# SL™ Series
# AC Brushless
# Axis Servodrive
# User's Manual

## For the SP2K™ Series

Revision 1.3 (6/99)
P/N MNLSL2k-1.3

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*Solutions in Motion*

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# TABLE OF CONTENTS





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# FOREWORD

## Manual Organization

This manual is organized in such a manner to present the relevant and necessary information in an order that will allow the user to get up and running quickly. By reviewing the information chapter by chapter in the order presented, the user is provided with important information in a logical manner.

This chapter, for example, provides information necessary to understand all of the options and configurations available with your SL Series Servo System.

## Typographic Conventions

⚠ **THIS SYMBOL REPRESENTS A CAUTION THAT WARNS OF POSSIBLE INJURY OR DEATH TO PERSONNEL OR DAMAGE TO MACHINERY. WHENEVER THIS SYMBOL IS PRESENT IN THIS MANUAL, IT IS EXTREMELY IMPORTANT THAT THE TEXT ASSOCIATED WITH THE SYMBOL IS COMPLETELY READ AND UNDERSTOOD. THIS WILL HELP AVOID PERSONAL INJURY, DEATH AND/OR DAMAGE TO MACHINES.**

This symbol represents a caution that warns of possible damage to the servodrive or machinery. Whenever this symbol is present in this manual, it is extremely important that the text associated with the symbol is completely read and understood. This will help avoid damage to the servodrives, motors and machinery.


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# SYSTEM COMPONENTS

This chapter provides an overview of the system configurations that make up the SL series servos for the SP2k.

## SL Series Power/Drive Modules

### Connections for the 97 to 265 VAC SL Series

The SL series products have an input voltage range from 97 to 265 VAC. Note that the motor's achievable top speed is directly related to the AC input voltage. Unless otherwise specified, all SL Series speed versus torque curves were generated based on a 240 VAC, three phase main. Lower than published top speeds can be expected with input voltage mains below 240 VAC or use of single phase power.

| | |
|---|---|
| DC Power Input/Shunt Connector | TB401 (pins 1 and 2) |
| Motor Output Power Connector | TB401 (pins 3,4,5 and 6) |
| Input Power Connector (AC ) | TB401 (pins 7,8,9,and 10) |
| Drive Input Commands Connector | J1 |
| Motor Feedback Connector | J2 |
| Control I/O Connector (HD15) | J11 (Special for SP2k usage) |

### Adjustments

There are no user adjustments on the SL Series Power/Drive Module when used with the SP2k.

### Fault Indicators

The Fault Indicator LEDs provide individual fault indications for all servodrive faults. In addition, a RESET push-button is provided to reset the servodrive manually after a servodrive fault has been cleared.


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The following LED Indications and their descriptions are listed below. For a detailed description of possible causes, refer to Trouble Shooting Guide, Fault Indications.

| Fault Condition | LED # | DESCRIPTION |
|---|---|---|
| FEEDBACK (ENCODER) FAULT | CR15 | Feedback (Encoder) Fault - Loss of an encoder signal. JP-15 on the control board must be removed to allow an Encoder Fault to create a latched fault condition. See J2 - Feedback Connector Encoder Fault, and Control Board Jumper definitions (JP-15) and specifications. |
| RMS | CR9 | RMS current has exceeded the servodrive's rating. |
| SURGE | CR10 | Surge over currents from the servodrive output, usually caused by a short circuit in the output leads. |
| GROUND | CR11 | Motor Ground Fault - Senses non-returning servodrive output currents, usually caused by a servodrive output lead being shorted to ground. |
| LOGIC | CR12 | 1- The sum of the + and - 12V has dropped below 22V.<br>2- The 5V source has dropped below 4.5V. |
| TEMP | CR13 | 1- Excessive servodrive heat sink temperature.<br>2- Excessive motor temperature. See J2 - Feedback Connector Motor Temp Fault, and User Configurable Jumpers. |
| REGEN | CR14 | 1- Excessive regenerative energy from a decelerating load.<br>2- One of the phases of the 3 phase AC input has failed. |


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# User - Configurable Jumpers

## J1 Limit / Enable Jumpers

The J1 connector has the following normally closed pins that must be satisfied for proper operation:

| J1 Pin# | Function /Description |
|---|---|
| 24 | **Normally Closed Negative Limit Input -** When this input is at a CMOS logic high, or allowed to float, all negative command inputs to the non-inverted input J1 pin 2 with respect to the inverted input J1 pin 1 are clamped. This input must be forced low for normal operation. Internal pull-ups will hold this pin at a CMOS (12V) logic high if it is allowed to float. Internal diodes allow for voltages of up to 40V to be applied to this pin when in its high state.<br>Note that this input disables all current in one direction only. The Drive Ready will remain asserted (Drive Ready will remain high, Drive Ready / will remain low). |
| 25 | **Normally Closed Positive Limit Input -** When this input is at a CMOS logic high, or allowed to float, all positive command inputs to the non-inverted input J1 pin 2 with respect to the inverted input J1 pin 1 are clamped. This input must be forced low for normal operation. Internal pull-ups hold the normal condition of this input at a CMOS (12V) logic high if it is allowed to float. Internal diodes allow for voltages of up to 40V to be applied to this pin when in its high state.<br>Note that this input disables all current in one direction only. The Drive Ready will remain asserted. (Drive Ready will remain high, Drive Ready / will remain low). |
| 26 | **Normally Closed Enable Input –** This input must be taken low for normal operation. An internal connection to the SP2k controller's normally-closed watchdog line through the axis control cable continues to satisfy this requirement as long as the SP2k controller CPU is functioning normally. If the controller CPU ceases to function, for example, if it were to lose power, the watchdog line would no longer hold pin 26 low, which would then disable this servodrive. Connecting pin 26 to pin 27 is not recommended, since this would defeat this protection.<br>Note that this input disables all output. |
| 27 | **Logic common** |

The factory default is for J1 pins 24 and 25 to be tied to Logic Common (J1 pin 27). This allows for normal operation when the normally closed Limit jumpers are not used. Internally, the normally closed watchdog line from the SP2k controller is tied to pin 26.

## Fast Power-Up Jumper

Without J1 pin 29 and 30 shorted together, the servodrive has a 1 to 2 second startup delay to allow motion controllers and other system components time to stabilize. After the startup delay time, the Drive Ready signal will be asserted (refer to


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Servodrive Connection Definitions and Specifications). When pins 29 and 30 are shorted together the startup delay is reduced to 100 to 200 milliseconds.

## Control I/O Connector J11

The Control I/O connector brings out the connections needed for a positioning controller to one connector, making multi-axis controller configurations easier to connect. The table below outlines the pin designations for this connector. Refer to J-11 Control I/O connector under *Servodrive Connection Definitions and Specifications* for a complete description and specifications for this connector.

| HD15 (P11) Pin# | Function |
|---|---|
| 1 | Speed/Torque / (Command Signal) Inverted Input |
| 2 | Speed/Torque (Command Signal) Non-Inverted Input |
| 3 | Ground |
| 4 | Z/ reference |
| 5 | Z reference |
| 6 | B/ reference |
| 7 | B reference |
| 8 | A/ reference |
| 9 | A reference |
| 10 | Servodrive Fault Reset / Disable input |
| 11 | Power On output |
| 12 | Fault bit 0 output |
| 13 | Fault bit 1 output |
| 14 | Fault bit 2 output |
| 15 | Fault bit 3 output |

## Control I/O Cable

A High Density cable is available from Westamp for the J11 connector. The cable consists of a matching HD15F connector on one end and a shrouded Phoenix connector for the SP2k on the other. The cable is available in 0.5 to 5 foot lengths. Refer to the drawings section for a cable description drawing.

# Shunt Regulators


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## What are they?

A shunt regulator is a dissipative device used to regulate the bus voltage of the servodrive. The bus is the voltage used by the output IGBT transistors to supply voltage and current to the motor. The output IGBT transistors and associated circuitry have safe operating voltage areas that must not be exceeded for reliable operation.

Under certain situations during deceleration of the motor and load, the motor returns a portion of the kinetic energy stored in the rotating load back to the servodrive. Since the input rectifiers on the servodrive will not allow the excessive voltage to be returned to the AC line, the bus voltage will increase to unsafe levels, if left uncontrolled.

Usually the shunt regulator is a passive device with only minimal power dissipation for control circuits. These control circuits "watch" the bus voltage levels and trigger the shunt IGBT power transistors on when the levels reach a preset level of approximately 375 VDC on the 230 volt series SL servodrives. The power transistor is in series with high power resistors (often supplied by the customer) that dissipate the regenerative energy in the form of the heat they generate.

## You need a shunt regulator if...

There are some "rules of thumb" that can be used to determine if a shunt will be required for a system. These are not absolutes, however. If your system has one or more of the following characteristics, chances are you will need a shunt regulator:

- ⇒ High inertia mismatch between the motor and the load (load being greater).
- ⇒ High mass load.
- ⇒ Low friction in load.
- ⇒ Vertical motion without the use of a counterbalance system.
- ⇒ System doesn’t have a shunt and the servodrive shuts down with a "REGEN" fault during deceleration cycle of the motor.

## Shunt Regulator Specifications


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There are three shunt regulators available for the SL Series drives. The table below outlines specifications for each.

| Part Number | Peak Power (kWatts) | Cont Power (kWatts) | Trigger ON Voltage | Protective Fuses |
|---|---|---|---|---|
| SP2k-SRM-11 | 1.0 | 0.1 | 370-380 VDC | 1 x 3-2/10A Slow Blow |
| SP2k-SRM-12 | 1.8 | 0.18 | 370-380 VDC | 2 x 3-2/10A Slow Blow |
| SP2k-SRM-13 | 2.6 | 0.26 | 370-380 VDC | 3 x 3-2/10A Slow Blow |

## Alternatives to Shunt Regulators

### ➢Additional Bus Capacitance

It is possible for some applications of the 230 volt SL series products that marginally require a shunt regulator to use additional bus capacitors to absorb the energy. If drive faults occur occasionally during some deceleration cycles, then this may indicate that only a small amount of energy is tripping the drive. Just enough to cause a problem sometimes. Experimentation is the best way to determine if additional capacitors will work in your application. For example, adding a 1000-4000 microfarad capacitor to the bus just might do the trick.

**Be careful, though! You'll need to use a capacitor with sufficient voltage for the drive. That means an electrolytic capacitor with a working voltage of no less than 450 VDC at 85$^{o}$C ambient. Using a capacitor rated for anything less could cause irreversible damage to the drive and is a significant fire hazard.**

Once a capacitor of sufficient voltage and capacitance has been obtained, simply connect the positive terminal of the capacitor to the "+" terminal of the Shunt connector (TB401 pin 2) and the negative terminal of the capacitor to the "-" terminal of the Shunt connector (TB401 pin 1).

**WARNING! The capacitor terminals should be covered preventing personnel from touching the dangerous voltages present when the drive is on and for several minutes after it has been turned off.**


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### ➢Tying multiple drives together in multi-axis systems

If your system includes more than one axis, you're in luck! One way to avoid the added expense of shunt regulators is to connect the buses of each drive together as one. This is similar to adding bus capacitors with an added benefit: If one axis is decelerating (returning energy to the drives) while another axis is accelerating or driving the load (drawing energy from the drives), then the energy of the decelerating drive will be used by the accelerating drive.

Note that if this configuration is to be used, then input power MUST be applied to each drive simultaneously!

**Make absolutely certain that the positive terminal of the shunt connector (TB401 pin 2) on each drive is connected together and the negative terminal of the shunt connector (TB401 pin 1) is connected to other negative terminals. Miswiring these terminals will cause irreversible damage to the drive.**

## Using a Shunt Regulator

As shown on the Shunt Regulator Mounting Dimensions drawing (in rear of this manual), the connections between the shunt regulator and the servodrive are two DC Bus Input wires which plug into the two input connector on the shunt regulator chassis, and a smaller three input connector for the plus and minus 12 volt logic power.

The DC Bus Input lines are customarily Red for plus (+) and Gray for minus (-). Note that the plus side of this connector is the one closer to the three-input connector. This is to be the red wire, and is to be connected to the plus side of the SHUNT/DC POWER terminal block on the SL. The gray minus wire is connected to the minus side of the SHUNT/DC POWER terminal block. It is mandatory that the polarity be correct.

The shunt regulator should be located near the servodrive, so


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that the interconnecting wires do not exceed approximately four feet in length. It is also recommended that the bus wires run parallel to each other and separate from other wires, so that the switching transients carried on these wires do not couple to any wires which might be in close proximity. This is to include the logic power wires for the shunt regulator.

