Chapter 4.
Service Tool

Introduction

This chapter covers tuning, configuring, calibrating, and servicing the control via the L-Series Service Tool. The control should already be installed on the engine.

IMPORTANT **Many applications are delivered pre-configured, calibrated, and tuned. These units do not require the use of the Service Tool.**

Description

The Service Tool software is used to configure, tune, and troubleshoot the L-Series controller. This chapter identifies the parameters available that can be viewed and provides detailed information on configuring and setting up the L-Series to the customer-specific field application.

The Service Tool software resides on a PC (personal computer) and communicates to the L-Series through connector pins 4 and 6. An external RS-232 transceiver is necessary to make communications possible with the Woodward L-Series service tool. A connectivity kit (Woodward # 8923-1061) can be purchased from Woodward to accomplish this.

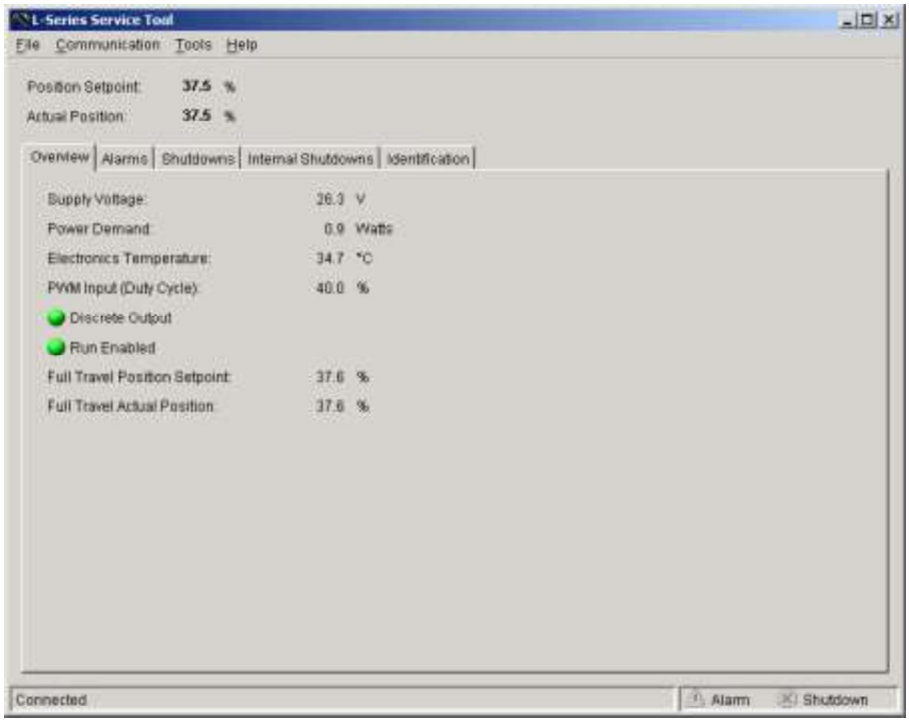


Figure 4-1. Example Service Tool Screen

The following hardware is required to work with the L-Series control:

- PC-compatible laptop or desktop computer with at least one available serial communications port, and Windows 2000, XP, NT 4.0, Vista, Win 7 (32- and 64-bit) as the operating system.
- Programming/datalink harness as shown in Figure 4-2.

In addition to the hardware, the following are the distributions of tool software needed to communicate with the control:

- Woodward part number 9927-1222, L-Series Service Tool

NOTICE

There is a potential for serial port damage when communicating with the L-Series control. This is caused by a difference in AC voltage between neutral and earth ground. If the PC RS-232 port ground is referenced to AC neutral, and the L-Series control is referenced to battery ground (AC earth ground), a large amount of current can be experienced. To avoid this situation, we strongly recommend placing an isolation transformer between the AC outlet and the PC.

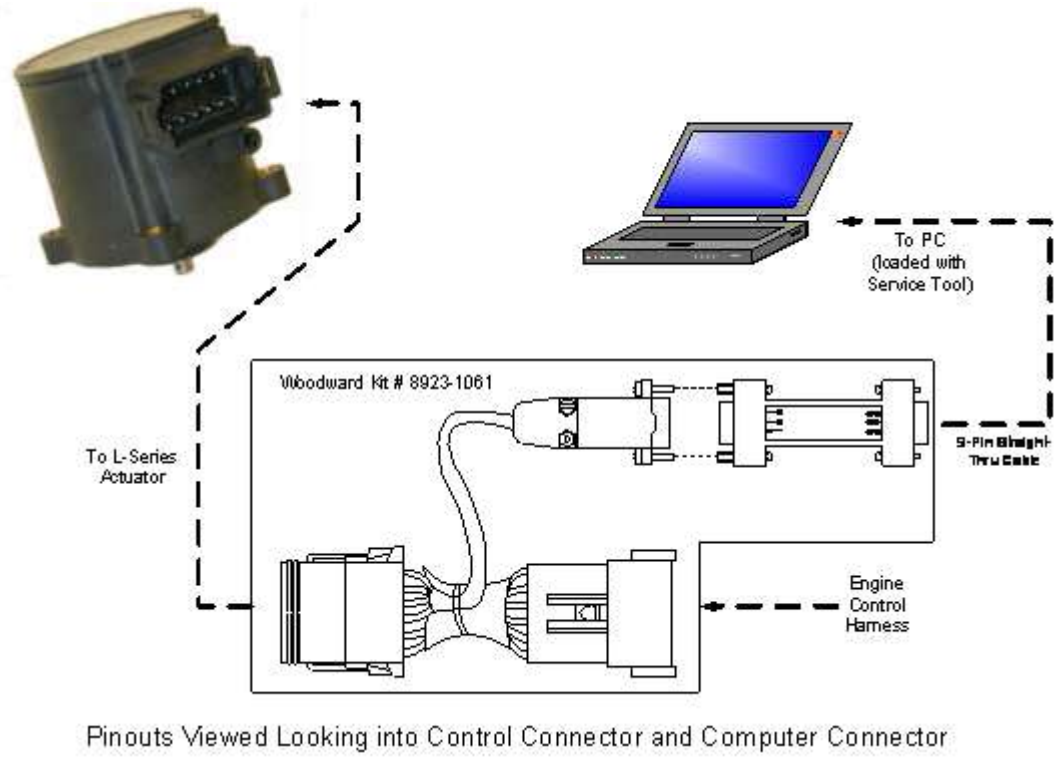


Figure 4-2. Typical Programming Datalink Harness Wiring

Getting Started

Installation Procedure

The Service Tool software can be downloaded and installed from the Woodward internet site (www.woodward.com/software).

WARNING

An improperly configured control could cause an overspeed or other damage to the engine. To prevent possible serious injury from an over-speeding engine, read and follow this entire procedure before starting the engine.

What to do next

After the software is installed, connect a serial communications cable between the RS-232 connections on the L-Series control and an unused serial port on your computer. Run the Service Tool program and

select the appropriate comm port. Once connected to the control, the status bar will display 'connected' and the Service Tool screen will populate with monitor parameters.

On CAN versions, the Communication/Connect command must be issued prior to powering-up the L-Series. Since the same I/O pins are used for both Service Tool and CAN communications, the only time the Service Tool is enabled is on power up. If a Service Tool connect is detected, CAN will be disabled and the Service Tool communications will remain active.

WARNING

An unsafe condition could occur with improper use of these software tools. Only trained personnel should have access to these tools.

Service Tool Help

More help on using Service Tool is available and included with the installation of the Service Tool product. Service Tool Help can be accessed from the Service Tool 'Contents' drop-down window selection under the Help menu located on the Main Window.

Software Version Identification

The Service Tool software version can found by selecting 'About' under the Help menu. The L-Series software version can be found on the right-most tab sheet (Identification) of the Service Tool screen. The Service Tool and Control must be connected to view this information. Refer to this version information in any correspondence with Woodward.

Configuration Password

If a password has been saved in the configuration file, the file cannot be opened without first entering the password. Once a configuration with a password has been loaded into the L-Series driver, the control configuration cannot be opened without the password. All other service tool functions do not require a password including: writing over a password protected file configuration, writing over a password protected control configuration, using the Position Calibration Tool, and using the Edit Position PID.

L-Series Configuration

The L-Series can be configured either on-line or off-line. On-line configuration can only be performed when the Service Tool is connected to and communicating with the L-Series control. Off-line configuration can be done at any time; however, settings will not take effect until they are loaded into the control.

IMPORTANT

If using non-linear mode, control power must be cycled after loading a new configuration.

The current L-Series control configuration settings can be viewed at any time when connected to the control by opening the Configuration Editor (File/Open Control Configuration). See Figure 4-3.

A Configuration Summary worksheet is provided in Appendix of this manual to allow documentation of application configuration settings.

OEM Configuration File Data

The OEM can save configuration file specific data with the service tool by selecting Properties under the File menu pull down. This is a text field and can be used to store data such as:

- Customer
- Engine Type
- Application Type
- Notes

Configuring the Unit—On-Line

Unit configuration is summarized as follows:

- Open the Configuration Editor Dialog by selecting 'File/Open Control Configuration'.
- Edit the configuration settings.
- Load the configuration to the L-Series control.

IMPORTANT

As changes are made to Configuration parameters, they are not used by the driver until a 'load' command is issued. Selecting the 'Close Window' box/button closes the Configuration Editor and does not make any changes to the driver.

Configuring the Unit—Off-Line

Unit configuration is summarized as follows:

- Open the Configuration Editor Dialog using the File/New or File/Open options.
- Edit the configuration settings.
- Save the configuration to a file. At a later date simply open the configuration and load it into the control.

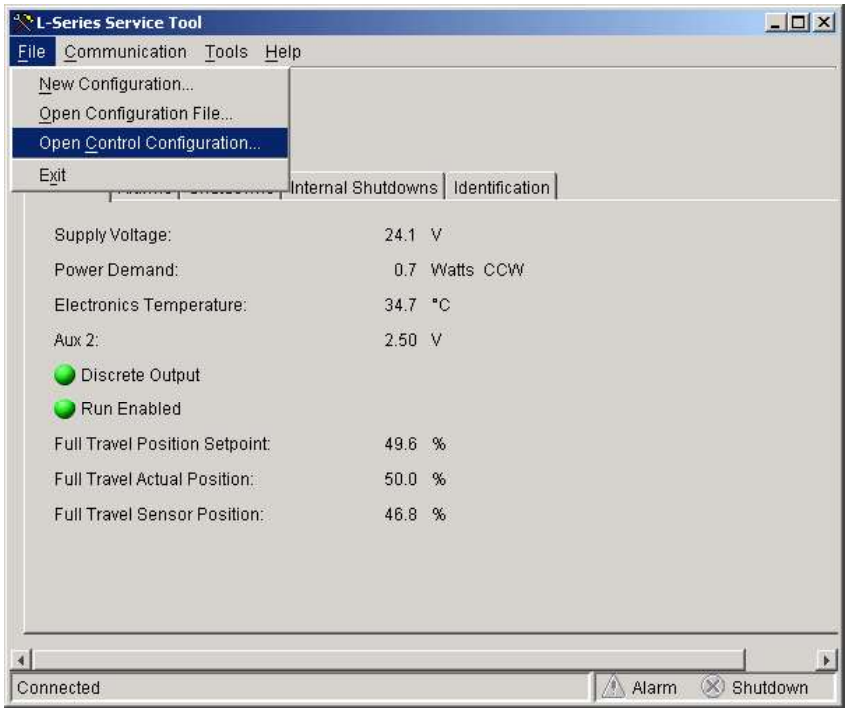


Figure 4-3. Configuration Selection Options

Configuration Parameters

There are five tab sheets that contain all the configuration settings: Overview, Setup, Discrete Output, Alarm/Shutdown and Security.

Overview Tab Sheet

The Overview tab (Figure 4-4) contains general positioning settings for the application. A description of each configuration parameter and its adjustment range is also available in the contents of the Service Tool Help.

