**IMPORTANT: Locking the handle of a door mounted disconnect switch does not work since the handle separates from the switch when the door is open. You must open the door and put your safety lockout device directly on the disconnect switch inside the enclosure!**

#### **4-2 EMERGENCY STOP PUSH BUTTON**

The **Emergency Stop Push Button** is intended to stop the machine by shutting off power to the moving parts. As the name suggests, this is a good button to press in an emergency situation. An emergency stop (or "E-Stop") will always be a large, red, mushroom-head push button. Sometimes these buttons will be detented so that they stay pushed in after you press them. In this case you must pull the button back out to reset it. It is common for a machine to have more than one emergency stop push button.

In some control systems, the E-Stop will cause the machine to enter a brief, orderly shutdown sequence before turning off power to the moving parts.

If the *PosiDrive* servo control is wired in to a bigger host machine then the E-Stop pushbuttons on the servo control should be wired in to the emergency stop circuits of the host machine.

#### **4-3 MASTER STOP PUSH BUTTON**

The **Master Stop Push Button** usually does exactly the same thing as an emergency stop push button. It just has a different name so it will "match" with a nearby "master start" push button. If your *PosiDrive* servo control is meant to be part of a larger host control system, then it probably will not have this button.

#### **4-4 MASTER START PUSH BUTTON**

The **Master Start Push Button** energizes the output control circuits so that a machine will run. You will need to press this button to restart a machine if you have stopped it with an E-Stop button or the master stop button. If your *PosiDrive* Servo Control is meant to be part of a larger host control system, then it probably will not have this button.

#### **4-5 SERVO STOP PUSH BUTTON**

The **Servo Stop Push Button** is intended to stop only the Servomotor by shutting off power to the servoamplifier. A servo stop is usually a large, red, mushroom-head push button. These buttons provide a way to kill power to just the mechanism being run by the *PosiDrive* servo control without shutting down the whole machine.

#### **4-6 SERVO ENABLE SELECTOR SWITCH**

The **Servo Enable Selector Switch** sends a logic signal to the Servoamplifier telling it to activate its power output stage. You must set the switch to "enable" in order to run the servomotor. If this switch is set to "disable" then the Servomotor will be released so that it can be turned by hand.

**IMPORTANT: The servo enable selector switch only sends an electronic signal to the servoamplifier. This does not meet the criterion to be considered a safety circuit. DO NOT use the disable function as a means of protecting people from injuries. Instead use servo stop, E-stop, master stop, or the main disconnect switch, as the situation demands.**

# Section 5

## HMI TOUCHSCREENS

The **PosiDrive Control Panel** is equipped with a **Touch Screen HMI (Human Machine Interface)**. This Intelligent interface is a programmable device and so its features will vary depending on your specific application. In general, there will be screens that provide operator controls for the following functions:

1. Selecting Pre-programmed Applications.
2. Configuring Motion Parameters.
3. Running the *PosiDrive* Servomotor in Manual or Automatic Mode.
4. Monitoring the *PosiDrive* Servoamplifier.
5. Tuning the *PosiDrive* Servoamplifier.

Some versions of our software allow you to select from different servo applications.

**For Example** - Our Catcher/Diverter Application Package used in manufacturing lines for roofing shingles can be selected to run as a Shingle Catcher or a Shingle Diverter using the pre-programmed HMI Screens.

Because we have integrated the set-up of parameters and tuning functions for our Servomotors into the HMI, most customers will not need to attach a laptop computer to the Servoamplifier during configuration or learn complicated proprietary software to implement their Servo Application.

The various functions of the HMI Touchscreen are accessed through a system of Menu Screens beginning with a Main Menu Screen. (See Figures 5.1 and 5.2)

Figure 5.1 shows the first 3-levels of Menu Screens and their functional relationship to each other, showing what screen you will access if you push a certain button.

### 5-1 POWER-UP MESSAGES AND MENU SCREENS

When power is first applied to the HMI Display several computer-like messages will flash across the screen before the Main Menu Screen comes up. They are listed in order here for diagnostic purposes, but in general they can be ignored.

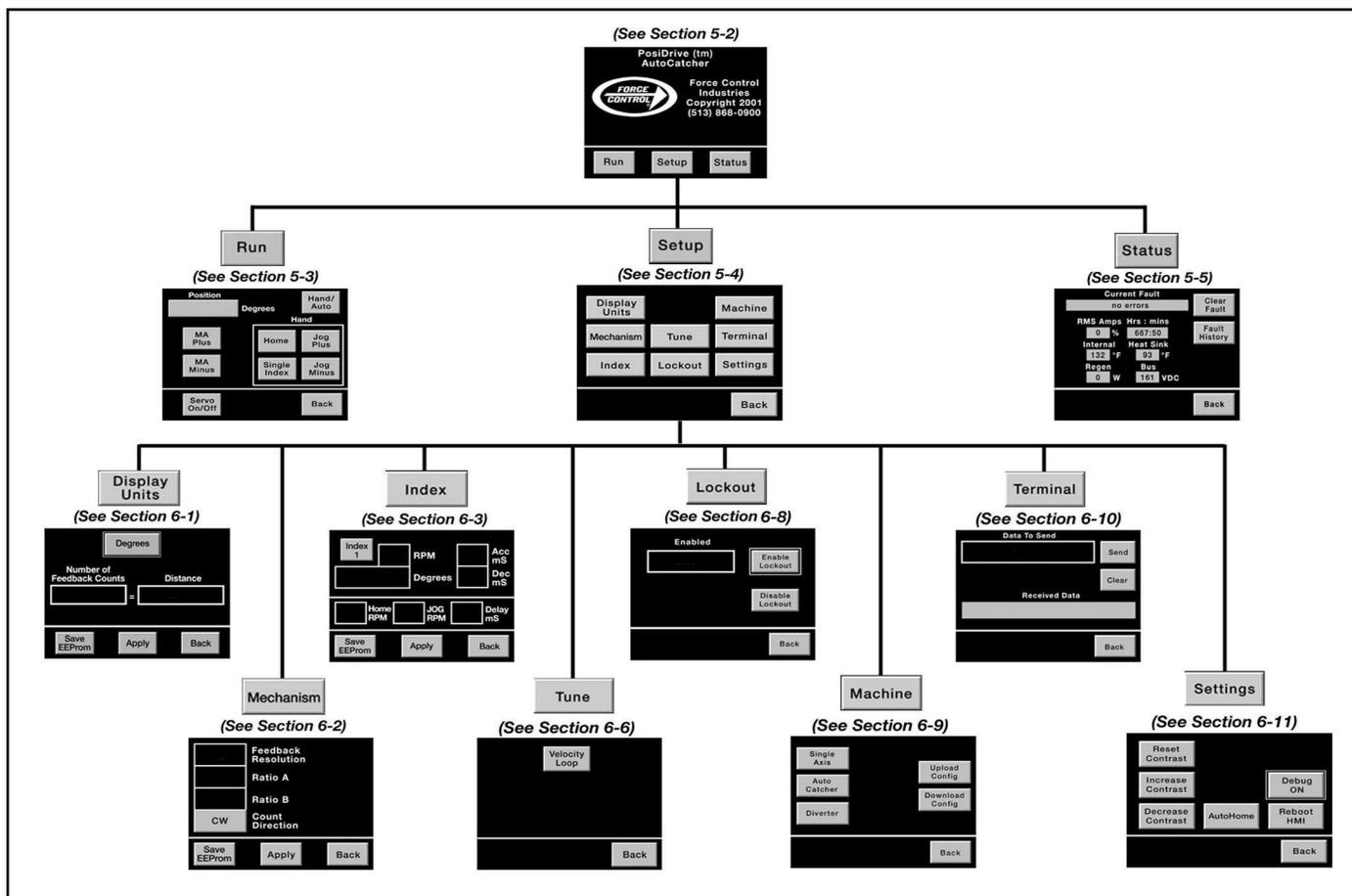


Figure 5.1 - Functional Relationship of Menu Screens

1. BIOS Version Information
2. Memory Check
3. Starting MS DOS
4. Controlware Version
5. Eason Technology WinBuild Version (Loading Application)
6. Setting Files and Drivers Information
7. Force Control and Application
8. Main Menu Screen (See Section 5-2)

## 5-2 MAIN MENU SCREEN

(See Figure 5.2)

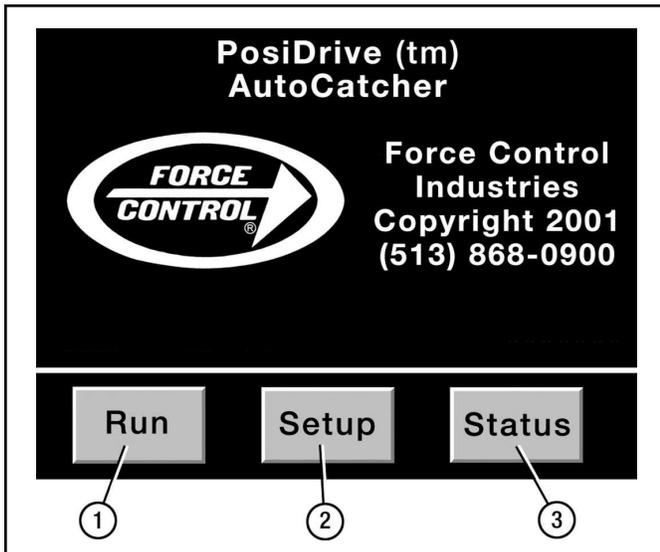


Figure 5.2 - Main Menu Screen

This is the first screen displayed after the HMI completes its **Power-Up Sequence**. It shows the Force Control Industries, Inc. logo together with contact and copyright information. It will also show the name of the Application at the top of the screen.

Along the bottom of the screen there are three touch buttons that access different sub-menus.

1. **“Run” Button** - This button accesses the **Run Screen**, which provides manual and automatic controls for the Servomotor. (See Section 5-3 for more detailed information.)
2. **“Set-Up” Button** - This button accesses the **Set-Up Menu Screen**, which is used to configure the parameters and settings of the Servoamplifier. (See Section 5-4 for more detailed information.)
3. **“Status” Button** - This button accesses the **Status Screen**, which monitors the Servoamplifier. Some of the monitored items include Current Fault, Fault History and Motor Current. (See Section 5-5 for more detailed information.)

## 5-3 RUN SCREEN

(See Figure 5.3)

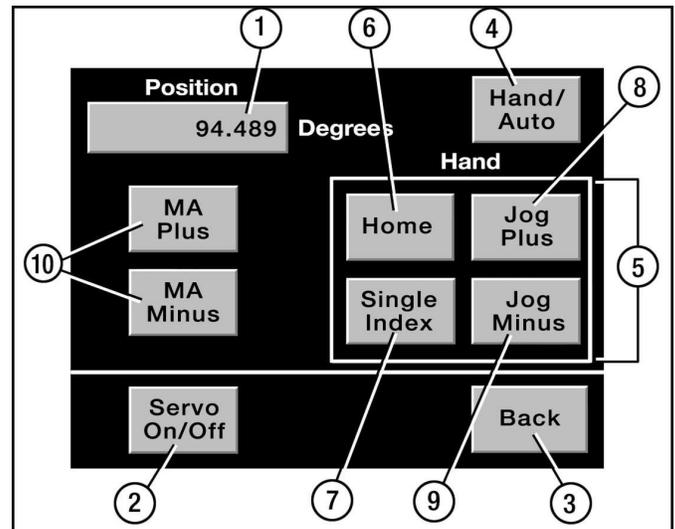


Figure 5.3 - Run Screen

The **Run Screen** allows you to switch between **“Auto” Run Mode** and **“Hand” Run Mode**. It also allows you to turn the Servomotor **“On”** or **“Off”**.

