SV2000 SERIES
DIGITAL BRUSHLESS POSITIONER
INSTALLATION AND CONFIGURATION MANUAL

Revisions

Version. 3.4

1. Changed text for detected problem and action/solution in section A2.2 for the Upper and Lower travel cutoff warnings to indicate that the warning occurs due to the command exceeding the cutoffs, not the actuator position.
2. In Appendix 1, Specifications, added specification for maximum customer load for the internal +/-10V power supply.
3. Fixed errors on Figures 5.3.4a, 5.3.4b, 5.3.4c, 5.4.1, 5.4.3, 5.5a, 5.5b, and 5.5c.
4. Removed the Ω symbol in AutoCAD drawings for figures 5.3.1 through 5.6, because the symbol did not print properly in the document. All values are in Ohms unless otherwise specified.
5. Updated Figures 6.2.1 through 15 to reflect the latest software.
6. Updated specifications in Appendix 1.
7. Added communications errors to Appendix 2.
8. Corrected errors in Fig. 5.3.1a and 5.3.1b. Customer connections to TB3-15 and 16 were incorrect on the drawings.
9. Updated the monitor view to show the new monitor window.
10. Provided further description for Rated Current parameter. Beginning with Rev. 9R, the SV determines if the motor is stalled and reduces the foldback current to 70% rated.
11. Modified Fig. 5.1 to properly name Output 3, 4, and 5 and R, S, and T outputs. Also, corrected the wiring table for resolver feedback wiring using EC4 cable.
12. The “Motor short circuit” fault listed in section 15.3 was changed to “Motor over current” to match the faults listed in Appendix A2.1.
13. The maximum allowed heatsink temperature was changed to identify as 90 C in the Detected Problem section of A2.1 for the “HEATSINK OVERTEMPERATURE” fault.
14. Removed specific references in the text to SV2015 and SV2008 models and replaced with a generic term “SV” to refer to all models of the SV2000 series products. Definition was added to definition section (2).

Version. 3.5

1. Added Figure 5.2.
2. Additional information was added to Section 5.3.3.
3. Inserted Appendix A3 to provide setup information when using VRVT for absolute position feedback for startup.
4. Modified dimension information in Figure 4.1a.
5. Added fuse information in Table 4.2.1.
6. Added suggested 4-20 mA isolators in Section 5.3.4 for use in the sourcing mode for position output.
7. Corrected the description of Current Limit Output operation in Section 5.4.2.
8. Specified the Fault Output Contact rating in Section 5.4.1
9. Added suggested RS-232/RS-485 converters in Section 5.5.
10. Added warning in Section 9.2.2 for setting the rated current above the rated motor current.
11. Added note in Section 9.3 about fault contact and fault LED during power up delay.

TABLE OF CONTENTS

1 INTRODUCTION

The unique and fully digital SV Series positioners operate from standard process control inputs allowing for simple retrofits of current fluid power applications. The SV Series positioners can also be used with Exlar's high performance linear and rotary actuators to replace low performance actuators, eliminating problems associated with actuator failures. Position can be controlled proportionally to an analog input signal allowing for simple control from DCS or PLC systems. Resolver feedback from the servo actuator offers reliable, robust, absolute feedback. The SV Series Process Controllers also offer the flexibility of operating with auxiliary linear feedback devices offering full absolute position capability.

Exlar's Windows™ based control software provides a simple-to-use operator interface with which to configure the SV Series for process control applications. Control setup, torque levels, position scaling and tuning parameters are all easily set through this software. PID tuning parameters allow for the combination of drive and motor to be matched to the exact requirements of process control applications.

This manual contains information concerning installation of the SV2000. It also describes the Windows™ based configuration and monitoring interface for the Exlar SV2000 Series of position controllers, which allows the user to configure the SV2000 for stroke length, speed and force, signal characteristics, tuning parameters and application operation parameters.

2 DEFINITIONS

Configuration program - refers to the Windows™ based configuration program used to communicate with the SV2000 for purpose of configuration and monitoring.
Drive - Refers to the SV2000.
Extend - Actuator rod is extending, CW motor rotation (i.e. right hand threaded screw directly driven by motor).
Retract - Actuator rod is retracting, CCW motor rotation (i.e. right hand threaded screw directly driven by motor).
SV – Refers to the various models of the SV2000 series position controllers.

3 SAFETY GUIDELINES

While the SV was designed to provide a level of protection to prevent failures and to minimize hazards to users, the possibility of unexpected motion should be considered by the user. A list of guidelines are provided below.

- Only qualified personnel familiar with the equipment should be permitted to install or maintain it.
- The SV should be installed in accordance with local safety regulations.
- Energy is stored inside the SV and dangerous voltages may exist even when input power is removed. Prior to working on the SV or working in the vicinity of the SV, verify that the voltages have been reduced to acceptable levels. A measurement of the voltage between +Bus (TB4-11) and -Bus (TB4-12) will determine if there are hazardous voltages stored.
- All connections on TB4 should be considered hazardous while high bus voltages exist.
- Be aware that -BUS is not at earth ground. Connecting -BUS to earth ground will result in catastrophic failure.
- Run/Enable should not be considered for safety shutdown. Power should be removed from the SV in emergency situations.

4 INSTALLING THE SV

4.1 Mounting Dimensions

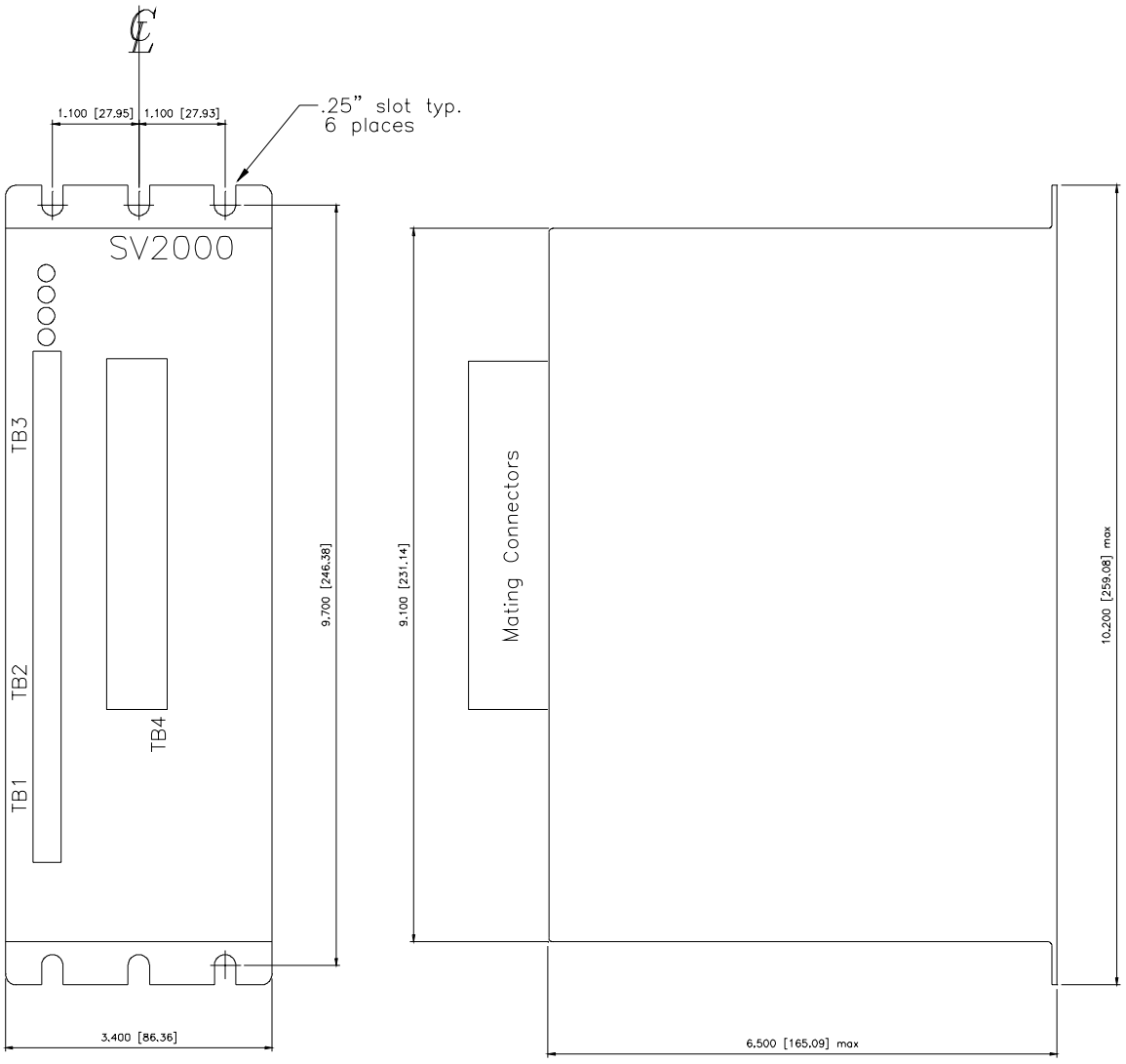


Figure 4.1a - SV Dimensions

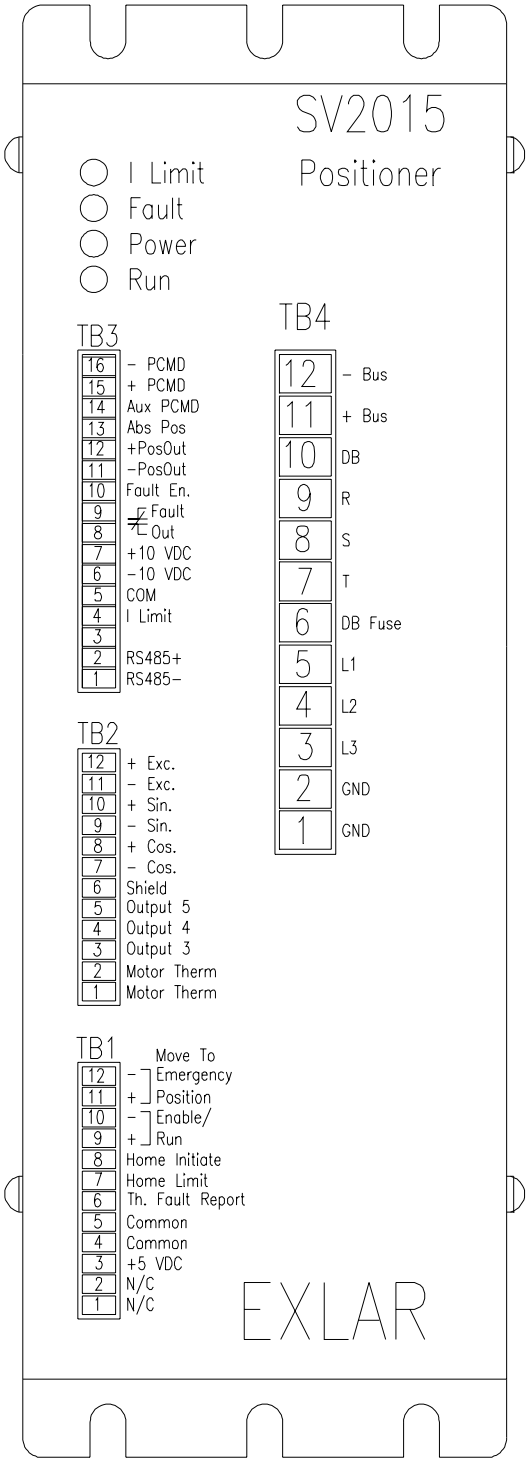


Figure 4.1b - Front view of SV2000

4.2 Startup

The startup procedure is intended to verify that the SV is properly connected and is functioning correctly. This will verify operation without external sources of friction, stiction, ground loops, etc. The suggested procedure is as follows:

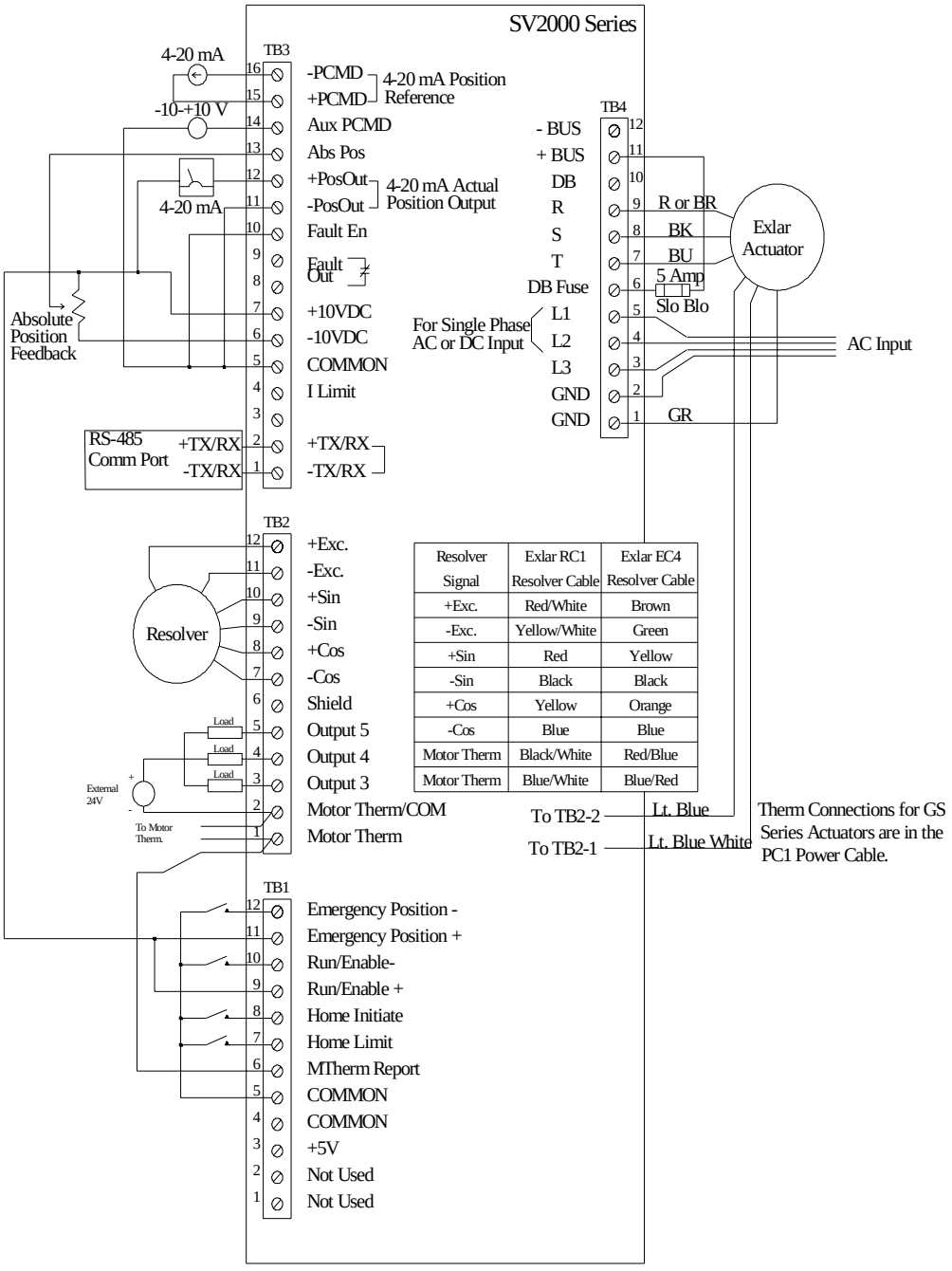
1. Connect the AC Input to TB4-2, -3, -4, and -5 as shown in Figure 5.1.
2. Without making any other connections, apply power to the SV and verify that the Power LED comes on and that the fans are running. Then remove power.
3. Verify that the Power LED and the fans turn off within 5 seconds of removing power and verify that the bus voltage has dropped to below 50V dc by checking the voltage between TB4-11 and TB4-12. Below 50V dc, there is little danger of electric shock. However, there is still sufficient energy stored in the bus capacitors to cause sparks, should a short circuit occur while making connection changes on TB4.
4. With the power off, make the following connections:
   A. Connect the Exlar motor cable between the SV and the Exlar actuator as shown in Figure 5.1.
   B. Connect the RS-485 cable from the PC running the SV Series Configuration Software to TB3 of the SV (refer to section 5.5).
   C. Connect the position reference signal to TB3 (-15 and -16 for 4-20 mA input and -14 and -5 for 10V input).
   D. Connect a jumper wire from TB3-7 to TB1-9, and from TB3-10 to TB3-5.
   E. Connect an enable switch between TB1-10 and TB1-5. If a switch is not available, then connect a jumper wire between TB1-10 and TB1-5. In this case the SV is enabled and disabled by plugging and unplugging TB1. Either disable the Enable switch or unplug TB1.
   F. If there are no motor thermal wires connected to TB2-1 and -2, connect a jumper wire between them. Also, connect a jumper wire from TB2-1 to TB1-6.
5. Apply power to the SV and again verify that the Power LED is on, but the Run LED is off.
6. Start up the configuration software (refer to section 6) and upload the parameters from the drive from the upload/download tab. If parameters do not upload properly, then verify that the communications are set up properly under the Communications menu item.
7. Section 8.1 discusses the motor pole settings and shows a table indicating the number of motor poles for the various Exlar actuators. Verify that the motor pole setting under the Options menu are set correctly.
8. On the Tuning Setup tab, set the "Valve Stroke" and the "Screw Lead" according to the actuator model. Set the extend and retract speeds to mid-range. Set the rated motor current to the rated rms current of the actuator. Set acceleration time to 0. Set the Proportional Gain to 20, Integral Gain to 5, Derivative Gain to 0, the Gain Scaling factor to 1, the Deadband to 0, and the Offset to 0.
9. On the Homing Setup tab, set for "Retract to home". Check the "Do not use resolver 0 home offset" checkbox and set the Home offset to 0. Set Homing Mode to "Home to stall". Set Homing Current to 0 and Homing Speed to 1 in/sec. Note: setting the Homing Current to 0 will cause the actuator to stall right away when the home routine is initiated (when the SV is enabled), and it will consider it's present position to be home. It will then move to the commanded position (from the position reference signal), so be aware that the actuator will try to move within 2 seconds after enable.
10. On the Command Setup tab, set parameters to appropriate values based on the source of the position reference signal.
11. On the Fault Setup tab, clear all checkboxes and set following error to 100%.
12. On Upload/Download, press the Download button to send the changes to the SV.
13. Open the Monitor under the Query menu item and start the Monitor.
14. Disconnect the Exlar actuator such that the shaft can rotate freely. Rotate the shaft clockwise until the shaft is fully retracted.
15. Enable the SV with the Enable switch or by plugging in TB1. The actuator should hold position for about a second and then move to the commanded position. Also, the Run LED should come on. If the actuator does

not move and the monitor indicates a difference between the commanded and actual positions and the current is around the rated motor current setpoint, then there may be a resolver or a motor connection problem, the motor poles was not set properly in step 7, the rated current is too low, or the actuator is binding.

16. Adjust the position reference signal and verify that the actuator follows the reference.
17. Stop the monitor and exit the Monitor Screen.
18. If the actuator has followed the reference signal properly, then the basic connections and operation of the SV and the Exlar actuator have been verified. Now the parameters can be adjusted to provide more optimal control to meet the functionality requirements of the application.