The shunt regulator logic portion is powered by plus and minus 12 volts and the customary colors used are green for GND, yellow for + 12 v, and blue for – 12 v. Note that the + 12 v input pin of the logic power connector is nearest the DC Bus Input connector, and that common is the center pin.

Again referring to the Shunt Regulator Mounting Dimensions drawing, the +12 wire connects to J1/P1 pin 10 on the SL; the GND wire to J1/P1 pin 11; and the -12 wire to J1/P1 pin 12. Here also, the polarity must be correct.

**WARNING: Failure to connect the shunt regulator properly can cause irreversible drive damage and WILL VOID YOUR WARRANTY!**

**WARNING: High voltages are present on the shunt regulator module and the Shunt connector on the drive when the drive is on & for several minutes after power has been removed. Appropriate precautions must be taken when working with or near the shunt regulator.**

## Sharing Shunt Regulators

Previously in this chapter, we demonstrated that it is possible to connect the bus connectors of drives together for multi-axis systems for the purposes of obviating the need for a shunt regulator. In some multi-axis applications, however, this may not work due to the excessive energy returned during motor deceleration, or if multiple axes are decelerating simultaneously. The obvious solution is to put a shunt regulator on each axis that is faulting on REGEN (bus over-voltage). Another possibility is to tie all buses together and use one shunt regulator for all drives in the system.


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When tying multiple axes together and using only one shunt regulator, you must consider the total energy returned to the servodrive. The application may call for two separate 100 Watt shunt regulators on two separate axes, or one (1) 160 Watt shunt regulator tied to both axes.


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# GETTING STARTED

This section provides a step-by-step startup procedure. It is designed to give the user all of the necessary steps to commission an SL Series servo system. Each step in this section should be carefully read and completed.

⚠ **WARNING: The following procedures detail working with the drive and its components. Many of the procedures include working with LETHAL voltages. These procedures should be carried out only by qualified engineers or technicians working with the appropriate test equipment. PROPER PRECAUTIONS SHOULD BE TAKEN TO AVOID PERSONAL INJURY OR DEATH!**

## Mounting Instructions

The first step is mounting your new drives in your enclosure. Please use the diagram on the next page to determine the mounting dimensions.


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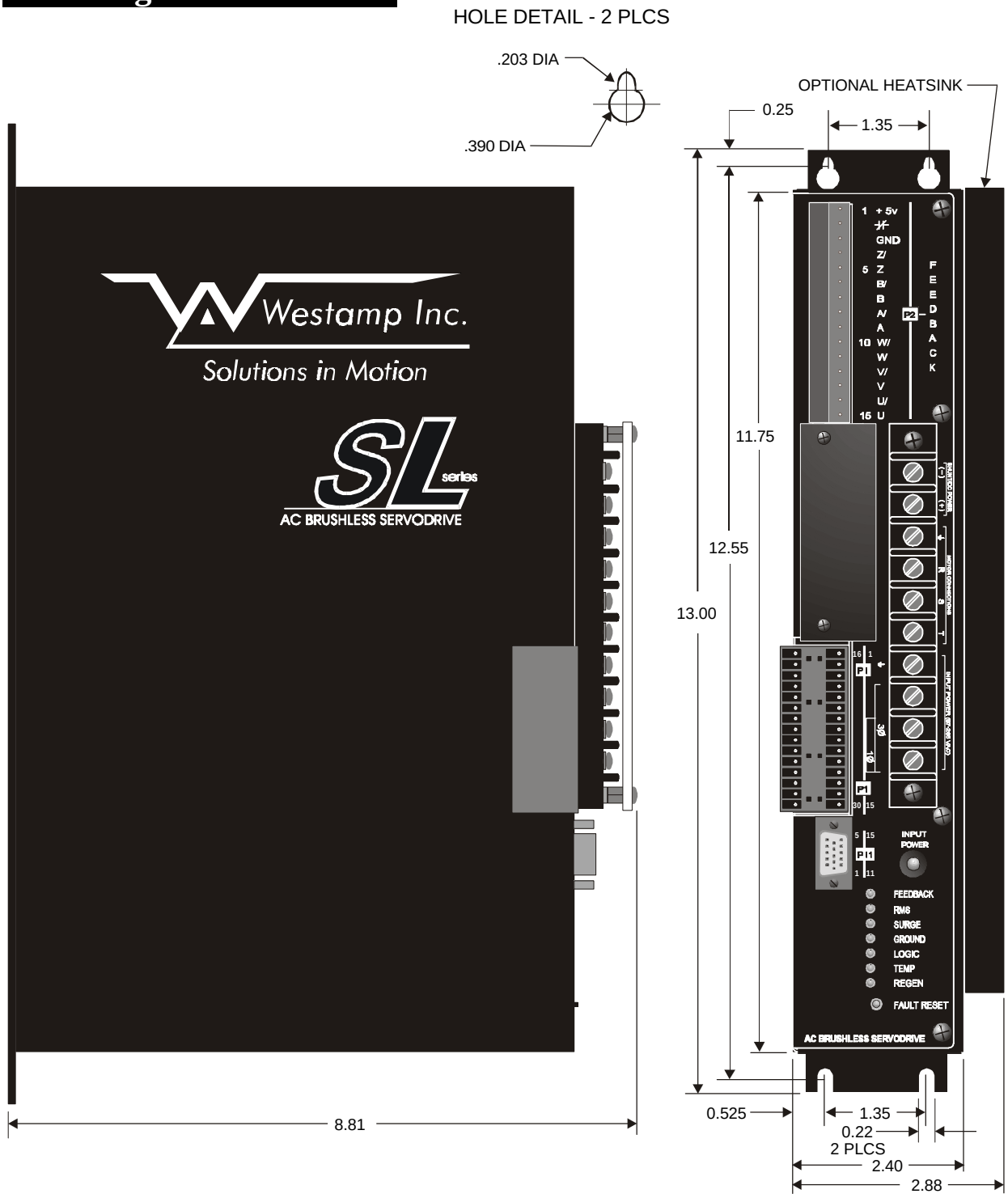
# Mounting Dimensions




All dimensions are in inches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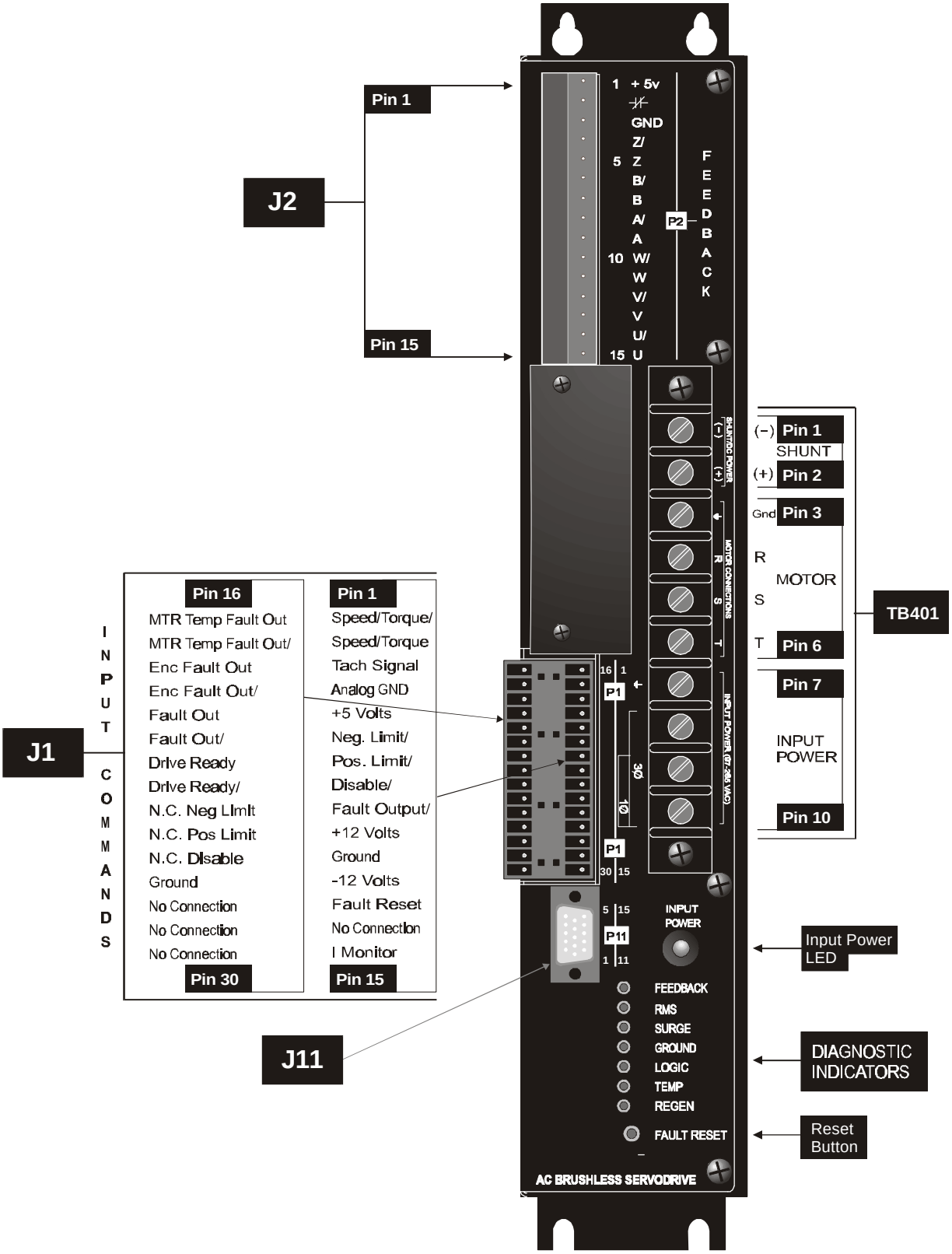
# Making Drive Connections





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## Input Power

Before connecting the power mains to the drive, insure that the voltage and frequency are within the allowable range. The table below shows the allowable ranges for the SL 230 Volt products:

| Drive Series | AC Voltage Range min-max | Frequency (Hz) min-max |
|---|---|---|
| SL 230 volt products Mains & Control | 97-265 | 47-63 |

### ➢SL 230 Volt Product Input Power Connections

The 230 volt SL series combines both the main and the control power on one connector, TB401. Use the illustration below to locate the connector.

Use the following table for main and control power connections:

| | PIN 10 | PIN 9 | PIN 8 | PIN 7 |
|---|---|---|---|---|
| TB401 | Phase A 97-265 VAC Line-Line<br><br>Single phase input A | Phase B 97-265 VAC Line-Line<br><br>Single phase input B | Phase C 97-265 VAC Line-Line | Earth Ground |

### ➢Single Phase Operation

For single phase operation, only phase A and phase B are needed: apply power to Pins 10 and 9 on TB401. Do not apply power to pin 8.

Single phase AC operation requires special consideration to the single phase current capability of the drive, which is lower than the three phase current capability. Due to the differences in the power supply ampacities and the drive output power, this affects only some drives in the SL Series.


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### ➢ Derating For Single Phase Operation

The table below details the effect of single phase operation for each drive and motor combination.

| Drive & Motor | Cont. Power Derating |
|---|---|
| SL10-2-BX-X (all) | 0 |
| SL20-2-BX-X and BR13-402000M | 0 |
| SL30-2-BX-X and BR25-402000M | 10% |
| SL30-2-BX-X and BR34-362000M | 10% |

## Input Power Filtering

Input power quality varies from site to site and from region to region. Westamp drives are designed to tolerate most transients and noise present on power mains. In certain applications, however, it may be necessary to use an input line filter.

### ➢When You Need One

There are certain symptoms that indicate that an input power filter may be useful. If any of the following symptoms persist, then it may be necessary to install an input power filter:

- ⇒ Intermittent REGEN faults
- ⇒ Positioning Module gains or loses position counts
- ⇒ Intermittent RMS faults when operating near zero speed
- ⇒ Positioning Module gets false I/O signals

Attacking the source of the noise or transient is the best way to prevent the problem from affecting other equipment, including the servodrive and the motion controller. There are certain events on, around or near the machine to look for when searching for the source of power line transients and noise.

If any of the above symptoms occur, take note of what happened with other equipment or machinery on, around or near the machine just prior to or during the fault condition. For example, an AC motor starting or stopping, a clutch or brake


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firing, or power contactors opening or closing are excellent power line transient generators.

If the drive symptom can be tied to one of these events, then it may be possible to resolve the problem at the source. Usually, putting a Metal-Oxide Varistor "MOV" on the power line on or near the source will prevent any transients from transmitting all over the power lines.

