

# **SEL-2533**

## **Annunciator**

### **Instruction Manual**

**20221007**

**SEL** SCHWEITZER ENGINEERING LABORATORIES, INC.<sup>®</sup>



© 2010–2022 by Schweitzer Engineering Laboratories, Inc. All rights reserved.

All brand or product names appearing in this document are the trademark or registered trademark of their respective holders. No SEL trademarks may be used without written permission. SEL products appearing in this document may be covered by U.S. and Foreign patents.

Schweitzer Engineering Laboratories, Inc. reserves all rights and benefits afforded under federal and international copyright and patent laws in its products, including without limitation software, firmware, and documentation.

The information in this document is provided for informational use only and is subject to change without notice. Schweitzer Engineering Laboratories, Inc. has approved only the English language document.

This product is covered by the standard SEL 10-year warranty. For warranty details, visit [selinc.com](http://selinc.com) or contact your customer service representative.

PM2533-01

# Table of Contents

---

<b>List of Tables .....</b>	iii
<b>List of Figures .....</b>	vii
<b>Preface .....</b>	ix
Manual Overview .....	ix
Safety Information.....	x
General Information .....	xii
<b>Section 1: Introduction and Specifications</b>	
Overview .....	1.1
Features.....	1.1
Models, Options, and Accessories.....	1.2
Applications.....	1.3
Hardware Connection Features .....	1.4
Getting Started.....	1.5
Specifications .....	1.8
<b>Section 2: Installation</b>	
Overview .....	2.1
Device Placement .....	2.1
Card Configurations .....	2.2
Front- and Rear-Panel Diagrams .....	2.5
Field Serviceability.....	2.8
<b>Section 3: PC Software</b>	
Overview .....	3.1
Setup .....	3.2
Terminal .....	3.3
Settings Database Management and Drivers.....	3.4
Settings .....	3.6
Meter and Control.....	3.10
Help .....	3.12
<b>Section 4: Logic Functions</b>	
Overview .....	4.1
Logic Settings (SET L Command).....	4.1
<b>Section 5: Annunciator Sequences</b>	
Overview .....	5.1
Sequence State Flow Diagrams .....	5.9
Default Alarm Sequence Routing.....	5.10
Advanced Annunciator Logic Routing.....	5.12
<b>Section 6: Settings</b>	
Overview .....	6.1
View/Change Settings Over Communications Port .....	6.2
Setting Entry Error Messages.....	6.3
Device Settings (SET Command) .....	6.3
Global Settings (SET G Command).....	6.4
Port Settings (SET P Command).....	6.10
Default Port Settings and Ranges .....	6.10
Report Settings (SET R Command) .....	6.12

## SEL-2533 Settings Sheets

## Section 7: Communications

Overview .....	7.1
Communications .....	7.1
Communications Protocol.....	7.6
ASCII Commands.....	7.11

## Section 8: Front-Panel Operations and Custom Labeling

Overview.....	8.1
Front-Panel Layout .....	8.1
Alarm Point LEDs and TEST Pushbutton .....	8.2
Alarm Window Labels.....	8.4

## Section 9: Analyzing SER Events

Overview.....	9.1
Sequential Events Recorder (SER) .....	9.1

## Section 10: Testing and Troubleshooting

Overview.....	10.1
Testing Tools .....	10.1
Periodic Tests (Routine Maintenance).....	10.2
Self-Test.....	10.3

## Appendix A: Firmware and Manual Versions

Firmware .....	A.1
Instruction Manual .....	A.2

## Appendix B: Firmware Upgrade Instructions

Overview.....	B.1
Upgrade Instructions .....	B.1

## Appendix C: SEL Communications Processors

SEL Communications Protocols .....	C.1
SEL Communications Processor .....	C.3
SEL Communications Processor and Device Architecture .....	C.5
SEL Communications Processor Example .....	C.7

## Appendix D: DNP3 Communications

Overview .....	D.1
Introduction to DNP3.....	D.1
DNP3 in the SEL-2533 .....	D.6
DNP3 Documentation .....	D.14

## Appendix E: Modbus RTU Communications Protocol

Overview .....	E.1
Communications Protocol.....	E.1
Modbus Register Map.....	E.19

## Appendix F: MIRRORED BITS Communications

Overview .....	F.1
----------------	-----

## Appendix G: Device Word Bits

Overview.....	G.1
Definitions .....	G.4

## Glossary

## Index

## SEL-2533 Command Summary

# List of Tables

---

Table 1.1	SEL-2533 Serial Port Settings.....	1.6
Table 2.1	Communications Ports .....	2.2
Table 2.2	Communication Card (SELECT EIA-232/EIA-485) Interfaces and Connectors.....	2.3
Table 2.3	Jumper Functions and Default Positions.....	2.4
Table 2.4	Communication Cables for Connecting the SEL-2533 to Other Devices .....	2.7
Table 3.1	SEL Software Solutions .....	3.1
Table 3.2	ACCELERATOR QuickSet SEL-5030 Software.....	3.1
Table 3.3	File Menus.....	3.6
Table 3.4	Device Editor Menus.....	3.8
Table 3.5	Help .....	3.12
Table 4.1	Setting Categories .....	4.1
Table 4.2	Enable Settings.....	4.1
Table 4.3	Latch Bits Equation Settings .....	4.2
Table 4.4	SELOGIC Control Equation Operators (Listed in Operator Precedence) .....	4.4
Table 4.5	Other SELOGIC Control Equation Operators/Values .....	4.5
Table 4.6	SELOGIC Variable Settings .....	4.6
Table 4.7	Output Contacts.....	4.6
Table 5.1	Sequence A Table.....	5.2
Table 5.2	Sequence M Table .....	5.2
Table 5.3	Sequence R Table.....	5.3
Table 5.4	Sequence T Table .....	5.4
Table 5.5	Sequence F1A Table .....	5.5
Table 5.6	Sequence F1M Table.....	5.5
Table 5.7	Sequence F2A Table .....	5.6
Table 5.8	Sequence F2M Table.....	5.7
Table 5.9	Sequence F3A Table .....	5.8
Table 6.1	Methods of Accessing Settings .....	6.1
Table 6.2	SHO Command Options.....	6.2
Table 6.3	SET Command .....	6.2
Table 6.4	SET Command Editing Keystrokes .....	6.3
Table 6.5	Device and Terminal Identifiers.....	6.3
Table 6.6	Alarm Group Settings.....	6.4
Table 6.7	General Global Settings .....	6.5
Table 6.8	Time Synchronization Source Setting.....	6.5
Table 6.9	General Global Settings .....	6.8
Table 6.10	Event Messenger Points .....	6.9
Table 6.11	Front-Panel Serial Port Settings .....	6.10
Table 6.12	Rear-Panel Fiber-Optic Serial (Multimode) Port Settings .....	6.11
Table 6.13	Rear-Panel Serial Port (EIA-232) Settings.....	6.11
Table 6.14	Rear-Panel Serial Port (EIA-232/EIA-485) Settings .....	6.11
Table 6.15	Auto-Removal Settings .....	6.12
Table 6.16	SER Trigger Settings.....	6.13
Table 6.17	Enable Alias Settings .....	6.13
Table 6.18	SET R SER Alias Settings .....	6.13
Table 7.1	SEL-2533 Port Description .....	7.1
Table 7.2	Serial Port Pin Functions.....	7.3
Table 7.3	Protocols Supported on the Various Ports.....	7.6
Table 7.4	Command Response Header .....	7.8
Table 7.5	Access Commands .....	7.9
Table 7.6	B NAMES Command.....	7.11
Table 7.7	CAL Command .....	7.11
Table 7.8	CASCII Command .....	7.11
Table 7.9	COM Command .....	7.12
Table 7.10	CONTROL Command .....	7.12

Table 7.11	CONTROL BUTTONS Command States.....	7.13
Table 7.12	CONTROL OUTPUTS States.....	7.13
Table 7.13	Control States for Remote Bits and BUTTONS Commands .....	7.13
Table 7.14	CSTATUS Command.....	7.13
Table 7.15	DATE Command .....	7.13
Table 7.16	FILE Command .....	7.14
Table 7.17	IDENTIFICATION Command.....	7.14
Table 7.18	IRIG Command .....	7.15
Table 7.19	L_D Command .....	7.15
Table 7.20	LOO Command .....	7.15
Table 7.21	MAP Command.....	7.16
Table 7.22	Password Command .....	7.16
Table 7.23	Factory Default Passwords .....	7.17
Table 7.24	Valid Password Characters .....	7.17
Table 7.25	PULSE Command .....	7.18
Table 7.26	QUIT Command .....	7.18
Table 7.27	SER Command (Sequential Events Recorder Report) .....	7.18
Table 7.28	SER Command Format.....	7.19
Table 7.29	SET Command .....	7.19
Table 7.30	SET Command Editing Keystrokes.....	7.19
Table 7.31	SHO Command.....	7.20
Table 7.32	SNS Command .....	7.20
Table 7.33	STATUS Command (Device Self-Test Status) .....	7.21
Table 7.34	STA Command Definitions .....	7.21
Table 7.35	TAR Command Definitions.....	7.22
Table 7.36	TIM Command Definitions .....	7.23
Table 8.1	Configurable Front-Panel Label Kit (Part No. 9260065).....	8.5
Table 10.1	SER Command (Sequential Events Recorder Report) .....	10.1
Table 10.2	TAR Command Definitions.....	10.2
Table 10.3	Device Self-Tests.....	10.3
Table A.1	R200 Series Firmware Revision History .....	A.1
Table A.2	R100 Series Firmware Revision History .....	A.1
Table A.3	Instruction Manual Revision History .....	A.2
Table C.1	Supported Serial Command Sets .....	C.1
Table C.2	Compressed ASCII Commands.....	C.2
Table C.3	SEL Communications Processors Protocol Interfaces .....	C.4
Table C.4	SEL Communications Processor PORT 1 Settings .....	C.7
Table C.5	SEL Communications Processor Data Collection Automessages .....	C.7
Table C.6	SEL Communications Processor PORT 1 Automatic Messaging Settings .....	C.8
Table C.7	SEL Communications Processor PORT 1 Region Map .....	C.8
Table C.8	Communications Processor METER Region Map for the SEL-2533 .....	C.8
Table C.9	Communications Processor TARGET Region .....	C.9
Table D.1	DNP3 Implementation Levels .....	D.2
Table D.2	Selected DNP3 Function Codes .....	D.3
Table D.3	DNP3 Access Methods .....	D.4
Table D.4	DNP3 Access Methods .....	D.6
Table D.5	SEL-2533 Event Buffer Capacity.....	D.8
Table D.6	Port DNP 3.00 Protocol Settings .....	D.9
Table D.7	Serial Port DNP 3.00 Modem Settings.....	D.10
Table D.8	SEL-2533 DNP 3.00 Device Profile.....	D.14
Table D.9	SEL-2533 DNP Object List .....	D.15
Table D.10	DNP 3.00 Reference Data Map .....	D.16
Table D.11	DNP3 Default Data Map .....	D.16
Table D.12	Example Object 12 Trip/Close or Code Selection Operation.....	D.18
Table E.2	SEL-2533 Modbus Function Codes .....	E.2
Table E.3	SEL-2533 Modbus Exception Codes .....	E.2
Table E.4	01h Read Discrete Output Coil Status Command .....	E.3
Table E.5	01h SEL-2533 Outputs .....	E.3

Table E.6	Response to 01h Read Discrete Output Coil Status Query Errors .....	E.6
Table E.7	02h Read Input Status Command.....	E.6
Table E.8	SEL-2533 Inputs .....	E.7
Table E.9	Responses to 02h Read Input Query Errors .....	E.10
Table E.10	03h Read Holding Register Command.....	E.10
Table E.11	Responses to 03h Read Holding Registry Query Errors .....	E.10
Table E.12	04h Read Input Register Command .....	E.11
Table E.13	Responses to 04h Read Holding Registry Query Errors .....	E.11
Table E.14	05h Force Single Coil Command.....	E.11
Table E.15	05 Force Single Coil Command.....	E.12
Table E.16	Responses to 05h Force Single Coil Query Errors.....	E.14
Table E.17	06h Preset Single Register Command.....	E.15
Table E.18	Responses to 06h Preset Single Register Query Errors.....	E.15
Table E.19	10h Preset Multiple Registers Command.....	E.15
Table E.20	10h Preset Multiple Register Query Error Messages .....	E.16
Table E.21	Device Outputs .....	E.16
Table E.22	SEL-2533 Modbus Command Region .....	E.17
Table E.23	SEL-2533 Modbus Command Region .....	E.18
Table E.24	Conversion Table .....	E.18
Table E.25	Modbus Register Map .....	E.19
Table F.2	Positions of the MIRRORED BITS .....	F.3
Table F.3	MIRRORED BITS Values for a RXDFLT Setting of 10100111 .....	F.3
Table F.4	MIRRORED BITS Protocol Settings .....	F.5
Table G.1	SEL-2533 Device Word Bits.....	G.1
Table G.2	Device Word Bit Definitions.....	G.4

**This page intentionally left blank**

# List of Figures

Figure 1.1	Example Application.....	1.3
Figure 1.2	Inputs, Outputs, and Communications Ports.....	1.4
Figure 1.3	Response Header .....	1.6
Figure 1.4	STA Command.....	1.6
Figure 2.1	SEL-2533 Annunciator Panel-Mount Dimensions .....	2.2
Figure 2.2	Pins for Password Jumper and SELBOOT Jumper .....	2.4
Figure 2.3	SEL-2533 Panel Mount.....	2.5
Figure 2.4	SEL-2533 Configured With the Optional EIA-232/EIA-485 Card and Repeat Contacts.....	2.5
Figure 2.5	SEL-2533 Connection Diagram for External Devices.....	2.7
Figure 3.1	Serial Port Communications Menu .....	3.2
Figure 3.2	Serial Port Communication Parameters Dialog Box.....	3.2
Figure 3.3	Network Parameters Dialog Box.....	3.3
Figure 3.4	Tools Menu .....	3.3
Figure 3.5	Device Response to the ID Command .....	3.4
Figure 3.6	Driver Selection.....	3.7
Figure 3.7	Update Part Number.....	3.7
Figure 3.8	New Setting Screen .....	3.7
Figure 3.9	Expressions Created With Expression Builder .....	3.9
Figure 3.10	Device Overview Screen.....	3.10
Figure 3.11	Control Screen.....	3.11
Figure 3.12	Remote Operation Selection.....	3.11
Figure 4.1	Schematic Diagram of a Traditional Latching Device.....	4.2
Figure 4.2	Logic Diagram of a Latch Switch .....	4.2
Figure 4.3	SELOGIC Control Equation Variable/Timers SV01/SV01T—SV40T .....	4.3
Figure 4.4	Result of Falling-Edge Operator on a Deasserting Input .....	4.5
Figure 4.5	Example Use of SELOGIC Variables/Timers .....	4.6
Figure 5.1	Sequence A State Diagram.....	5.2
Figure 5.2	Sequence M State Diagram .....	5.2
Figure 5.3	Sequence R State Diagram.....	5.3
Figure 5.4	Sequence T State Diagram .....	5.4
Figure 5.5	Sequence F1A State Diagram .....	5.4
Figure 5.6	Sequence F1M State Diagram.....	5.5
Figure 5.7	Sequence F2A State Diagram .....	5.6
Figure 5.8	Sequence F2M State Diagram (F2M Sequence Represented if You Remove Silence State) .....	5.7
Figure 5.9	Sequence F3A State Diagram .....	5.8
Figure 5.10	Default Logic Routing.....	5.10
Figure 5.11	Example of Advanced Annunciator Logic Routing.....	5.12
Figure 5.12	RB_ACK Trigger Options .....	5.12
Figure 5.13	ALIN_A1 Logic .....	5.12
Figure 5.14	Alarm Point Logic Outputs .....	5.13
Figure 6.1	DC Mode Processing.....	6.6
Figure 6.2	Timing Diagram When IN_A1R Changes From the Deasserted State to the Asserted State .....	6.7
Figure 6.3	Timing Diagram When Input IN_A1 Changes From the Asserted State to the Deasserted State .....	6.7
Figure 6.4	AC Mode Processing.....	6.8
Figure 6.5	Timing Diagram for Debounce Timer Operation When Operating in AC Mode .....	6.8
Figure 7.1	Connection Between PC Serial Port and SEL-2533 Front-Panel Serial Port .....	7.2
Figure 7.2	Connection When Installation Includes Other SEL Devices .....	7.2
Figure 7.3	EIA-232 DB-9 Connector Pin Numbers .....	7.3
Figure 7.4	SEL Cable SEL-C234A—SEL-2533 to DTE Device .....	7.4
Figure 7.5	SEL Cable SEL-C222—SEL-2533 to Modem .....	7.4
Figure 7.6	SEL Cable SEL-C272A—SEL-2533 to SEL Communications Processor (Without IRIG-B Signal) .....	7.5

Figure 7.7	SEL Cable SEL-C273A—SEL-2533 to SEL Communications Processor (With IRIG-B Signal).....	7.5
Figure 7.8	SEL Cable SEL-C387—SEL-2533 to SEL-3010 Event Messenger .....	7.5
Figure 7.9	SER Settings Using the SNS Command.....	7.21
Figure 7.10	Device Response to the STATUS Command.....	7.21
Figure 8.1	Front-Panel Overview.....	8.2
Figure 8.2	SEL-2533 Front-Panel LEDs.....	8.3
Figure 8.3	TEST Pushbutton Flow Chart.....	8.4
Figure 8.4	Blank Slide-In Label Set and Label Removal Tool.....	8.5
Figure 9.1	Sample SER Report .....	9.2
Figure 9.2	Example Sequential Events Recorder (SER) Event Report .....	9.3
Figure B.1	Firmware File Transfer Process.....	B.2
Figure C.1	SEL Communications Processor Star Integration Network .....	C.3
Figure C.2	Multitiered SEL Communications Processor Architecture .....	C.4
Figure C.3	Enhancing Multidrop Networks With SEL Communications Processors.....	C.6
Figure C.4	Example of SEL Device and SEL Communications Processor .....	C.7
Figure D.1	Application Confirmation Timing With URETRYn = 2.....	D.7
Figure D.2	Message Transmission Timing .....	D.7
Figure D.3	Sample Response to SHO DNP Command .....	D.11
Figure D.4	Port MAP Command .....	D.12
Figure D.5	Sample Custom DNP3 BO Map Settings .....	D.13
Figure D.6	Binary Output Map Entry in ACCELERATOR QUICKSET QuickSet.....	D.13

# Preface

---

## Manual Overview

---

The SEL-2533 Annunciator instruction manual provides specifications and describes installation, setting, testing and operation of the SEL-2533. It also includes detailed information about settings and serial port commands.

An overview of each manual section follows:

**Preface.** Describes the manual organization and conventions used to present information.

**Section 1: Introduction and Specifications.** Describes the basic features and functions of the SEL-2533, and lists the specifications.

**Section 2: Installation.** Describes how to mount and wire the SEL-2533, and illustrates wiring connections.

**Section 3: PC Software.** Describes how to get started with ACCELERATOR® QuickSet™ SEL-5030 software, a powerful setting, event analysis, and viewing tool that aids using and applying the SEL-2533.

**Section 4: Logic Functions.** Describes logic settings and functions, such as latch bits and Boolean operators in the device.

**Section 5: Annunciator Sequences.** Describes the alarm sequences that come standard in the SEL-2533 from the ISA-18.1 standard.

**Section 6: Settings.** Describes how to enter and record Group, Global, Port, and Report settings for the device; includes setting sheets.

**Section 7: Communications.** Describes how to connect the SEL-2533 to a PC for communications; shows serial port pinouts; lists and defines serial port ASCII commands.

**Section 8: Front-Panel Operations and Custom Labeling.** Describes the features and use of the front panel, including front-panel pushbuttons, status and alarm LEDs, and alarm window configuration.

**Section 9: Analyzing SER Events.** Describes the Sequential Events Recorder (SER) report.

**Section 10: Testing and Troubleshooting.** Describes testing tools and includes troubleshooting instructions.

**Appendix A: Firmware and Manual Versions.** Describes the current firmware versions and details the differences between the current and previous manual versions.

**Appendix B: Firmware Upgrade Instructions.** Describes the procedure to update the firmware stored in Flash memory.

**Appendix C: SEL Communications Processors.** Describes how SEL communications processors and PC software use SEL protocols optimized for performance and reliability.

**Appendix D: DNP3 Communications.** Describes the DNP 3.00 protocol support provided by the SEL-2533.

**Appendix E: Modbus RTU Communications Protocol.** Describes the Modbus® protocol support provided by the SEL-2533.

**Appendix F: MIRRORED BITS Communications.** Describes how the SEL-2533 can directly exchange information quietly, securely, and with minimum cost.

**Appendix G: Device Word Bits.** Lists and describes Device Word bits (outputs of alarm points and control elements).

**SEL-2533 Command Summary.** Describes the serial port commands that are fully described in *ASCII Commands on page 7.11*.

## Safety Information

---

### Dangers, Warnings, and Cautions

This manual uses three kinds of hazard statements, defined as follows:

#### **DANGER**

Indicates an imminently hazardous situation that, if not avoided, **will** result in death or serious injury.

#### **WARNING**

Indicates a potentially hazardous situation that, if not avoided, **could** result in death or serious injury.

#### **CAUTION**

Indicates a potentially hazardous situation that, if not avoided, **may** result in minor or moderate injury or equipment damage.

### Safety Symbols

The following symbols are often marked on SEL products.

	 <b>CAUTION</b> Refer to accompanying documents.	 <b>ATTENTION</b> Se reporter à la documentation.
	Earth (ground)	Terre
	Protective earth (ground)	Terre de protection
	Direct current	Courant continu
	Alternating current	Courant alternatif
	Both direct and alternating current	Courant continu et alternatif
	Instruction manual	Manuel d'instructions

## Safety Marks

The following statements apply to this device.

### General Safety Marks

<b>! CAUTION</b>	<b>! ATTENTION</b>
There is danger of explosion if the battery is incorrectly replaced. Replace only with Ray-O-Vac® no. BR2335 or equivalent recommended by manufacturer. See Owner's Manual for safety instructions. The battery used in this device may present a fire or chemical burn hazard if mistreated. Do not recharge, disassemble, heat above 100°C or incinerate. Dispose of used batteries according to the manufacturer's instructions. Keep battery out of reach of children.	Une pile remplacée incorrectement pose des risques d'explosion. Remplacez seulement avec un Ray-O-Vac® no BR2335 ou un produit équivalent recommandé par le fabricant. Voir le guide d'utilisateur pour les instructions de sécurité. La pile utilisée dans cet appareil peut présenter un risque d'incendie ou de brûlure chimique si vous en faites mauvais usage. Ne pas recharger, démonter, chauffer à plus de 100°C ou incinérer. Éliminez les vieilles piles suivant les instructions du fabricant. Gardez la pile hors de la portée des enfants.
For use in Pollution Degree 2 environment.	Pour l'utilisation dans un environnement de Degré de Pollution 2.
Ambient air temperature shall not exceed 40°C (104°F).	La température de l'air ambiant ne doit pas dépasser 40°C (104°F).
Terminal Ratings  Wire Material  Use copper supply wires suitable for 75°C (167°F).	Spécifications des bornes  Type de filage  Utilisez des fils d'alimentation en cuivre appropriés pour 75°C (167°F).
Tightening Torque  Terminal Blocks and Serial Ports: 0.6 to 0.8 Nm (5 to 7 in-lb)	Couple de serrage  Borniers et ports série : 0,6 à 0,8 Nm (5 à 7 livres-pouce)

### Other Safety Marks (Sheet 1 of 2)

<b>! DANGER</b> Disconnect or de-energize all external connections before opening this device. Contact with hazardous voltages and currents inside this device can cause electrical shock resulting in injury or death.	<b>! DANGER</b> Débrancher tous les raccordements externes avant d'ouvrir cet appareil. Tout contact avec des tensions ou courants internes à l'appareil peut causer un choc électrique pouvant entraîner des blessures ou la mort.
<b>! DANGER</b> Contact with instrument terminals can cause electrical shock that can result in injury or death.	<b>! DANGER</b> Tout contact avec les bornes de l'appareil peut causer un choc électrique pouvant entraîner des blessures ou la mort.
<b>! WARNING</b> Use of this equipment in a manner other than specified in this manual can impair operator safety safeguards provided by this equipment.	<b>! AVERTISSEMENT</b> L'utilisation de cet appareil suivant des procédures différentes de celles indiquées dans ce manuel peut désarmer les dispositifs de protection d'opérateur normalement actifs sur cet équipement.
<b>! WARNING</b> Have only qualified personnel service this equipment. If you are not qualified to service this equipment, you can injure yourself or others, or cause equipment damage.	<b>! AVERTISSEMENT</b> Seules des personnes qualifiées peuvent travailler sur cet appareil. Si vous n'êtes pas qualifiés pour ce travail, vous pourriez vous blesser avec d'autres personnes ou endommager l'équipement.
<b>! WARNING</b> This device is shipped with default passwords. Default passwords should be changed to private passwords at installation. Failure to change each default password to a private password may allow unauthorized access. SEL shall not be responsible for any damage resulting from unauthorized access.	<b>! AVERTISSEMENT</b> Cet appareil est expédié avec des mots de passe par défaut. A l'installation, les mots de passe par défaut devront être changés pour des mots de passe confidentiels. Dans le cas contraire, un accès non-autorisé à l'équipement peut être possible. SEL décline toute responsabilité pour tout dommage résultant de cet accès non-autorisé.
<b>! WARNING</b> To install an option card, the relay must be de-energized and then re-energized. When re-energized, the relay will reboot. Therefore, de-energize the protected equipment before installing the option card to prevent damage to the equipment.	<b>! AVERTISSEMENT</b> Pour installer une carte à option, le relais doit être éteint et ensuite rallumé. Quand il est rallumé, le relais redémarrera. Donc, il faut éteindre l'équipement protégé avant d'installer la carte à option pour empêcher des dégâts à l'équipement.
<b>! WARNING</b> Do not look into the fiber ports/connectors.	<b>! AVERTISSEMENT</b> Ne pas regarder vers les ports ou connecteurs de fibres optiques.

**Other Safety Marks (Sheet 2 of 2)**

<b>⚠️WARNING</b> Do not look into the end of an optical cable connected to an optical output.	<b>⚠️AVERTISSEMENT</b> Ne pas regarder vers l'extrémité d'un câble optique raccordé à une sortie optique.
<b>⚠️WARNING</b> During installation, maintenance, or testing of the optical ports, use only test equipment qualified for Class 1 laser products.	<b>⚠️AVERTISSEMENT</b> Durant l'installation, la maintenance ou le test des ports optiques, utilisez exclusivement des équipements de test homologués comme produits de type laser de Classe 1.
<b>⚠️CAUTION</b> Class 1 LASER Product. This product uses visible or invisible LASERS based on model option. Looking into optical connections, fiber ends, or bulkhead connections can result in hazardous radiation exposure.	<b>⚠️ATTENTION</b> Produit LASER de Classe 1. Ce produit utilise des LASERS visibles ou invisibles dépendant des options du modèle. Regarder vers les connecteurs optiques, les extrémités des fibres ou les connecteurs de cloison peut entraîner une exposition à des rayonnements dangereux.
<b>⚠️CAUTION</b> Equipment components are sensitive to electrostatic discharge (ESD). Undetectable permanent damage can result if you do not use proper ESD procedures. Ground yourself, your work surface, and this equipment before removing any cover from this equipment. If your facility is not equipped to work with these components, contact SEL about returning this device and related SEL equipment for service.	<b>⚠️ATTENTION</b> Les composants de cet équipement sont sensibles aux décharges électrostatiques (DES). Des dommages permanents non-détectables peuvent résulter de l'absence de précautions contre les DES. Raccordez-vous correctement à la terre, ainsi que la surface de travail et l'appareil avant d'en retirer un panneau. Si vous n'êtes pas équipés pour travailler avec ce type de composants, contacter SEL afin de retourner l'appareil pour un service en usine.
<b>⚠️CAUTION</b> The relay contains devices sensitive to Electrostatic Discharge (ESD). When working on the relay with the front panel removed, work surfaces and personnel must be properly grounded or equipment damage may result.	<b>⚠️ATTENTION</b> Le relais contient des pièces sensibles aux décharges électrostatiques. Quand on travaille sur le relais avec les panneaux avant ou du dessus enlevés, toutes les surfaces et le personnel doivent être mis à la terre convenablement pour éviter les dommages à l'équipement.
<b>⚠️CAUTION</b> Use of controls or adjustments, or performance of procedures other than those specified herein, may result in hazardous radiation exposure.	<b>⚠️ATTENTION</b> L'utilisation de commandes ou de réglages, ou l'application de tests de fonctionnement différents de ceux décrits ci-après peuvent entraîner l'exposition à des radiations dangereuses.

# General Information

## Environmental Conditions and Voltage Information

The following table lists important environmental and voltage information.

Condition	Range/Description
Indoor/Outdoor Use	Indoor
Altitude	Up to 2000 m
Temperature	
IEC Performance Rating (per IEC/EN 60068-2-1 and 60068-2-2)	-40° to +85°C (-40° to +185°F)
UL/CSA Safety Rating	-40° to +70°C (-40° to +158°F)
Relative Humidity	5 to 95%
Main Supply Voltage Fluctuations	As much as ±10% of nominal voltage
Overvoltage	Category II
Pollution	Degree 2
Atmospheric Pressure	80 to 110 kPa

## Wire Sizes and Insulation

Wire sizes for grounding (earthing) and contact connections are dictated by the terminal blocks and expected load currents. You may use the following table as a guide in selecting wire sizes:

Connection Type	Minimum Wire Size	Maximum Wire Size
Grounding (Earthing) Connection	14 AWG (2.5 mm <sup>2</sup> )	10 AWG (4 mm <sup>2</sup> )
Contact I/O	18 AWG (0.8 mm <sup>2</sup> )	14 AWG (2.5 mm <sup>2</sup> )
Other Connection	18 AWG (0.8 mm <sup>2</sup> )	14 AWG (2.5 mm <sup>2</sup> )

## Instructions for Cleaning and Decontamination

Use care when cleaning the SEL-2533. Use a mild soap or detergent solution and a damp cloth to clean the chassis. Do not use abrasive materials, polishing compounds, or harsh chemical solvents (such as xylene or acetone) on any surface.

## Technical Assistance

Obtain technical assistance from the following address:

Schweitzer Engineering Laboratories, Inc.  
2350 NE Hopkins Court  
Pullman, WA 99163-5603 U.S.A.  
Tel: +1.509.338.3838  
Fax: +1.509.332.7990  
Internet: [selinc.com](http://selinc.com)  
Email: [info@selinc.com](mailto:info@selinc.com)

**This page intentionally left blank**

# Section 1

## Introduction and Specifications

### Overview

---

The SEL-2533 Annunciator provides complete alarming, notification, reporting, and communication of station alarms. The Annunciator supports many standard ISA-18.1 annunciator sequences. The Annunciator comes standard with 10 alarm windows that can be independently programmed through contact inputs or through communications. The Annunciator is designed to read and acknowledge alarms locally and remotely.

This manual contains information required to install, test, operate, and maintain the SEL-2533 Annunciator. You need not review this entire manual in order to perform specific tasks.

### Features

---

#### Standard Features

- ISA-18.1 annunciator sequences: A, M, R, F1A, F1M, F2A, F2M, and F3A
- As many as fourteen digital inputs with orderable voltage ranges
- As many as fifteen digital contact outputs
- Ten front-panel alarm points with configurable window labels and indicating LEDs
- Programmable logic
- One front and one rear EIA-232 serial port
- IRIG-B input
- Password protection on all communications levels

#### Reporting/Monitoring Features

**NOTE:** The SEL-3010 is obsolete and no longer available to order.

- Sequential Events Recorder (SER) report with  $\pm 1$  ms time tag resolution
- Instant recording during the first change of status (not the time after debounce)
- SER chattering input identification and removal
- Ninety-six settable trigger conditions
- Storage of as many as 1024 entries in nonvolatile memory

- Communications
  - Transmission speed between 300 and 38400 bps (effective 9600 or better)
  - One nonisolated EIA-232 front-panel port and one nonisolated EIA-232 rear-panel port (DB-9 connector)
  - Optional fiber-optic rear serial port
  - Optional communications card (setting-select either EIA-232 or EIA-485)
- IRIG-B connection (standard feature)
- Modbus® RTU Slave
- Optional DNP3 Level 2 Outstation
- SEL MIRRORED BITS®
- Ymodem file transfer on front and rear ports
- Xmodem file transfer on front port
- SEL ASCII and Compressed ASCII
- SEL Fast Operate and SEL Fast SER
- SEL Fast Message
- Programmable Boolean operators (AND, OR, NOT, and parentheses)
- Programmable logic functions (timers and latches)
- Programmable rising and falling edge trigger/detect
- Remote control to close output contacts and acknowledge alarms from remote locations

## Communications Protocols

## Automation and Control

# Models, Options, and Accessories

## Models

Complete ordering information is not provided in this instruction manual; please see the latest SEL-2533 Model Option Table at [selinc.com](http://selinc.com). Options and accessories are listed below.

## Options

The Annunciator contains six card slots. Four of the card slots are configurable depending upon models selected. The rear fiber-optic serial port (**PORT 2**) is optional and the EIA-232/EIA-485 card in slot C is optional; the other three slots are for adding more digital inputs and digital outputs. The main board and power supply cannot be removed.

## Accessories

Contact your Technical Service Center or the SEL factory for additional details and ordering information on the following popular SEL accessories available for the SEL-2533:

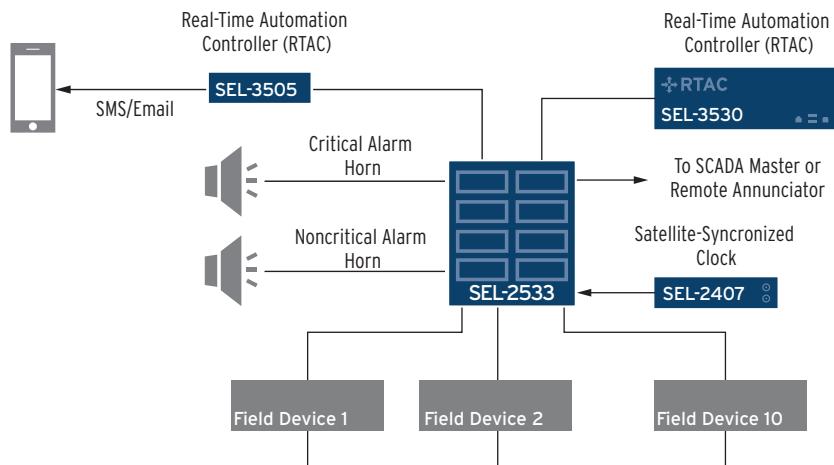
- SEL-2533 Configurable Labels (part 9260065)
- SEL-2810, SEL-2812, or SEL-2814 Fiber-Optic Transceivers
- Precise timing with the SEL-2407 Satellite-Synchronized Clock
- Automatic voice notification with the SEL Event Messenger

## Applications

### Advanced Annunciator

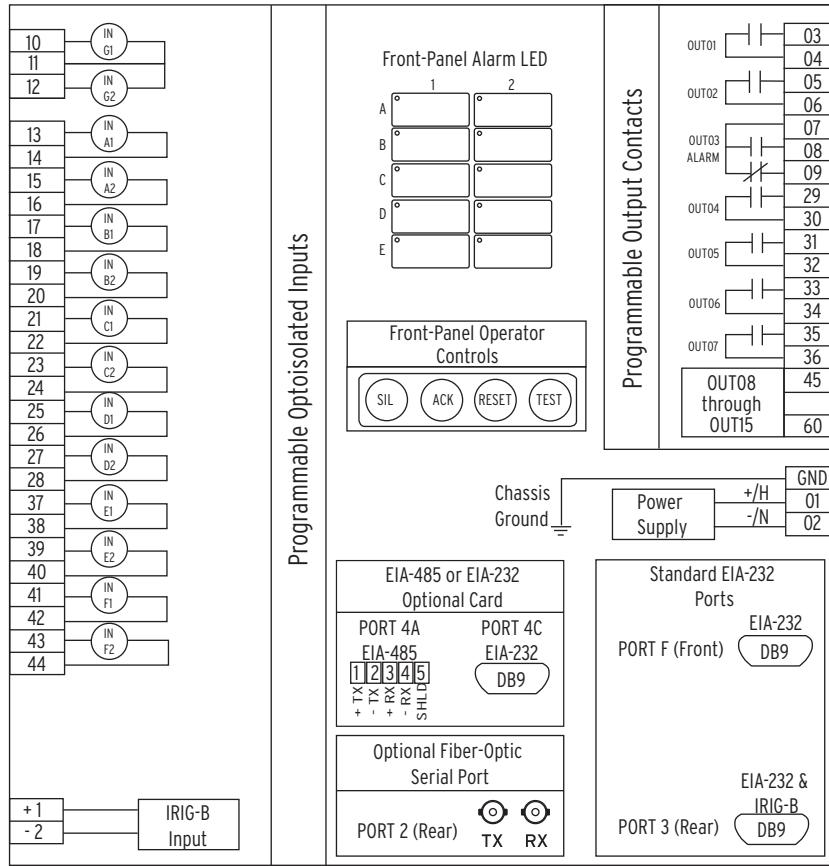
The following applications represent examples of typical alarm panel installations. Use the SEL-2533 Annunciator for indication on a wide variety of conditions, including the following:

- System status
- Quantity high/low
- Relay alarm status
- Intrusion/security status
- Device operational status
- Breaker/switch position
- Remote alarm status
- Remote acknowledgment



**Figure 1.1 Example Application**

# Hardware Connection Features



**Figure 1.2 Inputs, Outputs, and Communications Ports**

## Optoisolated Inputs

Each digital input is optoisolated from ground potential. The remote SEL-2533 comes with two inputs orderable with as many as 14 inputs with input voltage options at 24, 48, 110, 125, 220, or 250 Vdc. The inputs come with a software setting to debounce the input or assert the input upon ac voltage.

## Contact Outputs

The remote SEL-2533 comes with three dry contacts orderable with as many as 15 with the annunciator with repeat contacts. Fourteen contacts are Form A contacts, and one contact is a Form C contact. OUT03 is set for use as an alarm contact by default. See *Optoisolated Control Inputs on page 1.8* for more information.

## Power Supply

The SEL-2533 comes with an industrial-hardened internal power supply. You can order the power supply as 125/250 Vdc/Vac or 24/48 Vdc.

## Communications

The SEL-2533 comes with one front and one rear EIA-232 port. The SEL-2533 also has an optional fiber-optic serial port and an optional communications card that supports an EIA-232 or EIA-485 port.

## Time Synchronization

The SEL-2533 comes with many time setting methods. The most accurate method is the IRIG-B input or PORT 3 through pins 4 and 6. This connection provides accurate time synchronization up to 1 ms. The communications protocols Modbus and DNP can also be used to set the time.

See *Section 2: Installation* for more information on hardware and connections.

# Getting Started

---

Basic device operation principles and methods will help you use the SEL-2533 Annunciator effectively. This section presents the fundamental knowledge you need for Annunciator operation, organized by task. These tasks help you become familiar with the device and include the following:

- Powering the device
- Establishing communication
- Checking device status
- Setting the date and time

## Powering the Device

Power the Annunciator with 125/250 Vac/Vdc or 24/48 Vdc, depending on the part number. Observe proper polarity, as indicated by the **+/H** (terminal 01) and the **-/N** (terminal 02) on the power connections. Connect the ground lead (see *Grounding (Earthing) Connections on page 2.6*). Once connected to power, the device does an internal self-check and the **ENABLED** LED illuminates.

## Establishing Communication

The following steps require PC terminal emulation software and an SEL cable SEL-C234A, SEL-C662A, or equivalent to connect the Annunciator to the PC. See *Section 7: Communications* for further information on serial communications connections and the required cable pinout.

- Step 1. Use the serial communications cable to connect the PC and the Annunciator.
- Step 2. Apply power to both the PC and the Annunciator.
- Step 3. Start the PC terminal emulation program.
- Step 4. Set the PC terminal emulation program to the communications port settings listed in the Default Value column of *Table 1.1*. Set the terminal program to emulate either VT100 or VT52.
- Step 5. Press the **<Enter>** key on the PC keyboard to check the communications link.

You will see the = prompt at the left side of the computer screen (column 1).

If you do not see the = prompt, check the cable connections and confirm that the terminal emulation program is set to the default values shown in *Table 1.1*.

- Step 6. Type **QUIT <Enter>** to view the relay report header.  
You will see a computer screen display similar to *Figure 1.3*. If you see jumbled characters, change the terminal emulation type in the PC terminal emulation program.
- Step 7. Type **ACC <Enter>** and the appropriate password (see *Table 7.23* for factory default passwords) to go to Access Level 1.

**Table 1.1 SEL-2533 Serial Port Settings**

Description	Setting Label	Default Value
SPEED	SPEED	9600
DATA BITS	BITS	8
PARITY	PARITY	N
STOP BITS	STOP	1
PORT TIMEOUT	T_OUT	15
HWDR HANDSHAKING	RTSCTS	N

```
=ACC <Enter>
SEL-2533           Date: 01/29/2002      Time: 17:12:29
Device

Level 1

=>ZAC <Enter>
SEL-2533           Date: 01/29/2002      Time: 17:12:31
Device

Level 2

=>QUIT <Enter>
SEL-2533           Date: 01/29/2002      Time: 17:12:41
Device
```

**Figure 1.3 Response Header**

## Checking Device Status

Use the STA serial port command to view the operational status of the Annunciator. The monitored component status is listed in the status report depicted in *Figure 1.4*.

```
=>>STA <Enter>
SEL-2533           Date: 11/16/2010    Time: 11:31:48
ANNUNCIATOR

Serial Num = 201052348594054
FID = SEL-2533-R100-V0-Z001001-D20101129          CID = F756
Part Num = 253301213A0A3X0

Self Tests (W=Warn, F=Fail)
FPGA  GPSB  HMI  RAM  ROM  CR_RAM  NON_VOL  CLOCK  +3.3V  +5.0V  +2.5V
OK    OK     OK    OK    OK     OK       OK      OK     3.34    4.99    2.50
+3.75V -1.25V BATT
3.76   -1.25   3.16

I/O Cards
CARD_C  CARD_D  CARD_E  CARD_F
OK      OK       OK      OK

Device Enabled

=>>
```

**Figure 1.4 STA Command**

*Table 7.34* provides the definition of each status report designator. The beginning of the status report printout (see *Figure 1.4*) contains the device firmware identification string (FID) and checksum string (CID). These strings uniquely identify the device and the version of the operating firmware.

## Setting the Date and Time

### DAT (Date Command)

#### Viewing the Date

Type **DAT <Enter>** at the prompt to view the date stored in the Annunciator. If the date stored is July 29, 2007, and the DATE\_F setting is MDY, the Annunciator will reply:

7/29/2007

If the DATE\_F setting is YMD, the Annunciator will reply:

2007/7/29

If the DATE\_F setting is DMY, the Annunciator will reply:

29/7/2007

#### Changing the Date

Type **DAT** followed by the correct date at the prompt to change the date stored in the Annunciator. For example, to change the date to May 2, 2007 (DATE\_F = MDY), enter the following at the action prompt:

DAT 5/2/07

You can separate the month, day, and year parameters with spaces, commas, slashes, colons, and semicolons.

### TIM (Time Command)

#### Viewing the Time

Type **TIM** at the prompt to view the time stored in the Annunciator. The device will reply with the stored time. For example:

13:52:44

The time shown is 1:52 p.m. and 44 seconds.

#### Changing the Time

Type **TIM** followed by the correct time at the action prompt to change the time stored in the Annunciator. For example, to change the time to 6:32 a.m., enter the following at the prompt:

TIM 6:32:00

You can separate the hours, minutes, and seconds parameters with spaces, commas, slashes, colons, and semicolons.

# Specifications

## Compliance

Designed and manufactured under an ISO 9001 certified quality management system

UL Listed to U.S. and Canadian safety standards (File E220228; NRAQ, NRAQ7)

FCC: CFR 47 Part 15, Class A

**NOTE:** This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area may be likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. Any changes or modifications not expressly approved by the manufacturer can void the user's authority to operate the equipment.

## General

### Temperature Range

-40° to +85°C (-40° to +185°F), per IEC 60068-2-1 and 60068-2-2

**Note:** Not applicable to UL applications.

### Operating Environment

Pollution Degree:	2
Overvoltage Category:	II
Relative Humidity:	5–95%, noncondensing
Maximum Altitude:	2000 m

### Weight

4.2 kg (10 lb)

### Printable Window Size

30.5 mm x 61 mm (1.20" x 2.40")

## Inputs

### Optoisolated Control Inputs

#### When Used With DC Control Signals

250 V	ON for 200–275 Vdc	OFF below 150 Vdc
220 V	ON for 176–242 Vdc	OFF below 132 Vdc
125 V	ON for 100–137.5 Vdc	OFF below 75 Vdc
110 V	ON for 88–121 Vdc	OFF below 66 Vdc
48 V	ON for 38.4–52.8 Vdc	OFF below 28.8 Vdc
24 V	ON for 15–30 Vdc	OFF for <5 Vdc

#### When Used With AC Control Signals

250 V	ON for 170.6–300 Vac	OFF below 106 Vac
220 V	ON for 150.3–264 Vac	OFF below 93.2 Vac
125 V	ON for 85–150 Vac	OFF below 53 Vac
110 V	ON for 75.1–132 Vac	OFF below 46.6 Vac
48 V	ON for 32.8–57.6 Vac	OFF below 20.3 Vac
24 V	ON for 14–27 Vac	OFF below 5 Vac

#### Current Draw at

Nominal DC Voltage: 2 to 4 mA (except for 24 V, 8 mA)

Rated Insulation Voltage: 300 Vac

Rated Impulse Withstand Voltage ( $U_{imp}$ ): 4000 V

### Time-Code Input

Format: Demodulated IRIG-B

On (1) State:  $V_{ih} \geq 2.2$  V

Off (0) State:	$V_{il} \leq 0.8$ V
Input Impedance:	2 kΩ
Accuracy:	±1 ms

## Outputs

### General

OUT11 is Form C Trip Output, all other outputs are Form A.

