LVD Servo Drive

User Manual

Manual Revision: **3.1**
Firmware Version: **3.1.0**

Revision History

Document Revision	Date	Remarks
3.1	Mar. 2012	Digital I/O update
3.0	Mar. 2012	Support for additional inputs/outputs. Extended I/O. External enable. DIP switches. Dimensions.
2.1	Sep. 2011	Updated Documentation Set Correction p.31: Load from File
2.0	May 2011	Chapters/pages renumbered. Figures 4-4 and 4-5 fixed.
1.2	Mar. 2011	
1.1	Feb. 2011	Table 3-1 updated to include specifications for brush DC and voice-coil motors
1.0	Feb. 2011	Initial release

Hardware Revision	Firmware Revision	Software Revision	Remarks
5	3.1.0	1.0.0.5	

Important Notice

Disclaimer

The information in this manual was accurate and reliable at the time of its release. Servotronix Motion Control Ltd. reserves the right to change the specifications of the product described in this manual without notice at any time.

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For technical support, contact:
tech.support@servotronix.com

To order products, contact:
orders@servotronix.com

For all other inquiries regarding LVD drives or other Servotronix products, contact:
customer.service@servotronix.com

Part Number

For ordering the standard LVD, use part number: LVD48701

Warranty

The warranty is valid for 12 months from the date of shipment and applies only if material or workmanship is found to be defective. The warranty will be invalid if the customer fails to install, operate or maintain the product in accordance with the instructions in this user manual.

During the warranty period, the owner must pay the cost of shipping the product to the factory for repair, and Servotronix will pay for shipping the repaired product to the customer.

After the warranty period has expired, all shipping costs will be the responsibility of the customer.

Before returning the product, the customer must first request a Return Materials Authorization (RMA) number from Servotronix by email to rma@servotronix.com

The complete Warranty Statement can be found in the Terms and Conditions document on the Servotronix website:
www.servotronix.com/customer-service.html

Contents

1 Introduction

1.1 Documentation

1.1.1 About This Manual

This manual describes the Servotronix LVD digital servo drive.

It provides the information required for installation, configuration and basic operation of the LVD unit.

Note: This document is meant for skilled personnel who have been trained to work with the equipment described.

1.1.2 Documentation Set for the LVD

This manual is part of a documentation set. The set consists of the following:

- **LVD User Manual**. Hardware installation, configuration and operation.
- **LVD VarCom Reference Manual**. Parameters and commands used to program the LVD.
- **LVD CANopen Reference Manual**. LVD implementation of CiA 402 and 301 protocols.

1.2 Safety

The LVD is designed according to the guidelines of safety standard IEC 61800-5-1 second edition. In addition, the LVD is considered partly completed machinery according to EU directive 2006/42/EC (Article 2, Clause (g)), and is intended to be incorporated into other machinery.

Only qualified personnel are permitted to assemble, commission, and maintain this equipment. Properly qualified personnel are persons who are familiar with the assembly, installation, commissioning and operation of motors, and who have the appropriate qualifications for their jobs.

For safety, perform all of the following:

- Read all available documentation before assembling and commissioning. Incorrect handling of products can result in personal injury and equipment damage. Strictly heed all technical information regarding installation requirements.
- It is vital to ensure that all system components are connected to earth ground. Electrical safety is provided through a low-resistance earth ground connection (chassis).
- Be aware that during operation the product has electrically charged components and hot surfaces. The heat sink can reach a temperature of 80°C (176°F). Power cables can carry a high voltage even when the motor is not rotating.
- To avoid electric arcing and hazards to personnel and electric contacts, never disconnect or connect the product while the power source is energized.

1.3 Standards Compliance

- **CE**: The LVD is designed to meet the CE mark requirements for EMC.
- **UL:** Testing for conformance to UL508C is pending. UL508C conformance will apply only to operation up to 32 VDC.
- **RoHS**: The LVD complies with the Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment 2002/95/EC, commonly referred to as the Restriction of Hazardous Substances Directive (RoHS).

2 Product Description

2.1 Overview

2.1.1 General Description

The LVD is a compact, low-voltage, single-axis servo drive. LVD is a fully digital amplifier designed for driving brushed and brushless DC motors.

The LVD is powered by a 12-48 VDC supply, and is capable of sourcing 7A RMS continuous current, and 12A RMS peak current. The LVD can be operated in current, velocity or position mode. The PWM switching frequency can be set up to 100 kHz. Combined with advanced space-vector modulation, this enables operation with low inductance motors while minimizing current ripple and eliminating acoustic noise.

The LVD supports both RS-232 and CANopen communication interfaces, and operates in compliance with DS402 CANopen® device profile.

Configuration of the drive can be easily performed using the **Axis Manager** software supplied with the LVD.

2.1.2 Product Options

No product options are currently available.

2.2 Technical Specifications

2.2.1 Mechanical

Refer to *Figure 3-2* for a mechanical drawing showing the dimensions of the LVD.

Table 2-1. LVD Mechanical Specifications

Feature	Specification
Weight	250g, not including mating connectors
Dimensions	(L x W x H) 117 x 83.5 x 21.5 mm (L x W x H) 4.6 x 3.3 x 0.85 inch
Mounting	Brackets for vertical or horizontal mounting

2.2.2 Electrical

Table 2-2. LVD Electrical Specifications

Feature	Specification
Motor	Up to 475W Brush DC Brushless DC
Control modes	Interpolated position mode (PVT) Position control Velocity control Torque (current) control
Feedback	Incremental encoder with Hall sensors or commutation tracks
RMS continuous current	7 A
RMS peak current	12 A
Logic voltage (separate supply)	10 – 36 VDC
Bus voltage (separate supply)	12 – 48 VDC
Maximum output voltage	100% of operating voltage
PWM frequency	16 or 100 kHz
Maximum incremental encoder frequency	3 MHz
Sample rate - current loop	16 kHz
Sample rate - velocity loop	5.33 kHz
Sample rate - position loop	2.66 kHz

Table 2-3. Derating at 16 kHz PWM Frequency

	DC Brushless Motor						DC Brush Motor
Input voltage (V)	24 VDC		36 VDC		48 VDC		24 to 48 DC
Output current (A)	6	7	6	7	6	7	7
Maximum ambient temperature (°C)	45	35	45	35	45	35	45

Table 2-4. Derating at 100 kHz PWM Frequency

	DC Brushless Motor						DC Brush Motor	
Input voltage (V)	24 VDC		36 VDC		48 VDC		24 VDC	48 VDC
Output current (A)	4.5	5.5	5	6	3.5	4.5	6.5	5.5
Maximum ambient temperature (°C)	45	35	45	35	45	35	45	45

2.2.3 Inputs and Outputs

The I/O interfaces are located on the front panel of the LVD, as shown in *Figure 3-4*.

Table 2-5. LVD Input and Output Specifications

Feature	Specification
Inputs	**6 opto-isolated digital inputs**, configurable as dedicated inputs (over-travel limits and Home) Input Voltage Range: 6.5V to 24V Maximum current consumption: 10.7mA Input resistance: 2.5KΩ **2 configurable ±10 VDC analog inputs,** Gain Error < ±1.5%, Offset Error <±1.5% Analog to Digital 12 Bit Resolution Worst accuracy: 11.978 bits Band width: 8K
Outputs	**2 opto-isolated digital outputs**, controllable over the CAN bus Maximum current consumption: 110mA
External Enable	**1 opto-isolated digital input** (optional bypass using DIP switch) Input Voltage Range: 6.5V to 24V Maximum current consumption: 10.7mA Input resistance: 2.2KΩ

2.2.4 Communication

The communication interfaces are located on the front and side panels of the LVD, as shown in *Figure 3-4* and *Figure 3-6*.

Table 2-6. LVD Communication Specifications

Feature	Specification
Serial	RS-232 (115 kbps)
CAN	CANopen DS301 CANopen DS402

2.2.5 Environment

Table 2-7. LVD Environment Specifications

Feature	Specification
Operating temperature	-10 to 45°C (14° to 113°F)
Storage temperature	-25 to 55°C (-13° to 131°F)
Humidity	5 to 95%, non-condensing

Note the effect of ambient temperatures on output current, as specified in *Table* 2-3 and *Table* 2-4.

3 Installation

3.1 Preparation

- If not using ready-made cable assemblies, use Molex hand crimping tool 63819-0500 to crimp the wires for all connectors except P7 (Bus Power and Motor).
- Wires for all connectors, except P7, must be 24-30 AWG. For P7 the range is 12-30 AWG. Any deviation from these specifications may cause wires to come loose.
- Before crimping, strip 2 mm at the end of wire, as shown in *Figure 3-1*.

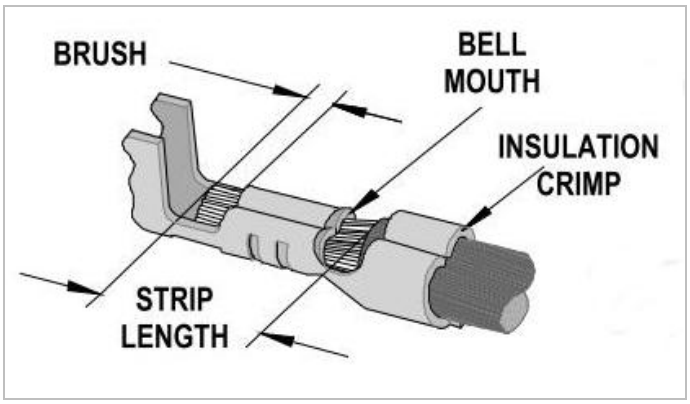


Figure 3-1. Stripped Wire in Crimp Pin

- To set the switches on the unit, you will need a precision, small screwdriver.
- To mount the unit, you will need M4 or #8 screws and an appropriate fastening tool. 4 screws are needed for the side brackets. 2 screws are needed for the rear bracket.

3.2 Mechanical Installation

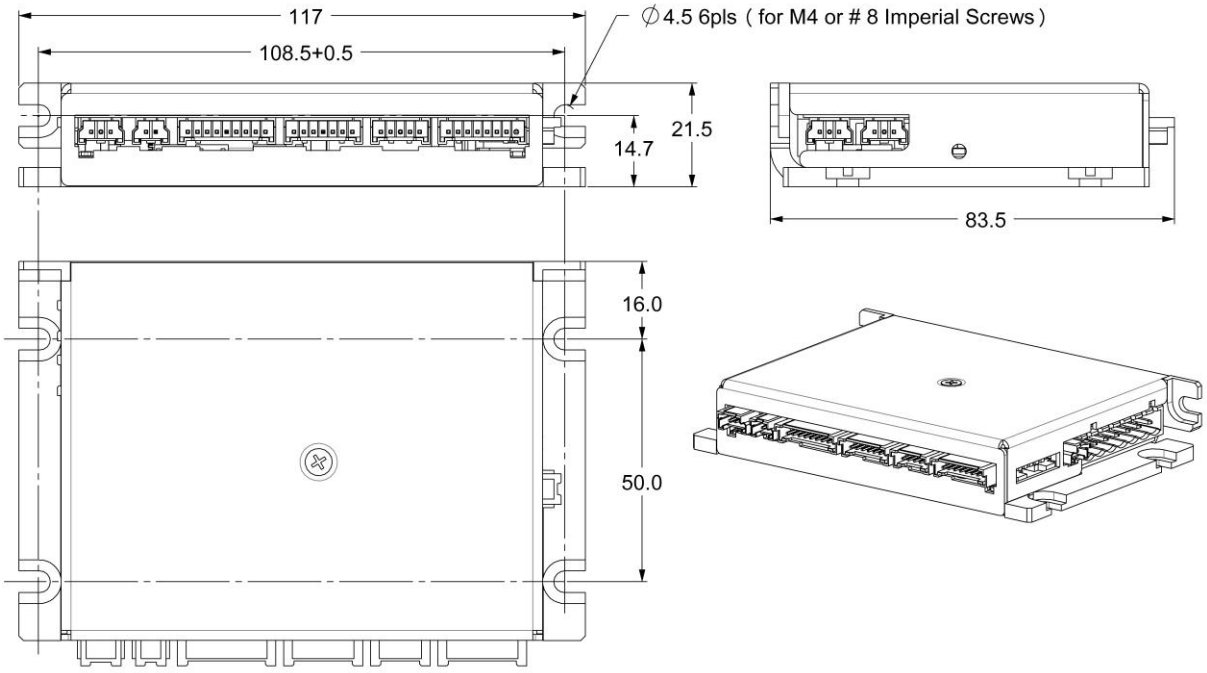


Figure 3-2. LVD Dimensions and Mounting Holes

3.2.1 Mounting the LVD

The unit can be positioned vertically or horizontally. The unit can be mounted using the bracket on the rear, which has two mounting holes. Alternately, it can be mounted using the two side brackets, each of which has two mounting holes.

3.2.2 Mounting Multiple LVD Units

When mounting multiple LVD units within a cabinet or enclosure, it is recommended that the units be spaced at least 20 mm apart.

It is important to maintain an ambient temperature within the enclosure that does not exceed 45°C (113°F).

3.3 Electrical Installation

3.3.1 Wiring Guidelines

The environment into which any electronic control system is installed can effect its operation. Attention to proper installation and field wiring are of prime importance to ensure long-term and trouble-free operation. Be sure you are familiar with and follow the installation and wiring instructions in this section. In addition to these practices, some localities and industries may require applicable electrical and safety codes, laws, and standards.

Particular care should be used when designing the layout of an enclosure. Efforts to separate power wires from small signal wires should be taken. The following guidelines highlight some important wiring practices:

- Control and signal cables must be separated from power and motor cables.

- Control and signal cables must be shielded to reduce the effects of radiated interference.
- Where control cables must cross power or motor cables, they should cross at a 90º angle, if possible. This reduces the field coupling effect.

3.3.2 Enclosure

The LVD is designed for panel assembly. This panel assembly should then be mounted in a metallic enclosure. Enclosures are supplied by the manufacturers of the final product and must meet the environmental IP rating of the end product. To ensure proper grounding (and to optimize EMC), the enclosure should have continuous ground continuity maintained between all metal panels.

This ground continuity is intended to be both a safety ground and a high frequency ground. The unit should be mounted on a back plane, which is installed into the enclosure. Ideally, the back plane should be an unpainted metallic surface to optimize electrical bonding of the frame and provide the lowest possible impedance path to earth ground. These enclosures also provide added safety.

3.3.3 Grounding

System grounding is essential for proper performance of the drive system. A ground bus bar may be used as a single point ground for the system. Safety grounding should be provided to all pieces of the system from a star point.