## ➢How to Specify an Input Power Filter

When specifying an input power filter, the most important factor is the rated voltage and current of the drive. Other factors, such as filter FCC and TUV classifications are important, but really any input filter, irrespective of classification, will be significantly better than no input filter.

The voltage and current, however, are critical. The wrong voltage rating and a dangerous short could develop between the power lines or from the power line to the casing of the filter.

⚠ **ONLY SPECIFY A FILTER THAT IS ENCLOSED IN A CONDUCTIVE METAL CASING. TO REDUCE THE HAZARD OF DEATH BY ELECTROCUTION, THE CASING MUST BE CONNECTED SECURELY TO EARTH GROUND!**

## ➢Minimum Filter Ratings

Use the below table to specify an input power filter's current ratings:

| Drive & Motor | Minimum Filter Rating* |
|---|---|
| SL20-2-BX and BR13-402000M | 3 Amperes |
| SL20-2-BX and BR13-402000M | 3 Amperes |
| SL30-2-BX and BR25-402000M | 5 Amperes |
| SL30-2-BX and BR34-362000M | 5 Amperes |
| SL30-2-BX and BR45-302000M | 10 Amperes |
| SL30-2-BX and BR69-302000M | 10 Amperes |
| SL30-2-BX and BR97-302000M | 15 Amperes |

* All current ratings are line currents based on 3 phase input mains. For single phase filter ratings, multiply above ratings by 1.73.


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## Motor Feedback

Before the drive will function properly, the motor feedback signals must be properly connected. Most startup problems have to do with the feedback signals. The following table shows the pin to pin relationship between the motor feedback connector and the servodrive feedback connector:

| Servodrive J2 Pin Number | Motor Pin Designator | Signal Description |
|---|---|---|
| 1 | K & L | +5 Volts (To Encoder & Thermal Switch) |
| 2 | A | Motor Thermal Switch (normally closed) |
| 3 | Cable Shield & T | Signal Shield & Encoder Common (Ground) |
| 4 | U | Encoder Marker Z/ |
| 5 | M | Encoder Marker Z |
| 6 | C | Encoder Channel B/ |
| 7 | B | Encoder Channel B |
| 8 | P | Encoder Channel A/ |
| 9 | N | Encoder Channel A |
| 10 | H | Commutation Track Channel W/ |
| 11 | G | Commutation Track Channel W |
| 12 | S | Commutation Track Channel V/ |
| 13 | F | Commutation Track Channel V |
| 14 | R | Commutation Track Channel U/ |
| 15 | E | Commutation Track Channel U |


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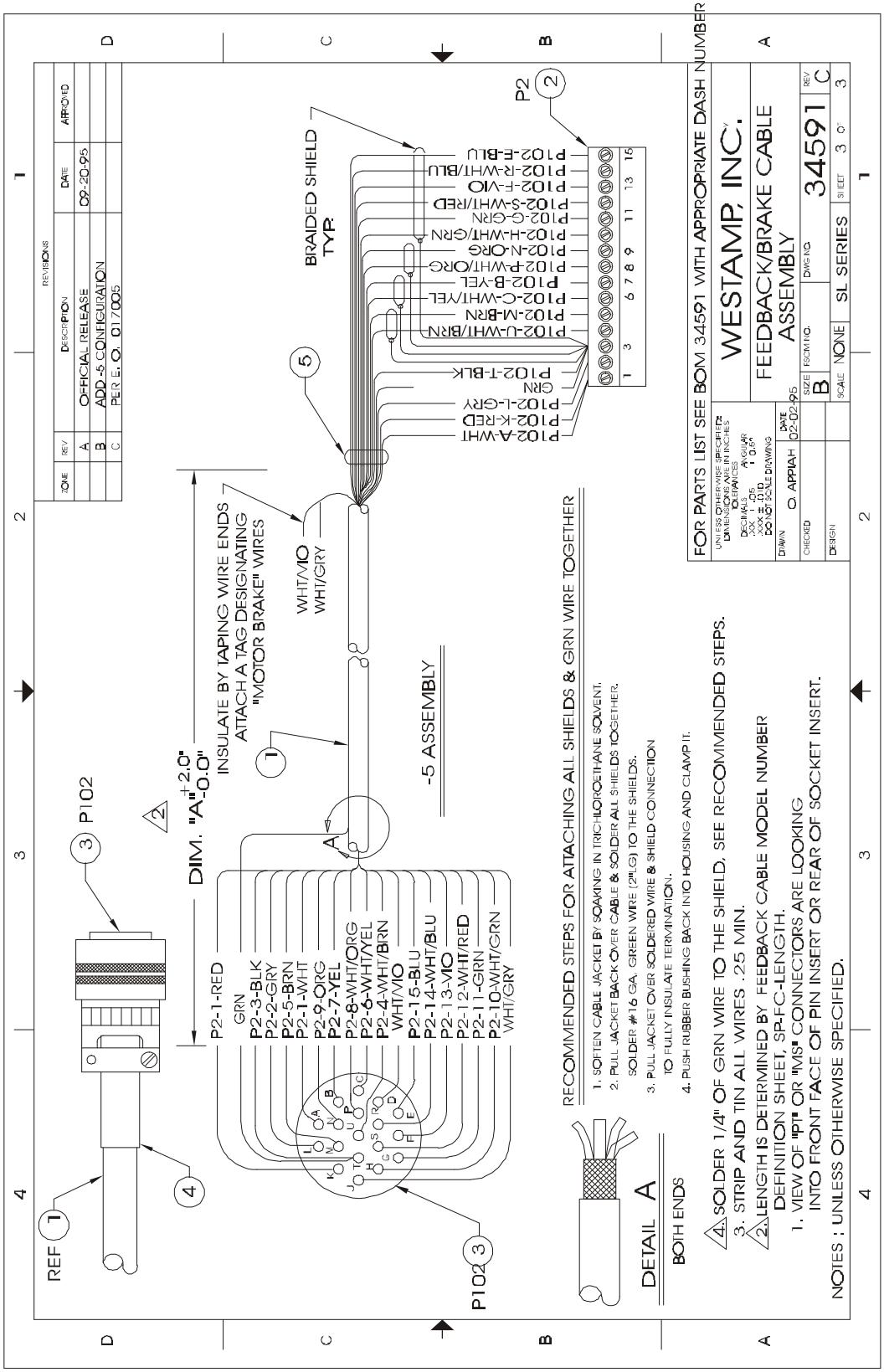


Please use the above drawing as an outline for the feedback cable.

## Motor Power


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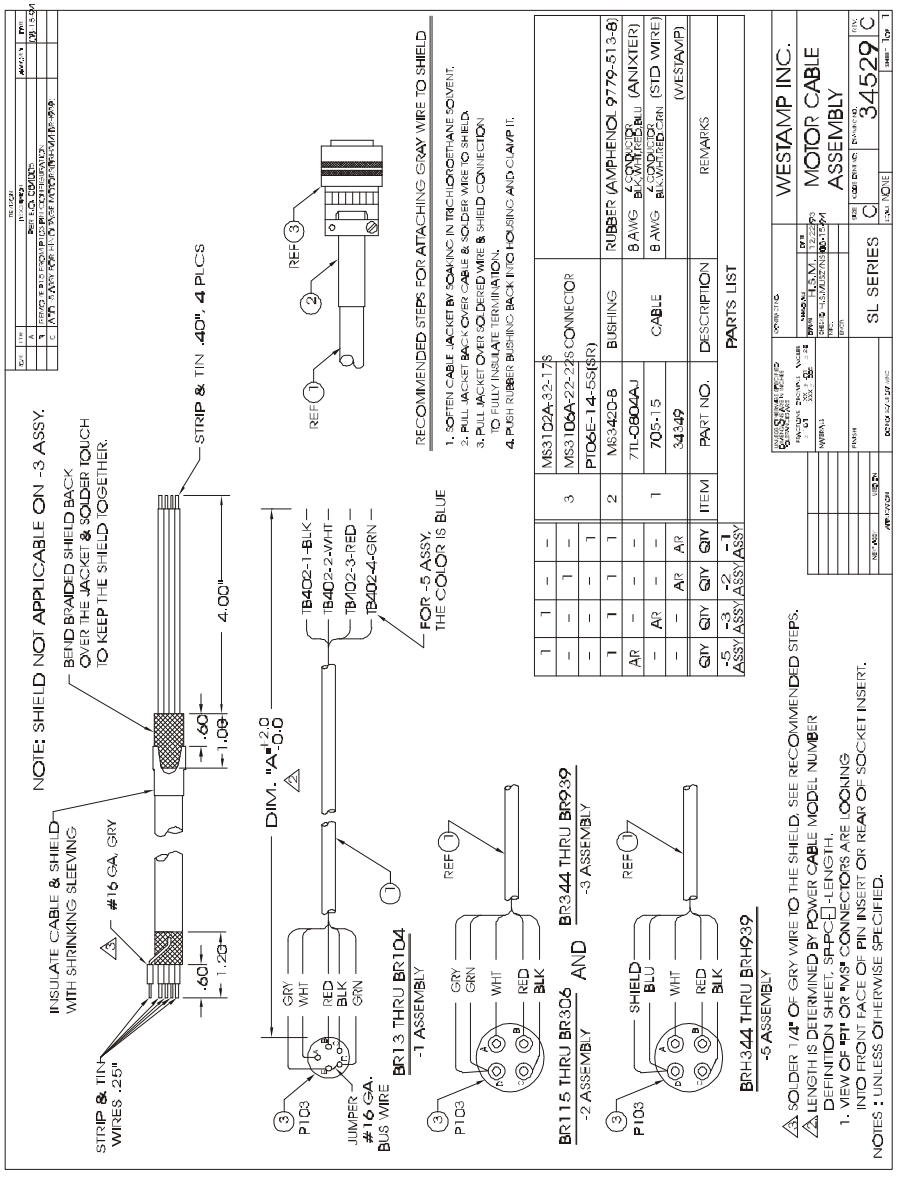
The following table outlines the motor power cable connections to the drive.

| Servodrive TB401 Pin Number | Motor Pin Designator | Description |
|---|---|---|
| 6 | C | Servodrive T Output |
| 5 | A | Servodrive S Output |
| 4 | B | Servodrive R Output |
| 3 | D | Servodrive Case & Cable Shield |





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# Input Command Signals and I/O

## Motor Temperature Fault Configuration

The Motor Temp Fault Open Collector Output and its compliment on J1 pin 16 and 17 are asserted any time the Motor Temperature Fault input on the feedback connector (J2-2) is not pulled to a 5V logic high. Under the Normal configuration, this input is wired on the motor feedback cable to a normally closed temperature sensor within the motor that will open when the motor temperature is excessive. This input can be configured to create a servodrive temperature fault, disabling the servodrive, or to continue operation only asserting J1 pin 16 & 17.

**Note**: Motor operation while the motor temperature rating has been exceeded could damage the motor and void your warranty.

Normal factory configuration is for the motor temperature fault to **Not** disable the servodrive (step 1). If this function is disabled (step 2) the motor temperature output (J1 pin 16 & 17) should be monitored by an external source. If a motor temperature fault occurs, the motor/servodrive should be shut down as quickly as possible to prevent damage to the motor.

The Motor Temperature Fault Normally Closed input (J2 pin 2) can be used with any normally closed contact or logic input that will hold this input at a logic high. If this input is used for something other than the Motor thermal switch, the motor temperature should be monitored elsewhere in the system.

**Note**: Failure to monitor the motor temperature outputs, or motor operation while the motor temperature rating has been exceeded could damage the motor and void your warranty.


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# Limit and Enable/Disable Inputs

## ➢Limit Input Configurations

The J1 Input/Output Commands Connector on the SL Series servodrives allow for both normally open and normally closed limit and enable inputs. The chart below lists the Limit and Enable inputs and their functions.