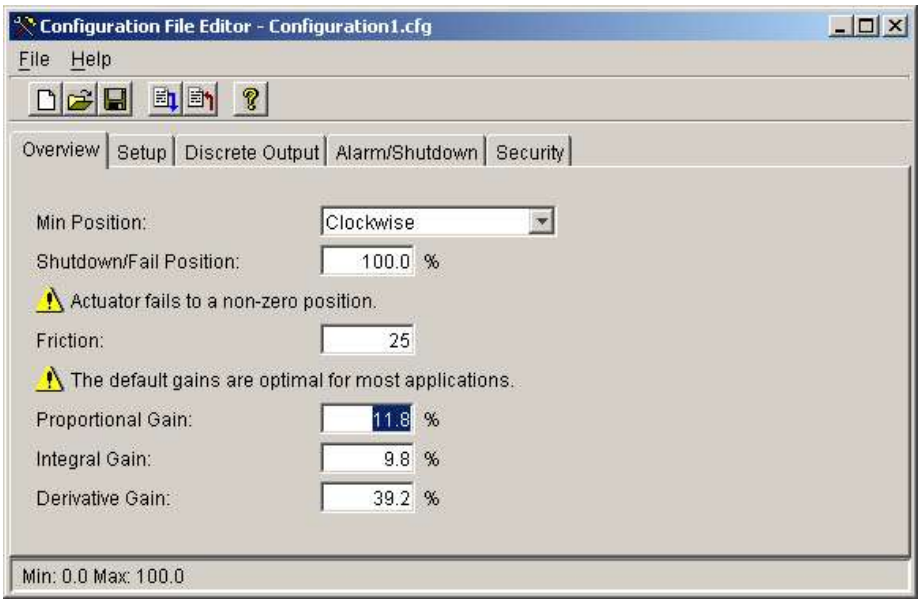


Figure 4-4. Configuration Editor—Overview Tab

Min Position
Sets the position controller direction. Allowed values: CW and CCW.

Shutdown/ Fail Position
Sets the position controller position, in percent, when a shutdown condition is detected. Allowed values: 0-100%.

Note: If the Shutdown/Fail Position is not set to '0.0', the 'Actuator fails to a non-zero position.' indication is activated. This is to alert the user of a potential unsafe condition.

Friction/Dither Setting
Sets the position controller's friction and dither values. This parameter should be set to zero (no effect) while tuning the PID and then increased for optimum response. If unsure, a typical value would be 25. Allowed values: 0–100.

Proportional Gain
Sets the position controller PID's proportional gain. Increased gain corresponds to increased PID output (higher proportional = faster response). This setting can also be dynamically adjusted using the PID Tuning screen. Allowed values: 0–100%.

Integral Gain
Sets the position controller PID's integral gain. Increased gain corresponds to increased PID output (higher integral = faster response). This setting can also be dynamically adjusted using the PID Tuning screen. Allowed values: 0–100%.

Derivative Gain
Sets the position controller PID's derivative gain. Increased gain corresponds to increased PID output (higher derivative = faster response). This setting can also be dynamically adjusted using the PID Tuning screen. Allowed values: 0–100%.

Setup Tab Sheet

The Setup tab (figure 4-5) provides all the position demand settings for the application including PWM, analog and CAN setup parameters. Changing the Demand Input Source will modify the parameter settings available as well as the displayed indications within the Service Tool.

A description of each configuration parameter and its adjustment range is also available in the contents of the Service Tool Help.

Demand Input Source

The Position Demand Source can be set to one of the following:

Single Selects a single, non-redundant position demand input.
Redundant Selects a redundant (primary/backup) position demand input.

Primary Position Demand Input

The Primary Position Demand source can be set to one of the following:

PWM Selects a PWM position demand input.
Analog Selects an analog (0–5 V) position demand input.
CAN Selects a CAN position demand input.

Backup Position Demand Input- *(only displayed if configured for Redundant Demand Inputs)*

The Backup Position Demand source can be set to one of the following:

PWM Selects a PWM position demand input.
Analog Selects an analog (0–5 V) position demand input.
CAN Selects a CAN position demand input.

Note: The Primary and Backup Position Demand input cannot be set to the same source.

Maximum Demand Difference - *(only displayed if configured for Redundant Demand Inputs)*

Sets the max difference between primary and backup demands.
Allowed values: 0.0 to 100%

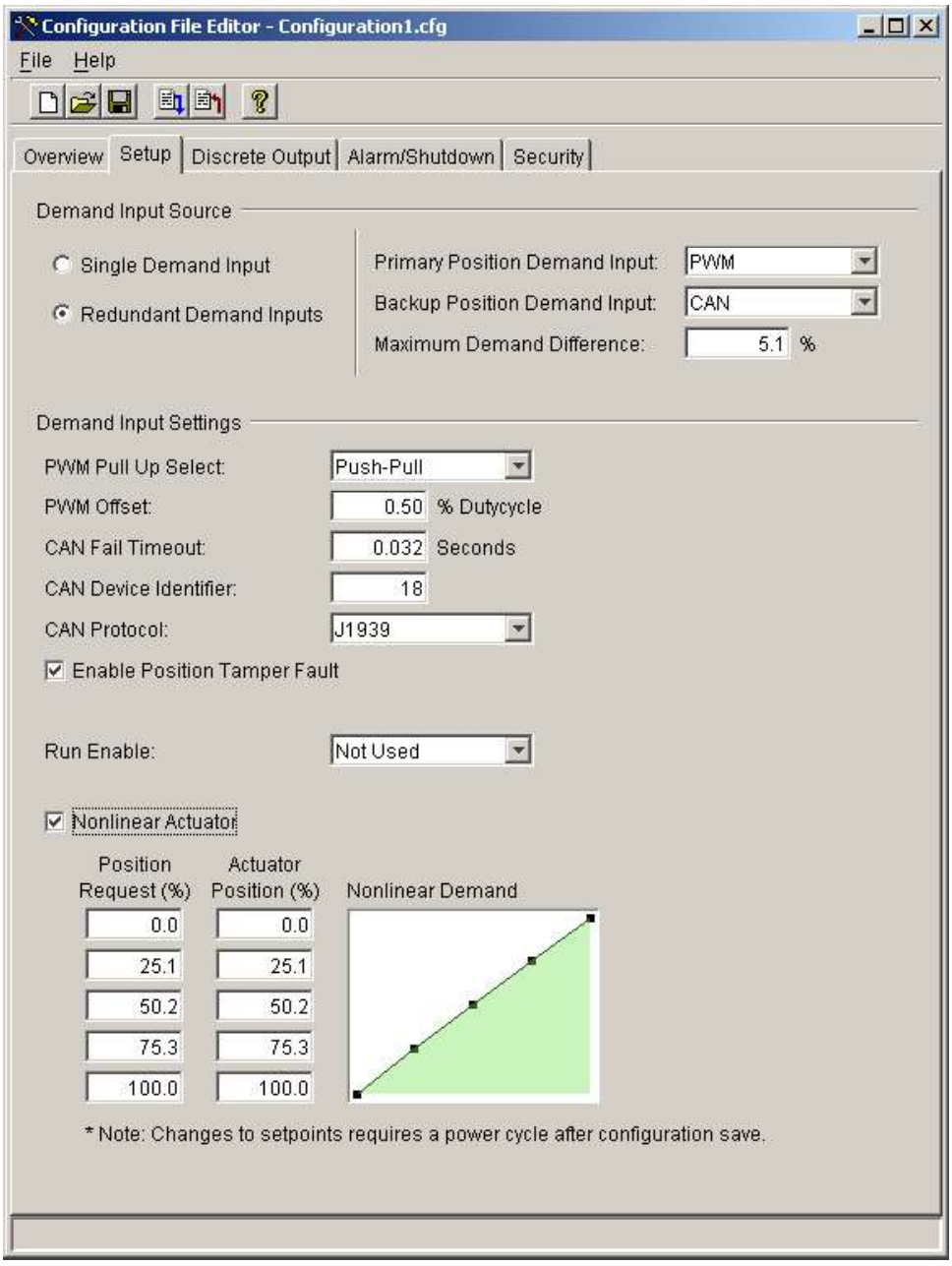


Figure 4-5. Configuration Editor—Setup Tab

PWM Settings - *(only displayed if PWM is selected as a Demand Input)*

Two additional configuration parameters appear when the position demand is set to PWM (see Figure 4-6).

PWM Pull Up Select

Selects the appropriate PWM source. This configures the L-Series input internally to provide the proper pull-up logic. For details on selection of this parameter, refer to Chapter 3. Allowed values: Push-Pull, High Side Drive, or Low Side Drive.

PWM Offset

Sets the PWM Duty cycle offset. This setting is provided to compensate for duty cycle variations in PWM input frequencies, voltages, and types.
Allowed values: –5.01 to +5.01%

CAN Settings

CAN Fail Timeout - *(only displayed if CAN is selected as a Demand Input)*
Sets the maximum allowed delay between CAN receive / inputs (Rx), in seconds, before a CAN Fault is annunciated. Allowed values: 0–10 seconds

CAN Protocol Select
Selects the desired CAN messaging format. For details refer to the CAN section in chapter 2. Allowed values: J1939 or CANopen.

CAN Device Identifier *(only displayed for CANopen)*
Sets the CAN Device ID (COB-ID). Allowed values: 1–127

CAN ID Discrete Input *(only displayed for J1939 with firmware 5418-6084)*
Determines if the CAN ID selector is used. When used, allows two to four different device identifiers, determined by the discrete input state on device power-up. Allowed values: Not Used or Aux 2.

CAN ID LOW Discrete Input *(only displayed for J1939 with firmware 5418-6638)*
Determines if the CAN ID selector is used. When used, allows two to four different device identifiers, determined by the discrete input state on device power-up. Allowed values: Not Used or Aux 2.

CAN ID HIGH Discrete Input *(only displayed for J1939 with firmware 5418-6638)*
Determines if the CAN ID selector is used. When used, allows two to four different device identifiers, determined by the discrete input state on device power-up. Allowed values: Not Used, Aux 1 or Aux5.

CAN Device Identifier *(only displayed for J1939)*
Sets the device source address. Allowed values: 18–21

CAN Device Identifier 2 *(only displayed for J1939 when using CAN ID LOW discrete input)*
Sets the device source address when the CAN ID discrete inputs select unit 2. Allowed values: 18–21

CAN Device Identifier 3 *(only displayed for J1939 when using CAN ID HIGH discrete input)*
Sets the device source address when the CAN ID discrete inputs select unit 3. Allowed values: 18–21

CAN Device Identifier 4 *(only displayed for J1939 when using both CAN ID HIGH and LOW discrete inputs)*
Sets the device source address when the CAN ID discrete inputs select unit 4. Allowed values: 18–21

CAN Data Rate *(only displayed for J1939)*
Selects the data rate for J1939 messaging. Allowed values: 250 or 500 kbps.

Enable Position Tamper Fault - *(only displayed if CAN is selected as the Backup Position Demand Input)*
When selected, activates the Position Tamper Fault logic which disables the Primary Demand if it doesn't track the CAN demand.

Heartbeat Producer Time - *(only displayed for CANopen)*
Sets the time increment for sending CANopen NMT heartbeat messages, in seconds. Allowed values: 0–10 seconds

Run Enable Select
Determines the functionality of Run Enable.
Allowed values: Not Used or Aux 1.

Non-linear Actuator

Selects either a Linear position command, when unchecked, or a Nonlinear 5-point curve command. Linear/Nonlinear refers to the relationship between the position requested and the position commanded to the position PID. When this box is checked, additional parameters appear to set up the 5-point demand curve.

IMPORTANT

If the non-linear curve is changed, control power must be cycled.

Position Request (%)

There are five breakpoint values that correspond to the position requested by the analog or PWM input signal. These values set up the curve inputs. Allowed values: 0–100%.

These values must maintain a monotonic increase in their values, in order from lowest to highest. Also, after the configuration is loaded into the control, power must be cycled on the control before the settings take effect.

Actuator Position (%)

There are five breakpoint values that correspond to the modified actuator position command. These values set up the curve outputs. Allowed values: 0–100%.

Discrete Output Tab Sheet

The Discrete Output (Figure 4-6) screen contains the discrete output configuration settings. If the discrete output is not used, these settings can be skipped.

Relay Output Configuration

The relay output can be configured to one of the following:

Normally On Sets the relay driver to a normally on mode that turns off for any of the faults selected. This is the preferred, failsafe output configuration.

Normally Off Sets the relay driver to a normally off mode that turns on for any of the faults selected.

WARNING

Woodward recommends that the Relay Output be configured for the failsafe 'Normally On' mode, to ensure maximum fault protection and annunciation. Failure to follow these guidelines could, under exceptional circumstances, lead to personal injury and/or property damage.

Relay Output Fault Selections

The list of faults displayed can be individually selected to activate the relay output. Any of the selected faults will either turn the output off if configured for Normally On or turn the output on if configured for Normally Off.

WARNING

Woodward recommends that all faults be configured to activate the discrete output, this ensures maximum fault annunciation.