5 Connecting the SV

5.1 Connection Diagram



Resolver Signal	Exlar RC1 Resolver Cable	Exlar EC4 Resolver Cable
+Exc.	Red/White	Brown
-Exc.	Yellow/White	Green
+Sin	Red	Yellow
-Sin	Black	Black
+Cos	Yellow	Orange
-Cos	Blue	Blue
Motor Therm	Black/White	Red/Blue
Motor Therm	Blue/White	Blue/Red

Figure 5.1 – SV2000 Typical Interconnect Diagram

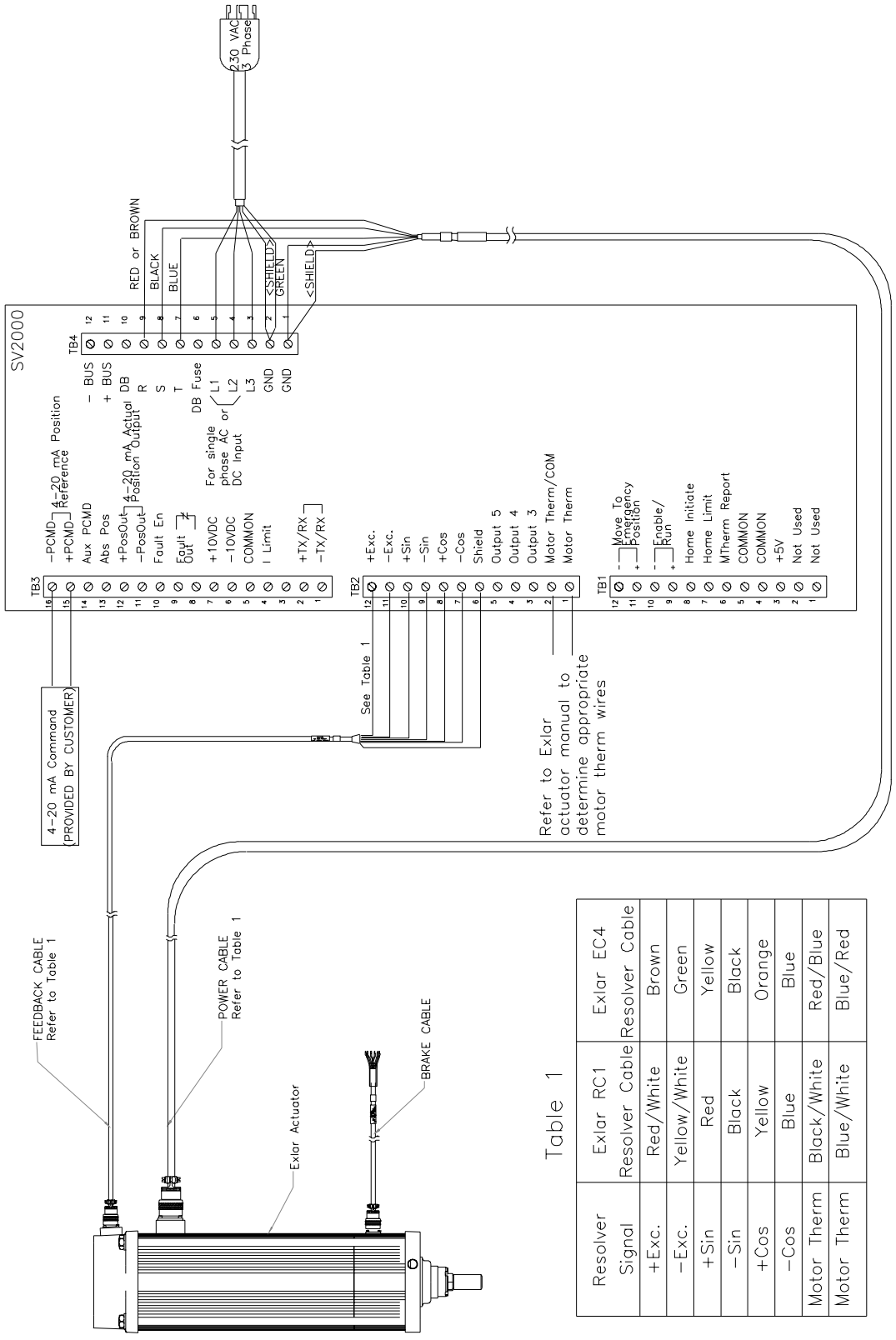


Table 1

Resolver Signal	Exlar RC1 Resolver Cable	Exlar EC4 Resolver Cable
+Exc.	Red/White	Brown
-Exc.	Yellow/White	Green
+Sin	Red	Yellow
-Sin	Black	Black
+Cos	Yellow	Orange
-Cos	Blue	Blue
Motor Therm	Black/White	Red/Blue
Motor Therm	Blue/White	Blue/Red

Figure 5.2: Connecting the SV to an Exlar actuator

5.2 Power Wiring

WARNING – Dangerous voltages may exist on TB4 connections after power is removed. Before connecting or disconnecting wires on TB4 terminals, verify that bus voltage is dropped to a safe level (<50V dc) by measuring voltage between terminal TB4-11 and TB4-12.

5.2.1 Input Power

The SV2000 Series products are designed to operate from a variety of power sources. They accept single-phase and 3-phase AC, as well as, DC. For more details concerning input voltage specifications, refer to the Technical Specifications in Appendix A1.

Power enters the SV2000 through terminals TB4-2, -3, -4, and –5. Terminal 2 is GND and 3, 4, and 5 are power. Each of the power inputs are internally fused with 15 Amp fuses, eliminating the requirement for external fusing. The AC input circuits are also protected from voltage transients on the power line with 250V MOV's. Use terminals L1 and L2 (TB4-4 and -5) for both AC and DC single-phase inputs. When applying a DC voltage, polarity does not matter. However, for consistency, it is recommended that the + line is connected to L1 and the – line to L2.

Fuse Identifier	Function	Fuse Type
F1	Protection for L3 (TB4-5)	3AB 15 Amp, Littlefuse #H314015
F2	Protection for L2 (TB4-4)	3AB 15 Amp, Littlefuse #H314015
F3	Protection for L1 (TB4-3)	3AB 15 Amp, Littlefuse #H314015
F4	Protection for Soft start resistor	MDL ½, 250V SloBlo

Table 4.2.1 - SV2000 Internal Fuses

An internal soft start circuit is provided to limit the input current surge to less than 3.5 Amps peak by connecting a 100 Ohm soft start resistor in series with the bus capacitors during power-up. Once the internal bus capacitors are charged, the soft start resistor is bypassed when the soft start relay contacts close. The soft start resistor is protected by fuse (F4).

A line loss detection circuit monitors power loss between L1 and L2. Line L3 is not monitored. Therefore, for single phase input power, L1 and L2 must be used, with L3 remaining disconnected.

5.2.2 Motor Output

The 3 phases (R, S, and T) plus GND (ground) for the motor are connected on TB4-9, -8, -7, and -1. Shielded motor cables, when used, should have the shields connected along with the GND at TB4-1. The motor output connections are protected against short circuit line-to-line by internal current monitoring circuitry. Short circuit to GND by any phase may result in damage to the SV2000. Short circuit conditions should be carefully checked. Each short circuit incident stresses the output power devices and can result in device failure.

5.2.3 Dynamic Brake

The dynamic brake, also referred to as a shunt resistor, provides a means of dumping energy quickly. This may be required during quick decelerations of the actuator. When a motor is decelerating, the current through the

motor is negative with respect to the voltage, which causes the bus capacitors in the SV2000 to charge. Before the capacitor voltage reaches the maximum voltage, the shunt circuit is turned on, which dumps the energy into a 27 Ohm dynamic brake resistor when the circuit is connected. In many applications, the dynamic brake is not necessary. A dynamic brake is necessary if the SV produces an OVERVOLTAGE fault.

If dynamic braking is required, it is necessary to connect from TB4-11 to TB4-6 through a 5 Amp, slo blo fuse.

5.3 Analog Connections

Three pre-defined analog inputs and one analog output are provided. PCMD and Aux PCMD provide the option of a current or a voltage source for the position reference signal. Abs Pos can be used to provide an absolute position reference voltage that the SV uses to determine position during startup. Finally, the PosOut provides a 4-20 mA output indicating the actuator position.

5.3.1 Position Command Reference (PCMD)

The Position Command Reference receives a 4-20 mA input position reference signal from an external command source. This circuit can be connected to either a sourcing or sinking 4-20 mA command source as shown in Fig. 5.3.1a and 5.3.1b. The 500 Ohm variable resistor is adjusted by the factory to provide proper scaling and is not accessible to the user. PCMD can be selected or de-selected as the input command source by the configuration software. The position command reference is scaled through the configuration software to define the extend and retract positions. Depending on the configuration, the 4 mA position can be defined as the fully extended or fully retracted position.

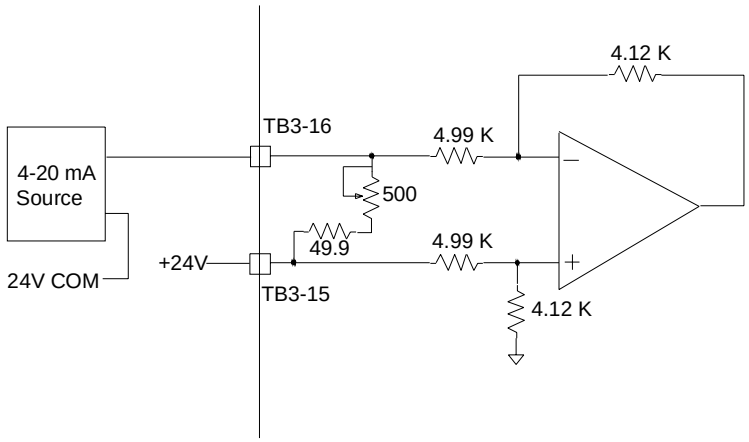


Figure 5.3.1a - PCMD Input Circuit with Sinking 4-20 mA

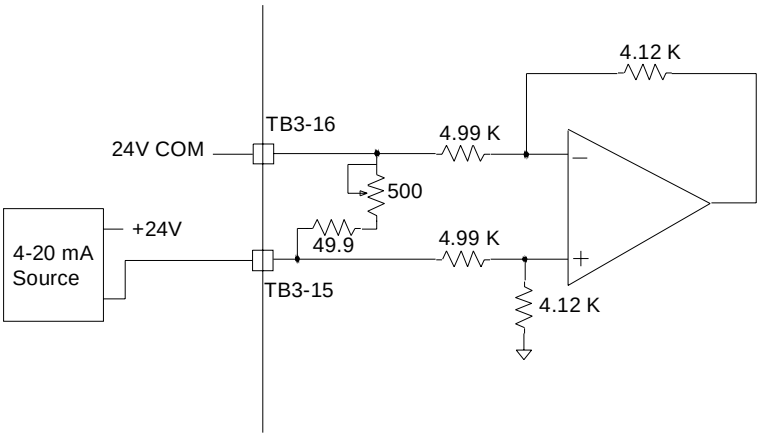


Figure 5.3.1b - PCMD Input Circuit with Sourcing 4-20 mA

5.3.2 Auxiliary Position Command Reference (Aux PCMD)

The Aux PCMD provides a voltage input alternative to the 4-20 mA position command reference. When selected through the configuration software the computed position command will follow the voltage on Aux PCMD. The voltage range is either 0V to10V or -10V to +10V, depending on the SV model selected. The standard model accepts -10V to +10V. The 10V position can be defined as the extend or retract position through the configuration software.

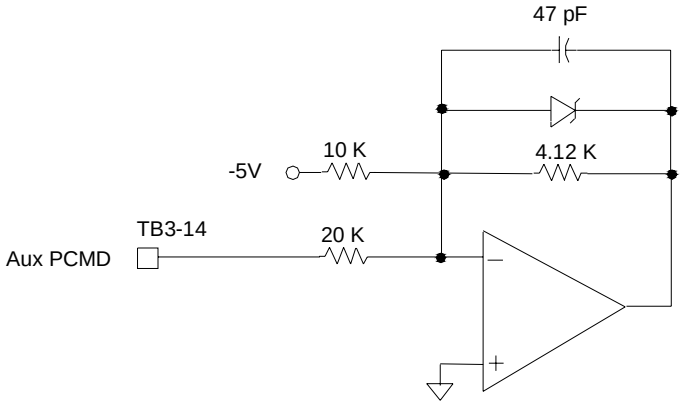


Figure 5.3.2 - Aux PCMD input circuit for Standard Models (-10V to +10V)

5.3.3 Absolute Position (Abs Pos)

Various methods of determining absolute position after powering up the SV is provided (refer to section 11.3). Some applications require the SV to determine the actuator location without requiring motion. For these applications, the absolute position input is provided. The output of an absolute position sensor such as an LVDT, VRVT, or potentiometer can be connected to this input to provide position information. If the SV is configured to "Home using aux analog input," then during power up, the Abs Pos input is used to locate the initial position of the actuator. The input voltage range is 0 - 5 Volts. Voltages outside the range of 0.25 to 4.75V will result in a "LVDT signal loss" fault when "Home using aux analog input" homing mode is selected. For the absolute position to be computed properly, the retract position must be at lower voltage than the extend position. The scaling of the Abs Pos input is discussed in section 11.4. Refer to Appendix A3 for a suggested setup procedure when using a VRVT.

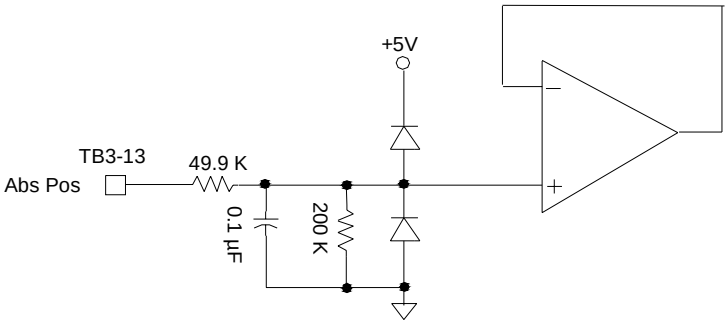


Figure 5.3.3 - Abs Pos Input Circuit

5.3.4 Actual Position Output (PosOut)

The Actual Position Output provides a 4-20 mA signal representing the actual position of the actuator. This closed loop circuit operates with transistor control of the current flow from TB3-12 to TB3-11 monitored through a 49.9 Ω resistive load. The PosOut output circuit will only work properly when connected in the sinking output mode as shown in Figure 5.3.4b. If sourcing configuration is required, then a 4-20 mA isolator (such as a Pepperl & Fuchs model KFD2-CR-1.300) is required.

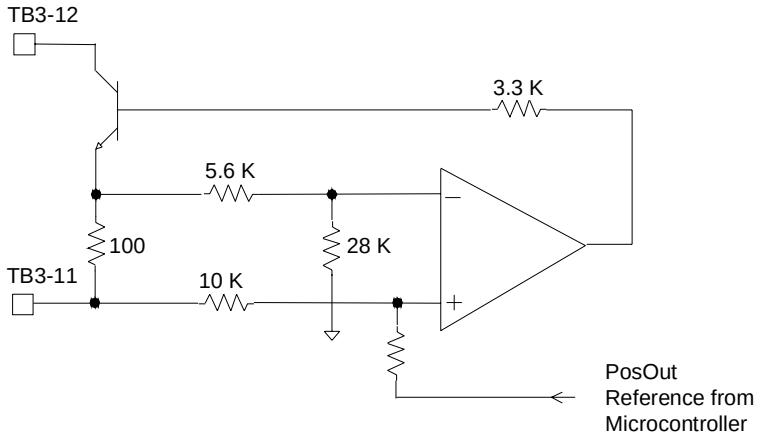


Figure 5.3.4a - PosOut 4-20 mA Output Circuit

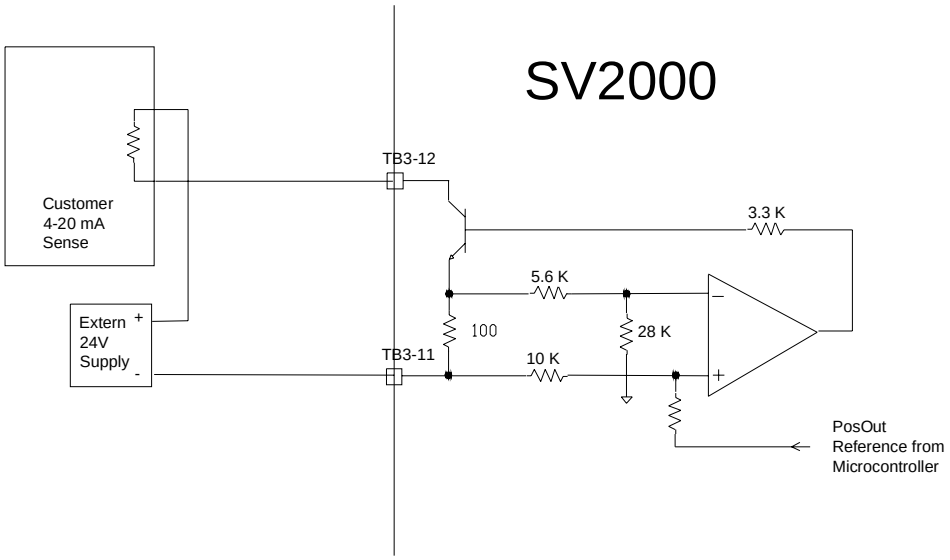


Figure 5.3.4b - PosOut Connected in Sinking Current Configuration

5.4 Digital I/O

5.4.1 Fault Output Contact (Fault Out) and Fault Enable (Fault En)

The Fault Out contact remains closed when the SV is not in fault condition and the Fault En is enabled (by connecting Fault En to COMMON). The Fault Out contacts will open when a fault is detected or the Fault En input is disabled. The Fault Out contact is rated for ½ Amp.

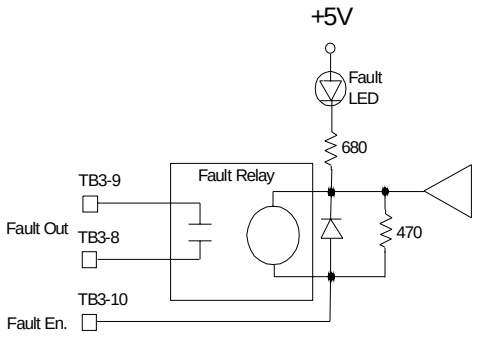


Figure 5.4.1 - Fault Output & Fault Enable Circuit

5.4.2 Current Limit Output (I Limit)

The Current Limit Output signals that the SV is exceeding the programmed rated motor current by pulling TB3-4 to COMMON. The red I Limit LED will also indicate this same condition. The maximum output current is limited to 2X the programmed rated motor current.

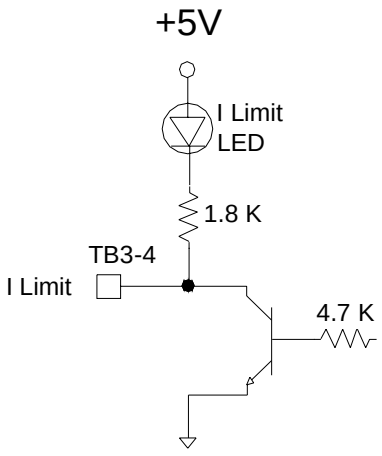


Figure 5.4.2 - I Limit Output

5.4.3 Digital Outputs (Output 3, Output 4, Output 5)

Digital outputs are TTL level open collector transistors with emitters connected to COMMON. Outputs 4 and 5 are programmed through the configuration software to provide indications of detected fault conditions in the drive. These outputs can be used to warn the controller of detected problems and allow for controlled shutdown. Output 3 is presently not used.