The **Position Display Window** shows the real time position of the Servo Motor at all times. It can be read in Degrees, Inches, Meters or Counts. (See Section 6-1 for changing the **Display Units**.)

1. **Position Display** - Shows the real time position of the Servomotor.
2. **Servo “On” or “Off” Button** - This Button enables or disables the Servomotor current loop.
3. **“Back” Button** - This button takes you back to the previous screen.
4. **“Hand/Auto” Button** - This button switches the **Run Mode** between **“Hand”** or **“Auto”**.

**NOTE** - When changing from Auto to Hand a **CAUTION Screen** as shown in Figure 5.4 will appear.

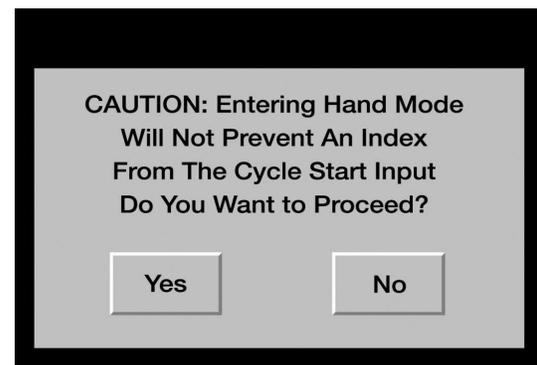


Figure 5.4 - Caution Screen

**WARNING - Putting the HMI into “Hand” Mode does not prevent your machine’s controller from ordering the Servo Motor to index. Before placing your hands into the machine, disable the Servo Motor by pressing the Servo Stop, Master Stop or the Emergency Stop Push Button.**

5. **Hand Control Window** - The appearance of this window changes as you switch from “*Hand*” to “*Auto*” Mode with **Button #4**. In “*Auto*” Mode this window will be empty and the legend “*Auto*” will be displayed above the top edge. In “*Hand*” Mode four additional buttons will be displayed inside the window as shown in *Figure 5.3*.
6. “**Home**” Button - Moves the Servomotor to the **Home Position**, usually by searching for an external proximity sensor.
7. “**Single Index**” Button - Indexes the Servomotor one complete index
8. “**Jog Plus**” Button - Jogs the Servomotor in a forward direction.
9. “**Jog Minus**” Button - Jogs the Servomotor in a reverse direction.

**NOTES:**

1. Holding down either the Jog Plus or the Jog Minus Button will run the Servo Motor until the button is released.
2. The Jog Speed (RPM) can be manually set in the Setup Menu Screen. (See *Section 5-4* for details.)

10. **Other Buttons** - These are buttons for specific applications. They will be described in supplement documents for each specific application. **They may not be visible for your application.**

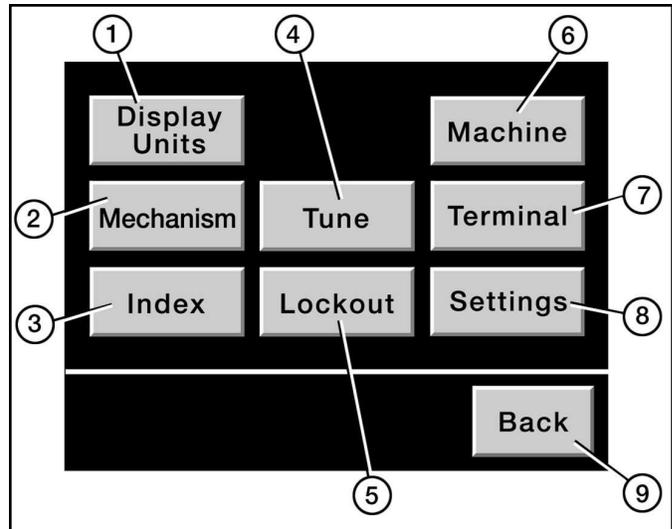
**NOTE:** The (2) extra buttons shown in *Figure 5.3* are the Manual Adjust Buttons for the AutoCatcher Application.

**5-4 SETUP MENU SCREEN**

(See *Figure 5.5*)

This **Setup Menu Screen** provides access to several Setup and Configuration Screens. These screens allow you to change the parameters and settings that control the motion of the Servo Motor and the operation of the HMI Display. Pressing the “**Setup**” Button on the **Main Menu Screen** accesses this screen.

This **Setup Menu Screen** can be protected with a **Password** if you choose. If the **Password Protection** is



*Figure 5.5 - SetUp Menu Screen*

active then a **Password Screen** as shown in *Figure 5.6* will pop up when you try to enter the Setup Menu.



*Figure 5.6 - Password Screen*

Pressing the **Password Window** will bring up an alpha/numeric keypad that you can use to type in your **Password**. (See *Section 6-8* for details to activate the **Password Protection**.)

The “**Setup**” Menu Screen generally provides eight or nine Touchscreen Buttons that access different parameters and settings. Some applications will vary from the screen shown in *Figure 5.5*.

1. “**Display Units**” Button - This button accesses the Display Units Screen, which is used to set the relationship between the Servomotor’s feedback counts and the displayed motion of your machine measured in Degrees, Inches, Millimeters, or Counts. (See *Section 6-1* for more information.)
2. “**Mechanism**” Button - This button accesses the Mechanism Screen, which is used to enter gear ratios and set the desired motor rotation direction. (See *Section 6-2* for more information.)

3. **“Index” Button** - This button accesses the Index Screen, which is used to program the index positions that the Servomotor will move to when your machine is running. This Index Screen also sets acceleration time, jog speeds and the homing speed. (See Section 6-3 for more information.)
4. **“Tune” Button** - This button accesses the Tuning Menu Screen, which is the master screen for functions related to tuning the Servo System. Servoamplifiers need to be tuned before they will run well. Tuning adjusts for the loads and inertia of your particular application. Force Control Industries develops tuning parameters for pre-programmed applications. You can generally use our default parameters, so you may never need this function. (See Section 6-6 and 6-7 for more information.)
5. **“Lockout” Button** - This button activates the Password Screen, which is used to setup **Password Protection** for the Setup Menu. If there is an active Password, the legend on the button will read **“Lockout Enabled”**. If you have not created a Password, the legend will read **“Lockout Disabled”**.(See Section 6-8 for more information.)
6. **“Machine” Button** - This button accesses the Machine Screen, which is used to select the HMI and Servoamplifier Settings for a particular application or to upload configuration data from the Servoamplifier. (See Section 6-9 for more information.)
7. **“Terminal” Button** - This button accesses the Terminal Screen, which allows you to key in command strings and transmit them directly to the Servo Amplifier. **This screen is intended for service personnel only.** (See Section 6-10 for more information.)
8. **“Settings” Button** - This button accesses the Settings Screen, which allows you to re-boot the HMI and adjust the contrast of the HMI screens. (See Section 6-11 for more information.)
9. **“Back” Button** - This button returns you to the previous menu. If you have changed any settings that should be stored in the Servo Amplifier’s EEPROM then a screen will appear that asks you if you want to do so. It is not necessary to save to EEPROM if your settings are experimental or temporary. If you do not save to EEPROM then your new settings will be lost when the Servo Amplifier loses power.

## 5-5 STATUS SCREEN

(See Figure 5.7)

The Status Screen monitors several conditions of the Servo-amplifier. Pressing the **“Status” Button** on the Main Menu Screen accesses this Status Screen.

1. **“Current Fault” Display** - Shows a Fault Code if the Servoamplifier is faulted, otherwise it displays “no errors”. (See Section 7 for a list of Fault Codes.)

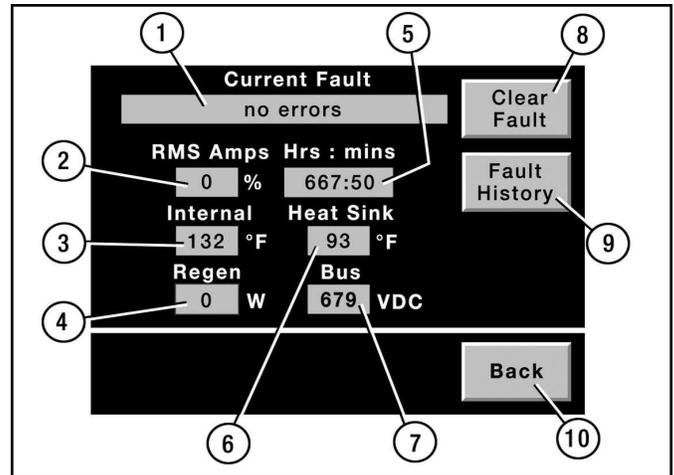


Figure 5.7 - Status Screen

2. **“RMS Amps” Display** - Shows the current as a percentage of the full load current. The Amplifier will fault at 105% current.
3. **“Internal” Display** - Shows the internal temperature of the Servoamplifier in Degrees Fahrenheit.
4. **“Regen” Display** - Shows the electrical power currently being dissipated in the Regeneration Resistor in Watts.
5. **“Hrs : Mins” Display** - Shows the total time that the Servoamplifier has been powered up in Hours and Minutes.
6. **“Heat sink” Display** - Shows the temperature of the Servoamplifier’s Heat Sink in degrees Fahrenheit.
7. **“Bus” display** - Shows the Servoamplifier’s DC Bus Voltage
8. **“Clear Fault” Button** - This button sends a fault reset command to the Servoamplifier.
9. **“Fault History” Button** - This button accesses the **Fault History** Screen, which displays up to ten prior faults along with time stamps. The Fault History Screen also has two Touch Buttons on it. There is a **“Clear History”** Button which resets the Historical Faults to **“No Errors”**. The other one is a **“Back”** Button which returns you to the Status Screen.

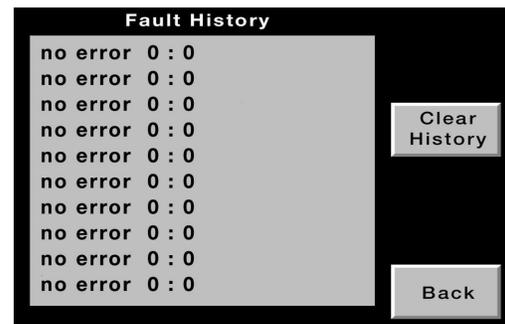


Figure 5.8 - Fault History

10. **“Back” Button** - This button returns you to the Main Menu.