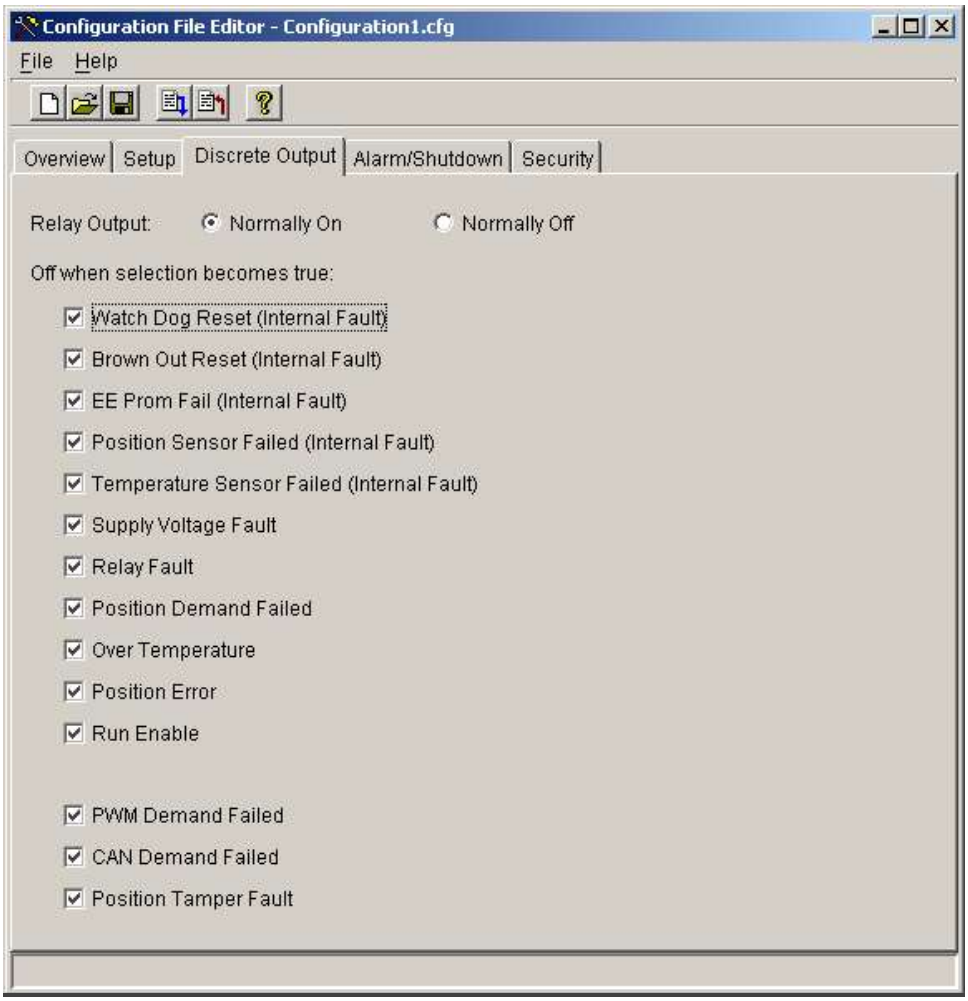


Figure 4-6. Configuration Editor—Discrete Output Tab

Alarm/Shutdown Tab Sheet

The Alarm/Shutdown (figure 4-7) screen contains the alarm and shutdown configuration settings.

Shutdown/Alarm Fault Selections

The list of faults displayed can be individually selected to either perform a Shutdown or just Alarm (no action).

WARNING

Woodward recommends that all faults be configured as shutdowns and selecting 'Enable Fault Latching', which ensures maximum fault protection. Failure to follow these guidelines could, under exceptional circumstances, lead to personal injury and/or property damage.

Enable Fault Latching

This setting determines whether the faults are latching or non-latching. When set to latching, a reset command is required to clear the fault.

Enable CAN Fault Latching – *(only displayed on CAN units if Enable Fault Latching is false)*
This setting determines whether the CAN fault is latching or non-latching. This option is provided to latch-in the CAN fault even though all other faults are set to non-latching.

Position Error Maximum (%)
Maximum deviation between the actual position and the position command. If the Error is exceeded for longer than the Position Error Delay, then the Position Error fault is annunciated. Allowed values: 0–100%.

Position Error Delay (sec)
Delay for position error annunciation. Allowed values: 0–10 seconds.

CAN Tracking Error Maximum (%) – *(only displayed if Position Tamper Fault is used)*
Maximum deviation between the primary position demand and the CAN position demand. If the Error is exceeded for longer than the CAN Tracking Error Delay, then the Position Tamper Fault is annunciated. Allowed values: 0–100% but must be greater than the Max Demand Difference setting.

CAN Tracking Error Delay (sec)
Delay for Position Tamper Fault. Allowed values: 0–10 seconds.

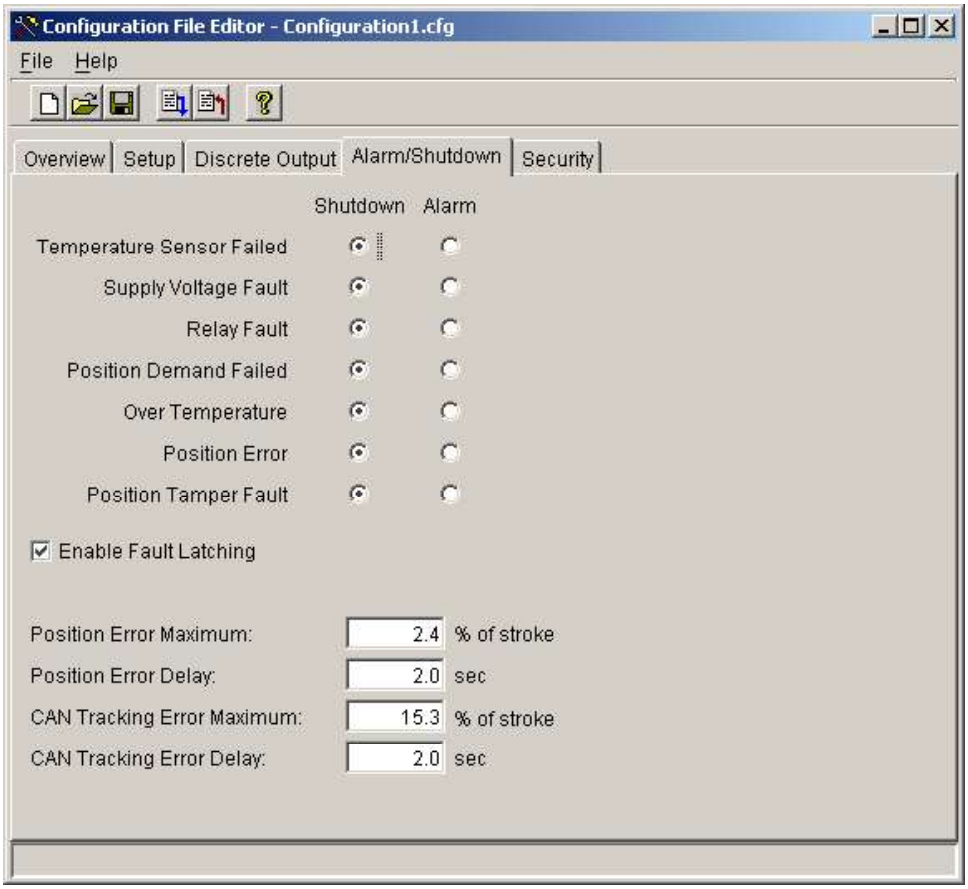


Figure 4-7. Configuration Editor—Alarm/Shutdown Tab

Security Tab Sheet

The security (Figure 4-8) screen contains the security configuration settings.

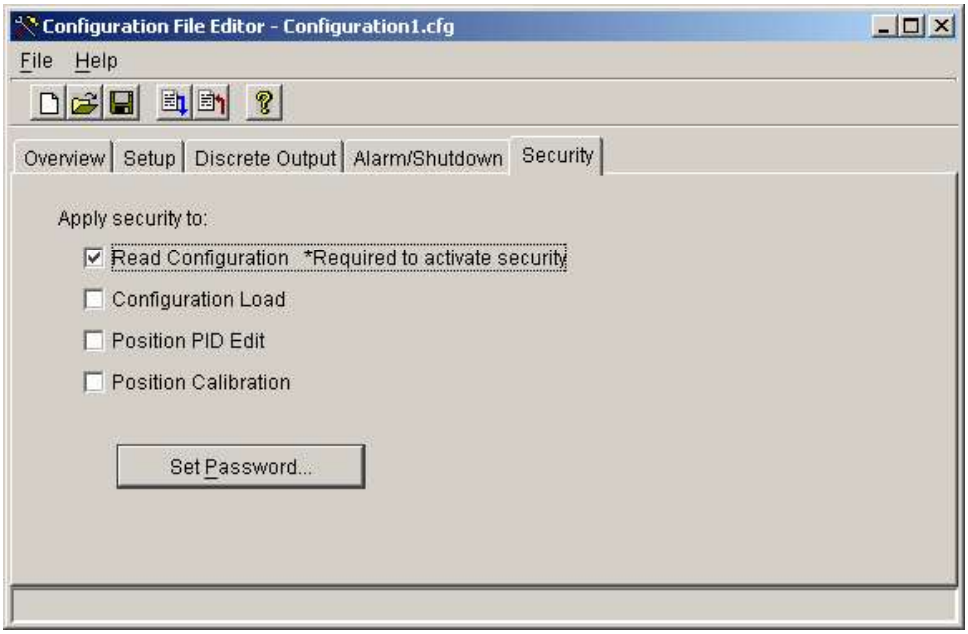


Figure 4-8. Configuration Editor— Security Tab

Security Configurations

All checked features will have the security password enforced prior to allowing the function. Unchecked features will not be prompted with a password.

Read Configuration

When checked, requires a password before the configuration can be read from the L-Series control (protects Open From Control execution).

This is the minimum level of protection and is required in order to use any other security option.

Configuration Load

When checked, requires a password before a configuration can be loaded into the L-Series control (protects Load to Control execution).

Position Calibration

When checked, requires a password before the position calibration mode can be entered (protects Manual and Automatic Position Calibration menu options).

Position PID Edit

When checked, requires a password before allowing tuning to the position PID (protects Edit Position PID menu option).

Figure 4-9. Security Tab Set Password Pop-up

Loading the Configuration (Save)

Select the File/'Load to Control' option from the menu or Blue Arrow icon on the Configuration Editor to load the changes into the control. The L-Series process must be zero prior to allowing a 'Load' command. This feature can be optionally password protected.

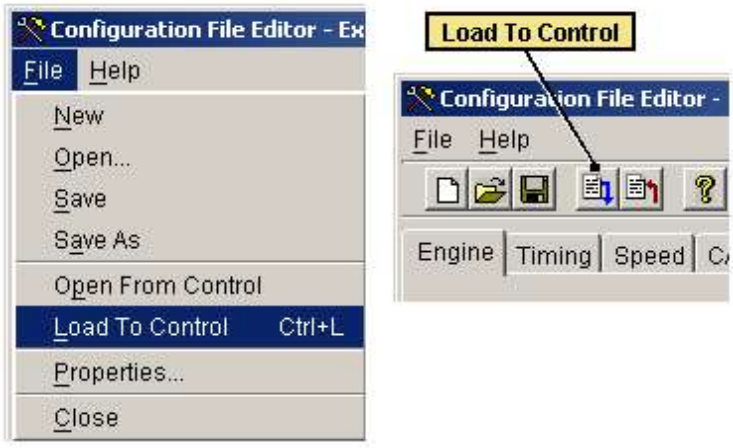


Figure 4-10. Security Tab Set Password Pop-up

Monitoring the Driver

The Service Tool has five different tab sheets to monitor driver parameters. The tab sheet screens include:

- Overview (Figure 4-11)
- Alarms (Figure 4-12)
- Shutdowns (Figure 4-13)
- Internal Shutdowns (Figure 4-14)
- Identification (Figures 4-15)

Each screen displays the position setpoint and actual position values.

Position Setpoint

Displayed value of the position demand, in percent.

Actual Position

Displayed value of the actual position, in percent.

Status Bar Indications

At the bottom of the Service Tool window is a status bar. The status bar has two sections. The bottom left section displays communication status and bottom right section displays alarm & shutdown status.

Communication Status

This section of the status bar shows the status of communication between the service tool and the L-Series Driver. For more information, see Establishing Communication.

- **Connected—**The Service Tool is connected to and communicating with the driver.
- **Not Connected—**The Service Tool is not connected to the driver.
- **Connecting—**The Service Tool is attempting to connect to the driver. This message is displayed when Connect is selected from the Communications menu or when attempting to re-establish communication to the driver. If the connection is lost it will continuously attempt to re-connect.

Alarm Status

Indicates that one or more alarms on the Alarms screen are active.

Shutdown Status

Indicates that one or more shutdowns on the Shutdowns or Internal Shutdowns screen are active.