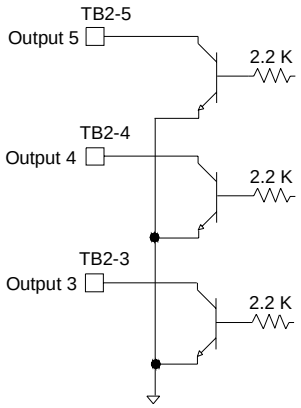


Figure 5.4.3 - Digital Outputs

5.4.4 Motor Thermal Inputs

Exlar actuators are equipped with embedded thermostats. When the thermostats detect high temperatures, they switch to an open circuit state. The SV contains a Motor Therm circuit to detect when the thermostat opens. The two wires from the thermostat connect to TB2-1 and TB2-2. By configuring the software fault monitor, the SV will fault when these two terminals are open circuit. In order for the configuration software fault monitor to detect the fault properly, TB2-1 must also be connected to TB1-6.

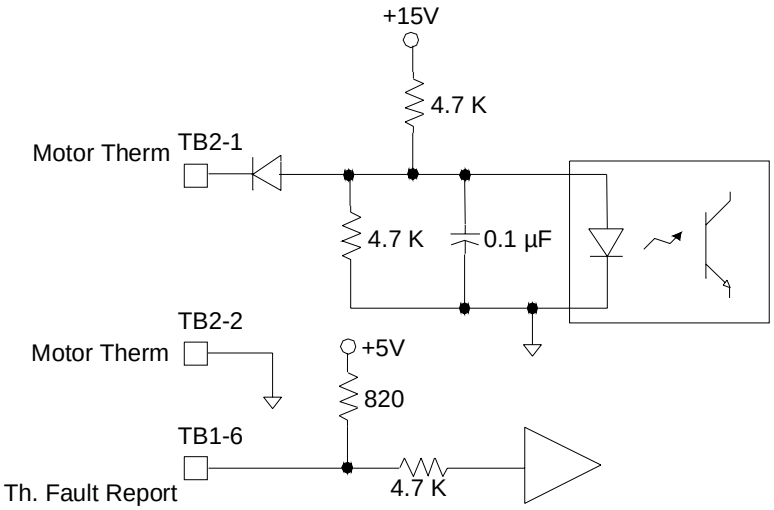


Figure 5.4.4a - Motor Thermal Input and Thermal Fault Report Circuit

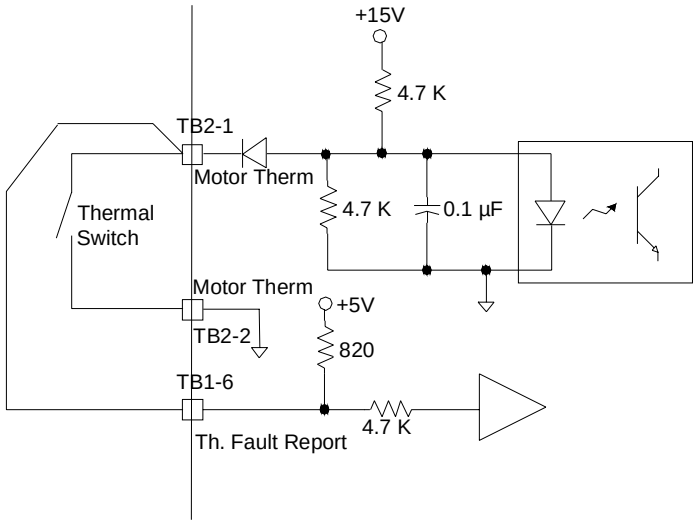


Figure 5.4.4b - Connecting to the Motor Thermal Input and Th. Fault Report

5.4.5 Control Inputs (Move to Emergency Position, Enable/Run)

The Move to Emergency Position and Enable/Run inputs are optically isolated and operate from either external 24V power or from the 10V supply provided on TB3-7. To turn the input on, voltage is applied across terminals TB1-9 and -10 and/or TB1-11 and -12, with positive voltage on pins 9 and 11.

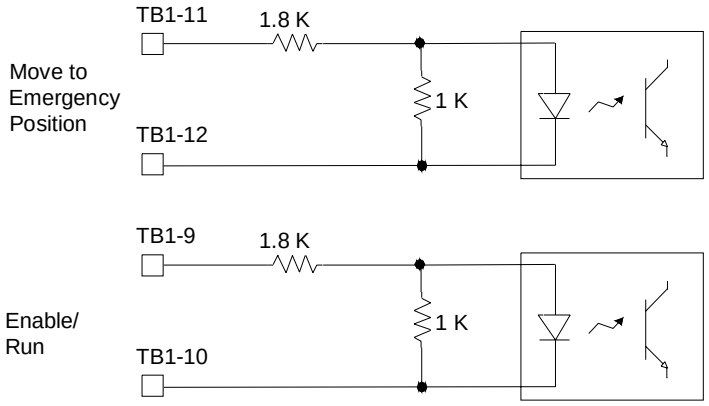


Figure 5.4.5 - Optically Isolated Inputs (Move to Emergency Position, Enable/Run)

5.4.6 Digital Inputs (Home Initiate, Home Limit)

TB1-6, -7, and -8 are TTL level digital inputs that are turned on by connecting to COMMON. The function of TB1-6, Motor Thermal Report, is described in section 5.4.4.

TB1-7 is the Home Limit input, which is normally connected to a limit switch on the machine to indicate the location of the home position. The other side of the limit switch must be connected to COMMON (TB1-4 or -5). Prior to searching for the home limit switch, the SV moves in the pre-programmed direction until it stalls at an end stop. It then reverses direction and searches for the home switch.

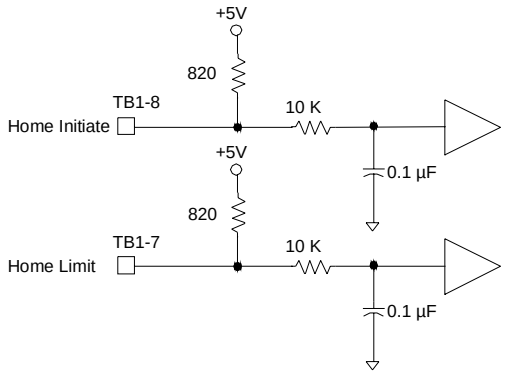


Figure 5.4.6 - Digital Inputs (Home Initiate, Home Limit)

TB1-8 is the Home Initiate input, which can be used to cause the SV to execute the home routine. Because the home routine will be executed automatically on power up and therefore this input is required only if there is a need to initiate the home routine during operation, without cycling power to the SV.

5.5 RS-485 Communications (T/RxD)

The SV is equipped with an RS-485, 2-wire, communications channel. The buadrate has been set to 19,200. Communication to the SV can occur either through the SV Configuration Software or through a Modbus protocol, which is described in Appendix A3.

The internal circuit is shown in Figure 5.5a, which shows 3 connections on TB3-1, -2, and -3. TB3-1 and -2 are used for RS-485 communications. TB3-3 is provided to accommodate communication to PC's through the RS-232 port. This type of communication should work with most RS-232 communication ports, but does not provide voltages meeting the RS-232 specifications and therefore is not recommended. For customers requiring RS-232 communications, an RS-232 to RS-485 converter between the PC and the SV is recommended.

For reference and convenience, the following RS-232/RS-485 converters that have been verified include:

B&B 485SD9R
B&B 485OT9L

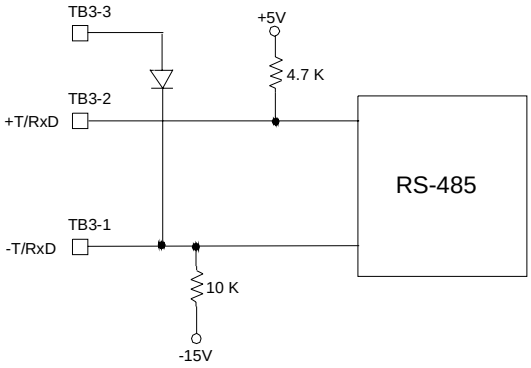


Figure 5.5a - Communications Circuit

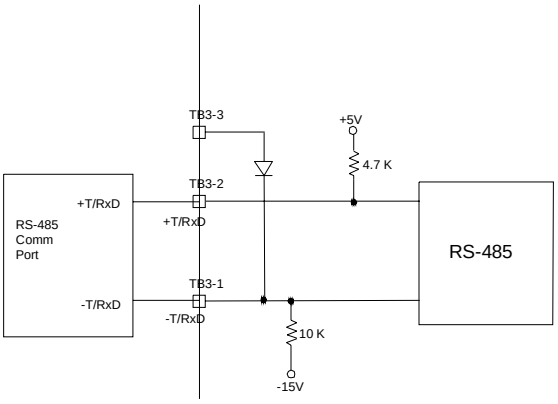


Figure 5.5b - Connecting with RS-485 Comms

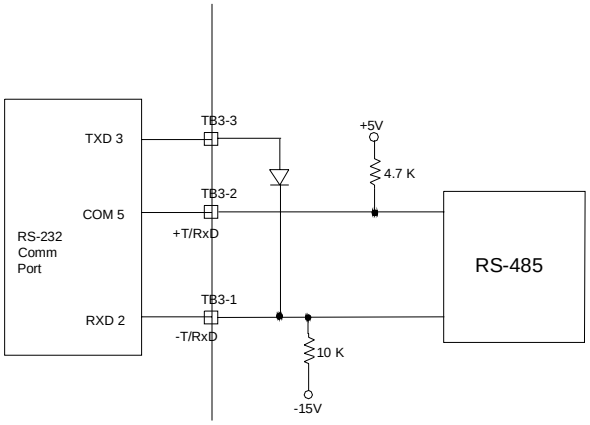


Figure 5.5c - Connecting with RS-232 Comms (Not Recommended)

5.6 Resolver Connections (Exc, Sin, Cos)

A resolver is mounted on the Exlar actuator to provide position feedback for commutation and position control. The resolver is excited with a sinusoidal signal. The SIN and COS are sinusoids modulated by the relative position of the resolver rotor to the stator. These signals are received, filtered by the SV, and passed to a resolver-to-digital converter which converts the SIN and COS feedback signals into a digital number representing the angle of rotation.

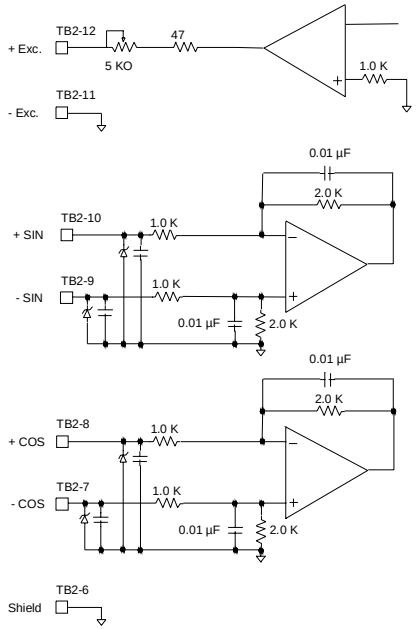


Figure 5.6 Resolver Interface

There are varieties of resolvers with varying transformation ratios of output voltage to input voltage. The SV2015 has a resolver excitation voltage potentiometer physically located between TB2 and TB3 to accommodate various transformation ratios. Typically, a transformation ratio of 0.5 is used in Exlar actuators. Under some circumstances, it may be necessary to adjust the excitation signal to provide the proper SIN and COS signal amplitudes. The SIN and COS signals from the resolver must peak at 1Vrms (1.4 V peak). In order to verify or adjust the signal voltages, either an oscilloscope or a true RMS voltmeter with frequency range extending beyond 5 KHz is required. While monitoring either SIN (between TB2-9 and -10) or COS (between TB2-7 and -8), the motor rotor must be rotated until the sinusoid is at a maximum amplitude. Then adjust the potentiometer until the voltage is 1.4 V peak or 1 V rms.

6 SOFTWARE INSTALLATION

6.1 Installation

The setup disk for the SV Configuration Software contains multiple files that are accessed during the setup process to generate the program for the appropriate Windows™ operating system. The result of the setup program is to create a new directory (default is "SV") and to create two files. The SV.exe file is the executable file and the customer.ini file contains initialization information. Neither of these files should require alteration by the customer.

6.1.1 Windows 3.1 and Lower

Access the floppy disk or CD Rom drive on which the source software is supplied. Double click on \setup and follow the instructions to install the software.

6.1.2 Windows 95/98/2000/NT/ME/XP™

Use Add/Remove programs from the start menu to install the SV Configuration Software.

6.2 Using this program

6.2.1 Product Selection

Upon opening the software to create a new SV set up file, a screen like that in Figure 6.2.1 will appear. Select the choice that matches the SV model being used and click **OK**.

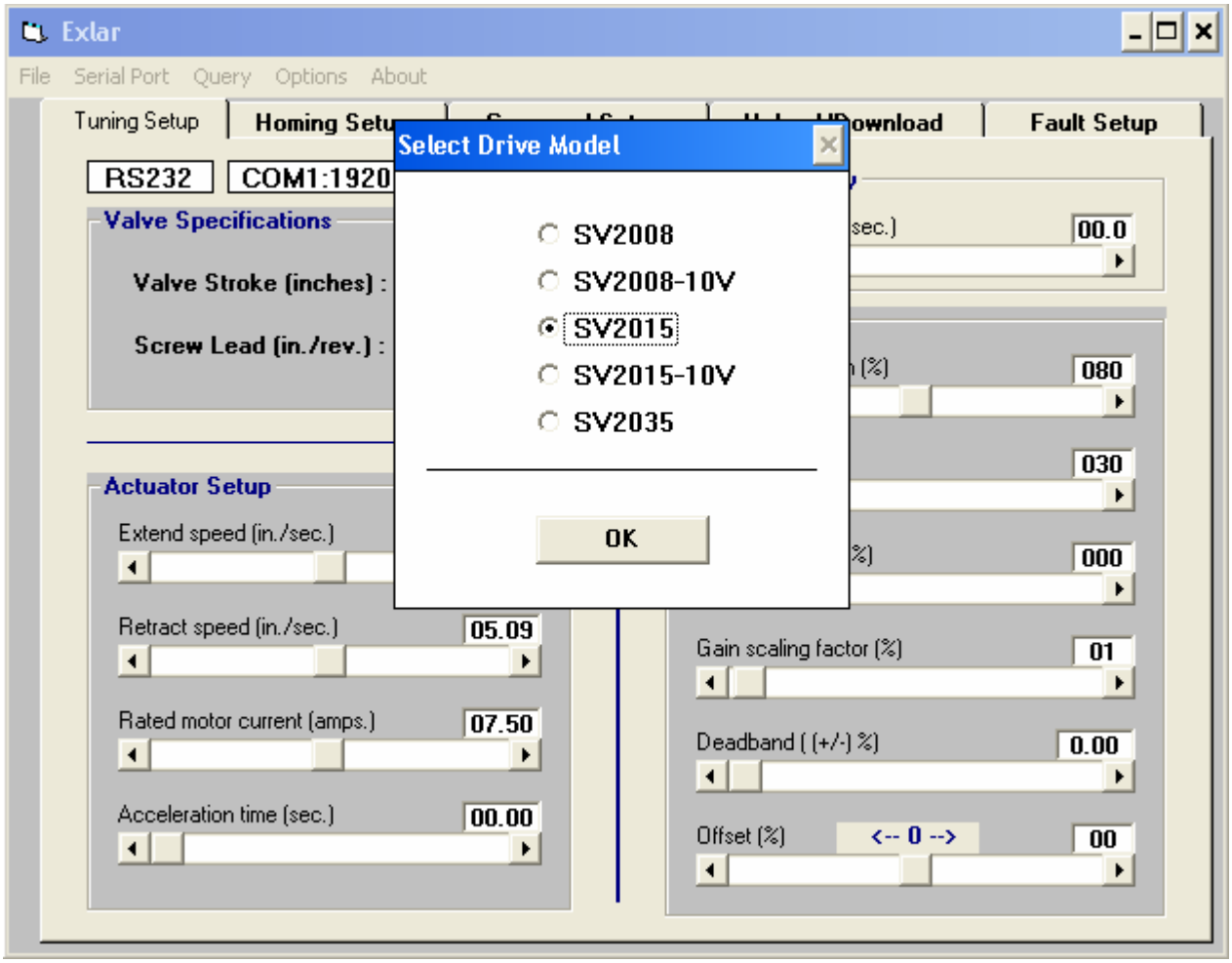


Figure 6.2.1: Product Selection

6.2.2 Select Communication Linetype

The next dialogue box that appears allows the user to select the type of SV to PC communications. See Figure 6.2.2. When RS232 is selected, each of the characters received from the SV are echoed by the configuration program. For RS485, the configuration program does not echo characters.

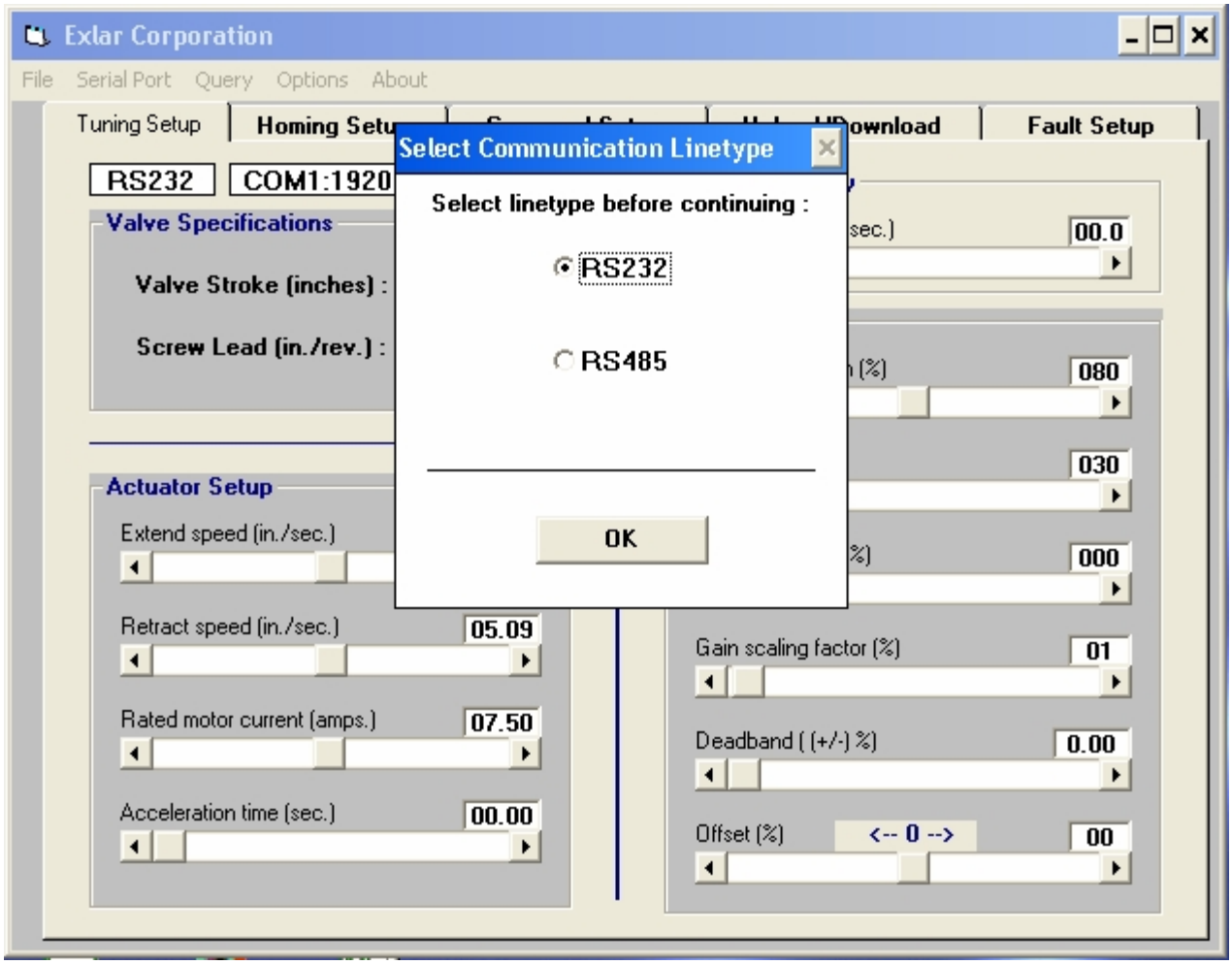


Figure 6.2.2: Serial Communications Line Type Selection During Startup

6.2.3 Changing parameters

The software allows the user to configure or change a variety of system parameters. Some parameter changes require that data be directly entered and some use slider bars, while others use check boxes and radio buttons. The slider bars provide for coarse adjustments and the adjustment arrows provide for the fine adjustments. The parameter changes do not take affect until a download of the parameters to the SV occurs.