In addition to the safety grounding, a high frequency ground must be provided that connects the back panel to the enclosure and to earth ground. The objective is to provide an extremely low impedance path between the filters, drives, power supplies, and earth ground.

This high frequency ground is accomplished with the use of a flat braid or copper bus bar. It is important not to rely on a standard wire for the high frequency ground. In general, wire has an inductance of 8 nH per inch, regardless of diameter. At higher frequencies, this unwanted inductance between grounds equates to limited filter performance. When connecting high frequency grounds, use the shortest braid possible.

3.3.4 Bonding

The proper bonding of shielded cables is imperative for minimizing noise emissions and increasing immunity levels of the drive system. Its effect is to reduce the impedance between the cable shield and the back panel. Servotronix recommends that all shielded cables be bonded to the back panel.

Power input wiring does not require shielding (screening) if the power is fed to the cabinet (enclosure) via metalized conduit. If the metalized conduit is used with proper high frequency grounds, bonding technology, and recommended wire routing, then power input wire shielding has no affect. In the event that metalized conduit is not implemented into the system, shielded cable is required on the power input wires and proper bonding technologies should be implemented. The motor and feedback cables should have the shield exposed as close to the drive as possible.

3.3.5 CE Filtering Techniques

The LVD meets the CE Mark standards stated in the *Standards Compliance* section in this manual. It is imperative to apply proper bonding and grounding techniques, described above, when incorporating EMC noise filtering components for the purpose of meeting this standard.

Noise currents often occur in two types. The first is conducted emissions that are passed through ground loops. The quality of the system grounding scheme inversely determines the noise amplitudes in the lines. These conducted emissions are of a common-mode nature from line to neutral (or ground). The second is radiated high-frequency emissions usually capacitively coupled from line-to-line and are differential in nature.

To properly mount the filters, the enclosure should have an unpainted metallic surface. This allows for more surface area to be in contact with the filter housing and provides a lower impedance path between this housing and the back plane. The back panel, in turn, has a high frequency ground strap connection to the enclosure frame or earth ground.

3.3.6 Motor Line Filtering

Motor filtering may not be necessary for CE compliance of LVD systems. However, this additional filtering increases the reliability of the system. Poor non-metallic enclosure surfaces and lengthy, unbonded (or unshielded) motor cables that couple noise line-to-line (differential) are just some of the factors that lead to the necessity of motor lead filtering.

Motor lead noise may be either common-mode or differential. The common-mode conducted currents occur between each motor lead and ground (line-to-neutral). Differential radiated currents exist from one motor lead to another (line-to-line). The filtering of the lines feeding the motor provide additional attenuation of noise currents that enter surrounding cables and equipment I/O ports in close proximity.

Differential mode currents commonly occur with lengthy motor cables. As the cable length increases, so does its capacitance and its ability to couple noise from line-to-line. While every final system is different and every application of the product causes a slightly different emission profile, it may become necessary to use differential mode chokes to provide additional noise attenuation to minimize the radiated emissions. The use of a ferrite core (placed at the drive end) on each motor lead (shown in the diagram below), attenuates differential mode noise and lower frequency (30-60 MHz) broadband emissions to within specifications. You should wrap each motor lead through the core several times, as shown in *Figure 3-3*.

***Warning**: Never wrap a ground lead through a core.*

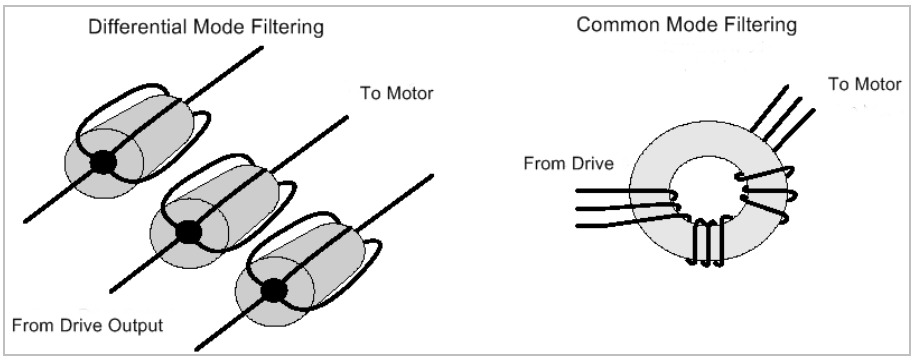


Figure 3-3. Mode Line Filtering

Common mode currents commonly occur from noise spikes created by the PWM switching frequency of the drive. The use of a ferrite or iron-powder core toroid places common mode impedance in the line between the motor and the drive. The use of a common mode choke on the motor leads increases signal integrity of encoder outputs and associated I/O signals.

3.3.7 I/O Filtering

I/O filtering may be desirable (depending on system installation, application, and integration with other equipment). To avoid unwanted signals entering and disturbing the drive system or other associated equipment, place ferrite cores on I/O lines. The Fair-Rite Products Corporation has a varied selection of ferrite parts used for I/O filtering and noise attenuation.

3.3.8 Interfaces

The unit interfaces are located on the front and side panels of the LVD, as shown in *Figure 3-4*, *Figure 3-5*, and *Figure 3-6.*

Table 3-20 lists the functions of the LED indicators.

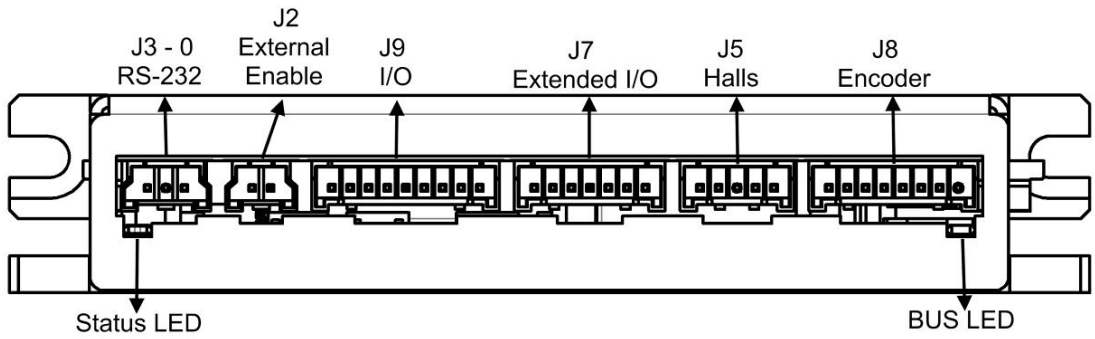


Figure 3-4. Front Panel

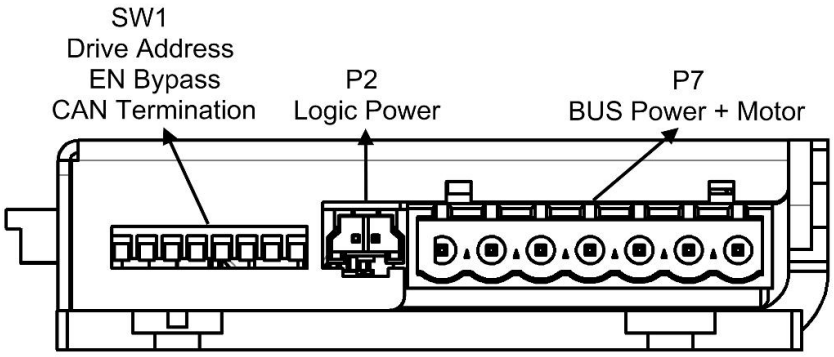


Figure 3-5. Right Side Panel

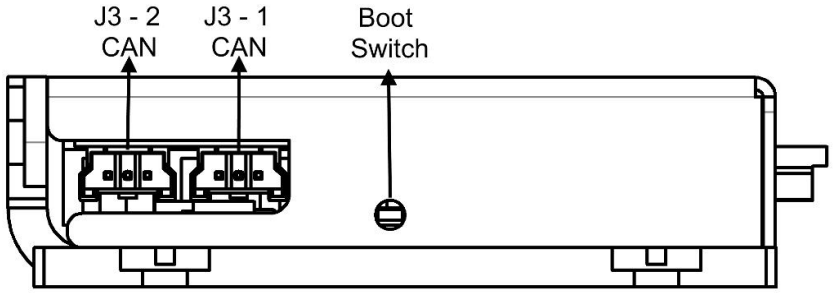


Figure 3-6. Left Side Panel

3.3.9 Connector Pinouts

Table 3-1 through *Table 3-18* provide the pin assignments and detailed information you will need to prepare the cables required for the LVD.

When preparing the cables, be sure the pinout and polarity of the mating connectors are in accordance with the printed labels on the LVD, and as described in detail in this section.

Bus Power and Motor – P7

Table 3-1. Bus Power and Motor Interface

Pin	Function	Description	
		Brushless DC Motor	**Brush DC & Voice-coil Motors**
1	BUS +	VDC supply for the bus; regulated or unregulated	VDC supply for the bus; regulated or unregulated
2	BUS -	Bus ground	Bus ground
3	REGEN OUT	Regeneration power output	Regeneration power output
4	MPHASEC	Motor phase C	No connection
5	MPHASEB	Motor phase B	Motor terminal 1
6	MPHASEA	Motor phase A	Motor terminal 2
7	CHASSIS	Motor ground. Refer to *Section 3.3.3*	Motor ground. Refer to *Section 3.3.3*

***Warning**: Use either Pin 7 or the LVD chassis itself for Motor ground. Do not use both.*

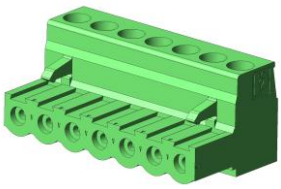


Figure 3-7. Bus Power and Motor Mating Connector

For Bus Power and Motor signals, either a single connector, or two separate connectors can be used, as specified in *Table 3-2*

Table 3-2. Bus Power and Motor Mating Connector

Item	Specification		
	Bus and Motor	**Bus** (Pins 1-2-3)	**Motor** (Pins 4-5-6-7)
Manufacturer	Phoenix Contact	Phoenix Contact	Phoenix Contact
Part Number	1754546	1754465	1754481
Wire Gauge	12-30 AWG	12-30 AWG	12-30 AWG

Logic Power – P2

Table 3-3. Logic Power Interface

Pin	Function	Description
1	$+V_{CC}$	10 to 36 VDC power supply
2	GND	Power supply ground

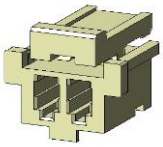


Figure 3-8. Logic Power Mating Connector

Table 3-4. Logic Power Mating Connector

Item	Specification
Manufacturer	Molex
Part Number	0355070200
Crimp Pins	Reel: 0502128000 Bag: 0502128100
Wire Gauge	24-30 AWG

Encoder – J8

Table 3-5. Encoder Interface

Pin	Function	Description	
		Differential Encoder	Single-Ended Encoder
1	$+V_{ENCODER}$	5 VDC supply for the encoder	5 VDC supply for the encoder
2	GND	Encoder ground	Encoder ground
3	Channel A+	Input from encoder channel A	Input from encoder channel A
4	Channel A-	Input from encoder channel A complement	Not in use
5	Channel B+	Input from encoder channel B	Input from encoder channel B
6	Channel B-	Input from encoder channel B complement	Not in use
7	Index +	Input from encoder Index	Input from encoder Index
8	Index -	Input from encoder Index complement	Not in use

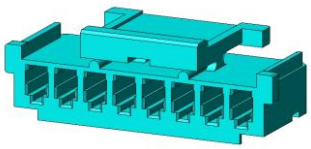


Figure 3-9. Encoder Mating Connector

Table 3-6. Encoder Mating Connector

Item	Specification
Manufacturer	Molex
Part Number	0355070800
Crimp Pins	Reel: 0502128000 Bag: 0502128100
Wire Gauge	24-30 AWG

Hall Sensor – J5

Table 3-7. Hall Sensor Interface

Pin	Function	Description
1	$+V_{HALL}$	5 VDC supply for the Hall sensors
2	GND	Hall sensor ground
3	Hall sensor 1	Input from Hall sensor 1
4	Hall sensor 2	Input from Hall sensor 2
5	Hall sensor 3	Input from Hall sensor 3

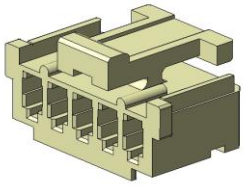


Figure 3-10. Hall Sensor Mating Connector

Table 3-8. Halls Sensor Mating Connector

Item	Specification
Manufacturer	Molex
Part Number	0355070500
Crimp Pins	Reel: 0502128000 Bag: 0502128100
Wire Gauge	24-30 AWG

I/O – J9

Table 3-9. I/O Interface

Pin	Function	Description
1	Digital input common	Return line for the Digital Inputs
2	Digital output common	Return line for the Digital Output
3	Digital input	Digital input 1
4	Digital input	Digital input 2
5	Digital input	Digital input 3
6	Digital input	Digital input 4
7	Digital output	Digital output 1
8	Analog Input 1-	Analog Differential Input 1- (Low)
9	Analog Input 1+	Analog Differential Input 1+ (High)

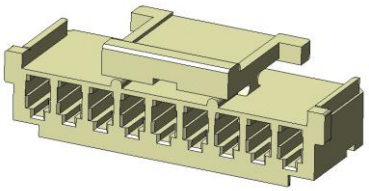


Figure 3-11. I/O Mating Connector

Table 3-10. I/O Mating Connector

Item	Specification
Manufacturer	Molex
Part Number	0355070900
Crimp Pins	Reel: 0502128000 Bag: 0502128100
Wire Gauge	24-30 AWG

Extended I/O - J7

Table 3-11. Extended I/O

Pin	Function	Description
1	ENC_STRB+	Encoder Strobe+
2	ENC_STRB-	Encoder Strobe-
3	Digital input	Digital input 5
4	Digital input	Digital input 6
5	Digital output	Digital output 2
6	Analog Input 2-	Analog Differential Input 2- (Low)
7	Analog Input 2+	Analog Differential Input 2+ (High)

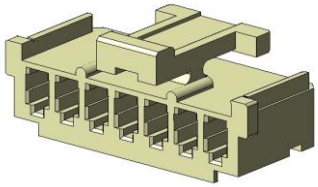


Figure 3-12. Extended I/O Connector

Table 3-12. Extended I/O Connector

Item	Specification
Manufacturer	Molex
Part Number	0355070700
Crimp Pins	Reel: 0502128000 Bag: 0502128100
Wire Gauge	24-30 AWG

External Enable – J2

If the External Enable connector is being used, the EN.BYPASS switch (DIP switch 2) must be set to the OFF position.