Dielectric Test Voltage: 2000 Vac

Impulse Withstand Voltage ( $U_{imp}$ ): 4000 V

Mechanical Durability: 10,000 no load operations

### DC Output Ratings

#### Electromechanical

Rated Operational Voltage: 250 Vdc

Rated Voltage Range: 19.2 to 275 Vdc

Rated Insulation Voltage: 300 Vdc

Make: 30 A @ 250 Vdc per IEEE C37.90

**Note:** Make rating per IEEE C37.90:1989.

Continuous Carry: 6 A @ 70°C; 4 A @ 85°C

Thermal: 50 A for 1 s

Contact Protection: 360 Vdc, 40 J MOV protection across open contacts

Operating Time (coil energization to contact closure, resistive load): Pickup or dropout time ≤8 ms typical

Breaking Capacity (10,000 operations) per IEC 60255-0-20:1974:

24 V	0.75 A	L/R = 40 ms
48 V	0.50 A	L/R = 40 ms
125 V	0.30 A	L/R = 40 ms
250 V	0.20 A	L/R = 40 ms

Cyclic Capacity (2.5 cycles/second) per IEC 60255-0-20:1974:

24 V	0.75 A	L/R = 40 ms
48 V	0.50 A	L/R = 40 ms
125 V	0.30 A	L/R = 40 ms
250 V	0.20 A	L/R = 40 ms

**Note:** Per IEC 60255-23:1994, using the simplified method of assessment.

### AC Output Ratings

#### Electromechanical

Maximum Operational Voltage ( $U_o$ ) Rating: 240 Vdc

Insulation Voltage ( $U_i$ ) Rating (excluding EN 61010-1): 300 Vac

Voltage Protection Across Open Contacts: 270 Vac, 40 J

Rated Operational Current ( $I_o$ ): 3 A @ 120 Vac; 1.5 A @ 240 Vac

#### Conventional Enclosed

Thermal Current ( $I_{the}$ ) Rating: 5 A

Rated Frequency: 50/60 ± 5 Hz

Pickup/Dropout Time:	$\leq 8$ ms (coil energization to contact closure)
Electrical Durability Make VA Rating:	3600 VA, $\cos\phi = 0.3$
Electrical Durability Break VA Rating:	360 VA, $\cos\phi = 0.3$

## Communications

### Communication Ports

Standard EIA-232 (2 Ports)

Location (fixed):	1 front panel 1 rear panel
-------------------	-------------------------------

Data Speed:	300–38400 bps
-------------	---------------

Multimode Fiber-Optic Serial Port (Ordering Option)

Class 1 LED product:	Complies with IEC 60825-1:1993 + A1:1997 + A2:2001
----------------------	--

### Optional Communications Card

Standard EIA-232 or EIA-485 (Ordering Option)

Data Speed:	300–38400 bps
-------------	---------------

### Fiber-Optic Serial Port Characteristics

Wavelength:	820 nm
Optical Connector Type:	ST
Fiber Type:	Multimode
Link Budget:	8 dB
Typical TX Power:	-16 dBm
RX Min. Sensitivity:	-24 dBm
Fiber Size:	50–200 $\mu$ m
Approximate Range:	~2 km with 62.5 $\mu$ m, ~1 km with 200 $\mu$ m
Data Rate:	300–38400 bps
Typical Fiber Attenuation:	-4 dB/km

### Protocols

Modbus RTU slave

DNP3 Level 2 Outstation (Serial)

SEL MIRRORED BITS (MBA, MBB, MB8A, MB8B)

Ymodem file transfer on the front and rear ports

Xmodem file transfer on the front port

SEL ASCII and Compressed ASCII

SEL Fast Meter

SEL Fast Operate

SEL Fast SER

SEL Fast Message read request

SEL Messenger Points

### Maximum Concurrent Connections

DNP3 Level 2 Outstation: 3

Modbus Slave: 3

## Power Supply

### Rated Supply Voltage

Low-Voltage Model: 24/48 Vdc

High-Voltage Model: 125/250 Vdc  
110/240 Vac, 50/60 Hz

### Input Voltage Range

All Models:  $\pm 10\%$  of Rated Supply Voltage

### Power Consumption

AC: <40 VA

DC: <15 W

### Interruptions

Low-Voltage Model: 10 ms @ 24 Vdc  
50 ms @ 48 Vdc

High-Voltage Model: 50 ms @ 125 Vac/Vdc  
100 ms @ 250 Vac/Vdc

## Sampling and Processing Specifications

### Digital Inputs

Sampling Rate: 2 kHz

### Contact Outputs

Refresh Rate: 2 kHz

Logic Update: Every 4 ms

Control Processing: Every 4 ms

## Type Tests

### Environmental Tests

Enclosure Protection: IEC 60529:2001  
IP40 front panel and IP20 for rear terminals

Vibration Resistance: IEC 60255-21-1:1988, Class 1  
IEC 60255-21-3:1993, Class 2

Shock Resistance: IEC 60255-21-2:1988, Class 1

Cold: IEC 60068-2-1:2007  
16 hr at -40°C

Damp Heat, Cyclic: IEC 60068-2-30:2005  
25° to 55°C, 6 cycles, 95% relative humidity

Dry Heat: IEC 60068-2-2:2007  
16 hr at +85°C

### Dielectric Strength and Impulse Tests

Dielectric (HiPot): IEC 60255-5:2000  
IEEE C37.90-2005  
2.0 kVac on contact I/O  
2.83 kVdc on power supply

Impulse: IEC 60255-5:2000  
IEEE C37.90:2005  
0.5 J, 5 kV on power supply,  
contact I/O

### RFI and Interference Tests

#### EMC Immunity

Electrostatic Discharge Immunity: IEC 61000-4-2:2001  
Severity Level 4  
8 kV contact discharge  
15 kV air discharge  
IEEE C37.90.3-2001  
8 kV contact discharge  
15 kV air discharge

Radiated RF Immunity: IEC 61000-4-3:2008, 10 V/m  
IEEE C37.90.2-2004, 35 V/m

Fast Transient, Burst Immunity: IEC 61000-4-4:2004 + CRGD:2006  
4 kV @ 5.0 kHz  
2 kV @ 5.0 kHz for comm. ports

Surge Withstand Capability:	IEC 60255-22-1:2005 2.5 kV common-mode 1 kV differential-mode IEEE C37.90.1-2002 2.5 kV oscillatory 4 kV fast transient
Conducted RF Immunity:	IEC 61000-4-6:2008, 10 Vrms
EMC Emissions	Radiated and Conducted Emissions: IEC 60255-25:2000 Canada ICES-001 (A) / NMB-001 (A)

#### **Power Interruption Tests**

Interruptions: IEC 61000-4-11:2004 Voltage Dips

#### **Operating Sequences**

All per ISA-18.1-1979 (R1992)

Sequence M—Manual Reset  
Ringback Sequence—Ringback  
Sequence A—Automatic Reset  
Sequence F2A—Automatic Reset First Out With no Subsequent Alarm Flashing  
Sequence F1M—Manual Reset First Out With no Subsequent Alarm State  
Sequence F1A—Automatic Reset First Out With no Subsequent Alarm State  
Sequence F2M—Automatic Reset First Out With no Alarm Flashing  
Sequence F3A—Automatic Reset First Out With First Out Flashing and Reset Pushbutton

# Section 2

## Installation

---

### Overview

---

This section describes common installation features, requirements, and I/O options for the SEL-2533 Annunciator.

To install and connect the Annunciator safely and effectively, you must be familiar with device configuration features and options. You should carefully plan device placement, cable connections, and device communications.

This section contains drawings of typical ac and dc connections to the Annunciator. Use these drawings as a starting point for planning your particular application.

### Device Placement

---

Proper placement of the SEL-2533 Annunciator ensures years of trouble-free service. Use the following guidelines for proper physical installation of the Annunciator.

#### Physical Location

You can mount the Annunciator in a sheltered indoor environment (a building or enclosed cabinet) where temperature and humidity do not exceed device ratings. The device is EN 61010-1 rated at Installation/Overvoltage Category II and Pollution Degree 2. This rating allows you to mount the device in an indoor or outdoor (extended) enclosure where the device is protected against exposure to direct sunlight, precipitation, and full wind pressure, but neither temperature nor humidity are controlled. For more information, see *Specifications on page 1.8*. For EN 61010 certification, the Annunciator rating is 2000 m (6560 feet) above mean sea level.

#### Device Mounting

The panel mount is designed for installation in a specified hole in a panel. The lip on the panel-mount covers the hole and provides a clean look. *Figure 2.1* shows mounting dimensions for the Annunciator mount.

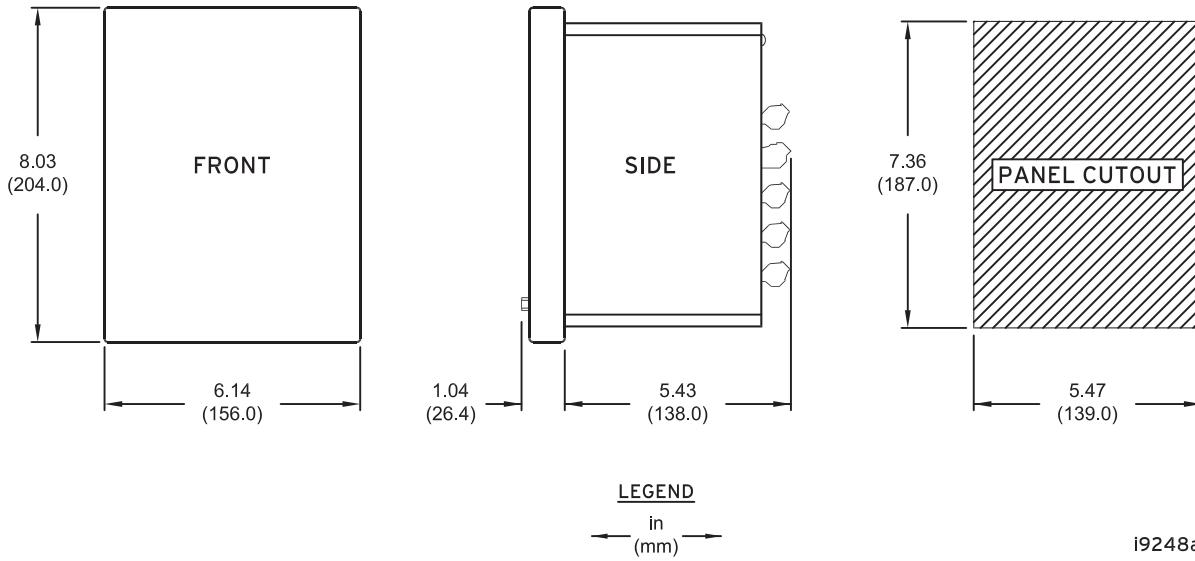
CHASSIS

Figure 2.1 SEL-2533 Annunciator Panel-Mount Dimensions

## Card Configurations

The SEL-2533 Annunciator has six card slots, two of which are fixed. The Annunciator will not function properly if the part number does not match the proper number of installed cards or if the cards are not in the correct location.

### Base-Unit Communications Ports

Select the communications ports necessary for your application from the base-unit options shown in *Table 2.1*.

**Table 2.1 Communications Ports**

Port	Location	Feature	Description
F	Front Panel	Standard	Nonisolated EIA-232 serial port
2	Rear Panel	Optional	Isolated multimode fiber-optic serial port with ST connector
3	Rear Panel	Standard	Nonisolated EIA-232 serial port
4	Rear Panel	Optional	Either nonisolated EIA-232 or EIA-485 serial port

**PORT F** supports the following protocols:

- SELBOOT
- SEL ASCII and Compressed ASCII Protocols
- SEL Settings File Transfer

**PORT 2** and **PORT 3** support the following protocols:

- Modbus® RTU Slave
- DNP3 Level 2 Outstation
- SEL ASCII and Compressed ASCII Protocols
- SEL Fast Meter
- SEL Fast Operate
- SEL Fast SER
- SEL Fast Message
- SEL Settings File Transfer
- SEL MIRRORED BITS® (MBA, MBB, MB8A, MB8B)
- SEL Messenger Points

## Communications Card (SELECT EIA-232/485)

Supported in card slot 2 only, the communications card provides one serial port with one of the following two serial port interfaces:

- **PORT 4C**, a nonisolated EIA-232 serial port interface, supporting the +5 Vdc interface
- **PORT 4A**, an isolated EIA-485 serial port interface

Select either EIA-232 or EIA-485 functionality (not both) using the **PORT 4** setting COMMINF. *Table 2.2* shows the port number, interface, and type of connector for the two protocols.

**Table 2.2 Communication Card (SELECT EIA-232/EIA-485) Interfaces and Connectors**

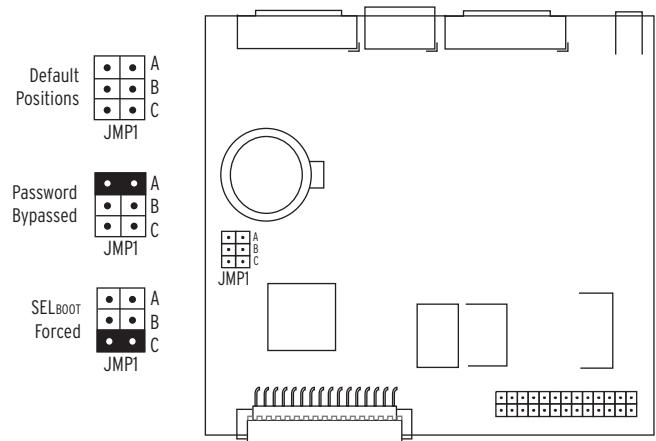
Port	Interface	Connectors
4C	EIA-232	D-sub
4A	EIA-485	5-pin Euro

The communications card supports the following protocols:

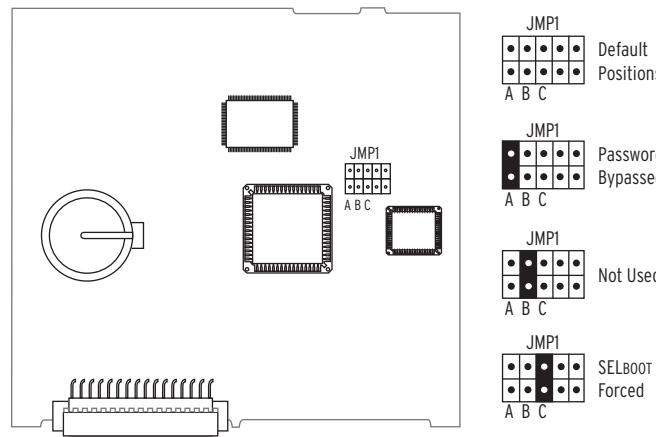
- Modbus RTU Slave
- DNP3 Level 2 Outstation
- SEL ASCII and Compressed ASCII Protocols
- SEL Fast Meter
- SEL Fast Operate
- SEL Fast SER
- SEL Fast Message
- SEL Settings File Transfer
- SEL MIRRORED BITS (MBA, MBB, MB8A, MB8B)
- SEL Messenger Points

## Password and SELBOOT Jumper Selection

*Figure 2.2 shows the major components of Card B in the base unit. Notice the three sets of pins labeled A, B, and C.*



(a) Card Layout for Relays With Firmware Versions Lower Than R200



(b) Card Layout for Relays With Firmware Versions R200 and Higher

**Figure 2.2 Pins for Password Jumper and SELBOOT Jumper**

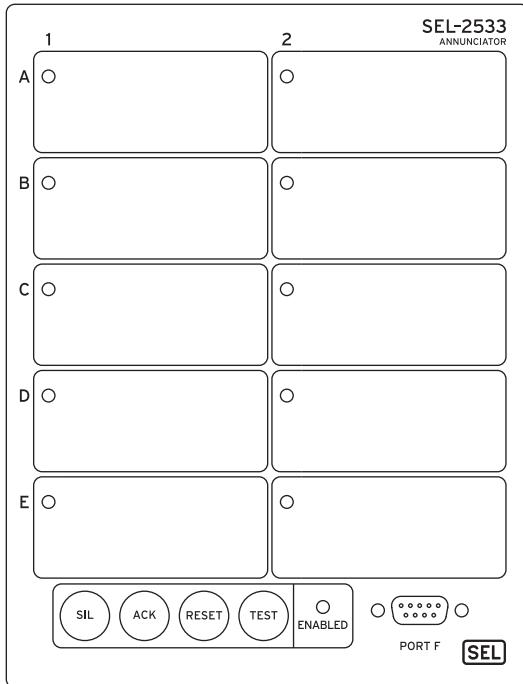
Pins labeled “A” bypass the password requirement, and pins labeled “C” force the device to the operating system called SELBOOT (pins labeled “B” are not used). In the unlikely event that the Annunciator suffers an internal failure, communications with the device may be compromised. Forcing the Annunciator to SELBOOT will allow you to download new firmware if you are unable to communicate with the device or have lost passwords. If you want to perform a firmware upgrade, see *Appendix B: Firmware Upgrade Instructions*. To force the Annunciator to operate in SELBOOT, position the jumper in Position C, as shown in *Figure 2.2* (SELBOOT forced). When forced to SELBOOT, you can only communicate with the device via the front-panel port.

To gain access to Level 1 and Level 2 without passwords, position the jumper in Position A, as shown in *Figure 2.2* (password bypassed). You will gain access to Level 2 without a password, but the alarm contact will still close momentarily. *Table 2.3* tabulates the functions of the three sets of pins and jumper default positions.

**Table 2.3 Jumper Functions and Default Positions**

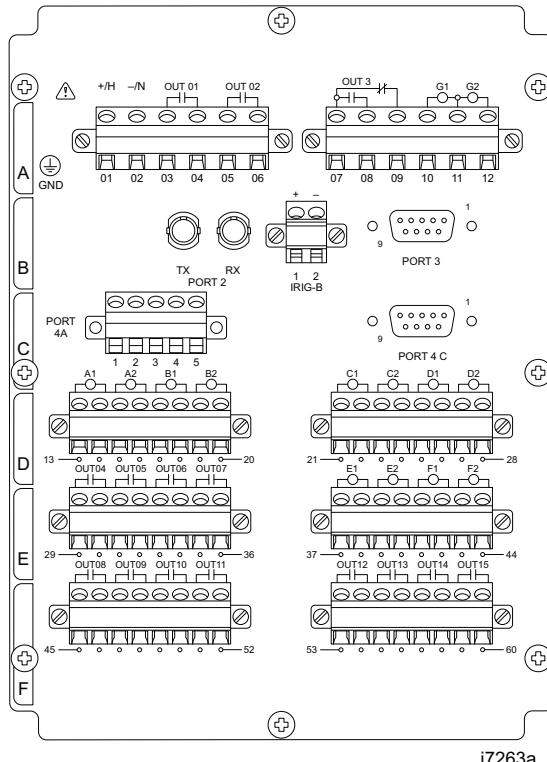
Pins	Jumper Default Position	Description
A	Not bypassed (requires password)	Password bypass
B	Not used	Not used
C	Not bypassed (not forced to SELBOOT)	Forced to SELBOOT

# Front- and Rear-Panel Diagrams



**Figure 2.3 SEL-2533 Panel Mount**

Figure 2.4 shows the physical layout of the connectors on the rear-panel diagram with the optional EIA-232/EIA-485 card.



**Figure 2.4 SEL-2533 Configured With the Optional EIA-232/EIA-485 Card and Repeat Contacts**

## Power Connections

### DANGER

Contact with instrument terminals can cause electrical shock that can result in injury or death.

### CAUTION

The relay contains devices sensitive to Electrostatic Discharge (ESD). When working on the relay with the front panel removed, work surfaces and personnel must be properly grounded or equipment damage may result.

### CAUTION

Devices manufactured before May 2022 may not include an orange connector for the 24/48 Vdc power supply. Check your device's part number to ensure that you are using an appropriate voltage for your power supply.

The power terminals on the rear panel (**(01(+/H)**) and (**(02(-/N)**) must connect to 110–240 Vac, 125–250 Vdc, or 24/48 Vdc (orange connector) (see *Powering the Device* on page 1.5 for complete power input specifications). The power terminals are isolated from chassis ground. Use 14 AWG (2.5 mm<sup>2</sup>) to 16 AWG (1.5 mm<sup>2</sup>) size wire to connect to the power terminals.

Place an external circuit breaker or switch no more than 3.0 m (9.8 feet) from the equipment. The circuit breaker (or equivalent approved disconnect device appropriate for the country of installation) must be compliant with IEC 60947-1 and IEC 60947-3, be identified as the disconnect device for the equipment, and be located near the equipment. This disconnect device must interrupt both the hot (**H**) and the neutral (**N**) power leads.

The maximum current rating for the power disconnect circuit breaker or overcurrent device (fuse) must be 20 A. An internal power supply fuse (T3.15AH250V, 5 x 20 mm) protects the operational power supply. Be sure to use fuses that comply with IEC 60127-2.

## Grounding (Earthing) Connections



## Output Contacts

You must connect the ground terminal labeled **GND** on the rear panel to a rack frame or switchgear ground for proper safety and performance. Use 14 AWG (2.5 mm<sup>2</sup>) wire less than 2 m (6.6 feet) in length for the ground connection.

The base unit has standard output contacts only (ten Form A and one Form C). Refer to *Specifications* on page 1.8 for output contact ratings. Standard output contacts are not polarity-dependent.

## Optoisolated Inputs

The Announcer optoisolated inputs (e.g., A1, B2) are not polarity-dependent. Each optoisolated input draws 2 to 6 mA of current with nominal control voltage applied. Refer to *Section 1: Introduction and Specifications* for optoisolated input ratings. Inputs can be configured to respond to the ac or dc control signals via global settings in IN\_A1D through IN\_F2D.

## Serial Ports

Because all ports (**F**, **2**, **3**, and **4**) are independent, you can communicate to any combination simultaneously. Although serial **PORT 4** on the optional communications card consists of an EIA-485 (**4A**) and an EIA-232 (**4C**) port, only one port is available at a time. Use the **PORT 4** communications interface COMMINF setting to select between EIA-485 and EIA-232.

The serial port EIA-485 plug-in connector accepts wire sized AWG 24 through AWG 12. Strip the wires 8 mm (0.31 inches) and install with a small, slotted-tip screwdriver. All EIA-232 ports accept 9-pin D-subminiature male connectors. **PORT 3** includes the IRIG-B time-code signal input (see below).

For connecting devices at distances of over 100 feet where metallic cable is not appropriate, SEL offers fiber-optic transceivers or the fiber-optic port. The SEL-2800 family of transceivers provides fiber-optic links between devices for electrical isolation and long-distance signal transmission. Contact SEL for further information on these products.

## IRIG-B Time-Code Input

The SEL-2533 accepts a demodulated IRIG-B time signal to synchronize the internal clock with an external source. Two options for IRIG-B signal input are given, but only one may be used at a time. IRIG-B (1 and 2 on the IRIG-B 2-pin connector) inputs or an SEL communications processor (e.g., SEL RTAC) via fiber-optic Port 2 or Serial Port 3 may be used. See *Table 6.8* for selecting the IRIG source for either **PORT 2** or **PORT 3**.

## Fiber-Optic Serial Port

You can order the SEL-2533 with an optional multimode fiber-optic port that is compatible with the SEL-2812 Fiber-Optic Transceiver. Connect to the fiber-optic port (**Port 2**) by using one of the cables listed in *Table 2.4*.

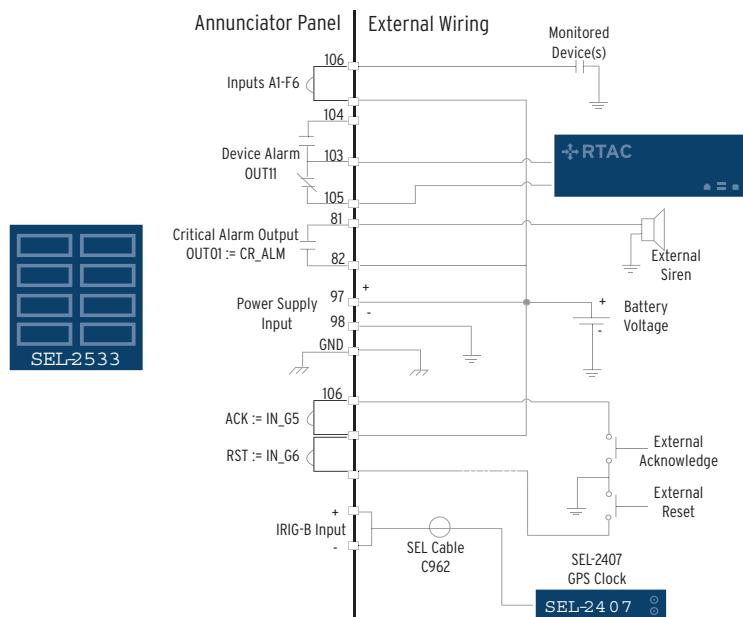
## Cables

**Table 2.4 Communication Cables for Connecting the SEL-2533 to Other Devices**

EIA-232 Serial Ports	Connect to Device	SEL Cable No.
All EIA-232 ports	Laptop, PC, 9-pin Male (DTE)	SEL-C287
EIA-232 Port 3 or 4	SEL RTAC without IRIG-B	SEL-C272A
EIA-232 Port 2 (Fiber)	SEL-2812/SEL-2814 Transceiver	SEL-C807Z
EIA-232 PORT 3	SEL RTAC with IRIG-B	SEL-C273A

## Example Connection Diagram

*Figure 2.5* shows an example connections system for your SEL-2533. The Annunciator comes with 10 alarm points. Each alarm point is set to trigger from a digital input. Each digital input connects to a contact on the monitored device. When the monitored device indicates an alarm condition by closing a contact, this contact will apply the external wetting voltage to a particular input on the SEL-2533 and cause an alarm indication. Refer to *Specifications on page 1.8* for information on the digital input assertion/deassertion levels.



**Figure 2.5 SEL-2533 Connection Diagram for External Devices**

All of the output contacts are dry Form A contacts that need to be wetted properly in order to drive the external device. OUT03 is a Form C contact set as the ALARM contact. This contact alerts if any of the self-test diagnostics fail. The acknowledge and reset buttons work from either the front panel of the Announcer or from digital inputs G1 and G2 externally wired to a manual switch.

The SEL-2533 comes with 1024 Sequential Events Recorder (SER) report. The SER report will keep track of any alarm that asserts as well as the time of assertion. Connecting the Announcer to a time source will time-synchronize the SER report to 1 ms.

# Field Serviceability

---

## CAUTION

Equipment components are sensitive to electrostatic discharge (ESD). Undetectable permanent damage can result if you do not use proper ESD procedures. Ground yourself, your work surface, and this equipment before removing any cover from this equipment. If your facility is not equipped to work with these components, contact SEL about returning this device and related SEL equipment for service.

SEL-2533 firmware may be upgraded in the field; refer to *Appendix B: Firmware Upgrade Instructions*. You can know a self-test failure has occurred by configuring an output contact to create a diagnostic alarm, as explained in *Section 4: Logic Functions*. Refer to *Section 10: Testing and Troubleshooting* for detailed information.

The only two components that may be replaced in the field are the power supply fuse and the real-time clock battery. A lithium battery powers the clock if the external power source is lost or removed. The battery is a 3 V lithium coin cell, Ray-O-Vac® BR2335, or equivalent. At room temperature (25°C), the battery will operate nominally for ten years at rated load. When the device is powered from an external source, the battery experiences a low self-discharge rate. Thus, battery life may extend well beyond ten years. The battery cannot be recharged.

## Fuse Replacement

## DANGER

Disconnect or de-energize all external connections before opening this device. Contact with hazardous voltages and currents inside this device can cause electrical shock resulting in injury or death.

To replace the power supply fuse, perform the following steps:

- Step 1. De-energize the device.
- Step 2. Remove the eight rear-panel screws and the rear panel.
- Step 3. Remove Card A printed circuit board.
- Step 4. Locate the fuse on the board.
- Step 5. Remove the fuse from the fuse holder.
- Step 6. Ensure the fuse holder has not been damaged, bent, or deformed.
- Step 7. Reform the fuse holder to ensure proper contact with the new fuse.
- Step 8. Replace the fuse with a time-delay, 5 x 20 mm, 3.15 A, high-breaking capacity, 250 V fuse (T3.15AH250V).
- Step 9. Insert the printed circuit board into Position A.
- Step 10. Replace the device rear-panel plate, reinstall all screws and connectors, and energize the unit.

## Real-Time Clock Battery Replacement

## CAUTION

There is danger of explosion if the battery is incorrectly replaced. Replace only with Ray-O-Vac® no. BR2335 or equivalent recommended by manufacturer. See Owner's Manual for safety instructions. The battery used in this device may present a fire or chemical burn hazard if mistreated. Do not recharge, disassemble, heat above 100°C or incinerate. Dispose of used batteries according to the manufacturer's instructions. Keep battery out of reach of children.

To replace the real-time clock battery, perform the following steps:

- Step 1. De-energize the device.
- Step 2. Remove the eight rear-panel screws and the rear panel.
- Step 3. Remove the Card B printed circuit board.
- Step 4. Locate the battery clip (holder) on the board.
- Step 5. Carefully remove the battery from beneath the clip. Properly dispose of the old battery.
- Step 6. Install the new battery with the positive (+) side facing up.
- Step 7. Insert the printed circuit board into Position B.
- Step 8. Replace the device rear panel, reinstall all screws and connectors, and energize the unit.
- Step 9. Set the device date and time.

# Section 3

## PC Software

---

### Overview

---

SEL provides many PC software applications to support the SEL-2533 Annunciator and other SEL devices, as listed in *Table 3.1*.

**Table 3.1 SEL Software Solutions**

Part Number	Product Name	Description
SEL-5030	ACSELERATOR QuickSet® SEL-5030 Software	See <i>Table 3.2</i>  Customizes SEL-2533 settings for your application
SEL-5801	SEL-5801 Cable Selector Software	Selects the proper SEL cables for your application

This section describes how to get started with the SEL-2533 and ACSELERATOR QuickSet SEL-5030 software. ACSELERATOR QuickSet is a powerful settings, SER event analysis, and visualization tool that aids in setting, applying, and using the SEL-2533. *Table 3.2* shows the suite of ACSELERATOR QuickSet applications provided for the SEL-2533.

**Table 3.2 ACSELERATOR QuickSet SEL-5030 Software**

Terminal	Provides a direct connection to the SEL device; use this communications method to interface directly with the device
Rules-Based Settings Editor	Provides on-line or off-line device settings that include interdependency checks; use this feature to create and manage settings for multiple devices in a database
SER Event Analysis	Provides Sequential Events Recorder (SER) tools to retrieve and view the data
HMI	Provides Human Machine Interface (HMI) viewing and control features
Setting Database Management	Provides a database to manage the settings of multiple devices
Help	Provides general ACSELERATOR QuickSet and device-specific ACSELERATOR QuickSet context help

# Setup

---

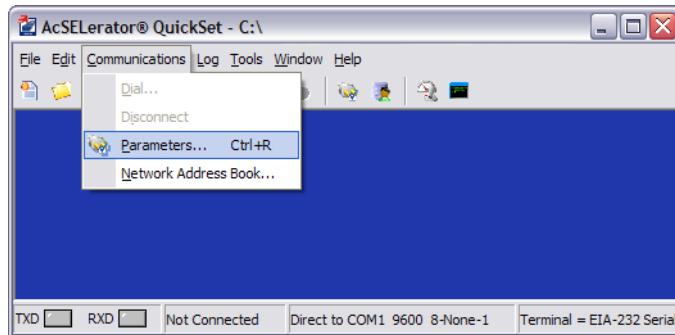
Follow the steps outlined in *Section 2: Installation* to prepare the SEL-2533 for use. Perform the following steps to initiate communications:

- Step 1. Connect the appropriate communications cable between the SEL-2533 and the PC.
- Step 2. Apply power to the SEL-2533.
- Step 3. Start ACSELERATOR QuickSet.

## Communications

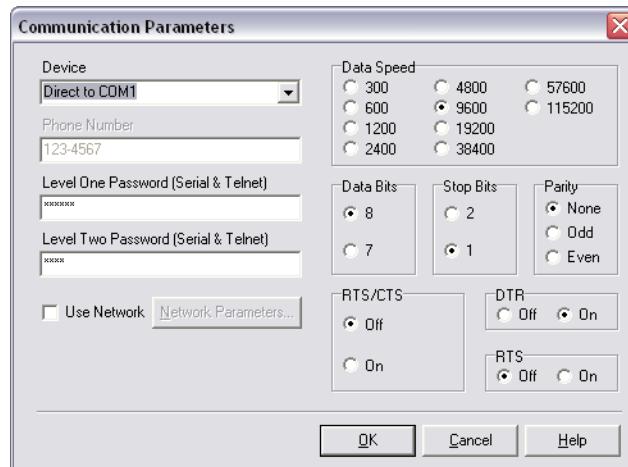
ACSELERATOR QuickSet uses device communications **PORT F** (front panel) to communicate with the SEL-2533. Perform the following steps to configure ACSELERATOR QuickSet to communicate effectively with the device.

- Step 1. Select **Communications** from the ACSELERATOR QuickSet main menu bar, as shown in *Figure 3.1*.



**Figure 3.1** Serial Port Communications Menu

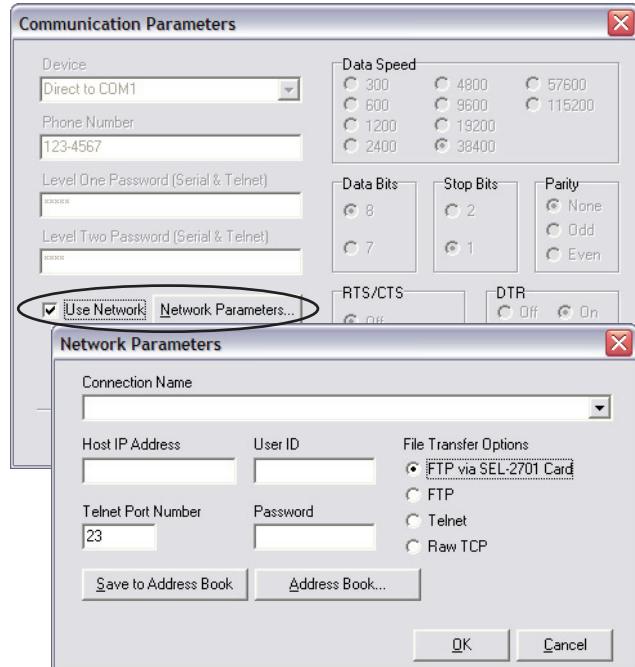
- Step 2. Select the **Parameters** submenu to display the screen shown in *Figure 3.2*.



**Figure 3.2** Serial Port Communication Parameters Dialog Box

- Step 3. Configure the PC port to match the device communications settings.
- Step 4. Configure ACSELERATOR QuickSet to match the SEL-2533 default settings by entering Access Level 1 and Access Level 2 passwords in the respective text boxes.

- Step 5. If a telephone modem is chosen from the device text box, enter the dial-up telephone number in the **Phone Number** text box.
- Step 6. For network communications, check the **Use Network** check box and enter the network parameters, as shown in *Figure 3.3*.



**Figure 3.3 Network Parameters Dialog Box**

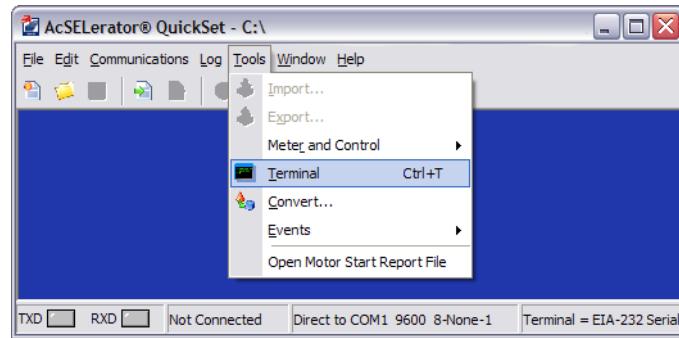
Step 7. Exit the menus by clicking **OK** when finished.

## Terminal

---

### Terminal Window

Select **Tools > Terminal** on the ACSELERATOR QuickSet main menu bar to open the terminal window, as shown in *Figure 3.4*.



**Figure 3.4 Tools Menu**

The terminal window is an ASCII interface with the device. This is a basic terminal emulation. Many third-party terminal emulation programs are available with file transfer encoding schemes. Open the terminal window by either clicking **Tools > Terminal** or by pressing **<Ctrl+T>**. Verify proper communications with the device by opening a terminal window, pressing **<Enter>** a few times, and verifying that a prompt is received. If a prompt is not received, verify proper setup.

## Terminal Logging

To create a file that contains all terminal communications with the device, select **Terminal Logging** in the **Log** menu, and specify a file at the prompt. ACSELERATOR QuickSet records communications events and errors in this file. Click **Log > Connect Log** to view the log. Clear the log by selecting **Log > Clear Connection Log**.

## Drivers and Part Number

After clicking **Log > Terminal**, access the device at Access Level 1. Issue the **ID** command to receive an identification report, as shown in *Figure 3.5*.

```
=>>ID <Enter>
"FIG=SEL-2533-R101-VO-Z001001-D20101109", "08D4"
"BFID=SLBT-2533-R200-VO-Z000000-D20100629", "0960"
"CID=F756", "0265"
"DEVID=SEL-2533", "03F7"
"DEVCODE=76", "0314"
"PARTNO=253301213A0A3X0", "05B2"
"CONFIG=00000000", "03E3"
=>>
```

**Figure 3.5 Device Response to the ID Command**

Locate and record the Z number (Z001001) in the FIG string. The first portion of the Z number (Z001...) determines the ACSELERATOR QuickSet device settings driver version when you are creating or editing device settings files. The Device Editor driver version is discussed in more detail in *Device Editor (Editor Mode) on page 3.8*. Compare the part number (PARTNO=2533XXXXXXXXXX) with the Model Option Table (MOT) to ensure correct device configuration.

# Settings Database Management and Drivers

ACSELERATOR QuickSet uses a database to save device settings and contain sets of all settings files for each device specified in the Database Manager. Choose appropriate storage backup methods and locations.

## Active Database

Change the active database to the one that needs to be modified by selecting **File > Active Database** on the main menu bar.

## Database Manager

Select **File > Database Manager** on the main menu bar to create new databases and manage records within existing databases.

## Settings Database

Step 1. Open the Database Manager to access the database. Click **File > Database Manager**. A dialog box will appear.

Relay.rdb is the default database file already configured in ACSELERATOR QuickSet. This database contains example settings files for SEL products that use ACSELERATOR Quickset.

Step 2. Enter descriptions for the database and for each device in the database in the **Database Description** and **Settings Description** dialog boxes.

Step 3. Enter special operating characteristics that describe the device settings in the **Settings Description** dialog box. These can include the protection scheme settings and communications settings.

Step 4. Highlight one of the devices listed in **Settings in Database**, and select **Copy** to create a new collection of settings.

ACSELERATOR QuickSet prompts for a new name. Be sure to enter a new description in **Settings Description**.

## Copy/Move Settings Between Databases

Step 1. Select the **Copy/Move Settings Between Databases** tab to create multiple databases with the **Database Manager**. These databases are useful for grouping similar protection schemes or geographic areas.

Step 2. Click **Open B** to open a device database.

Step 3. Type a filename and click **Open**.

a. Highlight a device or setting in the **A** database.

b. Select **Copy** or **Move**, and click the **>** button to create a new device or setting in the **B** database.

Step 4. Reverse this process to take devices from the **B** database to the **A** database. **Copy** creates an identical device that appears in both databases. **Move** removes the device from one database and places the device in another.

## Create a New Database

To create and copy an existing database of devices to a new database:

Step 1. Click **File > Database Manager**, and select the **Create New Database** button. ACSELERATOR QuickSet prompts you for a file name.

Step 2. Type the new database name (and location if the new location differs from the existing one), and click **Save**. ACSELERATOR QuickSet displays the message **Settings [path and filename] was successfully created**.

Step 3. Click **OK**.

## Copy an Existing Database

To copy an existing database of devices to a new database:

Step 1. Click **File > Database Manager**, and select the **Copy/Move Settings Between Databases** tab in the **Database Manager** dialog box.

ACSELERATOR QuickSet opens the last active database and assigns it as **Database A**.

Step 2. Click **Open B** and ACSELERATOR QuickSet prompts you for a file location.

Step 3. Type a new database name, click **Open** and click **Yes**; the program creates a new empty database. Load devices into the new database as shown in *Copy/Move Settings Between Databases on page 3.5*.

# Settings

---

ACSELERATOR QuickSet offers the ability to create settings for one or more SEL-2533 devices. Store existing device settings downloaded from SEL-2533 devices with ACSELERATOR QuickSet, thus creating a library of device settings, and then modify and upload these settings from the settings library to an SEL-2533. ACSELERATOR QuickSet makes setting the device easy and efficient. However, you do not have to use ACSELERATOR QuickSet to configure the SEL-2533; you can use an ASCII terminal or a computer running terminal emulation software. ACSELERATOR QuickSet advantages include rules-based settings checks, SELOGIC® control equation Expression Builder, operator control and HMI, SER event analysis, and help.

## Settings Editor

The Settings Editor shows device settings in categories that are easy to understand. The SEL-2533 settings structure makes setting the device easy and efficient. Settings are grouped logically, and device elements that are not used in the selected protection scheme are not accessible. The settings tree view remains constant whether settings categories are enabled or disabled, with any disabled settings dimmed.

## Settings Menu

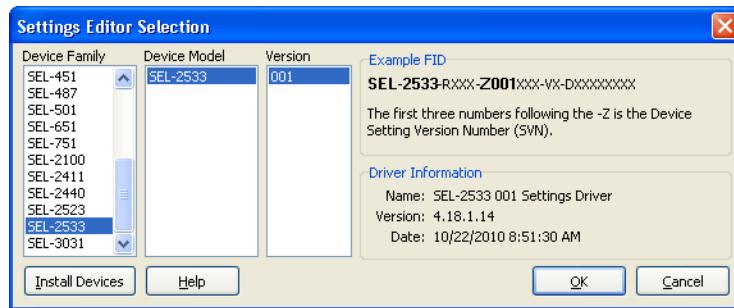
ACSELERATOR QuickSet uses a database to store and manage SEL device settings. Each unique device has its own record of settings. Use the **File** menu to open an existing record, create and open a new record, read device settings from a connected SEL-2533 and then create and open a new record, or convert and open an existing record. The record will be opened in the Setting Editor as a Setting Form (template) or in Editor Mode.

**Table 3.3 File Menus**

Menus	Description
<<, >>	Use these navigation menu buttons to move from one category to the next
New	Open a new record
Open	Open an existing record
Read	Read device settings and then create and open a new record
Convert	Convert and open an existing record

### File > New

Select **New** to create new settings files. ACSELERATOR QuickSet makes the new settings file from the driver that you specify in the **Settings Editor Selection** dialog box. ACSELERATOR QuickSet uses the Z number in the FID string to create a particular version of settings. To make SEL-2533 settings with the **Device Editor (Editor Mode)**, select **Settings > New** from the main menu bar, and SEL-2533 and 001 from the **Settings Editor Selection** window as shown in *Figure 3.6*.



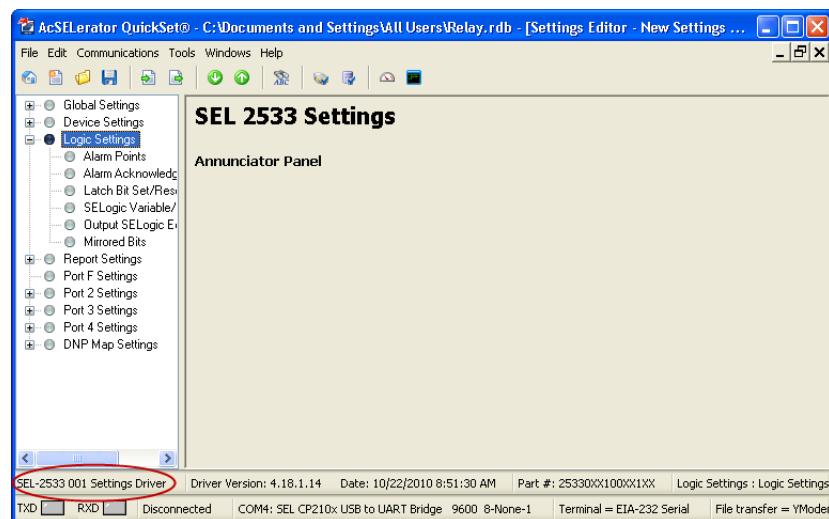
**Figure 3.6 Driver Selection**

After selecting the device model and settings driver, ACSELERATOR QuickSet presents the **Device Part Number** dialog box. Use this dialog box to configure the Device Editor to produce settings for a device with options determined by the part number, as shown in *Figure 3.7*. Press **OK** when finished.



**Figure 3.7 Update Part Number**

*Figure 3.8* shows the **Settings Editor** screen. View the bottom of the Device Editor window to check the **Settings Driver** number. Compare the ACSELERATOR QuickSet Settings Driver number and the first portion of the Z number in the FID string (select **HMI > Meter & Control > Status**). These numbers must match. ACSELERATOR QuickSet uses this first portion of the Z number to determine the correct **Device Editor** to display.



**Figure 3.8 New Setting Screen**

**File > Open**

The **Open** menu item opens an existing device from the active database folder. ACSELERATOR QuickSet prompts for a device to load in the **Device Editor**.

**File > Read**

When the **Read** menu is selected, ACSELERATOR QuickSet reads the device settings from a connected device. As ACSELERATOR QuickSet reads the device, a **Transfer Status** window appears. ACSELERATOR QuickSet uses serial protocols to read settings from SEL devices.

**Device Editor  
(Editor Mode)**

Use the **Device Editor (Editor Mode)** to enter settings. These features include the ACSELERATOR QuickSet settings driver version number (the first three digits of the Z number) in the lower left corner of the Device Editor.

**Entering Settings**

**NOTE:** Setting changes made during the edit session are not read by the device unless they are transferred to the device with a Send menu item.

- Step 1. Click the + marks and the buttons in the **Settings Tree View** to expand and select the settings you want to change.
- Step 2. Use **Tab** to navigate through the settings, or click on a setting.
- Step 3. To restore the previous value for a setting, right-click the mouse over the setting and select **Previous Value**.
- Step 4. To restore the factory default setting value, right-click in the setting dialog box and select **Default Value**.
- Step 5. If you enter a setting that is out of range or has an error, ACSELERATOR QuickSet shows the error at the bottom of the **Settings Editor**. Double-click the error listing to go to the setting and enter a valid input.

**Table 3.4 Device Editor Menus**

Menus	Description
<<, >>	Moves menu from one category to the next
Merge	Merges the open record with another record
Compare	Compares the open record with another record
Search	Searches for a particular setting
Part Number	Displays part number

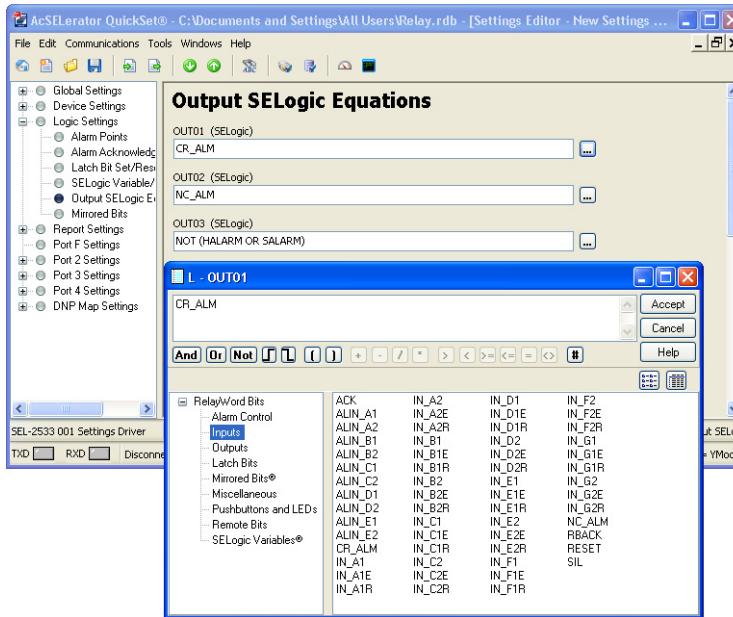
**Expression Builder**

**NOTE:** Be sure to enable the functions you need (Logic Settings > SELOGIC Enable) before using Expression Builder.

SELOGIC control equations are a powerful way to customize device performance. Creating these equations can be difficult due to the large number of device elements (Device Word bits) in the device. ACSELERATOR QuickSet simplifies this process with the Expression Builder, a rules-based editor for programming SELOGIC control equations. The Expression Builder organizes device elements and SELOGIC control equation variables and focuses equation decision-making.