There are many parameters that can be adjusted and then sent individually to the SV without requiring a download through the Upload/Download tab. If after adjusting a parameter, the parameter value is highlighted in yellow, some parameters can be sent to the SV by double clicking in the yellow area. If the data is received successfully, the yellow will change to white.

Some parameters that affect the position, such as Valve Stroke and Screw Lead, can not be downloaded without using the download button in the Upload/Download tab.

WARNING - The drive should be disabled prior to downloading changes that affect the actuator position --changes in Valve Stroke, Screw Lead, Offset, Command Source, Command direction, and Home offset, etc. Cycle power or activate Home Initiate prior to Enable/Run.

7 SERIAL COMMUNICATIONS

The SV products are designed to communicate via RS485. For customer convenience, it can also communicate via RS232 communications with some personal computers. It is highly recommended that the RS485 interface be used when continuous communications are required. As designed, the RS232 communications do not conform to the RS232 standards, specifically in the area of signal output voltage. The RS232 communications can be convenient for making parameter changes and momentary monitoring of the SV status. Refer to the Section 5.5 for details.

7.1 Serial Port Selection

From the *Serial Port* pull down menu, choose Port Setting and select the COM port to which the SV Position Controller is connected. See Figure 7.1.

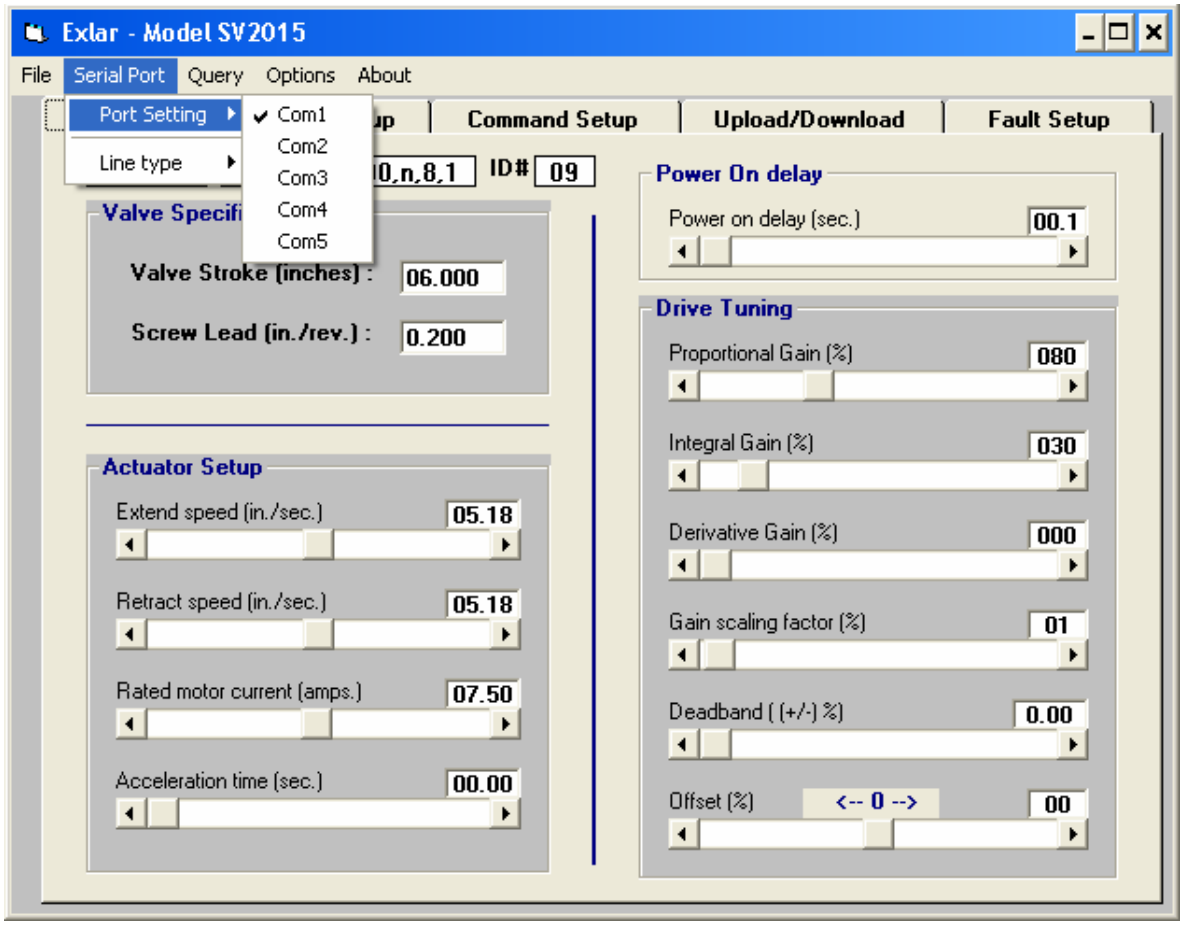


Figure 7.1: Serial Communications Port Selection

7.2 Communication Type

There are two ways to select the communication line type. The first occurs when first starting up the configuration software. After selecting the SV model, as shown in Figure 6.2.1, the box shown in Figure 6.2.3 is displayed. At this point, select communication line type used.

The second method of selecting the serial communications line type can be done at any time. From the *Serial Port* pull down menu, choose *Line Type* and select RS232 or RS485 to match the type of protocol that will be used with the SV. See Figure 7.1.

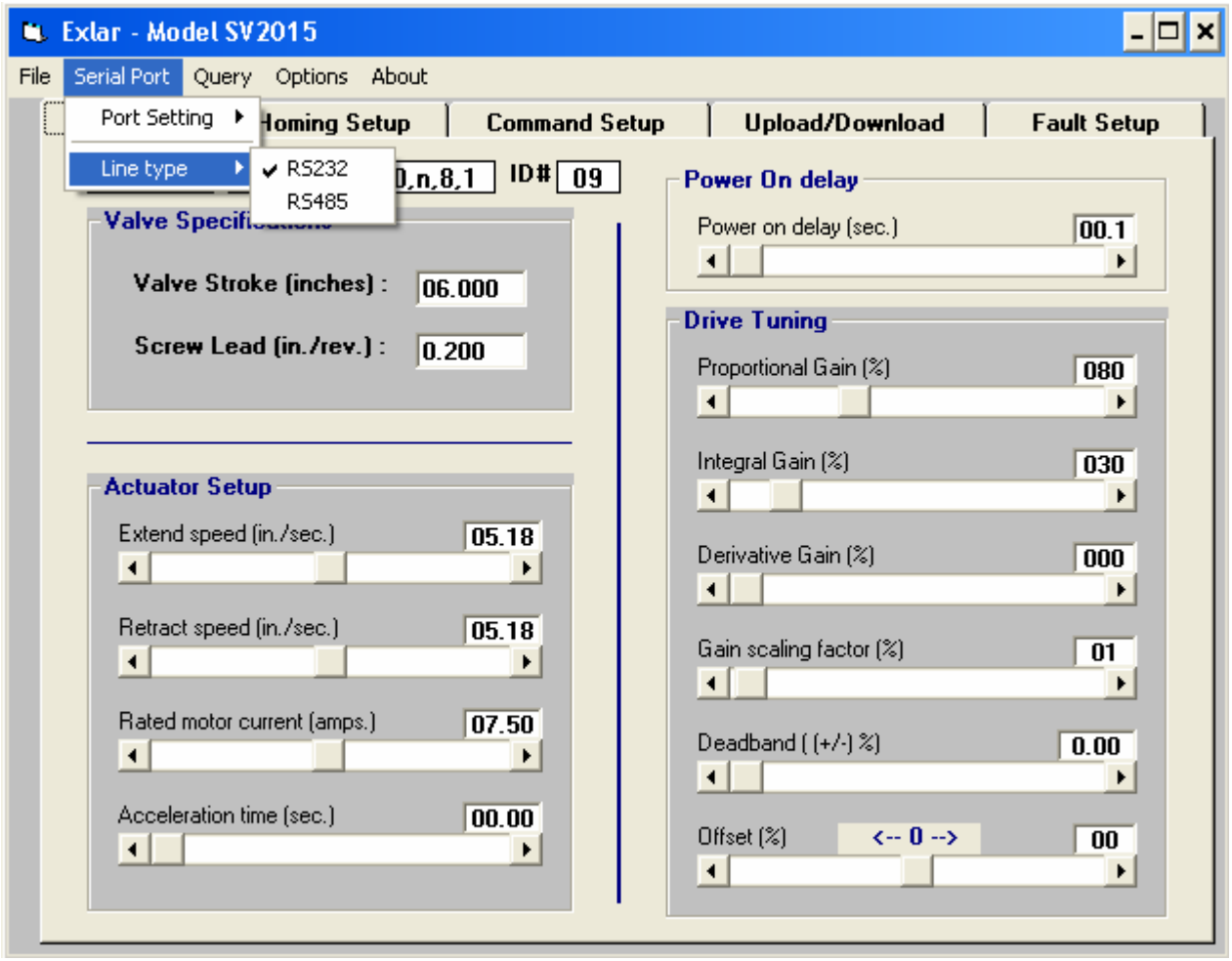


Figure 7.2: Selecting the Communication Line Type

8 OPTIONS MENU

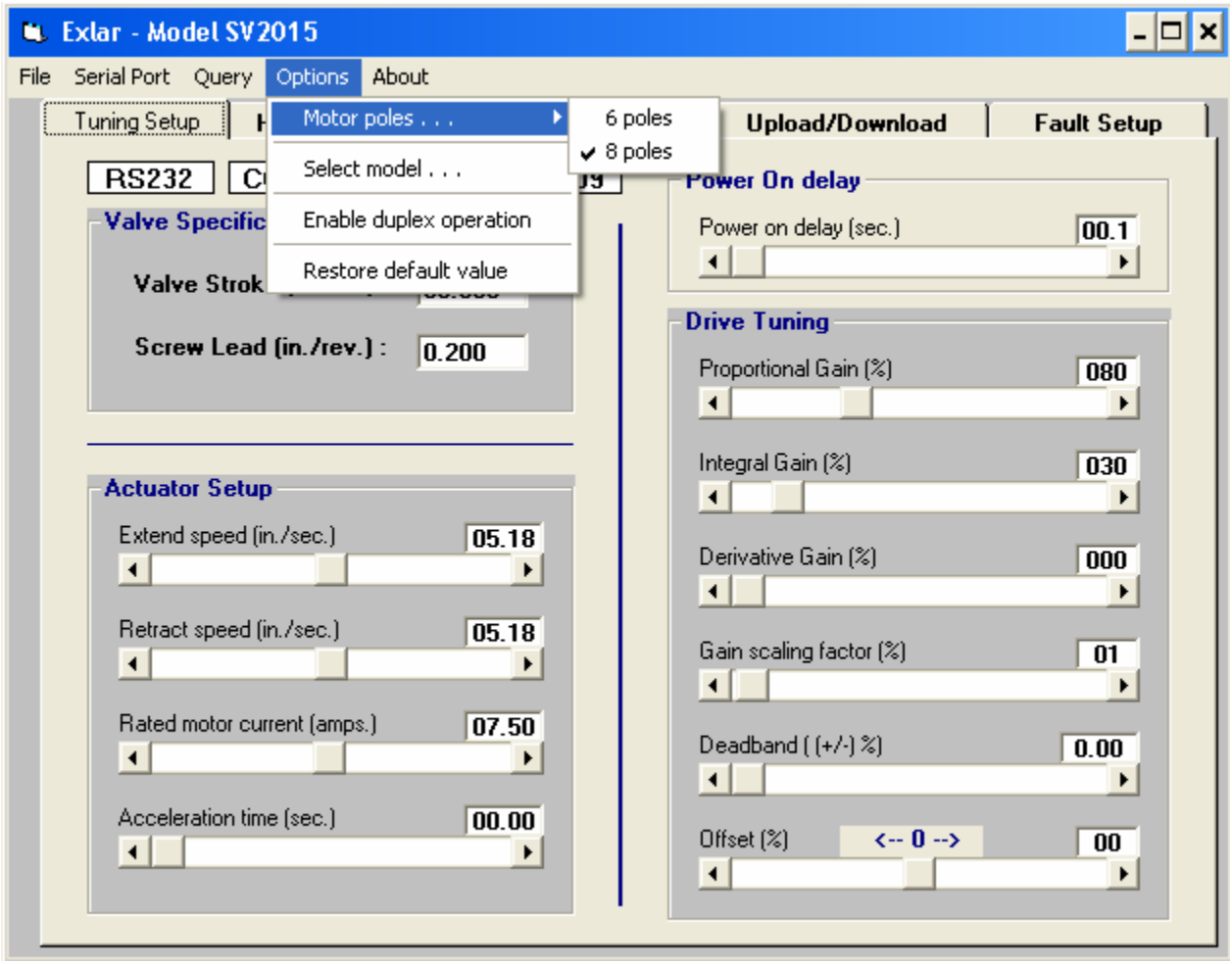


Figure 8: Motor pole Options

8.1 Motor Poles

The SV requires selection of the correct number of motor poles for the actuator being used. The SV allows for 6 pole or 8 pole brushless motors. As shown in Figure 8, the number of motor poles of the actuator being controlled by the SV is selected from the *Options* pull down menu by choosing *Motor poles* and selecting 6 poles or 8 poles.

The following table shows the number of motor poles (unless otherwise specified) for each model of Exlar actuator. These actuators should be configured with the "EX3" feedback option to operate with the SV.

Exlar 6 Pole Actuators	Exlar 8 Pole Actuators
GS20,GS30,GS45,GS60, PSA60,PSA90,PSA142	GS40, GSX, PSA115, SR, SLG, SLM

8.2 Select model

The model of SV can be selected during initialization of the configuration software as shown in Figure 6.2.1. The model can also be selected under Options/Select model.

8.3 Restore default value

Restore default value provides the user with a means of resetting the configuration software parameters to default values. This may be useful when configuring multiple SV's. After downloading the configuration of one SV, the Restore default value can be selected to reset the parameters before modifying them for the next SV.

Note: Configuration parameters are always set at default values when starting up this configuration program. The parameters in a SV are not uploaded to the configuration program until the upload command is issued.

9 TUNING / ACTUATOR SETUP

Tuning / Actuator Setup allows the user to configure the stroke length and screw lead of the linear actuator. It allows the setting of the maximum continuous motor current, maximum travel speed, and acceleration times. It provides the capability to configure the proportional, integral and derivative gains for the velocity regulator, and the gain scaling factor, signal dead band, and signal offset for the position regulator.

Each parameter can be set by using the slide bars to adjust the corresponding parameter.

When a parameter value is changed, the parameter window will turn yellow. When the window is yellow, it may be double clicked to immediately change that parameter value within the SV. When changed in the SV, the parameter window will revert to white. Values that affect the scaling of motion of the actuator (i.e. stroke and screw lead) require that **download to drive** be selected from the Upload/Download tab.

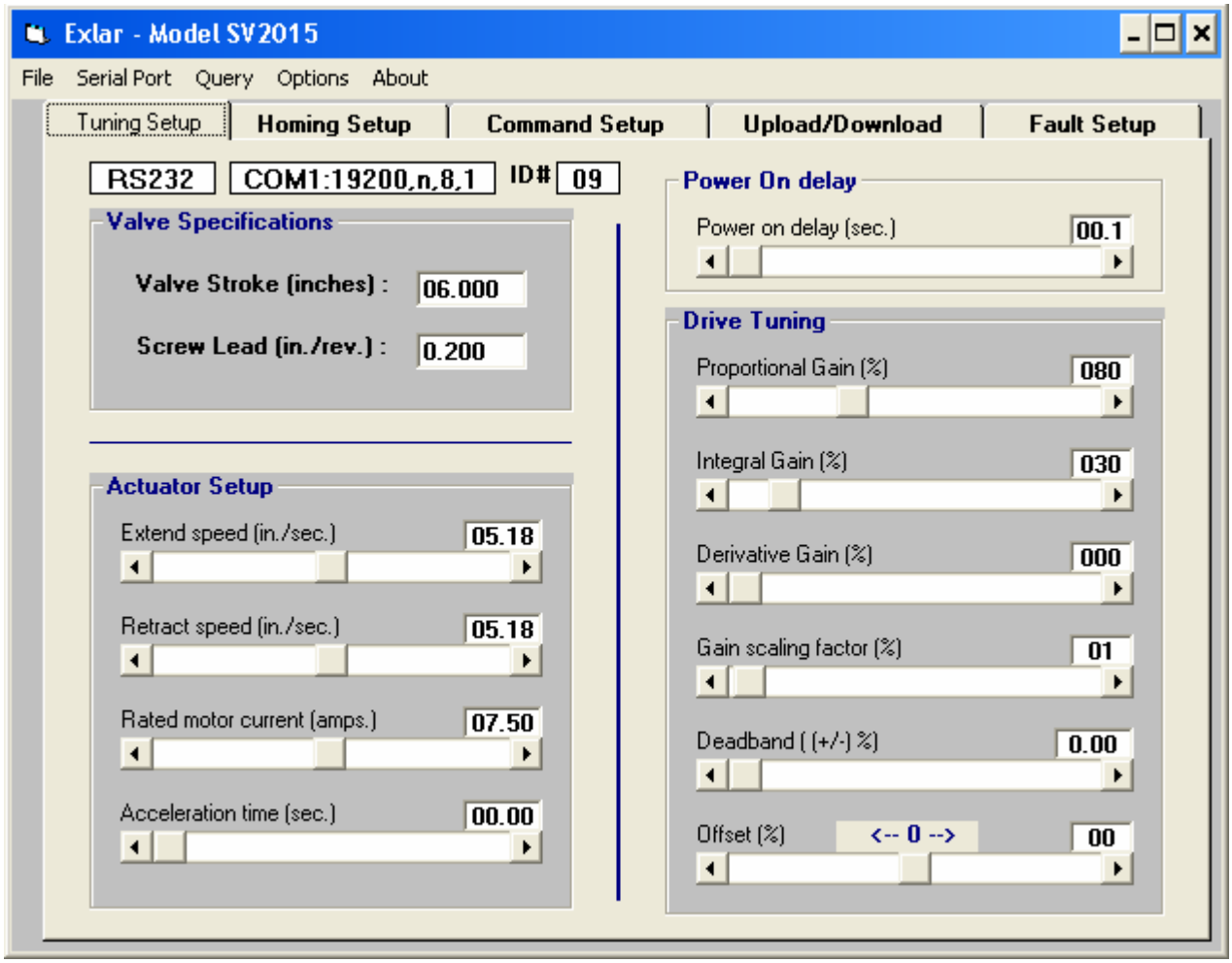


Figure 9: Tuning Setup Tab

9.1 Valve Specifications

9.1.1 Valve Stroke

The parameter *Valve Stroke* should be set to the desired operating distance, from fully retracted to fully extended. This value should be set in inches and must be within the stroke of the actuator used to control the valve. Changes to this value require the SV to be disabled and *download to drive* selected from the communications page of SV.