### J-1 Limit Enable and Disable Input Commands

| J1 Pin# | Function |
|---|---|
| 6 | **Negative Command Signal Input Limit / -** When this input is connected to J1 pin 11, or any other ground, or pulled to a CMOS logic low, all negative command inputs to the non-inverted input J1 pin 2, with respect to the inverted input J1 pin 1, are disabled. Internal pull-ups hold the normal condition of this input at a CMOS (12V) logic high.<br>Note that this input disables all current in one direction only. The Drive Ready remains asserted. |
| 7 | **Positive Command Signal Input Limit /-** When this input is connected to J1 pin 11, or any other ground, or pulled to a CMOS logic low, all positive command inputs to the non-inverted input J1 pin 2, with respect to the inverted input J1 pin 1, are disabled. Internal pull-ups hold the normal condition of this input at a CMOS (12V) logic high.<br>Note that this input disables all current in one direction only. The Drive Ready will remain asserted. |
| 8 | **Servodrive Disable Input**./ - The signal present at this pin will be at +VCC (logical high) when the SL servodrive is operating normally, and at common (logical low) when the SL servodrive has disabled output as a result of a fault condition. Internal pull-ups hold the normal condition of this input as a CMOS (12V) logic high.<br>Note that this input disables all output, and will place the servodrive in a "Not Ready" state when it is asserted (Drive Ready will go low, Drive Ready / will go high). |
| 24 | **Normally Closed Neg Limit Input -** When this input is at a CMOS logic high, or allowed to float, all negative command inputs to the non-inverted input J1 pin 2, with respect to the inverted input J1 pin 1, are clamped. This input must be forced low for normal operation. Internal pull-ups will hold this pin at a CMOS (12V) logic high if it is allowed to float. Internal diodes allow for voltages of up to 40V to be applied to this pin when in its high state.<br>Note that this input disables all current in one direction only. The Drive Ready will remain asserted (Drive Ready will remain high, Drive Ready / will remain low). |
| 25 | **Normally Closed Pos Limit Input -** When this input is at a CMOS logic high, or allowed to float, all positive command inputs to the non-inverted input J1 pin 2, with respect to the inverted input J1 pin 1, are clamped. This input must be forced low for normal operation. Internal pull-ups hold the normal condition of this input at a CMOS (12V) logic high if it is allowed to float. Internal diodes allow for voltages of up to 40V to be applied to this pin when in its high state.<br>Note that this input disables all current in one direction only. The Drive Ready will remain asserted. (Drive Ready will remain high, Drive Ready / will remain low). |
| 26 | **Normally Closed Disable Input -** When this input is at a CMOS logic high ,or allowed to float, all servodrive output will be disabled. This output must be forced low for normal operation. This input is internally pulled low by the SP2k controller's normally closed watchdog line through the axis control I/O cable. If the SP2k's CPU ceases to function correctly, this will cause pin 26 to disable this servodrive. |


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The logical NOT inputs on pins 6, 7, and 8 of the J1 Connector are Normally Open inputs that will become asserted if they are pulled to ground or a logical low. Westamp's default configuration for these inputs is to allow them to float high (No connection).

The Logical Inputs on pins 24 and 25 of the J1 Connector are Normally Closed inputs that will become asserted if they are allowed to float high. These inputs MUST be tied to ground or held at a CMOS logic low for normal servodrive operation. Westamp's default configuration for these inputs is to jumper them to logic common (J1 pin 27). Pin 26 is closed by an internal connection to the watchdog line coming from the SP2k via the axis control I/O cable.

A complete listing of the J1 -Input/Output Commands Connector can be found in the SL Drive Connection Definitions & Specifications portion of this manual.

## Using an External Power Supply for the Encoder

In certain circumstances, it may be desirable to use a power supply other than the drive's internally-developed 5 volt supply. This may be required because encoder power is needed even when the drive is turned off or due to noise generated by the drive that has become apparent on the drive's internally-developed 5 volt power source.

In either case, using an external 5 volt supply is easily accomplished by simply removing the wires on the feedback connector at J2 for +5 volts and Ground on pins 15 and 13, respectively, and connecting them to an external 5 volt source.

The external 5 volt source must be capable of supplying a minimum of 200 milliamperes of current and should be regulated to within ±1% of 5 volts.


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# Before Applying Power...

## Initial Adjustments

There no initial adjustments needed when used with the SP2k.

# Applying Power

As a final check before application of power, insure that the voltage and frequency of the power lines are correct for the drive model.

Apply power to the drive and observe motor operation. If the motor moves quickly to a high speed or operates erratically, turn off the power and check power and feedback cabling (see Troubleshooting Guide).

## Moving the Motor

### ➢With the SP2k Motion Controller

Enter a command to move the axis per the motion controller's instructions. If the motor runs away then change either the polarity of the input signal or the encoder feedback signals between the drive and motion controller.

To change the polarity of the input signal, see *Input Command Signals & I/O* in this manual. To change the encoder polarity switch the A and A Complement with the B and B Complement signals to the motion controller. **NOTE**: It is very important that the wiring from the encoder to the drive remain in compliance with the drawings located in this manual. Any swapping of the A, A Compliment and B, B Compliment must take place between the drive and the motion controller!

If the motor moves under control then phasing between the encoders and input command is correct. If the motor moves erratically or runs away, see the *Troubleshooting Guide* in this manual.


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If an external motion controller is used and the motor moves under control, but positive commands from the controller generate moves in a direction opposite the requirements of the application, then the feedback and command signals must be re-phased. This can be accomplished by switching the "A" and "B" encoder channels between the drive and the motion controller and switching the input command polarity. Remember, the encoder signals must NOT be swapped between the motor and the drive, so the above swap will have to take place between the drive and the motion controller.


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# TUNING

All tuning for this servodrive is accomplished through the use of the SP2k controller in the master drive. Refer to the documentation for the SP2k for directions on tuning the SL servodrive.


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# SERVODRIVE CONNECTION DEFINITIONS & SPECIFICATIONS

## J1- Input / Output commands

| Pin# | Function |
|---|---|
| 1 | **Speed/Torque / (Command Signal) Inverted Input** - Used in conjunction with pin 2. This input is the negative input of the Command Signal input when connected differentially, or it may be configured as either the Non-Inverted Command Signal input return (common), or the Inverted Command Signal input when connected single-ended. The gain for this input is set at 10 volts equal peak current.<br><br>**Single-ended input:**<br>For single-ended input, the signal is applied to J1-1 with respect to common (J1-2 or J1-4).<br><br>**Differential Input:**<br>For differential input, the signal is applied between J1 pin 1 and J1 pin 2. This pin(J1-1) becomes the negative input of the differential input command. |
| 2 | **Speed/Torque (Command Signal) Non-Inverted Input** - Used in conjunction with pin 1, this input is the positive input of the Command Signal input when connected differentially, or either the Non-Inverted Command Signal input, or the Inverted Command Signal input return (common) when connected single-ended. The gain for this input is set at 10 volts equal peak current.<br><br>**Single-ended Input:**<br>For single-ended input (Normal Westamp Configuration) the signal is applied to J1-2 with respect to common (J1-1 or J1-4).<br><br>**Differential Input:**<br>For differential input the signal is applied between J1 pin 1 and J1 pin 2. This pin becomes the negative input of the differential input command. |
| 3 | **Tachometer reference signal output** (not an input): Under Normal configuration, this signal is a reference indication of the electronically derived tachometer used by the SL servodrive. It is normally scaled to 1 volt / 1000 rpm for the SL series servodrives. This signal is internally generated. It may be used externally as a speed reference. |
| 4 | **Signal Command Common -** This is a signal ground that may be used to reference only command signal input related circuits. DO NOT USE THIS AS A CURRENT SINK FOR ANY OTHER CIRCUIT. |
| 5 | **+5V** - Up to 500ma is available for external use. |
| 6 | **Negative Command Signal Input Limit / -** When this input is connected to J1 pin 11, or any other ground, or pulled to a CMOS logic low, all negative command inputs to the non-inverted input J1 pin 2, with respect to the inverted input J1 pin 1, are disabled. Internal pull-ups hold the normal condition of this input at a CMOS (12V) logic high.<br>Note that this input disables all current in one direction only. The Drive Ready will remain asserted. |
| 7 | **Positive Command Signal Input Limit /-** When this input is connected to J1 pin 11, or any other ground, or pulled to a CMOS logic low, all positive command inputs to the non-inverted input J1 pin 2, with respect to the inverted input J1 pin 1, are disabled. Internal pull-ups hold the normal condition of this input at a CMOS (12V) logic high.<br>Note that this input disables all current in one direction only. The Drive Ready will remain asserted. |
| 8 | **Servodrive Disable Input**./ - The signal present at this pin will be at +VCC (logical high) when the servodrive is operating normally, and at common (logical low) when the servodrive has disabled output as a result of a fault condition. Internal pull-ups hold the normal condition of this input as |


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| Pin# | Function |
|---|---|
| | a CMOS (12V) logic high.<br>Note that this input disables all output, and will place the servodrive in a “Not Ready” state when it is asserted (Drive Ready will go low, Drive Ready / will go high). |
| 9 | **Fault output / (Latched output) -** The signal at this pin will be at a 12V logic high under normal operation, and will go to common (logic low) when a fault condition occurs. |
| 10 | **+VCC (+12VDC)** - Up to 50ma is available for external use. |
| 11 | **Logic Power Common.** |
| 12 | **-VCC (-12VDC)** - Up to 10ma is available for external use. |
| 13 | **Servodrive Fault Reset input** - On the servodrive, a fault condition can be cleared by pulling this pin from its normal high (+12V) state to common or a logic low, then back to high. A half second delay will occur after this pin is allowed to go high, before the servodrive becomes enabled. Internal pull-ups hold the normal condition of this input at a CMOS (12V) logic high . |
| 14 | **No Connection** |
| 15 | **Current monitor** - This pin provides a voltage proportional to the output current command. It is scaled to + / - 10 volts = + / - full Peak output current of the servodrive. Its accuracy is +/- 10 % at full scale. Note that the signal is not the actual output current, but it is a command for current to the Current loops and is accurate unless the servodrive is saturated. |
| | |
| 16 | **MTR Temp Fault Open Collector Output - (Latched Output) -** The Latched output signal at this pin will be at a common (logic low) under normal operation, and will go to a CMOS logic high when a motor overtemperature condition occurs (The thermal switch within the motor opens). This requires that the motor's Normally Closed thermal switch be tied between pins 1 (+5V) and 2 (Motor Temp Input) of the J2 feedback connector. (see J2-Feedback Connector Definition and specifications). |
| 17 | **MTR Temp Fault Open Collector Output / - (Latched Output) -** The Latched Output signal at this pin will be at a CMOS logic high under normal operation, and will go to common (logic low) when a motor overtemperature condition occurs (The thermal switch within the motor opens). This requires that the motors Normally Closed thermal switch be tied between pins 1 (+5V) and 2 (Motor Temp Input) of the J2 feedback connector. (see J2-Feedback Connector Definition and specifications). |
| 18 | **Enc Fault Open Collector Output - (Latched Output) -** The Latched output signal at this pin will be at a common (logic low) under normal operation, and will go to a CMOS logic high when a loss of one or more encoder signals at the J2 feedback connector occurs. (see J2-Feedback Connector Definition and Specifications).<br>If a servodrive fault/shutdown is NOT desired when a Encoder Fault condition occurs, the JP-15 jumper on the Control Board must be installed. If the JP-15 Jumper is not installed, the Enc Fault condition will disable the servodrive, creating a combination of a servodrive logic and a servodrive temperature fault. |
| 19 | **Enc Fault Open Collector Output / - (Latched Output) -** The Latched Output signal at this pin will be at a CMOS logic high Under normal operation, and will go to common (logic low) when a Loss of one or more encoder signals at the J2 feedback connector occurs. (see J2-Feedback Connector Definition and Specifications).<br>If a servodrive fault/shutdown is NOT desired when an Encoder Fault condition occurs, the JP-15 jumper on the control board must be installed. If the JP-15 Jumper is not installed, the Enc Fault condition will disable the servodrive, creating a combination of a servodrive logic and a servodrive temperature fault. |
| 20 | **Fault Open Collector output - (Latched Output) -** The Latched Output signal at this pin will be at a signal common (logic low) under normal operation, and will go to a CMOS logic high when a fault condition occurs. |
| 21 | **Fault Open Collector output / - (Latched Output) -** The Latched Output signal at this pin will be at a CMOS logic high under normal operation, and will go to common (logic low) when a fault condition occurs. |
| 22 | **Drive Ready Open Collector Output -** The signal at this pin will be at a signal common (logic |