## Access the Expression Builder

Use the ellipsis buttons [...] in the Settings dialog boxes of the **Device Editor** windows to create expressions, as shown in *Figure 3.9*.



**Figure 3.9 Expressions Created With Expression Builder**

## Expression Builder Organization

The Expression Builder dialog box is organized into two main parts representing the left side (LVALUE) and right side (RVALUE) of the SELOGIC control equation. The LVALUE is fixed for all settings.

## Using the Expression Builder

Use the right side of the equation (RVALUE) to select broad categories of device elements, timers, latches, and logic variables. Select a category in the RVALUE tree view, and the Expression Builder displays all operands for that category in the list box at the bottom right side. Directly underneath the right side of the equation, choose operators to be included in the RVALUE. These operators include basic logic, rising- and falling-edge triggers, expression compares, and comments.

## Sending Settings

Select **Save**, **Send**, or **Print** from the **File** menu of the Device Editor once settings are entered into ACSELERATOR QuickSet. This will help ensure the settings are not lost.

## Changing Part Number

Select **Edit > Part Number** to change the part number if it was entered incorrectly during an earlier step.

## Text Files

Select **Tools > File > Import** and **Tools > File > Export** on the Device Editor (Editor Mode) menu bar to import or export settings from or to a text file. Use this feature to create a small file that can be more easily stored or sent electronically.

# Meter and Control

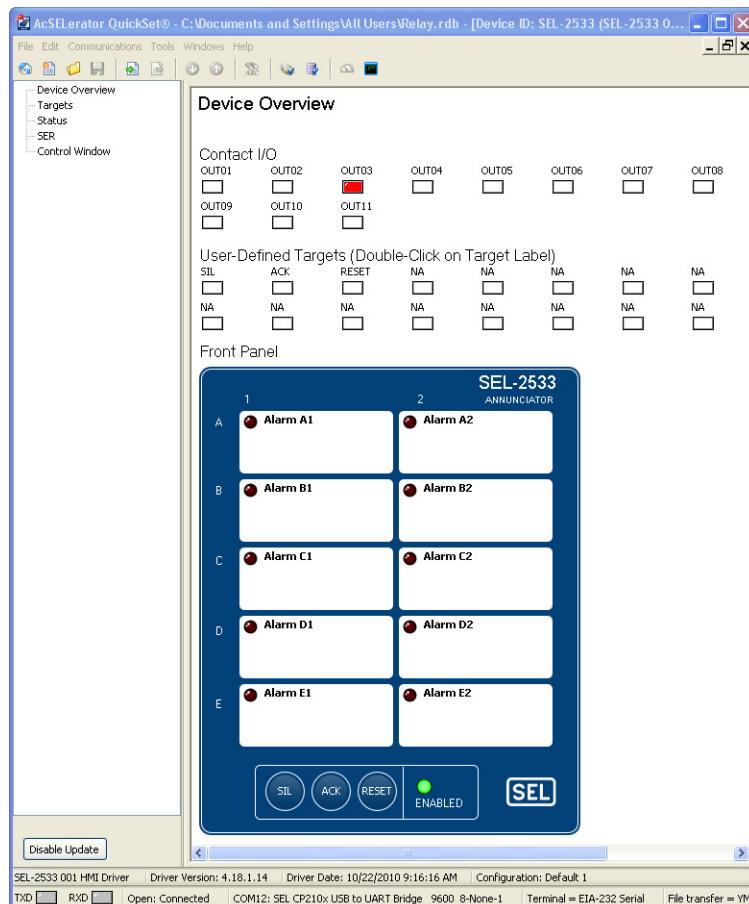
## Human Machine Interface (HMI)

Click on **Tools > HMI > Meter & Control** to bring up the screen shown in *Figure 3.10*. The HMI tree view shows all the functions available from the HMI function. The **Meter & Control** window is an easily-organized way to view real-time data or stored information from the SEL-2533.

## Device Overview

The device overview screen provides a real-time view of the annunciator to which it is connected (see *Figure 3.10*). A remote user can see the current status of the SEL-2533 and coordinate with local crews. The software allows customization and setting of each of the 10 alarm point windows to match what is displayed on the SEL-2533. Each of these configurations can be saved so that remote users can view all annunciators connected in the system.

The device overview screen also has interactive buttons to emulate what a user would do directly in front of the annunciator. The Silence (SIL), Acknowledge (ACK), and Reset (RESET) buttons can be issued remotely when you click the buttons with your mouse.

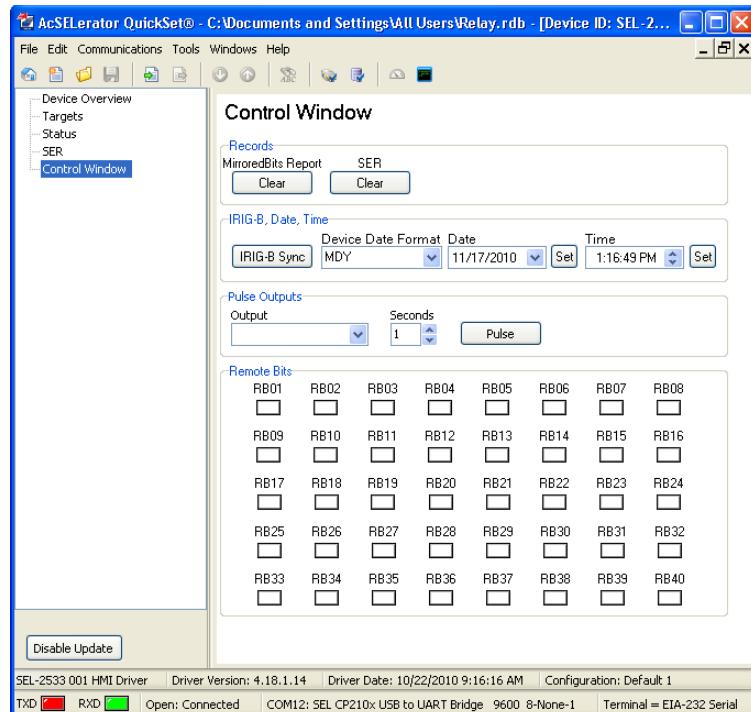


**Figure 3.10 Device Overview Screen**

Click **Target** to view the status of all Device Word bits. When a Device Word bit has a value of 1 (ENABLED = 1), the Device Word bit is asserted. When a Device Word bit has a value of 0 (RB02 = 0), the Device Word bit is deasserted.

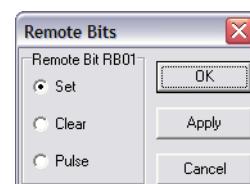
The **Status** and **SER** screens display the same information as the ASCII **STA** and **SER** commands.

*Figure 3.11* shows the control screen. From here you can clear the SER and MIRRORED BITS® communications report and trigger events. You can also reset the targets, synchronize with IRIG, and set the time and date.



**Figure 3.11 Control Screen**

To control the Remote bits, click on the appropriate square, then select the operation from the box shown in *Figure 3.12*.



**Figure 3.12 Remote Operation Selection**

# Help

---

Various forms of ACCELERATOR QuickSet help are available, as shown in *Table 3.5*. Press <F1> to open a context-sensitive help file with the appropriate topic as the default.

**Table 3.5 Help**

Help	Description
General ACCELERATOR QuickSet	Select <b>Help</b> from the main menu bar
Device Editor	Select <b>SEL-5030 Editor Help</b> from the <b>Device Editor</b> menu bar
SEL-2533 Settings	Select <b>Settings Help</b> from the <b>Device Editor</b> menu bar.
Database Manager	Select <b>Help</b> from the bottom of the <b>Database Manager</b> window

# Section 4

## Logic Functions

### Overview

---

For ease of setting the SEL-2533 Annunciator, settings are grouped into five categories, as shown in *Table 4.1*. This section describes the settings when using serial communications. This section describes the logic settings only. See *Section 6: Settings* for the remaining settings.

**Table 4.1 Setting Categories**

Category	Description
Device Settings	Lists settings associated with setting alarm sequences
Logic Settings	Lists settings associated with latches, timers, and output contacts
Global Settings	Lists date format settings and input debounce timer settings
Serial Port $p$ Settings	Lists settings that configure the device front-and rear-panel serial ports ( $p = F, 2, \text{ or } 3$ on the base unit $p = 4$ on optional communications card)
Report Settings	Lists settings for the Sequential Events Recorder (SER)

In general, settings are not case sensitive, but the device converts all nontext settings (except engineering unit settings) to capital letters. All settings are saved in nonvolatile memory, and are maintained during firmware upgrades.

### Logic Settings (SET L Command)

---

**NOTE:** SV in the Setting Range column of the settings tables indicates a SELOGIC® control equation.

Settings associated with latches, timers, and output contacts are listed below.

#### SELOGIC Enables

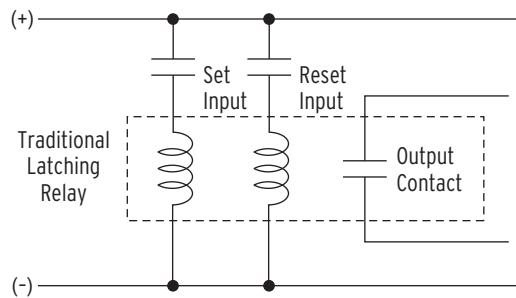
*Table 4.2* shows the enable settings for latch bits (ELAT) and SELOGIC control equations (including timers). This limits the number of settings needed. For example, if six timers are needed, only six timers are enabled.

**Table 4.2 Enable Settings**

Setting Prompt	Setting Range	Default Setting
SELOGIC Latches	N, 1–32	ELAT := N
SELOGIC Variables/Timers	N, 1–40	ESV := N

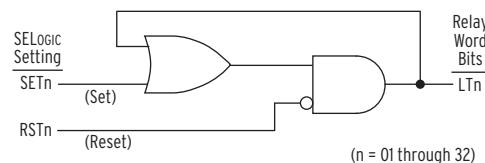
## Latch Bits

Latch control switches (latch bits are the outputs of these switches) replace traditional latching devices. Traditional latching devices maintain output contact state. The SEL-2533 latch control switch retains state even when the device loses power. If the latch control switch is set to a programmable output contact and device power is lost, the state of the latch control switch is stored in nonvolatile memory, and the device de-energizes the output contact. When power to the device is restored, the programmable output contact will go back to the state of the latch control switch after device initialization. Traditional latching device output contact states are changed by pulsing the latching device inputs (see *Figure 4.1*). Pulse the set input to close (set) the latching device output contact. Pulse the reset input to open (reset) the latching device output contact. The external contacts wired to the latching device inputs are often from remote control equipment (e.g., SCADA, RTU).



**Figure 4.1 Schematic Diagram of a Traditional Latching Device**

Thirty-two latch control switches in the SEL-2533 provide latching device functionality. *Figure 4.2* shows the logic diagram of a latch switch. The output of the latch control switch is a Device Word bit  $LTn$  ( $n = 01$  through 32), called a latch bit.



**Figure 4.2 Logic Diagram of a Latch Switch**

If setting  $SETn$  asserts to logical 1, latch bit  $LTn$  asserts to logical 1. If setting  $RSTn$  asserts to logical 1, latch bit  $LTn$  deasserts to logical 0. If both settings  $SETn$  and  $RSTn$  assert to logical 1, setting  $RSTn$  has priority and latch bit  $LTn$  deasserts to logical 0. You can use these latch bits in SELOGIC control equations to create custom logic for your application.

The SEL-2533 includes 32 latches. *Table 4.3* shows the **SET** and **RESET** default settings for Latch 1. The remaining latches have the same settings.

**Table 4.3 Latch Bits Equation Settings**

Settings Prompt	Setting Range	Setting Name := Factory Default
SET01	SV	SET01 := NA
RST01	SV	RST01 := NA
•	•	•
•	•	•
•	•	•
SET32	SV	SET32 := NA
RST32	SV	RST32 := NA

## Latch Bits: Nonvolatile State

### Power Loss

The states of the latch bits (LT01–LT32) are retained if power to the device is lost and then restored. If a latch bit is asserted (e.g., LT02 := logical 1) when power is lost, it is asserted (LT02 := logical 1) when power is restored. If a latch bit is deasserted (e.g., LT03 := logical 0) when power is lost, it is deasserted (LT03 := logical 0) when power is restored.

### Settings Change

If individual settings are changed, the states of the latch bits (Device Word bits LT01–LT32) are retained, as in the preceding *Power Loss* explanation. If individual settings changes cause a change in SELOGIC control equation settings SET $n$  or RST $n$  ( $n = 1–32$ ), the retained states of the latch bits can be changed, subject to the newly enabled settings SET $n$  or RST $n$ .

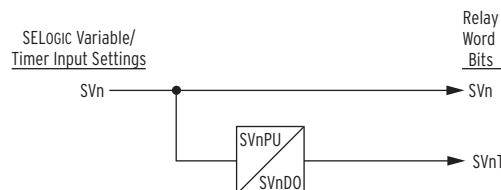
### Make Latch Control Switch Settings With Care

The latch bit states are stored in nonvolatile memory so they can be retained during power loss or settings changes. The nonvolatile memory is rated for a finite number of writes for all cumulative latch bit state changes. Exceeding the limit can result in a Flash self-test failure. An average of 70 cumulative latch bit state changes per day can be made for a 25-year device service life.

Settings SET $n$  and RST $n$  cannot result in continuous cyclical operation of latch bit LT $n$ . Use timers to qualify conditions set in settings SET $n$  and RST $n$ . If you use any optoisolated inputs in settings SET $n$  and RST $n$ , the inputs each have a separate debounce timer that can help to provide the necessary time qualification.

## SELOGIC Control Equation Variables/ Timers

Enable the number of SELOGIC control equations necessary for your application. Only the enabled SELOGIC control equations appear for settings. Each SELOGIC control equation variable/timer has a SELOGIC control equation setting input and variable/timer output as shown in *Figure 4.3*. Timers SV01T through SV40T in *Figure 4.3* have a settings range of 0.00–16000.00 seconds. This timer settings range applies to both pickup and dropout times (SV $n$ PU and SV $n$ DO,  $n = 1–40$ ).



**Figure 4.3 SELOGIC Control Equation Variable/Timers SV01/SV01T–SV40T**

You can enter as many as 15 elements per SELOGIC equation, including a total of 14 elements in parentheses (see *Table 4.4* for more information).

## SELOGIC Control Equation Operators

Use the Boolean operators to combine and evaluate Device Word bits. Combinations of AND, OR, NOT, and rising/falling triggers provide an easy way to customize annunciator operation. Alarm points can be triggered from many sources and Device Word bits can be summed using Boolean operators.

## Operator Precedence

When you combine several operators and operands within a single expression, the SEL-2533 evaluates the operators from left to right, starting with the highest precedence operators and working down to the lowest precedence. This means that if you write an equation with three AND operators, for example, SV01 AND SV02 AND SV03, each AND will be evaluated from the left to the right. If you substitute NOT SV04 for SV03 to make SV01 AND SV02 AND NOT SV04, the device evaluates the NOT operation of SV04 first and uses the result in subsequent evaluation of the expression.

**Table 4.4 SELOGIC Control Equation Operators (Listed in Operator Precedence)**

Operator	Function
( )	Parentheses
NOT	NOT
R_TRIGGER	Rising-edge trigger/detect
F_TRIGGER	Falling-edge trigger/detect
AND	AND
OR	OR

### Parentheses Operator ( )

You can use more than one set of parentheses in a SELOGIC control equation setting. For example, the following Boolean SELOGIC control equation setting has two sets of parentheses:

**SV04 := (SV04 OR IN\_A1) AND (IN\_A1 OR RB01)**

In the example above, the logic within the parentheses is processed first, and then the two parentheses resultants are ANDed together. Use as many as 14 sets of parentheses in a single SELOGIC control equation setting. The parentheses cannot be “nested” (parentheses within parentheses).

### Boolean NOT Operator (NOT)

Apply the NOT operator to a single Device Word bit and to multiple elements (within parentheses).

An example of a single Device Word bit is as follows:

**SV01:= NOT RB01**

When remote bit RB01 asserts from logical 0 to logical 1, the Boolean NOT operator, in turn, changes the logical 1 to a logical 0. In this example, SV01 deasserts when RB01 asserts.

The following is an example of the NOT operator applied to multiple elements within parentheses.

The Boolean SELOGIC control equation OUT101 setting can be set as follows:

**OUT101:= NOT(RB01 OR SV02)**

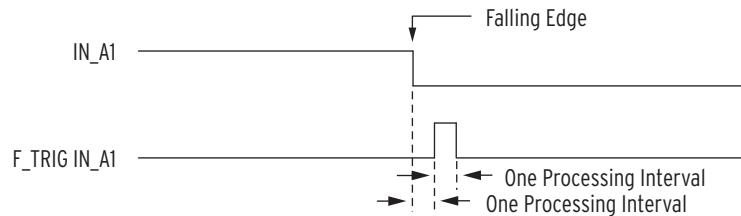
If both RB01 and SV02 are deasserted (= logical 0), output contact OUT101 asserts, i.e., OUT101 := NOT (logical 0 OR logical 0) = NOT (logical 0) = logical 1.

## Boolean Rising-Edge Operator (R\_TRIG)

Apply the rising-edge operator R\_TRIG to individual Device Word bits only; you cannot apply R\_TRIG to groups of elements within parentheses. When any Device Word bit asserts (going from logical 0 to logical 1), R\_TRIG interprets this logical 0 to logical 1 transition as a “rising edge” and asserts to logical 1 for one processing interval.

## Boolean Falling-Edge Operator (F\_TRIG)

Apply the falling-edge operator F\_TRIG to individual Device Word bits only; you cannot apply F\_TRIG to groups of elements within parentheses. F\_TRIG operates similarly to the rising-edge operator, but operates on Device Word bit deassertion (elements going from logical 1 to logical 0) instead of Device Word bit assertion. When the Device Word bit deasserts, F\_TRIG interprets this logical 1 to logical 0 transition as a “falling edge” and asserts to logical 1 for one processing interval, as shown in *Figure 4.4*.



**Figure 4.4 Result of Falling-Edge Operator on a Deasserting Input**

You can use the falling-edge operator with the NOT operator as long as the NOT operator precedes the F\_TRIG operator. The NOT F\_TRIG combination produces a logical 0 for one processing interval when it detects a falling edge on the specified element.

**Table 4.5 Other SELOGIC Control Equation Operators/Values**

Operator/ Value	Function
0	Sets SELOGIC control equation directly to logical 0 (XXX := 0)
1	Sets SELOGIC control equation directly to logical 1 (XXX := 1)
#	Characters entered after the # operator are not processed and deemed as comments
\	Indicates that the preceding logic should be continued on the next line (“\” is entered only at the end of a line)

## Timers Reset When Power Lost or Settings Changed

If the device loses power or if settings change, the SELOGIC control equation variables and timers reset. Device Word bits SV $n$  and SV $nT$  ( $n = 01$ –40) reset to logical 0 after power restoration or a settings change. *Figure 4.5* shows an effective seal-in logic circuit, created by the Device Word bit SV07 (SELOGIC control equation variable SV07) in SELOGIC control equation SV07:

$$\text{SV07} = (\text{SV07 OR OUT01}) \text{ AND } (\text{OUT02 OR OUT05})$$

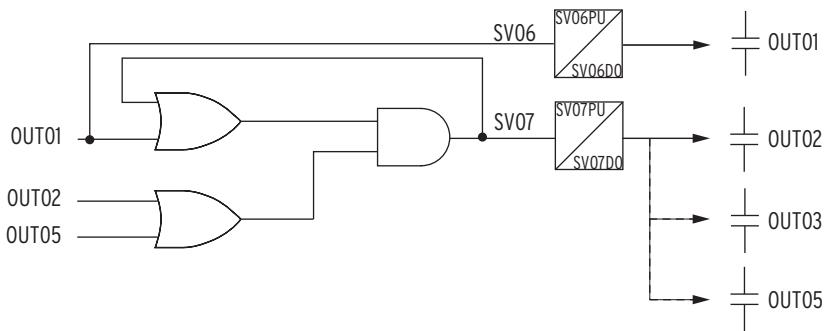


Figure 4.5 Example Use of SELogic Variables/Timers

## SV/Timers Settings

The SEL-2533 includes 40 SELogic variables. *Table 4.6* shows the pickup, dropout, and equation settings for SV01. The remaining SELogic variables have the same settings.

Table 4.6 SELogic Variable Settings

Setting Prompt	Setting Range	Default Settings
SV TIMER PICKUP	0.00–16000.00	SV01PU := 0.00
SV TIMER DROPOUT	0.00–16000.00	SV01DO := 0.00
SV INPUT EQ	SV	SV := NA
•	•	•
•	•	•
•	•	•

## Output Contacts

The SEL-2533 provides the ability to use SELogic control equations to map annunciator warnings and alarms and general-purpose control elements to the output, as shown in *Table 4.7*. You must enter an equation for the output settings. If you enter, for example, NA, then the device displays the message Output Contacts cannot be set to NA, and returns to the output setting. If you do not want to configure an output contact, then enter 0 as setting.

Table 4.7 Output Contacts

Setting Prompt	Setting Range	Default Settings
OUT01	SV	CR_ALM
OUT02	SV	NC_ALM
•	•	•
•	•	•
•	•	•

# Section 5

## Annunciator Sequences

---

### Overview

---

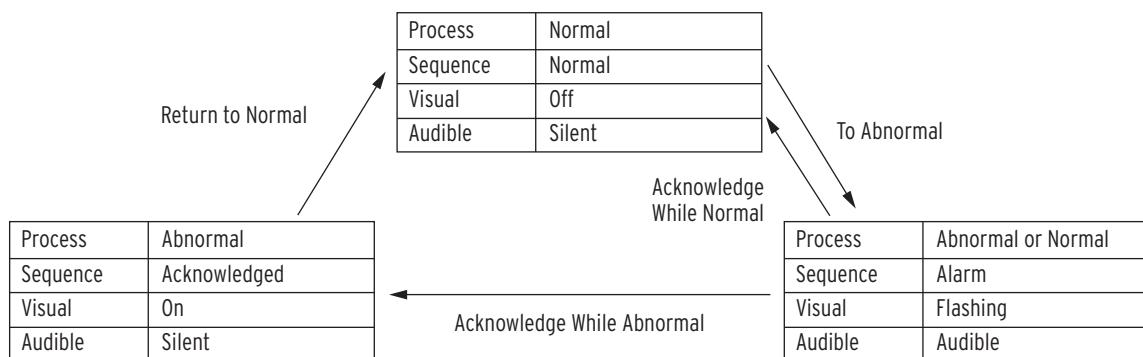
The SEL-2533 supports eight of the most popular ISA-18.1 Alarm Sequences: A, M, R, F1A, F1M, F2A, F2M, and F3A. The SEL-2533 also supports a custom sequence called T for target. This allows simple front-panel targeting with the assertion of an input.

The SEL-2533 is an excellent choice for alarm annunciation and event operation. The SEL-2533 indicates the status of as many as 10 inputs, and can be programmed to indicate as few or as many points as needed for each application. Multiple alarm panels can be used for high-density alarm applications. Field-configurable labels can be modified should the number or type of devices monitored change. A wide range of power supply and contact input voltages allow the SEL-2533 to be installed in virtually any system.

The SEL-2533 stores the current state of each alarm point in nonvolatile memory. If power is ever lost, the SEL-2533 will remember the current state of each alarm point and return to the last recorded state upon power up, and alarms recorded during events that cause power outages are maintained for post-event analysis.

The following nine figures show the nine alarm sequences supported by the SEL-2533. Each figure shows the flow diagram of the alarm through each sequence, indicating process, visual indication, audible output, and the present sequence state.

## Alarm Sequences



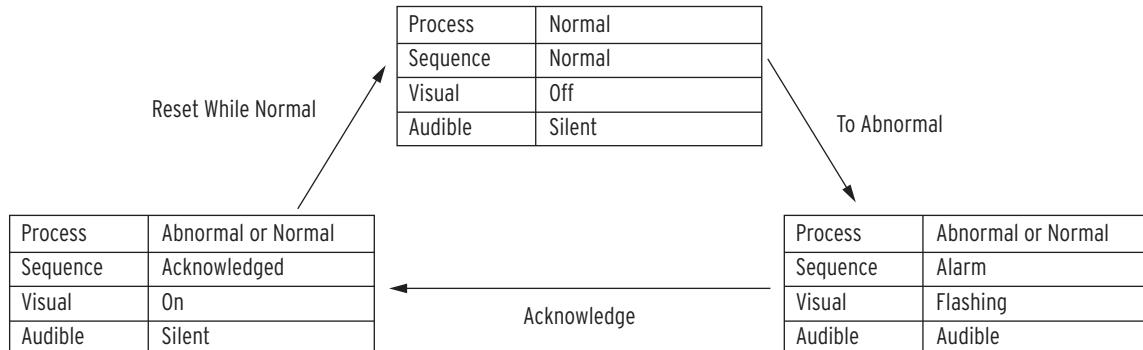
Copyright © 2004 – ISA. Used with permission of ISA. All rights reserved.

**Figure 5.1 Sequence A State Diagram**

**Table 5.1 Sequence A Table<sup>a</sup>**

Line	Process Condition	Pushbutton Operation	Sequence State	Visual Display	Audible Alarm Tone	Remarks
1	Normal	—	Normal	Off	Silent	
2	Abnormal	—	Alarm	Flashing	Audible	Latched
3a	Abnormal	Acknowledge	Acknowledge	On	Silent	Maintained Alarm
3b	Normal	Acknowledge	To Line 4			Momentary Alarm
4	Normal	—	Normal	Off	Silent	Automatic Reset

<sup>a</sup> Copyright © 2004 – ISA. Used with permission of ISA. All rights reserved.



Copyright © 2004 – ISA. Used with permission of ISA. All rights reserved.

**Figure 5.2 Sequence M State Diagram**

**NOTE:** Manual alarm silence adds a -1 to the sequence. Automatic alarm silence adds a -7 to the sequence.

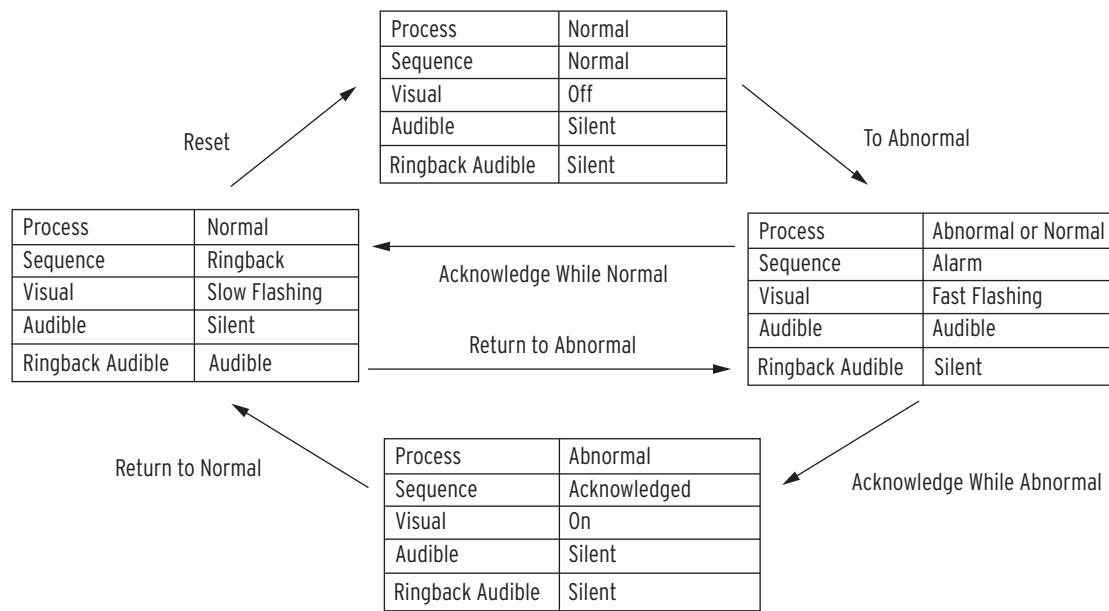
**Table 5.2 Sequence M Table<sup>a</sup> (Sheet 1 of 2)**

Line	Process Condition	Pushbutton Operation	Sequence State	Visual Display	Audible Alarm Tone	Remarks
1	Normal	—	Normal	Off	Silent	
2	Abnormal	—	Alarm	Flashing	Audible	Latched
3	Abnormal or Normal	Acknowledge	Acknowledge	On	Silent	Manual Reset

**Table 5.2 Sequence M Table<sup>a</sup> (Sheet 2 of 2)**

Line	Process Condition	Pushbutton Operation	Sequence State	Visual Display	Audible Alarm Tone	Remarks
<b>4a</b>	Abnormal	Reset			To Line 3	
<b>4b</b>	Normal	Reset	Normal	Off	Silent	Manual Reset

<sup>a</sup> Copyright © 2004 – ISA. Used with permission of ISA. All rights reserved.



Note: Ringback Audible and Alarm Audible Use the Same Internal Alarm Horn

#### Ringback Sequence Features

- 1) Acknowledge, Reset, and Test Pushbuttons
- 2) Alarm Audible Device
- 3) Lock-In of Momentary Alarms Until Acknowledged
- 4) Audible Device Is Silenced and Fast Flashing Stops When Acknowledged
- 5) Ringback Visual and Audible Indications When Process Conditions Return to Normal
- 6) Manual Reset of Ringback Indications
- 7) Operational Test

Copyright © 2004 – ISA. Used with permission of ISA. All rights reserved.

**Figure 5.3 Sequence R State Diagram**

**NOTE:** Manual alarm silence adds a -1 to the sequence. Automatic alarm silence adds a -7 to the sequence.

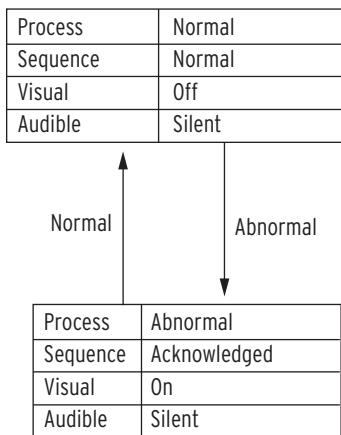
**Table 5.3 Sequence R Table<sup>a</sup> (Sheet 1 of 2)**

Line	Process Condition	Pushbutton Operation	Sequence State	Visual Display	Audible Alarm Tone	Ringback Audible Tone	Remarks
<b>1</b>	Normal	—	Normal	Off	Silent	Silent	
<b>2</b>	Abnormal	—	Alarm	Fast Flashing	Audible	Silent	Latched
<b>3a</b>	Abnormal	Acknowledge	Acknowledge	On	Silent	Silent	Maintained Alarm
<b>3b</b>	Normal	Acknowledge		To Line 4			Momentary Alarm

**Table 5.3 Sequence R Table<sup>a</sup> (Sheet 2 of 2)**

Line	Process Condition	Pushbutton Operation	Sequence State	Visual Display	Audible Alarm Tone	Ringback Audible Tone	Remarks
4	Normal	—	Ringback	Slow Flashing	Silent	Audible	Manual Reset Required
5	Abnormal	—	To Line 2				Return to Abnormal
6	Normal	Reset	Normal	Off	Silent	Silent	Manual Reset

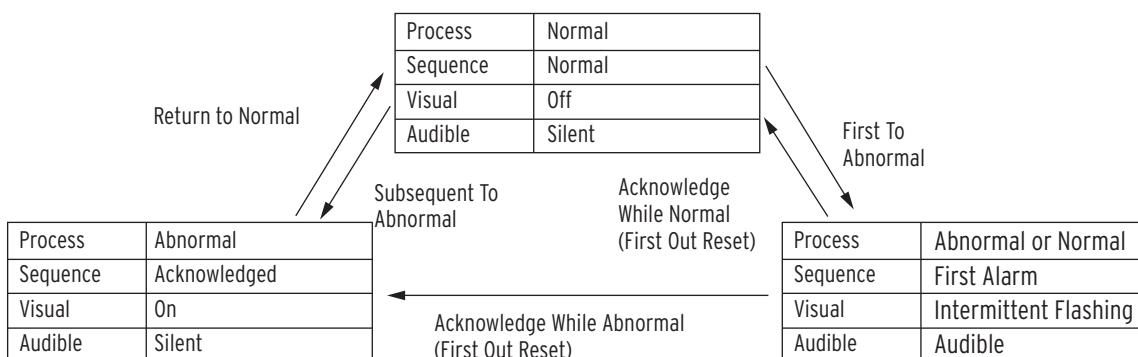
<sup>a</sup> Copyright © 2004 – ISA. Used with permission of ISA. All rights reserved.



**Figure 5.4 Sequence T State Diagram**

**Table 5.4 Sequence T Table**

Line	Process Condition	Pushbutton Operation	Sequence State	Visual Display	Audible Alarm Tone	Remarks
1	Normal	—	Normal	Off	Silent	
2	Abnormal	—	Acknowledge	On	Silent	Not Latched



Copyright © 2004 – ISA. Used with permission of ISA. All rights reserved.

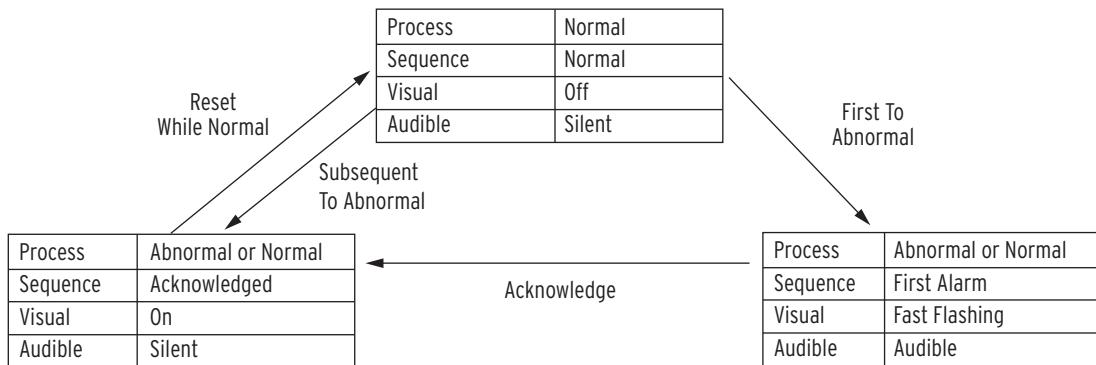
**Figure 5.5 Sequence F1A State Diagram**

**NOTE:** Manual alarm silence adds a -1 to the sequence. Automatic alarm silence adds a -7 to the sequence.

**Table 5.5 Sequence F1A Table<sup>a</sup>**

Line	Process Condition		Pushbutton Operation	Sequence State	Visual Display	Audible Alarm Tone	Remarks
1	Normal		—	Normal	Off	Silent	
2	First	Abnormal	—	First Alarm	Flashing	Audible	Latched
3	Sub.	Abnormal	—	Acknowledge	On	Silent	Not Latched
4a	First	Abnormal	Acknowledge	To Line 3			Maintained Alarm First Out Reset
4b	First	Normal	Acknowledge	To Line 5			Momentary Alarm First Out Reset
5	Normal		—	Normal	Off	Silent	Automatic Reset

<sup>a</sup> Copyright © 2004 – ISA. Used with permission of ISA. All rights reserved.



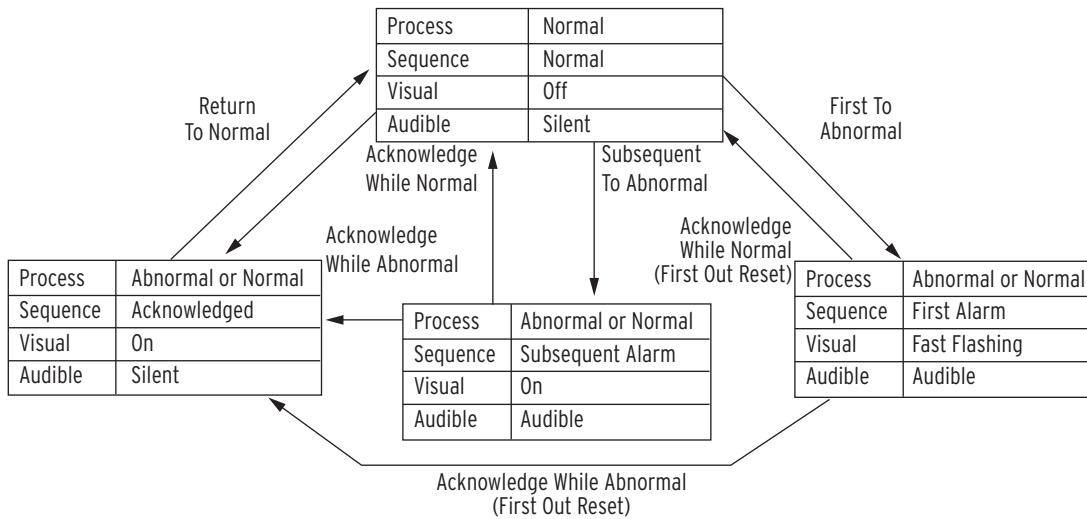
Copyright © 2004 – ISA. Used with permission of ISA. All rights reserved.

**Figure 5.6 Sequence F1M State Diagram**

**NOTE:** Manual alarm silence adds a -1 to the sequence. Automatic alarm silence adds a -7 to the sequence.

**Table 5.6 Sequence F1M Table**

Line	Process Condition		Pushbutton Operation	Sequence State	Visual Display	Audible Alarm Tone	Remarks
1	Normal		—	Normal	Off	Silent	
2	First	Abnormal	—	First Alarm	Flashing	Audible	Latched
3	Sub.	Abnormal	—	Acknowledge	On	Silent	Latched
4	First	Abnormal	Acknowledge	To Line 3			Maintained Alarm First Out Reset
5	Normal		Reset	To Line 6			Manual Reset
6	Normal		—	Normal	Off	Silent	Automatic Reset



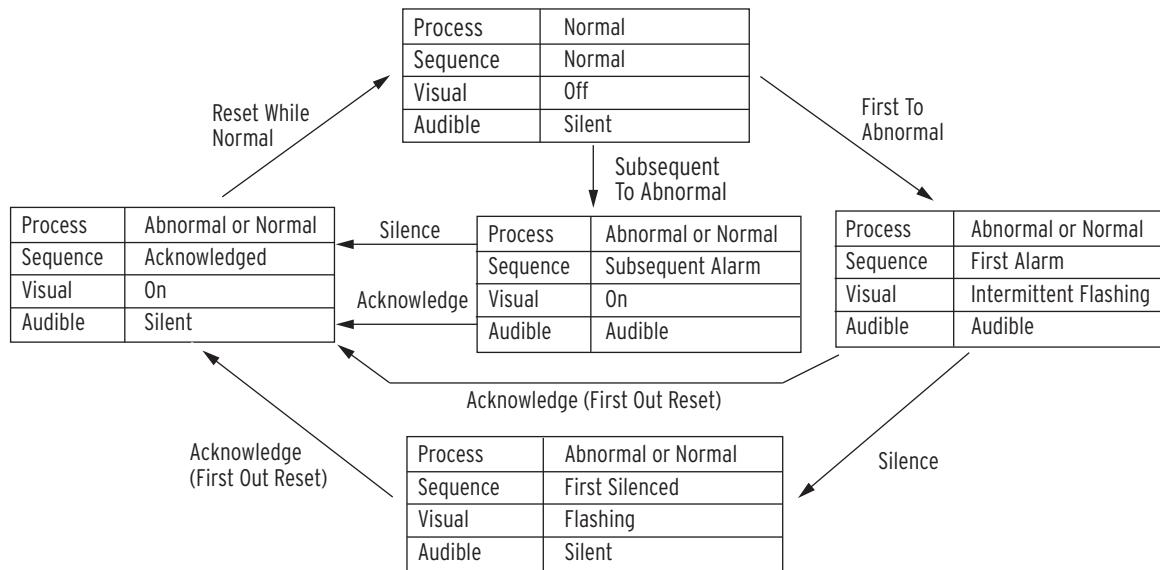
Copyright © 2004 – ISA. Used with permission of ISA. All rights reserved.

**Figure 5.7 Sequence F2A State Diagram**

**NOTE:** Manual alarm silence adds a -1 to the sequence. Automatic alarm silence adds a -7 to the sequence.

**Table 5.7 Sequence F2A Table**

Line	Process Condition		Pushbutton Operation	Sequence State	Visual Display	Audible Alarm Tone	Remarks
1	Normal		—	Normal	Off	Silent	
2	First	Abnormal	—	First Alarm	Flashing	Audible	Latched
3	Sub.	Abnormal	—	Subsequent Alarm	On	Audible	Latched
4a	First	Abnormal	Acknowledge	To Line 5a			First Out Reset
4b	First	Normal		To Line 6			
5a	Sub.	Abnormal		Acknowledge	On	Silent	Subsequent Reset
5b	Sub.	Normal		To Line 6			
6	Normal		Automatic Reset	Normal	Off	Silent	Manual Reset



Note: Ringback Audible and Alarm Audible Use the Same Internal Alarm Horn

#### Ringback Sequence Features

- 1) Acknowledge, Reset, and Test Pushbuttons
- 2) Alarm Audible Device
- 3) Lock-In of Momentary Alarms Until Acknowledged
- 4) Audible Device Is Silenced and Fast Flashing Stops When Acknowledged
- 5) Ringback Visual and Audible Indications When Process Conditions Return to Normal
- 6) Manual Reset of Ringback Indications
- 7) Operational Test

Copyright © 2004 – ISA. Used with permission of ISA. All rights reserved.

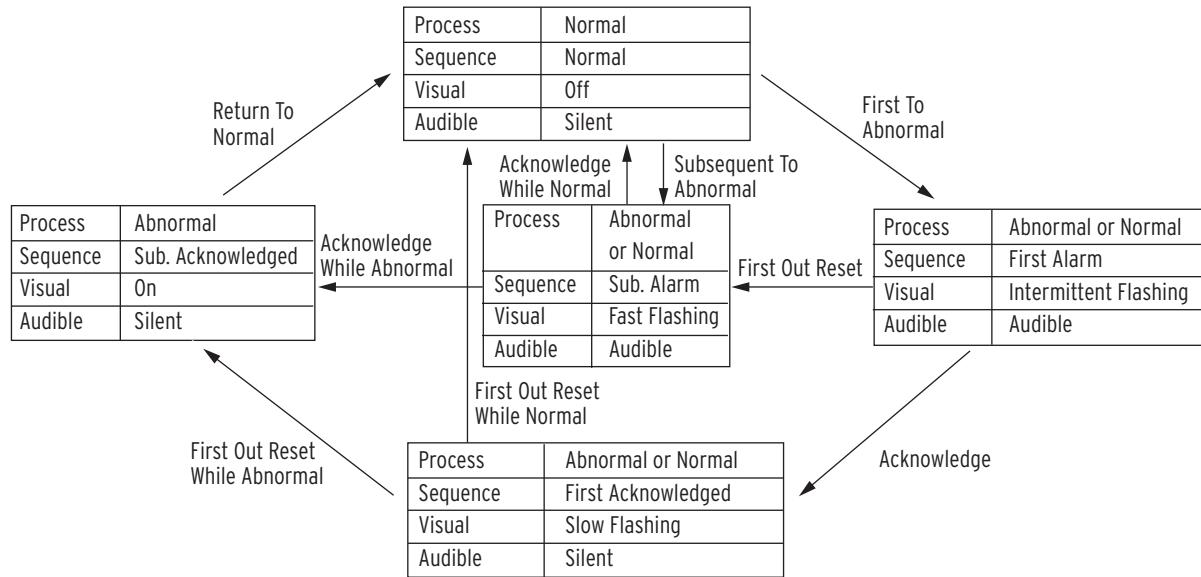
**Figure 5.8 Sequence F2M State Diagram (F2M Sequence Represented if You Remove Silence State)**

**NOTE:** Manual alarm silence adds a -1 to the sequence. Automatic alarm silence adds a -7 to the sequence.

**Table 5.8 Sequence F2M Table<sup>a</sup>**

Line	Process Condition		Pushbutton Operation	Sequence State	Visual Display	Audible Alarm Tone	Remarks
1	Normal		—	Normal	Off	Silent	
2	First	Abnormal	—	First Alarm	Intermittent Flashing	Audible	Latched
3	Sub.	Abnormal or Normal	—	Subsequent Alarm	On	Audible	Latched
4	First	Abnormal or Normal	Acknowledge	To Line 5			First Out Reset
5	Sub.	Abnormal or Normal	—	Acknowledge	On	Silent	
6	First	Abnormal or Normal	Silence	First Silenced	Flashing	Silent	
7	First	Abnormal or Normal	Acknowledge After Silence	To Line 5			First Out Reset
8	Normal		Reset	Normal	Off	Silent	Manual Reset

<sup>a</sup> Copyright © 2004 – ISA. Used with permission of ISA. All rights reserved.



Note: Ringback Audible and Alarm Audible Use the Same Internal Alarm Horn

#### Ringback Sequence Features

- 1) Acknowledge, Reset, and Test Pushbuttons
- 2) Alarm Audible Device
- 3) Lock-In of Momentary Alarms Until Acknowledged
- 4) Audible Device Is Silenced and Fast Flashing Stops When Acknowledged
- 5) Ringback Visual and Audible Indications When Process Conditions Return to Normal
- 6) Manual Reset of Ringback Indications
- 7) Operational Test

Copyright © 2004 – ISA. Used with permission of ISA. All rights reserved.