Note - The selection for valve stroke must be at least 1 full revolution of the motor or greater than or equal to the screw lead.

WARNING - Changing the Valve Stroke setting may result in unexpected motion during download to the SV. It is suggested that Enable/Run be disabled prior to download. Cycle power or activate Home Initiate prior to Enable/Run.

9.1.2 Screw Lead

The parameter *Screw Lead* should be set to equal the linear travel of the actuator per revolution of the brushless motor driving that actuator. If additional ratios are used between the motor and the driving screw, the effective lead of the screw should be given as the linear travel of the screw per revolution of the motor.

WARNING - Changing the Screw Lead setting may result in unexpected motion during download to the SV. It is suggested that Enable/Run be disabled prior to download. Cycle power or activate Home Initiate prior to Enable/Run.

9.2 Actuator Setup

9.2.1 Stroking Speed

The parameters *Extend Speed* and *Retract Speed* should be set to the maximum desired stroking speed required from the valve. The speeds are those achieved by the valve after acceleration and are set in inches per second. It should be considered that this value can be set to a level beyond what is achievable by the actuator depending on the voltage at which the SV is powered, the base speed of the actuator, and the screw lead of the actuator.. *Note: Setting speeds higher than achievable will result in maximum speeds lower than programmed.*

9.2.2 Rated motor current (Amps)

Rated motor current should be set to the nameplate continuous current of the actuator.

WARNING – Setting the rated motor current value above the continuous current rating of the motor can result in damage to the motor.

Maximum current to the motor will be limited to twice the rated motor current value. The SV will output current greater than rated current for only 1 second. After 1 second, the current will reduce to the foldback current value unless the "Overload- after 1 sec" Fault Relay checkbox is checked under the Fault Setup tab. If the "Overload – after 1 sec" is selected, an over current fault will occur which will disable the SV and place it in a fault condition. The 1 second timer counts up to 1 second when the current exceeds the rated motor current value. When the current drops below the rated motor current value, then the counter counts down to 0 at which time the current limit is again reset to twice rated current.

The foldback current value is normally set to rated motor current. However, if the motor speed drops below 47 RPM, then the foldback current is reduced to 70% of the rated motor current. When the motor speed exceeds 94 RPM, the foldback current is restored to the rated motor current value. This function protects the motor from overheating during a stall condition.

9.2.3 Acceleration Time

Acceleration Time should be set to the desired time, in seconds, the actuator will take to achieve *Extend Speed* or *Retract Speed*. Setting the value to zero will result in the SV accelerating the actuator at its maximum capability. It should be noted that the SV power may not be sufficient to achieve extremely short acceleration times, limiting the acceleration time to the maximum rate the SV power allows. Setting the acceleration time to 0 results in unnecessary current draw during acceleration can result in reduced overall system performance capability. The acceleration time should always be set to the actual acceleration time of the desire motion profile. Consult Exlar Applications for assistance with motion profile calculations.

9.3 Power On Delay

This parameter allows for a delay time before the system begins following the command signal upon power up. This can allow for the power up of other system components or for stabilization time of system signals prior to engaging position control. If the Fault En (TB3-10) is pulled to COMMON, during the Power On Delay period, the Fault LED will remain on and the Fault contact will remain open.

9.4 SV Tuning

The configuration interface allows the user to adjust the Proportional, Integral and Derivative gains within the SV to determine how the system will react to a particular control signal. Adjusting these gains will increase or decrease the response of the system to changes in the command signal.

To start the tuning process, with the Gain Scaling Factor set to 1, increase the Proportional Gain until the response to a rapid change in control signal results in erratic operation. Erratic operation would be described as overshooting, oscillation of the motor, harsh audible noise from the motor, or vibration. Reduce the proportional gain to the point where this erratic performance no longer occurs. The Integral and Derivative gains can then be adjusted as described below to achieve the final desired performance.

An alternative method for tuning is to start using the system with the default tuning parameters. As the system is monitored, the gains can be adjusted and the system performance monitored, until the desired performance is achieved. Each of the gain values can be adjusted while the SV is actively operating an actuator.

9.4.1 Gains

Proportional Gain: The velocity reference is subtracted from the actual velocity to develop a velocity error. The velocity error is then multiplied by the proportional gain setting, and summed with the integral and derivative terms, and is used as a direct current reference to the motor. The larger the error between the actual and commanded velocity, the higher the current response from the SV will be. Increasing Proportional Gain will increase the torque response of the actuator for a given following error. Excessively high gains produce instability in the velocity loop and cause the motor to oscillate or vibrate at high frequencies. When Integral Gain is non-zero, excessively low Proportional Gain can cause the actuator to oscillate at low frequencies or have poor response.

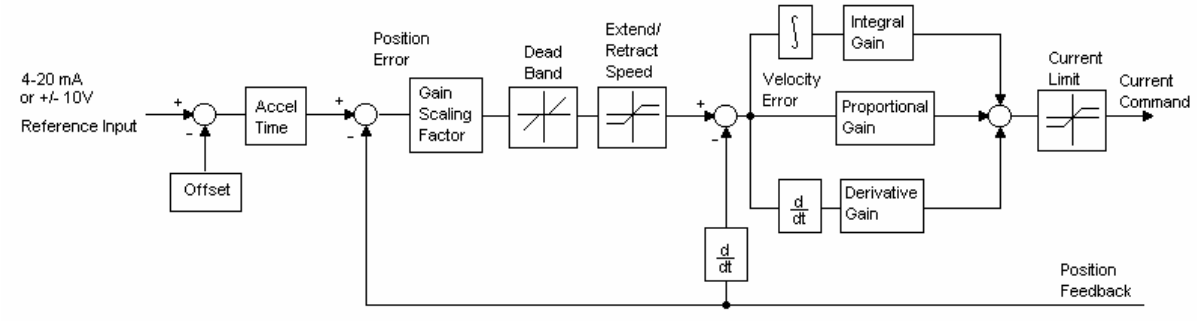


Figure 9.4.1: Block Diagram of SV Regulators

Integral Gain: Velocity errors are accumulated each sample time and are scaled and multiplied by the integral gain setting. The integrator has the purpose of eliminating steady state velocity errors. The Integral Gain parameter determines how quickly the error is eliminated. High integral gains will cause an overshoot. Low integral gains produce a slower response for correcting errors.

Derivative Gain: The velocity reference input is subtracted from the actual velocity to develop a velocity error. This error is subtracted from the previously sampled velocity error to develop a rate of change of velocity error. The calculated error is then multiplied by the derivative gain. The derivative term is summed with the proportional and integral terms, and is used as the current command to the motor. *Derivative Gain* may be helpful for reducing overshoot in applications requiring high integral gains. Normally, this value should remain 0.

Gain Scaling: Gain Scaling provides for adjustment of the proportional gain of the position error signal, which produces a velocity reference and is the input to the velocity loop. Once the velocity loop is tuned by adjusting the Proportional and Integral Gains, this value can be raised to improve response to position commands.

Deadband: Deadband allows the user to set a hysteresis value on the incoming position command. For example, setting the dead band to 1% will require a position command change of more than 1% of the stroke to affect a position change in the actuator. This allows for system stability in the presence of an unstable control signal.

Offset: Offset parameter allows the user to calibrate the offset of the position command signal. The value at which the SV sees the position command can be seen in the drive monitor window. Offset can be positive or negative and is set as a percentage of the total signal. The offset is added to the position command signal and will therefore adjust the actual position for a given position command.

10 COMMAND SETUP

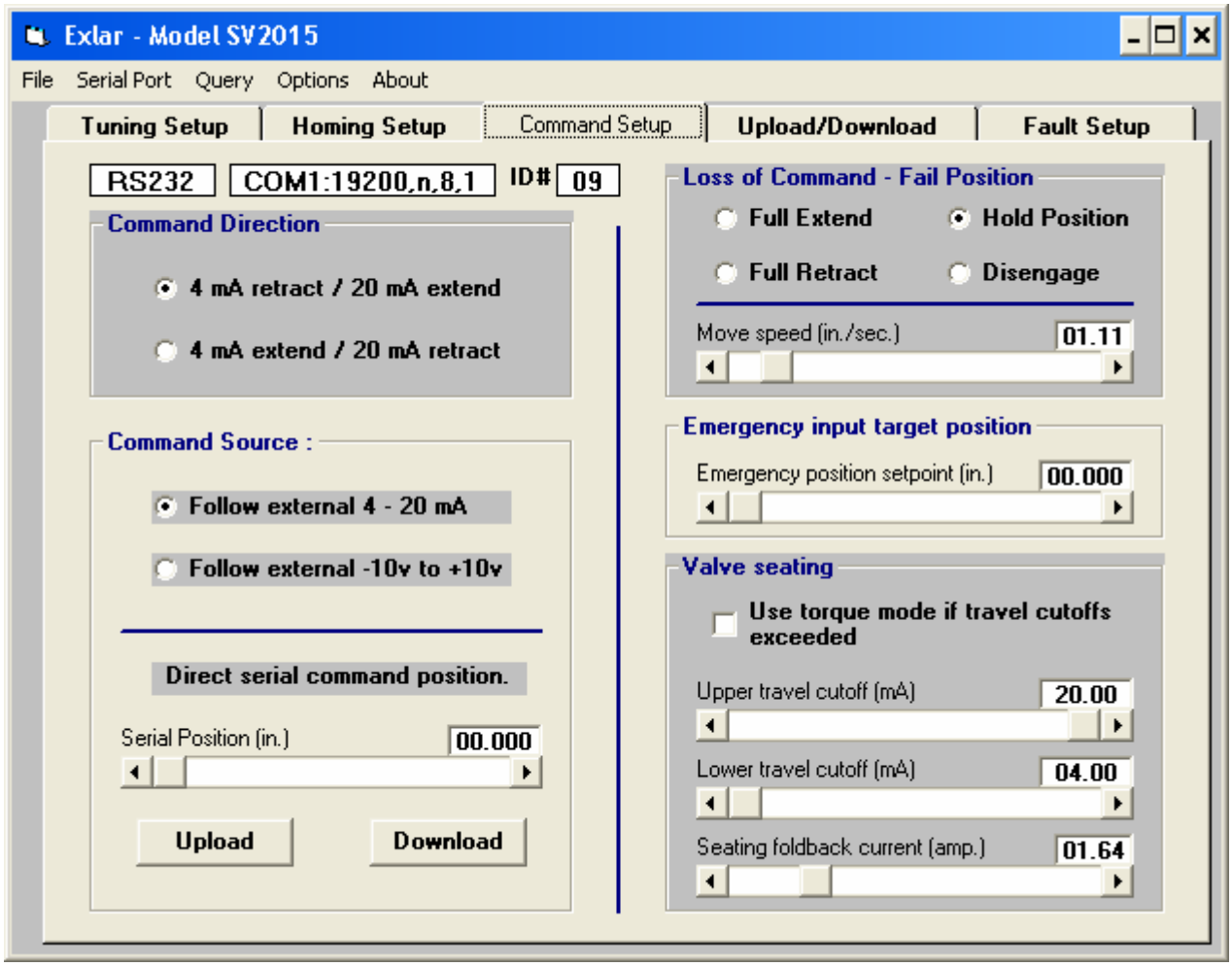


Figure 10: Command Setup Tab

10.1 Command Direction

Command direction is selected according to the desired polarity of the command signal related to the direction of the motion of the actuator controlling the valve.

10.2 Command Source

The Command source can be selected to follow a 4-20 mA signal, a +/- 10V signal, or a discreet position sent to the SV via serial communications.

WARNING - Changing the command source setting may result in unexpected motion during download to the SV due to changes in the command source. It is suggested that the SV be disabled prior to download. Only enable when certain that motion will not result in damage to the machine or personnel.

The serial position is referenced in inches according to the stroke of the actuator from the Tuning / Actuator Setup Page. After the serial position is selected, press the Download button to load the value into the SV. This position is maintained by the SV until a new position is downloaded, or the command source is changed. Setting the serial position to 0.000, returns control to the analog position reference (4-20 mA or +/-10V).

10.3 Loss of Command – Fail position

The Loss of Command function causes the actuator to either move to a full retract or extend position, hold present position, or disable upon loss of the 4-20 mA position command at TB3 pins 15 and 16. This function works only if the Command Source selected is "Follow External 4-20 mA." Refer to Section 10.2.

Note: The Loss of Reference checkbox in the Fault Relay column under the Fault Setup tab must be unchecked for this function to work.

Full Extend - the actuator is moved to the full extend position as defined by the Valve Stroke, the location of the home position, and by the home direction. When the 4-20 mA signal is restored, the actuator will return to the commanded position.

Full Retract - the actuator is moved to the full retract position as defined by the Valve Stroke, the location of the home position, and by the home direction. When the 4-20 mA signal is restored, the actuator will return to the commanded position.

Hold Position - the actuator actively holds the current position and ignores the commanded position until the 4-20 mA signal is restored and remains restored for 3 seconds.

Disengage - the SV disables until the 4-20 mA signal is restored for 3 seconds and then the Run / Enable input is disabled and re-enabled.

Note: When disengaged, the actuator/valve will be free to move based on system forces present to push or pull the valve in either direction. The SV will not attempt to hold or achieve any position. When disengaged the actuator may stand still, extend or retract, depending on the system forces present.

The speed at which the actuator will move during the loss of signal mode is determined by the Move Speed.

10.4 Emergency Input Target Position

The Emergency Input Target Position provides a function that causes the actuator to move to a preset position in the event that the Emergency Input is activated. When the Emergency Input is de-activated, the actuator will return to the position determined from the input commanded position. The speed of motion is determined by the extend speed and retract speed set in Section 9.2.1. The Position is set in inches, positive relative to the home position.

10.5 Valve Seating

Use torque mode if travel cutoffs exceeded: Some valve applications require that when the 4-20 mA control signal is above or below a certain level, that the actuator extend or retract with a certain force and hold that force. If this checkbox is selected and the Travel Cutoff Fault Relay checkboxes under the Fault Setup tab are de-selected, then the control is switched to torque mode when the Position Command exceeds the set upper or lower travel cutoff. This causes the actuator to apply a force without concern for actual position.

Upper Travel Cutoff: The upper travel cutoff parameter determines the upper limit for the 4-20 mA command. Exceeding this value produces a fault when the Upper travel cutoff / Fault relay checkbox is selected under the Fault Setup tab. It also determines when the control mode is switched to a constant torque mode when the "Use torque mode if travel cutoffs exceeded" checkbox is selected.

Lower Travel Cutoff: The lower travel cutoff parameter determines the lower limit for the 4-20 mA command. Exceeding this value produces a fault when the Lower travel cutoff / Fault relay checkbox is selected under the Fault Setup tab. It also determines when the control mode is switched to a constant torque mode when the "Use torque mode if travel cutoffs exceeded" checkbox is selected.

Warning: The cutoff parameters may be required to be set within certain limits to avoid damage to the valve or actuator.

Seating foldback current: The Seating foldback current determines the force that the actuator will hold. It should be set to provide the desired level of force. When calculating the seating foldback current, use the following equation to calculate the force applied:

Seating force (Lbf) = seating foldback current (Amps) x Kt (lb-in/Amp) x 5.34 / Screw Lead

Note: The valve seating force may be higher or lower than programmed in the SV depending on the system forces or pressures that are present.

11 HOME SETUP

Before normal motion of the actuator can begin, the SV must know the actual absolute position of the actuator. Four different modes of determining the absolute position are provided to accommodate a variety of applications. For the SV, home is considered to be the "zero" position. Normally, the home position will be at one end of the stroke and therefore a means of identifying the home direction is provided.

After the home position is reached and registered within the SV, the actuator will be move to the commanded position (as determined from the selected command source) at the commanded acceleration and velocity (under the Tuning Setup tab).

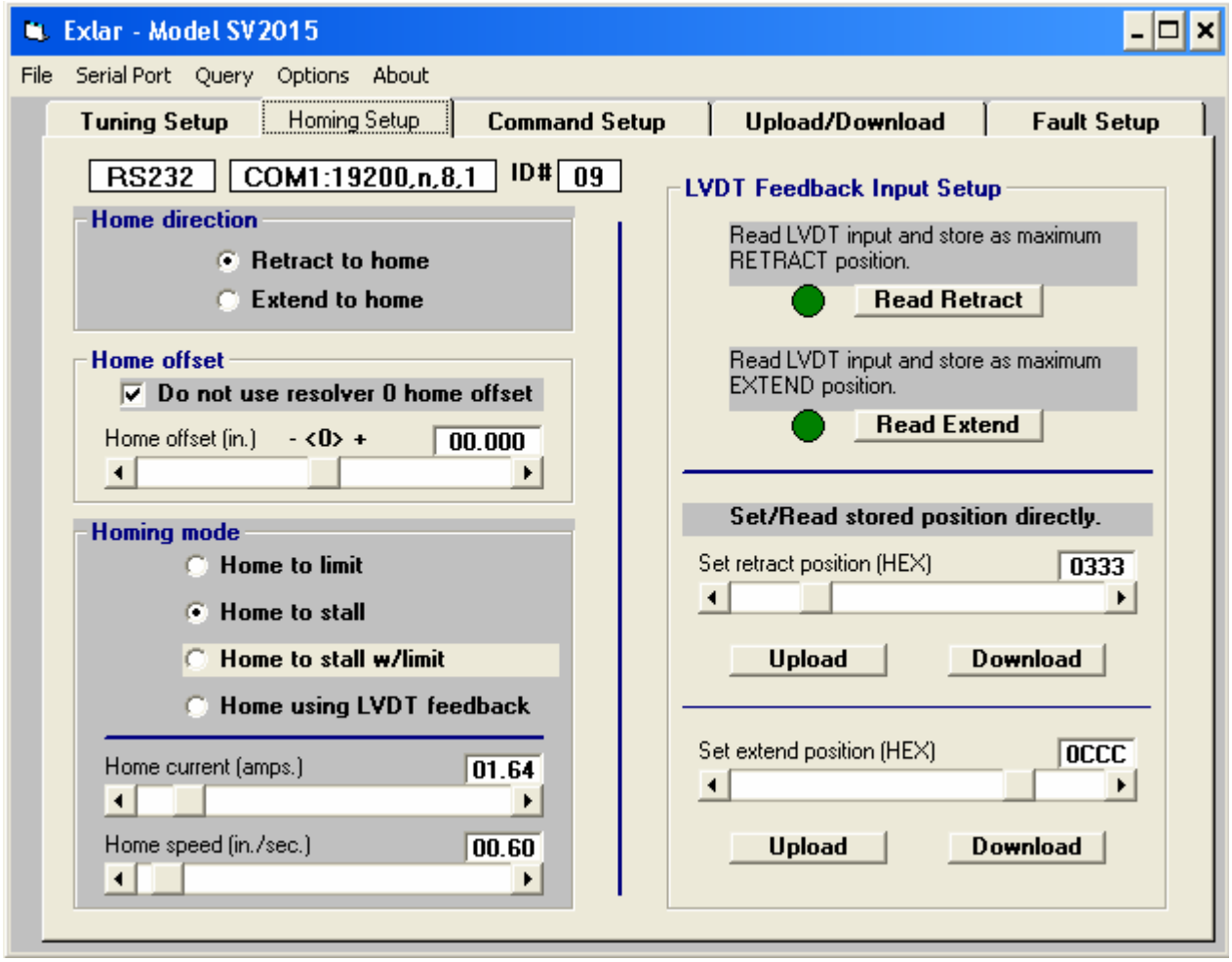


Figure 11: Homing Setup Tab

11.1 Home Direction

Retract to Home: Upon power up and enable, or on home initiate, the actuator will initially move in the direction to retract the actuator.