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| Pin# | Function |
|---|---|
| | low) when the servodrive output is disabled and will go to a CMOS logic high when the servodrive is operating. Note that when a Negative or Positive Limit occurs, which blocks output in one direction only, the servodrive will stay in the "Drive Ready" condition. (This pin will remain high). |
| 23 | **Drive Ready Open Collector Output / -** The signal at this pin will be at a CMOS logic high when the servodrive output is disabled and will go to a common (logic low) when the servodrive is operating. Note that when a Negative or Positive Limit occurs, which blocks output in one direction only, the servodrive will stay in the "Drive Ready" condition. (This pin will remain low). |
| | |
| 24 | **Normally Closed Neg Limit Input -** When this input is at a CMOS logic high, or allowed to float, all negative command inputs to the non-inverted input J1 pin 2, with respect to the inverted input J1 pin 1, are clamped. This input must be forced low for normal operation. Internal pull-ups will hold this pin at a CMOS (12V) logic high if it is allowed to float. Internal diodes allow for voltages of up to 40V to be applied to this pin when in its high state.<br>Note that this input disables all current in one direction only. The Drive Ready will remain asserted (Drive Ready will remain high, Drive Ready / will remain low). |
| 25 | **Normally Closed Pos Limit Input -** When this input is at a CMOS logic high, or allowed to float, all positive command inputs to the non-inverted input J1 pin 2, with respect to the inverted input J1 pin 1, are clamped. This input must be forced low for normal operation. Internal pull-ups hold the normal condition of this input at a CMOS (12V) logic high if it is allowed to float. Internal diodes allow for voltages of up to 40V to be applied to this pin when in its high state.<br>Note that this input disables all current in one direction only. The Drive Ready will remain asserted. (Drive Ready will remain high, Drive Ready / will remain low). |
| 26 | **Normally Closed Disable Input -** When this input is at a CMOS logic high ,or allowed to float, all servodrive output will be disabled. This output must be forced low for normal operation. This input is internally pulled low by the SP2k controller's normally closed watchdog line through the axis control I/O cable. If the SP2k's CPU ceases to function correctly, this will cause pin 26 to disable this servodrive. |
| 27 | **Logic common -** |
| 28 | **No Connection** |
| 29 | **Fast Power-Up Input**. (See pin 30 below) |
| 30 | **Fast Power-Up Input.** Without J1 pin 29 and 30 shorted together, the servodrive has a 1 to 2 second startup delay to allow motion controllers and other system components to stabilize. After the startup delay time, the Drive Ready signal will be asserted. When pins 29 and 30 are shorted together the startup delay is reduced to 100 to 200 milliseconds**.** |
| | |
| N<br>O<br>T<br>E<br>S | **The Open Collector CMOS Outputs** have internal pull-up resistors to 12V, with blocking diodes. If higher voltage levels are required, an external pull-up resistor is needed. This output may be pulled up to 40VDC and source a current of 50 milliamps.<br><br>**The Latched outputs** will permanently latch in the fault state if a momentary fault is sensed. The latched output will remain the fault condition even after the fault disappears. The Fault can be reset by removing and then reapplying logic power, or by creating a Reset. A Reset can be created by momentarily pulling J1-13 to a logic low, and then bringing it or allowing it to float high, or by pressing and releasing the reset button on the Fault Diagnostic Module. |


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## J2 -Feedback Connector

| Pin# | Function |
|---|---|
| 1 | **+5V** - A maximum of 1V is available for external use |
| 2 | **Motor temp input-** input pin for normally closed motor thermal switch (tied from this input pin to +5V).<br><br>The Motor Temperature Fault Normally Closed input (J2 pin 2) can be used with any normally closed contact, or logic input that will hold this input at a logic high. If this input is used for something other than the motor thermal switch, the motor temperature should be monitored elsewhere in the system.<br><br>**Note**: Failure to monitor the motor temperature outputs or motor operation while the motor temperature rating has been exceeded could damage the motor and void your warranty. |
| 3 | **Signal Ground** - use this pin as the ground for the encoder power and other digital signals. |
| 4 | **Encoder "Z" / input -** index or marker channel compliment input. |
| 5 | **Encoder "Z" input** - index or marker channel input. |
| 6 | **Encoder "B" / input** - Encoder data channel B compliment input. |
| 7 | **Encoder "B" input** - Encoder data channel B input. |
| 8 | **Encoder "A" / input** - Encoder data channel A compliment input. |
| 9 | **Encoder "A" input** - Encoder data channel A input. |
| 10 | **Hall "W" / input** - Hall W complement input. |
| 11 | **Hall "W" input -** Hall W input. |
| 12 | **Hall "V" / input** - Hall V complement input. |
| 13 | **Hall "V" input** - Hall V input. |
| 14 | **Hall "U" / input** - Hall U complement input. |
| 15 | **Hall "U" input** - Hall U input. |

## TB401 - Power / Motor Connector:

| Pin# | Function |
|---|---|
| 1 | **Shunt/power - (minus) -** Negative DC bus. Use this connector for the negative side of the shunt regulator, if needed. On a multi-axis servodrive, this would be the negative bus output for a servodrive with internal bus, or a negative bus input for servodrives without a bus supply . |
| 2 | **Shunt/power + (Plus) -** Positive DC bus. Use this connector for the positive side of the shunt regulator, if needed. On a multi-axis servodrive, this would be the positive bus output for a servodrive with internal bus, or a positive bus input for servodrives without a bus supply. |
| 3 | **Motor Case Ground**: - When using Westamp cables, this is the Green wire. |
| 4 | **Motor Terminal "R"** - When using Westamp cables, this is the Red wire. |
| 5 | **Motor Terminal "S**" - When using Westamp cables, this is the White wire. |
| 6 | **Motor Terminal "T"** - When using Westamp cables, this is the Black wire. |
| 7 | **Input Power GND -** Use this connector for the AC power input ground. |
| 8 | **Phase "C" 97-265VAC**. - Use this connector for 3 phase operation. This connector is not used on single phase operation. |
| 9 | **Phase "B" 97 - 265VAC**. - Use this connector for 3 phase or single phase operation. |
| 10 | **Phase "A" 97 - 265 VAC** - Use this connector for 3 phase or single phase operation. |


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## J11 -Control I/O Connector

| Pin# | Function |
|---|---|
| 1 | **Speed/Torque / (Command Signal) Inverted Input** - Used in conjunction with pin 2. This input is the negative input of the Command signal input when connected differentially, or may be configured as either the Non-Inverted Command signal input return (common), or the Inverted Command Signal input when connected single-ended. The gain for this input is set at 10 volts equal peak current.<br><br>**Single-ended input:**<br>For single-ended input, the signal is applied to J1-1 with respect to common (J1-2 or J1-4).<br><br>**Differential Input:**<br>For differential input, the signal is applied between J1 pin 1 and J1 pin 2. This pin (J1-1) becomes the negative input of the differential input command. |
| 2 | **Speed/Torque (Command Signal) Non-Inverted Input** - Used in conjunction with pin 1, this input is the positive input of the command signal input when connected differentially, or either the Non-Inverted Command Signal Input, or the Inverted Command Signal Input return (common) when connected single-ended. The gain for this input is set at 10 volts equal peak current.<br><br>**Single-ended Input:**<br>For single-ended input (Normal Westamp Configuration) the signal is applied to J1-2 with respect to common (J1-1 or J1-4).<br><br>**Differential Input:**<br>For differential input, the signal is applied between J1 pin 1 and J1 pin 2. This pin becomes the input of the differential input command. |
| 3 | **Signal Ground** - use this pin as the ground for the encoder power and other digital signals. |
| 4 | **Encoder "Z" / reference -** index or marker channel compliment reference. |
| 5 | **Encoder "Z" reference** - index or marker channel reference. |
| 6 | **Encoder "B" / reference** - Encoder data channel B compliment reference. |
| 7 | **Encoder "B" reference** - Encoder data channel B reference. |
| 8 | **Encoder "A" / reference** - Encoder data channel A compliment reference. |
| 9 | **Encoder "A" reference** - Encoder data channel A reference. |
| 10 | **Servodrive Fault Reset input** - On the SL servodrive, a fault condition can be cleared by setting this pin high, and then back to low. A half-second delay will occur after this pin is cycled back to low before the servodrive becomes enabled. Internal pull-up resistors hold this pin high.<br><br>**Servodrive Disable Input** - During the time that this pin is high, the servodrive will be disabled. A half-second delay will occur after this pin is pulled low, resetting and enabling the servodrive. |
| 11 | **Drive Power On -** This pin will be at a (12V) logic high when logic power has been applied to the servodrive. |
| 12 | **Fault Bit 0 output** - This signal is part of the four bit data word to indicate the status of the servodrive. Refer to the Fault Bit Status chart (next) for a description of this data word. |
| 13 | **Fault Bit 1 output** - This signal is part of the four bit data word to indicate the status of the servodrive. Refer to the Fault Bit Status chart (next) for a description of this data word. |
| 14 | **Fault Bit 2 output** - This signal is part of the four bit data word to indicate the status of the servodrive. Refer to the Fault Bit Status chart (next) for a description of this data word. |
| 15 | **Fault Bit 3 output** - This signal is part of the four bit data word to indicate the status of the servodrive. Refer to the Fault Bit Status chart (next) for a description of this data word. |

## J11 - Pins 12 to 15: Fault Bit Status Chart


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| MX_3 | MX_2 | MX_1 | MX_0 | | Status |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | | No Faults |
| 0 | 0 | 0 | 1 | | RMS Fault |
| 0 | 0 | 1 | 0 | | Surge Fault |
| 0 | 0 | 1 | 1 | | Ground Fault |
| 0 | 1 | 0 | 0 | | Logic Fault |
| 0 | 1 | 0 | 1 | | Servodrive Temp Fault |
| 0 | 1 | 1 | 0 | | Regen Fault |
| 0 | 1 | 1 | 1 | | Motor Temp Fault |
| 1 | 0 | 0 | 0 | | Feedback Fault |
| | | | | | |
| 1 | 0 | 0 | 1 | | reserved |
| 1 | 0 | 1 | 0 | | reserved |
| 1 | 0 | 1 | 1 | | reserved |
| 1 | 1 | 0 | 0 | | reserved |
| 1 | 1 | 0 | 1 | | reserved |
| 1 | 1 | 1 | 0 | | reserved |
| 1 | 1 | 1 | 1 | | reserved |

Note that the Fault Bit Output is a four bit data word. Along with the Power On output, this 4 bit word can be used to indicate the status of the servodrive. The output data is CMOS (12V) open collector with internal pull-ups. Because of the internal pull-ups, the No Fault State (0 0 0 0) will only be achieved when the servodrive is operating properly and all four lines are forced low.


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# CONNECTORS & CONFIGURATION JUMPERS

## Control Board Jumpers:

| Jumper# | Function |
|---|---|
| JP-14<br>JP-4<br>JP-5 | **A Hall Differential / Single-ended Jumper.**<br>**B Hall Differential / Single-ended Jumper.**<br>**C Hall Differential / Single-ended Jumper**.<br><br>**For use with differential input** on the Halls (Normal Westamp operation), these jumpers are to be removed.<br><br>**If single-ended input is needed** on the Halls, these three jumpers must be installed, and the differential load resistors must be removed from R172, pins 5-6, 7-8, 9-10. If pull-ups are needed for open collector single-ended Hall drivers, R171 may be installed (4.7 k ohms, parallel network resistors). For single-ended Hall operation, only the Hall inputs to the J2 connector , and not their compliments, will be used.<br>(Refer to J2 Feedback).<br><br>Differential input is the Normal Westamp Configuration. Due to the advantages of differential inputs, when connected to the outside world, it is recommended that whenever possible the differential inputs be used. |
| JP-6<br>JP-7 | **A Encoder Differential / Single-ended Jumper.**<br>**B Encoder Differential / Single-ended Jumper.**<br><br>**For use with differential input** on the encoders (Normal Westamp operation) these jumpers are to be removed.<br><br>**If single-ended input is needed** on the encoders, these two jumpers must be installed, and the differential load resistors must be removed from R172, pins 1-2, and 3-4. It is not recommended that open collector encoders be used. For single-ended encoder operation, the encoder inputs to the J2 connector , and not their compliments, will be used.<br>(Refer to J2 Feedback).<br>Differential input is the Normal Westamp Configuration. Due to the advantages of differential inputs when connected to the outside world, it is recommended that whenever possible the differential inputs be used. |
| JP-8 | **Sine / Six Jumper** - For normal Sine Wave operation, this jumper is placed on positions 1 and 2. If Six-Step operation is desired, the jumper should be placed in positions 2 and 3. Westamp's Normal and recommended configuration is for the servodrive to be configured for Sine Wave Operation. (Jumper on pins 1 and 2). |
| JP-14 | **A Hall Differential / Single-ended Jumper**. (see JP-4 and JP-5 above.) |
| JP-15 | **Feedback Encoder Fault Disable Jumper-** If a servodrive fault/shutdown is NOT desired when a Feedback Encoder Fault condition occurs, this jumper must be installed. With this jumper is installed, a Feedback Fault condition will be succeeded by the Feedback Fault Out pins (J1-18 and J1-19), but it will not disable the servodrive. If the JP-15 jumper is not installed, the Feedback Fault condition will disable the servodrive, creating a combination of a servodrive logic and a servodrive temperature fault.<br><br>Normal Configuration is for the JP-15 jumper to be installed. (Encoder fault will not cause a servodrive fault.) |


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# TROUBLESHOOTING GUIDE

The maintenance Procedures described in this manual should be attempted only by highly skilled technicians using proper test equipment. Before starting, read the warranty provisions to prevent voiding your warranty.