If the External Enable connector is not being used, the DIP switch 2 must be set to the ON position. Refer to *Section 3.3.10.*

Table 3-13. External Enable Interface

Pin	Function	Description
1	EXT_EN+	External enable positive
2	EXT_EN-	External enable negative

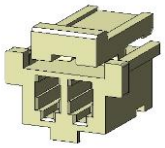


Figure 3-13. External Enable Mating Connector

Table 3-14. External Enable Mating Connector

Item	Specification
Manufacturer	Molex
Part Number	0355070200
Crimp Pins	Reel: 0502128000 Bag: 0502128100
Wire Gauge	24-30 AWG

RS-232 – J3-0

Table 3-15. RS-232 Interface

Pin	Function	Description
1	RX	LVD RS-232 receive
2	TX	LVD RS-232 transmit
3	GND	RS-232 ground

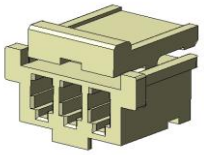


Figure 3-14. RS-232 Mating Connector

Table 3-16. RS-232 Mating Connector

Item	Specification
Manufacturer	Molex
Part Number	0355070300
Crimp Pins	Reel: 0502128000 Bag: 0502128100
Wire Gauge	24-30 AWG

CAN J3-1 and J3-2

Two connectors are provided for CAN bus connectivity. Either connector can be used for input or output signals.

Pins are wired-through so that drives can be daisy-chained and controlled with a single connection to the user's CAN interface. The CAN termination resistor should be activated in the last drive in the chain, using the DIP switch labeled CAN TERM.

Table 3-17. CAN Interface

Pin	Function	Description
1	CAN Low	CAN low bus line
2	CAN High	CAN high bus line
3	GND	CAN ground

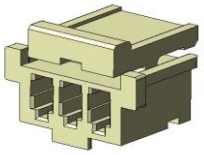


Figure 3-15. CAN Mating Connector

Table 3-18. CAN Mating Connector

Item	Specification
Manufacturer	Molex
Part Number	0355070300
Crimp Pins	Reel: 0502128000 Bag: 0502128100
Wire Gauge	24-30 AWG

3.3.10 DIP Switches

Drive Address – SW1

The drive's CAN ID, or node address, is set by means of 6 DIP switches. The address can be a value in the range 0–63. Each device on the network must have a different address.

When interfacing to the LVD via the RS232 serial port, the LVD address must be set to a non-zero value.

When working with CAN bus, the last device on the network must have a termination resistor between the CAN terminals. The LVD provides this functionality via the DIP switch labeled CAN TERM.

Note: When setting the switches, refer to the labels on the LVD (and not the numbers on the switches), as shown in *Figure 3-16*.

Table 3-19. Drive Address Switches

Label on LVD	Description	# on Switch	Binary Code = Valence
ADD 5	Address 5	8	$2^5 = 32$
[4]	Address 4	7	$2^4 = 16$
[3]	Address 3	6	$2^3 = 8$
[2]	Address 2	5	$2^2 = 4$
[1]	Address 1	4	$2^1 = 2$
ADD 0	Address 0	3	$2^0 = 1$
EN. BYPASS	External Enable Bypass	2	
CAN TERM	CAN Termination	1	

Note: EN.BYPASS (DIP switch 2) must be in the OFF position if External Enable is being used. The switch must be in the ON position if External Enable is not in use.

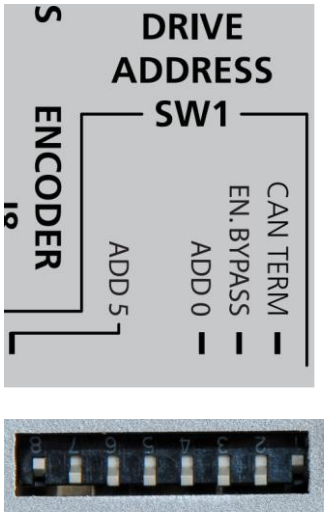


Figure 3-16. DIP Switches

3.3.11 Connecting the LVD

The cables can be connected in any sequence. Similarly, the switches for the drive address can be set at any point during the installation.

***Warning**: Make sure the power supplies are disconnected before making the cable connections.*

Note: Although the bus/motor power and the logic power can be connected to the same power supply, it is recommended that they be connected to separate power supplies to prevent electrical noise.

Note: The CAN connectors are jumpered internally; either connector can be used for input or output signals.

Connect the cables

- Connect the LVD to ground.
- Connect the bus power and the motor.
- Connect the logic power.
- Connect the encoder.
- Connect the Hall sensors, if required.
- Connect the External Enable, if required.
- Set DIP switch 2 in accordance with the absence or presence of the External Enable connection.
- Connect the LVD to host computer through either the RS-232 or CAN interface.

Set the drive address switches

Refer to *Table 3-19* for the drive addresses and switch settings.

3.4 Axis Manager Software Installation

The Axis Manager is graphical management tool that allows you to configure drive parameters and control multiple drives.

The **Axis Manager** software is available for download from the Servotronix website.

1. On the Servotronix website, go to the LVD product page.
2. Download and save the following file/s to the host computer:
   - **AxisManagerSetup.**zip.
   - If CAN communication protocol will be used, also download the **EDS** file
3. Extract the **AxisManager.ZIP** file. It contains one file, **AxisManagerSetup.exe**
4. Run **AxisManagerSetup.exe**, and follow the on-screen prompts to install the software.

   By default, the software is installed under Windows Programs in the folder \Servotronix\ Axis Manager.

5. When the installation is complete, you will see the Axis Manager shortcut on your desktop.

3.5 Power Up

1. Turn on logic power.
2. Turn on bus power.
3. Make sure the Bus and Status LEDs on the front panel light up, as described in the following section.

3.6 Indicators

The LVD has LEDs on the front panel, as shown in Figure 3-17.

Table 3-20 lists the functions of the LED indicators.

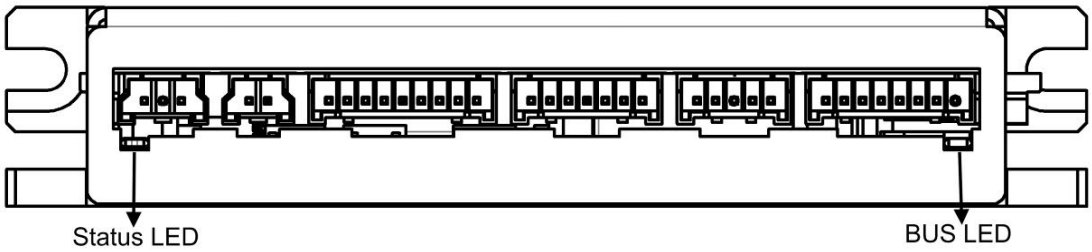


Figure 3-17. LED Indicators on Front Panel

Table 3-20. LED Indicators

Name	Color	Function
Bus	Yellow	**ON** – Bus power is connected and powered to at least 5 VDC.
Status	Green	**Blinking** – The drive is operational and ready to be enabled. No faults. **ON** – The drive is enabled. No faults.
	Red	**ON** – A fault has been detected and needs attention. **Blinking** – A fault that was detected no longer exists, but has not yet been cleared. (CLRFLT command).

For more information about faults, refer to the chapter *Troubleshooting*.

4 Configuration

4.1 Variables and Commands

Drive functionality is configured using various commands and variables, which are communicated over the serial port or over CAN bus.

Commands and variables are identified by both a mnemonic (VarCom) name and a CANopen index. For example, MPOLES is the VarCom equivalent of CANopen index 0x2442.

VarCom instructions, which are used with serial communications, are detailed in the *LVD VarCom Reference Manua*l.

CANopen instructions are described in the *LVD CANopen Reference Manual*.

Some variables are read-only, while others allow read/write access. Variables can be stored in the LVD's non-volatile memory (EEPROM) for use at each power-up.

Drives are shipped from the factory with motor parameters set to zero and application parameters set to their default values.

4.2 Axis Manager Software

4.2.1 About Axis Manager

Axis Manager is a graphic interface provided with the LVD to enable setup, configuration and tuning of the drive.

Axis Manager allows you to program the drive parameters specifically for the motor to which the LVD is connected, and for the particular operation that the drive will be performing in the machine.

The following sections present a brief overview of the menus and elements in the interface. The functions are explained in greater depth where relevant elsewhere in this manual.

4.2.2 Using Axis Manager

From the Windows Start menu or the shortcut on your desktop, activate Axis Manager.

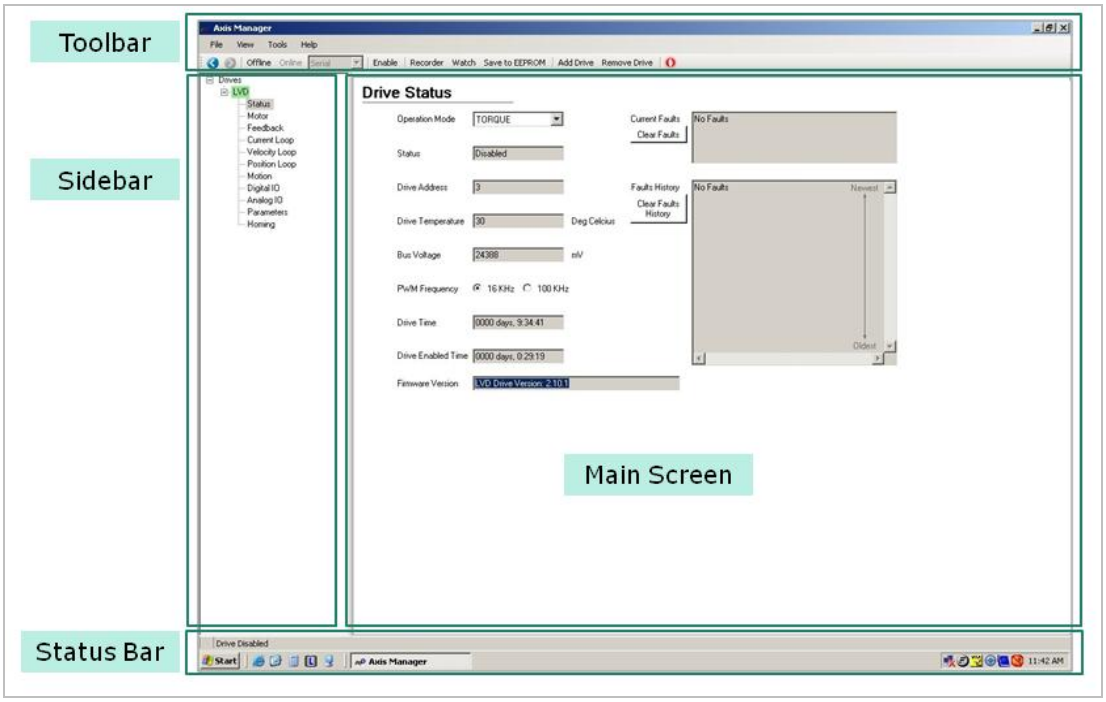


Figure 4-1. Axis Manager Software Interface

The Axis Manager window has four function areas:

Toolbar	Contains menus and quick access buttons.
Sidebar	Contains a navigation menu for the System tree and Drive nodes.
Main Screen	Displays various interactive screens for viewing, setting and testing parameters and drive configurations.
Status Bar	Displays messages and warnings. (Refer to the chapter *Troubleshooting*.)

4.2.3 Toolbar

The toolbar provides quick access to the most commonly used functions in Axis Manager.

< | >	Backward/Forward. Return to previously opened screens.
Offline| Online	Disconnects communication between the drive and the computer. Useful when the serial port is required for another application, such as Vulcan.
Serial | CANopen	A dropdown list. Selects the protocol to be used for communication with the drive.
Enable | Disable	A toggle button. Changes the Enabled/Disabled state of the drive.
Recorder	Opens the Recording application. (See *Section 4.6.11*.)
Watch	Opens the Watch dialog box. Allows you to monitor a set of parameters at a selectable sample rate.
Save to EEPROM	Writes the parameters to the drive's non-volatile memory (EEPROM).

Add Drive	Opens a dialog box and prompts for the settings to establish the connection between a drive and Axis Manager.
Remove Drive	Deletes the connection between the drive and Axis Manager. Removes the drive node from the System tree.
Emergency Stop	When pressed, disables all the drives that are connected to Axis Manager.

4.2.4 Sidebar

The sidebar on the left side of the screen contains a navigational menu that allows you to select the System and Drives you want to work with.

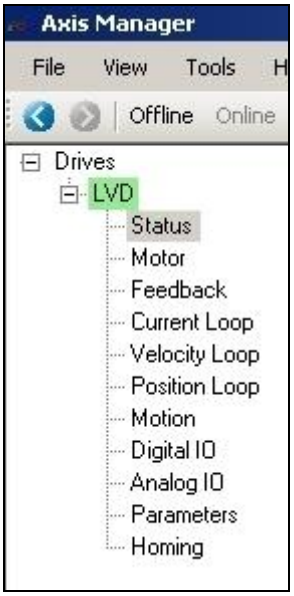


Figure 4-2. System Tree and Drive Node/s

The **system tree** (root) has one or more nodes. Each **node** is a single drive in the system. Each node is represented by a specific user-defined name that is assigned during the configuration. Each node has a specific drive address.

In the example shown in *Figure 4-2*, the system is called **Drives**, and the drive is named **LVD**.

Note: The system name is predefined and cannot be modified. The drive name is user-defined.

4.2.5 Menus

File

The **File** menu provides options for saving and loading files that contain the configuration data for drives and systems.

- A **drive** is a single drive with a specific drive address; it is one node on the system tree.

  It is recommended to save individual drive configurations so that the settings and parameters can be reused, for example, to add a drive to the same system, or to create another system with the same drive.

The ***.drive** file is for use in Axis Manager only. In addition to the drive parameters, the file contains the settings defined when establishing the connection between Axis Manager and the drive (refer to *Section 4.3.1*):

- Drive address
- EDS file location (if using CANopen)
- Motor name (if selected from the Motors database)

- A **system** is a configuration of multiple drives; it is the root of the tree.

  When you conFigure multiple drives, saving the system saves the settings and parameters of all the drives contained in the system.

  The ***.system** file is for use in Axis Manager only.

Open	Loads the *.drive or *.system configuration file from the host computer.
Save	Saves/Saves As the *.drive or *.system configuration file to the host computer.
Close System	Closes the currently loaded system configuration.
Recent Systems	Displays a list of recently opened systems.
Exit	Closes Axis Manager.

For more options and information regarding parameter and configuration files, refer to *Section 4.5.2*

View

The **View** menu provides an option to refresh the screen. You can also use **F5** for this purpose.