Extend to Home: Upon power up and enable, or on home initiate, the actuator will initially move in the direction to extend the actuator.

11.2 Home Offset

The home offset is the distance in inches from the stall or limit position. The offset position will then be the new zero position. Once the stall position, or limit switch, has been reached, the actual position is set to the Home offset value. For example, assume that the SV2000 is configured to retract to home with the 4 mA retract/ 20 mA extend and the homing mode set for home to stall. With a home offset of -1 inch, the 4 mA position will end up being 1 inch extended from the stall position.

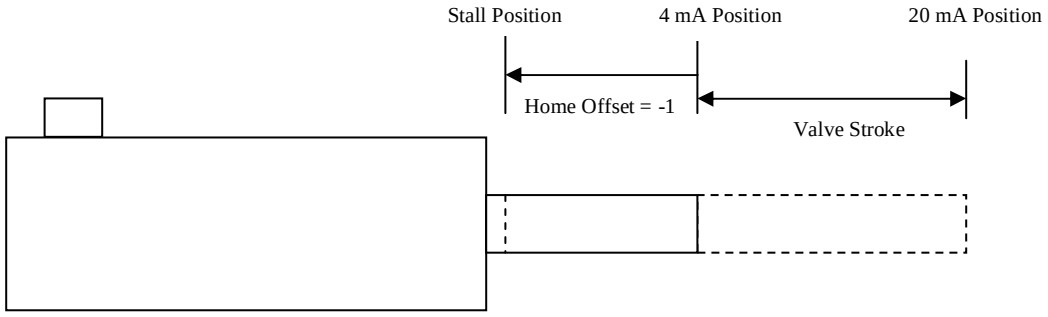


Figure 11.2: Adjusting Valve Position using Home Offset

A checkbox is included in the Home Offset entitled "**Do not user resolver 0 home offset**." This is a special feature that should normally remain checked. It is unchecked in applications requiring high repeatability of the absolute position despite temperature and other effects. When unchecked, the actual position is set to the absolute position of the feedback resolver plus the home offset when the stall position is located during execution of the home routine. The resolver position has a resolution of 4096 counts per motor revolution, is repeatable, and indicates the location of the motor rotor within one rotation.

11.3 Homing Mode

Home to limit: Selecting this homing mode configures the actuator to look for a home limit switch input as its home location. Before searching for the home limit switch, the actuator will move in the homing direction until it reaches the stall position, then it will reverse direction. When it detects the limit switch, it will set the Actual position (at the position of the limit switch) to the Home Offset and then move to the commanded position.

Home to stall: Selecting Home to stall configures the actuator to move in the home direction until stopped and the motor current rises to a level set by the user. This allows for a hard stop to be used as the physical reference for the home position. When the Home current level is reached, the actual position is set to the Home offset value then the actuator moves to the commanded position. To determine the Home to Stall force, the user should set the appropriate Home Current above the current required to move the actuator at the home speed, but below the rated current of the actuator.

Home to stall w/ limit: This mode operates the same as Home to stall, except that the stall position is qualified by the home limit switch input at TB1-7. Use of the home limit switch input in this case reduces the possibility of determining the wrong home position due to the actuator stalling at locations other than the valve seat.

Home using auxiliary analog input: This mode provides for the SV to determine its home position from an auxiliary analog input. This device can be, but is not limited to, a linear analog feedback device proportional to the linear stroke of the valve actuator or the load. For this mode to work properly, the analog voltage when the actuator is retracted must be less than the voltage when extended. The voltage must be between 0 and 5V throughout the entire range. Voltages outside this range may cause erroneous faults to be displayed.

In this homing mode, the auxiliary analog feedback device provides a voltage proportional to the travel of the valve/actuator combination. The analog voltage fed back from this device to the SV when the homing process is initiated will be registered as the current position, based on the initial set up of the analog device. After determining the actual position from the analog feedback device, the actuator will proceed to the current commanded position.

Home Current: Home current limits the maximum current command when seeking the home position or valve seat. The peak current is twice the Home current limit value, but it will remain at this value for only 1 second. The current then folds back to the Home Current value.

Home Speed: The speed at which the valve actuator will seek the home position is determined by the Home Speed parameter. This is set in inches/second. Care should be taken in setting this speed. In the Home to Stall mode, high homing speed has the potential to damage the valve, the actuator, or the mechanics of the system. High homing speed may also generate high acceleration current, falsely triggering the home position in home to Stall mode.

11.4 Auxiliary Analog Input / Potentiometer Setup

The scaling of an auxiliary analog input device can be accomplished in two ways. The first is to move the valve actuator to the retract position. In this position, the **Read Retract** button is pressed to load the position represented by auxiliary analog voltage into the SV. The valve actuator system is then moved to the extended position and the **Read Extend** button is pressed to load the extend position represented by the auxiliary analog voltage into the SV. This results in a linear scaling of the auxiliary feedback.

The scaling can also be done digitally by downloading the **set extend position** and **set retract position** as hexadecimal values proportional to the actuator stroke. The range of position is 0000h to 0FFFh. The resolution corresponds to the scaled stroke of the valve actuator system. The extended and retract positions may also be uploaded from the SV after the initial analog setup is performed.

The SV needs to detect voltage levels that correspond to the actuator stroke at both extremes of travel. The detection can be achieved by first configuring the SV to a Home to Stall or Home to limit mode, powering up the SV, executing the selected homing mode, and then commanding and downloading positions at both extremes of travel.

12 COMMUNICATIONS

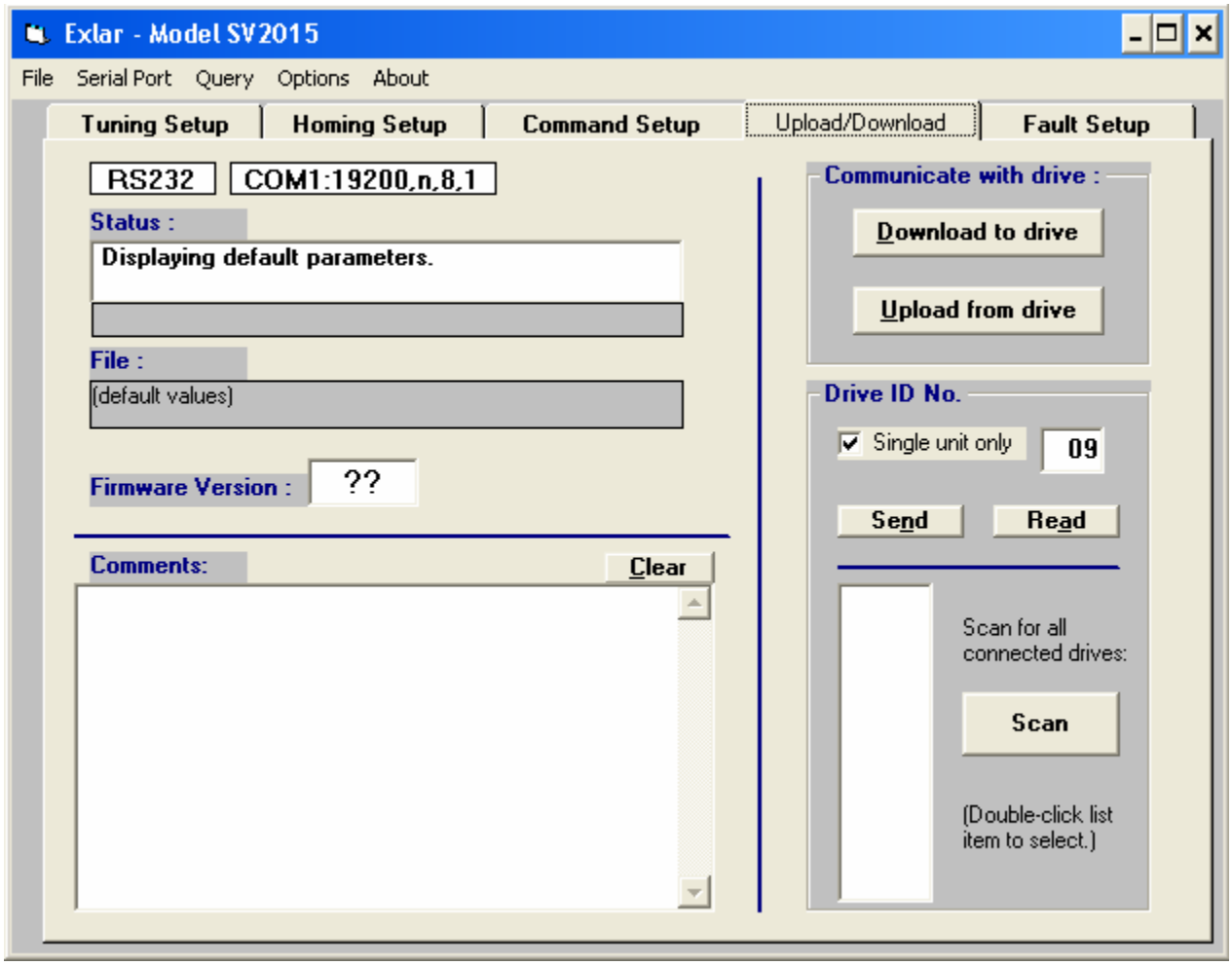


Figure 12: Upload/Download Tab

12.1 Status

The status window displays the latest activity of the communications of the SV. Some of the status messages include:

Displaying unit parameters - indicates that the data being displayed by the configuration program was uploaded from the SV.
Displaying default parameters - indicates that the parameters displayed are the configuration program defaults.
Displaying modified parameters - indicates that one or more of the parameters have been modified since the last upload.
Download Complete - indicates that the configuration parameters were successfully downloaded to the SV.

File read successful - indicates that a .DAT file from the PC has been successfully loaded to the configuration program.
Last Fault - identifies the last fault identified by the Query / Last Fault.
Upload Complete - the parameters were successfully uploaded from the SV to the configuration program.

12.2 File

The File display indicates the source of the configuration data. Some of the displayed messages include:

(Read from unit) - indicates that the configuration data was imported from the SV.
C:\SV2000\<filename>.DAT - indicates that the configuration data was imported from a data file on the PC.
(modified values) - indicates that the configuration data has been modified from the imported file.
(default values) - indicates that the configuration data contains default values. Data has not been imported from a saved file or from the SV.

12.3 Firmware Version

This display reports the version of the SV firmware following an **Upload from drive**.

12.4 Comments

The Comments Window allows the user to record comments or notes regarding the setup and operation of the process. These comments or notes are saved in the .DAT file and will be recalled when the .DAT file is opened. The comments are not saved in the SV.

12.5 Communicate with Drive

The **Download to Drive** button is pressed to send modified parameter information from the PC configuration program to the SV. If position relative information has been changed, the SV should be disabled when the information is downloaded to avoid sudden motion of the actuator.

The **Upload from Drive** button is pressed to upload the current parameter values from the SV to the SV Series Configuration Software.

12.6 Drive ID

If using RS485 communications, multiple SVs may be daisy-chained on the same communication line. Unique drive ID numbers can be set for each unit, allowing for discreet communications to each SV. SVs may be identified from 00 to 99. If only a single unit is being used, **single unit only** can be selected to eliminate a step of confirming the ID in the upload and download processes. The Send and Read buttons are used to send a particular SV a drive ID number, or read the current drive ID number from a particular SV. The default ID is 09, which is considered a broadcast ID.

12.7 Scan

Pressing the Scan button causes the configuration program to scan for the SVs connected to the RS485 communications lines. A list of ID numbers of connected SVs is displayed.

13 FILE MENU

13.1 Saving Files

When a configuration is completed within the SV Series Process Controller it can be saved as a .DAT file. With the current parameter settings displayed within the configuration Software, select *Save As* from the *File* menu. .DAT files for the SV can be saved in the default directory for the software, in other network folders, or to removable media drives.

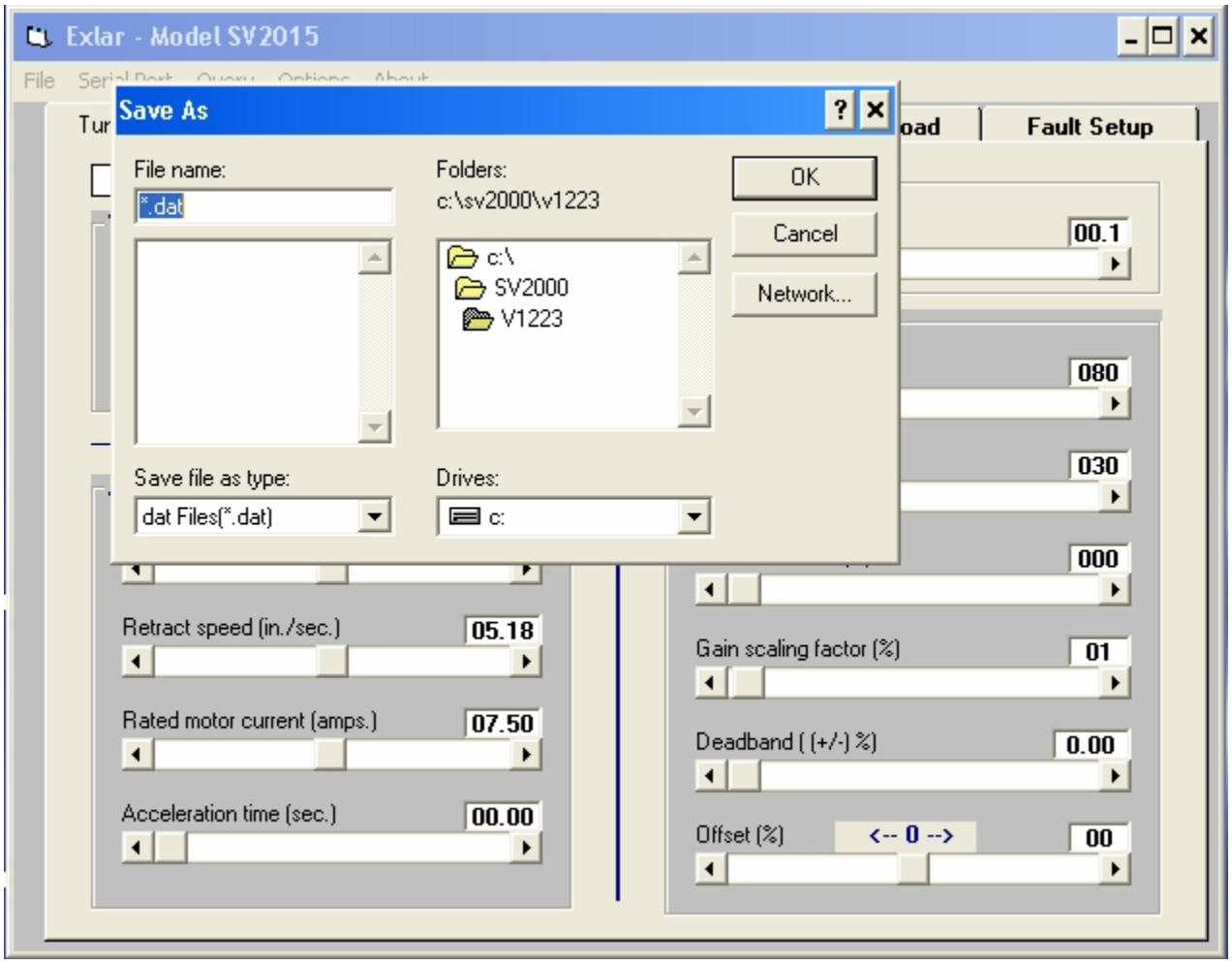


Figure 13.1: Save As Screen

Any time the download to drive action is initiated, the values present in the configuration software are loaded to the SV and stored until another data set is downloaded.

13.2 Opening Files

To open an existing .DAT file for the SV select *Open* from the *File* menu. Select the local disk drive or network location of the .DAT files and select the appropriate file. Click OK to open the file and load the values into the configuration software. The values in the saved .DAT file are not loaded into the SV until the download function is used.