Overview Parameters Screen

To monitor the overview parameters, go to the Overview page (Figure 4-11) on the main window.

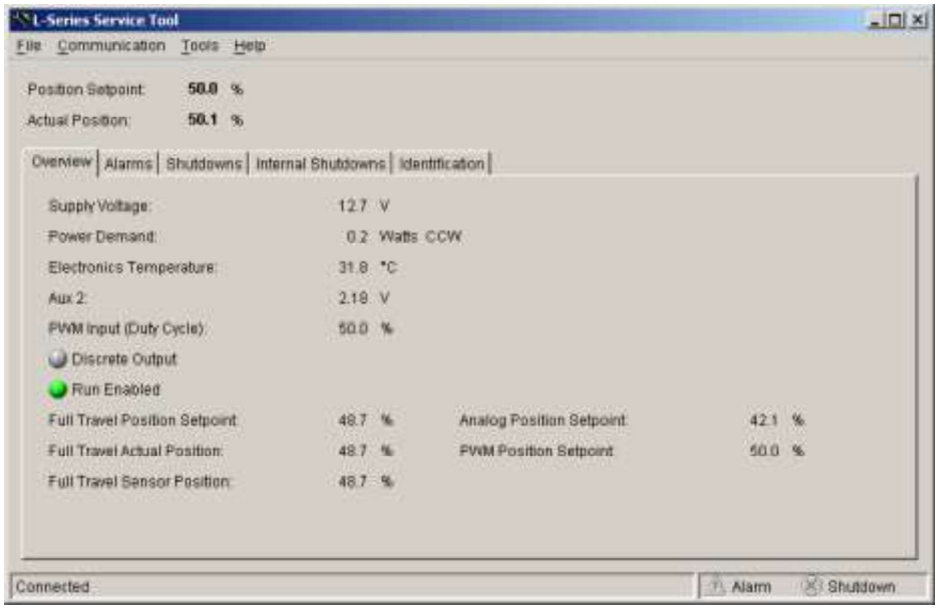


Figure 4-11. Service Tool—Overview Tab

Supply Voltage

Displayed value of the input power, in volts, as read by the processor.

Power Demand

Displayed value of the power demanded, in watts, as read by the processor. This is an indication of the work output.

Electronics Temperature

Displayed value of the electronics temperature sensor, in degrees Celsius, as read by the processor. The temperature sensor is physically located between the electronics module and the LAT motor.

PWM Input (Duty Cycle)
Displayed value of the PWM input, in percent duty cycle. This indication is displayed only when the position demand is set to 'PWM'.

AUX2 Input
Displayed value of the analog 0–5 V input, in volts. This indication is displayed only when the position demand is set to '0.5 V'.

Discrete Output
On/Off status of the discrete output command. The indicator is illuminated when the channel is commanded to ON and grayed-out when the command signal is OFF.

Run Enabled
Open (off) / Closed (on) indication of the Run Enable discrete input.

Full Travel Position Setpoint
Indication of the position setpoint in terms of total overall unit travel. Useful if a less than full-travel user-calibrated range is used.

Full Travel Actual Position
Indication of the actual position in terms of total overall unit travel. Useful if a less than full-travel user-calibrated range is used.

Full Travel Sensor Position
Indication of the position in terms of total overall unit travel before linearization. This value will match the TPS output.

Shutdown and Alarm Indications

The Shutdown and Alarm screens display the status is both active and logged fault conditions. The logged indications provide a history of events even after the unit has been power-cycle of run again.

 Indicates a logged alarm condition.

 Indicates an active alarm condition.

 Indicates a logged shutdown condition.

 Indicates an active shutdown condition.

An active fault is one that is currently active or latched in the control. The latching/non-latching faults configuration setting factors into this indication. If the fault is latching, then an active fault could either be one that is still present or one that occurred but has not been reset. Latched faults can be cleared by cycling power on the L-Series control or by selecting the 'Reset Alarms and Shutdowns' button on any of the Alarm or Shutdown screens.

A logged fault is one that occurred but is no longer currently active or latched in the control. Logged faults are permanently cleared by selecting the 'Reset Logged Alarms and Shutdowns' button on any of the Alarm or Shutdown screens.

Alarms Screen

To monitor the alarm conditions, go to the Alarms page on the main window. The values displayed on this screen dynamically change with the fault configuration. Refer to chapter 2 for a complete listing and details of all the faults.

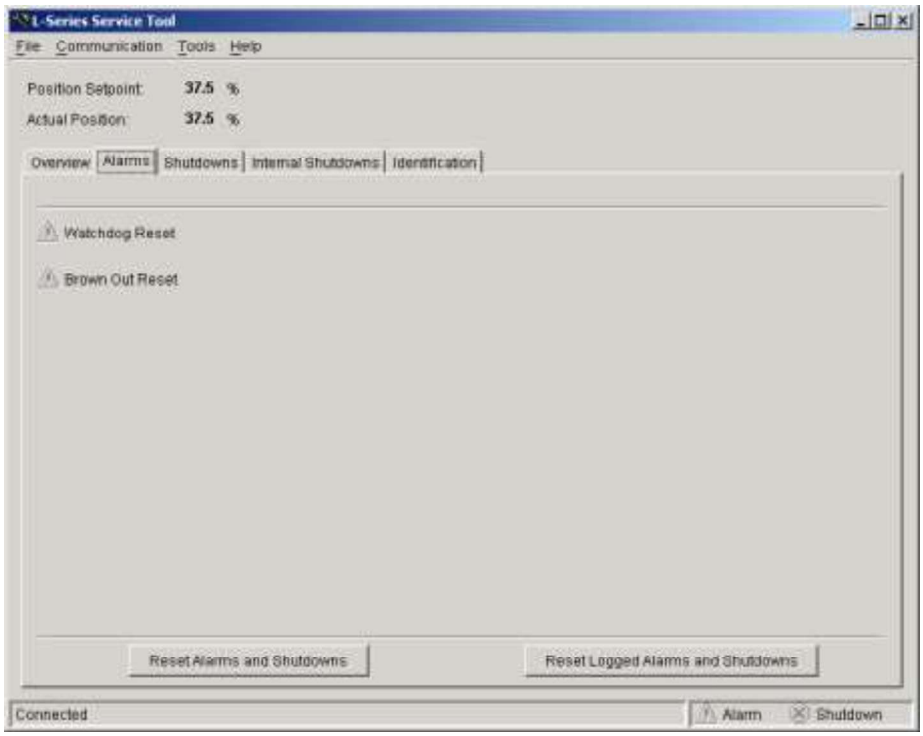


Figure 4-12. Service Tool – Alarms Tab

Shutdowns and Internal Shutdowns Screens

To monitor the shutdown conditions, go to the Shutdowns and the Internal Shutdowns pages on the main window. The values displayed on the Shutdowns screen dynamically change with the fault configuration. Refer to chapter 2 for a complete listing and details of all the faults.

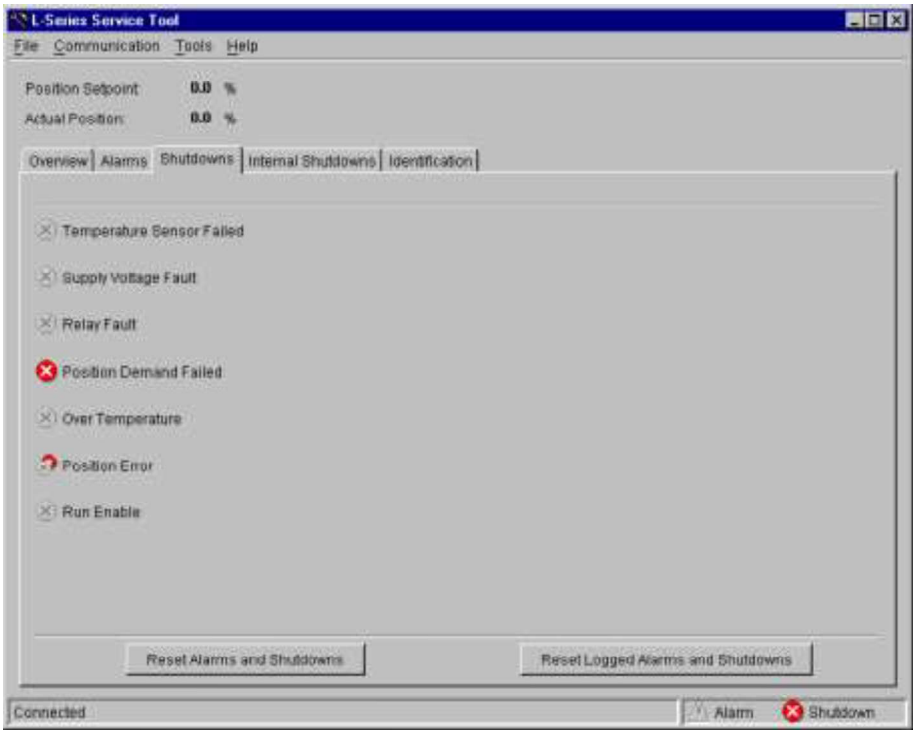


Figure 4-13. Service Tool – Shutdowns Tab

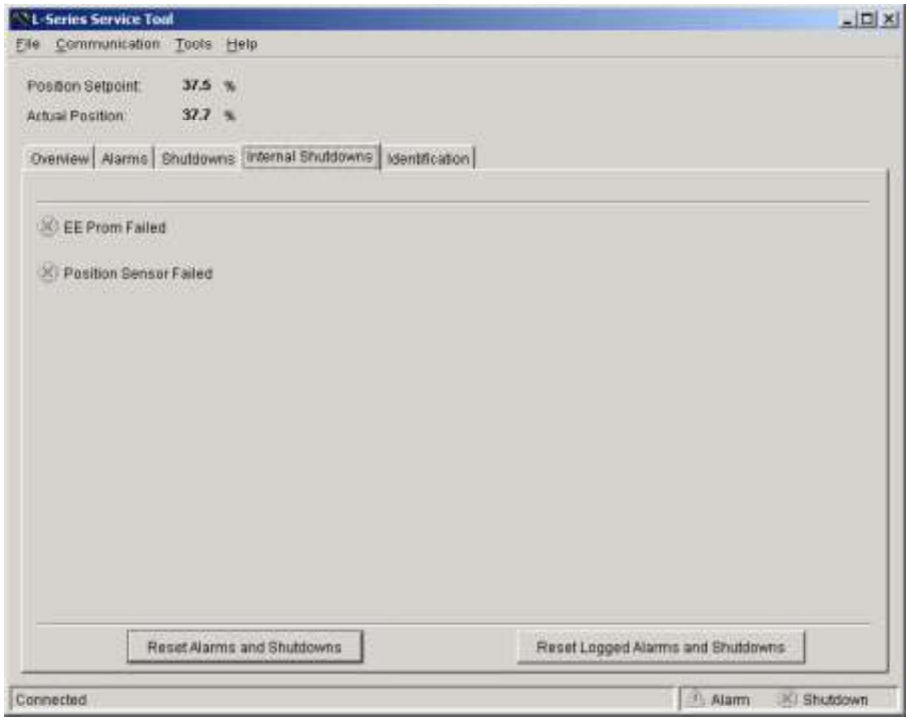


Figure 4-14. Service Tool – Internal Shutdowns Tab

Identification Screen

To monitor the L-Series product identification, go to the Identification (Figure 4-15) page on the main window.*