**Figure 5.9 Sequence F3A State Diagram**

**NOTE:** Manual alarm silence adds a -1 to the sequence. Automatic alarm silence adds a -7 to the sequence.

**Table 5.9 Sequence F3A Table<sup>a</sup> (Sheet 1 of 2)**

Line	Process Condition		Pushbutton Operation	Sequence State	Visual Display	Audible Alarm Tone	Remarks
1	Normal		—	Normal	Off	Silent	
2	First	Abnormal	—	First Alarm	Intermittent Flashing	Audible	Latched
3	Sub.	Abnormal	—	Subsequent Alarm	Fast Flashing	Audible	Latched
4	First	Abnormal or Normal	First Out Reset Before Acknowledge	To Line 3			First Out Reset
5	First	Abnormal or Normal	Acknowledge	First Acknowledged	Slow Flashing	Silent	First Out Reset Required
6A	Sub.	Abnormal		Sub. Acknowledge	On	Silent	Maintained Alarm
6B	Sub.	Normal		To Line 8			Momentary Alarm

**Table 5.9 Sequence F3A Table<sup>a</sup>** (Sheet 2 of 2)

Line	Process Condition		Pushbutton Operation	Sequence State	Visual Display	Audible Alarm Tone	Remarks
7A	First	Abnormal	First Out Reset After Acknowledge	To Line 6A		First Out Reset	
7B	First	Normal		To Line 8		First Out Reset	
8	Normal		—	Normal	Off	Silent	Automatic Reset

<sup>a</sup> Copyright © 2004 – ISA. Used with permission of ISA. All rights reserved.

## Sequence State Flow Diagrams

*Figure 5.1 through Figure 5.9* show the standard alarm sequences that come in the SEL-2533. All of these sequences, except sequence T, follow the ISA-18.1 standard for Annunciator Sequences and Specifications. The SEL-2533 supports the more popular sequences found in this standard. The ISA sequence M is the most common sequence and is the default sequence on the SEL-2533. The manual sequence is commonly used to alert personnel of any abnormal processes with audible and visual alerts. Once in this state, the user must acknowledge the alarm. Acknowledging the alarm will cause the audible to go silent and the LED to remain on. The SEL-2533 will remain in this state until the process has returned to normal and the user has reset the alarm. The acknowledge and reset of alarm points can be issued by the following three different actions:

- Front-panel pushbuttons
- External contact wired to one of the inputs
- Communications channels such as DNP, Modbus®, or Fast Operate

Refer to the ISA-18.1 standard for more information on the definitions of each process. Defined below is a list of the process conditions and how they relate to the operation of the SEL-2533.

### Process: Normal or Abnormal

The process refers to the current condition of an alarm point using a standard input contact as the state of the process. If the input is energized, the process is abnormal; if the input is de-energized, the process is normal. Most traditional alarm annunciators use contact inputs to relay process information as normal or abnormal. The SEL-2533 is much more advanced and flexible, and allows the processes to come in from a contact input, Device Word bit, or communications protocol. This is all accomplished with the logic that is included with the SEL-2533. This logic allows you to create an alarm point using Boolean logic to accomplish any task (see *Table 4.4* for a description of available Boolean operators).

### Sequence

The sequence identifies the alarm state. The possible values for sequence vary according to which sequence is used. The sequence is only used for state identification. The names used for the sequence are dependent on the current state of the alarm and acknowledge point.

### Visual

The visual indication can have several states, as defined in the ISA-18.1 alarm sequences. The visual indication on the SEL-2533 is found on the front-panel alarm LEDs. The front-panel alarm LED will illuminate when the

corresponding alarm triggers. The LED has states such as ON, OFF, flashing, fast flashing, intermittent flashing, and slow flashing, depending on the alarm sequence selected.

The fast flashing rate is two flashes per second. The slow flashing rate is one flash per second. Intermittent flashing will flash twice the first second following a one-second delay.

## Audible

The audible indication is an alarm tone produced on certain alarm states. The alarm tone has different tones to indicate different alarm conditions. The SEL-2533 also offers several ways to externally wire horns to the annunciator to produce a louder audible indication.

The alarm tone produces a rising alarm tone that cycles every two and a half seconds. The ringback audible tone produces a short tone every ten seconds.

# Default Alarm Sequence Routing

The SEL-2533 is shipped preprogrammed to work as a traditional annunciator. The default alarm points are set to the type M manual sequence, and every alarm point corresponds to the correct front-panel LED. For example, digital input A1 is configured to trigger alarm point A1 on the front panel. The alarms are all set as critical alarms and routed to output OUT01. The diagram below shows how the logic is routed for the default settings in the SEL-2533.

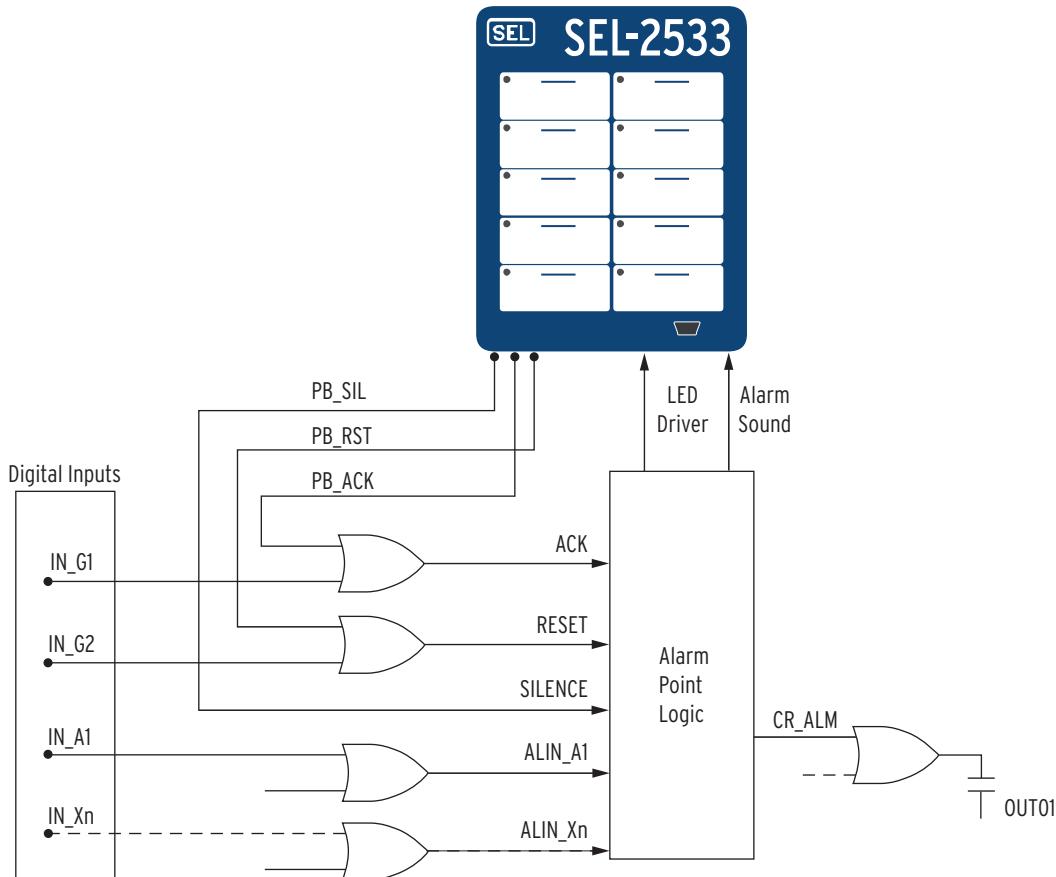


Figure 5.10 Default Logic Routing

The three alarm acknowledge functions needed in an annunciator are Acknowledge (ACK), Reset (RESET), and Silence (SIL). One or all of these will be applicable, depending on which sequence is used (see *Table 5.1* through *Table 5.9*). The SEL-2533 is set to the manual sequence by default. The manual sequence only uses the Acknowledge and Reset functions.

As shown in *Figure 5.10*, there are two ways to Acknowledge (ACK logic equation) and two ways to Reset (RESET logic equation) an alarm point. The pushbuttons on the front panel of the SEL-2533 perform the first method of alarm acknowledgement. When the user presses the ACK pushbutton it will trigger the Device Word bit PB\_ACK to assert. The PB\_ACK bit will run through the OR gate and through the logic equation ACK, thus telling the manual alarm sequence that any currently triggered alarm point has been acknowledged. A second path digital input IN\_G1 is set to assert the ACK equation when the digital input is asserted. This is very useful when an external switch is required. The logic equation for these two equations is as follows:

```
ACK := PB_ACK OR IN_G1
RESET := PB_RST OR IN_G2
```

The alarm points are all triggered by the logic equations corresponding to the alarm point. In *Figure 5.10*, the digital input IN\_A1 is connected to ALIN\_A1. This direct setting will trigger alarm point A1 when digital input A1 is asserted. The input IN\_Xn corresponds to the entire series of digital inputs IN\_A1 through IN\_E2 and alarm point input ALIN\_Xn corresponds to alarm point series ALIN\_A1 through ALIN\_E2. This means that, by default, all digital inputs are routed to the corresponding alarm points. If alarm input IN\_A1 is asserted, then the alarm point A1 will trigger. The following are the default logic equations for the alarm points:

```
ALIN_A1 := IN_A1
ALIN_A2 := IN_A2
ALIN_A3 := IN_B1
•
•
•
ALIN_F6 := IN_E2
```

The output of the annunciator is typically an output contact used to drive an external horn or flasher, or to alert another device. The default logic will automatically route all alarms to output contact OUT01.

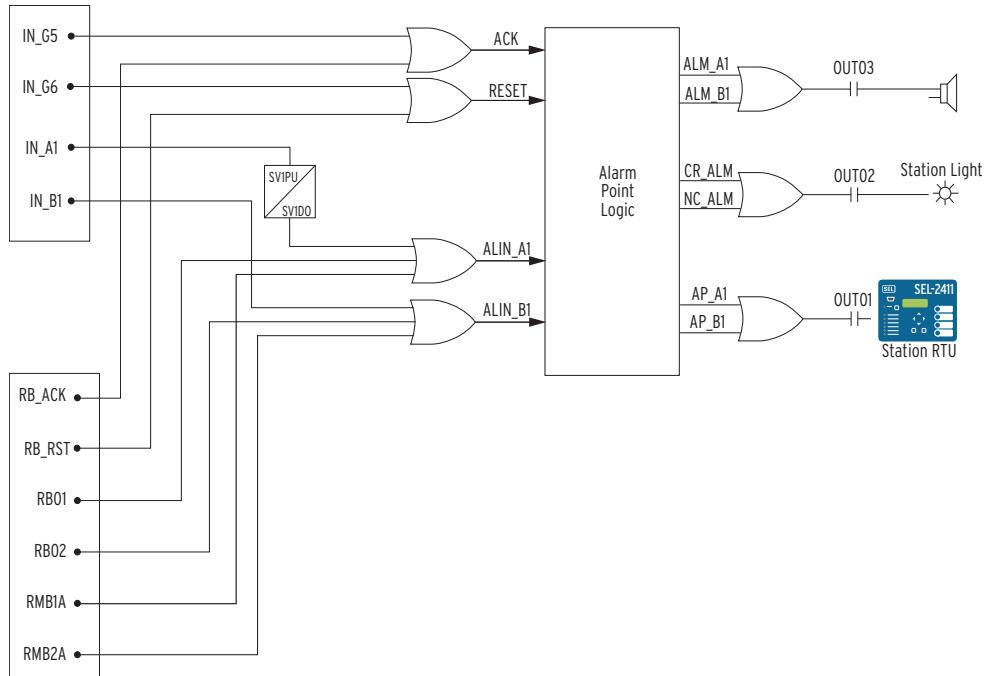
Each alarm point output is a Device Word bit labeled AP\_A1 through AP\_E2. When alarm point A1 changes to abnormal, Device Word bit AP\_A1 asserts. In order to group these alarm points easily, we included a setting called GR1\_TYPE set as either a critical or noncritical alarm group. If it is set to critical, then all of the alarm point outputs will automatically get routed to a Device Word bit called CR\_ALM. All of the alarms are set as a critical alarms by default.

The output equation in *Figure 5.11* is set to close upon any critical alarm point assertion.

```
OUT01 := CR_ALM
```

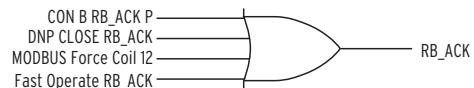
# Advanced Announcer Logic Routing

The ACK and RESET equations used in the previous example show triggering from front-panel pushbuttons or from a contact. *Figure 5.11* shows an advanced example of different methods of triggering the ACK, RESET, and alarm points through Device Word bits available in the SEL-2533. The RB\_ACK and RB\_RST Remote bits allow you to acknowledge and reset an alarm from various communications devices. *Figure 5.11* demonstrates each method used in triggering the ACK, RESET, and alarm point inputs.



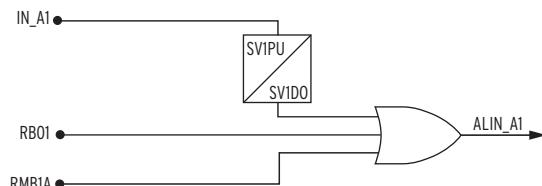
**Figure 5.11 Example of Advanced Announcer Logic Routing**

*Figure 5.12* shows four ways to remotely trigger RB\_ACK through communications. Using any of these routes will cause the ACK equation to assert.



**Figure 5.12 RB\_ACK Trigger Options**

*Figure 5.13* shows three different ways to trigger an alarm point. We used a standard input in the default example. In this example we use an input and Device Word bits to trigger the alarm. *Figure 5.13* shows the logic that drives ALIN\_A1.



**Figure 5.13 ALIN\_A1 Logic**

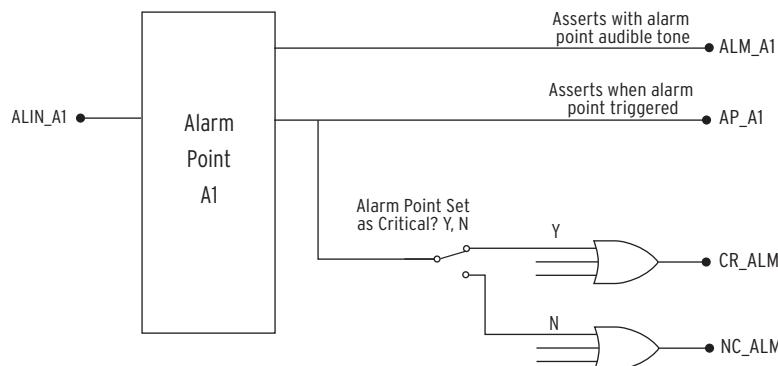
The first path to ALIN\_A1 is a standard input, though in the example above it is routed through a timer circuit. Timers are very useful for connecting to devices that false-assert for short periods of time. The timer rides through the false alarm and will only assert when a true alarm condition exists.

The second path is connected to Device Word bit RB01. This is a control bit that remotely triggers using various protocols. RB01 operates in the same manner as RB\_ACK, as shown in *Figure 5.12*. You can use Modbus, DNP, or Fast Operate to trigger RB01, which asserts the ALIN\_A1 equation.

The third path uses Device Word bit RMB1A. RMB1A is a Device Word bit that is used with MIRRORED BITS® communications. MIRRORED BITS is a device-to-device communications protocol used to quickly transfer the status of eight bits of information. See *Appendix F: MIRRORED BITS Communications* for more information. If an SEL-2505 or SEL-2411 detects an alarm condition remotely, it can transfer that information to the SEL-2533 using MIRRORED BITS and trigger RMB1A.

The SEL-2533 has three different types of outputs for each alarm point. These different outputs allow you to use various types of external equipment to alert personnel of an alarm condition. The routing of the following alarm points are illustrated below.

- AP\_A1 standard alarm triggered condition
- ALM\_A1 simulating an external speaker device
- CR\_ALM, NC\_ALM set to route through critical or non-critical alarms, depending on setting



**Figure 5.14** Alarm Point Logic Outputs

**This page intentionally left blank**

# Section 6

## Settings

---

### Overview

---

The SEL-2533 Annunciator stores the settings entered in nonvolatile memory. Settings are divided into the following six settings classes:

- Group
- Logic
- Global
- Port  $p$  (where  $p = F, 2, 3$ , or  $4$ )
- Report
- DNP

Some setting classes have multiple instances. In the list above, there are four port settings instances, one for each port. Settings may be viewed and set two ways, as shown in *Table 6.1*.

**Table 6.1 Methods of Accessing Settings**

	<b>Serial Port Commands<sup>a</sup></b>	<b>AcSELERATOR QuickSet® SEL-5030 Software<sup>b</sup></b>
<b>Display Settings</b>	All settings (SHO command)	All settings
<b>Change Settings</b>	All settings (SET command)	All settings

<sup>a</sup> Refer to Section 7: Communications for detailed information on set-up and use of the serial communications port.

<sup>b</sup> Refer to Section 3: PC Software for detailed information.

Settings entry error messages with corrective actions are also presented in this section to assist in correct settings entry.

The *SEL-2533 Settings Sheets* at the end of this section list all SEL-2533 settings, settings definitions, and input ranges. Refer to *Section 4: Logic Functions* for detailed information on individual elements and settings.

# View/Change Settings Over Communications Port

Refer to *Section 7: Communications* for information on how to set up and access the device serial port with a PC, as well as how to use ASCII commands to communicate with the device.

## View Settings

Use the **SHOW** command to view device settings. The **SHOW** command is available from Access Level 1 and Access Level 2. *Table 6.2* lists **SHOW** command options.

**Table 6.2 SHO Command Options**

Command	Description	Access Level
<b>SHO</b>	Show device settings	1
<b>SHO L</b>	Show logic settings	1
<b>SHO G</b>	Show global settings	1
<b>SHO P n</b>	Show serial port settings, <i>n</i> specifies either <b>PORT F</b> or <b>PORT 2</b> through <b>PORT 4</b> ; defaults to the active port if not listed	1
<b>SHO R</b>	Show report settings such as Sequential Events Recorder (SER)	1
<b>SHO DNP</b>	Show DNP3 settings	1

You may append a setting name to each of the commands to specify the first setting to display (e.g., **SHO GR1\_SEQ** displays the device settings, starting with setting **GR1\_SEQ**). The default is the first setting. The **SHOW** command displays only enabled settings.

## Enter Settings

The **SET** command (available from Access Level 2) allows you to view or change settings. *Table 6.3* lists **SET** command options.

**Table 6.3 SET Command**

Command	Description	Access Level
<b>SET</b>	Set device settings	2
<b>SET L</b>	Set logic settings	2
<b>SET G</b>	Set global settings	2
<b>SET P n</b>	Set serial port settings, depending on the device configuration, <i>n</i> specifies either <b>PORT F</b> or <b>PORT 2</b> through <b>PORT 4</b> ; defaults to the active port if not listed	2
<b>SET R</b>	Set SER report settings	2
<b>SET DNP</b>	Set DNP3 settings	2

You may append a setting name to each of the commands to specify the first setting to display (e.g., **SET GR1\_SEQ** displays the device settings starting with setting **GR1\_SEQ**). The default is the first setting.

When you issue the **SET** command, the device presents a list of settings. Enter a new setting, or press **<Enter>** to accept the existing setting. Editing keystrokes are listed in *Table 6.4*.

**Table 6.4 SET Command Editing Keystrokes**

Press Key(s)	Results
<Enter>	Retains the setting and moves to the next setting
^ <Enter>	Returns to the previous setting
< <Enter>	Returns to the previous setting category
> <Enter>	Moves to the next setting category
END <Enter>	Exits the editing session, then prompts you to save the settings
<Ctrl+X>	Aborts the editing session without saving changes

## Setting Entry Error Messages

---

As you enter device settings, the device checks the settings entered against the range for the settings as published on the device settings sheet. If any setting entered falls outside the corresponding range for that setting, the device immediately responds *Out of Range* and prompts you to reenter the setting.

Several settings have interdependency checks with other settings in addition to the immediate range check. The device checks settings interdependencies after Y is entered at the *Save Settings?* prompt, but before the settings are stored. If any of these checks fail, the device issues an error message and returns to the settings list for correction.

## Device Settings (SET Command)

---

Under the device settings category, set the device and terminal identifiers pertaining to the annunciator alarm sequence settings. The SEL-2533 displays the Device and Terminal Identifier strings at the top of the responses to serial port commands, identifying messages from individual devices. Enter as many as 16 characters, including capital letters A–Z, numbers 0–9, periods (.), dashes (-), and spaces. *Table 6.5* shows device and terminal identifiers settings.

**Table 6.5 Device and Terminal Identifiers**

Setting Prompt	Setting Range	Setting Name := Factory Default
Device ID	16 Characters	DID := SEL-2533
Terminal ID	16 Characters	TID := DEVICE

### Alarm Group Settings

The SEL-2533 comes standard with four groups of alarm sequences. The user can set any of the nine alarm sequences to any of the four alarm groups. Each alarm group has settings for any of the 10 individual alarm points.

**Table 6.6 Alarm Group Settings**

Setting Prompt	Setting Range	Setting Name <sup>a</sup> := Factory Default
Number of Alarm Groups	1–4	EALG := 1
Alarm Sequence	A,M,R,T,F1A,F1M,F2A,F2M,F3A	GRx_SEQ := M
Critical Alarm <sup>b</sup>	Y, N	GRx_TYPE := Y
Alarm Point List	A1–E2, NONE	GRx_ALPT := A1–E2

<sup>a</sup> x = 1–4 depending on EALG setting.

<sup>b</sup> Critical Alarm setting routes the alarm points to CR\_ALM and NC\_ALM device Word Bits and also sets the LED color. See below for more information.

The EALG setting enables the number of alarm groups needed (the default is one), and enables the settings in alarm group 1 shown in *Table 6.6*. If the EALG setting is set to > 1, then the next sequence of alarm group settings will enable.

Each of the four enabled alarm groups will have a setting for the alarm sequence, the critical alarm, and the alarm point list. The alarm sequence setting GRx\_SEQ identifies which alarm sequences is used in the alarm panel. See *Section 5: Announcer Sequences* for more information on available alarm sequences and flow diagrams.

The GRx\_TYPE setting makes the alarm group points into a critical or non-critical alarm type. Alarms are grouped into critical and noncritical alarms. If you set the GR1\_TYPE to Y, all alarm points in that group will automatically cause assertion of Device Word bit CR\_ALM. This Device Word bit makes it easy to group alarm points and set them directly to any of the available output contacts. If the GR1\_TYPE is set to N, the annunciator will group all alarm points into Device Word bit NC\_ALM. The Device Word bit can trigger an output contact or be sent through SCADA. In addition to setting the alarm points to Critical and Non-Critical this will set the LED color on the front. If the alarm point is set to Critical then the LED will illuminate red when alarmed. If the alarm point is set to Non-Critical then the LED will illuminate amber when alarmed.

The alarm point setting GRx\_ALPT assigns as many as 10 alarm points to the alarm group. GRx\_ALPT can be set with commas or ranges for the alarm point list. The points must be entered in order from left to right and top to bottom. Once you set an alarm point to an alarm point list it cannot be used in other alarm groups. An alarm point can only be set to one sequence. The following are some examples of possible alarm point lists:

- ▶ GR1\_ALPT := A1–B2, C1, C2, D1–D2
- ▶ GR2\_ALPT := E1–E2

## Global Settings (SET G Command)

Use the **SET G** serial command to access the Global settings category. In Global settings, we set the messenger points, date format, debounce times for each input, time-synchronization source, and internal alarm enable.

## General Settings

**Table 6.7 General Global Settings**

Setting Prompt	Setting Range	Setting Name := Factory Default
Date Format	MDY, YMD, DMY	DATE_F := MDY
Enable Internal Alarm	Y, N	ALM_EN := Y

The DATE\_F setting allows you to change the device date presentation format to either North American standard (Month/Day/Year), engineering standard (Year/Month/Day), or European standard (Day/Month/Year).

The ALM\_EN settings enables the internal piezo inside the SEL-2533. The default is set to Yes. When set to Y, the internal piezo will sound through set alarm sequences when an alarm point is triggered or acknowledged. This setting can be set to N if the internal piezo is not needed or an external alarm horn is preferred.

## Time-Synchronization Source

This setting is only available when the device configuration includes a fiber-optic port. Use the Time-Synchronization Source setting to declare the source of the IRIG input. The SEL-2411 accepts IRIG-B input from either **PORT 2** or **PORT 3**. If the IRIG-B source is **PORT 3**, select **IRIG1** as the setting. If the IRIG-B source is **Port 2** (fiber-optic port), select **IRIG2** as the setting.

**Table 6.8 Time Synchronization Source Setting**

Setting Prompt	Setting Range	Setting Name := Factory Default
IRIG Time Source	IRIG1, IRIG2	TIME_SRC := IRIG1

## Digital Input Debounce

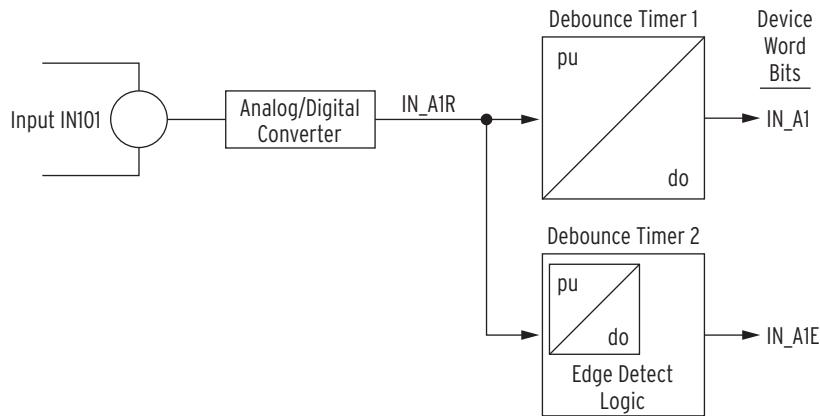
To comply with different control voltages, the SEL-2533 offers dc debounce as well as ac debounce modes. Therefore, if the control voltage is dc, select the dc mode of operation, and if the control voltage is ac, select the ac mode of operation. In general, debounce refers to a qualifying time delay before processing the change of state of a digital input. Normally, this delay applies to both the processing of the debounced input when used in device logic, as well as to the time stamping in the SER. In some cases, it is also important to record the time of the first assertion of the input. This information is useful for time-aligning events from two unsynchronized devices when one device operates on receipt of the output from the other device. To this end, the SEL-2533 provides both the time of the first assertion information as well as the delayed time information as separate Device Word bits when set to the dc debounce mode.

The SEL-2533 comes with a standard global debounce enable setting: EICIS. EICIS is set to Yes by default, which allows the debounce of all inputs to be set with one setting: IN\_GLD. IN\_GLD will automatically set all the inputs debounce modes. *Table 6.9* shows these and all debounce settings. The following shows both modes the debounce time can be set to in order to properly condition the input.

### DC Mode Processing (DC Control Voltage)

*Figure 6.1* shows the logic for the dc debounce mode of operation. To select the dc mode of debounce, set IN\_A1D to any number between 0 and 65000 ms. In the figure, input IN\_A1 becomes IN\_A1R (internal variable), after analog-to-digital conversion. On assertion, IN\_A1R starts Debounce Timer 1, producing Device Word bit IN\_A1 after the debounce time delay, and Device Word bit IN\_A1E from the edge detect logic. The debounce timer is a pickup/dropout combination timer, with debounce setting IN\_A1D applying to both

pickup and dropout timers of both Debounce Timer 1 and Debounce Timer 2, i.e., you cannot set any timer individually. For example, a setting of IN\_A1D := 20 ms delays processing of the input signal by 20 ms pickup and maintains the output of the timer dropout for 20 ms. Device Word bit IN\_A1 is the output of the debounce timer. If you do not want to debounce a particular input, use Device Word bit IN\_A1 in logic programming, but set the debounce time delay to 0 (IN\_A1D := 0).



**Figure 6.1 DC Mode Processing**

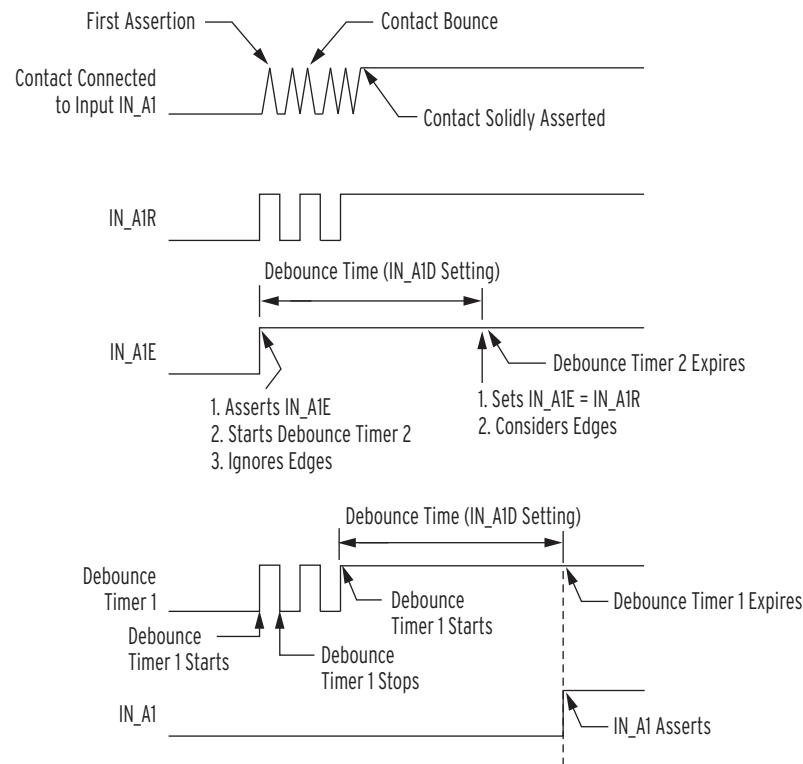
Figure 6.2 shows the timing diagram when IN\_A1R changes from the deasserted state to the asserted state. At the first assertion of IN\_A1R, the following takes place:

- Device Word bit IN\_A1E asserts
- Debounce Timer 2 starts
- All edge changes are ignored

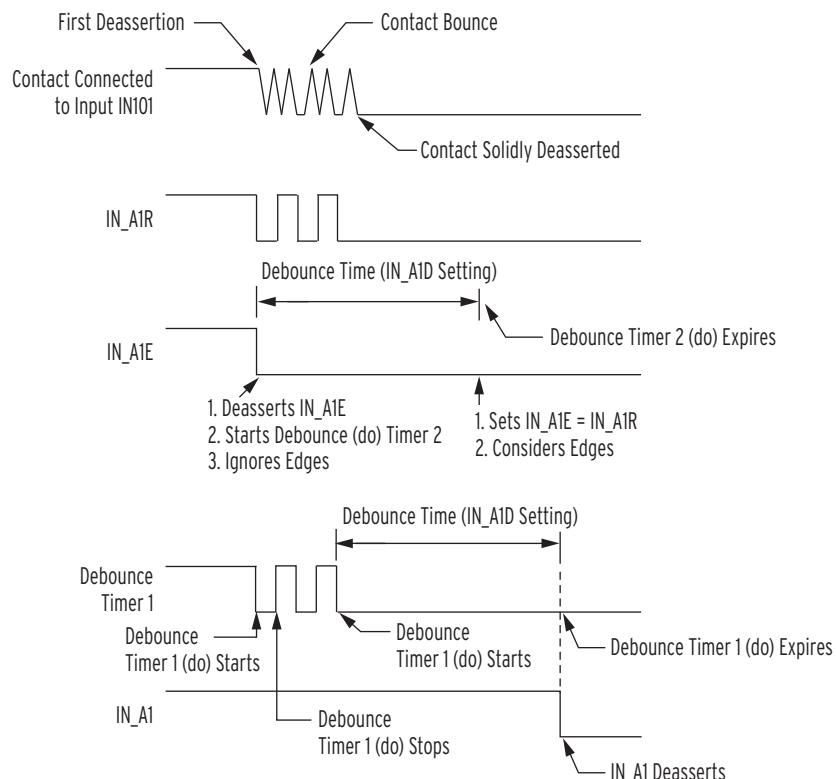
If you want to record the time of first assertion of IN\_A1, be sure to enter Device Word bit IN\_A1E in the SER (see *Report Settings (SET R Command)*). During the time when Debounce Timer 2 runs, the device ignores all edge changes. At the end of this timing period, the device evaluates the status of IN\_A1R (either logical 0 or logical 1), and sets Device Word bit IN\_A1E to this value. In Figure 6.2, IN\_A1R has a status of logical 1 and Device Word bit IN\_A1E remains at logical 1.

Device Word bit IN\_A1 asserts only if IN\_A1R stays asserted for the complete duration of Debounce Timer 1. If IN\_A1R deasserts at any point while Debounce Timer 1 is running, Debounce Timer 1 resets, and starts timing from the beginning at the next rising edge.

When changing from the asserted state to the deasserted state, the inverse operation applies, as shown in Figure 6.3.



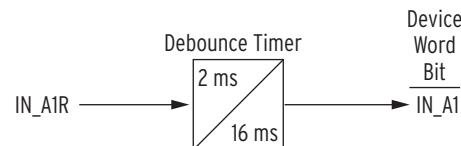
**Figure 6.2 Timing Diagram When IN\_A1R Changes From the Deasserted State to the Asserted State**



**Figure 6.3 Timing Diagram When Input IN\_A1 Changes From the Asserted State to the Deasserted State**

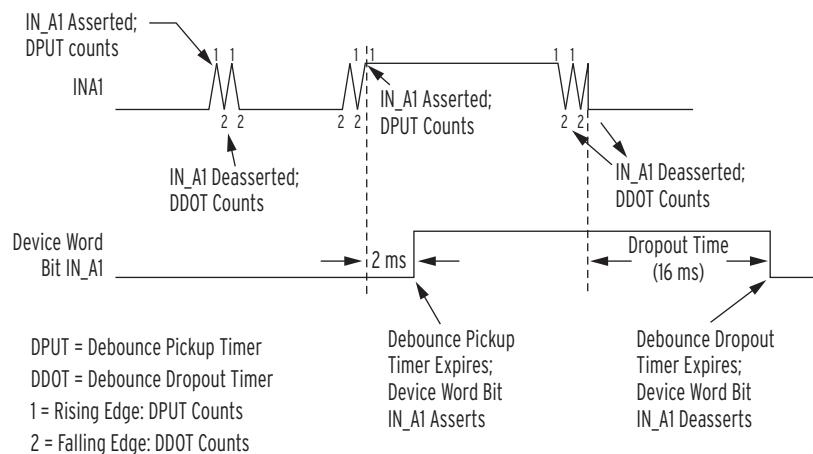
## AC Mode Processing (AC Control Voltage)

*Figure 6.5* shows IN\_A1R from input IN\_A1 applied to a pickup/dropout timer. Only the delayed time information is available in ac mode. There are also no time settings for the debounce timer in ac mode: the pickup time delay is fixed at 2 ms, and the dropout time is fixed at 16 ms. Device Word bit IN\_A1 is the output of the debounce timer. To select the ac mode of debounce, set IN\_A1D := AC.



**Figure 6.4 AC Mode Processing**

On the rising edge of IN\_A1R, the pickup timer starts timing (points marked 1 in *Figure 6.5*). If IN\_A1R deasserts (points marked 2 in *Figure 6.5*) before expiration of the pickup time setting, Device Word bit IN\_A1 does not assert, and remains at logical 0. If, however, IN\_A1R remains asserted for a period longer than the pickup timer setting, then Device Word bit IN\_A1 asserts to a logical 1.



**Figure 6.5 Timing Diagram for Debounce Timer Operation When Operating in AC Mode**

Deassertion follows the same logic. On the falling edge of IN\_A1R, the dropout timer starts timing. If IN\_A1R remains deasserted for a period longer than the dropout timer setting, then the Device Word bit IN\_A1 deasserts to a logical 0.

*Table 6.9* shows the settings prompt, setting range, and factory default settings for input debounce timers.

**Table 6.9 General Global Settings (Sheet 1 of 2)**

Setting Prompt	Setting Range	Setting Name <sup>a</sup> := Factory Default
Enable Independent Control of Input Setting	Y, N	EICIS := N
Global Input Debounce	AC, 0–20000 ms	IN_GLD := 10
IN_A1–IN_A2 Debounce	AC, 0–20000 ms	IN_AxD := 10
IN_B1–IN_B2 Debounce	AC, 0–20000 ms	IN_BxD := 10

**Table 6.9 General Global Settings (Sheet 2 of 2)**

Setting Prompt	Setting Range	Setting Name <sup>a</sup> := Factory Default
IN_C1-IN_C2 Debounce	AC, 0–20000 ms	IN_CxD := 10
IN_D1-IN_D2 Debounce	AC, 0–20000 ms	IN_DxD := 10
IN_E1-IN_E2 Debounce	AC, 0–20000 ms	IN_ExD := 10
IN_F1-IN_F2 Debounce	AC, 0–20000 ms	IN_FxD := 10
IN_G1_IN_G2 Debounce	AC, 0–20000 ms	IN_GxD := 10

<sup>a</sup> x = 1–2.

## Event Messenger Points

**NOTE:** The SEL-3010 is obsolete and no longer available to order.

The SEL-2533 can be configured to automatically send an ASCII message on a communications port when trigger conditions are satisfied. Use the **SET P** command to set PROTO := EVMSG on the desired port. This feature is designed to send messages to the SEL-3010 Event Messenger, however any device capable of receiving ASCII messages can be used.

**Table 6.10 Event Messenger Points**

Setting Prompt	Setting Range	Setting Name := Factory Default
MESSENGER POINTS ENABLE	N, 1–32	EMP := 2
MESSENGER POINT TRIGGER	Off, 1 Device Word bit	MPTR01 := CR_ALM
MESSENGER POINT TEXT	148 Characters	MPTX01 := Critical alarm has occurred
MESSENGER POINT TRIGGER	Off, 1 Device Word bit	MPTR02 := NC_ALM
MESSENGER POINT TEXT	148 Characters	MPTX02 := Non-critical alarm has occurred

**NOTE:** When Event Messenger points are selected for the desired port, all other communications on the selected port are disabled.

Set MPTR $x$  ( $x = 1$ –32) to the desired Device Word bits. The rising edge defines the trigger condition. Trigger conditions for Event Messenger points are updated every five seconds.

## Port Settings (SET P Command)

---

The SEL-2533 provides settings that allow you to configure parameters for the communications ports. See *Section 7: Communications* for detailed description of port connections. On the base unit, **PORt F** (front panel) and **PORt 3** (rear) are EIA-232 ports. **PORt 2** is an optional fiber-optic serial port (rear). On the optional communications card you can select EIA-485 or EIA-232 functionality (not both) by means of the COMMNF setting for **PORt 4**. (see *Communications Card (SELECT EIA-232/485) on page 2.3*). *Table 6.12*, *Table 6.13*, and *Table 6.14* show the port settings ranges and default settings for **PORt F**, **PORt 2**, **PORt 3**, and **PORt 4**.

Set the speed, data bits, parity, and stop bits settings to match the serial port configuration of the equipment that is communicating with the serial port. After port timeout inactivity on a serial port at Access Level 2, the port automatically returns to Access Level 0. This security feature helps prevent unauthorized access to the device settings if the device is accidentally left in Access Level 2. If you do not want the port to time out, set Port Timeout equal to 0 minutes (T\_OUT := 0).

Set the AUTO := Y to allow automatic messages at a serial port. The device EIA-232 serial ports support software (XON/XOFF) flow control. If you want to enable support for hardware (RTS/CTS) flow control, set the RTSCTS setting equal to Y.

Set FASTOP := Y to enable binary Fast Operate messages at the serial port.

Set FASTOP := N to block binary Fast Operate messages.

## Default Port Settings and Ranges

---

### PORt F

**Table 6.11 Front-Panel Serial Port Settings**

Setting Prompt	Setting Range	Setting Name := Factory Default
Speed	300–38400 bps	SPEED := 9600
Data Bits	7, 8 bits	BITS := 8
Parity	O, E, N	PARITY := N
Stop Bits	1, 2 bits	STOP := 1
Enable Hardware Handshaking	Y, N	RTSCTS := N
Minutes to Port Time-Out	0–30 min	T_OUT := 5
Send Automessages to Port	Y, N	AUTO := N
Fast Operate Enable	Y, N	FASTOP := Y

**PORT 2****Table 6.12 Rear-Panel Fiber-Optic Serial (Multimode) Port Settings**

<b>Setting Prompt</b>	<b>Setting Range</b>	<b>Setting Name := Factory Default</b>
Enable Port	Y, N	EPORT := Y
Protocol	SEL, DNP, MOD, MBA, MBB, MB8A, MB8B, EVMSG	PROTO := SEL
Speed	300–38400 bps	SPEED := 9600
Data Bits	7, 8 bits	
Parity	O, E, N	PARITY := N
Stop Bits	1, 2 bits	STOP := 1
Enable Hardware Handshaking	Y, N	RTSCTS := N
Minutes to Port Time-Out	0–30 min	T_OUT := 5
Send Automessages to Port	Y, N	AUTO := N
Fast Operate Enable	Y, N	FASTOP := Y

**PORT 3****Table 6.13 Rear-Panel Serial Port (EIA-232) Settings**

<b>Setting Prompt</b>	<b>Setting Range</b>	<b>Setting Name := Factory Default</b>
Enable Port	Y, N	EPORT := Y
Protocol	SEL, DNP, MOD, MBB, MB8A, MB8B, EVMSG	PROTO := SEL
Speed	300–38400 bps	SPEED := 9600
Data Bits	7, 8 bits	
Parity	O, E, N	PARITY := N
Stop Bits	1, 2 bits	STOP := 1
Enable Hardware Handshaking	Y, N	RTSCTS := N
Minutes to Port Time-Out	0–30 min	T_OUT := 5
Send Automessages to Port	Y, N	AUTO := N
Fast Operate Enable	Y, N	FASTOP := Y

**PORT 4****Table 6.14 Rear-Panel Serial Port (EIA-232/EIA-485) Settings(Sheet 1 of 2)**

<b>Setting Prompt</b>	<b>Setting Range</b>	<b>Setting Name := Factory Default</b>
Enable Port	Y, N	EPORT := Y
Protocol	SEL, DNP, MOD, MBA, MBB, MB8A, MB8B, EVMSG	PROTO := SEL
Comm Interface	232, 485	COMMINF := 232
Speed	300–38400 bps	SPEED := 9600
Data Bits	7, 8 bits	
Parity	O, E, N	PARITY := N
Stop Bits	1, 2 bits	STOP := 1
Enable Hardware Handshaking	Y, N	RTSCTS := N
Minutes to Port Time-Out	0–30 min	T_OUT := 5

**Table 6.14 Rear-Panel Serial Port (EIA-232/EIA-485) Settings(Sheet 2 of 2)**

<b>Setting Prompt</b>	<b>Setting Range</b>	<b>Setting Name := Factory Default</b>
Send Automessages to Port	Y, N	AUTO := N
Fast Operate Enable	Y, N	FASTOP := Y

## Report Settings (SET R Command)

---

Report settings use Device Word bits for the SER trigger as shown in *Table 6.15*. See *Appendix G: Device Word Bits* for more information.

### Automatic Deletion and Reinsertion

The SER includes an automatic deletion and reinsertion function to prevent overfilling the SER buffer with chattering information. The device checks the Device Word bits in the four SER reports for any changes of state at each processing interval. When detecting a change of state, the device adds a record to the SER report containing the Device Word bit(s), new state, time stamp, and checksum (see *Section 9: Analyzing SER Events* for more information).

Upon detecting oscillating SER items, the device automatically deletes these oscillating items from SER recording. *Table 6.15* shows autoremoval settings.

**Table 6.15 Auto-Removal Settings**

<b>Settings Prompt</b>	<b>Setting Range</b>	<b>Setting Name := Factory Default</b>
Auto-Removal Enable	Y, N	ESERDEL := N
Number of Counts	2–20	SRDLCNT := 5
Removal Time	0.1–90.0 s	SRDLTIM := 1.0

To use the automatic deletion and reinsertion function, proceed with the following steps:

Step 1. Set report setting ESERDEL (Enable SER Delete) to Y.

Step 2. Select values for the setting SRDLCNT (SER Delete Count) and the setting SRDLTIM (SER Delete Time) that mask the chattering SER element.

Setting SRDLTIM declares a time interval during which the device qualifies an input by comparing the changes of state of each input against the SRDLCNT setting. When an item changes state more than SRDLCNT times in an SRDLTIM interval, the device automatically removes these Device Word bits from the SER recording. Once deleted from the recording, the item(s) will be ignored for the next nine intervals. At the ninth interval, the chatter criteria will again be checked and, if the point does not exceed the criteria, it will automatically be reinserted into the recording at the starting of the tenth interval. The user can enable or disable the autodelete function via SER settings. Any autodeletion notice entry will be lost during settings changes.

### SER Trigger Lists

To capture element state changes in the SER report, enter the Device Word bit into one of the four SER (SER1 through SER4) trigger equations. Each of the four programmable trigger equations allow entry of as many as 24 Device

Word bits separated by spaces or commas. The SER report accepts a total of 96 Device Word bits. *Table 6.16* shows the settings prompt and default settings for the four SER trigger equations.

**Table 6.16 SER<sup>a</sup> Trigger Settings**

Setting Prompt	Setting Name := Factory Default
SER1	SER1 := SIL ACK RESET
SER2	SER2 := ALIN_A1 ALIN_A2 ALIN_B1 ALIN_B2 ALIN_C1 ALIN_C2 ALIN_D1 ALIN_D2 ALIN_E1 ALIN_E2
SER3	SER3 := AP_A1 AP_A2 AP_B1 AP_B2 AP_C1 AP_C2 AP_D1 AP_D2 AP_E1 AP_E2
SER4	SER4 := NA

<sup>a</sup> Use as many as 24 Device Word elements separated by spaces or commas for each setting.

## Relay Word Bit Aliases

**Table 6.17 Enable Alias Settings**

Setting Prompt	Setting Range	Setting Name := Factory Default
Enable ALIAS Settings (N, 1–96)	N, 1–96	EALIAS := 3

To simplify review of the information displayed in the SER record, the annunciator provides the Alias setting function. The Alias settings change the way device elements listed in the SER settings above are displayed in the report. The Alias settings can also allow the text displayed to change when a particular element is asserted and deasserted. The annunciator permits as many as 96 unique aliases, as defined by the Enable Alias Settings (EALIAS) setting. Factory default alias settings are shown in *Table 6.18*.

Define the enabled alias settings by entering the Device Word bit name, a space, the desired alias, a space, the text to display when the condition asserts, a space, and the text to display when the condition deasserts.

---

ALIAS1 = ACK ACKNOWLEDGE ON OFF

---

See *Table G.1* for the complete list of Device Word bits. Use as many as 15 characters to define the alias, asserted text, and deasserted text strings. You can use capital letters (A–Z), numbers (0–9), and the underscore character (\_) within each string. Do not attempt to use a space in a string, as the annunciator will interpret a space as a break between two strings. If you wish to clear a string, type NA.

**Table 6.18 SET R SER Alias Settings**

Setting Prompt	Relay Word Bit	Alias	Asserted Text	Deasserted Text
ALIAS1 :=	ACK	ACKNOWLEDGE	ON	OFF
ALIAS2 :=	RESET	RESET	ON	OFF
ALIAS3 :=	SIL	SILENCE	ON	OFF
ALIAS4– ALIAS96	NA			

**This page intentionally left blank**

# SEL-2533 Settings Sheets

These settings sheets include the definition and input range for each setting in the relay. You can access the settings from the relay front panel and the serial ports. Some of the settings ranges may be more restrictive than shown, because of settings interdependency checks performed when new settings are saved. The settings are not case sensitive.