When any fault is detected by the servodrive, a qualified technician should determine that all external connections to the servodrive, all signals, and the load are in good working order. Failure to verify that the situation that caused the fault has been resolved before resetting the servodrive can permanently damage the servodrive, motors, and machinery, and may void your warranty!

⚠ **Do not remove any connectors, jumpers, wires, etc., unless the POWER IS OFF!**

## Fault Indications

The table below describes some of the possible causes for LED fault indications:

| LED | POSSIBLE CAUSES |
|---|---|
| (MTR) GROUND | 1 - One or more output wires between the motor and the servodrive is shorted to ground.<br>2 - Breakdown in voltage (dielectric strength) in the output cables (shorted to ground).<br>3 - High parasitic capacitance in the output cables (particularly for long runs).<br>4 - Defective motor.<br>5 - Defective drive. |
| SURGE | 1 - One or more output wires shorted together.<br>2 - Breakdown in voltage (dielectric strength) in the output cables (shorted together).<br>3 - High parasitic capacitance in the output cables (particularly for long runs).<br>4 - Defective motor.<br>5 - Defective drive. |
| RMS<br><br><br><br>RMS (cont) | 1 - Excessive load current caused by mechanical binding or friction.<br>2 - Defective or miswired feedback cable.<br>3 - Defective or miswired power cable.<br>4 - Wrong Personality Module or EPROM installed for the motor being driven.<br>5 - Defective motor.<br>6 - Defective drive. |


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| LED | POSSIBLE CAUSES |
|---|---|
| REGEN with Green power LED ON | 1 - Excessive regenerative energy from decelerating load.<br>2 - Defective shunt regulator or no shunt regulator installed. |
| REGEN with green power LED OFF | 1 - One of the phases of the 3 phase AC input has failed.<br>2- Excessive noise on the AC input lines (see *Input Line Filters* in this manual).<br>3 - Defective drive. |
| TEMP | 1 - Excessive ambient temperature (drive is rated for 50 deg.<br>2 - C)<br>Defective internal fan in drive. |
| LOGIC | 1 - Input voltage out of range (drive is rated for 97-265 VAC, 47-63Hz).<br>2 - Defective drive. |
| FEEDBACK | Feedback Fault - The Feedback fault is an indication of a loss of an encoder signal. JP-15 on the control board must be removed to allow a Encoder Fault to create a latched fault condition. See J2-Feedback connector Encoder Fault, And control board Jumper definitions (JP-15) definitions and specifications. |


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# Troubleshooting Procedures

This section provides additional details about troubleshooting the drive and its components. It is intended to assist the trained technician or engineer in identifying defective system components. It is NOT intended to assist in the repair of any failed components.

| Symptom | Conditions | Possible Causes |
|---|---|---|
| No Output<br>No fault lights | Input power<br>LED NOT ON | Check three phase power input TB401 for proper AC input power. If single phase, insure that the single phase AC inputs are connected to pins TB401 pins 8 (ground), 9, and 10. |
| | Input power<br>LED ON | Insure that the motor feedback and armature cables are properly connected to the motor and servodrive. |
| | | Check J1 for the following voltages:<br>J1-5 = +5V<br>J1-10 = +12V<br>J1-12 = -12V<br>And Check J2 for the following voltage:<br>J2-1 = +5V<br>If any voltages are missing remove the J1 and J2 connectors, and after reapplying power, see if the voltages return. If they return, check for shorts in the cable/wiring. |
| | | Check to insure that the servodrive is not being disabled from an external condition. J1 pin 8 and J1 pin 13 must not be pulled low, or output will be disabled. J1 pin 26 must be pulled low (either by the factory installed jumper from J1 pin 26 to common, or by an external condition if the jumper is removed). Refer to the SL Drive Connection Definitions & Specifications for the J1 Connector. |
| | | Disconnect the motor power connector and manually turn the motor while observing the incremental encoder signals: A encoder signal = J2 pins 8 and 9, B encoder signal = J2 pins 6 and 7. (refer to the J2-Feedback connector description.) There should be a 90 degrees phase difference between the A and B encoder signals. The A NOT should be opposite the A (180 degree out of phase). Likewise, the B NOT should be opposite the B .<br><br>If any of the above signals are missing, recheck the cables for proper wiring. |
| | | Disconnect the motor power connector and manually turn the motor while observing the Hall signals at A Hall, (pins 15 and 14), B Hall (pins 13 and 12) and C Hall (pins 11 and 10). (see the J2-Feedback connector definitions and specifications.)<br><br>There should be 120 degree phase differences between the three Hall signals. The frequency of the Hall signals should be 3 HZ per motor revolution for a six pole motor, and 2 Hz per motor revolution for a four pole motor. If Differential Hall inputs are used, the Not (/) input should be opposite (180 degree out |


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| Symptom | Conditions | Possible Causes |
|---|---|---|
| | | of phase) the logical input. (A Not opposite A, B Not opposite B, C Not opposite C.) |
| | | If the motor configuration being used is different than the factory defaults, insure that the Control Board jumpers are properly configured. Factory Default settings are for Differential Inputs on both Hall and encoder inputs to the J2 Feedback connector. If a different configuration is used refer to the Control Board Jumpers chart under the Connectors & Configuration Jumpers section. |
| | | Replace Motor. |
| | | Replace Servodrive. |
| Erratic Movement motor jumps and kicks | No fault LEDs on | Insure that the motor feedback and armature cables are properly connected to the motor and servodrive. |
| | | Check for loose or broken wires on the J2 Feedback connector |
| | | Check and insure that the servodrive is properly grounded. The AC input Voltage connector pin TB401 pin 7 should be tied to Earth Ground. The servodrive output (Motor Armature) terminal TB401 pin 3 should be tied to the motor case ground. (This is the green wire on the Westamp cable). |
| | | It is recommended that shielded wire is used for the command signals and that differential input is used if your controller supports it. Terminate the shield for the encoder signals at the servodrive (feedback connector) end. Terminate the shield for the Command signals at the controller's end. |
| | | Observe the incremental encoder signals: "A" channel encoder signals are present on J2 pins 8 and 9, "B" channel encoder signals are present on J2 pins 6 and 7. Refer to the J2 Feedback connector description. There should be a 90 degree phase shift between the A and B encoder signals. The "A NOT" should be opposite the A (180 degree out of phase). Likewise, the "B NOT" should be opposite the B. |
| | | Observe the Hall signals on the J2 connector: A Hall = J2 pins 15 and 14, B Hall = J2 pins 13 and 12, C Hall = pins 11 and 10. (refer to the J2 Feedback connector description). There should be a 120 degree phase difference between the A, B, and C Hall (six step) signals. The A Not Hall should be opposite the A Hall (180 degree out of phase). Likewise the B Not and C Not Hall should be opposite the B and C Hall respectively.<br><br>If any of the above signals are missing, recheck the cables for proper wiring. |
| | | Disconnect the motor power connector and manually turn the motor while observing the Hall signals at A Hall, (pins 15 and 14), B Hall (pins 13 and 12) and C Hall (pins 11 and 10). (see the J2-Feedback connector definitions and specifications)<br><br>There should be 120 degree phase differences between the three Hall signals. The frequency of the Hall signals should be 3 HZ per motor revolution for a six pole motor, and 2 Hz per motor revolution for a four pole motor. If Differential Hall inputs |


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| Symptom | Conditions | Possible Causes |
|---|---|---|
| | | are used, the Not (/) input should be opposite (180 degree out of phase) the logical input. (A Not opposite A, B Not opposite B , C Not opposite C) |
| | | If the motor configuration being used is different than the factory defaults, insure that the Control Board jumpers are properly configured. Factory default settings are for Differential Inputs on both Hall and encoder inputs to the J2 Feedback connector. If a different configuration is used refer to the Control Board Jumpers chart under the Connectors & Configuration Jumpers section. |
| | | Temporarily convert the servodrive to the six step mode by removing the left side cover and installing the control board's JP-8 jumper on pins 2 and 3. If the problem clears when the servodrive is in the six step position, the problem is in the encoder/feedback cable/circuitry. Re-inspect/repair the feedback cable. Substitute the motor if one is available. If additional noise immunity is required an external logic supply may be used for the Encoder feedback circuitry. (Refer to the procedure on Using an External Logic Supply for the Encoder listed in the SL Manual). Placing the servodrive in the six step position should be for troubleshooting only. In most circumstances, you will not want to leave the servodrive in Six Step. This will cause poor performance at lower speeds. |
| RMS Fault | RMS LED light is on. | An RMS fault indicates that the servodrive has supplied a current above the RMS rated current of the system for an extended period of time. The RMS fault occurs to protect the servodrive/motor and mechanical system. |
| | | Insure that the load is not oversized. (The load is larger than the motor/ servodrive combination can safely handle.) |
| | | Insure that the motion profile does not have an extreme duty cycle. (The servodrive is pulling current above the RMS level for an excessive period of time.) |
| | | Insure there is no binding or defective mechanical components causing an increase in machine friction. (The servodrive is requested to supply more than normal current because of a mechanical bind. |
| | | The servodrive may not be properly compensated for the load. Recheck the Set - Up Procedure for the tach loop (refer to Set-Up Procedure in this manual). |
| | | The motor could be defective. Replace the motor. |
| | | Replace the servodrive. |
| SURGE Fault | SURGE LED is on | Turn power off and disconnect the motor cable at the servodrive. (TB401 pins 3, 4, 5 and 6 ). |
| | | If the SURGE fault light continues to illuminate after the motor cable has been disconnected at the servodrive end (TB401 pins 3, 4, 5 and 6), and power reapplied, replace the servodrive. |
| SURGE Fault (cont.) | | If the SURGE fault clears when the cable has been disconnected at the motor end (TB401 pins 3, 4, 5, and 6) and power reapplied, reconnect the cable at the motor end and disconnect the motor armature cable at the motor connector. |
| | | If the SURGE fault continues to illuminate after the motor cable has been disconnected at the motor end, the problem is |


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| Symptom | Conditions | Possible Causes |
|---|---|---|
| | | probably the motor cable. Inspect and/or replace the motor cable. |
| | | If the SURGE fault clears when the motor cable has been disconnected at the motor end, but illuminates when the cable is connected to the motor, there is an internal short in the motor. Replace the motor. |
| GROUND Fault | GROUND LED is on | Turn power off and disconnect the motor cable at the servodrive (TB401 pins 3,4,5 and 6 ). |
| | | If the GROUND fault light continues to illuminate after the motor cable has been disconnected at the servodrive end (TB401 pins 3,4,5 and 6) , and power reapplied, replace the servodrive. |
| | | If the GROUND fault clears when the cable has been disconnected at the motor end (TB401 pins 3, 4, 5 and 6) and power reapplied, reconnect the cable at the motor end, and disconnect the motor armature cable at the motor connector. |
| | | If the GROUND fault continues to illuminate after the motor cable has been disconnected at the motor end, the problem is probably the motor cable. Inspect and/or replace the motor cable. |
| | | If the GROUND fault clears when the motor cable has been disconnected at the motor end, but illuminates when the cable is connected to the motor, there is an grounded armature in the motor. Replace the motor. |
| LOGIC Fault | LOGIC fault LED is on | LOGIC fault indicates that the + 5V, -12V, or +12V logic voltage has dropped below the level required to reliably operate the logic circuits of the servodrive. |
| | | Check J1 for the following voltages:<br>J1-5 = +5V<br>J1-10 = +12V<br>J1-12 = -12V<br>And check J2 for the following voltage:<br>J2-1 = +5V<br>If any voltages are missing remove the J1 and J2 connectors, and after reapplying power, see if the voltages return. If they return, check for shorts in the cable/wiring. |
| TEMP Fault | TEMP fault LED is on | A TEMP fault indicates that the heat sink temperature, and thus the output transistor temperature has risen beyond the safe operating range of the servodrive. |
| | | Insure that the ambient temperature (the temperature directly outside of the servodrive) is below 50 degrees C. The servodrive is rated to pull rms. current at 50 degrees C. If the temperature is above this, the ambient temperature must be lowered. |
| | | If the servodrive uses a fan, insure that the fan is working properly. |
| TEMP Fault (cont.) | | Insure that there is room to allow proper ventilation of the servodrive. Do not obstruct the intake or exhaust outlets near the top or the bottom of the servodrive. The module should be mounted vertically, so that air naturally passes through the heatsink from the bottom of the module to the top of the module. |
| FEEDBACK | FEEDBACK | Check that the feedback cable is properly connected at P2. |