Tools

The **Tools** menu provides access to the same functions that are on the Axis Manager toolbar, described in *Section 4.2.3*.

It also has an **Options** item, which opens a dialog box for selecting communication settings.

Help

The **Help** menu allows you to view the current version and build of Axis Manager.

4.2.6 Status Bar

The status bar at the bottom of the computer screen displays the status of the drive.

A constant notification indicates whether the drive is enabled or disabled.

Warning messages are highlighted in yellow and may flash. Warnings are displayed when you attempt to assign an invalid value to a parameter. While a warning is in effect, the drive remains in its current enabled/disabled state.

Fault messages are highlighted in red and may flash. Faults occur when settings or conditions may cause improper operation of the drive/motor and/or equipment damage. When a fault occurs, the drive becomes disabled.

For more information about status messages, and how to resolve faults, refer to the chapter *Troubleshooting.*

4.3 Connecting to a Drive

4.3.1 Defining the Connection

1. From the Axis Manager toolbar, select the type of communication protocol to be used for communication between the drive and the host computer:
   - **Serial** (RS-232)
   - **CANopen**
2. From the Axis Manager toolbar, select Tools > **Options** to define and verify the settings for serial or CAN communication.

   The Options dialog box opens.

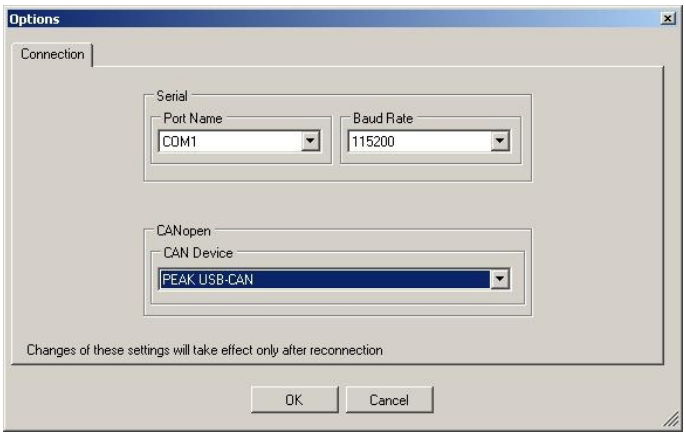


Figure 4-3. Options Dialog Box

The Options dialog box allows you to define the communication properties of the system.

3. Define and/or verify the following settings:
   - For **Serial communications**, set the COM port and the baud (data transfer) rate.
     - The COM port is the COM port of the host computer to which the serial cable is connected.
     - The baud rate for the LVD is fixed at 115200 bps.
   - For **CANopen communications**, select the CAN interface device that is being used. Currently only one device is defined.

     At present, Axis Manager can communicate only with the Peak Systems PCAN-USB dongle. For more information on this product, go to the Peak Systems website.

     In future software versions, additional devices will be supported, and will be available for selection in the list of CAN Devices.
4. From the toolbar, select **Add Drive**.

   The Add Drive dialog box opens.

Figure 4-4. Add Drive Dialog Box, Part One

5. Enter the required information in the dialog box:

Drive Name	**Drive #1** is the default drive name. It is recommended that you provide a name for the drive that reflects the function it performs, such as Axis 1 or Axis-X.
Drive Address	The drive address can be any value, from 1 to 127. The value you enter must match the drive address defined by the DIP switches (set during installation). **Note:** If you enter the wrong drive address (that is, the drive address does not match the DIP switch settings), the drive will be defined but considered disconnected. An error message (*No online drives found*) will be displayed when you attempt to make the connection. To remedy, select Remove Drive, and then repeat the steps to connect the drive using the correct drive address.
EDS File	This field is displayed only when CANopen communication is defined. Click the browse button to select and load the EDS file. The EDS (electronic data sheet) file can be downloaded from the LVD product page on the Servotronix website.

6. Click **Next**. Another dialog box prompts you for a parameter file.

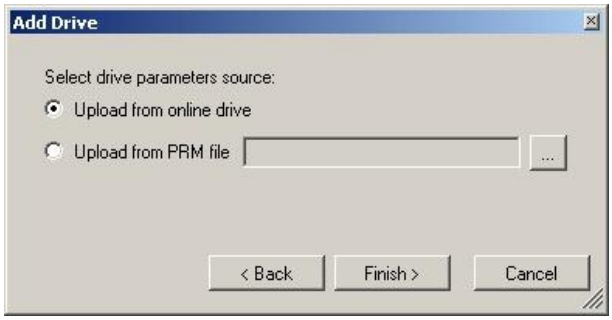


Figure 4-5. Add Drive Dialog Box, Part Two

7. Select the source of the parameters to be loaded:

Upload from online drive	The drive is considered **online** after its connection to the host computer has been established. Select this option if you want to upload the parameters that are currently in use in the drive. Upon first use of the drive, factory-set parameters are loaded. Afterwards, the EEPROM contains the set of parameter values last saved. Refer to *Section 4.5.2.*
Upload from PRM file	Select this option if you have saved parameters on your PC from this or another drive, and want to load those parameters to this drive. Browse to the *.prm file and select it. Refer to *Section 4.5.2.*

Note: The drive is shipped with factory defaults loaded. To reset the drive to its factory defaults, use the **Load Factory Defaults** option in the Drive Parameters screen. Refer to *Section 4.5.2.*

8. Click **Finish**.

The system displays a message indicating it is retrieving the parameters for the drive.

The Drives screen opens.

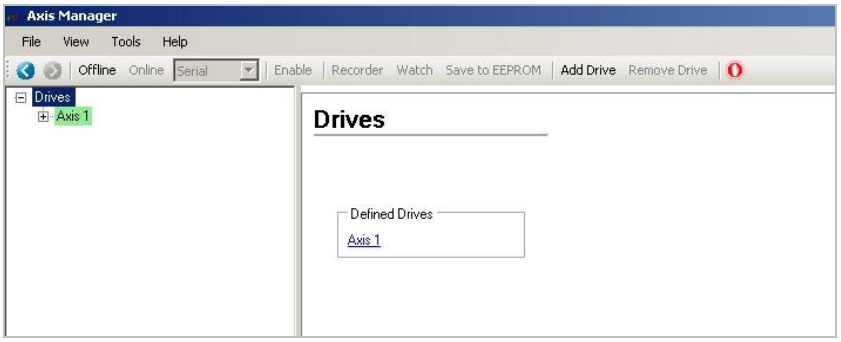


Figure 4-6. Drives Screen – Defined Drives

9. In the **Defined Drives** box, click on the name of one of the drives. (If you have connected to only one drive, the list will contain just one name.)

The **Drives** screen indicates that the drive is now connected (communicating) with the host computer. The drive is now online.

The options in the toolbar are now enabled.

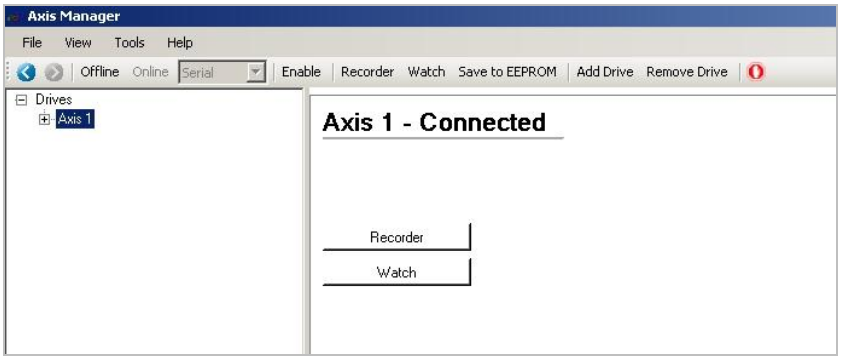


Figure 4-7. Drives Screen – Drive Connected

If you entered the wrong drive address in **Step 5**, or if the communication parameters are incorrect, an error message is displayed when you attempt to make the connection.

Click **OK**. The Drives screen indicates that the drive is defined but not connected.

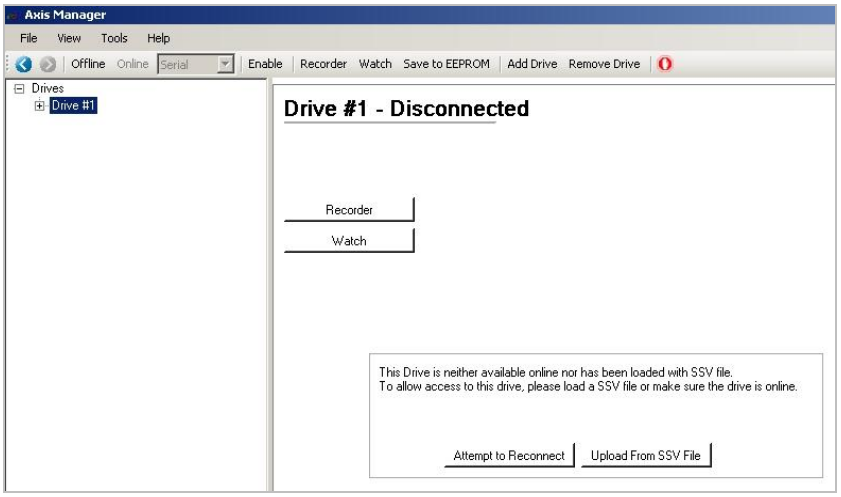


Figure 4-8. Drives Screen – Drive Disconnected

From the toolbar, select **Remove Drive**.

10. Repeat Steps 5 through 9 using the correct drive address.

11. Repeat Steps 5 through 9 for each drive that will be used in the application.

4.3.2 Drive Status Screen

- In the system tree, click on the drive name to expand the node, and select **Status**.

  The Drive Status screen is displayed.

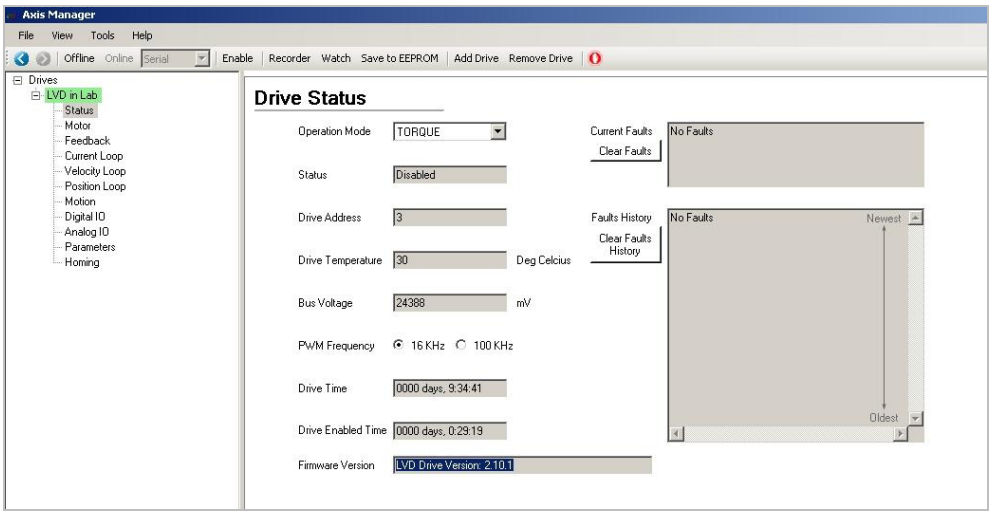


Figure 4-9. Drive Status Screen

The Drive Status screen shows the current properties and status of the selected drive. It allows you to select the drive's **Operation Mode** and **PWM Frequency**. All other fields are read-only.

It also displays current and previous faults. If **No Faults** is displayed in the Current Faults field, you can proceed to configure the parameters for the drive.

4.4 Enabling/Disabling a Drive

***Warning**: The drive must be disabled while parameters are being set.*

The state of the drive is indicated in the following locations:

- Toolbar
- Status bar at bottom of window
- Status field in the Drive Status screen

To disable the drive, use either of the following:

- The **Disable** button on the toolbar.
- The **Disable** option in the Tools menu.

Similarly, to enable the drive, use either of the following:

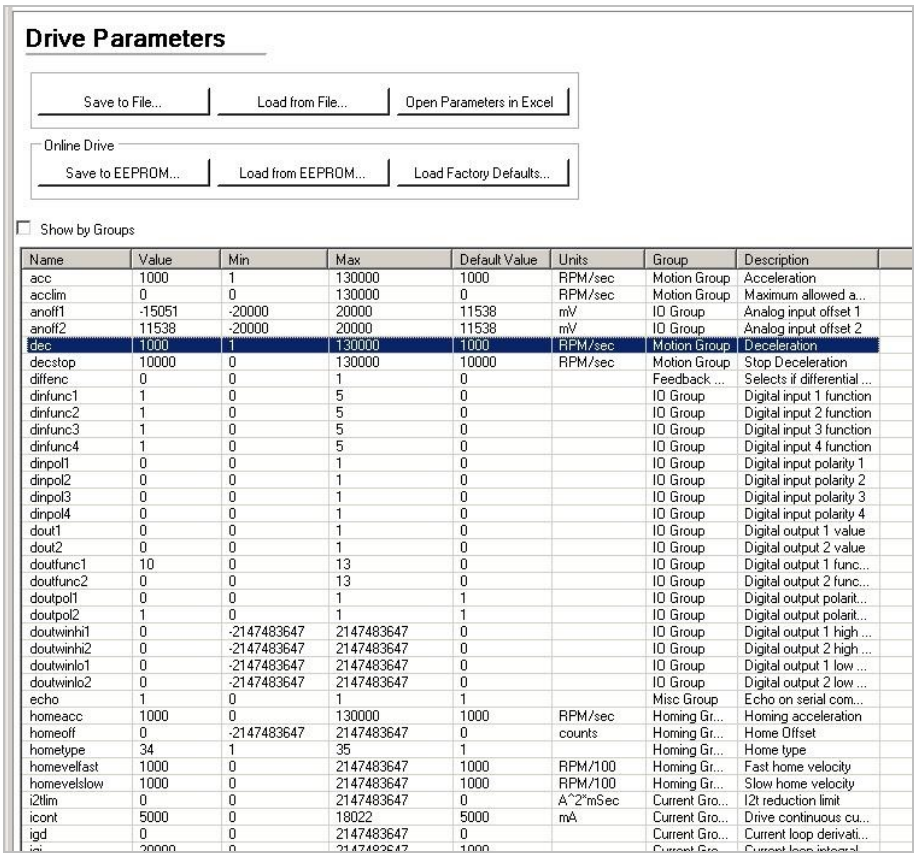
- The **Enable** button on the toolbar.
- The **Enable** option in the Tools menu.