## Device Settings (SET Command)

### Device Settings

Device Identification (16 characters)

**DID** := \_\_\_\_\_

Terminal ID (16 characters)

**TID** := \_\_\_\_\_

### Alarm Settings

Number of Alarm Groups

**EALG** := \_\_\_\_\_

### Alarm Group 1

Group 1 Alarm Sequence (A, M, R, T, F1A, F1M, F2A, F2M, F3A)

**GR1\_SEQ** := \_\_\_\_\_

Group 1 Critical Alarm (Y, N)

**GR1\_TYPE** := \_\_\_\_\_

Group 1 Alarm Point List (A1–E2, NONE)

**GR1\_ALPT** := \_\_\_\_\_

### Alarm Group 2

Group 2 Alarm Sequence (A, M, R, T, F1A, F1M, F2A, F2M, F3A)

**GR2\_SEQ** := \_\_\_\_\_

Group 2 Critical Alarm (Y, N)

**GR2\_TYPE** := \_\_\_\_\_

Group 2 Alarm Point List (A1–E2, NONE)

**GR2\_ALPT** := \_\_\_\_\_

### Alarm Group 3

Group 3 Alarm Sequence (A, M, R, T, F1A, F1M, F2A, F2M, F3A)

**GR3\_SEQ** := \_\_\_\_\_

Group 3 Critical Alarm (Y, N)

**GR3\_TYPE** := \_\_\_\_\_

Group 3 Alarm Point List (A1–E2, NONE)

**GR3\_ALPT** := \_\_\_\_\_

### Alarm Group 4

Group 4 Alarm Sequence (A, M, R, T, F1A, F1M, F2A, F2M, F3A)

**GR4\_SEQ** := \_\_\_\_\_

Group 4 Critical Alarm (Y, N)

**GR4\_TYPE** := \_\_\_\_\_

Group 4 Alarm Point List (A1–E2, NONE)

**GR4\_ALPT** := \_\_\_\_\_

# Logic Settings (SET L Command)

## SELOGIC Enables

Enable Independent Alarm Settings (Y, N)

**EIAS** := \_\_\_\_\_

SELOGIC Latches (N, 1–32)

**ELAT** := \_\_\_\_\_

SELOGIC Variables/Timers (N, 1–40)

**ESV** := \_\_\_\_\_

## Alarm Points

Alarm Point Input A1

**ALIN\_A1** := \_\_\_\_\_

Alarm Point Input A2

**ALIN\_A2** := \_\_\_\_\_

Alarm Point Input B1

**ALIN\_B1** := \_\_\_\_\_

Alarm Point Input B2

**ALIN\_B2** := \_\_\_\_\_

Alarm Point Input C1

**ALIN\_C1** := \_\_\_\_\_

Alarm Point Input C2

**ALIN\_C2** := \_\_\_\_\_

Alarm Point Input D1

**ALIN\_D1** := \_\_\_\_\_

Alarm Point Input D2

**ALIN\_D2** := \_\_\_\_\_

Alarm Point Input E1

**ALIN\_E1** := \_\_\_\_\_

Alarm Point Input E2

**ALIN\_E2** := \_\_\_\_\_

## Alarm Acknowledge

Silence

**SIL** := \_\_\_\_\_

Acknowledge

**ACK** := \_\_\_\_\_

Reset

**RESET** := \_\_\_\_\_

Test

**TEST** := \_\_\_\_\_

## Latch Bit Set/Reset Equations

**SET01** := \_\_\_\_\_

**RST01** := \_\_\_\_\_

**SET02** := \_\_\_\_\_

**RST02** := \_\_\_\_\_

**SET03** := \_\_\_\_\_

**RST03** := \_\_\_\_\_

**SET04** := \_\_\_\_\_

**RST04** := \_\_\_\_\_

**SET05** := \_\_\_\_\_

**RST05** := \_\_\_\_\_

**SET06** := \_\_\_\_\_

**RST06** := \_\_\_\_\_  
**SET07** := \_\_\_\_\_  
**RST07** := \_\_\_\_\_  
**SET08** := \_\_\_\_\_  
**RST08** := \_\_\_\_\_  
**SET09** := \_\_\_\_\_  
**RST09** := \_\_\_\_\_  
**SET10** := \_\_\_\_\_  
**RST10** := \_\_\_\_\_  
**SET11** := \_\_\_\_\_  
**RST11** := \_\_\_\_\_  
**SET12** := \_\_\_\_\_  
**RST12** := \_\_\_\_\_  
**SET13** := \_\_\_\_\_  
**RST13** := \_\_\_\_\_  
**SET14** := \_\_\_\_\_  
**RST14** := \_\_\_\_\_  
**SET15** := \_\_\_\_\_  
**RST15** := \_\_\_\_\_  
**SET16** := \_\_\_\_\_  
**RST16** := \_\_\_\_\_  
**SET17** := \_\_\_\_\_  
**RST17** := \_\_\_\_\_  
**SET18** := \_\_\_\_\_  
**RST18** := \_\_\_\_\_  
**SET19** := \_\_\_\_\_  
**RST19** := \_\_\_\_\_  
**SET20** := \_\_\_\_\_  
**RST20** := \_\_\_\_\_  
**SET21** := \_\_\_\_\_  
**RST21** := \_\_\_\_\_  
**SET22** := \_\_\_\_\_  
**RST22** := \_\_\_\_\_  
**SET23** := \_\_\_\_\_  
**RST23** := \_\_\_\_\_  
**SET24** := \_\_\_\_\_  
**RST24** := \_\_\_\_\_  
**SET25** := \_\_\_\_\_

RST25 := \_\_\_\_\_  
SET26 := \_\_\_\_\_  
RST26 := \_\_\_\_\_  
SET27 := \_\_\_\_\_  
RST27 := \_\_\_\_\_  
SET28 := \_\_\_\_\_  
RST28 := \_\_\_\_\_  
SET29 := \_\_\_\_\_  
RST29 := \_\_\_\_\_  
SET30 := \_\_\_\_\_  
RST30 := \_\_\_\_\_  
SET31 := \_\_\_\_\_  
RST31 := \_\_\_\_\_  
SET32 := \_\_\_\_\_  
RST32 := \_\_\_\_\_

## SELOGIC Variable/Timer Settings

SELOGIC Variable Input (SV)	SV01 := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	SV01PU := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	SV01DO := _____
SELOGIC Variable Input (SV)	SV02 := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	SV02PU := _____
SELOGIC Variable Timer Dropout (0.000–16000.000 s)	SV02DO := _____
SELOGIC Variable Input (SV)	SV03 := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	SV03PU := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	SV03DO := _____
SELOGIC Variable Input (SV)	SV04 := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	SV04PU := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	SV04DO := _____
SELOGIC Variable Input (SV)	SV05 := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	SV05PU := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	SV05DO := _____
SELOGIC Variable Input (SV)	SV06 := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	SV06PU := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	SV06DO := _____
SELOGIC Variable Input (SV)	SV07 := _____

SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV07PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV07DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV08</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV08PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV08DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV09</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV09PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV09DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV10</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV10PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV10DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV11</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV11PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV11DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV12</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV12PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV12DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV13</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV13PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV13DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV14</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV14PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV14DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV15</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV15PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV15DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV16</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV16PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV16DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV17</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV17PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV17DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV18</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV18PU</b> := _____

SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV18DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV19</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV19PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV19DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV20</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV20PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV20DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV21</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV21PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV21DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV22</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV22PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV22DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV23</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV23PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV23DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV24</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV24PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV24DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV25</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV25PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV25DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV26</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV26PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV26DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV27</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV27PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV27DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV28</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV28PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV28DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV29</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV29PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV29DO</b> := _____

SELOGIC Variable Input (SV)	<b>SV30</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV30PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV30DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV31</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV31PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV31DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV32</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV32PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV32DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV33</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV33PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV33DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV34</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV34PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV34DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV35</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV35PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV35DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV36</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV36PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV36DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV37</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV37PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV37DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV38</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV38PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV38DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV39</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV39PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV39DO</b> := _____
SELOGIC Variable Input (SV)	<b>SV40</b> := _____
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	<b>SV40PU</b> := _____
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	<b>SV40DO</b> := _____

## Output SELOGIC Equations

OUT01 := \_\_\_\_\_  
OUT02 := \_\_\_\_\_  
OUT03 := \_\_\_\_\_  
OUT04 := \_\_\_\_\_  
OUT05 := \_\_\_\_\_  
OUT06 := \_\_\_\_\_  
OUT07 := \_\_\_\_\_  
OUT08 := \_\_\_\_\_  
OUT09 := \_\_\_\_\_  
OUT10 := \_\_\_\_\_  
OUT11 := \_\_\_\_\_  
OUT12 := \_\_\_\_\_  
OUT13 := \_\_\_\_\_  
OUT14 := \_\_\_\_\_  
OUT15 := \_\_\_\_\_

## MIRRORED BITS

TMB1A := \_\_\_\_\_  
TMB2A := \_\_\_\_\_  
TMB3A := \_\_\_\_\_  
TMB4A := \_\_\_\_\_  
TMB5A := \_\_\_\_\_  
TMB6A := \_\_\_\_\_  
TMB7A := \_\_\_\_\_  
TMB8A := \_\_\_\_\_  
TMB1B := \_\_\_\_\_  
TMB2B := \_\_\_\_\_  
TMB3B := \_\_\_\_\_  
TMB4B := \_\_\_\_\_  
TMB5B := \_\_\_\_\_  
TMB6B := \_\_\_\_\_  
TMB7B := \_\_\_\_\_  
TMB8B := \_\_\_\_\_

# Global Settings (SET G Command)

---

## General Settings

Date Format (MDY, YMD, DMY)

**DATE\_F** := \_\_\_\_\_

Enable Internal Alarm (Y, N)

**ALM\_EN** := \_\_\_\_\_

## Time Synchronization Source

IRIG Time Source (IRIG1, IRIG2)

**TIME\_SRC** := \_\_\_\_\_

## Global Input Debounce Settings

Enable Independent Control of Input Settings (Y, N)

**EICIS** := \_\_\_\_\_

Global Input Debounce (AC, 0–20000 ms)

**IN\_GLD** := \_\_\_\_\_

## Input Debounce Settings

Input A1 Debounce (AC, 0–20000 ms)

**IN\_A1D** := \_\_\_\_\_

Input A2 Debounce (AC, 0–20000 ms)

**IN\_A2D** := \_\_\_\_\_

Input B1 Debounce (AC, 0–20000 ms)

**IN\_B1D** := \_\_\_\_\_

Input B2 Debounce (AC, 0–20000 ms)

**IN\_B2D** := \_\_\_\_\_

Input C1 Debounce (AC, 0–20000 ms)

**IN\_C1D** := \_\_\_\_\_

Input C2 Debounce (AC, 0–20000 ms)

**IN\_C2D** := \_\_\_\_\_

Input D1 Debounce (AC, 0–20000 ms)

**IN\_D1D** := \_\_\_\_\_

Input D2 Debounce (AC, 0–20000 ms)

**IN\_D2D** := \_\_\_\_\_

Input E1 Debounce (AC, 0–20000 ms)

**IN\_E1D** := \_\_\_\_\_

Input E2 Debounce (AC, 0–20000 ms)

**IN\_E2D** := \_\_\_\_\_

Input F1 Debounce (AC, 0–20000 ms)

**IN\_F1D** := \_\_\_\_\_

Input F2 Debounce (AC, 0–20000 ms)

**IN\_F2D** := \_\_\_\_\_

Input G1 Debounce (AC, 0–20000 ms)

**IN\_G1D** := \_\_\_\_\_

Input G2 Debounce (AC, 0–20000 ms)

**IN\_G2D** := \_\_\_\_\_

## Event Messenger Points

MESSENGER POINTS ENABLE (N, 1-32)

**EMP** := \_\_\_\_\_

MESSENGER POINT TRIGGER (Off, 1 Device Word bit)

**MPTR01** := \_\_\_\_\_

MESSENGER POINT TEXT (148 characters)

**MPTX01** := \_\_\_\_\_

MESSENGER POINT TRIGGER (Off, 1 Device Word bit)

**MPTR02** := \_\_\_\_\_

MESSENGER POINT TEXT (148 characters)

**MPTX02** := \_\_\_\_\_

MESSENGER POINT TRIGGER (Off, 1 Device Word bit)

**MPTR03** := \_\_\_\_\_

MESSENGER POINT TEXT (148 characters)	<b>MPTX03</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR04</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX04</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR05</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX05</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR06</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX06</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR07</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX07</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR08</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX08</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR09</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX09</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR10</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX10</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR11</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX11</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR12</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX12</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR13</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX13</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR14</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX14</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR15</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX15</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR16</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX16</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR17</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX17</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR18</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX18</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR19</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX19</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR20</b> := _____

MESSENGER POINT TEXT (148 characters)	<b>MPTX20</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR21</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX21</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR22</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX22</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR23</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX23</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR24</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX24</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR25</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX25</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR26</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX26</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR27</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX27</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR28</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX28</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR29</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX29</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR30</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX30</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR31</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX31</b> := _____
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	<b>MPTR32</b> := _____
MESSENGER POINT TEXT (148 characters)	<b>MPTX32</b> := _____

# Port Settings (SET P Command)

## Port F

Baud Rate (300 to 38400 bps)	<b>SPEED</b> := _____
Data Bits (7, 8 bits)	<b>BITS</b> := _____
Parity (O, E, N)	<b>PARITY</b> := _____
Stop Bits (1, 2 bits)	<b>STOP</b> := _____
Enable Hardware Handshaking (Y, N)	<b>RTSCTS</b> := _____
Minutes to Port Timeout (1–30 min)	<b>T_OUT</b> := _____
Send Auto Messages to Port (Y, N)	<b>AUTO</b> := _____
Fast Operate Enable (Y, N)	<b>FASTOP</b> := _____

## Port 2

Enable Port (Y, N)	<b>EPORT</b> := _____
Protocol (SEL, DNP, MOD, MBA, MBB, MB8A, MB8B, EVMSG)	<b>PROTO</b> := _____
Baud Rate (300 to 38400 bps)	<b>SPEED</b> := _____
Data Bits (7, 8 bits)	<b>BITS</b> := _____
Parity (O, E, N)	<b>PARITY</b> := _____
Stop Bits (1, 2 bits)	<b>STOP</b> := _____
Enable Hardware Handshaking (Y, N)	<b>RTSCTS</b> := _____
Minutes to Port Timeout (1–30 min)	<b>T_OUT</b> := _____
Send Auto Messages to Port (Y, N)	<b>AUTO</b> := _____
Fast Operate Enable (Y, N)	<b>FASTOP</b> := _____

## Port 3

Enable Port (Y, N)	<b>EPORT</b> := _____
Protocol (SEL, DNP, MOD, MBA, MBB, MB8A, MB8B, EVMSG)	<b>PROTO</b> := _____
Baud Rate(300 to 38400 bps)	<b>SPEED</b> := _____
Data Bits (7, 8 bits)	<b>BITS</b> := _____
Parity (O, E, N)	<b>PARITY</b> := _____
Stop Bits (1, 2 bits)	<b>STOP</b> := _____
Enable Hardware Handshaking (Y, N)	<b>RTSCTS</b> := _____
Minutes to Port Timeout (1–30 min)	<b>T_OUT</b> := _____

Send Auto Messages to Port (Y, N)

**AUTO** := \_\_\_\_\_

Fast Operate Enable (Y, N)

**FASTOP** := \_\_\_\_\_

## Port 4

Enable Port (Y, N)

**EPORT** := \_\_\_\_\_

Communication Interface (232, 485)

**COMMINF** := \_\_\_\_\_Protocol (SEL, DNP, MOD, MBA, MBB, MB8A, MB8B,  
EVMSG)**PROTO** := \_\_\_\_\_

Baud Rate (300 to 38400 bps)

**SPEED** := \_\_\_\_\_

Data Bits (7, 8 bits)

**BITS** := \_\_\_\_\_

Parity (O, E, N)

**PARITY** := \_\_\_\_\_

Stop Bits (1, 2 bits)

**STOP** := \_\_\_\_\_

Enable Hardware Handshaking (Y, N)

**RTSCTS** := \_\_\_\_\_

Minutes to Port Timeout (1–30 min)

**T\_OUT** := \_\_\_\_\_

Send Auto Messages to Port (Y, N)

**AUTO** := \_\_\_\_\_

Fast Operate Enable (Y, N)

**FASTOP** := \_\_\_\_\_

## MIRRORED BITS

MB Transmit Identifier (1–4)

**TXID** := \_\_\_\_\_

MB Receive Identifier (1–4)

**RXID** := \_\_\_\_\_

MB RX Bad Pickup Time (0–10000 s)

**RBADPU** := \_\_\_\_\_

PPM MB Channel Bad Pickup (1–10000)

**CBADPU** := \_\_\_\_\_

MB Receive Default State (8 characters)

**RXDFLT** := \_\_\_\_\_

RMB1 Pickup Debounce Messages (1–8)

**RMB1PU** := \_\_\_\_\_

RMB1 Dropout Debounce Messages (1–8)

**RMB1DO** := \_\_\_\_\_

RMB2 Pickup Debounce Messages (1–8)

**RMB2PU** := \_\_\_\_\_

RMB2 Dropout Debounce Messages (1–8)

**RMB2DO** := \_\_\_\_\_

RMB3 Pickup Debounce Messages (1–8)

**RMB3PU** := \_\_\_\_\_

RMB3 Dropout Debounce Messages (1–8)

**RMB3DO** := \_\_\_\_\_

RMB4 Pickup Debounce Messages (1–8)

**RMB4PU** := \_\_\_\_\_

RMB4 Dropout Debounce Messages (1–8)

**RMB4DO** := \_\_\_\_\_

RMB5 Pickup Debounce Messages (1–8)

**RMB5PU** := \_\_\_\_\_

RMB5 Dropout Debounce Messages (1–8)

**RMB5DO** := \_\_\_\_\_

RMB6 Pickup Debounce Messages (1–8)

**RMB6PU** := \_\_\_\_\_

RMB6 Dropout Debounce Messages (1–8)

**RMB6DO** := \_\_\_\_\_

RMB7 Pickup Debounce Messages (1–8)  
RMB7 Dropout Debounce Messages (1–8)  
RMB8 Pickup Debounce Messages (1–8)  
RMB8 Dropout Debounce Messages (1–8)

**RMB7PU** := \_\_\_\_\_  
**RMB7DO** := \_\_\_\_\_  
**RMB8PU** := \_\_\_\_\_  
**RMB8DO** := \_\_\_\_\_

# Report Settings (SET R Command)

---

## SER Chatter Criteria

Auto-Removal Enable (Y, N)

**ESERDEL** := \_\_\_\_\_

Number of Counts (2–20 counts)

**SRDLCNT** := \_\_\_\_\_

Removal Time (0.1–90.0 s)

**SRDLTIM** := \_\_\_\_\_

## SER Trigger Lists

Enter as many as 24 Device Word elements separated by spaces or commas in each of the four lists.  
Use NA to disable settings.

<b>SER1</b>	:= _____
<b>SER2</b>	:= _____
<b>SER3</b>	:= _____
<b>SER4</b>	:= _____

## Relay Word Bit Aliases

ALIASn= 'RW Bit'(space)'Alias'(space)'Asserted Text'(space)'Deasserted Text'. Alias, Asserted, and Deasserted text strings can be as many as 15 characters long. Use NA to disable setting.

Enable ALIAS (N, 1–96)	<b>EALIAS</b> := _____
ALIAS 1	<b>ALIAS1</b> := _____
ALIAS 2	<b>ALIAS2</b> := _____
ALIAS 3	<b>ALIAS3</b> := _____
ALIAS 4	<b>ALIAS4</b> := _____
ALIAS 5	<b>ALIAS5</b> := _____
ALIAS 6	<b>ALIAS6</b> := _____
ALIAS 7	<b>ALIAS7</b> := _____
ALIAS 8	<b>ALIAS8</b> := _____
ALIAS 9	<b>ALIAS9</b> := _____
ALIAS 10	<b>ALIAS10</b> := _____
ALIAS 11	<b>ALIAS11</b> := _____
ALIAS 12	<b>ALIAS12</b> := _____
ALIAS 13	<b>ALIAS13</b> := _____
ALIAS 14	<b>ALIAS14</b> := _____
ALIAS 15	<b>ALIAS15</b> := _____
ALIAS 16	<b>ALIAS16</b> := _____
ALIAS 17	<b>ALIAS17</b> := _____
ALIAS 18	<b>ALIAS18</b> := _____

ALIAS 19	<b>ALIAS19</b> := _____
ALIAS 20	<b>ALIAS20</b> := _____
ALIAS 21	<b>ALIAS21</b> := _____
ALIAS 22	<b>ALIAS22</b> := _____
ALIAS 23	<b>ALIAS23</b> := _____
ALIAS 24	<b>ALIAS24</b> := _____
ALIAS 25	<b>ALIAS25</b> := _____
ALIAS 26	<b>ALIAS26</b> := _____
ALIAS 27	<b>ALIAS27</b> := _____
ALIAS 28	<b>ALIAS28</b> := _____
ALIAS 29	<b>ALIAS29</b> := _____
ALIAS 30	<b>ALIAS30</b> := _____
ALIAS 31	<b>ALIAS31</b> := _____
ALIAS 32	<b>ALIAS32</b> := _____
ALIAS 33	<b>ALIAS33</b> := _____
ALIAS 34	<b>ALIAS34</b> := _____
ALIAS 35	<b>ALIAS35</b> := _____
ALIAS 36	<b>ALIAS36</b> := _____
ALIAS 37	<b>ALIAS37</b> := _____
ALIAS 38	<b>ALIAS38</b> := _____
ALIAS 39	<b>ALIAS39</b> := _____
ALIAS 40	<b>ALIAS40</b> := _____
ALIAS 41	<b>ALIAS41</b> := _____
ALIAS 42	<b>ALIAS42</b> := _____
ALIAS 43	<b>ALIAS43</b> := _____
ALIAS 44	<b>ALIAS44</b> := _____
ALIAS 45	<b>ALIAS45</b> := _____
ALIAS 46	<b>ALIAS46</b> := _____
ALIAS 47	<b>ALIAS47</b> := _____
ALIAS 48	<b>ALIAS48</b> := _____
ALIAS 49	<b>ALIAS49</b> := _____
ALIAS 50	<b>ALIAS50</b> := _____
ALIAS 51	<b>ALIAS51</b> := _____
ALIAS 52	<b>ALIAS52</b> := _____

ALIAS 53	<b>ALIAS53</b> := _____
ALIAS 54	<b>ALIAS54</b> := _____
ALIAS 55	<b>ALIAS55</b> := _____
ALIAS 56	<b>ALIAS56</b> := _____
ALIAS 57	<b>ALIAS57</b> := _____
ALIAS 58	<b>ALIAS58</b> := _____
ALIAS 59	<b>ALIAS59</b> := _____
ALIAS 60	<b>ALIAS60</b> := _____
ALIAS 61	<b>ALIAS61</b> := _____
ALIAS 62	<b>ALIAS62</b> := _____
ALIAS 63	<b>ALIAS63</b> := _____
ALIAS 64	<b>ALIAS64</b> := _____
ALIAS 65	<b>ALIAS65</b> := _____
ALIAS 66	<b>ALIAS66</b> := _____
ALIAS 67	<b>ALIAS67</b> := _____
ALIAS 68	<b>ALIAS68</b> := _____
ALIAS 69	<b>ALIAS69</b> := _____
ALIAS 70	<b>ALIAS70</b> := _____
ALIAS 71	<b>ALIAS71</b> := _____
ALIAS 72	<b>ALIAS72</b> := _____
ALIAS 73	<b>ALIAS73</b> := _____
ALIAS 74	<b>ALIAS74</b> := _____
ALIAS 75	<b>ALIAS75</b> := _____
ALIAS 76	<b>ALIAS76</b> := _____
ALIAS 77	<b>ALIAS77</b> := _____
ALIAS 78	<b>ALIAS78</b> := _____
ALIAS 79	<b>ALIAS79</b> := _____
ALIAS 80	<b>ALIAS80</b> := _____
ALIAS 81	<b>ALIAS81</b> := _____
ALIAS 82	<b>ALIAS82</b> := _____
ALIAS 83	<b>ALIAS83</b> := _____
ALIAS 84	<b>ALIAS84</b> := _____
ALIAS 85	<b>ALIAS85</b> := _____
ALIAS 86	<b>ALIAS86</b> := _____

ALIAS 87

**ALIAS87** := \_\_\_\_\_

ALIAS 88

**ALIAS88** := \_\_\_\_\_

ALIAS 89

**ALIAS89** := \_\_\_\_\_

ALIAS 90

**ALIAS90** := \_\_\_\_\_

ALIAS 91

**ALIAS91** := \_\_\_\_\_

ALIAS 92

**ALIAS92** := \_\_\_\_\_

ALIAS 93

**ALIAS93** := \_\_\_\_\_

ALIAS 94

**ALIAS94** := \_\_\_\_\_

ALIAS 95

**ALIAS95** := \_\_\_\_\_

ALIAS 96

**ALIAS96** := \_\_\_\_\_

# Section 7

## Communications

### Overview

---

This section lists commands (ASCII and CASCII formats) you can use to communicate with the device to perform control functions or to obtain information, reports, and data. You enter any commands on a keyboard when communicating via the serial port.

Commands, command options, and command variables are shown in bold. Lowercase italic letters and words in a command represent command variables that are determined for the application. Command options appear with brief explanations of the function. Refer to the references listed with the commands for more information on the control function corresponding to the command, or examples of the control response to the command.

You can simplify the task of entering commands by shortening any command to the first three characters, e.g., **ACCESS** is **ACC**. Always send a carriage return <CR> character or a carriage return character followed by a line feed character <CR><LF> to execute a command. Most terminals and terminal programs interpret the Enter key as <CR>. For example, to send the **ACCESS** command, type **ACC <Enter>**.

Tables in this section show access levels where the command or command option is available. Access levels in this device are Access Level 0, Access Level 1, and Access Level 2.

### Communications

---

#### Communications Ports

*Table 7.1* shows physical interfaces of the SEL-2533 Annunciator. Several options are available to provide alternative physical interfaces, including EIA-485 (see *Section 2: Installation* for more information on interface cards).

**Table 7.1 SEL-2533 Port Description**

Port	Communication Port Interface	Location/Comment
PORT F	EIA-232 (nonisolated)	Front
PORT 2	ST fiber	Optional (Use the fiber-optic port for safety (electrical isolation) and long communications distances (500 m to 4 km) with an SEL-2812.)
PORT 3	EIA-232 (nonisolated)	Rear
PORT 4C	EIA-232 (nonisolated)	Optional (communications card) Supports +5 Vdc power supply
PORT 4A	EIA-485 (isolated)	Optional (communications card)

Be sure to evaluate the installation and communications necessary for integration with existing devices before ordering your SEL-2533. The following is general information on possible applications of the different interfaces.

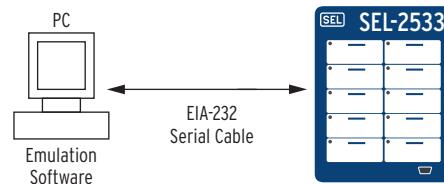
## Serial (EIA-485 and EIA-232)

Use the EIA-232 port for communications distances of  $\leq 15\text{ m}$  (50 ft) in low-noise environments. Use the optimal EIA-485 port for communications distances of  $\leq 1200\text{ m}$  (4000 ft) maximum distance (to achieve this performance, ensure proper line termination at the receiver).

## Serial Port Physical Interfaces

To connect a PC serial port to the device front-panel serial port and enter device commands, you will need the following:

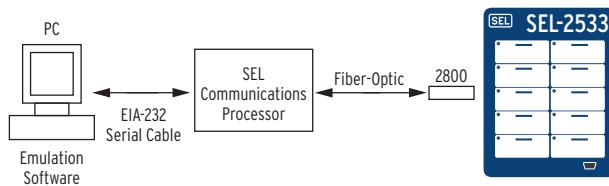
- PC equipped with one available EIA-232 serial port (if your PC does not have a serial port you can order an SEL-C662 cable that will convert a USB port to an EIA-232 port)
- Communications cable to connect the PC serial port to the device serial ports
- Terminal emulation software to control the PC serial port



**Figure 7.1 Connection Between PC Serial Port and SEL-2533 Front-Panel Serial Port**

Figure 7.2 shows the connection when the installation includes other SEL devices. Some of the SEL devices available for integration or communications-system robustness are included in the following list:

- SEL Communications Processors
- SEL-2800 Fiber-Optic Transceivers
- SEL-2890 Serial-to-Ethernet Transceiver



**Figure 7.2 Connection When Installation Includes Other SEL Devices**

A variety of terminal emulation programs for PCs can communicate with the device, e.g., ACCELERATOR QuickSet® SEL-5030 Software.

For the best display, use VT-100 terminal emulation or the closest variation. Default settings for all EIA-232 serial ports are as follows:

- Baud Rate = 9600
- Data Bits = 8
- Parity = N
- Stop Bits = 1

To change the port settings, use the **SET P** command (see *Section 6: Settings*).

## IRIG-B

Two physical interfaces are available for the demodulated IRIG-B time-code input. One physical interface is via **IRIG-B** terminals 1 and 2, and the other is part of the serial **PORT 3** physical interface. Only one interface can be used at a time. When using serial **PORT 3**, connect to an SEL communications processor with an SEL-C273A cable (see the cable diagrams that follow in this section or in the SEL-5801 Cable Selector software). If the unit has the fiber-optic serial option (**PORT 2**), IRIG can be received from a master device over an SEL-2812MT.

## +5 Vdc Power Supply

**NOTE:** Although the +5 Vdc power supply is available at more than one port, the total 5 V load from any combination of ports cannot exceed 0.5 A.

Serial port power can provide as much as 0.5 A total from all of the +5 Vdc pins. Some SEL communications devices require the +5 Vdc power supply. This +5 Vdc is available in any combination of Pins 1, 3, and 7 without the need for hardware jumpers.

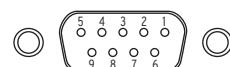
## Connect Your PC to the Device

The front port of the SEL-2533 is a standard female 9-pin connector with pin numbering shown in *Figure 7.3*. The pinout assignments for this port are shown in *Table 7.2*. You can connect to a standard 9-pin computer port with an SEL-C234A cable, as shown in *Figure 7.4*. SEL cable SEL-C234A and other cables are available in a variety of lengths. Use the SEL-5801 Cable Selector software to select an appropriate cable for another application. Download this software at [selinc.com](http://selinc.com).

For best performance, keep the length of SEL-C234A cable >15m (50 ft). For long-distance communications and for electrical isolation of communications ports, use the SEL family of fiber-optic transceivers. Contact SEL for more details on these devices.

## Port Connector and Communications Cables

*Figure 7.3* shows the front-panel EIA-232 serial port DB-9 connector pin numbering for the SEL-2533.



**Figure 7.3 EIA-232 DB-9 Connector Pin Numbers**

*Table 7.2* shows pin functions for the EIA-232 serial ports.

**Table 7.2 Serial Port Pin Functions (Sheet 1 of 2)**

Pin <sup>a</sup>	PORT 3 EIA-232	PORT 2, PORT 4C EIA-232	PORT 4A EIA-485	PORT F EIA-232
1	+5Vdc	+5Vdc	+TX	N/C
2	RXD	RXD, RX	-TX	RXD
3	TXD	TXD, TX	+RX	TXD

**Table 7.2 Serial Port Pin Functions (Sheet 2 of 2)**

<b>Pin<sup>a</sup></b>	<b>PORT 3 EIA-232</b>	<b>PORT 2, PORT 4C EIA-232</b>	<b>PORT 4A EIA-485</b>	<b>PORT F EIA-232</b>
4	IRIG+	N/C	-RX	N/C
5	GND	GND	Shield	GND
6	IRIG-	N/C		N/C
7	RTS	RTS		RTS
8	CTS	CTS		CTS
9	GND	GND		GND

<sup>a</sup> For EIA-485, the pin numbers represent relay terminals 1 through 5.

The following cable diagrams show several types of EIA-232 serial communications cables that connect the SEL-2533 to other devices. These and other cables are available from SEL.

<u>SEL-2523</u>		<sup>*</sup> DTE Device	
9-Pin Male		9-Pin Female	
D Subconnector		D Subconnector	
Pin		Pin	
Func.	Pin #	Pin #	Func.
RXD	2	3	TXD
TXD	3	2	RXD
GND	5	5	GND
CTS	8	8	CTS
		7	RTS
		1	DCD
		4	DTR
		6	DSR

\*DTE = Data Terminal Equipment (Computer, Terminal, etc.)

NOTE: For best results, limit the cable length to 15 meters (50 ft)

**Figure 7.4 SEL Cable SEL-C234A-SEL-2533 to DTE Device**

<u>SEL-2523</u>		<sup>**</sup> DCE Device	
9-Pin Male		25-Pin Female	
D Subconnector		D Subconnector	
Pin		Pin	
Func.	Pin #	Pin #	Func.
GND	5	7	GND
TXD	3	2	TXD (IN)
RTS	7	20	DTR (IN)
RXD	2	3	RXD (OUT)
CTS	8	8	CD (OUT)
GND	9	1	GND

\*\*DCE = Data Communications Equipment (Modem, etc.)

NOTE: For best results, limit the cable length to 15 meters (50 ft)

**Figure 7.5 SEL Cable SEL-C222-SEL-2533 to Modem**

<u>SEL Communications Processor</u>		<u>SEL-2523</u>	
9-Pin Male	D Subconnector	9-Pin Male	D Subconnector
Pin	Func.	Pin #	Pin
Func.	Pin #	Pin #	Func.
RXD	2	3	TXD
TXD	3	2	RXD
GND	5	5	GND
RTS	7	8	CTS
CTS	8	7	RTS

NOTE: For best results, limit the cable length to 15 meters (50 ft)

**Figure 7.6 SEL Cable SEL-C272A-SEL-2533 to SEL Communications Processor (Without IRIG-B Signal)**

<u>SEL Communications Processor</u>		<u>SEL-2523</u>	
9-Pin Male	D Subconnector	9-Pin Male	D Subconnector
Pin	Func.	Pin #	Pin
Func.	Pin #	Pin #	Func.
RXD	2	3	TXD
TXD	3	2	RXD
IRIG+	4	4	IRIG+
GND	5	5	GND
IRIG-	6	6	IRIG-
RTS	7	8	CTS
CTS	8	7	RTS

NOTE: For best results, limit the cable length to 15 meters (50 ft)

**Figure 7.7 SEL Cable SEL-C273A-SEL-2533 to SEL Communications Processor (With IRIG-B Signal)**

**NOTE:** The SEL-3010 is obsolete and no longer available to order.

<u>SEL-3010</u>		<u>SEL-2523</u>	
9-Pin Male	D Subconnector	9-Pin Male	D Subconnector
Pin	Func.	Pin #	Pin
Func.	Pin #	Pin #	Func.
DCD	1	1	DCD
RXD	2	2	RXD
TXD	3	3	TXD
DTR	4	4	DTR
GND	5	5	GND
DSR	6	6	DSR
RTS	7	7	RTS
CTS	8	8	CTS
RI/GND	9	9	RI/GND

NOTE: For best results, limit the cable length to 15 meters (50 ft)

**Figure 7.8 SEL Cable SEL-C387-SEL-2533 to SEL-3010 Event Messenger**

# Communications Protocol

## Hardware Flow Control

**NOTE:** RTS/CTS flow control will not work on Port 2 when the protocol is set to MODBUS.

All EIA-232 serial ports support RTS/CTS hardware handshaking (hardware flow control). To enable hardware handshaking, use the **SET P** command to set RTSCTS := Y. Disable hardware handshaking by setting RTSCTS := N.

- If RTSCTS := N, the relay permanently asserts the RTS line.
- If RTSCTS := Y, the relay deasserts RTS when it is unable to receive characters.
- If RTSCTS := Y, the relay does not send characters until the CTS input is asserted.

## Protocols

Although the SEL-2533 supports a wide range of protocols, not all protocols are available on all ports. Be sure to select the correct hardware to support a particular protocol. *Table 7.3* shows the ports and protocols available on each port.

**Table 7.3 Protocols Supported on the Various Ports**

PORT	Supported Protocol
PORT F	SEL ASCII and Compressed ASCII Protocols, SEL Fast Meter, SEL Fast Operate, SEL Fast SER, SELBOOT, and SEL Settings File Transfer
PORT 2	SEL ASCII and Compressed ASCII Protocols, SEL Fast Meter, SEL Fast Operate, SEL Fast SER, SEL Settings File Transfer, SEL MIRRORED BITS®, Modbus® RTU Slave, DNP3 Level 2 Outstation, and Event Messenger Points (EVMSG)
PORT 3	
PORT 4A, 4C	

### SEL Communications Protocols

**SEL ASCII.** Use this protocol to send ASCII commands and receive ASCII responses that are readable with an appropriate terminal emulation program.

**SEL Compressed ASCII.** This protocol provides compressed versions of some of the ASCII commands. The compressed commands are described in detail in *Appendix C: SEL Communications Processors*.

**SEL Fast Meter.** This protocol supports binary messages to transfer metering and digital element messages. Compressed ASCII commands that support Fast Meter are described in detail in *Appendix C: SEL Communications Processors*.

**SEL Fast Operate.** This protocol supports binary messages to transfer operation messages. The protocol is described in *Appendix C: SEL Communications Processors*.

**SEL Fast SER.** This protocol is used to receive binary Sequential Events Record unsolicited responses. The protocol is described in *Appendix C: SEL Communications Processors*.

**SEL Messenger Points.** This is an SEL ASCII protocol with eight Data bits, No Parity, and one Stop bit for transmitting data to an SEL Messenger Points. Only the Communications Speed is user settable to match the settings in the SEL-3010.

**NOTE:** The SEL-3010 is obsolete and no longer available to order.

## MIRRORED BITS Protocol

The SEL-2533 supports two MIRRORED BITS communications channels, designated A and B. Within each MIRRORED BITS communications message for a given channel (A or B), there are eight logical data channels (1–8). You can set MBA on **PORT 2** or **PORT 3** and MBB on **PORT 4A** of the optional communications card. Attempting to set the PROTO setting to MBA or MB8A when channel A is already assigned to another port (or MBB or MB8B when channel B is already assigned on another port) results in the following error message: This Mirrored Bits channel is assigned to another port. After displaying the error message, the device returns to the PROTO setting for reentry.

## Modbus RTU Protocol

The SEL-2533 provides Modbus RTU support. Modbus is described in *Appendix E: Modbus RTU Communications Protocol*.

## DNP (Distributed Network Protocol)

The SEL-2533 provides DNP3 support. DNP is an optional manufacturer-developed, hardware-independent communications protocol. The protocol is described in *Appendix D: DNP3 Communications*.

## Command Explanations

This section lists ASCII and CASCII commands alphabetically. Commands, command options, and command variables to enter are shown in bold. Lowercase italic letters and words in a command represent command variables that you determine, for the application.

Command options appear with brief explanations of the function. Refer to the references listed with the commands for more information on the control function corresponding to the command or examples of the control response to the command. You can simplify the task of entering commands by shortening any command to the first three characters; e.g., **ACCESS** is **ACC**. Always send a carriage return **<CR>** character or a carriage return character followed by a line feed character **<CR><LF>** to execute the command. Most terminals and terminal programs interpret the Enter key as **<CR>**. For example, to send the **ACCESS** command, type **ACC <Enter>**.

Tables in this section show access level(s) where the command or command option is active. Access levels in this device are Access Level 0, Access Level 1, and Access Level 2.

## Header

Many of the command responses display the following header at the beginning:

<b>SEL-2533 DEVICE</b>	<b>Date: 04/30/2005</b>	<b>Time: 11:14:10:736</b>
----------------------------	-------------------------	---------------------------

*Table 7.4* lists the header item definitions.

**Table 7.4 Command Response Header**

Item	Definition
DID Setting (SEL-2533)	This is the DID (Device Identifier) setting. The device is shipped with the default settings DID = SEL-2533; you can change the DID setting with a name appropriate to the installation.
TID Setting (Device)	This is the TID (Terminal Identifier) setting. The processor is shipped with the default setting TID = DEVICE; you can change the TID setting with a name appropriate to the installation.
Date	This is the date when the command response was given; you can modify the date display format (Month/Day/Year, Year/Month/Day, or Day/Month/Year) by changing the DATE_F setting.
Time	This is the time when the command response was given.

## Access Levels

Issue commands to the SEL-2533 via the serial port to view or change device settings. For security, these commands are available on different password-protected access levels. Each command description throughout this section indicates the access level at which the command is available. There are three access levels in the device, offering varying levels of control.

- Access Level 0 commands are the lowest security level. Access Level 0 commands support SEL communications processors.
- Access Level 1 commands are for reviewing information only (settings, targets, etc.), not for making changes.
- Access Level 2 commands are primarily for changing device settings.

### Access Level 0

Once serial port communication is established with the SEL-2533, the device sends the following prompt:

---



---



---

=

---



---

This is referred to as Access Level 0. Only a few commands are available at Access Level 0. One is the **ACC** command. See the *SEL-2533 Command Summary* at the end of this manual.

Enter the **ACC** command at the Access Level 0 prompt:

---



---



---

=ACC <Enter>

---



---

The **ACC** command takes the SEL-2533 to Access Level 1. See *Access Commands (ACCESS and 2ACCESS)* on page 7.9 for more detail.

### Access Level 1

When the SEL-2533 is in Access Level 1, the device sends the following prompt:

---



---



---

=>

---



---

See the *SEL-2533 Command Summary* at the end of this manual for the commands available from Access Level 1. From Access Level 1, use the **2AC** command to go to Access Level 2. See *Access Commands (ACCESS and 2ACCESS)* on page 7.9 for more detail.

Enter the **2AC** command at the Access Level 1 prompt:

---

```
=>2AC <Enter>
```

---

## Access Level 2

When the device is in Access Level 2, the SEL-2533 sends the prompt:

---

```
=>>
```

---

See the *SEL-2533 Command Summary* at the end of this manual for the commands available from Access Level 2. Any of the Access Level 1 commands are also available in Access Level 2.

The SEL-2533 responds with **Invalid Access Level** when a command is entered from an access level lower than the specified access level for the command. The processor responds with **Invalid Command** to commands that are not available or are entered incorrectly.

## Access Commands (ACCESS and 2ACCESS)

The **ACC** and **2AC** commands provide entry to multiple access levels, as shown in *Table 7.5*. Different commands are available at the different access levels, as shown in the *SEL-2533 Command Summary* at the end of this manual. Commands **ACC** and **2AC** are explained together because they operate similarly.

**Table 7.5 Access Commands**

Command	Description	Access Level
<b>ACC</b>	Moves from Access Level 0 to Access Level 1.	0
	Moves from Access Level 2 to Access Level 1.	2
<b>2AC</b>	Moves from Access Level 1 to Access Level 2.	1

## Password Requirements

After enabling the password function (see *Password and SELBOOT Jumper Selection* on page 2.4), you need to enter passwords to access each access level. See *PASSWORD Command (View/Change Passwords)* on page 7.16 for the list of default passwords and for more information on changing and disabling passwords.

## Access Level Attempt (Password Required)

Assume the following conditions:

- Access Level 1 password is not disabled
- Access Level is 0

At the Access Level 0 prompt, enter the **ACC** command.

---

```
=ACC <Enter>
```

---

Because the password is enabled, the device prompts you for the Access Level 1 password.

---

```
Password: ? @@@@@@@@
```

---

### ⚠️ WARNING

This device is shipped with default passwords. Default passwords should be changed to private passwords at installation. Failure to change each default password to a private password may allow unauthorized access. SEL shall not be responsible for any damage resulting from unauthorized access.

The processor is shipped with the default Access Level 1 password shown in *PASSWORD Command (View/Change Passwords) on page 7.16*. At the prompt, enter the default password and press the <Enter> key. The device responds with the following:

---

[RID Setting] [TID Setting] Level 1 =>	Date: mm/dd/yyyy Time: hh:mm:ss.sss Time Source: external
---	--

---

The SEL-2533 now suspends access to all access levels for 30 seconds and remains at Access Level 0 (= prompt).

### Access Level Attempt (Password Not Required)

Assume the following conditions:

- Access Level 1 password is disabled
- Access Level is 0

At the Access Level 0 prompt, enter the **ACC** command.

---

```
=ACC <Enter>
```

---

Because the password is disabled, the processor does not prompt you for a password and goes directly to Access Level 1. The device responds with the following:

---

[RID Setting] [TID Setting] Level 1 =>	Date: mm/dd/yyyy Time: hh:mm:ss.sss
---	-------------------------------------

---

The => prompt indicates the relay is now in Access Level 1. The two previous examples demonstrate going from Access Level 0 to Access Level 1. Going from Access Level 1 to Access Level 2 with the **2AC** command entered at the access level screen prompt is similar. The device pulses the SALARM Device Word bit for one second after successful level 2 access or if access is denied.

# ASCII Commands

---

The following is an alphabetical listing and discussion of all ASCII commands available in the SEL-2533.

## B NAMES Command (Binary Names)

Use the **BNA** command to produce the names of all device status bits reported in the Fast Meter Data Block (A5D1) message in Compressed ASCII format, as shown in *Table 7.6*. This command is only available as Compressed ASCII response.

**Table 7.6 B NAMES Command**

Command	Description	Access Level
BNA	Displays names of all device status bits, as shown below: =BNA <Enter> “*”, “*”, “*”, “*”, “*”, “PWRUP”, “STSET”, “07AD”	0

## C AL Command

Use the **CAL** command to gain access to Access Level C. See *Access Levels* for more information. Only go to Level C to modify the default password or under the direction of an SEL employee. The additional commands available at Level C are not intended for normal operational purposes.

**Table 7.7 CAL Command**

Command	Description	Access Level
CAL	Go to Access Level C.	2, C

## C ASCII Command (Compressed ASCII)

Use the **CAS** command to produce the Compressed ASCII configuration message. This configuration instructs an external computer on the method for extracting data from other Compressed ASCII commands, as shown in *Table 7.8*. This command is only available as a Compressed ASCII response.

**Table 7.8 C ASCII Command**

Command	Description	Access Level
CAS	Return the Compressed ASCII configuration message—shown below is an extract (only the first few lines are shown): “CAS”, 2, “01A5” “CST”, 1, “0187” “4H”, “SERIAL NUM”, “FID”, “CID”, “PART NUM”, “0966”	0

Upon receiving the **CAS** command, the device responds with configurations of Compressed ASCII command **CST**.