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| Symptom | Conditions | Possible Causes |
|---|---|---|
| Fault | LED is on | Check that the motor end of the feedback cable is correctly connected. Verify the feedback cable wiring connections at P2 per the applicable drawing. |
| REGEN Fault (BUS/PHASE) | REGEN LED is on | If a REGEN (bus overvoltage) fault occurs when the servodrive is first turned on, check three phase power input TB401 for proper AC input voltage. Insure that there is power on all three phases. Insure that the voltage is within the range listed for the servodrive. |
| | | If the overvoltage fault occurs during a move, the system may be producing regenerative energy that is being returned to the servodrive. The fault circuitry may be protecting the servodrive by shutting it off to prevent higher regeneration. |
| | | If there is no shunt regulator with the servodrive, it may be necessary to add one. If there is a shunt regulator, check to insure that the fuse has not blown. |
| Motor Slowly rotates With no input command. | Controller position loop open or no position loop. | Insure that there is no input signal command at the J1 connector (J1-1 and J1-2). |
| Motor Runs Away | Controller Position loop may be opened or closed. | Check (preferably with an oscilloscope) the signal levels at J1-3, the Tachometer signal monitor, with respect to J1-4, the signal command common (Refer to the J1 connector description). This reference voltage should be proportional to the speed of the motor. (normally scaled to either 0.5V or 1V / 1000 rpm.)<br><br>If there is a jumper on JP-12 inspect/repair the feedback connector as listed above. |


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# DRAWINGS

This section includes all system drawings, such as schematics, assembly drawings and cable drawings.


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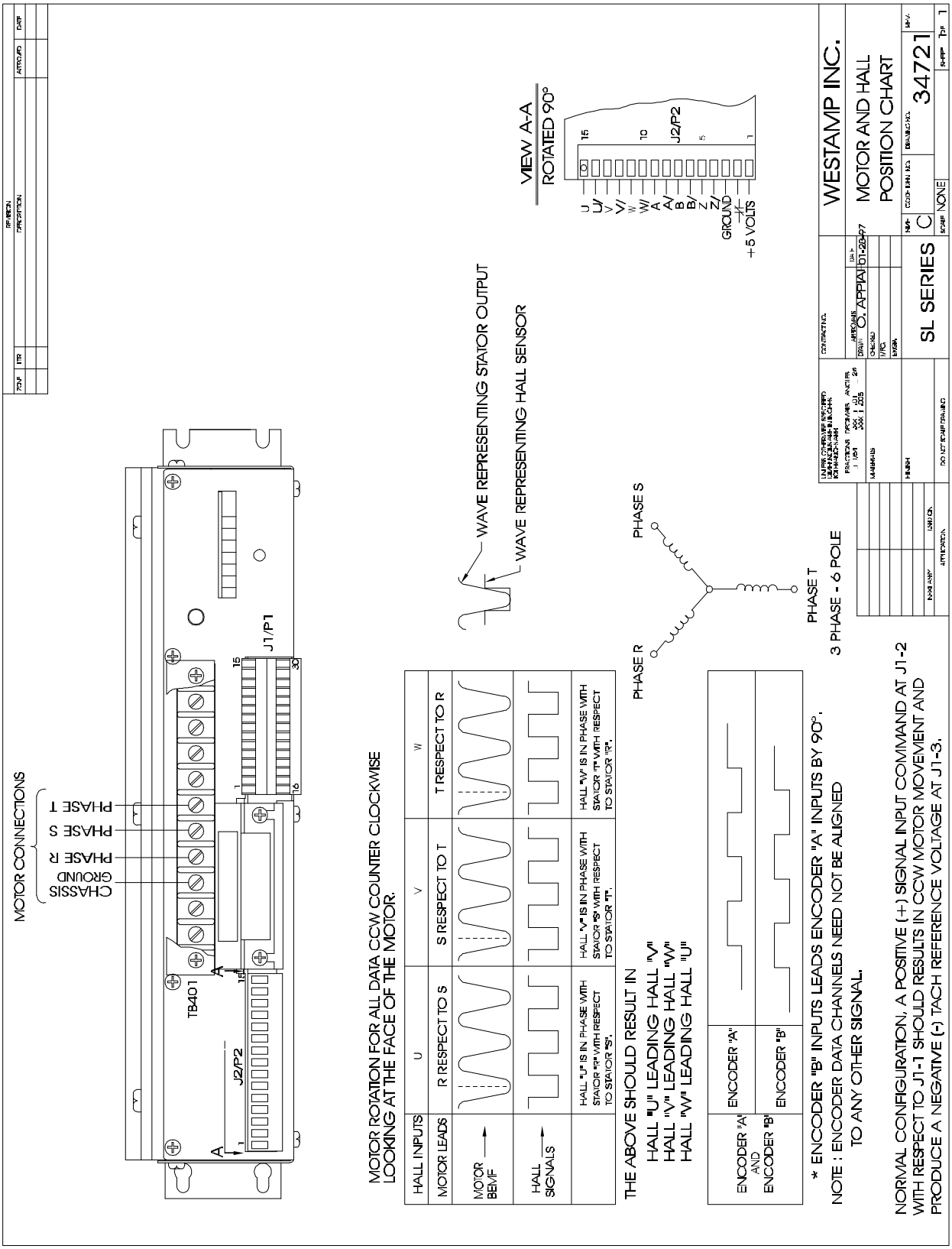
# SL Installation Diagram





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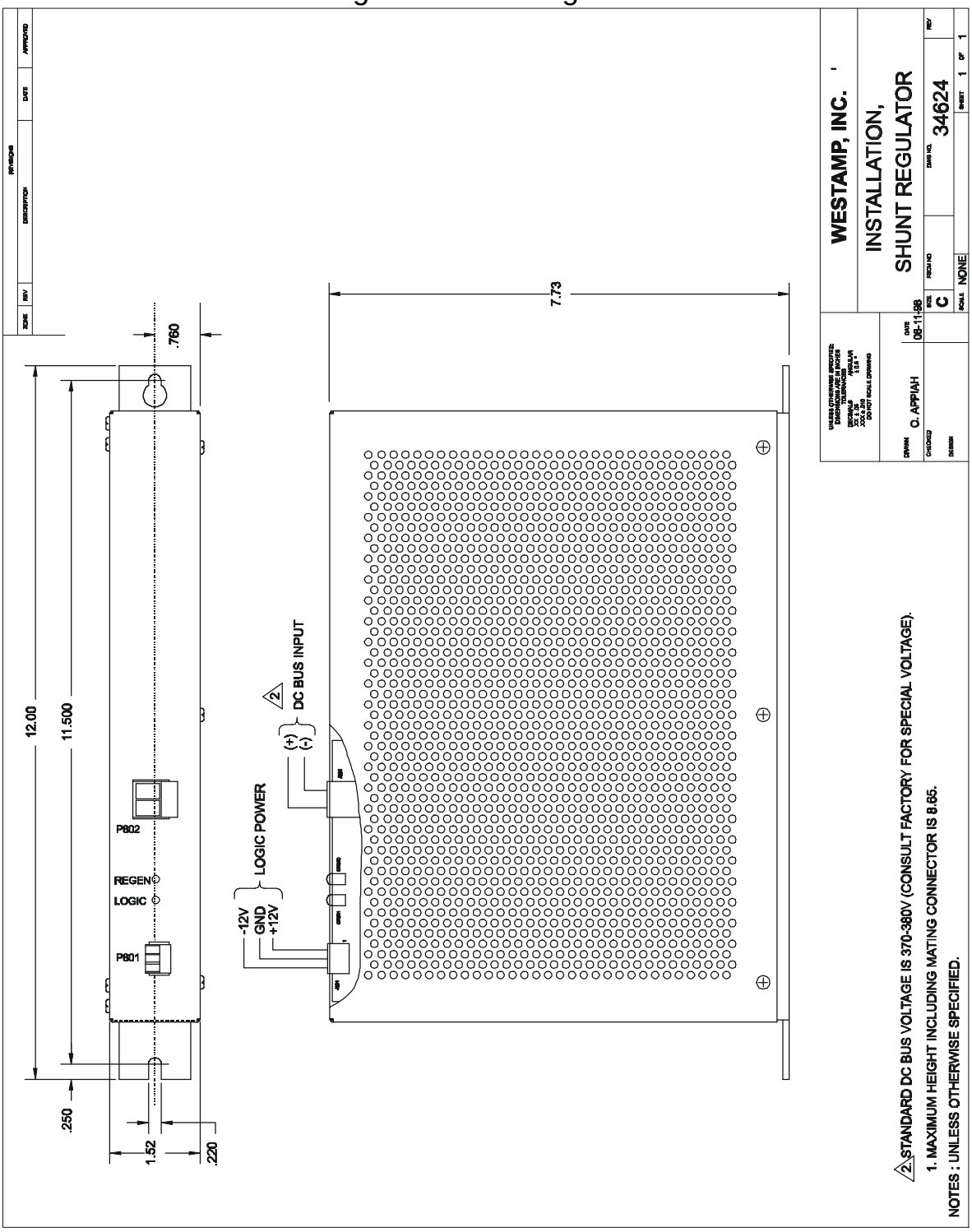
# Shunt Regulator Mounting Dimensions





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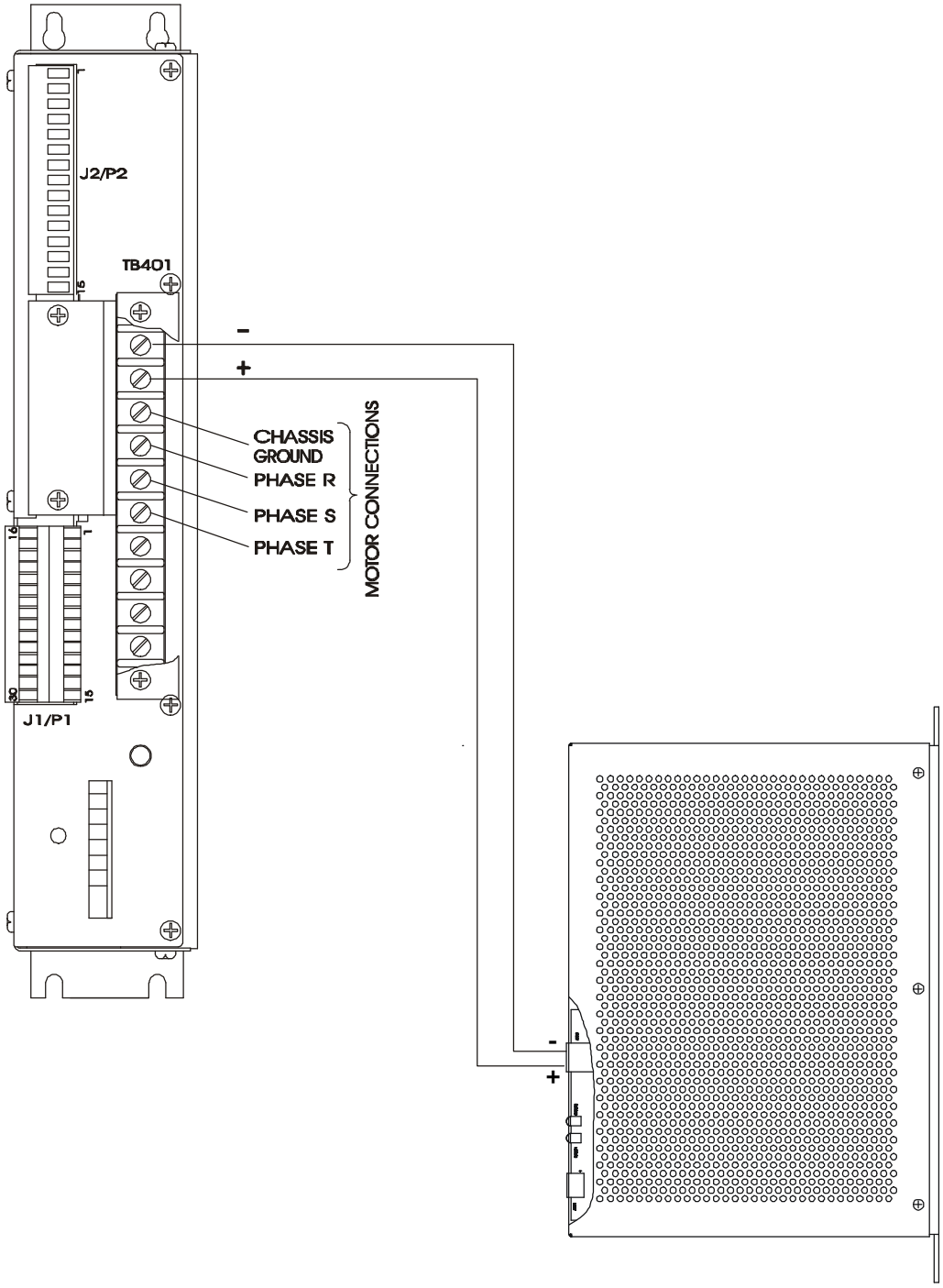
# Shunt/SL Installation