## Section 6

# SERVO SET-UP USING HMI SET-UP SCREENS

### 6-1 DISPLAY UNITS SCREEN

(See Figure 6.1)

The **Display Units Screen** is used to set the relationship between the servomotor's feedback counts and the displayed motion of your machine measured in degrees, inches, millimeters, or counts. For most applications Force Control Industries will have pre-programmed default settings for this screen. Access this screen by pressing the display units button on the setup menu.

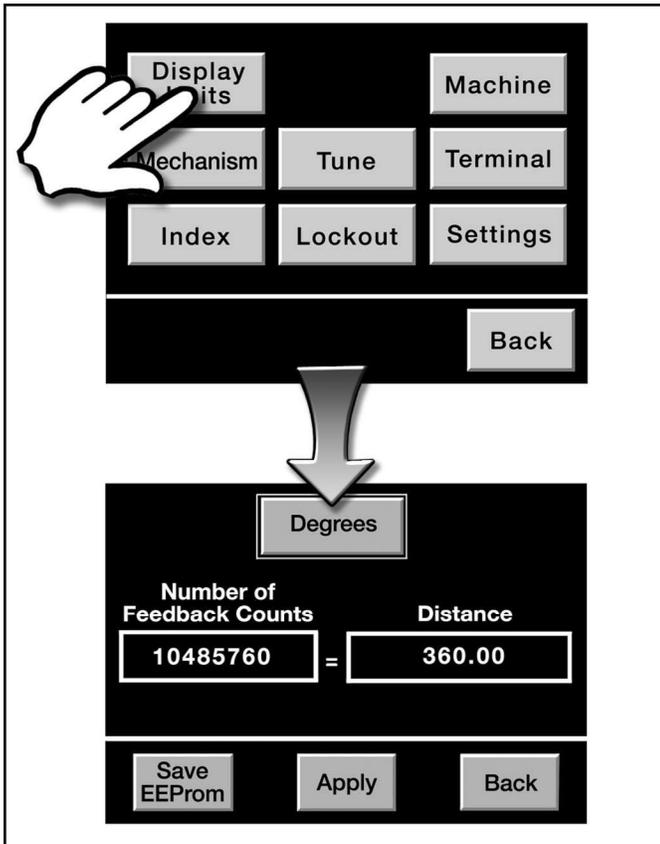


Figure 6.1 - Display Units Screen

1. **“Units” Button** – This button steps through four different units of measurement: Degrees; Inches; Millimeters; and Counts. The legend shown on the button will change each time you press it. The units should be set for the most convenient way of displaying the movement of the servo motor. For linear motions, set the units to inches or millimeters. For rotary motions, set the units to degrees.
2. **“Number of Feedback Counts” Parameter** – Set this in conjunction with the “Distance” parameter described below. Feedback counts track the rotation of the servo motor. Touching the Feedback Count

box will pop up a numeric keypad that you use to enter the desired value. If you selected Counts for the Units then this parameter is not used.

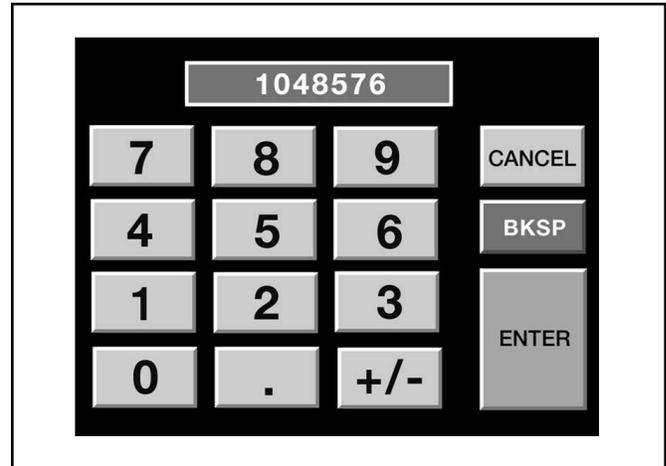


Figure 6.2 - Numeric Keypad

3. **“Distance” Parameter** – Set this in conjunction with the “Feedback Counts” parameter described above. The Distance parameter describes the motion of your machine in terms of the units you selected with the Units button. Touching the Distance box will pop up a numeric keypad that you use to enter the desired value. If you selected Counts for the Units then this parameter is not used.

The digital servoamplifier converts feedback signals from the servo motor's resolver in to a “feedback count” which shows the motor's position. For *PosiDrive* servomotors and servoamplifiers, the feedback resolution is usually 1,048,576 counts per revolution (2 to the 20th power). Based on the mechanics of your application there will be a fixed relationship between the feedback counts for the motor and the resulting motion of your machine. You have to calculate this relationship and then enter your results into the Feedback Counts and Distance parameters. By setting the correct ratio between these two parameters you will be able to order motion and read the results using convenient display units rather than having to work with huge numbers of “counts”. See *Examples on next page*.

**IMPORTANT: The direction of motor rotation can be reversed using a setting on the Mechanism Screen (See section 6-2). Do not try to reverse the motor by entering negative numbers in the Feedback Counts or Distance parameters.**

### Example #1:

**Shingle Catcher:** The servomotor drives a pair of “starwheels” on a roof shingle manufacturing line “catcher”. (Shingles coming off the end of the line stack up between two starwheels in the catcher and are then dropped vertically by rotating the starwheels). The mechanism includes a gear reducer with a 10:1 gear ratio. You might decide to use one complete revolution of the starwheels as your machine motion “distance”. One revolution equals 360 degrees, so you would set the units parameter to “degrees” using the Units button and enter 360 for the Distance Parameter. Next you will need to calculate the number of Feedback counts that equal a 360 degree turn of the starwheel. Since the gear box has a 10:1 gear ratio the servo motor must make 10 complete revolutions to turn the starwheels 360 degrees. Ten complete revolutions will produce  $10 \times 1,048,576$  or 10,485,760 feedback counts. Set the Feedback Counts parameter to 10485760.

The result of these settings is that the HMI will communicate in terms of degrees rather than counts. If you want to flip the starwheels half a turn, then you order them to index 180 degrees and let the digital servoamplifier take care of computing the 5,242,880 required counts. (See section 6-3 for details on setting up index movements).

### Example #2:

**Shingle Catcher:** It was not critical to pick 360 degrees for the Distance Parameter in Example #1. Other Distance Parameter settings will work provided you compute the corresponding feedback count correctly. Most starwheels rotate 90 degrees when they index, so it would be reasonable to enter 90 degrees for the Distance parameter and units. In this case the Feedback Counts parameter should be set to 2621440 based on **Calculation “A”** shown below.

### Example #3

**Linear Slide:** The servomotor drives a ball screw with a 16 millimeter pitch. You could select millimeters for the units and set the distance parameter to 1 millimeter. In this case the Feedback Counts parameter should be set to 65,536 based on **Calculation “B”** shown below.

4. **“Apply” Button** – This button downloads your parameter changes to the servoamplifier. This button will only be available if you have changed the parameters; otherwise the “apply” legend on the button will be hidden. See section 6-4 for more details.
5. **“Save EEPROM” Button** – This button saves your parameter changes to the servoamplifier’s permanent EEPROM memory so that they will not be lost if the amplifier loses power. This button will only be available after you have “applied” parameter changes using the **“Apply”** button, otherwise the “Save EEPROM” legend on the button will be hidden. See Section 6-5 for more details.
6. **“Back” Button** – This button returns you to the Setup Menu.

## 6-2 MECHANISM SCREEN

(See Figure 6.3 On Next Page)

The **Mechanism Screen** is used to set the relationship between the servomotor’s speed in RPMs and the displayed motion of your machine measured in RPMs. You do this by entering the gear ratio of any gear boxes that are part of your application. You also use this screen to set the desired motor rotation direction. For most applications Force Control Industries will have pre-program default settings for this screen. Access this screen by pressing the mechanism button on the setup menu screen.

1. **“Feedback Resolution” Parameter** – Set this parameter to the appropriate feedback resolution for you servomotor and servoamplifier. For *PosiDrive* servomotors and servoamplifiers, the feedback resolution is usually 1,048,576 counts per revolution (2 to the 20th power). Touching the **“Feedback Resolution”** box will pop up a Numeric Keypad that you use to enter the desired value. (See Figure 6.2)
2. **“Ratio A” Parameter** – Set this parameter in conjunction with the **“Ratio B”** parameter described below to show the gear ratio of your application. This parameter corresponds to the number of turns the input shaft makes in relation to the output shaft. In the case of a 20:1 gear reducer **“Ratio A”** would be set to 20. Touching the **“Ratio A”** box will pop up a numeric keypad that you use to enter the desired value. (See Figure 6.2)

### Calculation "A"

#### Feed Back Count Parameter

$$\begin{aligned} &= (\text{Motor Resolver Count}) \times (\text{Gear Ratio}) \times (\text{Distance Parameter}) \\ &= \left( \frac{1,048,576 \text{ Counts}}{360^\circ (\text{Motor})} \right) \left( \frac{10 (\text{Motor})}{1 (\text{Starwheel})} \right) (90^\circ (\text{Starwheel})) \\ &= 2,621,440 \text{ Counts} \end{aligned}$$

### Calculation "B"

#### Feed Back Count Parameter

$$\begin{aligned} &= (\text{Motor Resolver Count}) \times \left( \frac{1}{\text{Ball Scr Pitch}} \right) \times (\text{Distance Parameter}) \\ &= \left( \frac{1,048,576 \text{ Counts}}{\text{Revolution}} \right) \left( \frac{1 \text{ Revolution}}{16 \text{ mm}} \right) (1 \text{ mm}) \\ &= 65,536 \text{ Counts} \end{aligned}$$

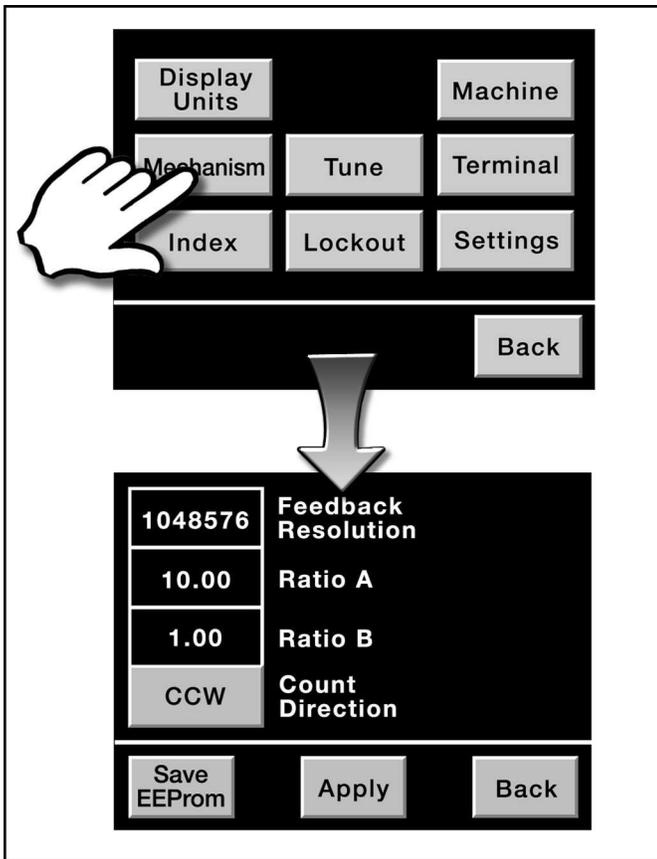


Figure 6.3 - Mechanism Screen

3. **“Ratio B” Parameter** – Set this parameter in conjunction with the **“Ratio A”** parameter described above to show the gear ratio of your application. This parameter corresponds to the number of turns the output shaft makes in relation to the input shaft. In the case of a 20:1 gear reducer **“Ratio B”** would be set to 1. Touching the **“Ratio B”** box will pop up a numeric keypad that you use to enter the desired value. (See Figure 6.2)
4. **“Count Direction” Button** – This button toggles the direction of the motor’s rotation. The legend shown on the button will indicate which direction is selected by showing either **“CW”** or **“CCW”**. These shaft directions are designated for an observer looking at the shaft end of the motor.