## COMMUNICATIONS Command

The **COM x** displays communications statistics for the MIRRORED BITS communications channels. For more information on MIRRORED BITS communications, see *Appendix F: MIRRORED BITS Communications*. The summary report includes information on the failure of ROKA and ROKB. The last error field displays the reason for the most recent channel error, even if the channel was already failed. We define failure reasons as one of the following error types:

- Device disabled
- Framing error
- Parity error

- Overrun
- Re-sync
- Data error
- Loopback
- Underrun

**Table 7.9 COM Command**

Command	Description	Access Level
<b>COM A</b>	Return a summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel A.	1
<b>COM B</b>	Return a summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel B.	1
<b>COM L A</b>	Appends a long report to the summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel A.	1
<b>COM L B</b>	Appends a long report to the summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel B.	1
<b>COM C</b>	Clears all communications records. If both MIRRORED BITS channels are enabled, omitting the channel specifier (A or B) clears both channels.	1
<b>COM C A</b>	Clears all communications records for Channel A.	1
<b>COM C B</b>	Clears all communications records for Channel B.	1

## CONTROL Command (Control Remote Bit)

Use the **CON** command to control remote bits (Device Word bits RB01–RB40), output contacts, and remote acknowledge of front-panel pushbuttons. Remote bits are device variables that you can set via serial port communication.

The control command is used to control three types of information. *Table 7.10* shows the three types of commands available with the control command. Each of the commands have subcommands, as shown in *Table 7.11*, *Table 7.12*, and *Table 7.13*.

**Table 7.10 CONTROL Command**

Command	Description	Access Level
<b>CON BUTTONS</b>	This command will allow you to remotely control the ACK, RESET, and SIL pushbuttons.	2
<b>CON OUTPUTS</b>	This command will allow you to override the functionality of the outputs and pulse for a defined period of time.	
<b>CON REMOTE BITS</b>	This command will allow you to set, clear, or pulse any of the 40 remote bits.	2

*Table 7.11* shows the commands used with the **CONTROL BUTTONS** command. The command was designed to remotely control the pushbuttons on the front of the SEL-2533.

**Table 7.11 CONTROL BUTTONS Command States**

Command	Description	Access Level
CON B RB_x P	Remotely actuate pushbuttons where $x = \text{SIL, ACK, RST, or CON}$ , and P pulses the bit for one processing interval.	2

The example below shows how you would remotely acknowledge a pending alarm:

---

```
=>>CON B RB_ACK P <Enter>
```

---

**Table 7.12 CONTROL OUTPUTS States**

Command	Description	Access Level
CON O n m	Remotely pulse outputs where $n = \text{OUT01–OUT11}$ and $m$ is the pulse time in seconds. $m$ defaults to 1 if unspecified.	2

**Table 7.13 Control States for Remote Bits and BUTTONS Commands**

Subcommand	Description	Access Level
CON RBn m	Control Remote Bits where $n = 01\text{--}40$ and $m = \text{C(Clear), P(Pulse), or S(SET)}$	2
S	Set Remote bit (ON position)	2
C	Clear Remote bit (OFF position)	2
P	Pulse Remote bit for 4 ms (MOMENTARY position)	2

For example, use the following steps to set Remote bit RB05:

---

```
=>>CON RB32 <Enter>
```

---

## CSTATUS Command (Compressed Status)

The **CST** command generates a device status report in Compressed ASCII format, as shown in *Table 7.14*.

**Table 7.14 CSTATUS Command**

Command	Description	Access Level
CST	Return the device status in Compressed ASCII format.	1

## DATE Command (View/Change Date)

Use the **DATE** command to view and set the device date, as shown in *Table 7.15*.

**Table 7.15 DATE Command**

Command	Description	Access Level
DAT	Display the internal clock date.	1
DAT date	Set the internal clock date using MM/DD/YYYY format (given DATE_F is set to MDY).	1

The device can overwrite the date entered by using other time sources, such as IRIG. Enter the **DATE** command to set the internal clock date. Separate the month, day, and year parameters with back slashes. Set the year in four-digit form (for dates 2000–2099). Global setting DATE\_F sets the date format.

## FILE Command (Manage Settings Files)

The **FIL** command provides a safe and efficient way to transfer settings files between Intelligent Electronic Devices (IEDs) and External Support Software (ESS). Use the **FIL** command to send settings to the SEL-2533 and receive settings from the device, as shown in *Table 7.16*.

**Table 7.16 FILE Command**

Command	Description	Access Level
<b>FIL DIR</b>	Return a list of files.	1
<b>FIL READ</b> <i>filename</i>	Transfer settings file <i>filename</i> from the device to the PC.	1
<b>FIL WRITE</b> <i>filename</i>	Transfer settings file <i>filename</i> from the PC to the device.	2
<b>FIL SHOW</b> <i>filename</i>	Displays the contents of the file <i>filename</i> .	1

## HELP Command

In response to the **HEL XXX** command, the device displays a short description of the ASCII command. Parameter *XXX* is any ASCII command, e.g., **HEL CON**.

## IDENTIFICATION Command

Use the **ID** command to extract device identification codes, as shown in *Table 7.17*. The **ID** command is only available as a compressed command.

**Table 7.17 IDENTIFICATION Command**

Command	Description	Access Level
<b>ID</b>	Return a list of device identification codes, as shown below:  <pre>=&gt;id&lt;Enter&gt; "VID=SEL-2533-R100-V0-Z001001-D20101109", "08D4" "BFID=SLBT-2533-R200-V0-Z000000-D20100629", "0960" "CID=F756", "0265" "DEVID=SEL-2533", "03F7" "DEVCODE=76", "0314" "PARTNO=253301213AOA3X0", "05B2" "CONFIG=00000000", "03E3"</pre>	0

## IRIG Command

Use the **IRI** command to read the demodulated IRIG-B time code at the serial port or IRIG-B input, and to force immediate synchronization of the internal clock with the IRIG-B signal (see *Table 7.18*). If an IRIG-B signal is present at the serial port or IRIG-B input, the device automatically synchronizes the internal clock with the IRIG-B signal in a time period not exceeding one minute. It is not necessary to issue the **IRI** command for this automatic one-minute synchronization. If you are testing the device and do not want to wait for the one-minute synchronization, then issue the **IRI** command to immediately force the device to synchronize with the IRIG-B signal. You can use the **IRI** command to determine if the device is properly reading the IRIG-B signal.

**Table 7.18 IRIG Command**

Command	Description	Access Level
<b>IRI</b>	Force synchronization of internal control clock to IRIG-B time-code input.	1

To force the device to synchronize to IRIG-B, enter the following command:

---

```
=>IRI <Enter>
```

---

If the device successfully synchronizes to IRIG, it sends the following header and access level prompt:

---

```
SEL-2533                               Date: 04/12/2008 Time: 15:41:29
DEVICE
=>
```

---

If no IRIG-B code is present at the serial port input or if the code cannot be read successfully, the device responds:

---

```
IRIG-B DATA ERROR
=>>
```

---

## L\_D Command (Load Firmware)

Use the **L\_D** command to load firmware, as shown in *Table 7.19*. See *Appendix A: Firmware and Manual Versions* for information on changes to the firmware and instruction manual. See *Appendix B: Firmware Upgrade Instructions* for further details on downloading firmware.

**Table 7.19 L\_D Command**

Command	Description	Access Level
<b>L_D</b>	Download firmware to the device (front panel only).	2

## LOOPBACK Command

The **LOO** command is used for testing the MIRRORED BITS communications channel for proper communication. For more information on MIRRORED BITS, see *Appendix F: MIRRORED BITS Communications*. With the transmitter of the communications channel physically looped back to the receiver, the MIRRORED BITS addressing will be wrong and ROK will be deasserted. The **LOO** command tells the MIRRORED BITS software to temporarily expect to see its own data looped back as its input. In this mode, LBOKA or LBOKB will assert if error-free data are received. The **LOO** command with just the channel specifier enables loopback mode on that channel for five minutes while the inputs are forced to the default values.

**Table 7.20 LOO Command**

Command	Description	Access Level
<b>LOO</b>	Enable loopback testing of MIRRORED BITS channels.	2
<b>LOO A</b>	Enable loopback on MIRRORED BITS Channel A for the next five minutes.	2
<b>LOO B</b>	Enable loopback on MIRRORED BITS Channel B for the next five minutes.	2

---

```
=>>LOO A <Enter>
Loopback will be enabled on Mirrored Bits channel A for the next 5 minutes.
The RMB values will be forced to default while loopback is enabled.
Are you sure (Y/N)?
```

---

=>>

---

If only one MIRRORED BITS port is enabled, the channel specifier (A or B) may be omitted. To enable loopback mode for other than the five-minute default, enter the desired number of minutes (1–5000) as a command parameter. To allow the loopback data to modify the RMB values, include the **DATA** parameter.

---

```
=>>LOO 10 DATA <Enter>
Loopback will be enabled on Mirrored Bits channel A for the next 10 minutes.
The RMB values will be allowed to change while loopback is enabled.
Are you sure (Y/N)? N <Enter>
Canceled.
```

---

=>>

---

To disable loopback mode before the selected number of minutes, re-issue the **LOO** command with the **R** parameter. The **R** parameter returns the device to normal operation. If both MIRRORED BITS channels are enabled, omitting the channel specifier in the disable command will cause both channels to be disabled.

---

```
=>>LOO R <Enter>
Loopback is disabled on both channels.
```

---

=>>

---

## MAP Command (Display DNP3 Maps)

The **MAP** command is only available if the DNP3 has been selected as the protocol on a serial port. The **MAP** command accesses the port DNP3 settings and is similar to the **SHOW DNP** command. However, unlike the **SHOW DNP** command, the **MAP** command displays DNP3 information by port number. You can issue the **MAP** command with the *port* parameter (from 2 to 4) to view the DNP3 settings for that port number.

**Table 7.21 MAP Command**

Command	Description	Access Level
<b>MAP</b> <i>port</i>	Show the serial DNP3 settings for port <i>port</i> (similar to <b>SHOW DN</b> ).	1, 2

## PASSWORD Command (View/Change Passwords)

Use the **PAS** command to inspect or change existing passwords, as shown in *Table 7.22* and *Table 7.23*.

**Table 7.22 Password Command**

Command	Description	Access Level
<b>PAS</b> <i>level</i> <sup>a</sup>	Set a password for <i>new password</i> for Access Level <i>level</i> .	2

<sup>a</sup> Parameter level represents the device Access Levels 1 or 2.

**Table 7.23 Factory Default Passwords**

Access Level	Password
1	OTTER
2	TAIL
C	CLARKE

**WARNING**

This device is shipped with default passwords. Default passwords should be changed to private passwords at installation. Failure to change each default password to a private password may allow unauthorized access. SEL shall not be responsible for any damage resulting from unauthorized access.

To change the password for Access Level 2 from the default password TAIL to new password Ot3579, enter the following:

```
=>>PAS 2 <Enter>
Old PW:? **** <Enter>
New PW:? ***** <Enter>
Confirm PW:? ***** <Enter>
Password Changed

CAUTION: This password can be strengthened. Strong passwords do not include a name, date, acronym, or word. They consist of the maximum allowable characters, with at least one special character, number, lower-case letter, and upper-case letter. A change in password is recommended.

=>>
```

Similarly, use **PAS 1** to change Level 1 passwords.

Passwords can contain as many as 12 characters. Uppercase and lowercase letters are treated as different characters. Strong passwords consist of 12 characters, with at least one special character or digit and mixed-case sensitivity, and do not form a name, date, acronym, or word. Passwords formed in this manner are less susceptible to password guessing and automated attacks. Examples of valid, distinct, strong passwords are shown below.

- #Ot3579!
- \$A24.68&
- (lh2dcs)
- \*4u-Iwg+

**Table 7.24 Valid Password Characters**

<b>Alpha</b>	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z a b c d e f g h i j k l m n o p q r s t u v w x y z
<b>Numeric</b>	0 1 2 3 4 5 6 7 8 9
<b>Special</b>	! " # \$ % & ' ( ) * + , - . / ; < = > ? @ [ \ ] ^ _ ` {   } ~

If you forget your password, you can reissue a new password as follows:

- In accordance with the appropriate safety regulations, power down the device, remove the rear plate screws and connectors and remove the processor card located on Card B.
- Disable the password function by locating Jumper JMP1 on the Card B (see *Password and SELBOOT Jumper Selection on page 2.4*) and placing JMP1 in position A.
- Replace the card and card plate cover and power up the device.
- Go to Access Level 2 and issue the **PAS x** ( $x = 1$  or  $2$ ) command to enter a new password.

- In accordance with the appropriate safety regulations, power down the device, remove the rear plate and Card B, and remove Jumper JMP1 to activate the password function.
- Replace card and rear plate cover and power up the device.

## PULSE Command (Test Outputs)

Use the **PUL** command to temporarily change the state of an output contact for one second. This command overrides the present settings for the particular output under test, as shown in *Table 7.25*.

**Table 7.25 PULSE Command**

Command	Description	Access Level
<b>PUL <i>n</i></b>	Pulse output contact <i>n</i> for 1 second, as shown below:  =>PUL OUT01 <Enter> PULSE OUTPUT Are you sure (Y,N)? Y <Enter> =>>	2

## QUIT Command

Use the **QUIT** command to revert to Access Level 0 from either Access Level 1 or Access Level 2, as shown in *Table 7.26*.

**Table 7.26 QUIT Command**

Command	Description	Access Level
<b>QUI</b>	Go to Access Level 0.	0

Access Level 0 is the lowest access level; the SEL-2533 performs no password check to descend to this level (or to remain at this level).

## SER Command (Sequential Events Recorder Report)

Use the **SER** commands to view and manage the Sequential Events Recorder report, as shown in *Table 7.27* and *Table 7.28*.

**Table 7.27 SER Command (Sequential Events Recorder Report)**

Command	Description	Access Level
<b>SER</b>	Use the <b>SER</b> command to display a chronological progression of all available SER rows (as many as 1012 rows); row 1 is the most recent triggered row and row 1012 is the oldest.	1
<b>SER <i>row 1</i></b> <b>SER <i>row 1</i> <i>row 2</i></b>	Use the <b>SER</b> command with parameters ( <i>row</i> or <i>date</i> ) to display a chronological or reverse chronological subset of the SER rows, see below.	1
<b>SER <i>date 1</i></b> <b>SER <i>date 1</i> <i>date 2</i></b>		
<b>SER C</b>	Use this command to clear/reset the SER records.	2

If the requested SER report rows do not exist, the device responds with the following:

---

No SER data

---

**Table 7.28 SER Command Format**

Parameter	Description
<i>row1</i>	Append <i>row 1</i> to return a chronological progression of the first <i>row 1</i> rows, e.g., use <b>SER 5</b> to return the first five rows.
<i>row1 row2</i>	Append <i>row 1</i> and <i>row 2</i> to return all rows between <i>row 1</i> and <i>row 2</i> , beginning with <i>row 1</i> and ending with <i>row 2</i> . Enter the smaller number first to display a numeric progression of rows through the report. Enter the larger number first to display a reverse numeric progression of rows, e.g., use <b>SER 1 10</b> to return the first 10 rows in numeric order or <b>SER 10 1</b> to return these same items in reverse numeric order.
<i>date1</i>	Append <i>date 1</i> to return all rows with this date, e.g., use <b>SER 1/1/2005</b> to return all records for January 1, 2005.
<i>date1 date2</i>	Append <i>date 1</i> and <i>date 2</i> to return all rows between <i>date 1</i> and <i>date 2</i> beginning with <i>date 1</i> and ending with <i>date 2</i> . Enter the oldest date first to display a chronological progression through the report. Enter the newest date first to display a reverse chronological progression. Date entries are dependent on the date format setting DATE_F, e.g., use <b>SER 1/5/2005 1/7/2005</b> to return all records for January 5, 6, and 7, 2005.

## SET Command (Change Settings)

The **SET** command is for viewing or changing device settings, as shown in *Table 7.29*. Append **TERSE** to skip the settings display after the last setting. Use this parameter to speed up the **SET** command. If you want to review the settings before saving, do not use the **TERSE** option.

**Table 7.29 SET Command**

Command	Description	Access Level
<b>SET s</b>	Set Device settings.	2
<b>SET L s</b>	Set Logic settings.	2
<b>SET G s</b>	Set Global settings.	2
<b>SET POR n s</b>	Set serial port settings, depending on the device configuration, <i>n</i> specifies either <b>PORT F</b> or <b>PORT 2</b> through <b>PORT 4</b> ; defaults to the active port if not listed.	2
<b>SET R s</b>	Set SER report settings.	2
<b>SET DN s</b>	Set DNP3 settings.	2

Append *s* and the specific setting name you want to change in the **SET** command to immediately jump to the setting. For example, if *s* is not entered, the device starts at the first setting. For example, to directly jump to the SER3 setting in the Report setting category, enter **SET R SER3 <Enter>**.

When you issue the **SET** command, the device presents a list of settings one at a time. Enter a new setting or press **<Enter>** to accept the existing setting, as shown in *Table 7.30*.

**Table 7.30 SET Command Editing Keystrokes (Sheet 1 of 2)**

Press Key	Results
<b>&lt;Enter&gt;</b>	Retains the setting and moves to the next setting.
<b>^&lt;Enter&gt;</b>	Returns to the previous setting.
<b>&lt; &lt;Enter&gt;</b>	Returns to the previous setting category.
<b>&gt; &lt;Enter&gt;</b>	Moves to the next setting category.

**Table 7.30 SET Command Editing Keystrokes (Sheet 2 of 2)**

Press Key	Results
<b>END&lt;Enter&gt;</b>	Exits the editing session, then prompts you to save the settings.
<b>&lt;Ctrl+X&gt;</b>	Aborts the editing session without saving changes.

The device checks each setting to ensure that it is within the allowed range. If the setting is not within the allowed range, the device generates an **Out of Range** message and prompts you for the setting again. When all the settings are entered, the device displays the new settings and prompts you for approval to enable them. Answer **Y <Enter>** to enable the new settings. The device is disabled for no longer than one second while saving the new settings. The **SALARM** Device Word bit asserts momentarily and the **ENABLED** LED extinguishes while the device is disabled.

## SHOW Command (Show/View Settings)

When showing settings, the relay displays the settings label and the present value from nonvolatile memory for each setting class as shown in *Table 7.31*.

**Table 7.31 SHO Command**

Command	Description	Access Level
<b>SHO s</b>	Show Device settings.	1
<b>SHO L s</b>	Show Logic settings.	1
<b>SHO G s</b>	Show Global settings.	1
<b>SHO POR n s</b>	Show serial port settings. <i>n</i> specifies either <b>PORT F</b> or <b>PORT 2</b> through <b>PORT 4</b> ; defaults to the active port if not listed.	1
<b>SHO R s</b>	Show report settings Sequential Events Recorder (SER) and Alias settings.	1
<b>SHO DN s</b>	Show DNP3 settings.	1

Append *s* and the specific settings name you want to view in the **SHOW** command to immediately jump to the setting. If *s* (and the settings name) is not included, the device presents settings beginning with the first in the group.

## SNS Command (Displays SER Settings)

The **SNS** command displays the SER settings in Compressed ASCII format, as shown in *Table 7.32*. The **SNS** command is available as a compressed command only.

**Table 7.32 SNS Command**

Command	Description	Access Level
<b>SNS</b>	The <b>SNS</b> command displays the SER trigger elements (entered with the <b>SET R SERn</b> ( <i>n</i> = 1 through 4) command) in Compressed ASCII format.	0

The SER trigger elements are gathered in groups of eight to be displayed on each line of the report, as shown in *Figure 7.9*. The last line of the report may have fewer than eight elements. Each line is formatted as a comma-separated list of quoted SER trigger elements, followed by a quoted hexadecimal representation of the checksum. The checksum is calculated from the first quote mark of the line up to the last comma before the checksum. If there are no SER trigger elements (i.e., all SER settings are NA), no lines are generated for the report.

```
=SNS<Enter>
"SIL","ACK","RESET","ALIN_A1","ALIN_A2","ALIN_B1","ALIN_B2","ALIN_C1","1089"
"ALIN_C2","ALIN_D1","ALIN_D2","ALIN_E1","ALIN_E2","AP_A1","AP_A2","AP_B1","1184"
"AP_B2","AP_C1","AP_C2","AP_D1","AP_D2","AP_E1","AP_E2","0CD5"
```

**Figure 7.9 SER Settings Using the SNS Command**

## STATUS Command (Device Self-Test Status)

The **STA** command displays the status report, as shown in *Table 7.33*.

**Table 7.33 STATUS Command (Device Self-Test Status)**

Command	Description	Access Level
<b>STA n</b>	Displays the device self-test information <i>n</i> times ( <i>n</i> = 1–32767). Defaults to 1 if <i>n</i> is not specified.	1
<b>STA S</b>	Displays the memory and execution utilization for the SELOGIC® control equations.	1
<b>STA R</b>	Reboots the device and clears self-test warning and failure status results.	2

Refer to *Section 10: Testing and Troubleshooting* for self-test thresholds and corrective actions, as well as hardware configuration conflict resolution.

*Figure 7.10* shows the device response to the **STA** command.

```
=>>STA <Enter>
SEL-2533                               Date: 11/18/2010    Time: 10:53:52
ANNUNCIATOR

Serial Num = 201068421587632
FID = SEL-2533-R100-V0-Z001001-D20101109          CID = F756
Part Num = 253301213A0A3X0

Self Tests (W=Warn, F=Fail)
FPGA   GPSB   HMI   RAM   ROM   CR_RAM   NON_VOL   CLOCK   +3.3V   +5.0V   +2.5V
OK     OK      OK     OK     OK      OK        OK       3.35     4.99     2.51
+3.75V -1.25V BATT
3.76   -1.25   3.23

I/O Cards
CARD_C   CARD_D   CARD_E   CARD_F
OK       OK       OK       OK

Device Enabled
=>
```

**Figure 7.10 Device Response to the STATUS Command**

As with all microprocessor devices, increasing the number of functions increases the processor burden. Use the **STA S** command to see the remaining processor capacity for SELOGIC equations. The SEL-2533 shows the available processing capacity for programming SELOGIC equations as Execution %. With equations running, the processor capacity (Execution %) is 100 percent.

*Table 7.34* shows the status report definitions and message formats for each test.

**Table 7.34 STA Command Definitions (Sheet 1 of 2)**

STATUS Report Designator	Definition	Message Format
FID	Firmware identifier string	Text Data
CID	Firmware checksum identifier	Hex
PART NUM	Part number	Text Data

**Table 7.34 STA Command Definitions (Sheet 2 of 2)**

<b>STATUS Report Designator</b>	<b>Definition</b>	<b>Message Format</b>
FPGA	FPGA programming unsuccessful or FPGA failed	OK/FAIL
GPSB	General Purpose Serial Bus	OK/FAIL
HMI	Front-panel FPGA programming unsuccessful or front-panel FPGA failed	OK/FAIL
RAM	Volatile memory integrity	OK/FAIL
ROM	Firmware integrity	OK/FAIL
CR_RAM	Integrity of settings in RAM and code that runs in RAM	OK/FAIL
NON_VOL	Integrity of data stored in nonvolatile memory	OK/FAIL
Clock	Clock functionality	OK/WARN
x.x V	Power supply status ( $x.x = +3.3, +5.0, +2.5, +3.75$ , and $-1.25$ )	Voltage/ WARN/FAIL
BATT	Clock battery voltage	Voltage/WARN
CARD_C	Integrity of Card C	OK/FAIL
CARD_D	Integrity of Card D	OK/FAIL
CARD_E	Integrity of Card E	OK/FAIL
CARD_F	Integrity of Card F	OK/FAIL

## TARGET Command (Display Relay Word Bit Status)

The **TAR** command displays the status of front-panel target LEDs or Device Word bits, whether these LEDs or Device Word bits are asserted or deasserted, as shown in *Table 7.35*.

**Table 7.35 TAR Command Definitions**

<b>Command</b>	<b>Description</b>	<b>Access Level</b>
<b>TAR</b>	Use TARGET without parameters to display Device Word row 0.	1
<b>TAR ROW</b>	Adding ROW to the command (e.g., <b>TAR 23</b> ) displays the eight Device Word bits in row 23 of the Device Word bits list (see <i>Appendix G: Device Word Bits</i> ).	1
<b>TAR n k</b>	Show Device Word row number $n$ (0–92) and heading, and repeat the status (0 or 1) of the eight Device Word bits in row $n$ , $k$ times (1–32767). See <i>Appendix G: Device Word Bits</i> for the Device Word bit table.	1
<b>TAR R</b>	Displays Device Word row 0.	1

The elements are represented as Device Word bits and are listed in rows of eight, called Device Word rows. All Device Word rows are described in *Appendix G: Device Word Bits*. Device Word bits are used in SELOGIC control equations.

## TIME Command (View/Change Time)

The **TIME** command returns information about the SEL-2533 internal clock, as shown in *Table 7.36*. You can also set the clock if you specify hours and minutes (seconds data are optional). Separate the hours, minutes, and seconds with colons, semicolons, spaces, commas, or slashes.

**Table 7.36 TIM Command Definitions**

Command	Description	Access Level
<b>TIME</b>	Display the present internal clock time.	1
<b>TIME <i>hh:mm</i></b>	Set the internal clock to <i>hh:mm</i> .	2
<b>TIME <i>hh:mm:ss</i></b>	Set the internal clock to <i>hh:mm:ss</i> .	2

Use the **TIME *hh:mm*** and **TIME *hh:mm:ss*** commands to set the internal clock time. The value ***hh*** is for hours from 0–23; the value ***mm*** is for minutes from 0–59; the value ***ss*** is for seconds from 0–59. If you enter a valid time, the device updates, saves the time in nonvolatile memory, and displays the time entered. If you enter an invalid time, the SEL-2533 responds with Invalid Time.

**This page intentionally left blank**

# Section 8

## Front-Panel Operations and Custom Labeling

---

### Overview

---

The SEL-2533 front panel makes alarm status and acknowledgement quick and efficient. Use the front panel to analyze the status of each alarm point, acknowledge alarms, and test the front panel. The features that help you operate the device from the front panel include the following:

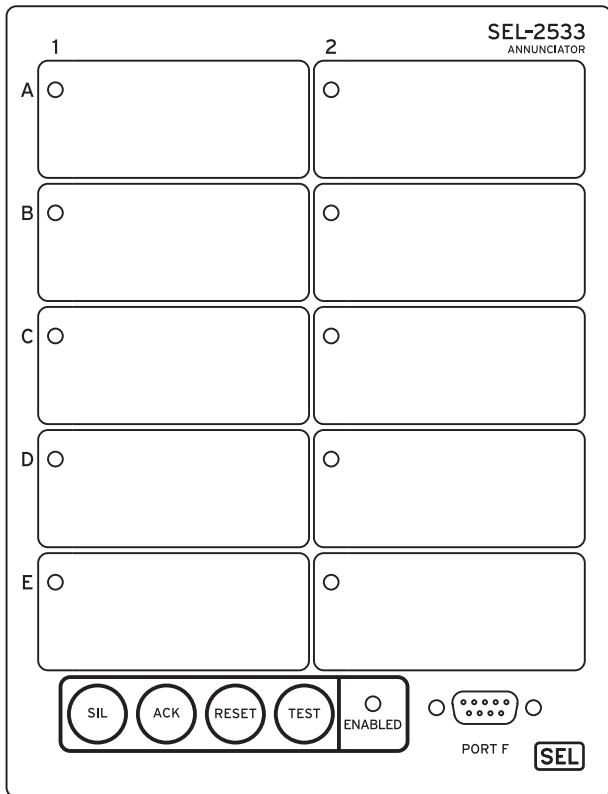
- Alarm point status
- Acknowledge, reset, and silence alarms
- Settings access
- Test function

### Front-Panel Layout

---

*Figure 8.1* shows the following regions:

- EIA-232 Serial Port (**PORT F**); see *Section 7: Communications* for details on the serial port
- Operation and Alarm point LEDs
- Pushbuttons



**Figure 8.1** Front-Panel Overview

This versatile front panel supports the following features:

- Programmable alarm point LEDs
- Acknowledge pushbuttons
- Slide-in configurable front-panel labels to properly name the alarm LED. You can find template files on the SEL-2533 Product Literature CD and on the SEL website at [selinc.com](http://selinc.com).

## Alarm Point LEDs and TEST Pushbutton

---

### Enabled LED

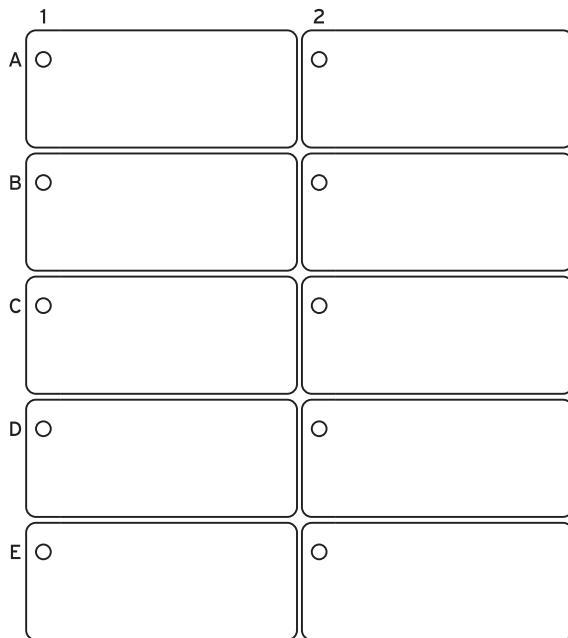
An illuminated **ENABLED** LED indicates the supply voltage is present, the device is healthy, and that processing is enabled. When the **ENABLED** LED is not illuminated, one of the following could be the cause:

- Absent supply voltage
- Firmware upload or download
- Self-test failure

See *Section 10: Testing and Troubleshooting* for more information.

### Alarm Point LEDs

The SEL-2533 provides quick confirmation of device conditions via alarm point LEDs. All of the 10 front-panel alarm point LEDs are driven from alarm sequences. See *Section 5: Annunciator Sequences* for information on alarm sequences and setting alarm points.



**Figure 8.2 SEL-2533 Front-Panel LEDs**

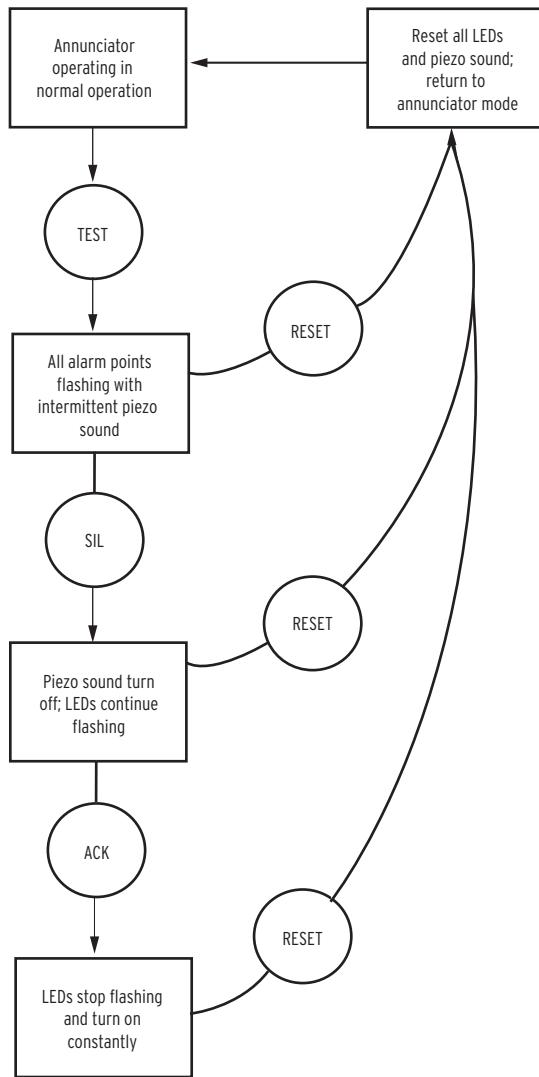
The front-panel alarm point LEDs have a matrix labeled on each window that ranges from A1 to E2. When setting or viewing alarm points using the communications interface, these will always be the names used to identify the alarm point. This assures clear communications between the local user and remote user when referencing alarms.

Each of the 10 alarm point LEDs contain different flashing modes to allow the local user to be aware of an alarm condition and state. For more information on the types of flashing modes available, refer to *Section 5: Annunciator Sequences*.

The SEL-2533 features slide-in labels for custom alarm point window LED designations that match custom alarm point LED logic. Use the slide-in labels to mark the LEDs with these custom names.

## TEST Pushbutton

Use the **TEST** pushbutton to test the front-panel LEDs and pushbuttons. When the **TEST** pushbutton is pressed, all alarm point LEDs automatically flash and beep the internal piezo alarm, simulating pressing the front-panel **TEST** button. The front panel asserts the DIS\_PB Device Word bit and then no longer responds to any incoming alarms. The SEL-2533 will still process all alarm sequences and new alarms, but it will not update the front panel. *Figure 8.4* below shows the flow process of the **TEST** pushbutton.



**Figure 8.3 TEST Pushbutton Flow Chart**

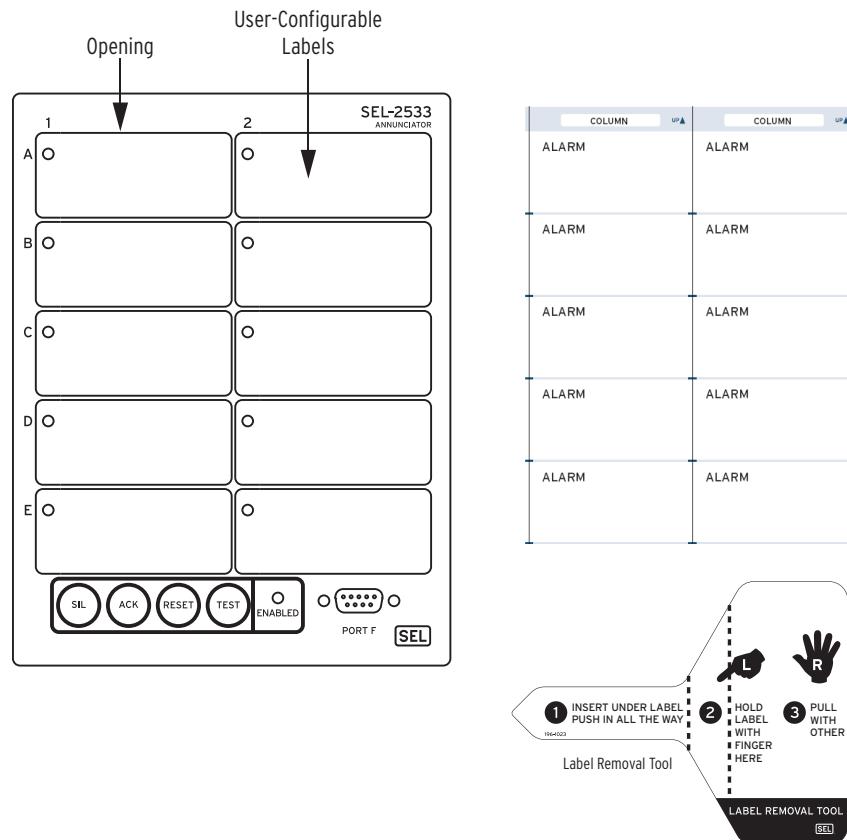
## Alarm Window Labels

---

The SEL-2533 features a versatile alarm panel that you can customize to fit your needs. Use the slide-in configurable front-panel labels to change the identification of alarm window LEDs to match the function indicated.

The blank slide-in label set, shown in *Figure 8.4*, is included with the SEL-2533. When installing the configurable labels, ensure that the labels installed in the front-panel pockets at the factory are removed before installing new labels. The aluminum chassis should be viewable through the front-panel windows when no labels are installed in the unit.

If you need additional configurable alarm window label supplies, order the labels kit or individual kit components using part number 9260065. Contact your Technical Service Center or the SEL factory to obtain these kits.



**Figure 8.4 Blank Slide-In Label Set and Label Removal Tool**

Table 8.1 provides a list and description for the items contained in the configurable labels kit.

**Table 8.1 Configurable Front-Panel Label Kit (Part No. 9260065)**

Content Descriptions	Quantity
Blank Customer Label Templates on perforated paper for laser printing	Five sets—two labels for each set
Label Removal Tool	One
SEL-2533 Product Literature CD-ROM	One

## Removing Configurable Front-Panel Labels

Use the label removal tool (shown in Figure 8.4) to remove labels from the front-panel pockets.

- Step 1. Slide the tip of the tool under the label at the pocket opening (see Figure 8.4 for opening locations).
- Step 2. Push the exposed edge of the label against the label removal tool while pulling out both the combined label and label removal tool to extract the label.

## Creating Laser-Printed Labels

Use the following procedure to create laser-printed labels. You can find these files on the SEL website ([selinc.com](http://selinc.com)). In addition, the label template files are included on the SEL-2533 Product Literature CD.

**NOTE:** The template is a Word 2000 file. The default template font is from the Arial family. You can use this font or choose a different font that is available on your computer system.

**NOTE:** You can adjust the font size to accommodate more text within the cell.

**NOTE:** Place the perforated stock sheet in the printer tray as indicated by the printer (either face up or face down).

Also, if your printer has duplex capability, be sure to set the printer to print single sided.

Step 1. Open the appropriate Microsoft® Word template.

Step 2. Fill in the fields.

Use the Tab and Arrow keys or your mouse to move from field to field. Field space is limited; only the text that displays on the screen prints on the label.

Save the file often to preserve your work in progress.

Step 3. Test the position of the label text by printing the template file to plain paper.

- a. From the document, select **File > Print > OK**.
- b. Examine the printed sheet for proper alignment. Carefully compare the printed page to the perforated stock sheets.
- c. If the printed sheet is not aligned properly, proceed to *Step 4*.
- d. If the labels appear as desired, proceed to *Step 5*.

Step 4. Make adjustments to margin settings, as necessary, to print in the proper location on the test sheet.

- a. Use the **File > Page Setup** menu to adjust only the top or left margins as needed to correct the alignment.  
DO NOT adjust the right or bottom margins.
- b. Do another test print on plain paper.
- c. Examine the label position.
- d. Repeat as necessary until the alignment is correct.

Step 5. Print the labels on the perforated stock sheets.

If the labels printed incorrectly, repeat this procedure beginning with *Step 3*.

Step 6. Fold and tear the perforated edges of the stock paper to remove the labels from the sheet.

Step 7. Remove the existing labels from the front-panel label pockets with the label removal tool.

Step 8. Insert the newly created labels in the appropriate pockets on the relay front panel.

# Section 9

## Analyzing SER Events

### Overview

---

The SEL-2533 Annunciator provides the following tool to analyze the cause of device operations:

#### Sequential Events Recorder Report

- Resolution: 0.1 ms
- Accuracy:  $\pm 1$  ms

### Sequential Events Recorder (SER)

---

The SEL-2533 SER report gives you detailed information on device alarm states and alarm operations. The SER captures and time-tags Device Word bit state changes and device conditions. These conditions include power up, device enable and disable, settings changes, and SER automatic removal and reinsertion.

The SER records as many as 1024 state changes of as many as 96 Device Word bits listed in the SER trigger equations. All reports are stored in nonvolatile memory, ensuring that a loss of power to the SEL-2533 will not result in lost data.

#### SER Report

*Figure 9.1* shows the following data contained in the SER report:

- Device and terminal identification
- Date and time of report
- SER number
- SER date and time
- Device element or condition
- Element state

SEL-2533 DEVICE				DATE: 12/20/2010	TIME: 17:11:21
<b>Serial No = 201056985478513</b>				<b>FID = SEL-2533-R100-V0-Z001001-D20101129 CID = A476</b>	
#	DATE	TIME	ELEMENT	STATE	
17	12/19/2010	14:44:16.3927	AP_A1	Deasserted	
16	12/19/2010	14:44:16.3927	AP_A2	Deasserted	
15	12/19/2010	14:44:16.3927	AP_C2	Deasserted	
14	12/19/2010	14:44:16.3927	AP_D1	Deasserted	
13	12/19/2010	14:44:16.3927	AP_D2	Deasserted	
12	12/19/2010	14:44:16.3927	AP_E1	Deasserted	
11	12/19/2010	14:44:16.3927	AP_B2	Deasserted	
10	12/19/2010	14:44:16.3389	ACKNOWLEDGE	OFF	
9	12/19/2010	14:44:20.1724	RESET	ON	
8	12/19/2010	14:44:20.1724	AP_B1	Deasserted	
7	12/19/2010	14:44:20.1724	AP_F1	Deasserted	
6	12/19/2010	14:44:20.1724	AP_F2	Deasserted	
5	12/19/2010	14:44:20.2861	RESET	OFF	
4	12/19/2010	15:28:15.0902	ALIN_A2	Asserted	
3	12/19/2010	15:28:15.0902	AP_A2	Asserted	
2	12/19/2010	15:28:26.7949	ACKNOWLEDGE	ON	
1	12/19/2010	15:28:27.1436	ACKNOWLEDGE	OFF	

**Figure 9.1 Sample SER Report**

Each entry in the SER report includes the SER row number, date, time, element name, and element state. In the SER report, the oldest information has the highest number, i.e., the newest information is the Number 1 entry (Acknowledge in *Figure 9.1*).

When using a computer terminal, you can change the order of the SER records in the SER report. See *SER Command (Sequential Events Recorder Report) on page 7.18* for more information.

## SER Triggering

To capture element state changes in the SER report, enter the element name (Device Word bit) into one of the four SER (SER 1 through SER 4) trigger equations. Each of the four programmable trigger equations allows entry of as many as 24 device elements separated by spaces or commas; the SER report accepts a total of 96 Device Word bits.

## SER Aliases

You may rename as many as 96 of the SER trigger conditions using the ALIAS settings. For instance, the factory default alias setting 1 renames Device Word bit ACK for reporting in the SER:

```
ALIAS 1 := ACK ACKNOWLEDGE ON OFF
```

When Device Word bit ACK is asserted, the SER report will show date and time of ACKNOWLEDGE ON. When Device Word bit ACK is deasserted, the SER report will show the date and time of ACKNOWLEDGE OFF. With this and other alias assignments, the SER record is easier for the operator to review. See *Relay Word Bit Aliases on page U.6.13* for additional details.

## Viewing and Clearing SER Reports

The device displays the SER records in ASCII format. To retrieve SER information, type **SER <Enter>** at Access Level 1 or higher to see a report similar to that shown in *Figure 9.1* (see *SER Command (Sequential Events Recorder Report) on page 7.18* for details on the **SER** command). *Figure 9.2* shows how to clear the SER report.

---

```
=>SER C <Enter>
SER Clear
Are you sure (Y,N)? Y<Enter>
Clearing Complete
```

```
=>
```

---

**Figure 9.2 Example Sequential Events Recorder (SER) Event Report**

**This page intentionally left blank**

# Section 10

## Testing and Troubleshooting

### Overview

---

Device testing is typically divided into two categories:

- Tests performed at the time the device is installed or commissioned
- Tests performed periodically once the device is in service

This section provides information on both types of testing for the SEL-2533 Annunciator. Because the SEL-2533 is equipped with extensive self-tests, traditional periodic test procedures may be eliminated or greatly reduced.

### Testing Tools

---

#### SER Command

The device provides a Sequential Events Recorder (SER) report that time-tags changes in device element and input/output contact states. The SER provides a convenient way to verify the pickup/dropout of any alarm point or state in the device. *Table 10.1* shows **SER** commands used to view and manage the SER report.

**Table 10.1 SER Command (Sequential Events Recorder Report)**

Command	Description	Access Level
<b>SER</b>	Use the <b>SER</b> command to display a chronological progression of all available SER rows (as many as 1024 rows); row 1 is the most recent triggered row and row 1024 is the oldest.	1
<b>SER row 1</b> <b>SER row 1 row 2</b> <b>SER date 1</b> <b>SER date 1 date 2</b>	Use the <b>SER</b> parameters (row or date) to display a chronological or reverse chronological subset of the SER rows (see <i>Table 7.27</i> ).	1
<b>SER C</b>	Use this command to clear/reset the SER records.	2
<b>SER D</b>	Use this command to see elements that are presently removed from the SER records due to chattering.	1

#### TARGET Command

Use the **TARGET** command to view the state of device control inputs, device outputs, and individual alarm points during a test. The **TAR** command displays the status of front-panel LEDs or Device Word bits and whether those LEDs or Device Word bits are asserted or deasserted, as shown in *Table 10.2*. The **TARGET** command is available at the serial ports and the front panel.

**Table 10.2 TAR Command Definitions**

Command	Description	Access Level
<b>TAR</b>	Use <b>TARGET</b> without parameters to display Device Word row 0 or last displayed target row.	1
<b>TAR ROW</b>	Adding <b>ROW</b> to the command to display the Device Word row number at the start of each line.	1
<b>TAR name ROW</b>	Display Device Word row with Device Word bit <i>name</i> .	1
<b>TAR n k ROW</b>	Show Device Word row number <i>n</i> (0–92) and repeat <i>k</i> times (1–32767).	1

The elements are represented as Device Word bits and are listed in rows of eight, called Device Word rows. All Device Word rows are described in *Appendix G: Device Word Bits*.

## Periodic Tests (Routine Maintenance)

---

Because the SEL-2533 is equipped with extensive self-tests, monitoring the front-panel status **ENABLED** LED after a self-test failure is the most effective maintenance task.

The SEL-2533 does not require specific routine tests, but your operation standards may require some degree of periodic device verification. If you need or would like to perform periodic device verification, the following checks are recommended.

### Device Status Verification

Use the front-panel **STATUS** or serial port **STATUS** command to verify that the device self-tests have not detected any **WARN** or **FAIL** conditions.

### Control Input Verification

Using the **TARGET** command, check input integrity and the control input status in the device. As you apply rated voltage to each input, the position in Row 21–22 corresponding to that input should change from zero (0) to one (1).

### Contact Output Verification

For each output contact, set the input to logical 1. This causes the output contact to close. For example, setting OUT01 = 1 causes the output OUT01 contact to close. Repeat this process for all contact outputs.

Make sure that each contact closure does what you want it to do in the annunciation, control, or trip circuit associated with that contact closure.

# Self-Test

---

The SEL-2533 runs a variety of self-tests. Two Device Word bits, HALARM and SALARM, signal self-test problems. SALARM is pulsed for software-programmed conditions such as settings changes, access level changes, and three consecutive unsuccessful password entry attempts. HALARM is pulsed for hardware self-test warnings. HALARM is continuously asserted (set to logical 1) for hardware self-test failures.

**NOTE:** After a device failure, all digital output contacts revert to their de-energized state, i.e., all normally open contacts (A contacts) open and all normally closed contacts (B contacts) close.

*Table 10.3* lists hardware self-tests. In the Alarm Status column, Latched indicates that HALARM is continuously asserted, Not Latched indicates that HALARM is pulsed for five seconds, and NA indicates that HALARM is not asserted. All hardware self-test failures generate a front-panel message that is automatically sent to the serial port. All hardware self-test failures (Latched entry in Alarm Status column) disable the device.