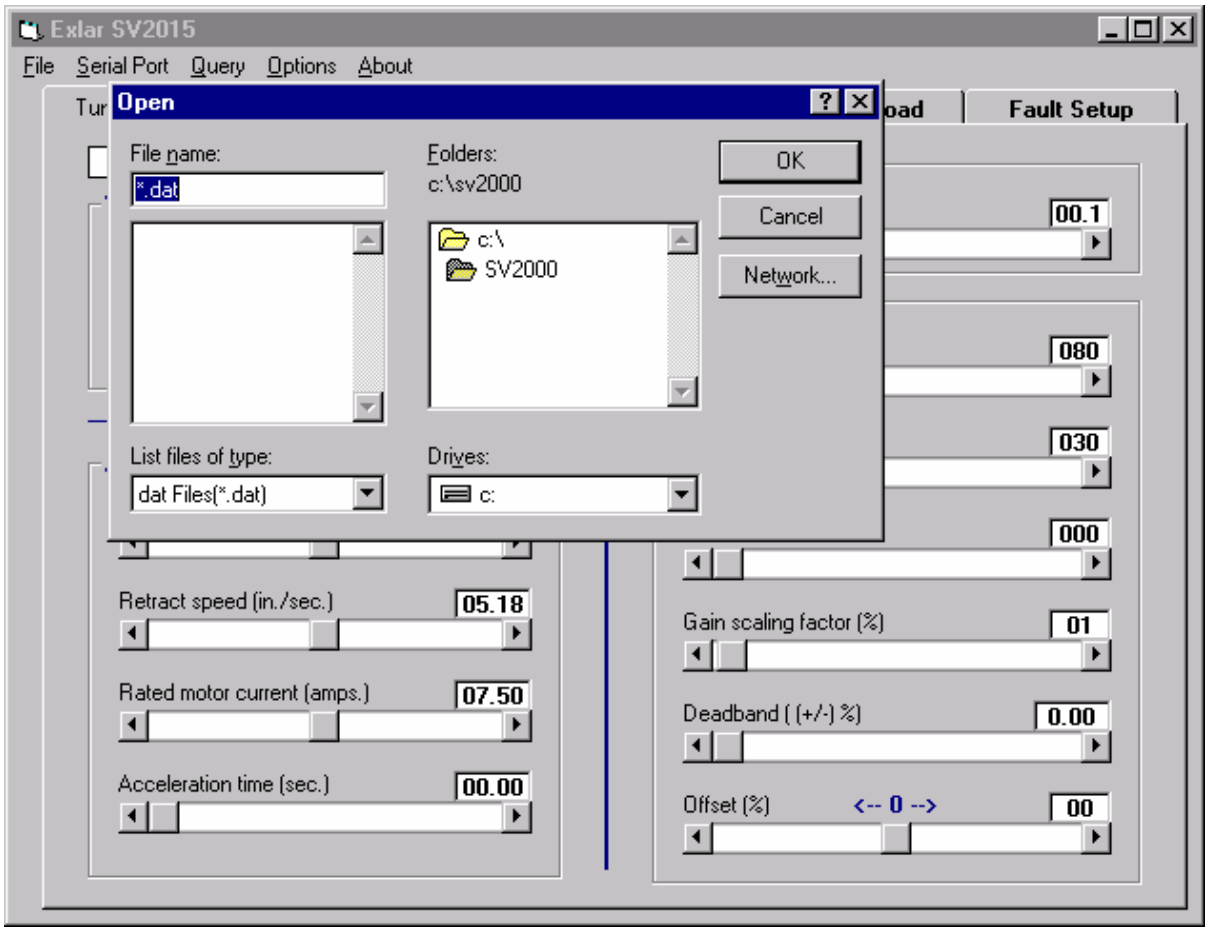


Figure 13.2: Open Screen

14 MONITORING THE SV

The SV Configuration Software is equipped with a monitoring window. This monitoring window provides feedback of position command (mA), actual position (mA), motor current (amps), motor revolutions (revolutions, a reference to the position of the actuator) and the heat sink temperature (degrees Centigrade or Fahrenheit).

14.1 Opening the Monitor Window

To open the Monitor window, select *Monitor Drive…* from the *Query* menu.

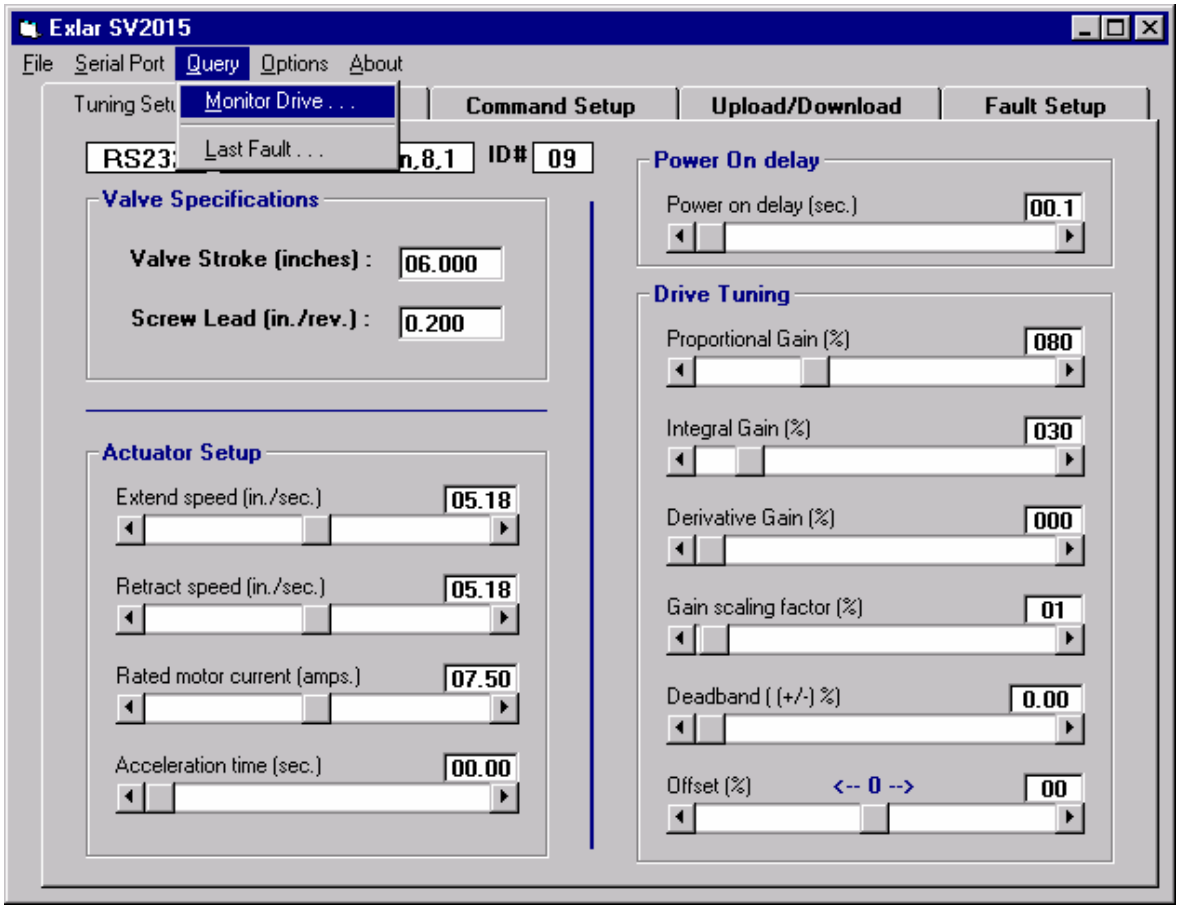


Figure 14.1: Selecting the Monitor

14.2 Using the Monitor Window

Once opened, press the *Monitor* button to activate the monitor window. The black dot will flash red, indicating that data is being exchanged with the SV.

To discontinue the monitor process, press the *Stop* Button. To Exit the monitor window press the *Close* button.

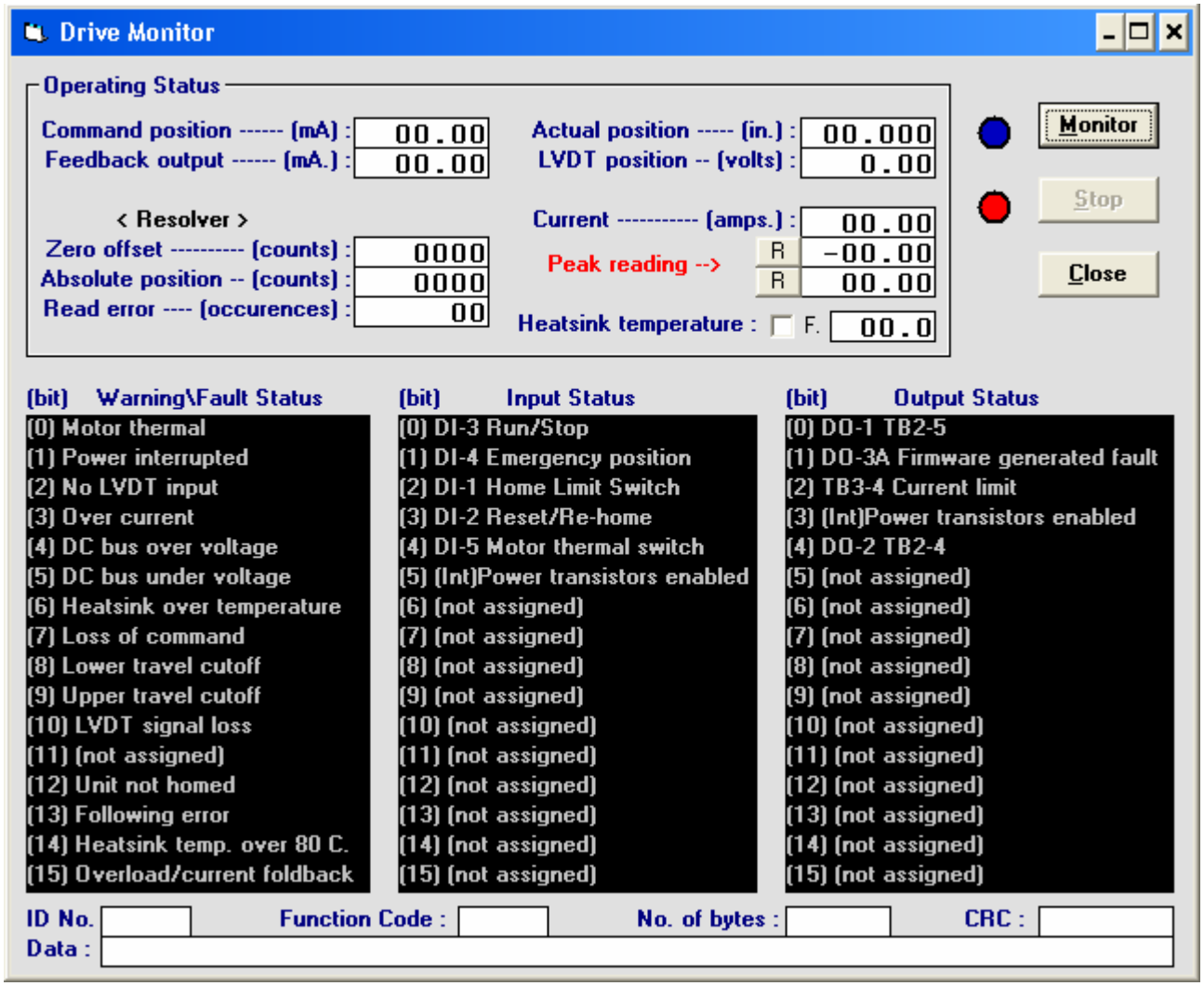


Figure 14.2: Drive Monitor View

Note - When the command source is the +/-10V auxiliary input, the Command position of the Drive Monitor will be displayed in volts. However, the Actual position is always displayed as a 4-20 mA position.

15 Fault Setup Tab

If a fault occurs, the user can choose the action that results when the fault is detected. The actions are programmed through the use of checkboxes under the Fault Output Assignment section. Also, the user has the ability to set up the conditions that generate a following error fault.

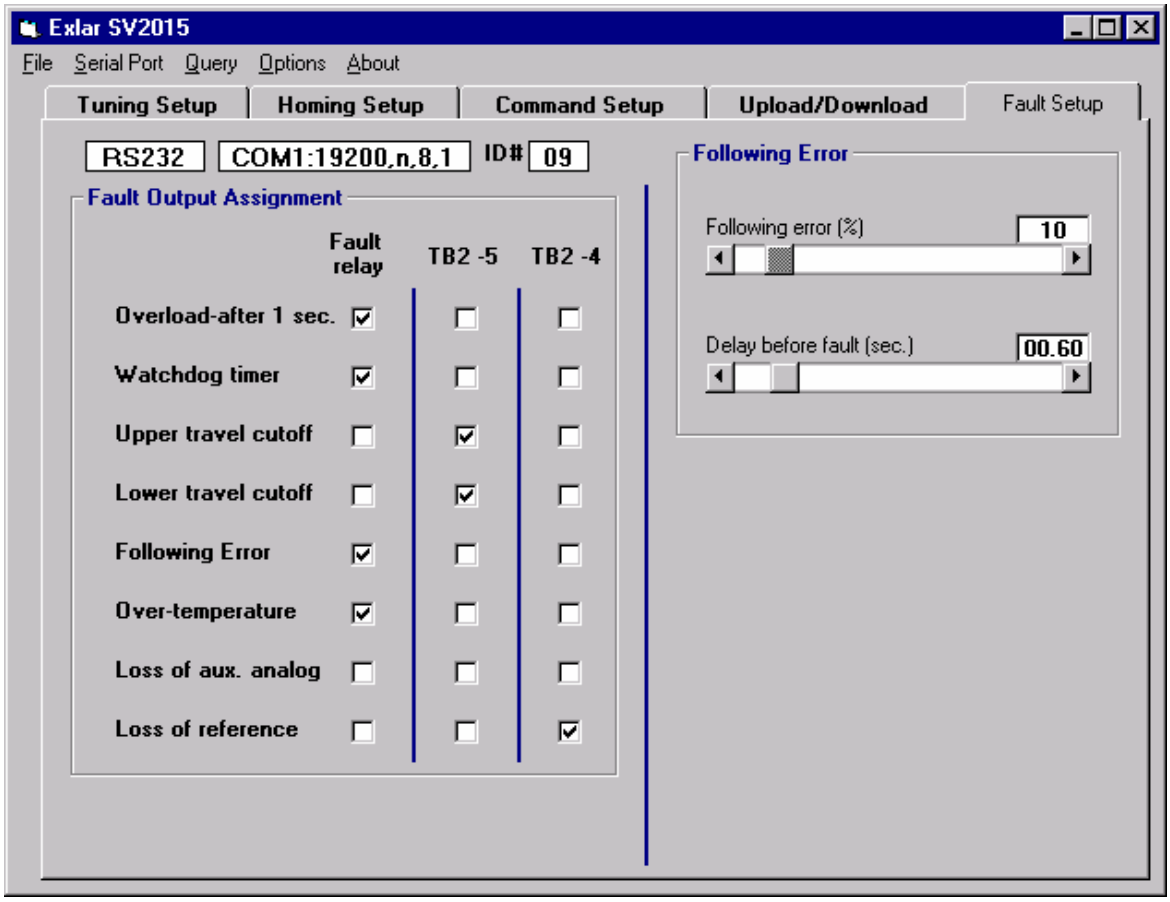


Figure 15: Fault Setup View

15.1 Fault Output Assignment

There are 3 checkboxes besides each of the detected faults for the SV. The checkboxes in the **Fault relay** column, when checked, will cause the SV to fault and disable when a fault is detected. If the Fault En input (TB3-10) is enabled, then the fault relay (TB3-8 and TB3-9) will also open to provide an external indication of

the fault status of the SV. If the checkbox is not checked in this column, the SV will not fault and disable, but will continue to operate. In the case of "Overload- after 1 sec.," the current will fold back to the programmed rated motor current value in the Tuning Setup tab (see Section 9.2.2).

The TB2-5 and TB2-4 columns provide a means of warning through a digital output that the selected faults have been detected. However, the SV will not be disabled. This allows a supervisory controller to determine actions to be taken when faults and warnings are detected and provide for a controlled shut-down. "TB2-5" and "TB2-4" refers to the hardware connector and pin s for the two outputs.

15.2 Following error

A detection of following error provides a level of safety that detects when the SV is not responding appropriately to the position command input signal. The **Following error (%)** defines the amount of following error that is allowed. The data is entered as a percentage of the full stroke.

The **Delay before fault (sec)** defines the time that the following error limit can be exceeded before the fault occurs.

15.3 Hardware Faults

The following faults are not programmable as warnings and will always disable the SV and generate a fault:

- Power interrupt or AC line loss
- High bus voltage
- Low bus voltage
- Motor thermal
- Motor over current
- SV Heat Sink temperature > 90°C

Appendix

A1. Technical Specifications

Power Input	SV2015-x-S	71 -240 VAC, 3ϕ or 1ϕ, 15 A rms 100 - 350 VDC, 15 A
	SV2008-x-S	71 -240 VAC, 3ϕ or 1ϕ, 7 A rms 100 - 350 VDC, 15 A*
	SV2015-x-24	20 - 50 VDC, 15 A
	SV2008-x-24	20 - 50 VDC, 15 A* * SV2008 can handle higher input currents for DC voltage input.
Power Output	SV2015-x-x	2.5 KW maximum 15 A rms Continuous at 45 °C for 3ϕ AC input 12 A rms Continuous at 60 °C for 3ϕ AC input (Derate 0.2A/°C above 45 °C) 7 A rms Continuous for 1ϕ AC input 15 A rms Continuous for 1ϕ DC input 30 A rms Peak for 1 second
	SV2008-x-x	2 KW maximum 8 A rms Continuous at 60 °C for 3ϕ AC input 7 A rms Continuous for 1ϕ AC input 15 A rms Peak for 1 second
DC Bus Regulator	SV20xx-x-S	400V turn-on voltage 27Ω, 300 W continuous 4500 W peak
	SV20xx-x-24	65V turn-on voltage 27Ω, 300 W continuous 4500 W peak
Discrete Inputs	All SV2000 models	Optically isolated, dual ended, 24V, 5 mA turn-on, 16.5 mA max: TB1-9, TB1-10 Enable/Run TB1-11, TB1-12 Move to Emergency Pos
Discrete Inputs		Optically isolated, single ended, 15V, 3.2 mA: TB2-1, TB2-2 Motor Thermal Input

(continued)		Non-isolated, TTL, single-ended, active low, 5V, 6 mA nominal: TB1-8 - Home Limit switch TB1-7 - Home Initiate TB1-6 - Thermal Fault Report
Discrete Outputs	All models	Relay contact, Normally closed, 0.5 Amp max: TB3-8, TB3-9 Fault Out Open collector, Sinking, 50 mA max: TB2-3 - Not used TB2-4 - Programmable as Warning TB2-5 - Programmable as Warning TB1-4 - In Current Limit
Environment	All models	Operating Temperature: 0 - 60 °C Storage Temperature: -40 - 70 °C Humidity: 5% to 95% non-condensing Altitude: 5000 ft., derate 3% per 1000 ft. above 5000 ft.
Analog Inputs	All models SVxxxx-S-x SVxxxx-10V-x All models	**4 - 20 mA** TB3,15 - TB3,16 Position Command Input, 12 bit **-10V - + 10V** TB3,14 Auxiliary Position Command Input, 12 bit **0 - 10V** TB3,14 Auxiliary Position Command Input, 12 bit **0 - 5V** TB3,13 Absolute Position Feedback, 12 bit
Analog Output	All models	4-20 mA TB3,11 - TB3,12 Actual Position 12 bit resolution
Feedback	All models	Resolver: Excitation - 2 Vrms adustable, 5 KHz nominal SIN - 1 Vrms COS - 1 Vrms Alignment - COS maximum coupling to Excitation as motor R phase crosses 0 rising. SIN leads COS for clockwise rotation of the rotor facing mounting plate.
PWM Frequency	SV2008, SV2015	17 KHz nominal
Regulation	All models	0.626 millisecond update and sampling rate
Supply load	All models	+/-10V – 20 mA available for customer circuits
Micro-controller	All models	Intel TN87C251SB16
Serial Comms	All models	RS-485. Up to 32 drives linked. RS-232 can be used on some PC's, but is not recommended or guaranteed. For communicating with PC's with RS-232, we recommend using an RS-232/RS-485 Converter, such as the B&B Model #4850T9L.

A2. Error Messages

Determination of faults and warnings for the SV products requires communications through the serial interface, whether through the SV Configuration Software or through Modbus. To determine errors using the Configuration Software, the Query/Last Fault menu item will report the last detected fault. The messages that are displayed are shown below.