4.5 Managing Drive Parameters

4.5.1 Drive Parameters Screen

- In the System tree, expand the Drive node, and select **Parameters**.

  The Drive Parameters screen is displayed.

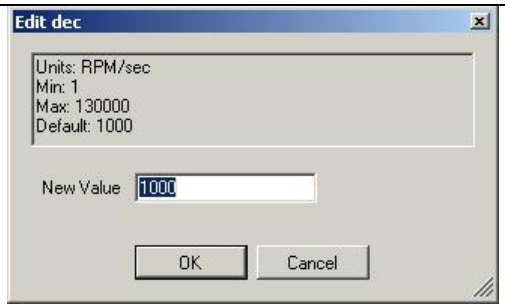


Name	Value	Min	Max	Default Value	Units	Group	Description
acc	1000	1	130000	1000	RPM/sec	Motion Group	Acceleration
acclim	0	0	130000	0	RPM/sec	Motion Group	Maximum allowed a...
anoff1	-15051	-20000	20000	11538	mV	IO Group	Analog input offset 1
anoff2	11538	-20000	20000	11538	mV	IO Group	Analog input offset 2
dec	1000	1	130000	1000	RPM/sec	Motion Group	Deceleration
decstop	10000	0	130000	10000	RPM/sec	Motion Group	Stop Deceleration
diffenc	0	0	1	0		Feedback ...	Selects if differential ...
dinfunc1	1	0	5	0		IO Group	Digital input 1 function
dinfunc2	1	0	5	0		IO Group	Digital input 2 function
dinfunc3	1	0	5	0		IO Group	Digital input 3 function
dinfunc4	1	0	5	0		IO Group	Digital input 4 function
dinpol1	0	0	1	0		IO Group	Digital input polarity 1
dinpol2	0	0	1	0		IO Group	Digital input polarity 2
dinpol3	0	0	1	0		IO Group	Digital input polarity 3
dinpol4	0	0	1	0		IO Group	Digital input polarity 4
dout1	0	0	1	0		IO Group	Digital output 1 value
dout2	0	0	1	0		IO Group	Digital output 2 value
doutfunc1	10	0	13	0		IO Group	Digital output 1 func...
doutfunc2	0	0	13	0		IO Group	Digital output 2 func...
doutpol1	0	0	1	1		IO Group	Digital output polarit...
doutpol2	1	0	1	1		IO Group	Digital output polarit...
doutwinhi1	0	-2147483647	2147483647	0		IO Group	Digital output 1 high ...
doutwinhi2	0	-2147483647	2147483647	0		IO Group	Digital output 2 high ...
doutwinlo1	0	-2147483647	2147483647	0		IO Group	Digital output 1 low ...
doutwinlo2	0	-2147483647	2147483647	0		IO Group	Digital output 2 low ...
echo	1	0	1	1		Misc Group	Echo on serial com...
homeacc	1000	0	130000	1000	RPM/sec	Homing Gr...	Homing acceleration
homeoff	0	-2147483647	2147483647	0	counts	Homing Gr...	Home Offset
hometype	34	1	35	1		Homing Gr...	Home type
homevelfast	1000	0	2147483647	1000	RPM/100	Homing Gr...	Fast home velocity
homevelslow	1000	0	2147483647	1000	RPM/100	Homing Gr...	Slow home velocity
i2tlim	0	0	2147483647	0	A^2*mSec	Current Gro...	I2t reduction limit
icont	5000	0	18022	5000	mA	Current Gro...	Drive continuous cu...
igd	0	0	2147483647	0		Current Gro...	Current loop derivati...

Figure 4-10. Drive Parameters Screen

The Drive Parameters screen allows you to view and modify the drive parameter values.

Show by Groups	When this option is selected, parameters are listed in groups according to function, such as velocity, current, and position. When not selected, parameters are listed alphabetically.
Change the Value of a Parameter	To change a parameter value, click on the row of the parameter you want to modify. A dialog box opens, showing the current value for the parameter, as shown in the example:

	 Note the displayed units, minimum values, and maximum values. Be sure the parameter value you set is within the allowed range. **Note**: If you attempt to set a value that exceeds the limits of either the minimum or maximum value, the parameter is not changed, and an error message displays "VALUE OUT OF BOUNDS".

For detailed descriptions of parameters, refer to the *LVD VarCom Reference Manual*.

4.5.2 Loading and Saving Parameters

The LVD drive has several types of memory for storing the drive's parameters:

- **Flash**: Non-volatile memory. It holds the drive's default parameter values. (It also contains the drive's firmware.)
- **RAM**: Volatile memory. The drive's working memory. Parameter values are maintained in RAM while you configure and test the drive and adjust parameters. If power to the drive is disconnected, any unsaved changes in the parameters will be lost.
- **EEPROM**: Non-volatile memory, stores the parameters even when power is shut off. After you have tested and confirmed that the drive is performing as intended, save the parameters to the EEPROM. (You should also save them to a file as a backup.)

During power up, the LVD loads parameter values from the EEPROM to the RAM, and a checksum of these parameter values is calculated. If the checksum is invalid, default parameter values (which are hard-coded in the drive's firmware) are loaded into RAM and an EEPROM Checksum Fault is set.

The Drive Parameters screen also includes options for loading and saving the drive's parameters.

Save to File	Axis Manager saves parameters in a file named *.**prm**. This is a tab-delimited text file, which can be read using any text editor or spreadsheet application, and uploaded directly from a PC to the drive.
Load from File	Loads the parameters from *.prm file to RAM.
Open Parameters in Excel	Activates Excel and displays the parameters currently in RAM in an Excel worksheet.

Save to EEPROM	Saves the parameters currently in RAM to the EEPROM.
Load from EEPROM	Loads into RAM the parameter values last saved in the EEPROM. Use this option to revert to the previous configuration.
Load Factory Defaults	Loads the factory-defined parameters from the drive's Flash memory.

The following diagram illustrates the relationships among the different types of memory.

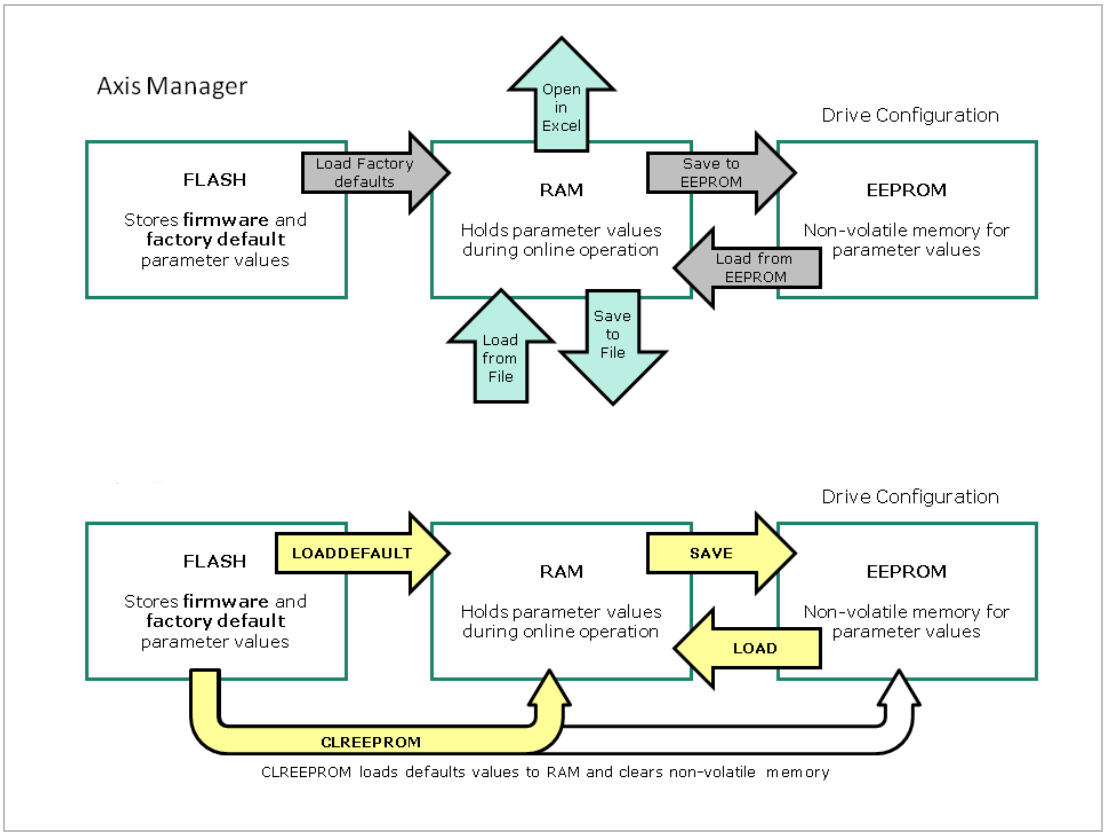


Figure 4-11. Drive Memory Architecture

For more information on the commands for saving and loading parameters, refer to the *LVD VarCom Reference Manual*.

4.6 Configuring Parameters

Warning: Disable the drive before manipulating Motor and Feedback parameters.

Many parameters can be modified while the drive is enabled. Exercise caution, however, as motor behavior will change.
If a parameter cannot be modified while the drive is enabled, Axis Manager will prompt you to disable the drive.

While setting the parameters, pay close attention to any warning or error messages displayed by Axis Manager.

4.6.1 Configuration Sequence

It is recommended that you perform the drive configuration according to the sequence shown in *Figure 4-12*.

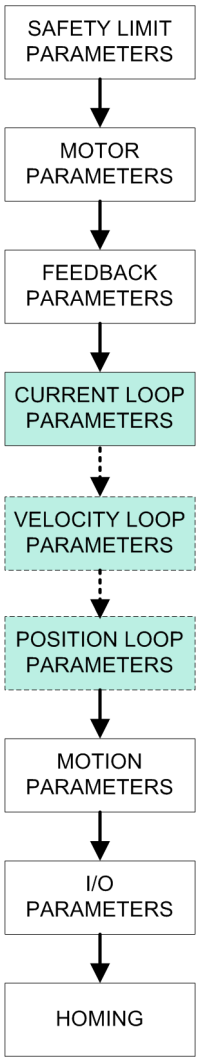


Figure 4-12. Drive Parameter Configuration Sequence

4.6.2 Tuning and Testing

Axis Manager provides several methods for modifying and testing parameters that you can use during the configuration process to optimize and evaluate the drive's performance.

- **Tuning**. Available in each of the Control Loop parameter screens. For more information, refer to *Section 4.6.9*.
- **Motion Profile** testing. Accessed from the navigation menu in the Sidebar. For more information, refer to *Section 4.6.10*.
- **Recorder**. Accessed from the Toolbar. For more information, refer to *Section 4.6.11*.

4.6.3 Safety Limit Parameters

To ensure proper and safe operation of the drive, begin the drive configuration by setting the parameters that define the limits of velocity, current, position and acceleration/deceleration.

Warning: *Many parameters can be modified while the drive is enabled. Exercise caution, however, as motor behavior will change.*

While setting the parameters, pay close attention to any warning or error messages displayed by Axis Manager.

It is easiest to use the Drive Parameters screen for viewing and modifying the values of the parameters. The various configuration screens also enable access to the relevant parameters.

Current	**IMAX**	Gets/sets the maximum peak current for the drive. If motor current exceeds 1.2 of IMAX, the drive will issue a fault.
	ISAT	Gets/sets the current saturation value. If you attempt to use a higher value, the current command will not exceed the ISAT value and a fault will not be issued.
	ICONT	Gets/sets the value of maximum continuous current for the drive.
	I2TLIM	Gets/sets the I^2T integrator limit value. If this value is exceeded, the drive will issue a fault. Setting I2TLIM to 0 disables this function. **Note:** The I^2T integrator limits the energy delivered to the motor to the continuous current rating of the drive; it is calculated: I2T= $\int (I - I_{cont})^2 dt$
Velocity	**VOSPD**	Gets/sets the velocity value that triggers the over-speed protection fault.
	VLIM	Gets/sets the velocity limit value. The velocity command will not exceed the VLIM value. Values higher than VLIM will be ignored and a fault will not be issued.

Acceleration/ Deceleration	**ACC**	Gets/sets the acceleration rate in the velocity and position loops.
	DEC	Gets/sets the deceleration rate in the velocity and position loops.
	ACCLIM	Gets/sets the maximum acceleration/ deceleration value. If the drive detects acceleration or deceleration that is a higher than the ACCLIM value, it will issue a fault. Setting ACCLIM to 0 disables this function.
Position	**PLIMPOS**	Gets/sets the maximum position limit for motion. The drive will not accept MOVE commands beyond this position. Upon reaching this limit the drive will execute a STOP command.
	PLIMNEG	Gets/sets minimum position limit for motion. The drive will not accept MOVE commands beyond this position. Upon reaching this limit the drive will execute a STOP command
	PSTOPMODE	Configures the STOP functionality. Defines how the LVD reacts to the software position limits PLIMPOS and PLIMNEG.
	PEMAX	Gets/sets the position error value that triggers the position error fault. This parameter is used in Point to Point, Interpolated Position and Jog in Position operation modes.

4.6.4 Motor Parameters

Warning: *Disable the drive before modifying Motor parameters.*

1. In the System tree, expand the Drive node, and select **Motor**.

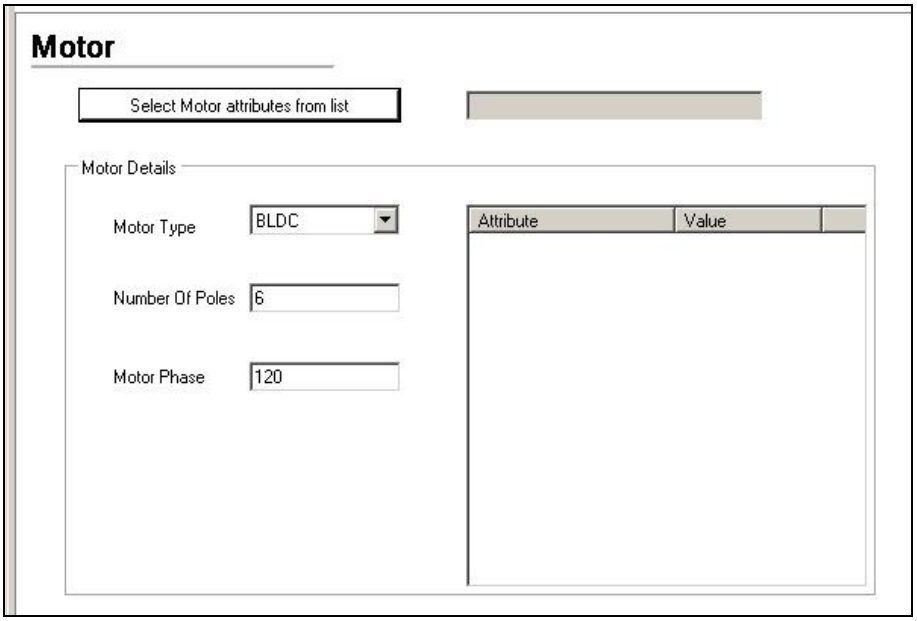


Figure 4-13. Motor Parameters Screen

The Motor screen lets you define the properties of the motor that is connected to the drive, either by selecting a motor from a predefined list or by manually entering values.