**Table 10.3 Device Self-Tests (Sheet 1 of 2)**

Self-Test	Description	Limits	Device Disabled on Failure	Alarm Status	Status Message
External RAM (power up)	Performs a read/write test on system RAM		Yes	Latched	RAM FAIL
External RAM (run time)	Performs a read/write test on system RAM		Yes	Latched	RAM FAIL
Internal RAM (power up)	Performs a read/write test on CPU RAM		Yes	Latched	RAM FAIL
Internal RAM (run time)	Performs a read/write test on CPU RAM		Yes	Latched	RAM FAIL
Critical RAM (settings)	Performs a checksum test on the active copy of settings	Checksum	Yes	Latched	RAM FAIL
Code RAM (run time)	Verify instruction matches Flash image		Yes	Latched	RAM FAIL
Code Flash (power up)	SELBOOT qualifies code with a checksum	Checksum	NA	NA	
Code Flash (run time)	Checksum is computed on the entire code base	Checksum	Yes	Latched	ROM FAIL
Data Flash (power up)	Checksum is computed on critical data	Checksum	Yes	Latched	NON_VOL FAIL
Data Flash (run time)	Checksum is computed on critical data	Checksum	Yes	Latched	NON_VOL FAIL
Front Panel (power up)	Fail if ID registers do not match expected or if FPGA programming is unsuccessful		Yes	Latched	HMI FAIL
I/O Board Failure	Check if I/O boards are in the correct location		Yes	Latched	I/O CARD_X FAIL
Exception Vector	CPU error		Yes	Latched	
+3.3 V Warn	Monitor +3.3 V power supply	3.16–3.43 V	No	Pulse, 5 sec	+3.3 V WARN (#.##W)
+3.3 V Fail	Monitor +3.3 V power supply	3.07–3.53 V	Yes	Latched	+3.3 V FAIL (#.##F)
+5 V Warn	Monitor +5 V power supply	4.75–5.25 V	No	Pulse, 5 sec	+5.0 V WARN (#.##W)

**Table 10.3 Device Self-Tests (Sheet 2 of 2)**

Self-Test	Description	Limits	Device Disabled on Failure	Alarm Status	Status Message
+5 V Fail	Monitor +5 V power supply	4.65–5.35 V	Yes	Latched	+5 V FAIL (#.##F)
+2.5 V Warn	Monitor +2.5 V power supply	2.40–2.6 V	No	Pulse, 5 sec	+2.5 V WARN (#.##W)
+2.5 V Fail	Monitor +2.5 V power supply	2.32–2.68 V	Yes	Latched	+2.5 V FAIL (#.##F)
+3.75 V Warn	Monitor +3.75 V power supply	3.6–3.9 V	No	Pulse, 5 sec	+3.75 V WARN (#.##W)
+3.75 V Fail	Monitor +3.75 V power supply	3.48–4.02 V	Yes	Latched	+3.75 V FAIL (#.##F)
-1.25 V Warn	Monitor -1.25 V power supply	-1.2 to -1.30 V	No	Pulse, 5 sec	-1.25 V WARN (#.##W)
-1.25 V Fail	Monitor -1.25 V power supply	-1.16 to -1.34 V	Yes	Latched	-1.25 V FAIL (#.##F)
Clock Battery Warn	Check clock battery		No	Not Latched	BATT WARN (#.##W)
RTC Chip	Unable to communicate with clock or fails time keeping test		No	Not Latched	CLOCK WARN
RTC Chip Internal RAM	Clock chip static RAM fails		No	Not Latched	CLOCK WARN
Mainboard FPGA (power up)	Fail if mainboard Field Programmable Gate Array does not accept program		Yes	Latched	FPGA FAIL
Mainboard FPGA (run time)	Fail on lack of data acquisition interrupts		Yes	Latched	FPGA FAIL
Back-plane comms diagnostics	Fail if GPSB is busy on entry to processing interval		Yes	Latched	GPSB FAIL

# Appendix A

## Firmware and Manual Versions

### Firmware

#### Determining the Firmware Version in Your Device

To determine the firmware version, use the **STA** command (see *STATUS Command (Device Self-Test Status) on page 7.21* for more information). The status report displays the Firmware Identification (FID) number.

The firmware revision number is after the R, and the release date is after the D. For example, the following is firmware revision number R100, date code November 29, 2010:

FID=SEL-2533-R100-V0-Z001001-D20101129

*Table A.1* and *Table A.2* list the firmware versions, revision descriptions, and corresponding instruction manual date codes. The most recent firmware version is listed first.

Starting with revisions published after March 1, 2022, changes that address security vulnerabilities are marked with “[Cybersecurity]”. Improvements to cybersecurity functionality that should be evaluated for potential cybersecurity importance are marked with “[Cybersecurity Enhancement]”.

**Table A.1 R200 Series Firmware Revision History**

Firmware Identification (FID) Number	Summary of Revisions	Manual Date Code
SEL-2533-R200-V0-Z002001-D20221007	<ul style="list-style-type: none"><li>➤ Revised the firmware to support a new CPU board. This new CPU board includes an optional fiber-optic serial port in place of the standard EIA-232 serial port (<b>PORT 2</b>). Previous versions cannot be upgraded to R200-V0.</li><li>➤ Modified the setting range for IRIG time source (TIME_SRC).</li><li>➤ Resolved an issue where Modbus communications may not work properly when enabled on <b>PORT 2</b> and <b>PORT 4</b> simultaneously.</li><li>➤ Resolved an issue where an alarm sequence may not work correctly after changing the alarm sequence setting (GR1_SEQ, GR2_SEQ, GR3_SEQ, or GR4_SEQ) from “A” to any other sequence setting.</li></ul>	20221007

**Table A.2 R100 Series Firmware Revision History**

Firmware Identification (FID) Number	Summary of Revisions	Manual Date Code
SEL-2533-R101-V0-Z001001-D20130910	<ul style="list-style-type: none"><li>➤ Corrected an issue with the DNP3 protocol implementation that would prevent configuration of remote bit trip/close pairs.</li></ul>	20130910
SEL-2533-R100-V0-Z001001-D20101129	<ul style="list-style-type: none"><li>➤ Initial version.</li></ul>	20101129

# Instruction Manual

---

The date code at the bottom of each page of this manual reflects the creation or revision date.

*Table A.3* lists the instruction manual release dates and a description of modifications. The most recent instruction manual revisions are listed at the top.

**Table A.3 Instruction Manual Revision History (Sheet 1 of 2)**

Revision Date	Summary of Revisions
20221007	<p><b>Section 1</b></p> <ul style="list-style-type: none"> <li>➤ Updated <i>Standard Features, Reporting/Monitoring Features, Options, and Accessories</i>.</li> <li>➤ Updated <i>Figure 1.1: Example Application</i> and <i>Figure 1.2 Inputs, Outputs, and Communications Ports</i>.</li> <li>➤ Updated <i>Communications</i>.</li> <li>➤ Updated <i>Establishing Communication</i>.</li> <li>➤ Updated <i>Specifications</i>.</li> </ul> <p><b>Section 2</b></p> <ul style="list-style-type: none"> <li>➤ Updated <i>Table 2.1: Communications Ports</i>.</li> <li>➤ Updated <i>Communications Card (SELECT EIA-232/485)</i>.</li> <li>➤ Updated <i>Figure 2.4: SEL-2533 Configured With the Optional EIA-232/EIA-485 Card and Repeat Contacts</i>.</li> <li>➤ Updated <i>IRIG-B Time-Code Input</i>.</li> <li>➤ Added <i>Fiber-Optic Serial Port</i>.</li> <li>➤ Added <i>Cables</i>.</li> <li>➤ Updated <i>Table 2.4: Communications Cables for Connecting the SEL-2533 to Other Devices</i>.</li> </ul> <p><b>Section 6</b></p> <ul style="list-style-type: none"> <li>➤ Updated <i>Time-Synchronization Source</i>.</li> <li>➤ Updated <i>Port Settings (SET P Command)</i>.</li> <li>➤ Updated <i>Table 6.12: Rear-Panel Fiber-Optic Serial (Multimode) Port Settings</i>.</li> </ul> <p><b>Section 7</b></p> <ul style="list-style-type: none"> <li>➤ Updated <i>Table 7.1: SEL-2533 Port Description</i>.</li> <li>➤ Updated <i>IRIG-B</i>.</li> <li>➤ Updated <i>MIRRORED BITS Protocol</i>.</li> </ul> <p><b>Section 10</b></p> <ul style="list-style-type: none"> <li>➤ Updated <i>Table 10.3: Device Self-Tests</i>.</li> </ul> <p><b>Appendix A</b></p> <ul style="list-style-type: none"> <li>➤ Updated for firmware version R200-V0.</li> </ul> <p><b>Appendix E</b></p> <ul style="list-style-type: none"> <li>➤ Updated <i>Overview</i>.</li> </ul>
20220520	<p><b>Section 2</b></p> <ul style="list-style-type: none"> <li>➤ Updated <i>Power Connections</i>.</li> </ul>
20210923	<p><b>Section 1</b></p> <ul style="list-style-type: none"> <li>➤ Added Canada ICES-001 (A) / NMB-001 (A) to <i>EMC Emissions in Specifications</i>.</li> </ul>
20210702	<p><b>Section 1</b></p> <ul style="list-style-type: none"> <li>➤ Updated <i>Dielectric Strength and Impulse Tests in Specifications</i>.</li> </ul>
20210324	<p><b>Section 1</b></p> <ul style="list-style-type: none"> <li>➤ Updated <i>Compliance in Specifications</i>.</li> </ul>
20200724	<p><b>Section 1</b></p> <ul style="list-style-type: none"> <li>➤ Updated <i>Compliance in Specifications</i>.</li> </ul>
20170526	<p><b>Section 1</b></p> <ul style="list-style-type: none"> <li>➤ Updated <i>Figure 1.1: Example Application</i>.</li> <li>➤ Updated <i>Compliance in Specifications</i>.</li> </ul>

**Table A.3 Instruction Manual Revision History (Sheet 2 of 2)**

<b>Revision Date</b>	<b>Summary of Revisions</b>
20150123	<p><b>Preface</b></p> <ul style="list-style-type: none"> <li>► Updated <i>Safety Information</i>.</li> </ul> <p><b>Section 1</b></p> <ul style="list-style-type: none"> <li>► Updated <i>Compliance section of Specifications</i>.</li> </ul>
20140603	<p><b>Section 2</b></p> <ul style="list-style-type: none"> <li>► Updated <i>Figure 2.5: SEL-2533 Connection Diagram for External Devices</i>.</li> </ul> <p><b>Section 7</b></p> <ul style="list-style-type: none"> <li>► Updated <i>Figure 7.1: Connection Between PC Serial Port and SEL-2533 Front-Panel Serial Port</i>.</li> <li>► Updated <i>Figure 7.2: Connection When Installation Includes Other SEL Devices</i>.</li> </ul>
20130910	<p><b>Appendix A</b></p> <ul style="list-style-type: none"> <li>► Revised for firmware version R101.</li> </ul>
20130423	<p><b>Section 1</b></p> <ul style="list-style-type: none"> <li>► Updated <i>Type Tests in Specifications</i>.</li> </ul>
20120203	<p><b>Section 7</b></p> <ul style="list-style-type: none"> <li>► Added <b>CAL</b> command description and password.</li> </ul>
20110622	<p><b>Section 1</b></p> <ul style="list-style-type: none"> <li>► Updated for 24V Power Supply UL certification.</li> </ul> <p><b>Section 2</b></p> <ul style="list-style-type: none"> <li>► Updated <i>Figure 2.2: Pins for Password Jumper and SELBOOT Jumper</i>.</li> </ul>
20101129	<ul style="list-style-type: none"> <li>► Initial version.</li> </ul>

**This page intentionally left blank**

# Appendix B

## Firmware Upgrade Instructions

### Overview

---

SEL will offer firmware upgrades to improve the performance of your device. Because the SEL-2533 Announcer stores firmware in Flash memory, changing physical components is not necessary. Upgrade the device firmware by downloading a file from a PC to the device via the front-panel serial port, as outlined in the following sections.

#### Required Equipment

Gather the following equipment before starting this firmware upgrade:

- Personal computer (PC)
- Terminal emulation software that supports Xmodem/CRC or 1k Xmodem/CRC protocol
- Serial communications cable (SEL-C234A or equivalent, or a null-modem cable)
- Disk containing the firmware file (e.g., r1002533.s19)

### Upgrade Instructions

The instructions below assume you have a working knowledge of your PC terminal emulation software. In particular, you must be able to modify your serial communications parameters (data rate, data bits, parity, etc.), select transfer protocol (Xmodem/CRC or 1k Xmodem/CRC), and transfer files (e.g., send and receive binary files).

- Step 1. If the device is in service, open the device control circuits.
- Step 2. Connect the PC to the front-panel serial port and enter Access Level 2.
- Step 3. Save the current device settings.

PC software (described in *Section 3: PC Software*) can be used to save and restore settings easily. Otherwise, use the following steps.

- a. Issue the following commands at the ASCII prompt:  
**SHO, SHO L, SHO G, SHO P, SHO R**, etc.
- b. Record all the settings for possible re-entry after the firmware upgrade.

Step 4. Start upgrading of firmware.

- a. Issue the **L\_D** command to the device.
- b. Type **Y <Enter>** at the following prompt:  
Disable device to receive firmware (Y/N)?
- c. Type **Y <Enter>** at the following prompt:  
Are you sure (Y,N)?  
The device will send the **!>** prompt.

**NOTE:** If you have difficulty at 115200 bps, choose a slower data transfer rate (e.g., 38400 bps or 57600 bps). Be sure to match the relay and PC data rates.

Step 5. Increase the data rate to reduce the upgrade time.

- a. Type **BAU 115200 <Enter>**.  
This will change the data rate of the communications port to 115200.
- b. Change the data rate of the PC to 115200 to match the device.

Step 6. Begin the transfer of new firmware to the device by issuing the **REC** command.

Step 7. Type **Y** to erase the existing firmware or press **<Enter>** to abort.

Step 8. Press any key (e.g., **<Enter>**) when the device sends a prompt.

Step 9. Start the file transfer.

Select the send file option in your communications software, e.g., use the Xmodem or 1k Xmodem protocol, and send the file that contains the new firmware (e.g., r1002533.s19).

The file transfer takes approximately 10 minutes at 115200 baud and with 1k Xmodem transfer protocol. After the transfer is complete, the device will reboot and return to Access Level 0.

*Figure B.1 shows the entire process.*

```
=>>L_D <Enter>
Disable device to receive firmware(Y/N) ? Y <Enter>
Are you sure (Y,N) ? Y <Enter>
Device Disabled
!>BAU 115200 <Enter>
!>REC <Enter>
Caution! This command erases the firmware.
If you erase the firmware then new firmware
must be loaded before returning the IED to service.
Are you sure you want to erase the existing firmware(Y/N)? Y <Enter>
Erasing firmware.
Erase successful.
Press any key to begin transfer and then start transfer at the terminal. <Enter>
Upload completed successfully. Attempting a restart.
```

**Figure B.1 Firmware File Transfer Process**

Step 10. The device will illuminate the **ENABLED** front-panel LED if the device settings were retained through the download.

If the **ENABLED** LED is illuminated, proceed to *Step 11*.

If the **ENABLED** LED is not illuminated, use the following procedure to restore the factory default settings:

- a. Set the communications software settings to 9600 bps, 8 data bits, and 1 stop bit.
- b. Enter Access Level 2 by issuing the **2AC** command.

- c. Issue the **R\_S** command to restore the factory default settings. The relay will then reboot with the factory default settings.
- d. Enter Access Level 2.
- e. Restore device settings back to the settings saved in *Step 3*.

Step 11. Change the PC data rate to match that of the device prior to *Step 5*, and enter Access Level 2.

Step 12. Issue the **STATUS** command; verify all device self-test results are OK.

The device is now ready for your commissioning procedure.

**This page intentionally left blank**

# Appendix C

## SEL Communications Processors

### SEL Communications Protocols

The SEL-2533 Annunciator supports the SEL protocols and command sets shown in *Table C.1*.

**Table C.1 Supported Serial Command Sets**

Command Set	Description
SEL ASCII	Use this protocol to send ASCII commands and receive ASCII responses that are readable with an appropriate terminal emulation program.
SEL Compressed ASCII	Use this protocol to send ASCII commands and receive Compressed ASCII responses that are comma-delimited for use with spreadsheet and database programs or for use by Intelligent Electronic Devices (IEDs).
SEL Fast Meter	Use this protocol to send binary commands and receive binary meter and target responses.
SEL Fast Operate	Use this protocol to receive binary control commands.
SEL Fast SER	Use this protocol to receive binary Sequential Events Recorder (SER) unsolicited responses.

#### SEL ASCII Commands

SEL ASCII commands were designed for communications between the device and a human operator via keyboard and monitor or a printing terminal. A PC with a serial port can also use the SEL ASCII protocol to communicate with the device, collect data, and issue commands.

#### SEL Compressed ASCII Commands

The SEL-2533 supports a subset of SEL ASCII commands identified as Compressed ASCII commands. Each of these commands results in a comma-delimited message that includes a checksum field. Most spreadsheet and database programs can directly import comma-delimited files. Devices with embedded processors connected to the device can execute software to parse and interpret comma-delimited messages without expending the customization and maintenance labor needed to interpret nondelimited messages. The device calculates a checksum for each line by numerically summing all of the bytes that precede the checksum field in the message. The program that uses the data can detect transmission errors in the message by summing the characters of the received message and comparing this sum against the received checksum.

Most commands are available only in SEL ASCII or Compressed ASCII format. Selected commands have versions in both standard SEL ASCII and Compressed ASCII formats. Compressed ASCII reports generally have fewer

characters than conventional SEL ASCII reports, as compressed reports reduce blanks, tabs, and other white space between data fields to a single comma.

*Table C.2* lists Compressed ASCII commands and the contents of the command responses.

**Table C.2 Compressed ASCII Commands**

Command	Response	Access Level
<b>CASCII</b>	Configuration data of all Compressed ASCII commands available at Access Level 1 or higher	0
<b>CSTATUS</b>	Relay status	1
<b>ID</b>	Relay identification	0
<b>SNS</b>	ASCII names for SER data reported in Fast Meter	0

## Interleaved ASCII and Binary Messages

SEL devices have two separate data streams that share the same physical serial port. Human data communications with the device consist of ASCII character commands and reports that are viewable with a terminal or terminal emulation package. The binary data streams can interrupt the ASCII data stream to obtain information. The ASCII data stream continues after the interruption. This mechanism uses a single communications channel for ASCII communications (transmission of an event report, for example) interleaved with short bursts of binary data to support fast acquisition of metering data. The device connected to the other end of the link requires software that uses the separate data streams to exploit this feature. However, you do not need a device to interleave data streams to use the binary or ASCII commands. Note that XON, XOFF, and CAN operations operate on only the ASCII data stream.

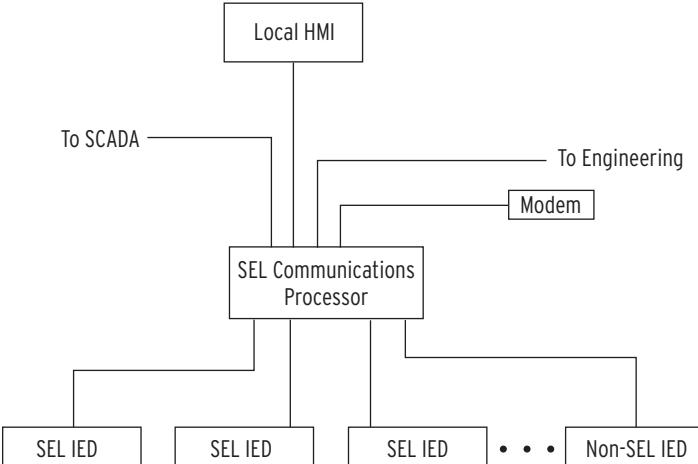
An example of interleaved data stream use is seen in SEL-2533 and SEL communications processor communications. SEL communications processors perform autoconfiguration by using a single data stream and SEL Compressed ASCII and binary messages. In subsequent operations, the SEL communications processor uses the binary data stream for Fast Meter and Fast Operate messages in order to populate a local database and perform SCADA operations. You can use the binary data stream to connect transparently to the SEL-2533 and to use the ASCII data stream for commands and responses.

## SEL Fast Meter, Fast Operate, and Fast SER

SEL Fast Meter is a binary message that you solicit with binary commands. Fast Operate is a binary message for control. The device can also send unsolicited Fast SER messages automatically. If the device is connected to an SEL communications processor, these messages provide the mechanism that the communications processor uses for SCADA functions that occur simultaneously with ASCII interaction.

# SEL Communications Processor

The SEL communications processor is a powerful tool for system integration and automation. The SEL-2030 series and the SEL-2020 communications processors are similar, except that the SEL-2030 series has two slots for network protocol cards. These devices provide a single point of contact for integration networks with a star topology, as shown in *Figure C.1*.

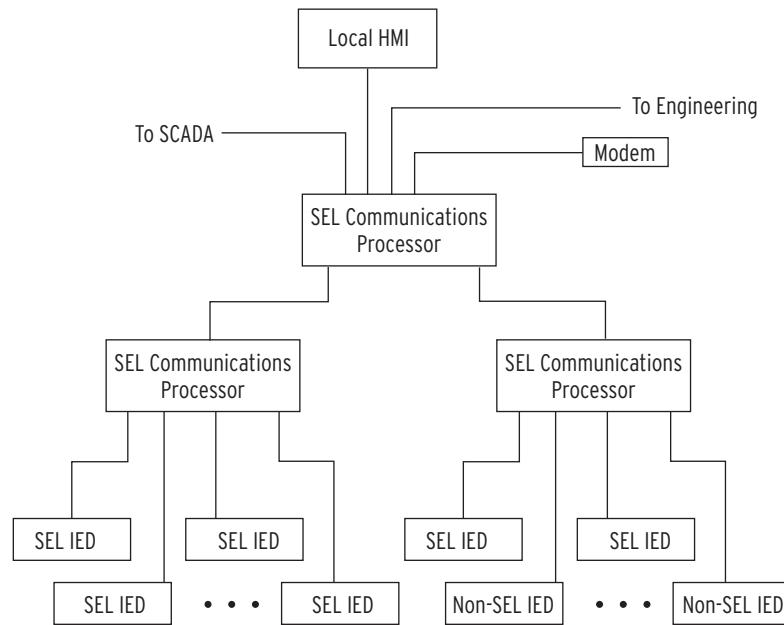


**Figure C.1 SEL Communications Processor Star Integration Network**

In the star topology network in *Figure C.1*, the SEL communications processor offers the following substation integration functions:

- Collection of real-time data from SEL and non-SEL IEDs
- Calculation, concentration, and aggregation of real-time IED data into databases for SCADA, HMI, and other data consumers
- Access to the IEDs for engineering functions including configuration, report data retrieval, and control through local serial, remote dial-in, and Ethernet network connections
- Distribution of IRIG-B time synchronization signal to IEDs based on external IRIG-B input, internal clock, or protocol interface
- Simultaneous collection of SCADA data and engineering connection to SEL IEDs over a single cable
- Automated dial-out on alarms

The SEL communications processors have 16 serial ports and a front port. This port configuration does not limit the size of a substation integration project, because you can create a multilayered solution as shown in *Figure C.2*. In this multilayered system, the lower-tier SEL communications processors forward data to the upper-tier SEL communications processor, which serves as the central point of access to substation data and substation IEDs.



**Figure C.2 Multitiered SEL Communications Processor Architecture**

You can add additional communications processors to provide redundancy and eliminate possible single points of failure. SEL communications processors provide an integration solution with a reliability comparable to that of SEL relays. In terms of MTBF (Mean Time Between Failures), SEL communications processors are 100 to 1000 times more reliable than computer-based and industrial technology-based solutions.

Configuration of an SEL communications processor is different from other general-purpose integration platforms. You can configure SEL communications processors with a system of communication-specific keywords and data movement commands, rather than programming in C or another general-purpose computer language. SEL communications processors offer the protocol interfaces listed in *Table C.3*.

**Table C.3 SEL Communications Processors Protocol Interfaces**

Protocol	Connect to
DNP 3.00 Level 2 Outstation	DNP 3.00 masters
Modbus® RTU Protocol	Modbus masters
SEL ASCII/Fast Message	SEL protocol masters
SEL ASCII/Fast Message Master	SEL protocol slaves including other communications processors and SEL relays
ASCII and Binary auto messaging	SEL and non-SEL IED master and slave devices
Modbus Plus	Modbus Plus peers with global data and Modbus Plus masters
FTP (File Transfer Protocol)	FTP clients
Telnet	Telnet servers and clients

# SEL Communications Processor and Device Architecture

---

You can apply SEL communications processors and SEL devices in a limitless variety of applications that integrate, automate, and improve station operation. Most system integration architectures utilizing SEL communications processors involve either developing a star network or enhancing a multidrop network.

## Developing Star Networks

*Figure C.1* shows the simplest architecture using both the SEL-2533 and an SEL communications processor. In this architecture, the SEL communications processor collects data from the SEL-2533 and other station IEDs. The SEL communications processor acts as a single point of access for local and remote data consumers (local HMI, SCADA, engineers). The communications processor also provides a single point of access for engineering operations, including configuration and the collection of report-based information.

By configuring a data set optimized to each data consumer, you can significantly increase the utilization efficiency on each link. A system that uses an SEL communications processor to provide a protocol interface to an RTU will have a shorter lag time (data latency). Communications overhead is much less for a single data exchange conversation to collect all substation data (from a communications processor) than for many conversations required to collect data directly from each individual IED. You can further reduce data latency by connecting any SEL communications processor directly to the SCADA master and eliminating redundant communication processing in the RTU.

The SEL communications processor is responsible for the protocol interface, so you can install, test, and even upgrade the system in the future without disturbing protective devices and other station IEDs. This insulation of the protective devices from the communications interface assists greatly in situations where different departments are responsible for SCADA operation, communication, and protection.

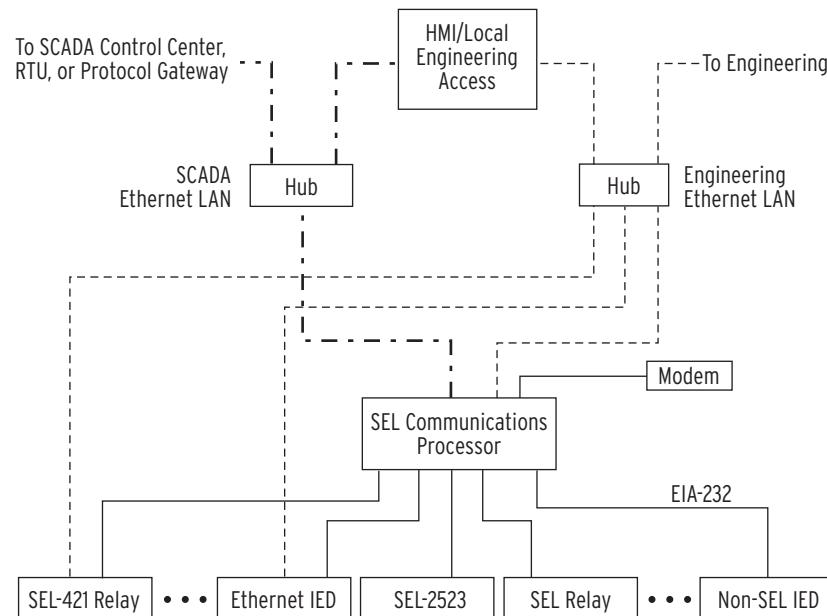
The engineering connection can use either an Ethernet network connection through the Ethernet Processor or a serial port connection. This versatility will accommodate the channel that is available between the station and the engineering center. SEL software can use either a serial port connection or an Ethernet network connection from an engineering workstation to the devices in the field.

## Enhancing Multidrop Networks

You can also use an SEL communications processor to enhance a multidrop architecture similar to the one shown in *Figure C.3*. In this example, the SEL communications processor enhances a system that uses the Ethernet Processor with an Ethernet HMI multidrop network. In the example, there are two Ethernet networks, the SCADA LAN and the Engineering LAN. The SCADA LAN provides real-time data directly to the SCADA Control Center via a protocol gateway and to the HMI (Human Machine Interface).

In this example, the SEL communications processor provides the following enhancements when compared to a system that employs only the multidrop network:

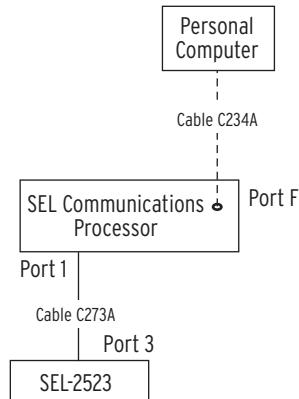
- Ethernet access for IEDs with serial ports
- Backup engineering access through the dial-in modem
- IRIG-B time signal distribution to all station IEDs
- Integration of IEDs without Ethernet
- Single point of access for real-time data for SCADA, HMI, and other uses
- Significant cost savings by use of existing IEDs with serial ports



**Figure C.3 Enhancing Multidrop Networks With SEL Communications Processors**

# SEL Communications Processor Example

This example demonstrates the data and control points available in the SEL communications processor when you connect an SEL-2533. The physical configuration used in this example is shown in *Figure C.4*.



**Figure C.4 Example of SEL Device and SEL Communications Processor**

*Table C.4* shows the PORT 1 settings for the SEL communications processor.

**Table C.4 SEL Communications Processor PORT 1 Settings**

Setting Name	Setting	Description
DEVICE	S	Connected device is an SEL device
CONFIG	Y	Allow autoconfiguration for this device
PORTRID	<i>Device 1</i>	Name of connected device <sup>a</sup>
BAUD	19200	Channel speed of 19200 bits per second <sup>a</sup>
DATABIT	8	Eight data bits <sup>a</sup>
STOPBIT	1	One stop bit
PARITY	N	No parity
RTS_CTS	N	Hardware flow control enabled
TIMEOUT	30	Idle timeout that terminates transparent connections of 30 seconds

<sup>a</sup> Automatically collected by the SEL communications processor during autoconfiguration.

## Data Collection

The SEL communications processor is configured to collect data from the SEL-2533, using the list in *Table C.5*.

**Table C.5 SEL Communications Processor Data Collection Automessages**

Message	Data Collected
20METER	Power system metering data
20TARGET	Selected Relay Word bit elements
20STATUS	Status Command (ASCII)

*Table C.6* shows the SEL communications processor automessages (**SET A**) settings for data collection from the SEL-2533.

**Table C.6 SEL Communications Processor PORT 1 Automatic Messaging Settings**

Setting Name	Setting	Description
AUTOBUF	Y	Save unsolicited messages
STARTUP	ACC\nOTTER\n	Automatically log-in at Access Level 1
SEND_OPER	Y	Send Fast Operate messages for remote bit and breaker bit control
REC_SER	Y	Enable automatic sequential event recorder data collection
NOCONN	NA	No SELOGIC® control equation entered to selectively block connections to this port
MSG_CNT	2	Two automessages
ISSUE1	P00:00:01:0	Issue Message 1 every second
MESG1	20METER	Collect metering data
ISSUE2	P00:00:01:0	Issue Message 2 every second
MESG2	20TARGET	Collect Relay Word bit data
ARCH_EN	N	Archive memory disabled
USER	0	No USER region registers reserved

Table C.7 shows the map of regions in the SEL communications processor for data collected from the SEL-2533. Use the **MAP n** command to view these data.

**Table C.7 SEL Communications Processor PORT 1 Region Map**

Region	Data Collection Message Type	Region Name	Description
D1	Binary	METER	Device metering data
D2	Binary	TARGET	Device Word bit data
D3–D8	n/a	n/a	Unused
A1–A3	n/a	n/a	Unused
USER	n/a	n/a	Unused

## Device Fast Meter Data

Table C.8 shows the list of meter data available in the SEL communications processor and the location and data type for the memory areas within D1 (Data Region 1) cards. The type field indicates the data type and size. The *int* type is a 16-bit integer. The *float* type is a 32-bit IEEE floating point number. Use the **VIE n:D1** command to view these data.

**Table C.8 Communications Processor METER Region Map for the SEL-2533 (Sheet 1 of 2)**

Item	Starting Address	Type
_YEAR	2000h	int
DAY_OF_YEAR	2001h	int
TIME(ms)	2002h	int[2]
MONTH	2004h	char
DATE	2005h	char
YEAR	2006h	char
HOUR	2007h	char

**Table C.8 Communications Processor METER Region Map for the SEL-2533**  
(Sheet 2 of 2)

Item	Starting Address	Type
MIN	2008h	char
SECONDS	2009h	char
MSEC	200Ah	int

## Device Word Bits Information

**Table C.9 Communications Processor TARGET Region**

Address	Device Word Bits (in Bits 7-0)							
	7	6	5	4	3	2	1	0
2804h								STSET
2805h								See Table G.1, Row 0
2806h								See Table G.1, Row 1
2807h								See Table G.1, Row 2
2808h								See Table G.1, Row 3
2809h								See Table G.1, Row 4
280Ah								See Table G.1, Row 5
280Bh								See Table G.1, Row 6
280Ch								See Table G.1, Row 6
280Dh								See Table G.1, Row 8
280Eh								See Table G.1, Row 9
280Fh								See Table G.1, Row 10
•								•
•								•
•								•
2866h								See Table G.1, Row 119

## Control Points

The SEL communications processor can automatically pass control messages, called Fast Operate messages, to the SEL-2533. You must enable Fast Operate messages by using the FASTOP setting in the SEL-2533 port settings for the port connected to the SEL communications processor. You must also enable Fast Operate messages in the SEL communications processor by setting the automessage setting SEND\_OPER equal to Y.

When you enable Fast Operate functions, the SEL communications processor automatically sends messages to the device for changes in remote bits RB01–RB16 on the corresponding SEL communications processor port. In this example, if you set RB01 on PORT1 in the SEL communications processor, it automatically sets RB01 in the SEL-2533.

There are no breaker bits in the SEL-2533.

**This page intentionally left blank**

# Appendix D

## DNP3 Communications

---

### Overview

---

The SEL-2533 Announcer provides a Distributed Network Protocol Version 3.0 (DNP3) Level 2 Outstation interface for direct serial connections to the device.

This section covers the following topics:

- Introduction to DNP3
- DNP3 in the SEL-2533
- DNP3 Documentation, Object Tables, and Data Maps

### Introduction to DNP3

---

A supervisory Control and Data Acquisition (SCADA) manufacturer developed the first versions of DNP from the lower layers of IEC 60870-5. Originally designed for use in telecontrol applications, Version 3.0 of the protocol has also become popular for local substation data collection. DNP3 is one of the protocols included in the IEEE® Recommended Practice for Data Communication between Remote Terminal Units (RTUs) and Intelligent Electronic Devices (IEDs) in a Substation.

The DNP Users Group maintains and publishes DNP3 standards. See the DNP Users Group website, [www.dnp.org](http://www.dnp.org), for more information on standards, implementers, and tools for working with DNP3.

#### DNP3 Specifications

DNP3 is a feature-rich protocol with many ways to accomplish tasks, defined in a series of specifications known as the Basic 4. A companion specification called the Subset Definitions simplifies DNP3 implementation by providing three standard interoperable implementation levels. The levels are listed in *Table D.1*.

**Table D.1 DNP3 Implementation Levels**

<b>Level</b>	<b>Description</b>	<b>Equipment Types</b>
1	Simple: limited communication requirements	Meters, simple IEDs
2	Moderately complex: monitoring and metering devices and multifunction devices that contain more data	Protective relays, RTUs
3	Sophisticated: devices with great amounts of data or complex communications requirements	Large RTUs, SCADA masters

Each level is a proper superset of the previous lower-numbered level. A higher-level device can act as a master to a lower-level device, but can only use the data types and functions implemented in the lower level device. For example, a typical SCADA master is a Level 3 device and can use Level 2 (or lower) functions to poll a Level 2 (or lower) device for Level 2 (or lower) data. Similarly, a lower-level device can poll a higher-level device, but the lower level device can only access the features and data available to its level.

In addition to the Basic 4 and the Subset Definitions, the protocol is further refined by conformance requirements, optional features, and a series of technical bulletins. The technical bulletins supplement the specifications with discussion and examples of specific features of DNP3.

## Data Handling

### Objects

DNP3 uses a system of data references called objects, defined by the Basic 4 standard object library. Each subset level specification requires a minimum implementation of object types and recommends several optional object types. DNP3 object types, commonly referred to as objects, are specifications for the type of data the object carries. An object can include a single value or more complex data. Some objects serve as shorthand references for special operations, including collections of data, time synchronization, or even all data within the DNP3 device.

If there can be more than one instance of a type of object, then each instance of the object includes an index that makes it unique. For example, each binary status point (Object 1) has an index. If there are 16 binary status points, these points are Object 1, Index 0 through Object 1, Index 15.

Each object also includes multiple versions called variations. For example, Object 1 (binary inputs) has three variations: 0, 1, and 2. You can use variation 0 to request all variations, variation 1 to specify binary input values only, and variation 2 to specify binary input values with status information.

Each DNP3 device has both a list of objects and a map of object indices. The list of objects defines the available objects, variations, and qualifier codes. The map defines the indices for objects that have multiple instances and defines what data or control points correspond with each index.

A master initiates all DNP3 message exchanges except unsolicited data. DNP3 terminology describes all points from the perspective of the master. Binary points for control that move from the master to the remote are called Binary Outputs, while binary status points within the remote are called Binary Inputs.

## Function Codes

Each DNP3 message includes a function code. Each object has a limited set of function codes that a master may use to manipulate the object. The object listing for the device shows the permitted function codes for each type of object. The most common DNP3 function codes are listed in *Table D.2*.

**Table D.2 Selected DNP3 Function Codes**

Function Code	Function	Description
1	Read	Request data from the remote
2	Write	Send data to the remote
3	Select	First part of a select-before-operate operation
4	Operate	Second part of a select-before-operate operation
5	Direct operate	One-step operation with reply
6	Direct operate, no reply	One-step operation with no reply

## Qualifier Codes and Ranges

DNP3 masters use qualifier codes and ranges to make requests for specific objects by index. Qualifier codes specify the style of range, and the range specifies the indices of the objects of interest. DNP3 masters use qualifier codes to compose the shortest, most concise message possible when requesting points from a DNP3 remote.

For example, the qualifier code 01 specifies that the request for points will include a start address and a stop address. Each of these two addresses uses two bytes. An example request using qualifier code 01 might have the four hexadecimal byte range field, 00h 04h 00h 10h, which specifies points in the range 4 to 16.

## Access Methods

DNP3 has many features that help obtain maximum possible message efficiency. DNP3 masters send requests with the least number of bytes using special objects, variations, and qualifiers that reduce the message size. Other features eliminate the continual exchange of static (unchanging) data values. These features optimize use of bandwidth and maximize performance over a connection of any speed.

DNP3 event data collection eliminates the need to use bandwidth to transmit values that have not changed. Event data are time-stamped records that show when observed measurements changed. For binary points, the remote device (DNP3 outstation) logs changes from logical 1 to logical 0 and from logical 0 to logical 1. For analog points, the remote device logs changes that exceed a dead band. DNP3 remote devices collect event data in a buffer that either the master can request or the device can send to the master without a request message. Data sent from the remote to the master without a polling request are called unsolicited data.

DNP3 data fit into one of four event classes: 0, 1, 2, or 3. Class 0 is reserved for reading the present value data (static data). Classes 1, 2, and 3 are event data classes. The meaning of Classes 1 through 3 is arbitrary and defined by the application at hand. With remotes that contain great amounts of data or in large systems, the three event classes provide a framework for prioritizing different types of data. For example, you can poll once a minute for Class 1 data, once an hour for Class 2 data, and once a day for Class 3 data.

DNP3 also supports static polling: simple polling of the present value of data points within the remote. By combining event data, unsolicited polling, and static polling, you can operate your system in one of the four access methods shown in *Table D.3*.

The access methods listed in *Table D.3* are listed in order of increasing communication efficiency. With various tradeoffs, each method is less demanding of communication bandwidth than the previous one. For example, unsolicited report-by-exception consumes less communication bandwidth than polled report-by-exception because that method does not require polling messages from the master. In order to properly evaluate which access method provides optimum performance for your application, you must also consider overall system size and the volume of data communication expected.

**Table D.3 DNP3 Access Methods**

Access Method	Description
Polled static	Master polls for present value (Class 0) data only
Polled report-by-exception	Master polls frequently for event data and occasionally for Class 0 data
Unsolicited report-by-exception	Remote devices send unsolicited event data to the master, and the master occasionally polls for Class 0 data
Quiescent	Master never polls and relies on unsolicited reports only

## Binary Control Operations

DNP3 masters use Object 12, control device output block, to perform DNP3 binary control operations. The control device output block has both a trip/close selection and a code selection. The trip/close selection allows a single DNP3 index to operate two related control points such as trip and close or raise and lower. Trip/close pair operation is not recommended for new DNP3 devices, but is often included for interoperability with older DNP3 master implementations.

The control device output block code selection specifies either a latch or pulse operation on the point. In many cases, DNP3 remotes have only a limited subset of the possible combinations of the code field. Sometimes, DNP3 remotes assign special operation characteristics to the latch and pulse selections. *Table D.12* describes control point operation for the SEL-2533.

## Conformance Testing

In addition to the protocol specifications, the DNP Users Group has approved conformance-testing requirements for Level 1 and Level 2 devices. Some implementers perform their own conformance specification testing, while some contract with independent companies to perform conformance testing.

Conformance testing does not always guarantee that a master and remote will be fully interoperable (that is, work together properly for all implemented features). Conformance testing does help to standardize the testing procedure and move the DNP3 implementers toward a higher level of interoperability.

## DNP3 Serial Network Issues

### Data Link Layer Operation

DNP3 employs a three-layer version of the seven-layer OSI (Open Systems Interconnect) model called the enhanced performance architecture. The layer definition helps to categorize functions and duties of various software components that make up the protocol. The middle layer, the Data Link Layer, includes several functions for error checking and media access control.

A feature called data link confirmation is a mechanism that provides positive confirmation of message receipt by the receiving DNP3 device. While this feature helps you recognize a failed device or failed communications link quickly, it also adds significant overhead to the DNP3 conversation. You should consider whether you require this link integrity function in your application at the expense of overall system speed and performance.

The DNP3 technical bulletin (*DNP Confirmation and Retry Guidelines 9804-002*) on confirmation processes recommends against using data link confirmations because these processes can add to traffic in situations where communications are marginal. The increased traffic will reduce connection throughput further, possibly preventing the system from operating properly.

### Network Medium Contention

When more than one device requires access to a single (serial) network medium, you must provide a mechanism to resolve the resulting network medium contention. For example, unsolicited reporting results in network medium contention if you do not design your serial network as a star topology of point-to point connections or use carrier detection on a multidrop network.

To avoid collisions among devices trying to send messages, DNP 3.00 includes a collision avoidance feature. Before sending a message, a DNP 3.00 device listens for a carrier signal to verify that no other node is transmitting data. The device transmits if there is no carrier or waits for a random time before transmitting. However, if two nodes both detect a lack of carrier at the same instant, these two nodes could begin simultaneous transmission of data and cause a data collision. If your serial network allows for spontaneous data transmission including unsolicited event data transmissions, you also must use application confirmation to provide a retry mechanism for messages lost due to data collisions.

# DNP3 in the SEL-2533

---

The SEL-2533 is a DNP3 Level 2 remote (outstation) device.

## Data Access

*Table D.4* lists DNP3 data access methods along with corresponding SEL-2533 settings. You must select a data access method and configure each DNP3 master for polling as specified.

**Table D.4 DNP3 Access Methods**

**NOTE:** Because unsolicited messaging is problematic in most circumstances, SEL recommends using the polled report-by-exception access method to maximize performance and minimize risk of configuration problems.

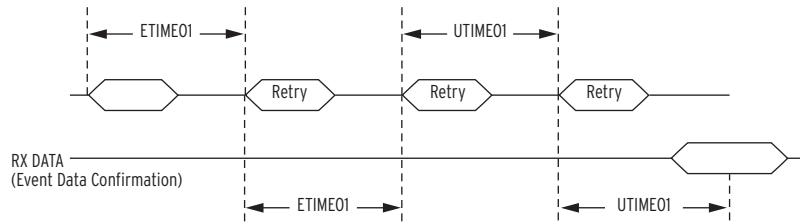
Access Method	Master Polling	SEL-2533 Settings
Polled static	Class 0	Set ECLASSB1 to 0; UNSOL1 to No
Polled report-by-exception	Class 0 occasionally, Class 1, 2, 3 frequently	Set ECLASSB1 to the desired event class; UNSOL1 to No
Unsolicited report-by-exception	Class 0 occasionally, optional Class 1, 2, 3 less frequently; mainly relies on unsolicited messages	Set ECLASSB1 to the desired event class; set UNSOL1 to Yes and PUNSOL1 to Yes or No
Quiescent	Class 0, 1, 2, 3 never; relies completely on unsolicited messages	Set ECLASSB1 to the desired event class; set UNSOL1 and PUNSOL1 to Yes

In both the unsolicited report-by-exception and quiescent polling methods shown in *Table D.4*, you must make a selection for the PUNSOL1 setting. This setting enables or disables unsolicited data reporting at power up. If your DNP3 master can send a message to enable unsolicited reporting on the SEL-2533, you should set PUNSOL1 to No.

While automatic unsolicited data transmission on power up is convenient, this can cause problems if your DNP3 master is not prepared to start receiving data immediately on power up. If the master does not acknowledge the unsolicited data with an Application Confirm, the device will resend the data until it is acknowledged. On a large system, or in systems where the processing power of the master is limited, you may have problems when several devices simultaneously begin sending data and waiting for acknowledgement messages.

The SEL-2533 allows you to set the conditions for transmitting unsolicited event data on a class-by-class basis. It also allows you to assign points to event classes on a point-by-point basis (see *Configurable Data Mapping on page D.10*). You can prioritize data transmission with these event class features. For example, you might place high-priority points in event class 1 and set it with low thresholds (NUMEVE1 and AGEEVE1 settings) so that changes to these points will be sent to the master quickly. You may then place low priority data in event class 2 with higher thresholds.

If the SEL-2533 does not receive an Application Confirm in response to unsolicited data, it will wait for ETIMEO1 seconds and then repeat the unsolicited message. In order to prevent clogging of the network with unsolicited data retries, the SEL-2533 uses the URETRY1 and UTIMEO1 settings to increase retry time when the number of retries set in URETRY1 is exceeded. After URETRY1 has been exceeded, the SEL-2533 pauses UTIMEO1 seconds and then transmits the unsolicited data again. *Figure D.1* provides an example with URETRY1 = 2.



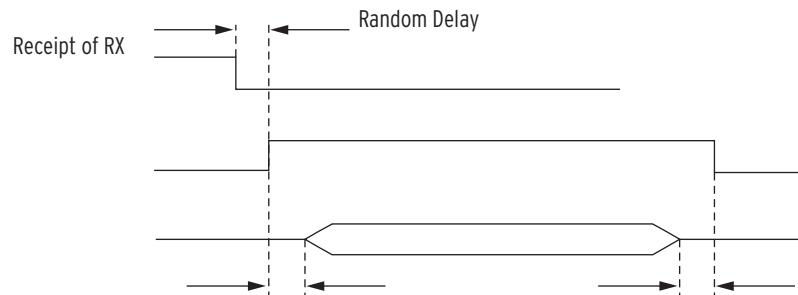
**Figure D.1 Application Confirmation Timing With URETRYn = 2**

## Collision Avoidance

If your application uses unsolicited reporting on a serial network, you must select a half-duplex medium or a medium that includes carrier detection to avoid data collisions. EIA-485 two-wire networks are half-duplex. EIA-485 four-wire networks do not provide carrier detection, while EIA-232 systems can support carrier detection.