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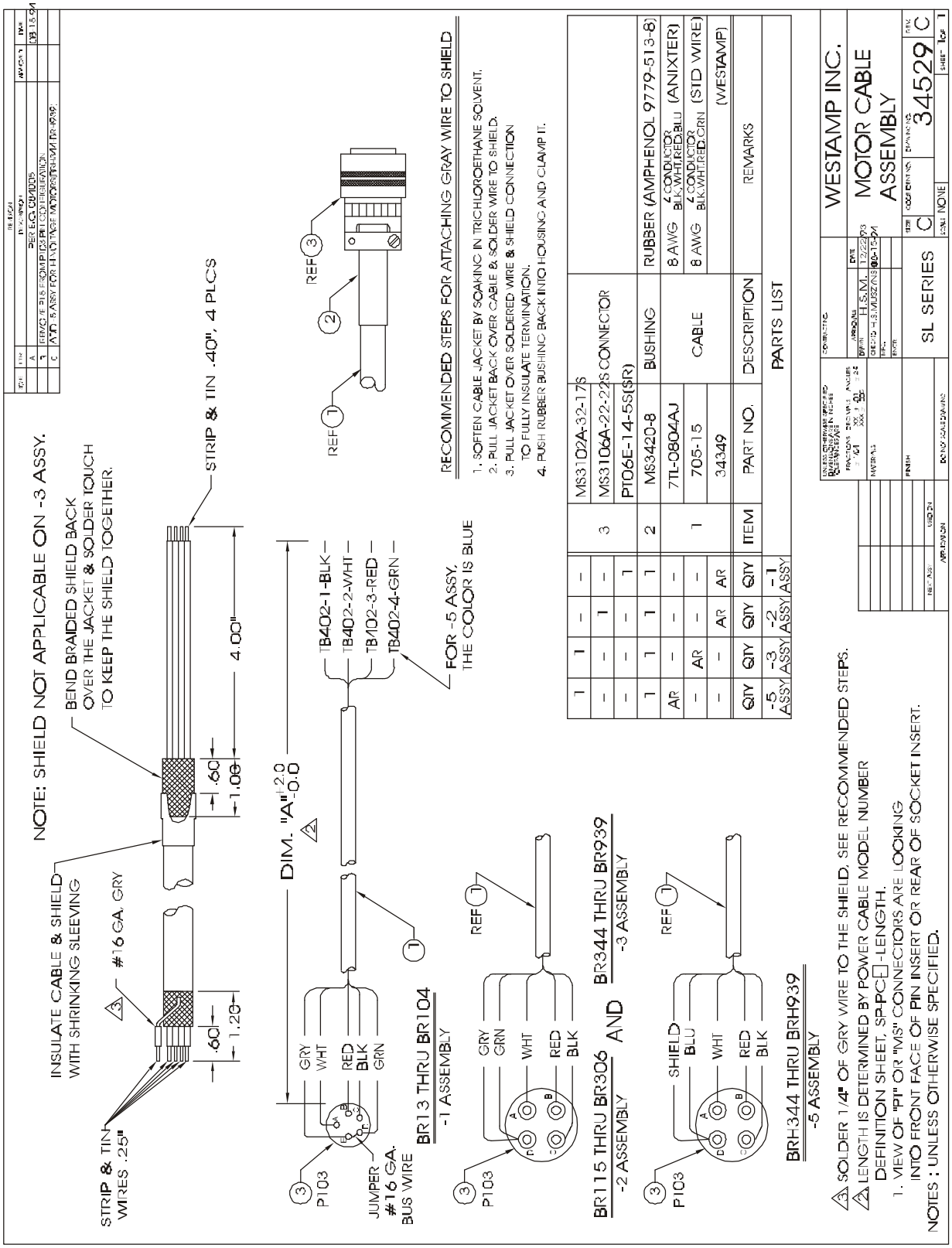
# Motor Power Cable Assembly





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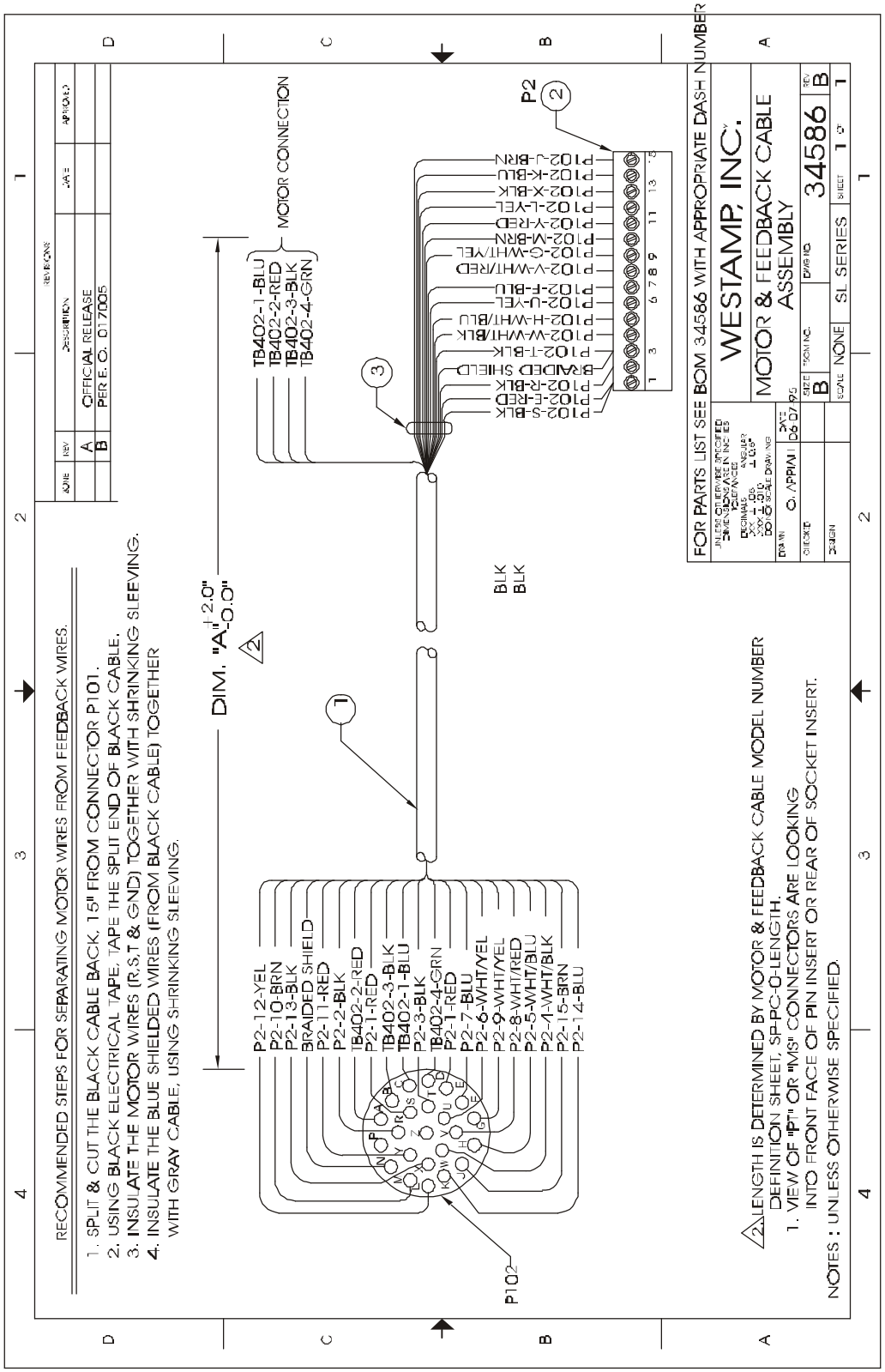
# Motor Feedback Cable Assembly





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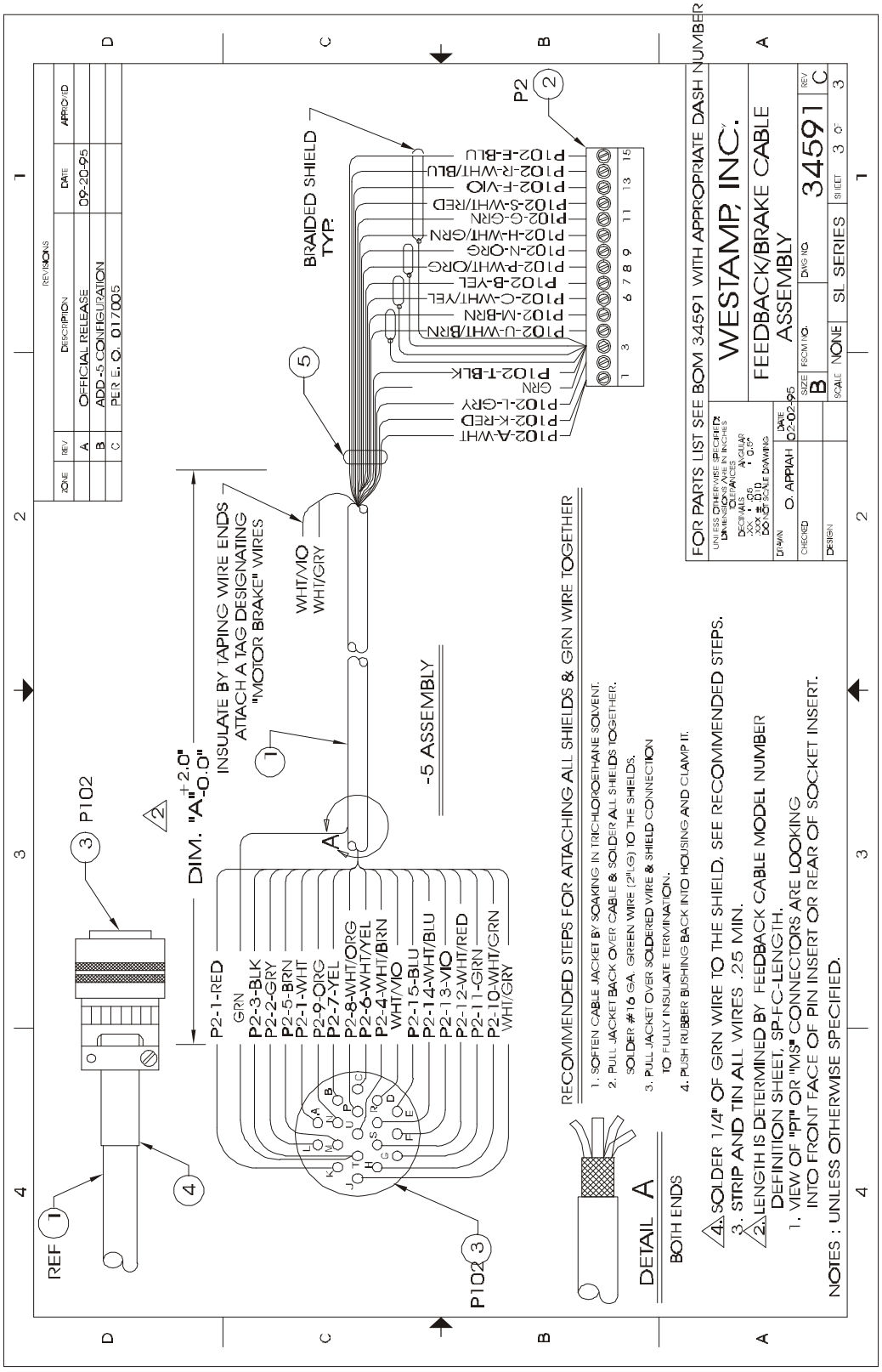
# Motor Feedback w/Brake
# Used Only w/SL-PC-2 Power Cables





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