When you press the **Count Direction** button a warning screen will pop up to inform you that the servo amplifier will need to be disabled and reset. The warning screen has “yes” and “no” buttons that allow you to apply your change or else abort. Pressing the “yes” button transmits the new direction parameter to the servo amplifier. A “please wait” screen will pop up for a few moments during this process. When the operation is finished you will be returned to the mechanism screen. (See Figure 6.4)

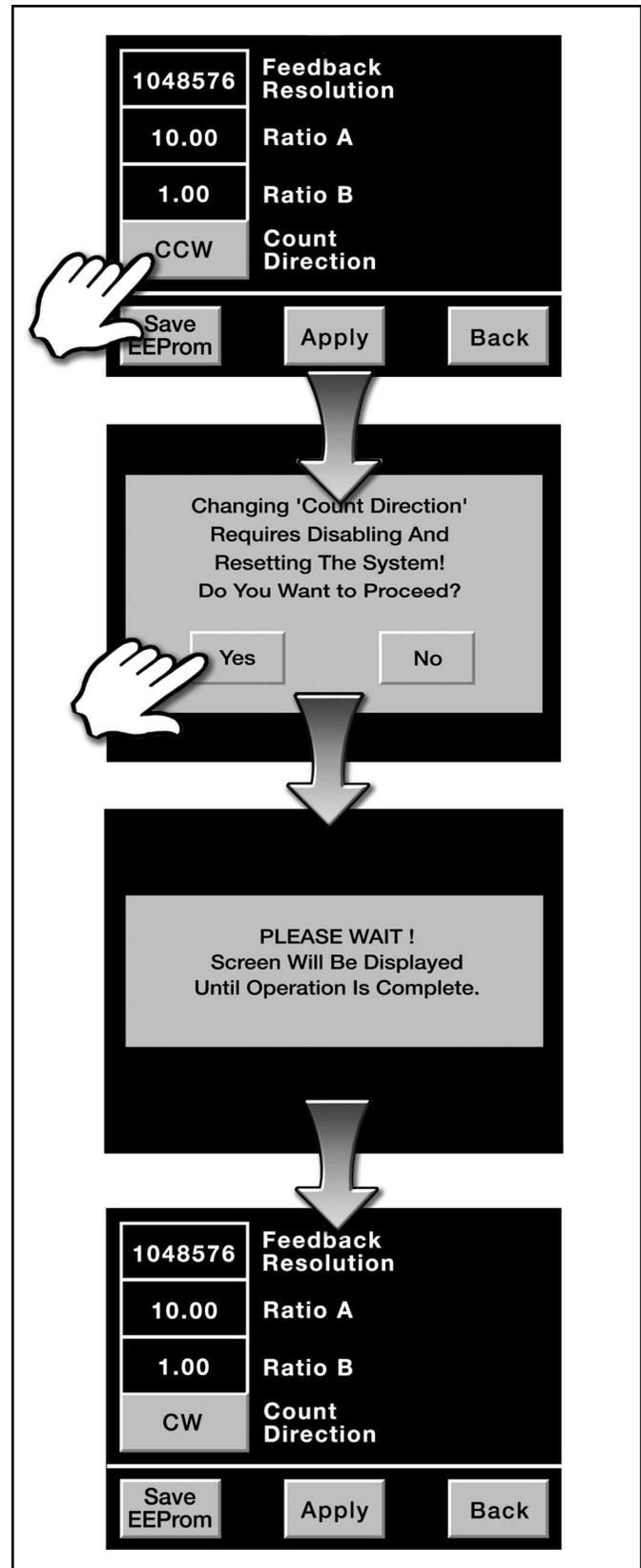


Figure 6.4 - Changing Count Direction

It is not possible to process a direction change if there are other parameter changes that have not been saved to the servoamplifier's EEPROM. **See section 6-5** for more details on saving parameters. If you attempt to change the rotation direction when there are other unsaved parameter changes then a warning screen will pop up to notify you of the problem.

Based on the mechanics of your application there will be a fixed relationship between the feedback counts for the motor and the resulting output shaft speed of your machine. You set this relationship by entering the gear ratio in to the Ratio A and Ratio B parameters. By setting the correct ratio between these two parameters you will be able to order motion speeds using RPMs as your display units.

**Example #1:**

**Shingle Catcher:** The servomotor drives a pair of “star-wheels” on a roof shingle manufacturing line “catcher”. (Shingles coming off the end of the line stack up between two starwheels in the catcher and are then dropped vertically by rotating the starwheels). The mechanism includes a gear reducer with a 10:1 gear ratio. The “Feedback Resolution” parameter should be set to 1048576, the standard resolution of *PosiDrive* amplifiers and motors. Since the gear box is a 10:1 reducer the Ratio A parameter should be set to 10 and the Ratio B parameter should be set to 1.

The result of these settings is that the HMI will communicate shaft speeds in terms of Star Wheel revolutions per minute (RPMs).

5. **“Apply” Button** – This button downloads your parameter changes to the servoamplifier. This button will only be available if you have changed the parameters; otherwise the “apply” legend on the button will be hidden. *See section 6-4 for more details.*
6. **“Save EEPROM” Button** – This button saves your parameter changes to the servo amplifier’s permanent EEPROM memory so that they will not be lost if the amplifier loses power. This button will only be available after you have “applied” parameters changes using the **“Apply”** button, otherwise the “Save EEPROM” legend on the button will be hidden. *See Section 6-5 for more details.*
7. **“Back” Button** – This button returns you to the Setup Menu.

**6-3 INDEX SCREEN**

(See Figure 6.5)

The Index Screen is used to program the index positions that the servomotor will move to when your machine is running. This screen also sets acceleration times, jog speeds, and the homing speed. For most applications

Force Control Industries will have pre-programmed default settings for this screen. Access this screen by pressing the **Index Button** on the Setup Menu.

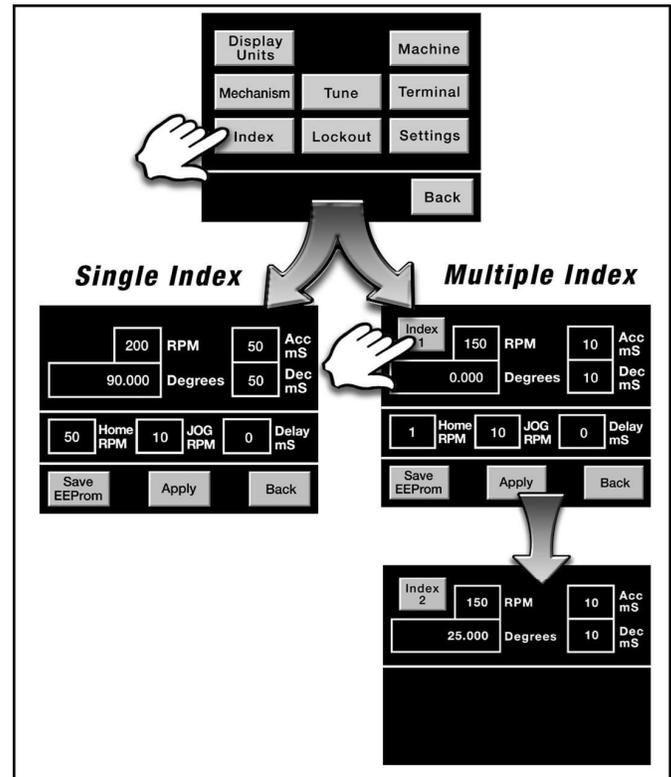


Figure 6.5 - Index Screens

**NOTE** - If the parameters in the Display Units Screen (See Section 6-1) and the Mechanism Screen (See Section 6-2) have been set up correctly, then the index parameters on this screen will be referenced to the actual motion of your machine.

**Example:** The final driven segment of your servo system is a rotating shaft. There is a 10:1 gear reducer between the servomotor and the shaft. Entering a 90° index on this screen will program the motor to turn 2-1/2 revolutions (900°) so that the output shaft will turn 90°.

1. **“Index” Button** – This button selects which index will be displayed on the Index Screen. For applications with only a Single programmed index position, this button will not be present. For applications with multiple programmed index positions, the legend on the button will indicate which index position is being displayed by showing a number beneath the word “index”. Each time you press the button the index number will increase by one so that you step through all the available index screens. The **RPM**, **Degrees**, **Acc mS** and **Dec mS** parameters all have unique settings for each programmed index, so they will be

updated with the appropriate values as you step through the Index Screens. The **Home RPM**, **Jog RPM** and **Delay mS** parameters are only displayed with **Index 1**; for other Index numbers they are not required.

2. **"RPM" Parameter** – This parameter sets the speed of the selected index movement in revolutions per minute. This speed is scaled to match your application using the parameters on the Mechanism Screen (See section 6-2). A separate RPM parameter is entered for each index move.
3. **"Position" Parameter** – This parameter sets the target position of the selected index movement. On the example screens shown in *Figure 6.5* this parameter is labeled **"Degrees"**. In general the label will depend on which display units have been selected: degrees; inches; millimeters; or counts (See Section 6-1). This position is scaled to match your application using the parameters on the Display Units Screen (See Section 6-1). A separate position parameter is entered for each index move.
4. **"Acc mS" Parameter** – This parameter sets the acceleration time for the selected index movement in milliseconds. While indexing, the servo motor will accelerate from zero to full speed in as many milliseconds as have been set in this parameter. A separate acceleration parameter is entered for each index.
5. **"Dec mS" Parameter** – This parameter sets the deceleration time for the selected index movement in milliseconds. A separate deceleration parameter is entered for each index move.
6. **"Home RPM" Parameter** – This parameter sets the servomotor's speed during a homing operation. While homing, the servo motor should turn slowly as it seeks the home sensor. This parameter is only shown on the first index screen.
7. **"Jog RPM" Parameter** – This parameter sets the servomotor's speed for jogging. This parameter is only shown on the first index screen. The servo motor can be jogged manually using buttons on the Run Screen. (See Section 5-3.)
8. **"Delay mS" Parameter** – This parameter sets a delay time in milliseconds. After receiving a "cycle start" command, the servoamplifier will wait for the delay time before it begins indexing the servomotor. The cycle start command is a physical signal which is wired to the servoamplifier's digital input #1. (See *schematics for details.*) This parameter is only shown on the first index screen.
9. **"Apply" Button** – This button downloads your parameter changes to the servoamplifier. This button will

only be available if you have changed the parameters; otherwise the **"Apply"** legend on the button will be hidden. (See section 6-4 for more details.)