A2.1. Faults

Fault Message	Detected Problem	Action/Solution
LOSS OF COMMAND	4-20 mA Position Command signal has dropped below 2 mA.	Check for broken wires or bad connections to TB3-15 and TB3-16.
HEATSINK OVER TEMPERATURE	The SV heatsink has exceeded maximum allowed temperature of 90°C.	Check that fans are operational. Check for poor cabinet ventilation.
BUS UNDER VOLTAGE	The DC bus voltage has dropped below minimum operational bus voltage.	Verify proper voltage at power input.
BUS OVER VOLTAGE	The maximum allowed bus voltage has been exceeded. (Probably due to shunt circuit not operating.)	Verify fuse between TB4-6 and TB4-11 is not blown. See note below.
OVER CURRENT	The maximum allowed current has been exceeded.	Check motor cable and connections for short circuits. Check motor for shorts or overheating.
LVDT SIGNAL LOSS	The auxiliary analog input signal is outside the appropriate voltage range of 0.25 – 4.75V.	Check for broken wires or bad connections to TB3-13.
POWER INTERRUPTED	The input voltage has dropped below the minimum voltage.	Check the L1, L2, and L3 input voltages. Detection circuit is between TB4-4 and TB4-5. TB4-3 is not monitored.
MOTOR THERMAL	The thermal switch in the actuator has opened due to excessive temperatures.	If actuator is cold, check for broken wires or connections to TB2-2, TB2-1 and TB1-6.
OVERLOAD	The motor current exceeded the programmed rated motor current for more than one second.	Check for excessive friction at the actuator or low rated motor current value.

Note that voltages exceeding the specified range on the Aux PCMD (TB3-14) and the Abs Pos (TB3-13) inputs may result in erroneous fault indications such as, BUS OVERVOLTAGE, LOSS OF COMMAND, LVDT SIGNAL LOSS, or OVERLOAD.

A2.2. Warnings

Warning Messages	Detected Problem	Action/Solution
HEATSINK TEMPERATURE OVER 80 DEG.C	Heatsink temperature is above 80°C	Check both fans on the SV.
FOLLOWING ERROR	The maximum allowed following error has been exceeded for more than the programmed following error time.	Check for excessive friction at the actuator shaft. Check for reduced current due to current foldback. Check for appropriate accel time, rated motor current, following error, and tuning parameter values.
LVDT SIGNAL LOSS	The LVDT signal is not within 0.25 to 4.75 V.	Check for broken wires or bad connections to TB3-13.
UPPER TRAVEL CUTOFF	The position command has exceeded the programmed upper travel cutoff position.	Verify configuration parameters. Verify position-related parameter calibrations. Check position command.
LOWER TRAVEL CUTOFF	The position command has exceeded the programmed lower travel cutoff position.	Verify configuration parameters. Verify position-related parameter calibrations. Check position command.

A2.3. Communications Errors

Fault Message	Detected Problem
Received invalid data	A parameter value from the drive was determined to be outside the range of acceptable values.
Verify error	Values sent to the drive are sent back. The return value does not match the one sent.
Unit not responding	A request for data was sent to the drive and the drive did not respond within an acceptable time.
Unit has stopped responding	Same as “Unit not responding,” but for the monitor screen and modbus protocol.
CRC checksum failure	An invalid CRC was computed for the modbus message.
Overflow	
Type mismatch	

A3. VRVT Setup Procedure

The VRVT is a device that consists of a rod and a cylinder with coils and an electronic conditioning module. The conditioning module is connected via short wires to the VRVT and is usually located very close to the actuator. A long cable may connect the conditioning module to the controller. As the rod is moved in the cylinder the position of the rod changes the coupling of the magnetic field in the cylinder. A signal conditioner is required to provide the excitation signal and to receive the feedback signal and to convert it to an analog voltage, which is the output that is connected to the Abs Pos input at TB3-13. Due to the fact that the actuator position is determined by changes in the magnetic field in the VRVT, it has become evident through testing that magnetic fields external to the VRVT sensor can affect the position measurements. For this reason, in order to use the VRVT as a position measurement device, there must not be any currents in the Exlar actuators when the absolute position is determined. This includes current through the motor phases and through brakes integrated into the actuators.

When setting up the VRVT, there are some conditions to be aware of:

- The VRVT conditioning module requires a warm up time of more than 3 minutes in order to provide an accurate feedback signal. As a result, the conditioning module must be powered at least 3 minutes prior to calibration of the VRVT.
- The VRVT responds to magnetic fields, including the current in the motor windings and in a brake integral to the actuator (if so equipped). During VRVT calibration and also during power up, it is important to have no current through the motor or brake until the VRVT position is read by the drive.
- The voltage applied to the Abs Pos (TB3-13) by the VRVT conditioner output must be in the operating range of 0.25 to 4.75 V. When this range is exceeded, a “LVDT signal loss” error results.

A suggested setup procedure for determining absolute position during power up using a VRVT is as follows:

1. Set the jumpers in the VRVT conditioning module such that the retract voltage is less than the extend voltage and will be in the 0-5V range. This would normally be the 0-5V setting, however, if the actual stroke length of the application is less than half the actuator stroke length then the 0-10V setting may provide greater resolution and still be within the 0-5V requirement because of the reduced stroke length.
2. Connect the VRVT conditioner output to the Abs Pos input (TB3-13) on the SV. The COMMON connection on the conditioner must be connected to COMMON (TB3-5 or TB1-4 or TB1-5).
3. With the PC connected to the SV through the RS-485 and the actuator connected, apply power to the SV. If a brake is included in the actuator, release the brake by applying 24V.
4. Using the SV Configuration Software, upload the parameters from the SV.

5. Go to the Homing Setup Tab and set the Homing mode to “Home to stall”. Set the Home current and Home speed to appropriate values. Under the Upload/Download tab, press “Download to drive”.
6. Cycle power to the SV. When power is cycled and the SV is enabled, the actuator will move in the Home direction until it stalls (current reaches the Home current). The position where the actuator stalls will be the home position. After about 1 second in the stalled position, the actuator will then move to the reference position from PCMD or Aux. PCMD, whichever is selected as the command source under the command setup tab.
7. Change the position reference command to place the actuator in the desired fully retracted position.
8. Disable the drive (remove Enable/Run at TB1-9 and TB1-10). If a brake is included in the actuator, remove power to the brake. Power to the SV must remain.
9. Adjust the offset on the VRVT conditioning module to produce a positive voltage greater than 0.2V
10. Go to the Homing Setup tab and press the “Read Retract” button under “LVDT Feedback Input Setup”. The Abs Pos input voltage is read and converted to a digital number which is displayed in the “Set retract position”.
11. Restore power to the brake and enable the SV. Change the position reference command to place the actuator in the desired fully extended position.
12. Adjust the Gain on the VRVT conditioning module to produce a voltage of just under 5V. Note that the offset value determined in 9 above may change as the scale is adjusted and steps 7-12 may have to be repeated multiple times to achieve desired voltages.
13. Disable the drive (remove Enable/Run at TB1-9 and TB1-10). If a brake is included in the actuator, remove power to the brake.
14. Go to the Homing Setup tab and press the “Read Extend” button under “LVDT Feedback Input Setup”. The Abs Pos input voltage is read and converted to a digital number which is displayed in the “Set extend position”.
15. At this point the SV absolute position data has been stored in the SV.
16. Set the Homing mode to “Home using LVDT feedback”
17. In order to provide sufficient delay to allow the VRVT to be read after power-up with no power to the actuator or brake, it is suggested that the “Power on delay (sec)” under the Tuning Setup tab be set to a value greater than 2 seconds.
18. Under the Upload/Download tab press “Download to drive”.

A4. Communicating via Modbus

The SV provides a Modbus interface for communications to supervisory controls and monitors. In order to use the Modbus protocol, the RS-485 communications mode must be used. RS-232 communications cannot be used with Modbus for this product. This section describes the Modbus registers that are available.

The Modbus protocol follows the form:

Address	01H	ID of SV
Function Code	04H	Read Input Register
Register Starting Address	0002H	Start with register 3
Quantity of Inputs	0002H	Read 2 registers
CRC	D00BH	Checksum

The response from the SV if there are no errors follows the form:

Address	01H	ID of SV
Function Code	04H	Read Input Register
Byte Count	04H	4 bytes of data
Register Data	0623H	Register 3 data
	00EDH	Register 4 data
CRC	CA9AH	Checksum

If there are errors the response follows the form:

Address	01H	ID of SV
Function Code	84H	Function code + 80H
Exception code	07H	Exception 07
CRC	XXXXH	Checksum

Exception codes:

Only exception code 07 which indicates a NAK, or no acknowledge, is supported with this product. If there are any detected communications problems, exception code 07 is sent.

Supported Modbus Registers:

Address	Bytes	Read/Write	Description [scale]
0001H	2	R	LVDT Analog Input [0000 to 0FFF = 0 to 5V]
0002H	2	R	Resolver absolute position at home reference [0000 to 0FFF].
0003H	2	R	4-20 mA Command Input [0000 to 0FFF = 0 to 20 mA]
0004H	2	R	Heatsink Temperature [0000 to 03E8 = 0 C to 100 C]
0005H	2	R	Current Loop Command [0000 to 0FFF = -30 to 30 Amps for SV2015] [0000 to 0FFF = -15 to 15 Amps for SV2008]
0006H	2	R	4-20 mA Output [0000 to 0FFF = 0 to 20 mA]
0007H	2	R	Actual Position from Resolver [0000 to 0FFF = 0 to full stroke]
0008H	2	R	Warning & Fault bits (see below for bit definitions)
0009H	2	R	Input Status (see below for bit definitions)
000AH	2	R	Output Status (see below for bit definitions)
000BH	2	R	Resolver error counter (in high byte), [Rev. DR or later firmware required.]
000CH	2	R	Resolver absolute position, [Rev. DR or later firmware required.]
0015H	2	W	Position Command [0000 = Follow analog input cmnd] [0001 to 0FFF = 0 to full stroke]

Warning & Fault Bit Definitions (0008H)

Bit	Type	Description
0	Fault	Motor Thermal
1	Fault	Power Interrupt
2	Fault	LVDT Input
3	Fault	Over Current
4	Fault	DC Bus Overvoltage
5	Fault	DC Bus Undervoltage
6	Fault	Heatsink Overtemperature
7	Warning	Loss of Command
8	Warning	Lower Travel Cutoff
9	Warning	Upper Travel Cutoff
10	Warning	LVDT Signal Loss
11		Undefined
12		Undefined
13	Warning	Following Error
14	Warning	Heatsink Temperature Exceeds 80 C
15	Warning	Overload / Current Foldback

Input Status Bit Definitions (0009H)

Bit	Input	Description
0	TB1-9,10	Enable/Run [1 = Enabled]
1	TB1-11,12	Emergency Position [1 = On]
2	TB1-7	Home Limit Switch [1= On]
3	TB1-8	Home Initiate [1 = On]
4	TB1-6	Motor thermal report [1 = Motor therm OK]
5	Internal	Power transistors enabled [1 = disabled]
6		Undefined
7		Undefined
8		Undefined
9		Undefined
10		Undefined
11		Undefined
12		Undefined
13		Undefined
14		Undefined
15		Undefined

Output Status Bit Definitions (000AH)

Bit	Output	Description
0	TB2-5	Assigned Warning Output
1		Firmware Generated Fault
2	TB3-4	Current Limit Output
3	Internal	Power Transistor Enable
4	TB2-4	Assigned Warning Output
5		
6		Undefined
7		Undefined
8		Undefined
9		Undefined
10		Undefined
11		Undefined
12		Undefined
13		Undefined
14		Undefined
15		Undefined

A5. Redundant Operation

In some applications, it is necessary to have backup systems that begin operating when a primary system fails. The SV has incorporated functionality to provide for redundant operation. In order to understand the operation of a redundant system, consider two SVs connected to two actuators. One SV is labeled the primary and the other is the secondary, or backup. In order for this system to operate properly, several conditions must be met:

- The primary and the secondary actuators must be homed
- Only one allowed to operate at a time
- If the primary fails, the secondary must take over control
- Either the primary or secondary system must be able to be removed without interrupting the normal operation of the system that is in control
- Either the primary or the secondary systems must be able to home without interrupting the normal operation of the system that is in control
- Control should be able to switch between the primary and secondary systems without significant disturbances.

A5.1. Setting the SV for redundant mode of operation

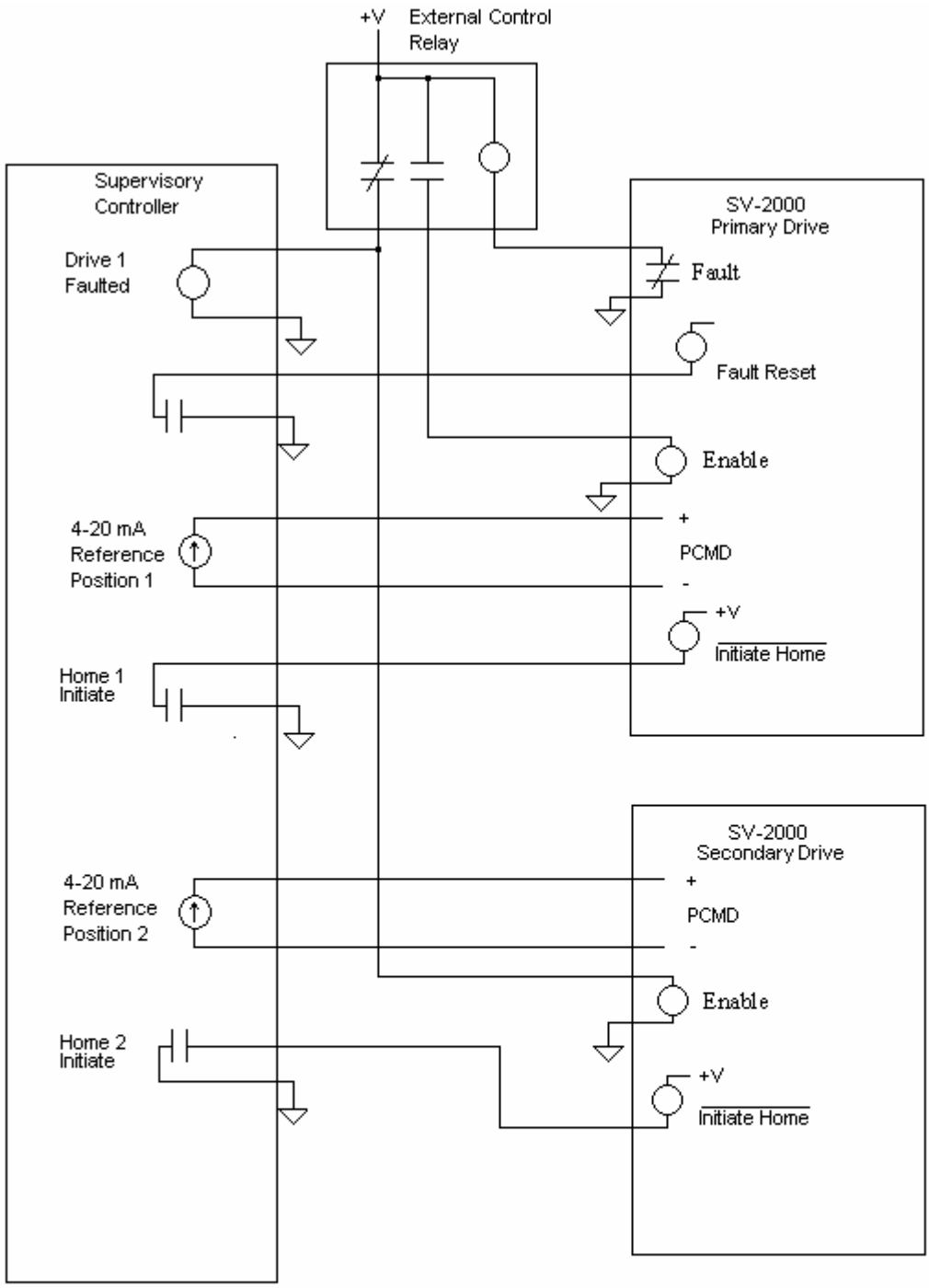
In order to change the SV to operate in the redundant mode, the customer.ini file in the SV directory must be modified. The mode of operation is set by editing the "OPTION" as follows:

OPTION=XRS (for simplex or non-redundant operation)
OPTION=XRD (for duplex or redundant operation)

A5.2. Functional effects of redundant mode

When in redundant mode of operation, the following functional changes occur:

A5.2.1. Home Limit input becomes the Fault Reset input
A5.2.2. SV is in the fault condition on power up
A5.2.3. Home Initiate sets resolver feedback position to 4-20 mA position if SV is disabled


+V
External Control Relay
Supervisory Controller
SV-2000 Primary Drive
Drive 1 Faulted
Fault
Fault Reset
Enable
4-20 mA Reference Position 1
+
PCMD
-
+V
Initiate Home
Home 1 Initiate
SV-2000 Secondary Drive
4-20 mA Reference Position 2
+
PCMD
-
Enable
Home 2 Initiate
+V
Initiate Home

A6. Warranty

EXLAR CORPORATION GUARANTEES ITS PRODUCTS AGAINST DEFECTS IN WORKMANSHIP AND MATERIALS FOR A PERIOD OF TWELVE (12) MONTHS FROM DATE OF PURCHASE, NOT TO EXCEED TWENTY-FOUR (24) MONTHS FROM DATE OF MANUFACTURE. FINAL DETERMINATION OF WHETHER A DEVICE IS DEFECTIVE RESTS WITH EXLAR CORPORATION. EXLAR CORPORATION MUST BE NOTIFIED ABOUT ANY ALLEGED DEFECTS, AND WILL PROVIDE THE CUSTOMER WITH SHIPPING INSTRUCTIONS. IF INSPECTION REVEALS DEFECTS CAUSED BY FAULTY MATERIALS OR WORKMANSHIP, EXLAR RESERVES THE RIGHT EITHER TO REBUILD THE DEVICE USING NEW OR REFURBISHED AND WARRANTED PARTS OR TO REPLACE THE DEVICE WITH A NEW DEVICE, RETURNING TO THE BUYER A DEVICE MEETING FULL FACTORY STANDARDS FOR NEW PERFORMANCE. ANY REPAIRS NECESSARY DUE TO CUSTOMER MODIFICATION WILL BE CONSIDERED NON-WARRANTY AND BILLED BY THE FACTORY AT CURRENT RATES. BUYER WILL BEAR COSTS OF TRANSPORTATION TO AND FROM THE FACTORY, RISK OF LOSS FOR GOODS NOT AT THE FACTORY, AND COSTS REQUIRED TO REMOVE OR PREPARE FOR SHIPMENT AND TO REINSTALL EQUIPMENT AFTER REPAIR. EXLAR CORPORATION ASSUMES NO RESPONSIBILITY FOR INJURIES OR DAMAGES TO PERSONS OR PROPERTY ARISING OUT OF IMPROPER USE OF THIS DEVICE, AND EXLAR CORPORATION'S LIABILITY ARISING OUT OF THE DEVICE OR ITS USE, WHETHER ON WARRANTY OR OTHERWISE, SHALL NOT EXCEED THE COST OF CORRECTING DEFECTS. THERE ARE NO EXPRESSED OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE THAT APPLY TO THIS DEVICE. EXLAR CORPORATION RESERVES THE RIGHT TO MAKE CHANGES OR IMPROVEMENTS IN ITS PRODUCTS WITHOUT INCURRING ANY OBLIGATION TO MAKE SUCH CHANGES OR IMPROVEMENTS IN THE SIMILAR PRODUCTS PREVIOUSLY PURCHASED.

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