2. To load a predefined motor, use the following option:

Select Motor attributes from List	Press this button and select a motor from a list of known motors. Parameters for these motors will be loaded automatically. *Refer to Figure 4-14.*

To manually enter motor attributes, use the **Motor Details** options:

Motor Type	Select either **BLDC** (brushless DC) or **DC** (brush DC)
Number of Poles	Enter the number of individual poles for the motor. **Note:** Not pairs of poles.
Motor Phase	**Note**: Motor phase can be defined after testing in Current Loop.

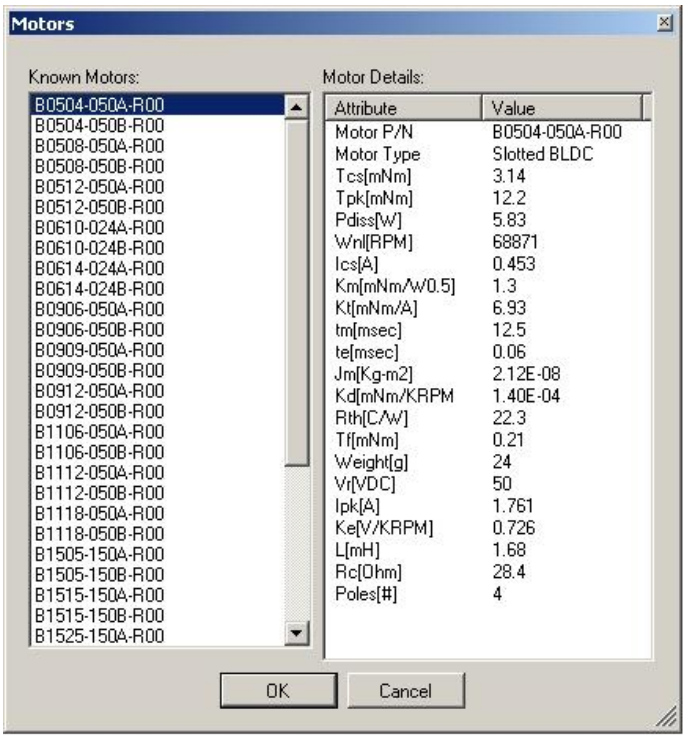


Figure 4-14. List of Predefined Motors

3. When finished setting the Motor parameters, continue to the Feedback parameters.

4.6.5 Feedback Parameters

Warning: *Disable the drive before modifying Feedback parameters.*

1. In the System tree, expand the Drive node, and select **Feedback**.

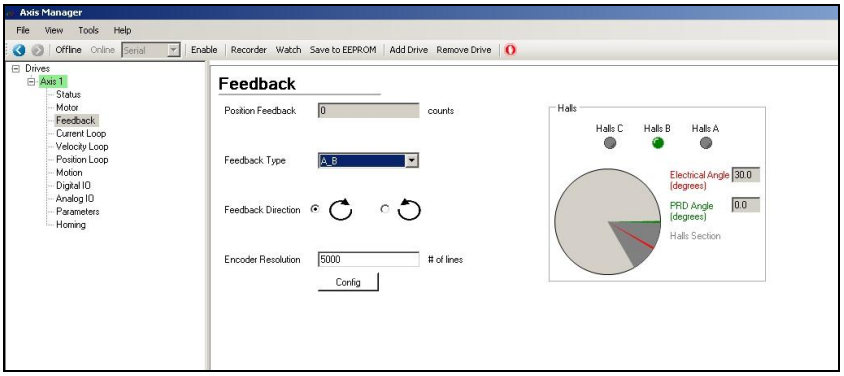


Figure 4-15. Feedback Parameters Screen

The Feedback Parameters screen contains the following elements:

Position Feedback (counts)	This field shows the motor position in encoder counts. Displays the motor position, in encoder counts, relative to its initial position when the drive was turned on.

Feedback Type	Select the device to be used for feedback: **AB**, **Halls** or **Index**.
Feedback Direction	Select either **clockwise** or **counterclockwise** for the positive direction of feedback.
Encoder Resolution (# of lines)	Enter the encoder resolution**.** **Note:** Enter the number of lines per revolution (not counts per revolution).
Halls	This section of the screen displays an animation representing the status of the Hall sensors, the motor shaft angle, and the electrical angle.
Config	Calculates and sets the drive's unit scaling according to the feedback parameters.

2. To configure the feedback parameters, do the following:
   - Select the type of feedback.
   - Set the direction of the encoder.
   - Set the encoder resolution.
3. Click **Config**.
4. If possible, manually turn the motor shaft one rotation in the positive direction. Look at the **Position Feedback** field, and confirm that the number of counts is as expected.
5. If possible, repeat Step 4, turning the shaft in the negative direction.
6. If you are satisfied with the behavior, continue to the Current Loop parameters.

4.6.6 Current Loop Parameters

Warning: *Many parameters can be modified while the drive is enabled. Exercise caution, however, as motor behavior will change.*

1. From the Drive node select **Current Loop.**

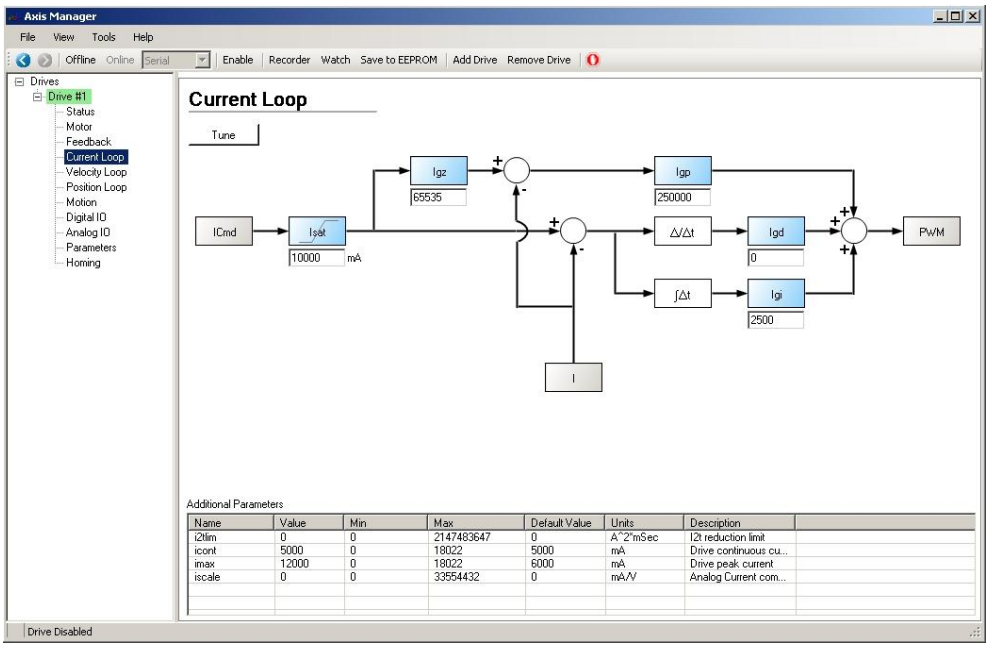


Figure 4-16. Current Loop Parameters Screen

The current loop is implemented by a proportional-integral-derivative (PID) control algorithm.

2. User-configurable parameters are displayed in blue boxes in the Current Loop diagram. You can click on a parameter box to modify its settings.

Alternately, click **Tune**, and use the Tuning utility to set and test the current loop parameters. Refer to *Section 4.6.9.*

The following parameters are user-configurable in the Current Loop:

IGZ	Gets/sets the separation term for gain paths of the current PID loop.
IGP	Gets/sets the proportional gain for the current PID loop.
IGI	Gets/sets the integral gain for the current PID loop.
IGD	Gets/sets the derivative gain for the current PID loop.
ISAT	Gets/sets the current saturation value. Refer to the safety limit parameters in *Section 4.6.3*.

The Current Loop screen also includes a table of **Additional Parameters**, which are relevant to current but not to control. You can modify these parameters in the same way you work with parameters in the Drive Parameters screen. Refer to *Section 4.5.1* and to the *LVD VarCom Reference Manual*.

To verify the behavior of the current control loop, go to the **Motion** screen, and use the **Torque Profile** tab to test the current loop step response. Refer to *Section 4.6.10*.

4.6.7 Velocity Loop Parameters

Warning: *Many parameters can be modified while the drive is enabled. Exercise caution, however, as motor behavior will change.*

1. From the Drive node select **Velocity Loop**.

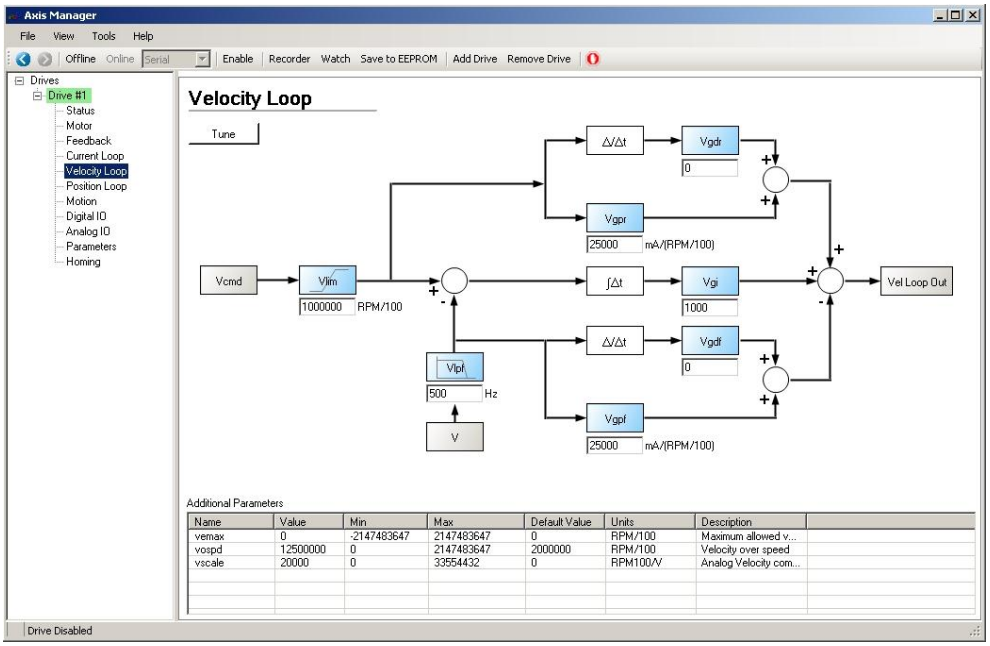


Figure 4-17. Velocity Loop Parameters Screen

The velocity loop is implemented by a pseudo-derivative feed forward (PDFF) control algorithm.

2. User-configurable parameters are displayed in blue boxes in the Velocity Loop diagram. You can click on a parameter box to modify its settings.

Alternately, click **Tune**, and use the Tuning utility to set and test the current loop parameters. Refer to *Section 4.6.9.*

The following parameters are user-configurable in the Velocity Loop:

VGI	Gets/sets the integral gain for the velocity loop.
VGPR	Gets/sets the proportional gain for the velocity loop.
VGPF	Gets/sets the feedback proportional gain of the velocity loop.
VGDR	Gets/sets the derivative gain for the velocity loop.
VGDF	Gets/sets the feedback derivative gain for the velocity loop.
VLPF	Gets/sets the low pass filter cutoff frequency for the velocity loop.
VLIM	Gets/sets the velocity limit value. Refer to the safety limit parameters in *Section 4.6.3*.

The Velocity Loop screen also includes a table of **Additional Parameters**, which are relevant to velocity but not to control. You can modify these parameters in the same way you work with parameters in the Drive Parameters screen. Refer to *Section 4.5.1* and to the *LVD VarCom Reference Manual.*

To verify the behavior of the velocity control loop, go to the **Motion** screen, and use the **Velocity Profile** tab to test the current loop step response. Refer to *Section 4.6.10*.

4.6.8 Position Loop Parameters

Warning: *Many parameters can be modified while the drive is enabled. Exercise caution, however, as motor behavior will change.*

1. From the Drive node select **Position Loop**.

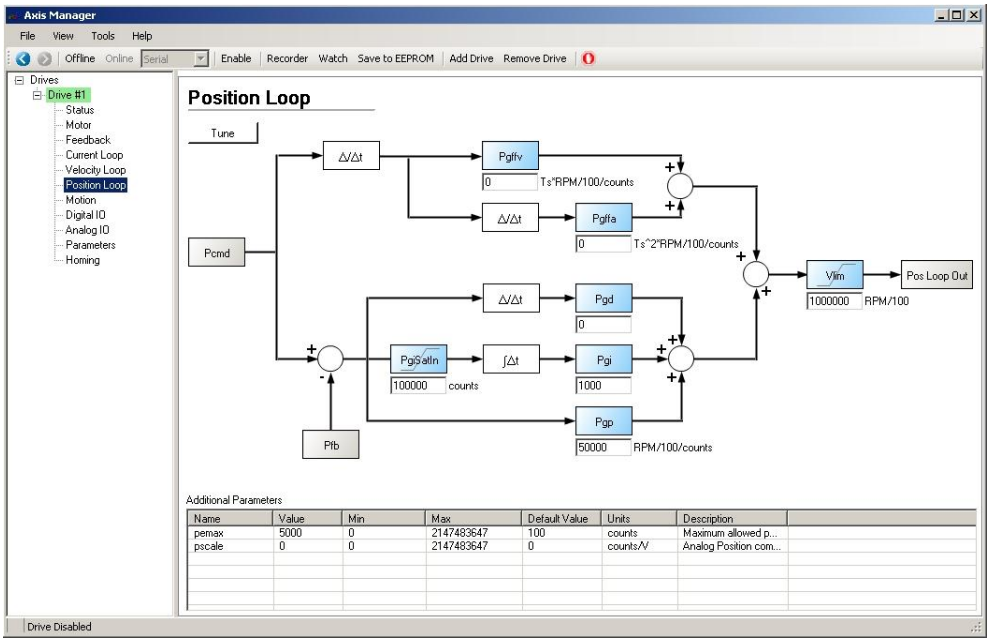


Figure 4-18. Position Loop Parameters Screen

The position loop is implemented by a proportional-integral-derivative (PID) control algorithm with velocity and acceleration feed forward options.