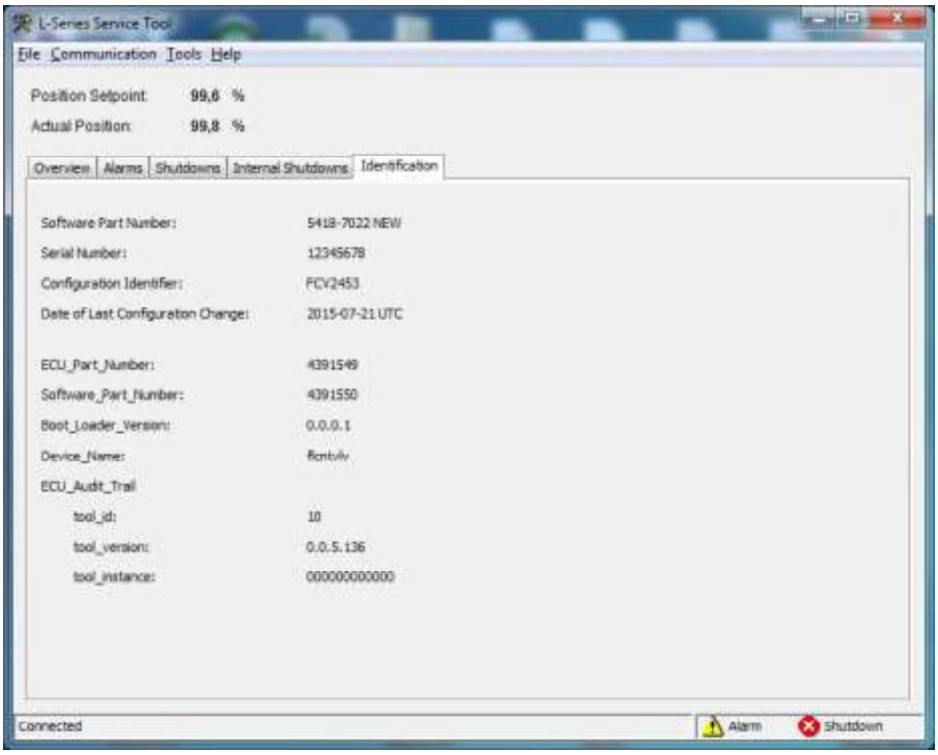
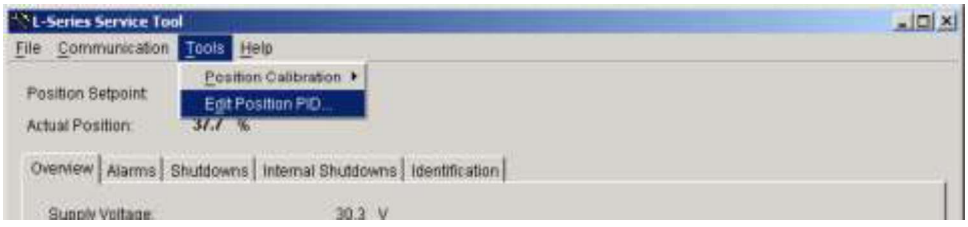


Figure 4-15. Service Tool—Identification Tab

* ECU_Part_Number, Software_Part_Number, Boot_Loader_Version, Device_Name and ECU_Audit_Trail are available in 5418-7022 only.

Tuning the PID

The Service Tool can be used to tune the PID or to just trend/monitor the PID output. To get to the PID Tuning screen, select the Edit Position PID from the Tools menu selection.



The L-Series controller can be put into a manual control mode from this screen by selecting the “Enable Manual Position Tuning’ checkbox (Figure 4-16). Once in manual mode, the position setpoint box is highlighted and the value displayed is actively positioning the output. Use this command to create step changes for the PID and monitor the response using the displayed trend.

Pressing the Properties button pops open the Properties Window (Figure 4-17). From this window the user can adjust the trending window properties including the update rate and display range.

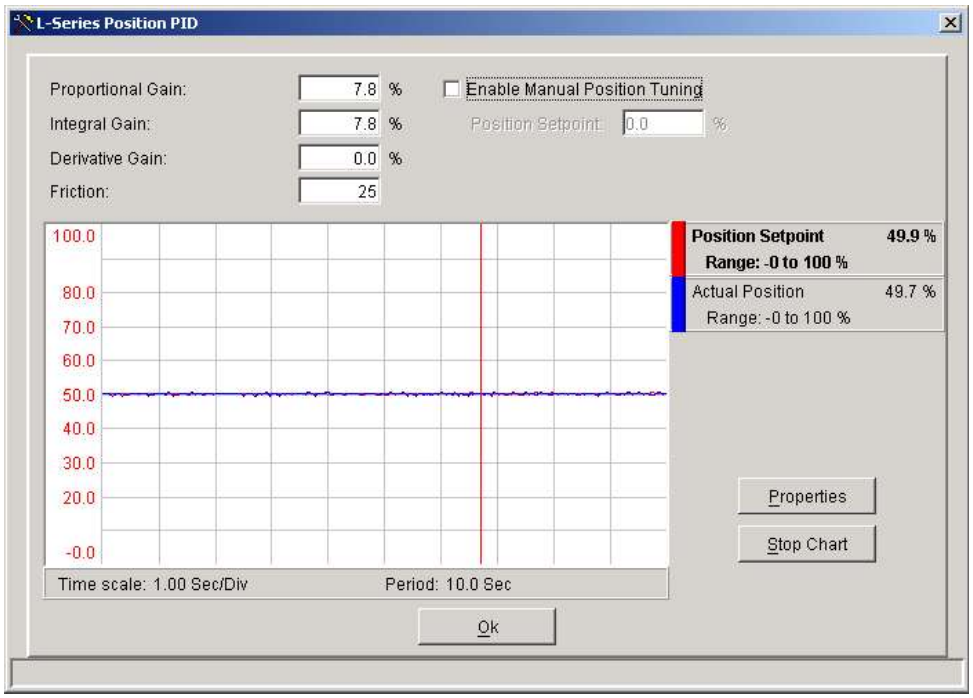


Figure 4-16. Service Tool—PID Tuning Window

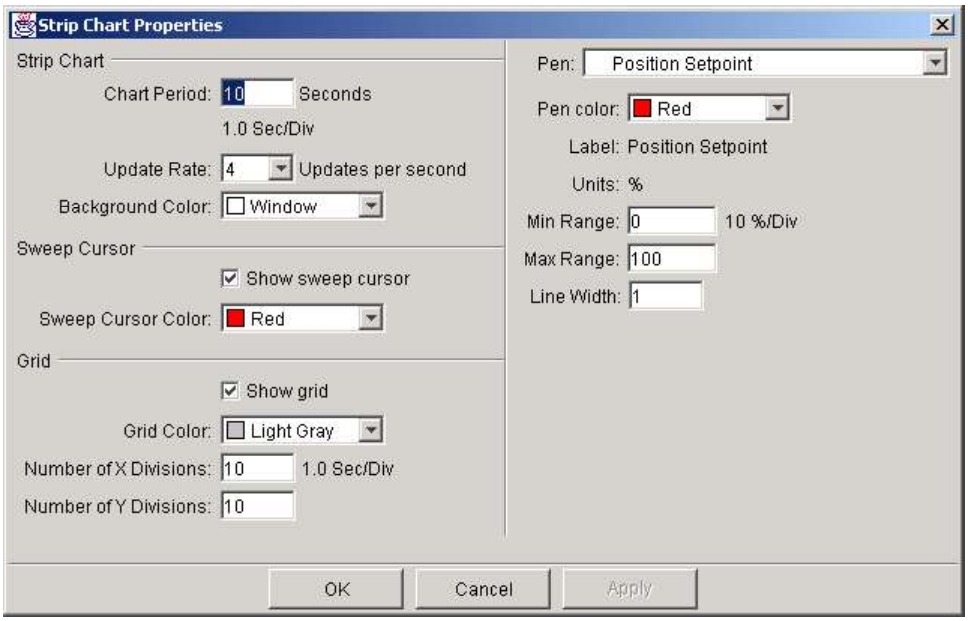


Figure 4-17. Service Tool—PID Tuning Properties Window

Position Calibration and Verification

Position calibration is available to map the position command input to the actual rotational travel of the unit. It is only used when the full travel of the actuator is constrained or limited such that 0 to 60 degrees of travel is not used. For example, an application-specific position calibration could map 0–100% position command to 10–40 degrees actual rotation.

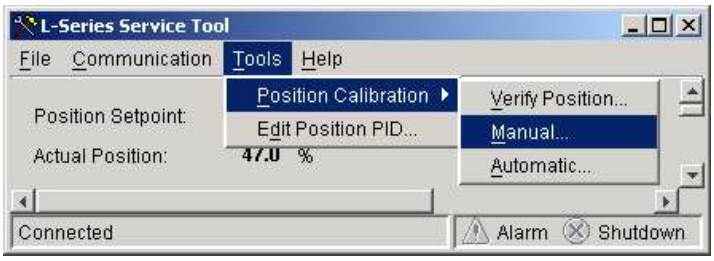
There are two methods available to perform a position calibration: Automatic or Manual. If the application has hard stops that correspond to the actual min/max travel, then either Auto or Manual methods can be

used—although auto is easier. If hard stops are not available, then the auto method will give invalid results and the manual method must be followed.

The Service Tool can be used to calibrate the control to end user stops (physical or soft) or to verify the position calibration. To get to the Position Calibration screens select the desired function from Position Calibration under the Tools menu selection.

IMPORTANT

Position Calibration is only used when the full travel of the actuator is constrained or limited such that 0 to 60 degrees of travel is not used.



Calibration Sequence Overview

The following outlines the basic steps required to execute the position calibration.

Automatic Mode

1. Select Automatic Position Calibration Mode.
2. Select CW or CCW Direction.
3. L-Series automatically rotates in both CW and CCW directions until the stops are detected. The values are then captured and stored.
4. When completed, cycle the power on the L-Series.
5. Woodward recommends that a Position Verification be performed to confirm the calibration is correct. See Position Verification below.

Manual

1. Determine to rotational travel limits. This can be done by positioning the unit to the minimum and maximum positions and recording the position settings.
2. Select Manual Position Calibration Mode.
3. Select Direction.
4. Enter the pre-determined rotational travel limits values.
5. When completed, cycle the power on the L-Series.
6. Woodward recommends that a Position Verification be performed to confirm the calibration is correct. See Position Verification below.

Position Verification

When the Verify Position screen is entered, the control is put into position control and the position is set to the position the control was at when the screen was entered. The screen displays the “User” Requested Position, Actual Position, Minimum Position, and Maximum Position (see Figure 4-18). These User Positions are calculated from the user-calibrated stops.

The Full Travel Actual Position is the full stroke factory position without user stops after software linearization. The Full Travel Sensor Position is the full stroke factory position without user stops before software linearization. The Full Travel Sensor Position will match the TPS Output Signal.

The Verify Position screen can be used to check the calibration or to get the minimum and maximum position values for the manual calibration. If the Enable Requested Position Tuning box is checked the valve can be positioned anywhere from 0 to 100% of the user minimum and maximum stops by entering a value into the Requested Position. If the Enable Requested Position Tuning box is unchecked the valve will go limp and can be physical positioned by hand.

IMPORTANT

If the full factory position calibration range is not being used (the Manual or Automatic Calibration has been performed) and the minimum position direction is changed, the calibration must be run again for the Verify Position mode to work correctly.

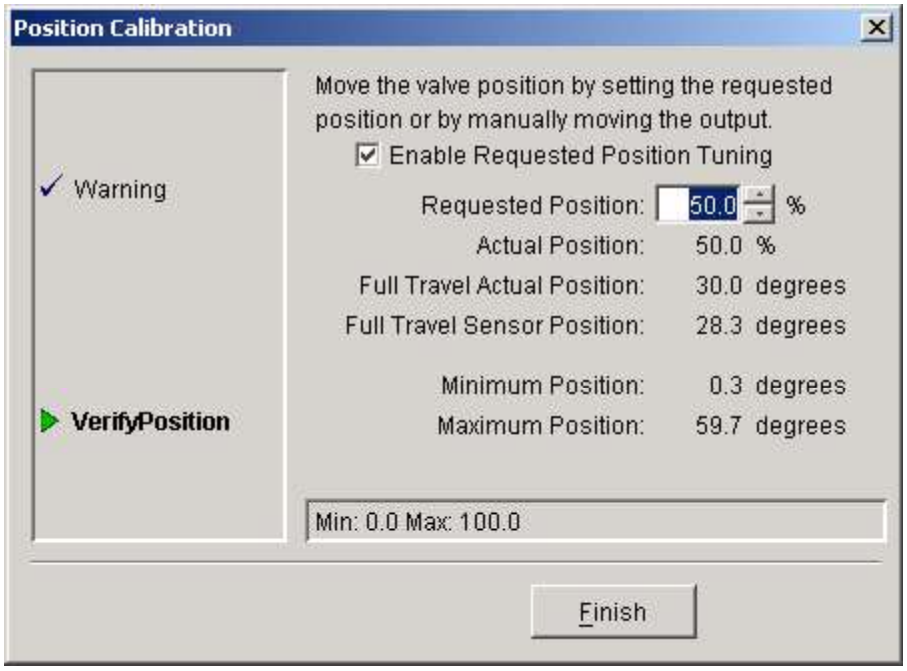


Figure 4-18. Service Tool—Verify Position Calibration

Manual Calibration

The manual calibration mode is used to set the minimum position and fail direction and to calibrate the valve to user soft stops (inside of any physical stops). The first screen to appear when entering the manual mode is used to set the minimum position and fail direction. This setting must be correct before manually calibrating the valve.