10. **"Save EEPROM" Button** – This button saves your parameter changes to the servoamplifier's permanent **EEProm** memory so that they will not be lost if the amplifier loses power. This button will only be available after you have "applied" parameters changes using the **"Apply"** button, otherwise the **"Save EEPROM"** legend on the button will be hidden. (See Section 6-5 for more details.)
11. **"Back" Button** – This button returns you to the Setup Menu.

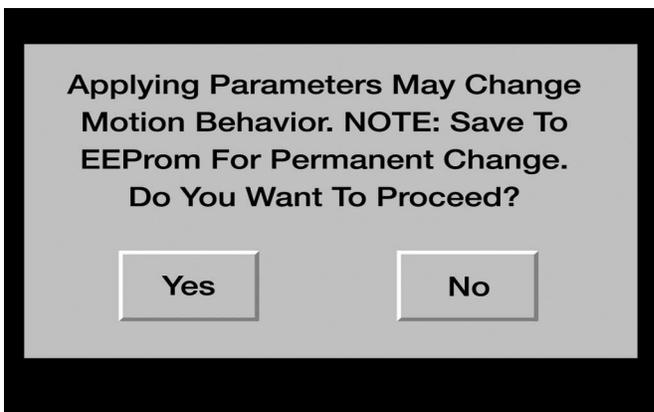
## 6-4 APPLYING PARAMETERS

Several of the screens that are accessed from the Setup Menu have an **"Apply" Button**. This button is used to download parameter changes to the Servoamplifier. Changing parameter settings on the HMI screens has no effect on the motion of the Servomotor until you apply your changes using this button. It is important to note that saving parameter changes permanently in to the Servoamplifier's EEPROM Memory is a separate process that uses a different button (See Section 6-5).

**HINT** - You can apply parameter changes while the servo system continues to run. This allows you to make **"On the Fly"** Adjustments without shutting your machine down.

The **Apply** button will only be available if you have changed a parameter. When there are no changes pending the **"Apply"** legend on the button will be hidden and the button will not operate.

When you press the **Apply** button a **Warning Screen** will pop up. The warning screen reminds you that applying the new parameters will change the motion of the Servomotor. It also reminds you to save your changes to EEPROM if you want them to be permanent. (See *Figure 6.6*)



*Figure 6.6 - Applying Parameters*

The warning screen has **"Yes"** and **"No"** buttons that allow you to apply your changes or else abort. Pressing

the **"Yes"** button transmits the new parameters to the servoamplifier. A **"Please Wait"** screen will pop up for a few moments during this process. When the operation is finished you will be returned to the parameter screen you started from.

## 6-5 SAVING PARAMETERS TO EEPROM

Several of the screens that are accessed from the Setup Menu have a **"Save EEPROM"** Button. This button is used to save changed parameters in the servoamplifier's permanent memory. If you do not save your changes to EEPROM then they will be lost when you shut off power to the servoamplifier

The **Save EEPROM** button will only be available if you have **"Applied"** a change using the **Apply** button. (See Section 6-4.) When there are no changes pending the **"Save EEPROM"** legend on the button will be hidden and the button will not operate.

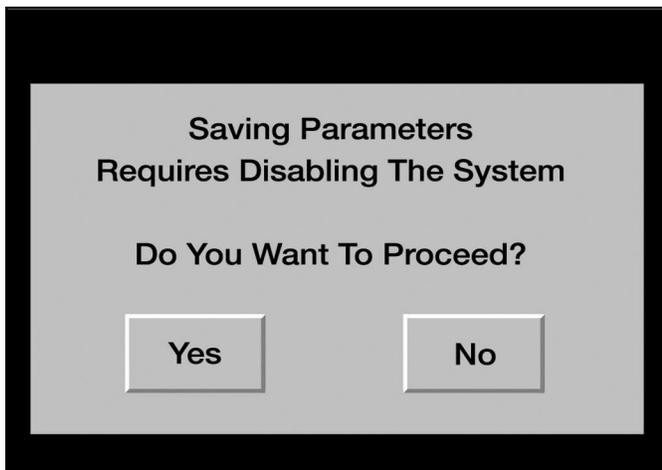


Figure 6.7 - Saving Parameters to EEPROM

When you press the **Save EEPROM** button a **Warning Screen** will pop up. (See Figure 6.7) The warning screen notifies you that the Save operation requires the temporary disabling of the system. The warning screen has **"Yes"** and **"No"** buttons that allow you to save your changes or else abort. Pressing the **"Yes"** button disables the drive and then saves the parameters to permanent memory. A **"Please Wait"** screen will pop up for a few moments during this process. When the operation is finished you will be returned to the parameter screen you started from.

## 6-6 TUNE MENU SCREEN

The **Tune Menu Screen** is the master screen for functions related to tuning the servo system. Servo Amplifiers need to be tuned before they will run well. Tuning adjusts for the loads and inertia of your particular application. Force Control Industries develops tuning parameters for pre-programmed applications. You can generally use our default parameters, so you may never

need this function. Access this screen by pressing the **"Tune"** Button on the Setup Menu.

1. **"Velocity Loop" Button** – This button accesses the **Velocity Tune Screen**, which is used to automatically tune the servo amplifier's velocity loop. (See Section 6-7).

2. **"Back" Button** – This button returns you to the Setup Menu.

At this time, **"Velocity Loop"** is the only tuning operation that can be accessed through the HMI.

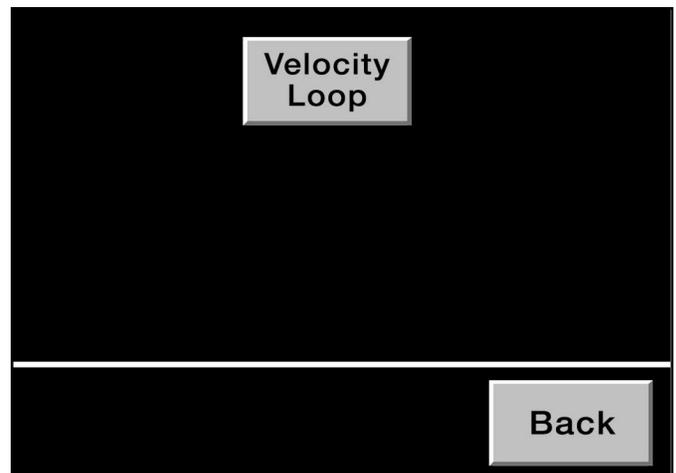


Figure 6.8 - Tune Screen

## 6-7 VELOCITY TUNE SCREEN

**WARNING! Before Tuning you should use the manual controls on the Run Screen to position the servo driven motion in a safe location. The automatic tuning process moves the motor a small amount, so you will want to position the motion where it will not hurt anything when it starts moving. Do not start with the motion up against a mechanical stop; instead jog it to the midpoint of its travel. There is a possibility that the machine will move violently so you need to be alert while running this procedure. There is a "Cancel" button on the HMI that will abort the test.**

The **Velocity Tune Screen** is used to invoke an automatic tuning sequence and to monitor the results. Tuning adjusts for the loads and inertia of your particular application. Force Control Industries develops tuning parameters for pre-programmed applications. You can generally use our default parameters, so you may never need this function. Access this screen by pressing the Velocity Loop button on the **Tuning Menu Screen**.

When you activate the automatic tuning process, the servo amplifier drives the servo motor to make a series

of very short moves back and forth. In addition to oscillating, the machine will also vibrate. The frequency of the vibration will increase in steps over the course of about a minute as the amplifier "test drives" the motor. At the end of the test the display will show a "Done" message plus a "GV" value, and a "GVTN" value. The GV value is the proportional gain of the velocity loop. The GVTN value is the integration time constant.

It may be useful to record the GV and GVTN values. If they were to change drastically it would indicate a change in the dynamics of your machine.

In some cases the servo motor will vibrate violently at the beginning of the tuning procedure but will quiet down quickly. This happens as soon as the servo amplifier takes its first data point, and starts to adapt to the mechanical load.

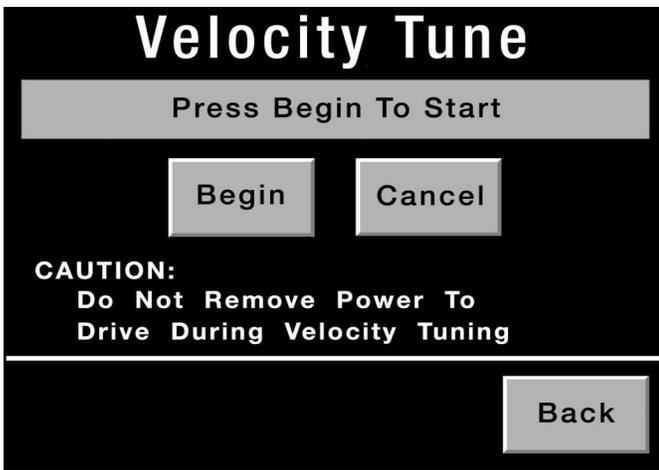


Figure 6.9 - Velocity Tune Screen

1. **"Begin" Button** – This button starts the automatic tuning sequence. The legend in this button changes to **"Wait"** while the test is running. Be ready to hit the **Cancel** button if the machine starts to vibrate too badly or "runs away".

**Caution! Do Not remove power to the drive during velocity tuning!**

2. **"Cancel" Button** – This button aborts the velocity tuning sequence. Normally this button is blank; the **"Cancel"** legend only appears after you have started a test with the **Begin** button.
3. **"Back" Button** – This button returns you to the Tuning Menu Screen.

## 6-8 PASSWORD ENTRY SCREEN

(See Figures 6.10 and 6.11)

The Password Entry Screen is used to set up password protection for the Setup Menu. Access this screen by pressing the **"Lockout" Button** on the setup menu.