2. User-configurable parameters are displayed in blue boxes in the Position Loop diagram. You can click on a parameter box to modify its settings.

Alternately, click **Tune**, and use the Tuning utility to set and test the current loop parameters. Refer to *Section 4.6.9.*

The following parameters are user-configurable in the Position Loop:

PGP	Gets/sets the proportional gain for the position PID loop.
PGI	Gets/sets the integral gain for the position PID loop.
PGD	Gets/sets the derivative gain for the position PID loop.
PGFFV	Gets/sets the feed forward velocity term gain for the position PID loop.
PGFFA	Gets/sets the feed forward acceleration term gain for the Position PID loop.
PGISATIN	Gets/sets the input saturation level for the position loop integrator.
VLIM	Gets/sets the velocity limit value. Refer to the safety limit parameters in *Section 4.6.3*.

The Position Loop screen also includes a table of **Additional Parameters**, which are relevant to current but not to control. You can modify these parameters in the same way you work with parameters in the Drive Parameters screen. Refer to *Section 4.5.1* and to the *LVD VarCom Reference Manual.*

To verify the behavior of the position control loop, go to the **Motion** screen, and use the **Position Profile** tab to test the current loop step response. Refer to *Section 4.6.10*.

4.6.9 Control Loop Tuning

Each control loop screen has a **Tune** button that activates a dedicated Tuning utility. Each Tuning screen enables you to adjust the relevant control loop gains and parameters in order to achieve the desired performance.

Figure 4-19 shows, for example, the Tuning screen for the Current control loop.

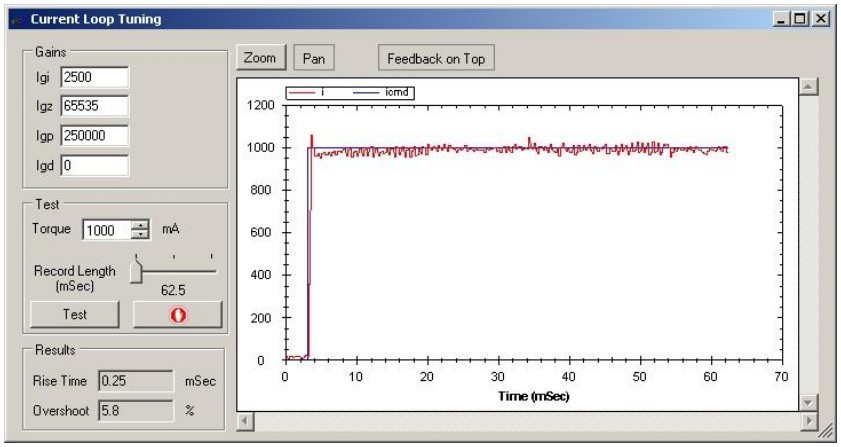


Figure 4-19. Tuning Screen for Current Loop

Clicking the **Test** button initiates a step command. The tuning screen displays the response to the command with the gains currently configured.

***Warning**: Use with caution. As soon as the Test button is pressed, Axis Manager activates the selected control loop and enables the drive, and the motor will begin to move.*

The tuning screen also displays information such as rise time and overshoot for the step response.

4.6.10 Motion Profile Testing

Axis Manager includes a motion profile testing utility.

The Motion screen has tabs for the three basic types of operation: **Torque** (current), **Velocity** (jog) and **Position**.

When activated, the Motion screen opens to the profile tab that corresponds to the operation mode currently defined in the Status screen. (See *Section 4.3.2*.)

- CURRENT operation mode: Torque Profile tab.
- JOG operation mode: Velocity Profile tab.
- POSITION operation mode: Position Profile tab.

Each tab allows you to modify parameters, issue commands, and monitor feedback for the selected profile.

Figure 4-20 shows, for example, the Velocity Profile tab in the Motion screen.

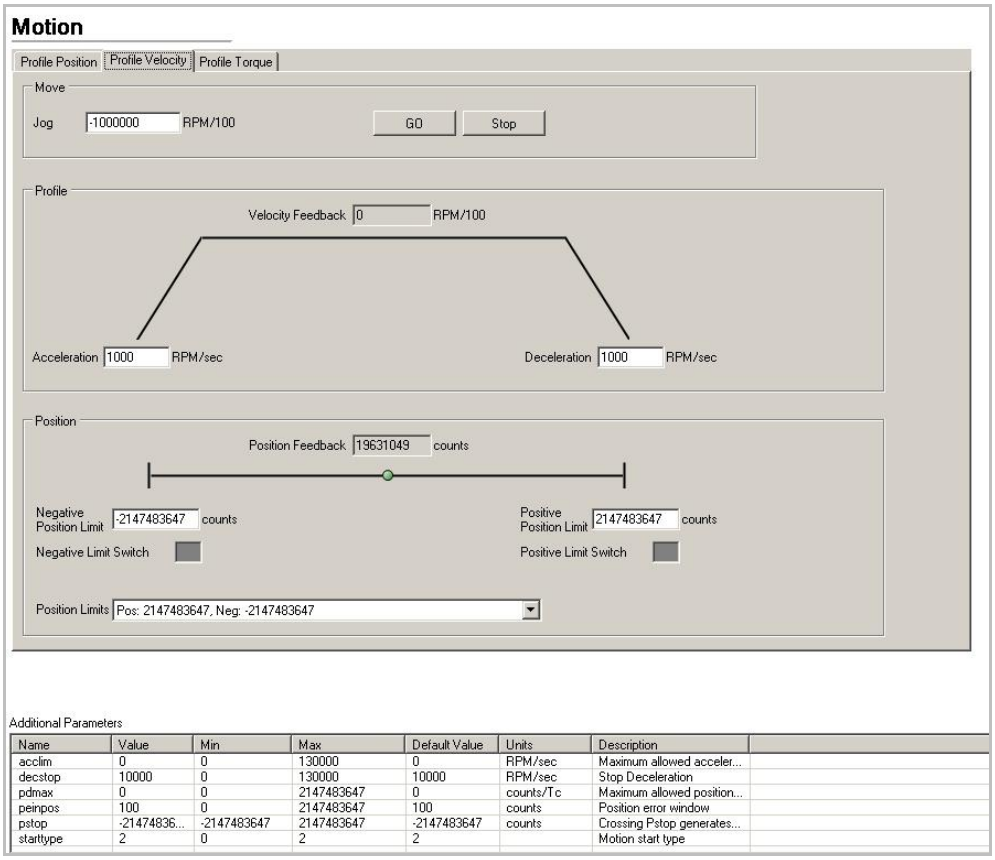


Figure 4-20. Motion Screen – Velocity Profile Tab

Each tab has three sections:

Move	Varies in each tab: ■ Torque tab: Apply Torque (current) ■ Velocity tab: Jog ■ Position tab: Move (in encoder counts) **GO** initiates the command. **Stop** decelerates the drive to a halt using the DEC value.

Profile	Varies in each tab: ■ Torque tab: Current Feedback ■ Velocity tab: Velocity Feedback acceleration/ deceleration ■ Position tab: Cruise Velocity acceleration/ deceleration
Position	Same in all three tabs. Displays information about the position limits and position feedback. Allows you to select the type of position limits: ■ **Pos**: 2147483647, **Neg**: -2147483647 ■ **Pos**: Positive position limit, **Neg**: Negative position limit ■ **Pos**: Positive position limit, **Neg**: Negative position limit and stop on PSTOP.

The Motion screen also includes a table of **Additional Parameters**, which are relevant to motion. The parameters are the same in each tab. You can modify these parameters in the same way you work with parameters in the Drive Parameters screen. Refer to *Section 4.5.1* and to the *LVD VarCom Reference Manual.*

4.6.11 Data Recording

Axis Manager has a data **Recorder** application for testing the drive's performance.

To activate the Recorder screen, use either of the following:

- The **Recorder** button on the toolbar.
- The **Recorder** option in the Tools menu.

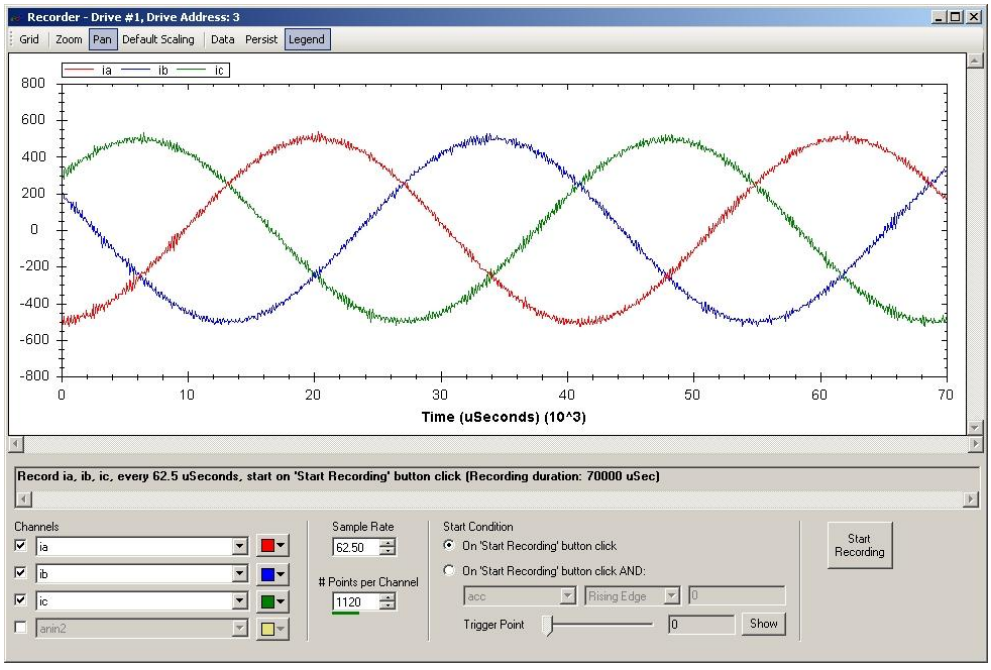


Figure 4-21. Recorder Screen

The **Recorder** allows recording of up to four different parameters.

The field below the plot area displays a textual summary of the currently defined settings for recording.

Grid	When enabled, gridlines are displayed in the plot background.
Zoom	When enabled, allows you to select and enlarge a section of the plot.
Pan	When enabled, allows you to use the mouse to drag the plot.
Default Scaling	Resets the plot to its default size.
Data	Displays the data in textual format rather than as graph.
Persist	Adds newly recorded data on top of the existing plot rather than clearing data and starting a new plot.
Legend	When enabled, a legend for the plotted parameters is displayed above the plot.
Channels	Allow you to select up to four parameters for recording.
Sample Rate	Allows you to set the time interval between two consecutive samples. Defined in microseconds. The LVD sampling rate is 62.5 µs.
# Points per Channel	Allows you to select the number of data points to record. A maximum of 8184 points can be recorded for all channels combined. The green bar below this field indicates the current usage of the recording buffer.
Start Condition	■ **On Start Recording button click**: Recording will begin when the **Start Recording** button is pressed. ■ **On Start Recording button click AND** [*options*]: Recording will begin when defined conditions exist after the **Start Recording** button has been pressed. This is the trigger point. **Trigger Point**: Sets the number of points to be recorded prior to the trigger point. [AXY]
Show	Marks the trigger point with a vertical line on the plot.
Start Recording	Begins the recording.

4.7 Digital Inputs and Outputs

The Digital IO screen displays the status of the IOs, and allows you to set the functionality of up to four digital inputs and two digital outputs.

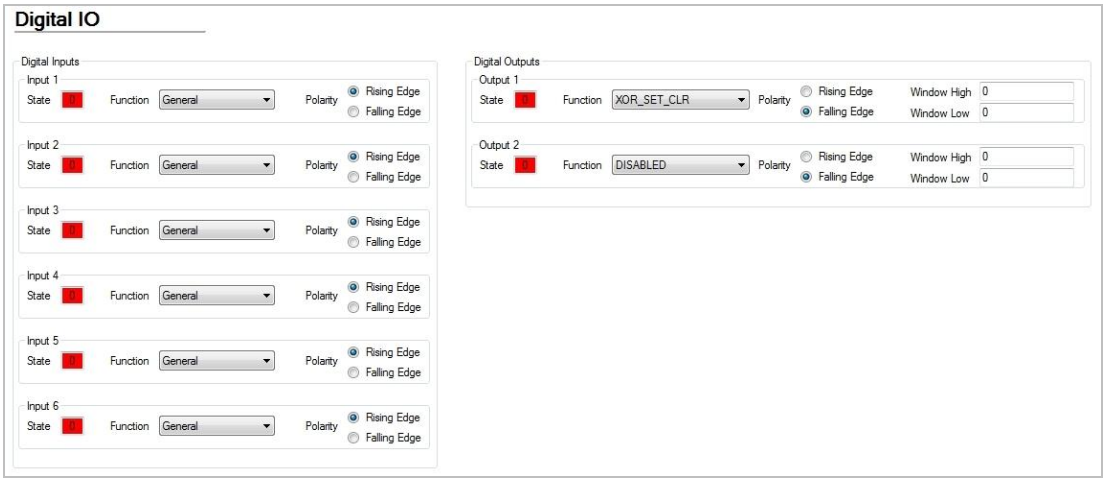


Figure 4-22. Digital Inputs/Outputs Screen

State	Displays the status of the inputs and outputs: ■ **1**: On (green) ■ **0**: Off (red)
Function	■ **Digital Inputs**: Allows you to select the input functionality, or to define the input as Disabled. ■ **Digital Outputs**: Allows you to select the event or condition that triggers an output signal, or to define the output as Disabled.
Polarity	Allows you to select whether or not to the logic of the output is inverted. ■ **Rising Edge** ■ **Falling Edge** ■ **Window High**: High limit of the function window ■ **Window Low**: Low limit of the function window

4.8 Analog Inputs

The Analog IO screen displays the analog input voltage level, and allows you to set the analog input offset value.