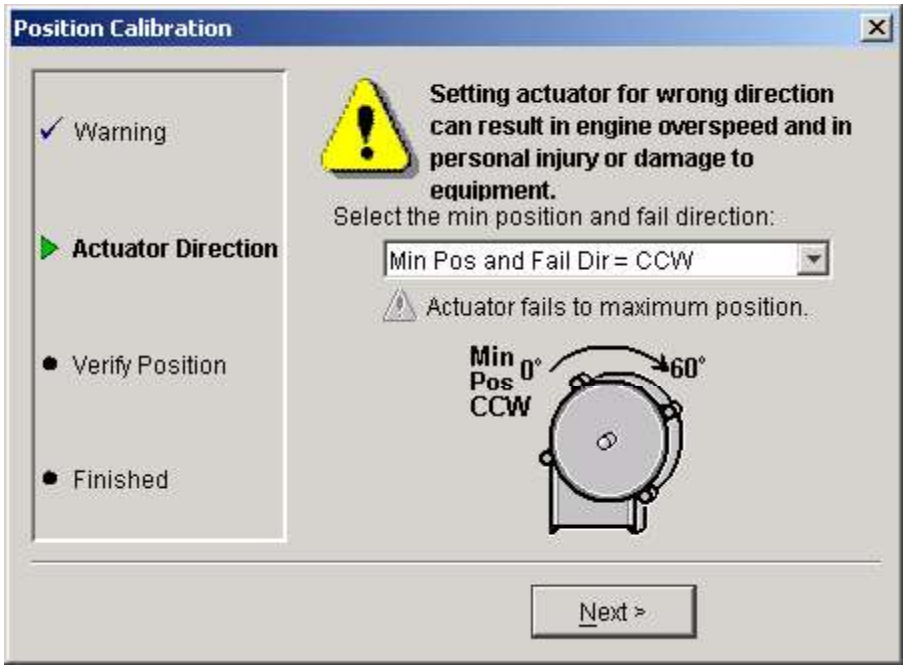


Figure 4-19. Service Tool—Manual Position Calibration

The next screen is used to set the minimum and maximum positions for the user soft stops. To find the minimum and maximum soft stops use the verify position mode described above to position the valve and use the Full Travel Actual Position reading for minimum and maximum position values.

IMPORTANT **After leaving this mode, power must be cycled for the new settings to take effect.**

IMPORTANT **Review ALL settings shown on ALL Configuration screens to verify that all configuration settings are correct before loading settings to the control. Configuration changes do not take effect until they are loaded to the control.**

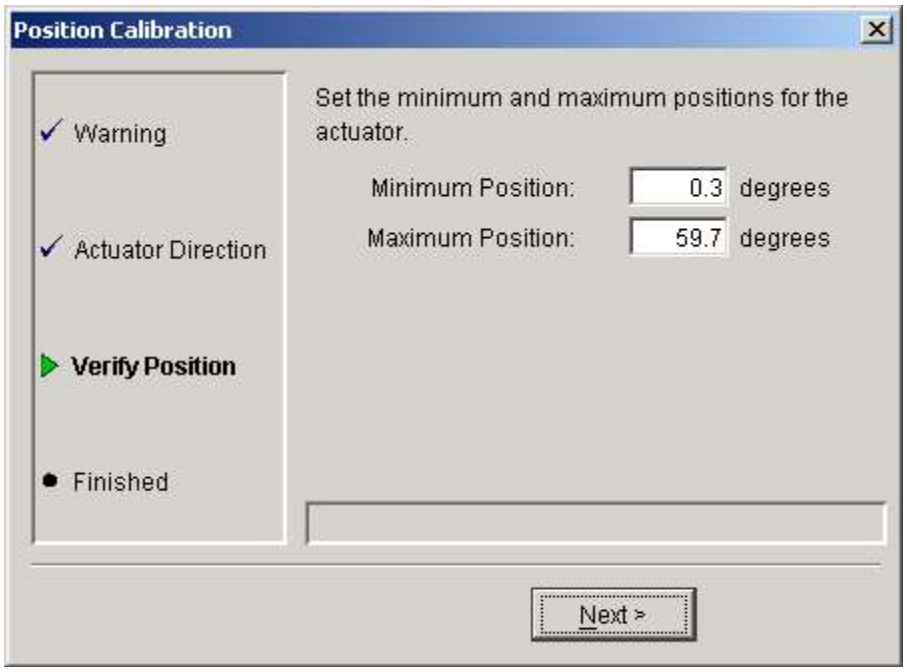


Figure 4-20. Service Tool—Manual Position Calibration Settings

Automatic Calibration

The automatic calibration mode is used to set the minimum position and fail direction and to calibrate the valve to user physical stops (mechanical hard stops). Like the manual mode, the first screen to appear is used to set the minimum position and fail direction. This setting must be correct before automatic calibration is performed.

After setting minimum position and fail direction the screen below will appear. The control is now moving first to the CCW stop and then to the CW stop to get the physical minimum and maximum positions.

IMPORTANT

After leaving this mode, power must be cycled for the new settings to take effect.

IMPORTANT

Review ALL settings shown on ALL Configuration screens to verify that all configuration settings are correct before loading settings to the control. Configuration changes do not take effect until they are loaded to the control.

Figure 4-21. Service Tool – Auto Position Calibration

Chapter 5. Specifications

Specifications

Power Supply	12/24 V systems (10–32 Vdc) reverse polarity protection, 2.5 A max
Power Consumption	32 W maximum
Torque	Nominal: 0.34 N·m (0.25 lb-ft) at 25 °C Maximum Transient (at 105 °C): 0.20 N·m (0.15 lb-ft) Minimum Continuous (at 105 °C): 0.14 N·m (0.10 lb-ft)
Mass/Weight	425 g (15 oz)
Power-Up to Operation Time	<250 ms (< 1 s CAN versions)

Performance

Positioning Accuracy	±2% at 25 °C ±4% (analog), ±3.6% (PWM), ±3% (CAN)–over temp range
Slew Time 10%–90%	33 ms
Overshoot	1%
Settling Time	10 ms
–6 db Roll-off at ±0.5% Input	32 Hz
–3 db Roll-off at ±2% Input	8 Hz

Environment

Ambient Operating Temperature	–40 to +105 °C (–40 to +221 °F)
Storage Temperature	–40 to +125 °C (–40 to +257 °F)
EMI/RFI	EN61000-6-2 : Immunity for Industrial Environments EN61000-6-4 : Emissions for Industrial Environments SAE J1113-21: Radiated Immunity (100 V/m) SAE J1113-11: Conducted Transient Immunity – Pulse 5b Suppressed Load Dump (45 V)
Humidity	US MIL-STD 810E, Method 507.3, Procedure III
Salt Spray	US MIL-STD 810E, Method 509.3, Procedure I
Shock	MS1-40G 11 ms sawtooth
Random Vibration	Random: 0.3 G²/Hz, 10–2000 Hz (22.1 Grms) 3 h/axis Sine: 5 G 2.5 mm peak-to-peak, 5–2000 Hz, 3 h/axis, 90 min dwells, 1 octave/min
Drop	SAE J1211, Paragraph 4.8.3 (modified)
Thermal Shock	SAE J1455, Paragraph 4.1.3.2
Ingress Protection	IP56 per EN60529

Analog Command Input

Table 5-1. Analog Command Input

Parameter	Value
Input Type	0–5 V, Single-Ended Input
Input Scaling	0.5 V = 0% and 4.5 V = 100% position
Max Input (Full Scale)	5 V ± 1%
Isolation	None
Transient Protection	According to EMC norm
Input Impedance	499 kΩ
Anti-Aliasing Filter	1 anti-aliasing pole at 0.001 ms (159 kHz)
Resolution	10 bits
Accuracy	±1.3% of full scale over the temperature range of –40 to +125 °C, including drift
I/O Latency	8.2 ms
Calibration Method	2-point linear software calibration
Out of Range Signal	< 0.2 V or > 4.8 V
Overvoltage Protection	Input protected against 32 Vdc steady state

PWM Command Input

Table 5-2. PWM Command Input

Parameter	Value
Input Magnitude	5–32 V p-p
Frequency Range	300–1500 Hz
Duty Cycle Scaling	10% = fully closed and 90% = fully open
Isolation	None
Input Impedance Push-Pull Mode	44 kΩ–113 kΩ
Input Impedance Open Collector Mode, High Side or Low Side.	15 kΩ
Resolution	16 bits at 300 Hz, 14 bits at 1.5 kHz
Accuracy	±1% of full scale (duty cycle), over the temperature range of –40 to +125 °C, including drift
I/O Latency	8.2 ms
Calibration	Duty cycle offset adjustment is available in Service Tool. This will tailor the input to the signal source
Out of Range Frequency	None
Out of Range Duty Cycle	< 3% or > 97%

Discrete Input

Table 5-3. Discrete Input

Parameter	Value
Input Current	0.5 mA @ 5 Vdc
Input Type	Ground referenced discrete input
Delay Time for Shutdown	< 200 ms for system to recognize shutdown
Delay Time for Reset Detection	< 1 s for valves to move to minimum position
Max Voltage from + Connection	32 V (power input voltage)
Isolation	None. Intended for use with external relay or other dry contact
Input Thresholds	> 3.1 Vdc = “ON” < 0.8 Vdc = “OFF”
Input Current	0.5 mA @ 5 Vdc

Discrete Output

Table 5-4. Discrete Output

Parameter	Value
Output Type	Low-side output driver
Max Contact Voltage (Open)	32 V
Max Current	0.5 A
Max Contact Voltage at 0.5 A (Closed)	1.5 V
Max Delay Time for Opening Contact	8.2 ms
Default at Power Up	Configurable in software
Error Condition	Configurable in software
OK Condition	Configurable in software
Driving Inductive Loads	Yes, internally protected low-side switch
Protection	Utilizes circuitry that will open the contact when output contacts are short-circuited. Self-resetting when fault is removed

TPS Output

Table 5-5. TPS Output

Parameter	Value
Output Type	0–5 V, single-ended
Output Scaling	0.75 V = full CCW position and 4.25 V = full CW position
Isolation	None
3 db Circuit Bandwidth	350 Hz
Transient Protection	According to EMC norm
Output Impedance	2.8 kΩ (±1%)
Accuracy	±10% of full scale, @ 25 °C
Temperature Drift	±0.4% over the full temperature range
I/O Latency	n/a – direct from position sensor
Calibration Method	Sensor-in-place factory calibration. 2-point linear
Out of Range Signal	< 0.25 V or > 4.75 V
Overvoltage Protection	Output protected against 32 Vdc, steady-state; if >28 V is applied to pin 2, a position-related error will be annunciated

RS-232 Serial Communication Service Port

Table 5-6. RS-232 Serial Communication Service Port

Parameter	Value
Isolation	None
Baud Rate	Fixed 19.2 Kbaud
Electrical Interface	Outputs are TTL level. Requires external transceiver for conversion to RS-232 levels for proper communication
Pinout	Tx = pin 4, Rx = pin 6, Gnd = pin 3
Maximum Cable Length	10 m (33 ft), not meant for permanent connection (for service only)
Cable Type	Straight-through (no crossover)

CAN Communications (optional)

Table 5-7. CAN Communications (optional)

Parameter	Value
Type	2-wire CAN, version 2.0B software selectable CANopen or J1939
J1939	Complies with SAE J1939 but uses proprietary group extensions; 29-bit
CANopen	CANopen node (ref CiA DS301 Version 4.02)
Device Identifier	Service Tool software setting
Isolation	None
Baud Rate	Fixed 250 kbps (CANopen) 250 or 500 kbps (J1939)
Pinout	Lo = pin 6 (AUX4), Hi = pin 4 (AUX3) (shared with RS-232 communications)
Line Limitations	40 m (130 ft) If an isolator is used: Trunk Length: 250 m (820 ft) Maximum Drop: 6 m (20 ft) Cumulative Drop: 78 m (256 ft)
Fault Detection	Service Tool setting

Electronics Temperature Sensor

Table 5-8. Electronics Temperature Sensor

Parameter	Value
Accuracy	±2 °C at 25 °C ambient ±3 °C over full range (–40 to +125 °C)
I/O Latency	8.2 ms

Software Execution Rates

Table 5-9. Software Execution Rates

Software Routine	Nominal Software Execution Rate
Position Control Algorithms	1.6 ms
Position Demand Algorithms	8.2 ms
Analog Input Logic	8.2 ms
PWM Input Logic	8.2 ms
Serial Port	background task
CAN communications	8.2 ms
Run Enable Discrete Input	8.2 ms
Discrete Output	8.2 ms
Diagnostics	8.2 ms

Reliability and Quality Goals

The L-Series control system has a reliability target of 17 500 hours MTBF. It also has a quality goal of less than 25 PPM when measuring out-of-the-box defects. This quality goal is a target based on continuous improvement.