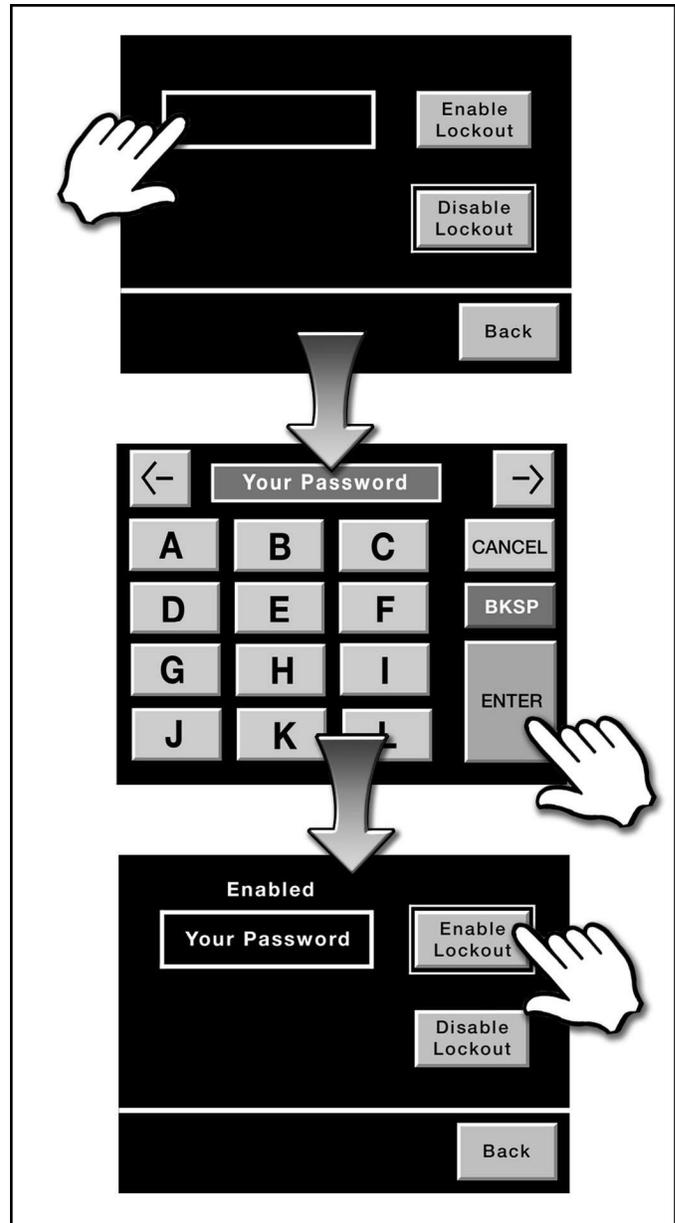


Figure 6.10 - Enable/Disable Lockout Window

1. **"Password" Window** – This window displays the password if one has been entered. Pressing the **Password** Window will bring up an alpha/numeric keypad. Use the keypad to type in a password and then press the **Enter** Button. The password can use any character that is on the keypad, including spaces, and can be of almost any reasonable length. (The Password Window can display 13 characters. You can enter longer Passwords but they will scroll out of the window.)

The keypad shows the letters A – L when it first pops up. Use the left and right arrows on the keypad to scroll through screens with additional letters, numbers, and characters. The **"Cancel" Button** will return you to the

Password Screen without keeping the new entry. The **"BKSP" Button** backspaces and deletes the last letter you typed in. The **"Enter" Button** returns you to the Password Screen and displays your new password in the password window. (See Figure 6.10)

2. **"Enable Lockout" Button** – This button activates the password shown in the password window. Pressing this button causes the legend **"Enabled"** to appear above the password window.

**Important** - Be sure to press the **"Enable Lockout" Button** after changing the password. You can change the password while it is enabled, but the new password does not take effect until you press the **Enable Lockout Button**. If you fail to do this before you exit the password screen then the previous password will still be the valid one, even though the new password was displayed in the password window.

3. **"Disable Lockout" Button** – This button deactivates the password feature and clears the password window.

4. **"Back" Button** – This button returns you to the Setup Menu.

The new password will take effect once you exit the Setup Menu and return to the Main Menu.

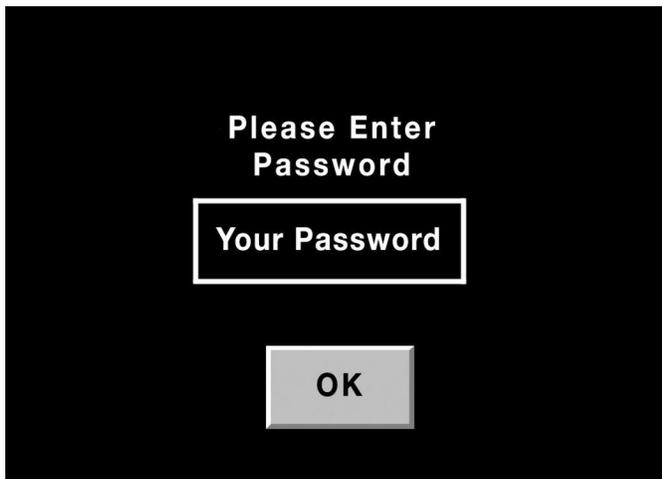


Figure 6.11- Password Window

Once **Password Protection** is activated it will be necessary to enter the password in order to access the Setup Menu from the Main Menu. When you press the **"Setup" Button** on the Main Menu; a Password Screen, as shown in Figure 6.11 will pop up. Pressing the Password Window on this screen will bring up the same Alpha/Numeric keypad that was described above. Use the keypad to enter the password and press the **"Enter" Button**. Pressing **"Enter"** returns you to the Password Screen, where you then press the **"OK" Button**. If the password you typed in is correct, then the Setup Menu will be displayed. If your password is not

valid then the message **"Password Error"** will flash across the top of the screen, and you will be returned to the Main Menu.

## 6-9 MACHINE SCREEN

(See Figure 6.12)

The Machine Screen is used to load the pre-programmed servo applications for your *PosiDrive* Control Package. There are also utilities for uploading and downloading configuration data from the servo amplifier. Access this screen by pressing the Machine Button on the Setup Menu.

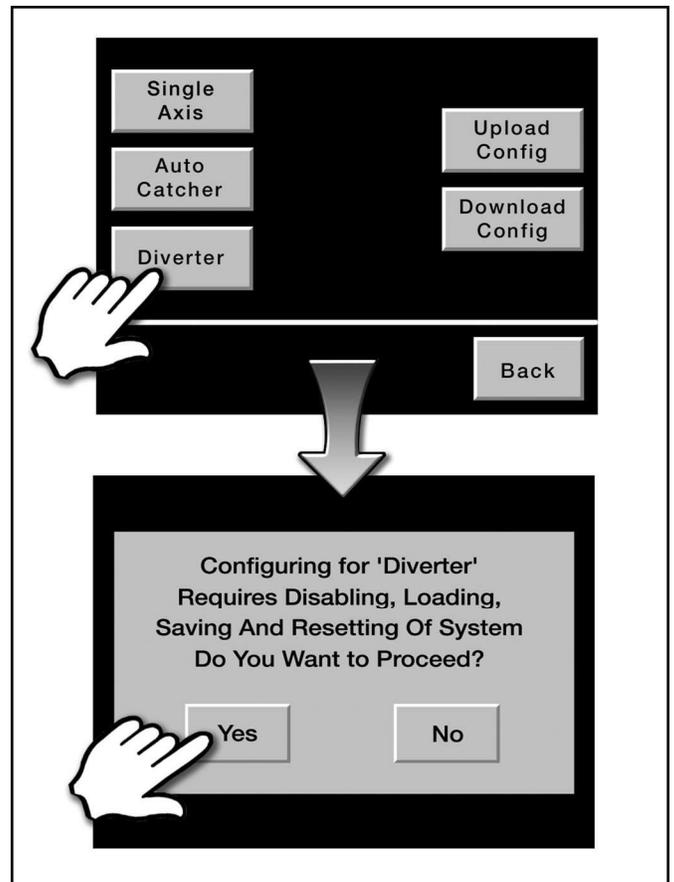


Figure 6.12 - Machine Screen - Changing Applications

1. **"Application" Buttons** – These buttons are used to load pre-programmed applications in to the servo-amplifier and HMI. The selection of pre-programmed applications will vary from system to system depending on your specific needs. The sample screen shown in Figure 6.12 has three applications to choose from: **Single Axis, Auto Catcher and Diverter**.

Pressing an **Application Button** begins the process of configuring the servoamplifier and the HMI display to run a particular piece of equipment. For some applications there will be extra screens that pop up requesting more information. After that a **warning screen** will be

displayed. If your application has any of the extra screens then they will be described in the supplemental documentation.

The **warning screen** informs you that the servo amplifier will need to be disabled and reset. It has **"yes"** and **"no"** buttons that allow you to continue the operation or else abort. Pressing the **"yes"** button transmits the new parameters to the servo amplifier and configures the HMI display. A **"Please Wait"** screen will display for a few moments during this process. When the operation is finished you will be returned to the Machine Screen and the servo system will be ready to run your application.

2. **"Upload Config" Button** – This button is used to read the parameters out of the servoamplifier and store them in the HMI display. If you have had to change the amplifier parameters from the default values, then uploading them is a good way to "back them up".

The **Upload Configuration** function only reads and saves the parameters from the servoamplifier. It does not save configuration settings for the HMI display. It also does not restore the settings shown on the HMI screens to match the parameters in the drive. This may get confusing if you have changed settings in the HMI but have not Applied them to the servoamplifier (See section 6-4). It can also be confusing if you have applied parameters to the servo amplifier but not saved them to EEPROM (See section 6-5). In these sorts of circumstances you can wind up with different parameters in the drive than are shown on the configuration screens of the HMI. The best way to stay organized is to avoid keying parameter changes in to the HMI display that you don't immediately apply to the servo amplifier, then save to EEPROM, then upload back to the HMI memory.

3. **"Download Config" Button** – This button is used to write previously stored parameters to the servoamplifier. If you have uploaded the servoamplifier's configuration parameters using the Upload Config button then you can use this button to write those parameters back in to the amplifier. This could be useful if you needed to replace a faulty amplifier, or if you want to undo changes you have made to the drive parameters since you last uploaded them. If you do not have any parameters saved in the HMI, then the Download Config button will not function and its legend will be hidden. Loading pre-programmed applications will also deactivate the Download Config Button because that operation clears uploaded configuration data from the HMI memory

The same caution given above applies here. The data in the servo amplifier will be changed, the data displayed on the HMI will not.

4. **"Back" Button** – This button returns you to the Setup Menu.

## 6-10 TERMINAL SCREEN

(See Figure 6.13)

The **Terminal Screen** allows you to key in command strings and transmit them directly to the servo amplifier. This screen is intended for service personnel only. Access this screen by pressing the **"Terminal" Button** on the setup menu screen.



Figure 6.13 - Terminal Screen

The *PosiDrive* Servoamplifier and the Eason HMI display communicate over a serial cable, which is plugged in to connector-X6 on the servo amplifier. Parameters, commands, and data are exchanged over this serial link using an instruction set of over 350 different variable/command codes.

The program running in the *PosiDrive* HMI handles all of this behind the scenes. However, it is possible to enter these commands "by hand" on the terminal screen.