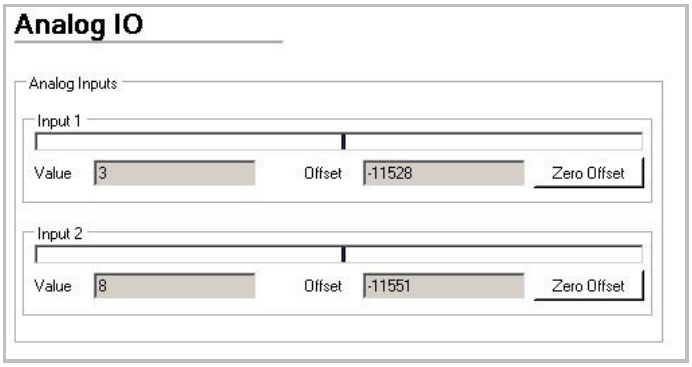


Figure 4-23. Analog Inputs/Outputs Screen

Value	Displays the value of the analog input, in millivolts. In addition, the graphic display indicates the current value of the input within the measurable range.
Zero Offset	Sets the current value of the analog input to 0, making it the reference level for the input signal.

4.9 Homing

The Homing screen allows you to select the methods and parameters to be used for homing the motor, and to initiate and monitor the homing process.

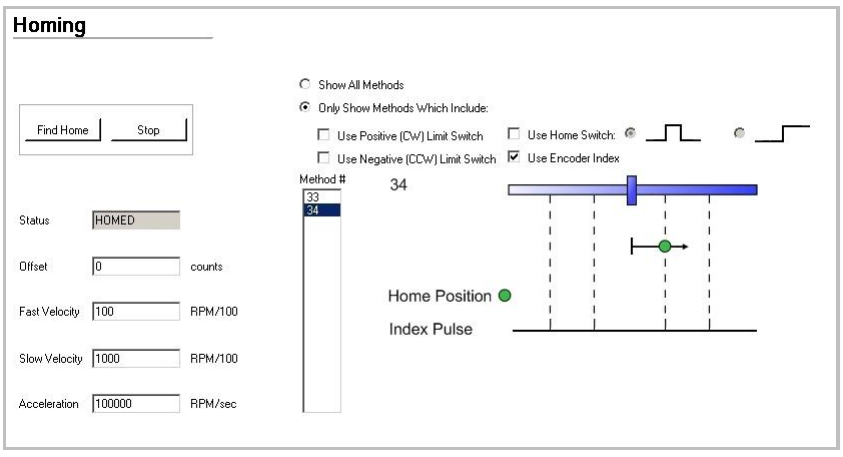


Figure 4-24. Homing Screen

Find Home	Initiates the homing process.
Stop	Stops the homing process.
Status	Displays the current state of the system: Homed or Not Homed

Offset	Sets an offset, in counts, for the Home position.
Fast Velocity	The velocity used during search for the home switch.
Slow Velocity	The velocity used during search for the index signal.
Acceleration	The value of acceleration and deceleration during the homing process.
Show All Methods	When selected, displays the complete list of 35 homing methods, per CANopen standard. For more information about homing methods, refer to the document "CANopen Device Profile Drives and Motion Control" (CiA Draft Standard Proposal 402).
Only Shows Methods Which Include:	When selected, allows you to choose one or more options for the home search: ■ Position (CW) Limit Switch ■ Negative (CCW) Limit Switch ■ Home Switch has two options: level trigger or edge trigger ■ Encoder Index
Method #	Lists either all methods, or just the homing methods that match the option/s selected.
[*graphic*]	A graphic display representing the method selected for the homing process.

5 Firmware Upgrade

Note: Upgrading the drive is a sensitive operation. Pay close attention when performing this task.

The **Vulcan** application is used for upgrading the LVD firmware. Vulcan burns firmware onto the drive's flash memory via a serial connection.

Vulcan is available for download from the Servotronix website.

5.1 Preparation

1. **Important:** Before upgrading the firmware, backup the drive parameters since parameter settings may be lost during the upgrade. After the upgrade is completed, the parameters can be reloaded/restored.
2. On the Servotronix website, go to the LVD product page.
3. Download and save the **VulcanSetup.ZIP** file to the host computer.
4. Run **VulcanSetup.exe** and follow the on-screen prompts to install the software.
5. By default, the software is installed under Windows Program Files in the folder \Servotronix\Vulcan.

5.2 Using Vulcan

1. From the Windows Start menu, go to [All] Programs > Servotronix > Drive Tools > **Vulcan**.
2. Typically, you will use the Software (Boot Type) upgrade method, according to the instructions in *Section 5.3*.
   If using the Hardware (Boot Type) method, follow the instructions in *Section 5.4*.

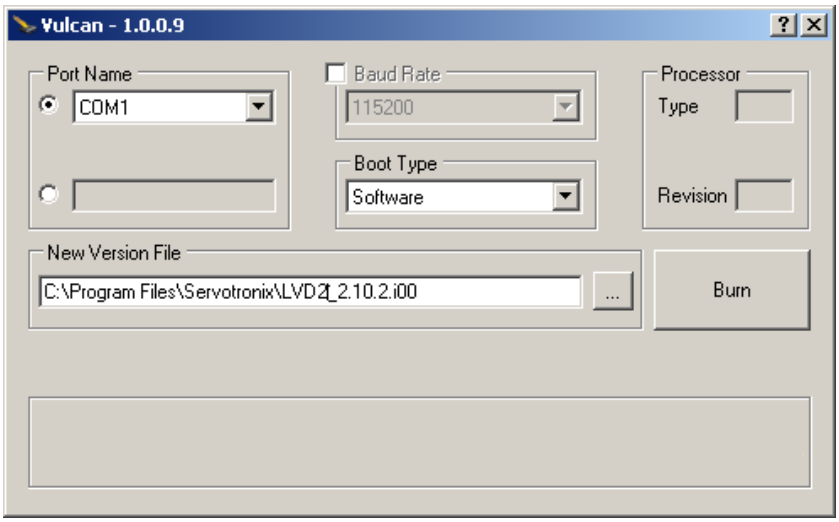


Figure 5-1. Vulcan Application for Firmware Upgrade

Port Name	The COM port of the host computer to which the LVD is connected by means of a serial cable. Make sure this COM port is not used by any other application. If the port name is not included in the list, use the blank field to type in the name of the port you want to use.
Baud Rate	For the Software (Boot Type) upgrade method, the rate is 115200. For the Hardware (Boot Type) upgrade method, the rate is 19200. Vulcan automatically sets the correct baud rate when the Boot Type is changed.
Boot Type	The method used for burning the new firmware on the drive's flash memory, either Software or Hardware, as explained below.
Processor	Displays the Type and Revision of the processor used in the LVD. Read-only field.
New Version File	The path and name of the file containing the firmware upgrade.
Burn	Starts the burning operation.

5.3 Software Boot Upgrade

The software boot method is used for upgrading a drive that is operational and able to communicate with the PC via a serial connection.

Note: Parameter settings are not erased during the software boot upgrade. However, the ECHO parameter is set to 0 (inactive) during the upgrade, and will need to be reset after the procedure is completed.

1. Turn the drive power off, then turn it on.
2. Complete the selections and information required in the Vulcan screen:
   - Port name
   - Make sure Boot Type is **Software**
   - Make sure Baud Rate is **115200**.
3. Browse to and select the firmware upgrade file (***.i00**).
4. Press **Burn** to start the upgrade.

   A progress bar and messages are displayed on the screen during the upgrade operation.

   When performing a software boot upgrade, parameters are automatically backed up and restored.

   ***Warning**: During the burning operation, do not close the application, do not disconnect the serial cable, and do not turn off the drive. Any of the actions may cause the drive to stop responding.*

If the upgrade operation is successful, a message is displayed on screen, and you can continue to Step 5.

If the upgrade operation is unsuccessful, a red fault message flashes, and you are prompted to view the operation log file.

5. Turn off the drive power, then turn it on.

   If the drive does not respond after cycling power, repeat the upgrade using the **hardware** boot method, as described below in *Section 5.4.*

5.4 Hardware Boot Upgrade

The hardware boot method is used for upgrading a drive when the software boot method fails, or when the drive does not respond when power is switched on.

Note: Parameter settings are erased during the hardware boot upgrade and must be restored after the upgrade is completed.

These instructions assume that the hardware is functional.

1. Make sure the drive power switch is **off**.
2. Complete the selections and information required in the Vulcan screen:
   - Port Name
   - Make sure Boot Type is **Hardware**
   - Make sure Baud Rate is **19200**
3. Browse to and select the firmware upgrade file (***.i00**).
4. Using a non-metallic instrument, press and hold the **boot switch** on the side of the LVD (see *Figure 3-6*) and simultaneously turn on the drive.
5. Press **Burn** to start the upgrade.

   A progress bar and messages are displayed on the screen during the upgrade operation.
6. If the upgrade operation is successful, a message is displayed on screen, and you can continue to Step 7.
7. Turn the drive power off, then turn it on.
8. Restore the drive parameters.

If the upgrade operation is unsuccessful, a red fault message flashes, and you are prompted to view the operation log file.

If the error persists, send a copy of the operation log file to Servotronix Technical Support at tech.support@servotronix.com

6 Troubleshooting

6.1 Built-in Protection

When a drive fault occurs, the fault is automatically latched and the drive is disabled. Faults must be explicitly cleared before the drive can be reenabled.

Drive faults are described in *Section 6.3*.

6.2 Diagnostic Tools

6.2.1 LEDs

The LVD has 2 LED indicators. Refer to *Section 3.6*

Table 6-1. LED Indicators

Name	Color	Function
Bus	**Yellow**	**ON** – Bus power is connected and powered to at least 5 VDC.
Status	**Green**	**Blinking** – The drive is operational and ready to be enabled. No faults. **ON** – The drive is enabled. No faults.
	Red	**ON** – A fault has been detected and needs attention. The LED remains ON until the error is resolved by user or the system itself. **Blinking** – A fault that was detected no longer exists, but has not yet been cleared. (Use the CLRFLT command or the Drive Status screen to clear the fault).

6.2.2 Axis Manager Status Messages

The Axis Manager interface displays the status of the drive in the status bar, at the bottom left of the screen.

Warning: **Flashing yellow**	Indicates that the parameter values you have entered are out of range and cannot be used. See *Figure 6-1*. Clicking the Warning message opens a dialog box that displays information and allows you to correct the error.
Fault: **Flashing red**	Indicates that a drive fault has occurred and drive has been disabled. See *Figure 6-2*. Clicking the Fault message opens the Drive Status screen, which displays faults and allows you to clear them. See *Figure 6-3* and *Section 6.3*.

Communication Error: Steady red	The far left of the status bar is reserved for indicating communication errors. This segment of the status bar is lit when Axis Manager is unable to communicate with a drive. See *Figure 6-4*.

Figure 6-1. Warning Message in Status Bar

Figure 6-2. Fault Message in Status Bar

Figure 6-3. Faults Displayed in Drive Status Screen

Figure 6-4. Communication Error Message in Status Bar

6.3 Faults

Following are the fault notifications that the LVD recognizes.

To troubleshoot the problem, perform the suggested solutions.

For detailed explanation of the commands and parameters, refer to the *LVD VarCom Reference Manual*.

Acceleration/Deceleration Violation

Description	The motor acceleration or deceleration is greater than ACCLIM.
Solution	1. Check the values of control loop parameters. 2. Check the demanded velocity, acceleration and deceleration. 3. Increase ACCLIM if needed, or set it to 0 to disable this functionality.

Commutation Fault

Description	A mismatch between the position of the Hall sensors and the encoder.
Solution	1. Check MENCRES, MENCDIR and the Halls cable. 2. Use CONFIG to reset the Halls commutation angle.

EEPROM Checksum Fault

Description	Checksum error while loading parameters.
Solution	1. Use the LOAD command to reload the parameters from the EEPROM. 2. Load the configuration file from the PC to the drive, save the configuration, and reset the drive. 3. The EEPROM might be damaged. The drive requires service.

EEPROM Reading Fault / EEPROM Writing Fault

Description	The drive's firmware could not access the EEPROM, during one of the following: SAVE, LOAD, CLRHST, TIMEON or TIMEEN
Solution	1. Reset the drive, and try again. 2. The EEPROM might be damaged. The drive requires service.

Encoder Line Break

Description	A disconnection of one of the encoder inputs was detected.
Solution	1. Check the encoder cable wiring. 2. If single ended encoder is used, set DIFFENC to 0 to configure the drive correctly.

General Error

Description	Undefined error occurred.
Solution	Contact Technical Support for assistance.

Halls/Address Read Failed

Description	The drive's firmware could not access the parallel to serial converter.
Solution	1. Reset the drive, and try again. 2. The parallel to serial converter might be damaged. The drive requires service.

I2T Limit

Description	Energy usage is higher than I2TLIM
Solution	1. Check the parameter values in the control loops. 2. Check the demanded velocity, acceleration and deceleration and motor load. 3. Increase I2TLIM if needed, or set it to 0 to disable this functionality.

Illegal Halls

Description	Illegal state for the HALLS sensors reading.
Solution	1. Check Halls cable wiring. 2. Check that the Halls sensor is functioning.

Over Current

Description	Hardware or software over current was detected.
Solution	1. Check the Current-Loop parameters (IGP, IGI). 2. Increase IMAX or reduce ISAT

Over Speed

Description	Actual speed exceeds VOSPD value.
Solution	1. Check the Velocity-Loop parameters (VGI, VGPR, VGPF). 2. Increase VOSPD or reduce VLIM.

Over Temperature

Description	The temperature of the drive is higher than 90°C (194°F) or lower than -30°C (-22°F), or the temperature sensor has a malfunction.
Solution	1. Check the drive operation conditions, using DRIVETEMP to read the measured temperature. 2. Reduce the load on the drive.

Over Voltage

Description	Bus voltage exceeds VBUSOV value.
Solution	1. Check the bus power voltage. 2. Increase the value of VBUSOV

Position Command Error

Description	The difference between two sequential position commands is greater than PDMAX. Note: Interpolated mode only.
Solution	1. Check the motion controller configuration. 2. Check the demanded velocity, acceleration and deceleration. 3. Increase PDMAX if needed, or set it to zero in order to disable this functionality.

Position Error

Description	The difference between the position command and the actual position is greater than PEMAX.
Solution	1. Check control loops parameters. 2. Check the demanded velocity, acceleration and deceleration. 3. Increase PEMAX.

Under Voltage

Description	Bus voltage is lower than VBUSUV value.
Solution	1. Verify bus power connection 2. Reduce the value of VBUSUV

Velocity Error Fault

Description	The difference between the velocity command and the actual velocity is greater than VEMAX.
Solution	1. Check the parameter values in the control loops. 2. Check the demanded velocity, acceleration and deceleration. 3. Increase VEMAX if needed, or set it to 0 to disable this functionality.