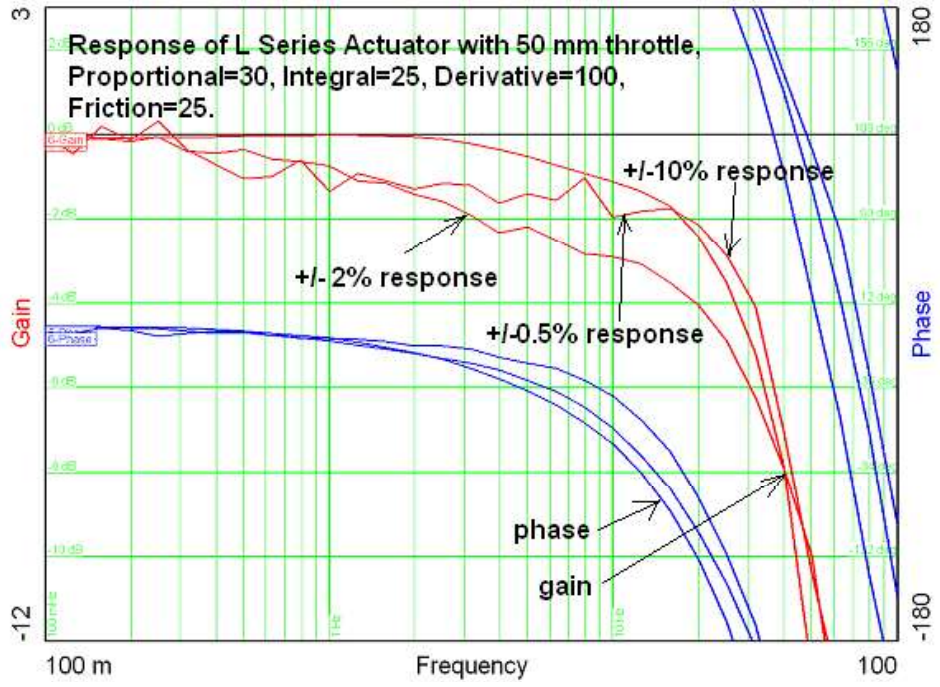


Figure 5-1. Bode Plot of L-Series Response

Chapter 6. Troubleshooting

Introduction

This chapter presents several broad categories of application failures typically experienced in the field, possible causes, and some tests used to verify the causes. Because the exact failure experienced in the field is the product of the mechanical/electrical failure combined with the configuration file resident in the control, it is left as the OEM's responsibility to create a more detailed troubleshooting chart for the end user. Ideally, this end-user troubleshooting chart will contain information about mechanical, electrical, engine, and load failures in addition to the possible governor failures. For more detailed information about governor system failure modes and effects, contact Woodward for a copy of the system DFMEA.

The troubleshooting scenarios listed below assume that the end user has a digital multi-meter at his disposal for testing voltages and checking continuity, and assume that the application has been engineered and tested thoroughly.

⚠WARNING

The actions described in this troubleshooting section are not always appropriate in every situation. Always make sure that any action taken will not result in loss of equipment, personal injury, or loss of life. Check with the local authority having jurisdiction.

⚠WARNING

Independent Fuel Shutoff Required (Overspeed / Overtemperature / Overpressure)

The engine, turbine, or other type of prime mover should be equipped with an independent fuel shut-off device to protect against fuel leakage or damage to the prime mover with possible personal injury, loss of life, or property damage. The fuel shut off device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

⚠WARNING

The L-Series wiring must be in accordance with North American Class I, Division 2 or European Zone 2, Category 3 wiring methods as applicable, and in accordance with the authority having jurisdiction.

⚠CAUTION

The L-Series is used on engines that typically have a high noise level. Always use appropriate hearing protection while working around the L-Series.

General System Troubleshooting Guide

The following is a general troubleshooting guide for areas to check which may present potential difficulties. By making these checks appropriate to your engine/turbine before contacting Woodward for technical assistance, your system problems can be more quickly and accurately assessed.

- Valves
- Is the wiring correct?
- Is the direction of the stroke correct?
- Is the direction of the failsafe shutdown correct?
- Does the valve move through its proper stroke smoothly?
- Does the valve travel its full stroke?
- Can mid-stroke be obtained and held?
- Does the valve fully seat (close)?
- Does the valve fully open?

Engine/Generator Troubleshooting

Table 6-1. Engine/Generator Troubleshooting Chart

Problem	Possible Cause	Suggested Test/Correction
Engine does not start	Stuck throttle/frozen shaft	Move throttle by hand. Assess smoothness, friction, and return spring force.
	Power not applied to control	Disconnect starter motor solenoid. Disconnect harness from governor. Activate application. Test for +12/24 V between +12/24 V pin and ground pin.
	Run Enable not closed	Verify status of input. Measure input. Verify input and configuration using Service Tool.
	No configuration or incorrect configuration in controller.	Using Service Tool, read configuration from controller and evaluate parameters for correction.
	Fault detected in controller.	Using Service Tool, read faults from controller. Verify/correct any shutdown conditions.
	Unsuccessful reflashing*	Do a power cycle and reflash L-Series again. L-Series will use communication settings from last reflashing event. If L-Series will fail to read non-volatile memory correctly it will use default communication settings: CAN baud rate 250k, Device Address 0x15, ECU_Part_Number 4385563 and Device_Name 'flcntvlv'.
Engine unstable	Improperly tuned dynamics.	Using Service Tool, tune the position dynamics.
	Intermittent position command input signal.	Using Service Tool, verify fault indications.
	Device sending position command is sending oscillating signal.	Measure input signal. Verify signal using Service Tool.
Poor frequency control	Improperly tuned dynamics.	Using Service Tool, tune the position dynamics.
	Friction/dither improperly set.	Using Service Tool, adjust the Friction/Dither setting.
Unable to develop full power	Non-indexed linkage slipped on shaft.	Manually verify full travel of throttle plate.
	Fault detected in controller.	Using Service Tool, view status of fault codes. Take appropriate action for active faults.

Table 6-1. Engine/Generator Troubleshooting Chart (cont'd.)

Problem	Possible Cause	Suggested Test/Correction
Not controlling at desired position setpoint	PWM input signal inaccuracy.	Measure input duty cycle and convert to percentage. Verify controller signal using Service Tool. If different, adjust the PWM Offset value in the Configuration Editor.
	Wiring fault or ground loop.	Check the wiring. Look for loose connections and disconnected or misconnected cables and connections. Remove all wiring except the position command and power input and verify operation/functionality.
	Analog input signal inaccuracy.	Measure the analog command voltage arriving at pin 10 to verify that it is at the expected value in the range of 0.5 to 4.5 V. Use the service tool to verify that AUX2 is being read correctly.
	Output shaft is bound or sticking.	Manually verify full shaft movement. Use the "verify position" function of the service tool (Chapter 4).
Discrete output not working	Wiring fault.	Check the wiring leading to pin 9 for open connections or misconnections. Verify that pin 9 is not connected directly to input power or ground.
	Configuration.	Using the Service Tool, verify that the faults and shutdowns are selected properly and that the output is configured for expected operation (either normally "on" or normally "off").
Service Tool not communicating –'Not Connected' status indicated	Wiring fault.	Check AUX3 and AUX4 connections. Verify harness setup and connections (see chapter 4) Check that Service Tool is running. Verify the port setting is correct.
	CAN is enabled.	Must be 'connecting' during power-up on CAN units.
Service Tool not communicating –'Error message displayed on PC when trying to connect	Old version of Service Tool or file corruption or bad install.	Re-install Service Tool, get the latest version from the Woodward web site (www.woodward.com)
Service Tool will not accept password	Cap Lock is on.	Password is case-sensitive, make sure you enter the password correctly using upper and lower case. If password is lost contact the OEM for retrieval.

* Available in 5418-7022 only

Troubleshooting Diagnostic Flags

Table 6-2. Troubleshooting Diagnostic Flags

Error Flag	Description	Possible Source	Possible Action
Supply Voltage Failure	The power supply voltage is higher than the diagnostic limits.	Bad or damaged battery.	Replace battery.
		Defective battery charging system.	Fix battery charging system.
	The power supply voltage is lower than the diagnostic limits.	Incorrect setting of power supply voltage level.	Set correct voltage levels on power supply.
		Power supply wiring too long or too thin. Control will flag low voltage during higher power uses.	Make sure wiring is of the correct thickness and length according to manual.
Temperature Sense Failed	This error is set if the temperature inside the control is higher or lower than allowed by the specifications.	Control has been placed in an environment that is too hot or too cold.	Lower temperature by adding cooling, heat shielding, moving the unit, etc.
		The internal temperature sensor is defective. This can be determined by checking the temperature of the unit and comparing this to the service tool value of the electronics temperature.	Increase temperature by adding heat.
			Return unit to Woodward for repair.
Position Error	If the demanded position and the actual position are outside the configured limits.	Incorrect position control dynamics or friction setting.	Check/tune position dynamics using the Service Tool.
		Binding or excessive friction in the actuator linkage, or stops are set inside the desired range of travel.	Perform a position calibration.
			Check all mechanical linkages and stops.
Position Sensor Failure	If the internal position sensor is outside the diagnostic limits.	Internal failure of position sensor.	Return unit to Woodward.
Internal Shutdown	All internal shutdowns will set this flag.	The control is defective.	Return unit to Woodward.
EEPROM Failure	The software can't write to the EEPROM.	The control is defective.	Return unit to Woodward.
	The software can't read from the EEPROM.		
Brown Out Reset	The brown out detection flag indicates power to the control has sagged to a point of non-operation and is now restored.	Power source voltage drop.	Possible power problem.
		Loss of power or intermittent power supply wiring.	Check wiring for bad or loose connection.
		Power supply wiring to long or too thin. L-Series will reset during transient power uses.	Make sure wiring is of the correct thickness and length according to manual.
Watchdog Reset	If the watchdog has reset the control, this flag will set.	After software update, the software watchdog will reset the control.	This is a normal situation. Reset the error code and reset the stored errors.
		The software is disrupted by EMI or an internal component failure.	This is an abnormal situation. Return the unit to Woodward.

Table 6-2. Troubleshooting Diagnostic Flags (cont'd.)

Error Flag	Description	Possible Source	Possible Action
Overtemperature	High internal temperature.	Detection of high of temperature.	Check ambient temperature around control. Verify temperature reading using service tool. If the temperatures seem normal, could indicate a problem with the temperature sensor.
Relay Fail Short	Control detected a fault in the discrete out wiring.	Incorrect or intermittent wiring problem.	Check wiring for bad or lost connection.
Run Enable Shutdown	Control detected that the Run Enable discrete in is not active.	Incorrect or intermittent wiring problem. Incorrect configuration.	Check wiring for bad or lost connection. Verify configuration. Check Run Enable setting.
Position Demand Failed	Control detected all position demands failed.	Incorrect or intermittent wiring problem. Incorrect configuration.	Check wiring for bad or lost connection. Verify configuration. Check Run Enable setting.
Analog Demand Failed	Control detected analog (0–5 V) position demand failed.	Incorrect or intermittent wiring problem. Incorrect configuration.	Check wiring for bad or lost connection. Following Analog Input troubleshooting listed below. Verify configuration.
PWM Demand Failed	Control detected PWM position demand failed.	Incorrect or intermittent wiring problem. Incorrect configuration.	Check wiring for bad or lost connection. Following PWM Input troubleshooting listed below. Verify configuration.
CAN Demand Failed	Indicates CAN communication fault or bus arbitration failure (J1939 address claim) or that CAN messages are received at a rate slower than the configured minimum update rate (CAN Fail Timeout).	Incorrect or intermittent wiring problem. Incorrect configuration. Device not sending updates fast enough or regularly (bursts).	Check wiring for bad or lost connection. Follow the CAN troubleshooting listed below. Verify CAN configuration settings. Verify ECM messages and update rates. Verify configuration of L-Series min update rate.
Position Tamper Fault	Control determined the primary demand is not tracking the CAN position demand.	Incorrect or intermittent wiring problem. Incorrect configuration.	Check wiring for bad or lost connection. Verify configuration. Check CAN Tracking settings.

Electrical Troubleshooting Guide

Analog Input

If the Analog Input is not functioning properly, verify the following:

- Measure the input voltage. It should be in the range of 0.5–4.5 V.
- Check the values seen by the L-Series driver using the Service Tool and verify that it matches the input signal.
- Verify that there are no or minimal AC components to the Analog Input signal. AC components can be caused by improper shielding.
- Check the wiring. If the inputs are reading 0 or the engineering units that correspond to 0 V, look for loose connections and disconnected / misconnected cables/connections.
- Check the software configuration to ensure that the input is configured properly as the Demand Source.