1. **"Data To Send" Window** – This window is used to enter command codes. Pressing the box will bring up the standard alpha/numeric keypad, which you use to type in the desired command. Pressing the **"Enter" Button** on the keypad returns you to the Terminal Screen. (See section 6-8 Password Entry Screen for a more complete description of the keypad).
2. **"Received Data" Display** – This display shows data that is returned from the servo amplifier in response to commands you issue from the "Data To Send" window.
3. **"Send" Button** – This button transmits commands displayed in the **"Data To Send"** window to the Servo Amplifier.
4. **"Clear" Button** – This button clears commands out of the **"Data To Send"** window.
5. **"Back" Button** – This button returns you to the Setup Menu.

## 6-11 SETTINGS SCREEN

(See Figure 6.14)

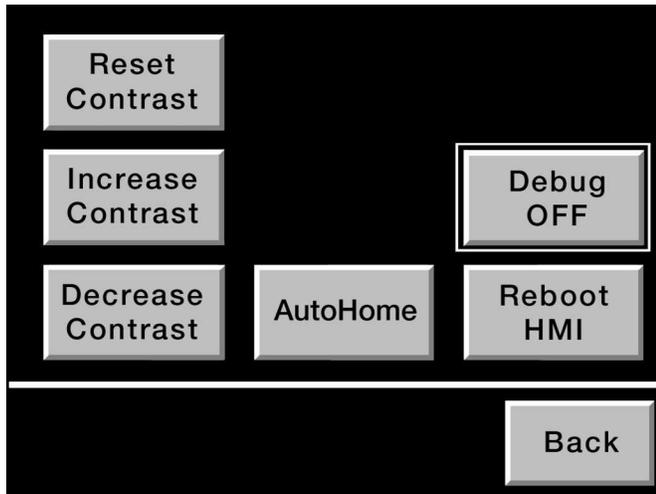


Figure 6.14 - Settings Screen

The **Settings Screen** allows you to reboot the HMI, and adjust the contrast of the HMI screen. This screen may have additional, application specific, buttons that are not shown or described here. They will be described in supplemental documents. Access this screen by pressing the **"Settings" Button** on the Setup Menu Screen.

1. **"Reset Contrast" Button** – This button restores the HMI contrast to its default setting.
2. **"Increase Contrast" Button** – This button increases the contrast of the HMI display screen.
3. **"Decrease Contrast" Button** – This button decreases the contrast of the HMI display screen.
4. **"AutoHome" Button** - This button accesses the **AutoHome Screen**, which sets up the servo system to home automatically on HMI Power Up. See Section 6-12 for a description of the **AutoHome Screen**. The AutoHome feature only works for the pre-programmed Diverter Application. (See Section 6-9)
5. **"Debug On/Off" Button** – This button is intended for service personnel only. The legend on this button toggles between **"Debug OFF"** and **"Debug ON"** to indicate if Debug mode is active or not. You should leave the Debug mode **Off**. (See section 6-12 for more information on the "Debug" mode.)
6. **"Reboot HMI" Button** – This button reboots the HMI display.
7. **"Back" Button** – This button returns you to the Setup Menu.

## 6-12 AUTOHOME SCREEN

(See Figure 6.15)

The **AutoHome Screen** sets up the servo system to

automatically begin a homing sequence after the HMI is powered up. This feature only works for the pre-programmed Diverter Application. (See Section 6-9 for more information about pre-programmed applications on the **Machine Screen**.) Access this screen by pressing the **"AutoHome" Button** on the Settings Screen.

**WARNING - Before setting the "AutoHome" feature you need to consider the safety implications of allowing the servo system to start moving as soon as it is powered up. If there is any danger that a person might be working on the machine when the servo is powered up then you should not activate the AutoHome feature. Make sure the machine is adequately guarded and use the current reduction feature (described below).**

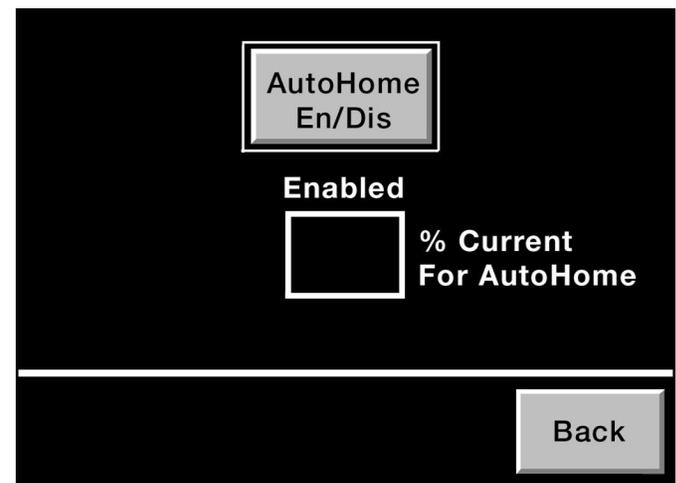


Figure 6.15 - AutoHome Screen

1. **"AutoHome En/Dis" Button** - This button toggles the **AutoHome** feature on and off. The current enabled or disabled status of the **AutoHome** feature is displayed directly below this button.
2. **"Enabled/Disabled" Display** - This display shows the On or Off status of the **AutoHome** feature.
3. **"% Current For AutoHome" Window** - This window sets the percentage of full motor current that the servomotor will utilize during the homing operation. This is an important safety feature. By reducing the current you reduce the motor torque. This reduces the danger that the machine will be damaged in the event that the home sensor fails and the servo system runs past the normal limits of operation.
4. **"Back" Button** - This button returns you to the Settings Menu.

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## 6-13 DEBUG MODE

(See Figure 6.16)

The **Debug Mode** allows Force Control Industries engineers to bench test applications using different servo motors, amplifiers, and electrical supplies than the real application will require. **Debug Mode** is activated using the **Debug Button** on the Settings Screen (See Section 6-11). You should leave **Debug Mode "OFF"**.

Setting the **Debug Mode "On"** prevents the HMI from downloading several of the usual pre-programmed parameters in to the servo amplifier when the "Application" buttons on the Machine Screen are pressed (See Section 6-9).

Pressing the Debug button toggles the status of the Debug mode between **"OFF"** and **"ON"**. If Debug mode is on, then the message **"DEBUG MODE"** and a number will be displayed near the bottom of the Main Menu Screen. In the screen message the number shows the amount of free memory in Kbytes. (See Figure 6.16)

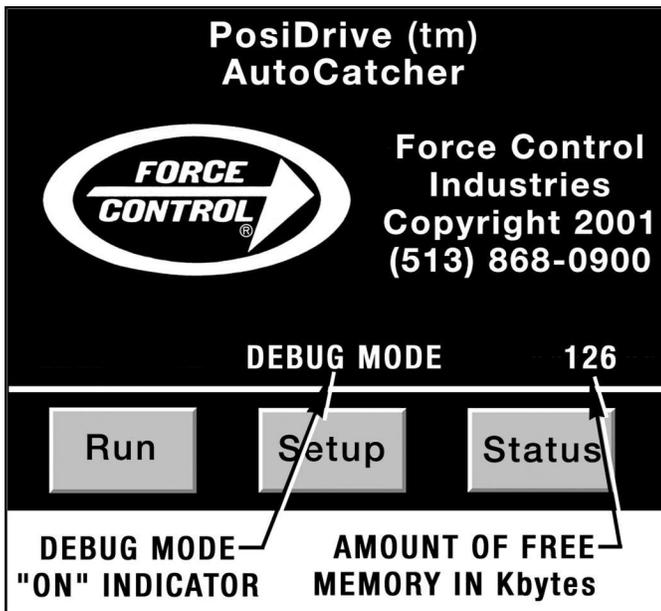


Figure 6.16 - Main Screen in Debug Mode

# Section 7

## TROUBLESHOOTING

### 7-1 SERVOAMPLIFIER FAULT CODES

When a *PosiDrive* Series RS Servoamplifier is faulted it will display an error code. These error codes can be read from the two digit, 7 segment LED display on the front of the servoamplifier. Error codes are also transmitted to the touchscreen HMI and displayed on the Status Screen (See section 5-5). **Table 7.1** shows the fault codes and their explanations.

When any of these faults occur, the output stage of the servoamplifier will be switched off and the contacts of the ready output will open. Shutting down the output stage removes power from the servomotor, causing it to lose torque. If the motor is equipped with a built in brake, then the brake will be engaged since the drive will drop the 24VDC power that releases the brake.

**Table 7.1 - Servoamplifier Fault Codes**

DISPLAY FAULT CODE	HMI FAULT MESSAGE	EXPLANATION
F01*	ERR 1 heat sink temperature !!!	The heat sink temperature is too high. The limit is factory set to 80° C.
F02*	ERR 2 overvoltage !!!	Overvoltage in the DC-link circuit. The limit depends on the supply voltage.
F03*	ERR 3 following error !!!	The following error is too large.
F04	ERR 4 feedback !!!	Resolver cable break, short circuit or short to ground.
F05*	ERR 5 under voltage !!!	Under-voltage in the DC-link. The default limit setting is 100V.
F06	ERR 6 motor temperature !!!	The motor temperature is too high or the temperature sensor is faulty. The default limit setting is 145° C.
F07	ERR 7 v fault (int. supply) !!!	Internal auxiliary voltage not ok.
F08*	ERR 8 overspeed !!!	The motor is running away or the speed is higher than permitted.
F09	ERR 9 EEPROM !!!	EEPROM Checksum error.
F10	ERR 10 Flash-EPROM !!!	Flash-EPROM Checksum error.
F11	ERR 11 brake !!!	Brake cable break, short circuit or short to ground.
F12	ERR 12 motor phase !!!	Motor phase missing (cable break or similar).
F13*	ERR 13 internal temperature !!!	Internal temperature is too high.
F14	ERR 14 output stage !!!	Fault in the output stage.
F15	ERR 15 I <sup>2</sup> t max. !!!	I <sup>2</sup> t max. value exceeded.
F16*	ERR 16 mains BTB/RTO !!!	Two or three supply phases missing.
F17	ERR 17 A/D converter !!!	Error in the analog-digital conversion.
F18	ERR 18 regen !!!	Regeneration circuit faulty or incorrect setting.
F19*	ERR 19 mains phase !!!	A supply phase is missing. (Can be switched off for 1-phase operation.)
F20	ERR 20 Slot error !!!	Hardware error on the expansion card.
F21	ERR 21 Handling error !!!	Software error on the expansion card.
F22	ERR 22 Short circuit to earth !!!	40/70 amp types only: Short circuit to earth.
F23	ERR 23 CAN bus off !!!	CAN bus total communication error.
F24	ERR 24 Warning !!!	Warning display as error.
F25	ERR 25 Commutation error !!!	Commutation error. (Run-away of the motor.)
F26	ERR 26 Limit switch !!!	Homing error (Hardware limit switch reached.)
F27	ERR 27 AS-Option !!!	Operating error for AS-option.
F28	ERR 28 reserved !!!	Reserved.

\* - These error messages can be cancelled by the remote reset without the drive performing a coldstart. The non-astrick Error Messages will coldstart the drive.

**Table 7.1 - Servoamplifier Fault Codes (Continued)**

DISPLAY FAULT CODE	HMI FAULT MESSAGE	EXPLANATION
F29	ERR 29 Sercos !!!	Sercos error.
F30	ERR 30 Emerg. Stop Timeout !!!	Emergency stop timeout.
F31	ERR 31 wrong Firmware-version !!!	Wrong Firmware-Version.
F32	ERR 32 system fault !!!	System software not responding correctly.

**7-2 SERVOAMPLIFIER WARNING CODES**

When a *PosiDrive* Series RS servoamplifier experiences a fault that is not severe enough to warrant a total shut down, it will display a warning code. These warning codes can be read from the two digit, 7 segment LED display on the front of the servoamplifier. Error codes are not transmitted to the touchscreen HMI at this time. **Table 7.2** shows the warning codes and their explanations.

Some of these faults do trigger a controlled shutdown of the drive (as opposed to total shutdown). During a controlled shutdown the motor and load are stopped using the emergency deceleration ramp.

**7-3 CHECKING 480V 3-PHASE SYSTEM GROUNDING**

As was explained in **Section 3-5**, *PosiDrive* Servoamplifiers can be damaged if they are connected

to ungrounded or asymmetrically grounded 480VAC three-phase power. The following **Test Procedure** described on page 32 will allow you to run a quick check if you are unsure of how the power is set up in your factory. This procedure is somewhat dangerous since it involves testing live, 480 volt circuits. It should only be carried out by a qualified electrician or engineer. A qualified electrician should also be able to confirm the results of this test procedure by inspecting the electrical service equipment that powers your plant.

*Figure 7.1* on the next page shows schematics of the various Acceptable 3-Phase Electrical Systems. The right hand column also shows how to connect an Isolation Transformer to protect the drives if your power system is ungrounded or asymmetrically grounded.

**Table 7.2 - Servoamplifier Warning Codes**

WARNING CODE	NAME	EXPLANATION
n01	I <sup>2</sup> t	I <sup>2</sup> t threshold exceeded.
n02	Regen power	Preset regen power reached.
n03*	FError	Exceeded preset following error window.
n04*	Node guarding	Response monitoring (fieldbus) is active.
n05	Mains phase missing	Supply phase missing.
n06*	Sw limit-switch 1	Passed software limit-switch 1.
n07*	Sw limit-switch 2	Passed software limit-switch 2.
n08	Motion task error	A faulty motion task was started.
n09	No reference point	No reference point set at start of task.
n10*	PSTOP	PSTOP limit-switch activated.
n11*	NSTOP	NSTOP limit-switch activated.
n12	Default values	Only HIPERFACE®:motor default values were loaded.
n13*	Expansion card	Expansion card not functioning properly.
n14	SinCos	SinCos commutation is not determined.
n15-n31	Reserved	Reserved.
n32	Firmware beta version	The firmware is not a released beta version.

\* - These warning messages lead to a controlled shutdown of the drive. (Braking with an emergency ramp.)

## A. Connecting to Different 3-Phase Systems Schematics

On Figure 7.1 you will find all possible connection variations to different Electrical Networks

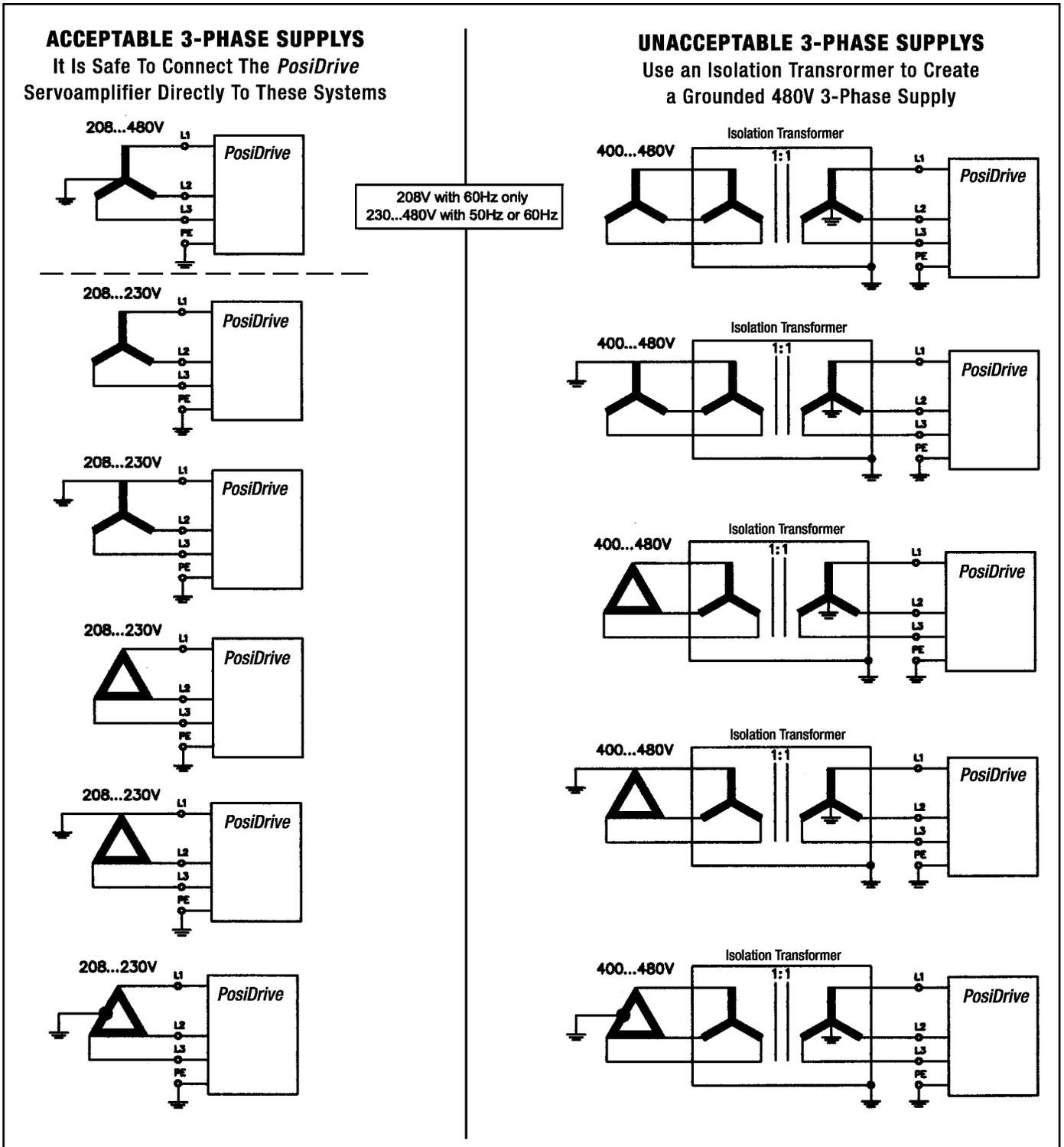


Figure 7.1 - Connecting To Different 3-Phase Systems Schematics

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## **B. Test Procedure For Checking 480 Volt 3-Phase System Grounding**

Sometimes you can tell how a factory power circuit is grounded by measuring the line voltages using both a DVM (digital voltmeter) and a "Wiggy" type solenoid voltage tester. The trick is that the Wiggy will not respond to small leakage currents from line to ground in an ungrounded system, while the DVM will. With grounded systems the two meters will generally agree with each other for all the readings. With ungrounded systems the Wiggy will sometimes find little or no voltage on a wire where the DVM does.

There are confounding factors that can make these tests harder to interpret. One is the presence of connected loads in your factory that create a partial ground reference in an ungrounded system.

1. Measure the line to line voltages using either meter. All three of them should be close to 480VAC. Then measure the line to ground voltages for all three legs using both meters and compare your results to the following examples.
2. If both meters measure 277VAC from line to ground for all three legs, then the system is probably a 480Y/277, three or four-wire circuit. This is a good power supply for the *PosiDrive* servo system.
3. If both meters measure 240VAC from line to ground for two of the legs and about 415VAC on the remaining leg, then your power system is probably delta connected with one phase center-tapped. A drive isolation transformer will be necessary to power the servo system so that the high voltage of the 415VAC "wild leg" will not fry the power supply circuits of the servoamplifier.
4. If both meters measure 480VAC from line to ground for two of the legs and zero volts on the remaining leg, then your power system is either a wye or delta connected circuit with one of the "corners" grounded. You will need to use a drive isolation transformer to power the servo system.
5. If the DVM measures voltage from line to ground for all three legs, but the Wiggy does not find voltage then the power system is ungrounded. The DVM, with its high impedance MOSFET inputs, is responding to small leakage currents that can flow through or around the insulation somewhere in the system. The Wiggy has low input impedance and takes more power to operate than the leakage paths can provide. Some times the voltage readings taken by the DVM will be balance at 277VAC, but it would not be surprising if some were higher and some lower than 277. If you leave the DVM attached to one of the legs and then connect the Wiggy from line to ground on one of the other legs you may see the voltage on the DVM shoot up to 480VAC. You will need to use a drive isolation transformer to power the servo system.
6. If both meters agree on the voltages from line to ground but the voltages are not balanced then the system may be an ungrounded one that is picking up a stray ground reference from one of the other connected loads. This is not a good situation and you should get it fixed. In the mean time you will need to use a drive isolation transformer to power the servo system.

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## **Section 8**

### **ORDERING REPAIR PARTS**

#### **8-1 FACTORY REPAIR SERVICE**

Repair Service is offered by Force Control Industries, Inc. at the factory.

Contact Force Control Industries, Inc. for authorization and shipping instruction before returning a control unit for this service. Force Control cannot be responsible for units returned to the factory without prior notice and authorization.

Care must be given to the packing of returned control units. Always protect the control cabinet by attaching to a skid. Also make sure that any external cables are tied down to the skid. Shipment damage always delays repairs. It is usually impossible to recover damage costs from the carrier. When possible, describe the problem experienced on your shipping papers.

Return to: **Force Control Industries, Inc.**  
**3660 Dixie Highway**  
**Fairfield, Ohio 45014**  
**Phone: (513) 868-0900**  
**Fax: (513) 868-2105**  
**E-Mail: [info@forcecontrol.com](mailto:info@forcecontrol.com)**  
**Web: [www.forcecontrol.com](http://www.forcecontrol.com)**

#### **8-2 ORDERING REPLACEMENT PARTS**

When ordering replacement parts, please specify all of the following information:

1. *PosiDrive* Control Panel Model Number (On the Name Plate.)
2. *PosiDrive* Control Panel Serial Number (On the Name Plate.)
3. Part Reference Number, Part Name and Quantity. (From the Panel Layout, Bill of Material and Schematic furnished with your *PosiDrive* Control Panel)
4. Complete Shipping Information.

Failure to include information for items 1 through 4 will only delay your parts order. Unless another method is specified for item 6, parts weighing less than 150 Lbs. will be shipped United Parcel Service. Parts weighing more than 150 Lbs. will be shipped Motor Freight. Air freight and other transportation services are available but only if specified on your order.

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***Worldwide Leader in Oil Shear Technology***

*Providing Today's Industries With  
Oil Shear Clutch/Brake Drives  
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