PWM Input

If the PWM input is not functioning properly, verify the following:

- Measure the input voltage, frequency, and duty cycle.
- Check the values seen by the L-Series driver using the Service Tool and verify that is matches the input signal.
- Check the wiring. Look for loose connections and disconnected / misconnected cables/connections.
- Check the software configuration to ensure that the input is configured properly as the demand source.

CAN Input

If the CAN connection is not functioning properly, verify the following:

- Check the values seen by the L-Series driver, if any, using the Service Tool and verify that is matches the sent signal and/or received signal.
- Check the wiring. Look for loose connections and disconnected / misconnected cables/connections. Verify 120 Ohm resistor at ends of transmission lines.
- Check the software configuration to ensure that the signal is configured properly (Device ID, fail timeout, protocol, etc).

Run Enable Discrete Input

If the run enable discrete input is not functioning properly, verify the following:

- Measure the input voltage on the terminal block. It should be in the range of 10–28 Vdc.
- Check the status of the input from the Overview screen of the Service Tool.
- Check the wiring, looking for loose connections or misconnected cables.
- Verify the input is properly configured.

Alarm or Shutdown Conditions

If the L-Series control has any alarm or shutdown conditions, refer to Chapter 2 for details on the exact cause of the condition. The Service Tool must be used to determine the cause of any shutdown or alarm condition. Refer also to the ‘Troubleshooting Diagnostics Flags’ section above.

Discrete Output

If the discrete output is not functioning properly, verify the following:

- Measure the output voltage on the terminal block. It should be in the range of 10–28 Vdc when the output is off/false. The voltage will be in this range only if all shutdowns are false. This can be verified through the Service Tool.
- Check the wiring, looking for loose connections or disconnected / misconnected cables.
- Verify the configuration of the output.

Service Tool

If the service tool is not functioning properly, review the installation information in Chapter 4. Verify the following:

- Check the wiring, looking for loose connections or disconnected / misconnected cables.
- Check that Service Tool is running. Verify the Port setting is correct.
- Follow on-screen error messages. Re-install software as needed. The latest version of software is available for download from the Woodward web site (www.woodward.com).
- Service Tool will not communicate if reflashing has been unsuccessful (this is available only in firmware version 5418-7022). See 'Unsuccessful reflash' section for more details.

IMPORTANT

Following a detected error, the L-Series actuator will not attempt to operate again until power to the valve is cycled. If an error persists, the actuator must be replaced.

Unsuccessful Reflash

The ability to reflash is only provided in firmware version 5418-7022 using J1939 PGN 55808. On an unsuccessful reflash the device will not function and will remain in boot mode. The output shaft will be limp (no drive current). To recover do a power cycle and repeat reflashing sequence. Communication settings (CAN baud rate, Device Address, Identification) will remain inherited from previously installed firmware. Nevertheless in rare occasion when L-Series was unable to read EEPROM, communication settings and identity may be defaulted:

- CAN baud rate set to 250kbps,
- Device Address set to 0x15.
- Serial Number set to 12345678

When device is in a boot mode, following NAME is used in J1939 Address Claim:

L-Series NAME fields:

Arbitrary Address Capable:	0 / Disabled
Industry Group Field:	0 / Global
Vehicle System Instance:	0 / First Instance
Vehicle System Field:	0 / Non-specific System
Function Field:	15 / Fuel System
Function Instance Field:	0 / First
ECU Instance Field:	0 / Device 1
Manufacturer Code Field:	153 / Woodward Governor Industrial Controls
Identity Number Field:	Unique

Also please note that Device Address is based on configuration, so if that changes in reflashed firmware, Device Address may be changed as well.

Chapter 7
Product Support and Service Options

Product Support Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

1. Consult the troubleshooting guide in the manual.
2. Contact the **OE Manufacturer or Packager** of your system.
3. Contact the **Woodward Business Partner** serving your area.
4. Contact Woodward technical assistance via email (EngineHelpDesk@Woodward.com) with detailed information on the product, application, and symptoms. Your email will be forwarded to an appropriate expert on the product and application to respond by telephone or return email.
5. If the issue cannot be resolved, you can select a further course of action to pursue based on the available services listed in this chapter.

OEM or Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full-Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.

A current list of Woodward Business Partners is available at www.woodward.com/directory.

Product Service Options

Depending on the type of product, the following options for servicing Woodward products may be available through your local Full-Service Distributor or the OEM or Packager of the equipment system.

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime.

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Flat Rate Repair: Flat Rate Repair is available for many of the standard mechanical products and some of the electronic products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option, with the exception that the unit will be returned to you in "like-new" condition. This option is applicable to mechanical products only.

IMPORTANT

There are no serviceable parts on the L-Series.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:
- return number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing a Control

Use the following materials when returning a complete control:
- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

NOTICE

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Replacement Parts

When ordering replacement parts for controls, include the following information:
- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

Engineering Services

Woodward's Full-Service Distributors offer various Engineering Services for our products. For these services, you can contact the Distributor by telephone or by email.

- Technical Support
- Product Training
- Field Service

Technical Support is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact.

Product Training is available as standard classes at many Distributor locations. Customized classes are also available, which can be tailored to your needs and held at one of our Distributor locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

Field Service engineering on-site support is available, depending on the product and location, from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact one of the Full-Service Distributors listed at **www.woodward.com/directory**.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at **www.woodward.com/directory**, which also contains the most current product support and contact information.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

Products Used in Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Products Used in Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used in Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

General

Your Name _____

Site Location _____

Phone Number _____

Fax Number

Engine Information

Manufacturer _____

Engine Model Number _____

Number of Cylinders _____

Type of Fuel (gas, gaseous, diesel, dual-fuel, etc.) _____

Power Output Rating _____

Application (power generation, marine, etc.)

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #2

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #3

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Symptoms

Description _____

_____

If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.

Appendix A.
L-Series Configuration Summary

APPLICATION _____

ACTUATOR SERIAL NUMBER _____
For details on individual settings, refer to Chapter 4.

Configuration Settings – Position Controller

Overview

Min Position Direction	CCW ____ CW ____
Shutdown Position (%)	= _____
Proportional Gain (%)	= _____
Integral Gain (%)	= _____
Derivative Gain (%)	= _____
Friction / Dither Setting	= _____

Setup

Single or Redundant/Backup Selection	Single ____ Redundant ____
Primary Position Demand Selection	PWM ____ Analog ____ CAN ____
Backup Position Demand Selection	PWM ____ Analog ____ CAN ____
Maximum Demand Difference (%)	= _____

PWM Input

PWM Drive Select	Push-Pull ____ High Side ____ Low Side ____
PWM Offset (%)	= _____

CAN

CAN Fail Timeout (sec)	= _____
Protocol	J1939 ____ CANopen ____
CAN ID LOW Discrete Input	Not Used ____ Aux 2 ____
CAN ID HIGH Discrete Input	Not Used ____ Aux 1 ____ Aux 5 ____
Device Identifier	= _____
Device Identifier 2	= _____
Device Identifier 3	= _____
Device Identifier 4	= _____
Data Rate	250 K ____ 500 K ____
Heartbeat Producer Time (sec)	= _____
Enable Position Tamper Fault?	Yes ____ No ____
Run Enable	Not Used ____ Aux 1 ____
Use Non-linear Actuator Curve?	Yes ____ No ____

Non-Linear Actuator Settings

Position Request (pt 0) (%)	= _____
Position Request (pt 1) (%)	= _____
Position Request (pt 2) (%)	= _____
Position Request (pt 3) (%)	= _____
Position Request (pt 4) (%)	= _____
Actuator Position (pt 0) (%)	= _____
Actuator Position (pt 1) (%)	= _____
Actuator Position (pt 2) (%)	= _____
Actuator Position (pt 3) (%)	= _____
Actuator Position (pt 4) (%)	= _____

Discrete Out

Discrete Out Normally On?	Yes ____ No ____
Indicates Watchdog Reset?	Yes ____ No ____
Indicates Brownout Reset?	Yes ____ No ____
Indicates EE Prom Failure?	Yes ____ No ____
Indicates Position Sensor Failure?	Yes ____ No ____
Indicates Temperature Sensor Failure?	Yes ____ No ____
Indicates Supply Voltage Fault?	Yes ____ No ____
Indicates Relay Fault?	Yes ____ No ____
Indicates Position Demand Failure?	Yes ____ No ____
Indicates Overtemperature?	Yes ____ No ____
Indicates Position Error?	Yes ____ No ____
Indicates Run Enable Shutdown?	Yes ____ No ____
Indicates Analog Demand Failed?	Yes ____ No ____
Indicates PWM Demand Failed?	Yes ____ No ____
Indicates CAN Demand Failed?	Yes ____ No ____
Indicates Position Tamper Fault?	Yes ____ No ____
Indicates CAN Stop Command?	Yes ____ No ____

Faults (Shutdown/Alarms)

Temp Sensor Failure Action	Shutdown ____ Alarm ____
Supply Voltage Fault Action	Shutdown ____ Alarm ____
Relay Fault Action	Shutdown ____ Alarm ____
Position Demand Failure Action	Shutdown ____ Alarm ____
Overtemperature Action	Shutdown ____ Alarm ____
Position Error Action	Shutdown ____ Alarm ____
Position Tamper Fault	Shutdown ____ Alarm ____

Faults are Latched?	Yes ____ No ____
CAN Fault is Latched?	Yes ____ No ____

Position Error Max (%)	= _____
Position Error Delay (sec)	= _____
CAN Tracking Error Max (%)	= _____
CAN Tracking Error Delay (sec)	= _____

Security

Apply security to Configuration Reading?	Yes ____ No ____
Apply security to Configuration Loading?	Yes ____ No ____
Apply security to Position PID Edit?	Yes ____ No ____
Apply security to Position Calibration?	Yes ____ No ____
Password	= _____

Revision History

New Manual—

Declarations

EU DECLARATION OF CONFORMITY

EU DoC No.:	00240-04-EU-02-09
Manufacturer's Name:	WOODWARD INC.
Manufacturer's Contact Address:	3800 Wilson Avenue Loveland, CO 80538 USA
Model Name(s)/Number(s):	L-Series ITB and LC-50
The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:	Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC) Units marked for ATEX (8404-7226, 8404-7227 only): Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment Exemption in use: 6(a), 6(c), 7(a), 7(c)-I
Markings in addition to CE marking:	II 3 G, Ex nA IIC T3 X Gc
Applicable Standards:	EN61000-6-2, 2005: EMC Part 6-2: Generic Standards - Immunity for Industrial Environments EN61000-6-4, 2011: EMC Part 6-4: Generic Standards - Emissions for Industrial Environments EN60079-15, (2003) Electrical apparatus for explosive gas atmospheres – Part 15: Type of protection 'n'
Conformity Assessment:	Woodward EMC Conformity Assessment 00240-04-EU-EMC-06-03

This declaration of conformity is issued under the sole responsibility of the manufacturer
We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER

Signature

Mike Row
Full Name

Compliance Engineering Supervisor
Position

Woodward, Fort Collins, CO, USA
Place

12-July-2019
Date

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5-09-1183 Rev 30

DECLARATION OF INCORPORATION
Of Partly Completed Machinery
2006/42/EC

File Name:	00240-04-EU-02-03
Manufacturer's Name:	WOODWARD INC
Manufacturer's Address:	3800 N. Wilson Ave. Loveland, CO, USA 80538
Model Names:	L-Series Actuator
This product complies, where applicable, with the following Essential Requirements of Annex I:	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7

The relevant technical documentation is compiled in accordance with part B of Annex VII. Woodward shall transmit relevant information if required by a reasoned request by the national authorities. The method of transmittal shall be agreed upon by the applicable parties.

The person authorized to compile the technical documentation:

Name: Dominik Kania, Managing Director
Address: Woodward Poland Sp. z o.o., ul. Skarbowa 32, 32-005 Niepolomice, Poland

This product must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of this Directive, where appropriate.

The undersigned hereby declares, on behalf of Woodward, Inc., of Loveland and Fort Collins, Colorado that the above referenced product is in conformity with Directive 2006/42/EC as partly completed machinery:

MANUFACTURER

Signature

Mike Row
Full Name

Engineering Supervisor
Position

Woodward, Inc, Fort Collins, CO, USA
Place

March 20th, 2019
Date

5-09-1182 (REV. 16) 00240-04-EU-02-03

Released

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 35155.

B 3 5 1 5 5 : -

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Phone +1 (970) 482-5811

Email and Website—www.woodward.com

Woodward has company-owned plants, subsidiaries, and branches, as well as authorized distributors and other authorized service and sales facilities throughout the world.

Complete address / phone / fax / email information for all locations is available on our website.