The SEL-2533 uses Application Confirmation messages to guarantee delivery of unsolicited event data before erasing the local event data buffer. Data collisions are typically resolved when messages are repeated until confirmed.

The SEL-2533 pauses for a random delay between the settings MAXDLY and MINDLY when it detects a carrier through data on the receive line or the CTS pin. For example, if you use the settings of 0.10 seconds for MAXDLY and 0.05 seconds for MINDLY, the SEL-2533 will insert a random delay of 50 to 100 ms (milliseconds) between the end of carrier detection and the start of data transmission (see *Figure D.2*).



**Figure D.2 Message Transmission Timing**

## Transmission Control

If you use a media transceiver (for example, EIA-232 to EIA-485) or a radio system for your DNP 3.00 network, you may need to adjust data transmission properties. Use the PREDLY and POSTDLY settings to provide a delay between RTS signal control and data transmission (see *Figure D.2*). For example, an EIA-485 transceiver typically requires 10 to 20 ms to change from receive to transmit. If you set the pre-delay to 30 ms, you will avoid data loss resulting from data transmission beginning at the same time as RTS signal assertion.

## Event Data

DNP 3.00 event data objects contain change-of-state and time-stamp information that the SEL-2533 collects and stores in a buffer. Points assigned in the Binary Input Map that are also assigned in the Sequential Events Recorder (SER) settings carry the time stamp of actual occurrence. Binary input points not assigned in the SER settings will carry a time stamp based on the DNP map scan time. This may be significantly delayed from when the original source changed and should not be used for sequence-of-events determination. The DNP map is scanned approximately once per second to

generate events. You can configure the SEL-2533 to either report the data without a polling request from the master (unsolicited data) or hold the data until the master requests it with an event poll message.

**NOTE:** Most RTUs that act as substation DNP 3.00 masters perform an event poll that collects event data of all classes simultaneously. You must confirm that the polling configuration of your master allows independent polling for each class before implementing separate classes in the SEL-2533.

For event data collection you must also consider and enter appropriate settings for dead band and scaling operation on analog points shown in *Table D.6*. You can:

- Set and use default dead band and scaling according to data type
- Use a custom data map to select dead bands on a point-by-point basis

See *Configurable Data Mapping on page D.10* for a discussion of how to set scaling and dead-band operation on a point-by-point basis.

The SEL-2533 uses the NUMEVE<sub>n</sub> and AGEEVE<sub>n</sub> settings to decide when to send unsolicited data to the master. The device sends an unsolicited report when the total number of events accumulated in the event buffer for master *n* reaches NUMEVE<sub>n</sub>. The device also sends an unsolicited report if the age of the oldest event in the master *n* buffer exceeds AGEEVE<sub>n</sub>. The SEL-2533 has the buffer capacities listed in *Table D.5*.

**Table D.5 SEL-2533 Event Buffer Capacity**

Type	Maximum Number of Events
Binary	1024

## Binary Controls

The SEL-2533 provides more than one way to control individual points. The SEL-2533 maps incoming control points either to remote bits or to internal command bits that cause alarm point operations. *Table D.12* lists control points and control methods available in the SEL-2533.

A DNP 3.00 technical bulletin (*Control Relay Output Block Minimum Implementation 9701-002*) recommends that you use one point per Object 12, control block output device. You can use this method to perform Pulse On, Pulse Off, Latch On, and Latch Off operations on selected remote bits.

If your master does not support the single-point-per-index messages or single operation database points, you can use the trip/close operation or use the code field in the DNP 3.00 message to specify operation of the points shown in *Control Point Operation on page D.17*.

## Time Synchronization

The accuracy of DNP 3.00 time synchronization is insufficient for most protection and oscillography needs. DNP 3.00 time synchronization provides backup time synchronization in the event the device loses primary synchronization through the IRIG-B input. You can enable time synchronization with the TIMERQ<sub>n</sub> setting and then use Object 50, Variation 1, and Object 52, Variation 2, to set the time via the Session *n* DNP 3.00 master.

By default, the SEL-2533 accepts and ignores time set requests (TIMERQ1=I). (This mode allows the SEL-2533 to use a high accuracy, IRIG time source, but still interoperate with DNP 3.00 masters that send time synchronization messages.) It can be set to request time synchronization periodically by setting the TIMERQ1 setting to the desired period. It can also be set to not request, but accept time synchronization (TIMERQ1=M).

## Modem Support

The SEL-2533 DNP implementation includes modem support for serial ports. Your DNP 3.00 master can dial-in to the SEL-2533 and establish a DNP 3.00 connection. The SEL-2533 can automatically dial out and deliver unsolicited DNP 3.00 event data.

When the device dials out, it waits for the “CONNECT” message from the local modem and for assertion of the device CTS line before continuing the DNP transaction. This requires a connection from the modem DCD to the device CTS line.

**NOTE:** Contact SEL for information on serial cable configurations and requirements for connecting your SEL-2533 to other devices.

You can either connect the modem to a computer and configure it before connecting it to the SEL-2533, or program the appropriate modem setup string in the modem startup string setting MSTR. You should use the PH\_NUM1 and (optional) PH\_NUM2 settings to set the phone numbers that you want the SEL-2533 to call. The SEL-2533 will automatically send the ATDT modem dial command and then the contents of the PH\_NUM1 setting when dialing the modem. If PH\_NUM2 is set, the RETRY1 setting is used to configure the number of times the SEL-2533 tries to dial PH\_NUM1 before dialing PH\_NUM2. Similarly, the RETRY2 setting is the number of attempts the SEL-2533 tries to dial PH\_NUM2 before trying PH\_NUM1. MDTIME sets the length of time from initiating the call to declaring it failed because of no connection, and MDRET sets the time between dial-out attempts.

**NOTE:** RTS/CTS hardware flow control is not available for a DNP 3.00 modem connection. You must use either X-ON/X-OFF software flow control or set the port data speed slower than the effective data rate of the modem.

The settings PH\_NUM1 and PH\_NUM2 must conform to the AT modem command set dialing string standard, including:

- A comma (,) inserts a four-second pause
- If necessary, use 9 to reach an outside line
- Include 1 and the area code if the number requires long distance access
- Add any special codes your telephone service provider designates to block call waiting and other telephone line features

## DNP 3.00 Settings

The DNP 3.00 port configuration settings available on the SEL-2533 are shown in *Table D.6*. You can enable DNP 3.00 on serial **PORT 2** through **PORT 4**, up to a maximum of three concurrent DNP 3.00 sessions. Each session defines the characteristics of the connected DNP 3.00.

**Table D.6 Port DNP 3.00 Protocol Settings (Sheet 1 of 2)**

Name	Description	Range	Default
DNPADR	Device DNP 3.00 address	0–65534	0
REPADR1	DNP 3.00 address of the Master to send messages to	0–65519	1
ECLASSB1	Class for binary event data, 0 disables	0–3	1
TIMERQ1	Time-set request interval, minutes (M = Disables time sync requests, but still accepts and applies time syncs from Master; I = Ignores (does not apply) time syncs from Master)	I, M, 1–32767	I
STIMEO1	Select/operate time-out, seconds	0.0–30.0	1.0
DRETRY1	Data link retries	0–15	3
DTIMEO1	Data link time-out, seconds; hidden if DRETRY1 set to 0	0.0–5.0	1
ETIMEO1	Event message confirm time-out, seconds	1–50	5

**Table D.6 Port DNP 3.00 Protocol Settings (Sheet 2 of 2)**

Name	Description	Range	Default
UNSOL1	Enable unsolicited reporting; hidden and set to N if ECLASSB1, ECLASSC1, and ECLASSA1 set to 0	Y, N	N
PUNSOL1	Enable unsolicited reporting at power up; hidden and set to N if UNSOL1 set to N	Y, N	N
NUMEVE1 <sup>a</sup>	Number of events to transmit on	1–200	10
AGEEVE1 <sup>a</sup>	Oldest event to transmit on, seconds	0.0–99999.0	2.0
URETRY1 <sup>a</sup>	Unsolicited messages maximum retry attempts	2–10	3
UTIMEO1 <sup>a</sup>	Unsolicited messages offline timeout, seconds	1–5000	60
<b>Serial Port Settings</b>			
MINDLY	Minimum delay from DCD to TX, seconds	0.00–1.00	0.05
MAXDLY	Maximum delay from DCD to TX, seconds	0.00–1.00	0.10
PREDLY	Settle time from RTS on to TX; Off disables PSTDLY	OFF, 0.00–30.00	0.00
PSTDLY	Settle time from TX to RTS off; hidden if PREDLY set to Off	0.00–30.00	0.00

<sup>a</sup> Hidden if UNSOLn set to N.

The modem settings in *Table D.7* are available on any DNP 3.00 serial port sessions.

**Table D.7 Serial Port DNP 3.00 Modem Settings**

Name	Description	Range	Default
MODEM	Modem connected to port; all following settings are hidden if MODEM set to N	Y, N	N
MSTR	Modem startup string	Up to 30 characters	"EOX0 &D0S0 =4"
PH_NUM1	Primary phone number for dial-out	Up to 30 characters	""
PH_NUM2	Secondary phone number for dial-out	Up to 30 characters	""
RETRY1	Retry attempt for primary dial-out; hidden and unused if PH_NUM set to ""	1–20	5
RETRY2	Retry attempt for secondary dial-out; hidden and unused if PH_NUM set to ""	1–20	5
MDTIME	Time from initiating call to failure due to no connection, seconds	5–300	60
MDRET	Time between dial-out attempts	5–3600	120

## Configurable Data Mapping

One of the most powerful features of the SEL-2533 implementation is the ability to remap DNP 3.00. Remapping is the process of selecting data from the reference map and organizing it into a data subset optimized for your application. The SEL-2533 uses object and point labels, rather than point indices, to streamline the remapping process. This enables you to quickly create a custom map without having to search for each point index in a large reference map.

You may use the available DNP 3.00 maps with as many as three unique DNP 3.00 masters. The map is initially populated with default data points, as described in *Default Data Map on page D.16*. You may remap the points in a default map to create a custom map with as many as:

- 200 Binary Inputs
- 63 Binary Outputs

You can use the **SHOW DNP** command to view the DNP 3.00 data map settings. See *Figure D.3* for an example display of the data map.

---

```
=>>SHO DNP <Enter>
DNP Map 1 Settings
Binary Input Map
BI_00    := ENABLED    BI_01    := AP_A1        BI_02    := AP_A2
BI_03    := AP_B1       BI_04    := AP_B2        BI_05    := AP_C1
BI_06    := AP_C2       BI_07    := AP_D1        BI_08    := AP_D2
BI_09    := AP_E1       BI_10    := AP_E2        BI_11    := ALIN_A1
BI_12    := ALIN_A2       BI_13    := ALIN_B1        BI_14    := ALIN_B2
BI_15    := ALIN_C1       BI_16    := ALIN_C2        BI_17    := ALIN_D1
BI_18    := ALIN_D2       BI_19    := ALIN_E1        BI_20    := ALIN_E2
BI_21    := SIL          BI_22    := PB_SIL        BI_23    := RB_SIL
BI_24    := ACK          BI_25    := PB_ACK        BI_26    := RB_ACK
BI_27    := RESET         BI_28    := PB_RST        BI_29    := RB_RST
BI_30    := TEST          BI_31    := PB_TST        BI_32    := RB_CON1
...
=>>
```

---

**Figure D.3 Sample Response to SHO DNP Command**

You can also use the **MAP y <Enter>** command to display DNP 3.00 maps, but the parameter *y* is the port number from 2 to 4. See *Figure D.4* for an example of a **MAP** command that shows the same map as in *Figure D.3*.

---

```
=>>MAP 4 <Enter>
SEL-2533                               Date: 11/18/2010    Time: 12:59:23
ANNUNCIATOR

Map          1
Device DNP Address 0
Master DNP Address 1

Binary Inputs
-----
INDEX POINT LABEL EVENT CLASS SER TIMESTAMP
0      ENABLED     1
1      AP_A1       1      Yes
2      AP_A2       1      Yes
3      AP_B1       1      Yes
4      AP_B2       1      Yes
5      AP_C1       1      Yes
6      AP_C2       1      Yes
7      AP_D1       1      Yes
8      AP_D2       1      Yes
9      AP_E1       1      Yes
10     AP_E2       1      Yes
11     ALIN_A1     1      Yes
12     ALIN_A2     1      Yes
13     ALIN_B1     1      Yes
14     ALIN_B2     1      Yes
15     ALIN_C1     1      Yes
16     ALIN_C2     1      Yes
17     ALIN_D1     1      Yes
18     ALIN_D2     1      Yes
19     ALIN_E1     1      Yes
20     ALIN_E2     1      Yes
21     SIL          1      Yes
22     PB_SIL      1
23     RB_SIL      1
24     ACK          1      Yes
25     PB_ACK      1
26     RB_ACK      1
27     RESET        1      Yes
28     PB_RST      1
29     RB_RST      1
30     TEST         1
31     PB_TST      1
32     RB_CON1     1

Binary Outputs
-----
INDEX POINT LABEL
0      RB01
1      RB02
2      RB03
...
=>>
```

---

**Figure D.4 Port MAP Command**

You can use the command **SET DNP** to edit or create a custom DNP 3.00 data map. You can also use the ACSELERATOR QuickSet® SEL-5030 Software, which is recommended for this purpose.

The following example describes how to create a custom DNP 3.00 map by point type. The example demonstrates the SEL ASCII command **SET DNP** for each point type, but the entire configuration may be completed without saving changes between point types. To do this, you simply continue entering data and save the entire map at the end. Alternately, you can use ACSELERATOR QuickSet to simplify custom data map creation.

You can use the command **SET DNP BO\_00 TERSE <Enter>** to change the binary output map as shown in *Figure D.5*. You may populate the custom BO map with any of the 40 remote bits (RB01–RB40). You can define bit pairs in BO maps by including a colon (:) between the bit labels.

```

=>>SET DNP BO_00 TERSE <Enter>
Binary Output Map

DNP Binary Output Label Name (23 characters)
BO_00 := NA
? > RB01 <Enter>

DNP Binary Output Label Name (23 characters)
BO_01 := NA
? > RB02 <Enter>

DNP Binary Output Label Name (23 characters)
BO_02 := NA
? > RB03:RB04 <Enter>

DNP Binary Output Label Name (23 characters)
BO_03 := NA
? > RB05:RB06 <Enter>

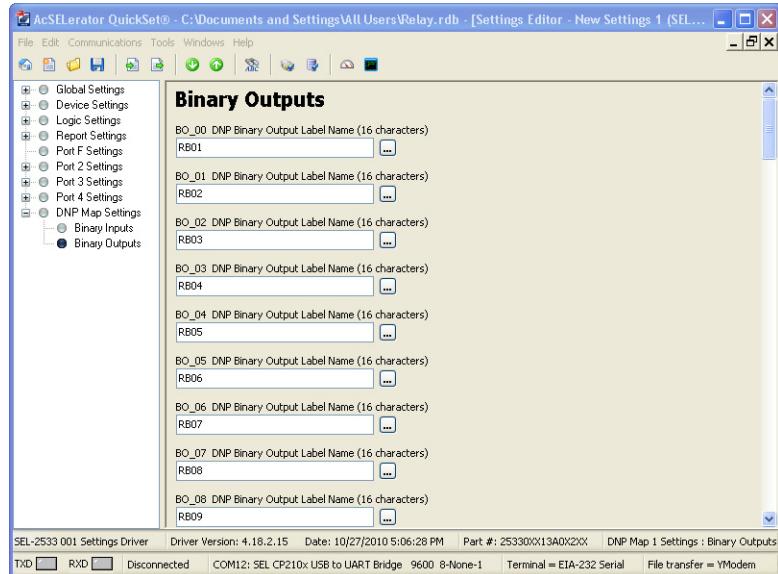
DNP Binary Output Label Name (23 characters)
BO_04 := NA
? > end <Enter>

=>>

```

**Figure D.5 Sample Custom DNP3 BO Map Settings**

You may also use ACSELERATOR QUICKSET QuickSet to enter the BO map settings as shown in the screen capture in *Figure D.6*.

**Figure D.6 Binary Output Map Entry in ACSELERATOR QUICKSET QuickSet**

The binary input (BI) maps are modified in a similar manner, but pairs are not allowed.

# DNP3 Documentation

---

## Device Profile

*Table D.8* contains the standard DNP 3.00 device profile information. Rather than check boxes in the example Device Profile in the DNP 3.00 Subset Definitions, only the relevant selections are shown.

**Table D.8 SEL-2533 DNP 3.00 Device Profile**

Parameter	Value
Vendor name	Schweitzer Engineering Laboratories
Device name	SEL-2533
Highest DNP request level	Level 2
Highest DNP response level	Level 2
Device function	Outstation
Maximum data link frame size transmitted/received (octets)	292
Maximum data link retries	Configurable, range 0–15
Requires data link layer confirmation	Configurable by setting
Maximum application fragment size transmitted/received (octets)	2048
Maximum application layer retries	None
Requires application layer confirmation	When reporting Event Data
Data link confirm time-out	Configurable
Complete application fragment time-out	None
Application confirm time-out	Configurable
Complete Application response time-out	None
Executes control WRITE binary outputs	Always
Executes control SELECT/OPERATE	Always
Executes control DIRECT OPERATE	Always
Executes control DIRECT OPERATE-NO ACK	Always
Executes control count greater than 1	Never
Executes control Pulse On	Always
Executes control Pulse Off	Always
Executes control Latch Off	Always
Executes control Latch On	Always
Executes control Queue	Never
Executes control Clear Queue	Never
Reports binary input change events when no specific variation requested	Only time-tagged
Reports time-tagged binary input change events when no specific variation requested	Binary Input change with time
Sends unsolicited responses	Configurable with unsolicited message enable settings. Increases retry time (configurable) when a maximum retry setting is exceeded.
Sends static data in unsolicited responses	Never
Sends multi fragment responses	No

In response to the delay measurement function code, the SEL-2533 will return a time delay accurate to within 50 milliseconds.

## Object List

*Table D.9* lists the objects and variations with supported function codes and qualifier codes available in the SEL-2533. The list of supported objects conforms to the format laid out in the DNP specifications and includes both supported and unsupported objects. Those that are supported include the function and qualifier codes. The objects that are not supported are shown without any corresponding function and qualifier codes.

**Table D.9 SEL-2533 DNP Object List (Sheet 1 of 2)**

Obj.	Var.	Description	Request <sup>a</sup>		Response <sup>b</sup>	
			Funct. Codes <sup>c</sup>	Qual. Codes <sup>d</sup>	Funct. Codes <sup>c</sup>	Qual. Codes <sup>d</sup>
1	0	Binary Input—All Variations	1	0, 1, 6, 7, 8, 17, 28		
1	1	Binary Input	1	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
1	2 <sup>e</sup>	Binary Input With Status	1	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
2	0	Binary Input Change—All Variations	1	6, 7, 8		
2	1	Binary Input Change Without Time	1	6, 7, 8	129	17, 28
2	2 <sup>e</sup>	Binary Input Change With Time	1	6, 7, 8	129, 130	17, 28
2	3	Binary Input Change With Relative Time	1	6, 7, 8	129	17, 28
10	0	Binary Output—All Variations	1	0, 1, 6, 7, 8		
10	1	Binary Output				
10	2 <sup>e</sup>	Binary Output Status	1	0, 1, 6, 7, 8	129	0, 1
12	0	Control Block—All Variations				
12	1	Control Relay Output Block	3, 4, 5, 6	17, 28	129	echo of request
12	2	Pattern Control Block				
12	3	Pattern Mask				
50	0	Time and Date—All Variations				
50	1	Time and Date	1, 2	7, 8 index=0	129	07, quantity=1
50	2	Time and Date With Interval				
50	3	Time and Date Last Recorded	2	7, 8		
51	0	Time and Date CTO—All Variations				
51	1	Time and Date CTO				
51	2	Unsynchronized Time and Date CTO			129	07, quantity=1
52	0	Time Delay—All Variations				
52	1	Time Delay, Coarse				
52	2	Time Delay, Fine			129	07, quantity=1
60	0	All Classes of Data	1, 20, 21	6, 7, 8		
60	1	Class 0 Data	1, 20, 21	6, 7, 8		
60	2	Class 1 Data	1	6, 7, 8		

**Table D.9 SEL-2533 DNP Object List (Sheet 2 of 2)**

Obj.	Var.	Description	Request <sup>a</sup>		Response <sup>b</sup>	
			Funct. Codes <sup>c</sup>	Qual. Codes <sup>d</sup>	Funct. Codes <sup>c</sup>	Qual. Codes <sup>d</sup>
60	3	Class 2 Data	1, 20, 21	6, 7, 8		
60	4	Class 3 Data	1, 20, 21	6, 7, 8		
80	1	Internal Indications	2	0, 1 index=7		

<sup>a</sup> Supported in requests from master

<sup>b</sup> May generate in response to master

<sup>c</sup> Decimal

<sup>d</sup> Hexadecimal

<sup>e</sup> Default variation

## Reference Data Map

*Table D.10* shows the SEL-2533 reference data map. The reference map shows the data available to a DNP 3.00 master. You can use the default map or the custom DNP 3.00 mapping functions of the SEL-2533 to retrieve only the points required by your application.

**Table D.10 DNP 3.00 Reference Data Map**

Object	Labels	Description
<b>Binary Inputs</b>		
01, 02	STFAIL	Device Diagnostic Failure
	STWARN	Device Diagnostic Warning
	Enabled	Device Enabled
	SALARM-SLOW_F6	Device Word Elements (see <i>Table G.1</i> )
	STSET	Settings Changed
<b>Binary Outputs</b>		
10, 12	RBxx	Remote Bits (xx = 01–40)
	RB_SIL	Silence Button
	RB_ACK	Acknowledge Pushbutton
	RB_RST	Reset Pushbutton
	RB_CON1	Auxiliary Control Bit

**NOTE:** Although not shown as part of the reference maps you may use any Device Word bit label when creating custom maps.

## Default Data Map

The default data map is an automatically generated subset of the reference map. All data maps are initialized to the default values, based on the SEL-2533 part number. *Table D.11* shows the SEL-2533 default data map. If the default maps are not appropriate, you can also use the custom DNP mapping commands **SET DN** and **SHOW DN** to create the map required for your application.

**Table D.11 DNP3 Default Data Map (Sheet 1 of 2)**

Object	Default Index	Point Label
01, 02	0	ENABLED
	1	AP_A1
	2	AP_A2
	3	AP_B1
	4	AP_B2

**Table D.11 DNP3 Default Data Map (Sheet 2 of 2)**

<b>Object</b>	<b>Default Index</b>	<b>Point Label</b>
	5	AP_C1
	6	AP_C2
	7	AP_D1
	8	AP_D2
	9	AP_E1
	10	AP_E2
	11	ALIN_A1
	12	ALIN_A2
	13	ALIN_B1
	14	ALIN_B2
	15	ALIN_C1
	16	ALIN_C2
	17	ALIN_D1
	18	ALIN_D2
	19	ALIN_E1
	20	ALIN_E2
	21	SIL
	22	PB_SIL
	23	RB_SIL
	24	ACK
	25	PB_ACK
	26	RB_ACK
	27	RESET
	28	PB_RST
	29	RB_RST
	30	TEST
	31	PB_TST
	32	RB_CON1
10,12	0-39	RB01-RB40 Remote Bits RB_SIL Remote Silence Pushbutton RB_ACK Remote Acknowledge Pushbutton RB_RST Remote Reset Pushbutton RB_CON1 Remote Auxiliary Control

## Control Point Operation

You can define any two RB points as a pair for Trip/Close or Code Selection operations with Object 12 control device output block command messages. The SEL-2533 assigns some special operations to the code portion of the control device output block command. The example in *Table D.12* demonstrates how you may use this functionality for both paired and non-paired points. Because the SEL-2533 allows only one control bit to be pulsed at a time, you should send consecutive control bits in consecutive messages. Pulse operations provide a pulse with duration of one processing interval.

**Table D.12 Example Object 12 Trip/Close or Code Selection Operation**

Control Points	Trip / Close		Code Selection Operation			
	Close (0x4X)	Trip (0x8X)	Latch On (3)	Latch Off (4)	Pulse On (1)	Pulse Off (2)
RB01:RB02	PULSE ON RB02	PULSE ON RB01	PULSE ON RB02	PULSE ON RB01	PULSE ON RB02	PULSE ON RB01
RB03	SET RB03	CLEAR RB03	SET RB03	CLEAR RB03	SET RB03	CLEAR RB03
RB04	SET RB04	CLEAR RB04	SET RB04	CLEAR RB04	SET RB04	CLEAR RB04
RB05:RB06	PULSE ON RB06	PULSE ON RB05	PULSE ON RB06	PULSE ON RB05	PULSE ON RB06	PULSE ON RB05
RB07	SET RB07	CLEAR RB07	SET RB07	CLEAR RB07	SET RB07	CLEAR RB07
RB08	SET RB08	CLEAR RB08	SET RB08	CLEAR RB08	SET RB08	CLEAR RB08
RB14:RB14	PULSE ON RB14	PULSE ON RB14	PULSE ON RB14	PULSE ON RB14	PULSE ON RB14	PULSE ON RB14
RB18:RB21	PULSE ON RB21	PULSE ON RB18	PULSE ON RB21	PULSE ON RB18	PULSE ON RB21	PULSE ON RB18

# Appendix E

## Modbus RTU Communications Protocol

---

### Overview

---

This appendix describes Modbus® RTU communications features supported by the SEL-2533.

Complete specifications for the Modbus protocol are available from the Modbus website at [www.modbus.org](http://www.modbus.org).

Enable Modbus RTU protocol with the serial port settings. When Modbus RTU protocol is enabled, the device switches the port to Modbus RTU protocol and deactivates the ASCII protocol.

Modbus RTU is a binary protocol that permits communication between a single master device and multiple slave devices. The communication is half duplex—only one device transmits at a time. The master transmits a binary command that includes the address of the desired slave device. All of the slave devices receive the message, but only the slave device with the matching address responds.

The SEL-2533 Modbus communication allows a Modbus master to do the following:

- Acquire metering and monitoring from the device
- Control SEL-2533 output contacts and acknowledge alarms
- Read the SEL-2533 self-test status

### Communications Protocol

---

#### Modbus Queries

Modbus RTU master devices initiate all exchanges by sending a query. The query consists of the fields shown in *Table E.1*.

**Table E.1 Modbus Query Fields**

Field	Number of Bytes
Slave Device Address	1 byte
Function Code	1 byte
Data Region	0–251 bytes
Cyclical Redundancy Check (CRC)	2 bytes

The SEL-2533 SLAVEID setting defines the device address. Set this value to a unique number for each device on the Modbus network. For Modbus communication to operate properly, each slave device must have a different address.

The cyclical redundancy check detects errors in the received data. If an error is detected, the device discards the packet.

## Modbus Responses

The slave device sends a response message after it performs the action the query specifies. If the slave device cannot execute the query command for any reason, it sends an error response. Otherwise the slave device response is formatted similarly to the query and includes the slave address, function code, data (if applicable), and a cyclical redundancy check value.

## Supported Modbus Function Codes

The SEL-2533 supports the Modbus function codes shown in *Table E.2*.

**Table E.2 SEL-2533 Modbus Function Codes**

Codes	Modbus Description	Device Description
01h	Read Discrete Output Coil Status	Read the status of the digital output and remote bits.
02h	Read Discrete Input Status	Read the status of the digital inputs.
03h	Read Holding Registers	Read data from the Modbus map
04h	Read Input Register	Read data from the Modbus map similarly to function code 03
05h <sup>a</sup>	Force Single Coil	Control the status of the digital outputs and remote bits
06h <sup>a</sup>	Preset Single Register	Write data directly to a single register in the Modbus map
08h	Diagnostic Command	Test the Modbus communications channel
10h <sup>a</sup>	Preset Multiple Register	Preset Multiple Register

<sup>a</sup> The SEL-2533 supports the Broadcast function on these functions.

## Modbus Exception Responses

The SEL-2533 sends an exception code under the conditions described in *Table E.3*.

**Table E.3 SEL-2533 Modbus Exception Codes**

Exception Code	Error Type	Description
1	Illegal Function Code	The received function code is either undefined or unsupported
2	Illegal Data Address	The received command contains an unsupported address in the data field
3	Illegal Data Value	The received command contains a value that is out of range
4	Device Error	The SEL-2533 is in the wrong state for the function a query specifies; The device is unable to perform the action specified by a query (i.e., cannot write to a read-only register)
6	Busy	The device is unable to process the command at this time, due to a busy resource
8	Memory Error	Checksum error on stored data

In the event that any of the errors listed in *Table E.3* occur, the device assembles a response message that includes the exception code in the data field. The device sets the most significant bit in the function code field to indicate to the master that the data field contains an error code instead of the required data.

## Cyclical Redundancy Check

The SEL-2533 calculates a 2-byte CRC value through use of the device address, function code, and data region. It appends this value to the end of every Modbus response. When the master device receives the response, it recalculates the CRC. If the calculated CRC matches the CRC sent by the SEL-2533, the master device uses the data received. If there is no match, the check fails and the message is ignored. The devices use a similar process when the master sends queries.

## 01h Read Discrete Output Coil Status Command

Use function code 01h to read the On/Off status of the selected bits (coils) (see the SEL-2533 Outputs Map shown in *Table E.5*). You can read the status of all 94 coils per query, using the fields shown in *Table E.4*. Note that the SEL-2533 coil addresses start at 0 (e.g., Coil 1 is located at address zero). The coil status is packed one coil per bit of the data field. The Least Significant Bit (LSB) of the first data byte contains the starting coil address in the query. The other coils follow towards the high order end of this byte and from low order to high order in subsequent bytes.

**Table E.4 01h Read Discrete Output Coil Status Command**

Bytes	Field
Requests from the master must have the following format:	
1 byte	Slave Address
1 byte	Function Code (01h)
2 bytes	Address of the first bit
2 bytes	Number of bits to read
2 bytes	CRC-16
A successful response from the slave will have the following format:	
1 byte	Slave Address
1 byte	Function Code (01h)
1 byte	Bytes of data ( <i>n</i> )
<i>n</i> bytes	Data
2 bytes	CRC-16

To build the response, the SEL-2533 calculates the number of bytes required to contain the number of bits requested. If the number of bits requested is not evenly divisible by eight, the device adds one more byte to maintain the balance of bits, padded by zeroes to make an even byte. *Table E.5* includes the coil number and lists all possible coils (identified as Outputs and Remote bits) available in the device.

**Table E.5 01h SEL-2533 Outputs (Sheet 1 of 4)**

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description	Note
0	0	01h	OUT01	
1	1	01h	OUT02	
2	2	01h	OUT03	
3	3	01h	OUT04	
4	4	01h	OUT05	
5	5	01h	OUT06	
6	6	01h	OUT07	
7	7	01h	OUT08	

**Table E.5 01h SEL-2533 Outputs (Sheet 2 of 4)**

<b>Coil Address in Decimal</b>	<b>Coil Address in Hex</b>	<b>Function Code Supported</b>	<b>Coil Description</b>	<b>Note</b>
8	8	01h	OUT09	
9	9	01h	OUT10	
10	A	01h	OUT11	
11	B	01h	OUT12	
12	C	01h	OUT13	
13	D	01h	OUT14	
14	E	01h	OUT15	
15	F	01h	RB_SIL	(1 SELOGIC Processing Interval)
16	10	01h	RB_ACK	(1 SELOGIC Processing Interval)
17	11	01h	RB_RST	(1 SELOGIC Processing Interval)
18	12	01h	RB_CON1	(1 SELOGIC Processing Interval)
19	13	01h	RB01	
20	14	01h	RB02	
21	15	01h	RB03	
22	16	01h	RB04	
23	17	01h	RB05	
24	18	01h	RB06	
25	19	01h	RB07	
26	1A	01h	RB08	
27	1B	01h	RB09	
28	1C	01h	RB10	
29	1D	01h	RB11	
30	1E	01h	RB12	
31	1F	01h	RB13	
32	20	01h	RB14	
33	21	01h	RB15	
34	22	01h	RB16	
35	23	01h	RB17	
36	24	01h	RB18	
37	25	01h	RB19	
38	26	01h	RB20	
39	27	01h	RB21	
40	28	01h	RB22	
41	29	01h	RB23	
42	2A	01h	RB24	
43	2B	01h	RB25	
44	2C	01h	RB26	
45	2D	01h	RB27	
46	2E	01h	RB28	
47	2F	01h	RB29	

**Table E.5 01h SEL-2533 Outputs (Sheet 3 of 4)**

<b>Coil Address in Decimal</b>	<b>Coil Address in Hex</b>	<b>Function Code Supported</b>	<b>Coil Description</b>	<b>Note</b>
48	30	01h	RB30	
49	31	01h	RB31	
50	32	01h	RB32	
51	33	01h	RB33	
52	34	01h	RB34	
53	35	01h	RB35	
54	36	01h	RB36	
55	37	01h	RB37	
56	38	01h	RB38	
57	39	01h	RB39	
58	3A	01h	RB40	
59	3B	01h	RB01	(1 SELOGIC Processing Interval)
60	3C	01h	RB02	(1 SELOGIC Processing Interval)
61	3D	01h	RB03	(1 SELOGIC Processing Interval)
62	3E	01h	RB04	(1 SELOGIC Processing Interval)
63	3F	01h	RB05	(1 SELOGIC Processing Interval)
64	40	01h	RB06	(1 SELOGIC Processing Interval)
65	41	01h	RB07	(1 SELOGIC Processing Interval)
66	42	01h	RB08	(1 SELOGIC Processing Interval)
67	43	01h	RB09	(1 SELOGIC Processing Interval)
68	44	01h	RB10	(1 SELOGIC Processing Interval)
69	45	01h	RB11	(1 SELOGIC Processing Interval)
70	46	01h	RB12	(1 SELOGIC Processing Interval)
71	47	01h	RB13	(1 SELOGIC Processing Interval)
72	48	01h	RB14	(1 SELOGIC Processing Interval)
73	49	01h	RB15	(1 SELOGIC Processing Interval)
74	4A	01h	RB16	(1 SELOGIC Processing Interval)
75	4B	01h	RB17	(1 SELOGIC Processing Interval)
76	4C	01h	RB18	(1 SELOGIC Processing Interval)
77	4D	01h	RB19	(1 SELOGIC Processing Interval)
78	4E	01h	RB20	(1 SELOGIC Processing Interval)
79	4F	01h	RB21	(1 SELOGIC Processing Interval)
80	50	01h	RB22	(1 SELOGIC Processing Interval)
81	51	01h	RB23	(1 SELOGIC Processing Interval)
82	52	01h	RB24	(1 SELOGIC Processing Interval)
83	53	01h	RB25	(1 SELOGIC Processing Interval)
84	54	01h	RB26	(1 SELOGIC Processing Interval)
85	55	01h	RB27	(1 SELOGIC Processing Interval)
86	56	01h	RB28	(1 SELOGIC Processing Interval)
87	57	01h	RB29	(1 SELOGIC Processing Interval)

**Table E.5 01h SEL-2533 Outputs (Sheet 4 of 4)**

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description	Note
88	58	01h	RB30	(1 SELOGIC Processing Interval)
89	59	01h	RB31	(1 SELOGIC Processing Interval)
90	5A	01h	RB32	(1 SELOGIC Processing Interval)
91	5B	01h	RB33	(1 SELOGIC Processing Interval)
92	5C	01h	RB34	(1 SELOGIC Processing Interval)
93	5D	01h	RB35	(1 SELOGIC Processing Interval)
94	5E	01h	RB36	(1 SELOGIC Processing Interval)
95	5F	01h	RB37	(1 SELOGIC Processing Interval)
96	60	01h	RB38	(1 SELOGIC Processing Interval)
97	61	01h	RB39	(1 SELOGIC Processing Interval)
98	62	01h	RB40	(1 SELOGIC Processing Interval)

The device responses to errors in the query are shown in *Table E.6*.

**Table E.6 Response to 01h Read Discrete Output Coil Status Query Errors**

Error	Error Code Returned	Communication Counter Increments
Invalid bit to read	Illegal Data Address (02h)	Invalid Address
Invalid number of bits to read	Illegal Data Value (03h)	Illegal Register
Format error	Illegal Data Value (03h)	Bad Packet Format

## 02 Read Input Status Command

Use function code 02h to read the On/Off status of the selected bits (inputs), as shown in *Table E.7*. You can read the status of all 743 inputs per query. Note that input addresses start at 0 (e.g., Input 1 is located at address zero). The input status is packed one input per bit of the data field. The LSB of the first data byte contains the starting input address in the query. The other inputs follow towards the high order end of this byte, and from low order to high order in subsequent bytes.

**Table E.7 02h Read Input Status Command**

Bytes	Field
Requests from the master must have the following format:	
1 byte	Slave Address
1 byte	Function Code (02h)
2 bytes	Address of the first bit
2 bytes	Number of bits to read
2 bytes	CRC-16
A successful response from the slave will have the following format:	
1 byte	Slave Address
1 byte	Function Code (02h)
1 byte	Bytes of data ( <i>n</i> )
<i>n</i> bytes	Data
2 bytes	CRC-16

To build the response, the device calculates the number of bytes required to contain the number of bits requested. If the number of bits requested is not evenly divisible by eight, the device adds one more byte to maintain the balance of bits, padded by zeroes to make an even byte.

In each row, the input numbers are assigned from the right-most input to the left-most input (i.e., Input 8 is RBACK and Input 15 is SALARM). Input addresses start at 0000 (i.e., Input 1 is located at Input Address 0000). *Table E.8* includes the coil address in decimal and hex and lists all possible inputs (Device Word bits) available in the device. The device responses to errors in the query are shown in *Table E.9*. To see a list of all Device Word bits for each of the row descriptions, go to *Appendix G: Device Word Bits*.

**Table E.8 SEL-2533 Inputs (Sheet 1 of 4)**

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description	Notes
0–7	0–7	02h	Relay Element Status Row 0	The input numbers are assigned from the right-most input to the left-most input in the Relay row as show in an example below. Address 7 = ENABLED Address 6 = * Address 5 = * Address 4 = * Address 3 = * Address 2 = * Address 1 = * Address 0 = *
8–15	8–F	02h	Relay Element Status Row 1	The input numbers are assigned from the right-most input to the left-most input in the Relay row as show in an example below. Address 15 = SALARM Address 14 = HALARM Address 13 = CR_AL Address 12 = NC_ALM Address 11 = SIL Address 10 = ACK Address 9 = RESET Address 8 = RBACK
16–23	10–17	02h	Relay Element Status Row 2	
24–31	18–1F	02h	Relay Element Status Row 3	
32–39	20–27	02h	Relay Element Status Row 4	
40–47	28–2F	02h	Relay Element Status Row 5	
48–55	30–37	02h	Relay Element Status Row 6	
56–63	38–3F	02h	Relay Element Status Row 7	
64–71	40–47	02h	Relay Element Status Row 8	
72–79	48–4F	02h	Relay Element Status Row 9	
80–87	50–57	02h	Relay Element Status Row 10	
88–95	58–5F	02h	Relay Element Status Row 11	
96–103	60–67	02h	Relay Element Status Row 12	
104–111	68–6F	02h	Relay Element Status Row 13	
112–119	70–77	02h	Relay Element Status Row 14	

**Table E.8 SEL-2533 Inputs (Sheet 2 of 4)**

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description	Notes
120–127	78–7F	02h	Relay Element Status Row 15	
128–135	80–87	02h	Relay Element Status Row 16	
136–143	88–8F	02h	Relay Element Status Row 17	
144–151	90–97	02h	Relay Element Status Row 18	
152–159	98–9F	02h	Relay Element Status Row 19	
160–167	A0–A7	02h	Relay Element Status Row 20	
168–175	A8–AF	02h	Relay Element Status Row 21	
176–183	B0–B7	02h	Relay Element Status Row 22	
184–191	B8–BF	02h	Relay Element Status Row 23	
192–199	C0–C7	02h	Relay Element Status Row 24	
200–207	C8–CF	02h	Relay Element Status Row 25	
208–215	D0–D7	02h	Relay Element Status Row 26	
216–223	D8–DF	02h	Relay Element Status Row 27	
224–231	E0–E7	02h	Relay Element Status Row 28	
232–239	E8–EF	02h	Relay Element Status Row 29	
240–247	F0–F7	02h	Relay Element Status Row 30	
248–255	F8–FF	02h	Relay Element Status Row 31	
256–263	100–107	02h	Relay Element Status Row 32	
264–271	108–10F	02h	Relay Element Status Row 33	
272–279	110–117	02h	Relay Element Status Row 34	
280–287	118–11F	02h	Relay Element Status Row 35	
288–295	120–127	02h	Relay Element Status Row 36	
296–303	128–12F	02h	Relay Element Status Row 37	
304–311	130–137	02h	Relay Element Status Row 38	
312–319	138–13F	02h	Relay Element Status Row 39	
320–327	140–147	02h	Relay Element Status Row 40	
328–335	148–14F	02h	Relay Element Status Row 41	
336–343	150–157	02h	Relay Element Status Row 42	
344–351	158–15F	02h	Relay Element Status Row 43	
352–359	160–167	02h	Relay Element Status Row 44	
360–367	168–16F	02h	Relay Element Status Row 45	
368–375	170–177	02h	Relay Element Status Row 46	
376–383	178–17F	02h	Relay Element Status Row 47	
384–391	180–187	02h	Relay Element Status Row 48	
392–399	188–18F	02h	Relay Element Status Row 49	
400–407	190–197	02h	Relay Element Status Row 50	
408–415	198–19F	02h	Relay Element Status Row 51	
416–423	1A0–1A7	02h	Relay Element Status Row 52	
424–431	1A8–1AF	02h	Relay Element Status Row 53	
432–439	1B0–1B7	02h	Relay Element Status Row 54	

**Table E.8 SEL-2533 Inputs (Sheet 3 of 4)**

<b>Coil Address in Decimal</b>	<b>Coil Address in Hex</b>	<b>Function Code Supported</b>	<b>Coil Description</b>	<b>Notes</b>
440–447	1B8–1BF	02h	Relay Element Status Row 55	
448–455	1C0–1C7	02h	Relay Element Status Row 56	
456–463	1C8–1CF	02h	Relay Element Status Row 57	
464–471	1D0–1D7	02h	Relay Element Status Row 58	
472–479	1D8–1DF	02h	Relay Element Status Row 59	
480–487	1E0–1E7	02h	Relay Element Status Row 60	
488–495	1E8–1EF	02h	Relay Element Status Row 61	
496–503	1F0–1F7	02h	Relay Element Status Row 62	
504–511	1F8–1FF	02h	Relay Element Status Row 63	
512–519	200–207	02h	Relay Element Status Row 64	
520–527	208–20F	02h	Relay Element Status Row 65	
528–535	210–217	02h	Relay Element Status Row 66	
536–543	218–21F	02h	Relay Element Status Row 67	
544–551	220–227	02h	Relay Element Status Row 68	
552–559	228–22F	02h	Relay Element Status Row 69	
560–567	230–237	02h	Relay Element Status Row 70	
568–575	238–23F	02h	Relay Element Status Row 71	
576–583	240–247	02h	Relay Element Status Row 72	
584–591	248–24F	02h	Relay Element Status Row 73	
592–599	250–257	02h	Relay Element Status Row 74	
600–607	258–25F	02h	Relay Element Status Row 75	
608–615	260–267	02h	Relay Element Status Row 76	
616–623	268–26F	02h	Relay Element Status Row 77	
624–631	270–277	02h	Relay Element Status Row 78	
632–639	278–27F	02h	Relay Element Status Row 79	
640–647	280–287	02h	Relay Element Status Row 80	
648–655	288–28F	02h	Relay Element Status Row 81	
656–663	290–297	02h	Relay Element Status Row 82	
664–671	298–29F	02h	Relay Element Status Row 83	
672–679	2A0–2A7	02h	Relay Element Status Row 84	
680–687	2A8–2AF	02h	Relay Element Status Row 85	
688–695	2B0–2B7	02h	Relay Element Status Row 86	
696–703	2B8–2BF	02h	Relay Element Status Row 87	
704–711	2C0–2C7	02h	Relay Element Status Row 88	
712–719	2C8–2CF	02h	Relay Element Status Row 89	
720–727	2D0–2D7	02h	Relay Element Status Row 90	
728–735	2D8–2DF	02h	Relay Element Status Row 91	
736–743	2E0–2E7	02h	Relay Element Status Row 92	
744–751	2E8–2EF	02h	Relay Element Status Row 93	
752–759	2F0–2F7	02h	Relay Element Status Row 94	

**Table E.8 SEL-2533 Inputs (Sheet 4 of 4)**

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description	Notes
760–767	2F8–2FF	02h	Relay Element Status Row 95	
768–775	300–307	02h	Relay Element Status Row 96	

**Table E.9 Responses to 02h Read Input Query Errors**

Error	Error Code Returned	Communication Counter Increments
Invalid bit to read	Illegal Data Address (02h)	Invalid Address
Invalid number of bits to read	Illegal Data Value (03h)	Illegal Register
Format Error	Illegal Data Value (03h)	Bad Packet Format

## 03h Read Holding Register Command

Use function code 03h to read directly from the Modbus Register Map shown in *Table E.25*.

You can read a maximum of 125 registers at once with this function code, using the fields shown in *Table E.10*. Most masters use 4X references with this function code. If you are accustomed to 4X references with this function code, for five-digit addressing, add 40001 to the standard database address.

**Table E.10 03h Read Holding Register Command**

Bytes	Field
Requests from the master must have the following format:	
1 byte	Slave Address
1 byte	Function Code (03h)
2 bytes	Starting Register Address
2 bytes	Number of Registers to Read
2 bytes	CRC-16
A successful response from the slave will have the following format:	
1 byte	Slave Address
1 byte	Function Code (03h)
1 byte	Bytes of Data ( <i>n</i> )
<i>n</i> bytes	Data (2–250)
2 bytes	CRC-16

The device responses to errors in the query are shown in *Table E.11*.

**Table E.11 Responses to 03h Read Holding Registry Query Errors**

Error	Error Code Returned	Communication Counter Increments
Invalid register to read	Illegal Data Address (02h)	Invalid Address
Invalid number of registers to read	Illegal Data Value (03h)	Illegal Register
Format Error	Illegal Data Value (03h)	Bad Packet Format

## 04h Read Input Register Command

Use function code 04h to read directly from the Modbus Register Map shown in *Table E.25*. You can read a maximum of 125 registers at once with this function code, using the fields shown in *Table E.12*. Most masters use 3X references with this function code. If you are accustomed to 3X references with this function code, for five-digit addressing, add 30001 to the standard database address.

**Table E.12 04h Read Input Register Command**

Bytes	Field
Requests from the master must have the following format:	
1 byte	Slave Address
1 byte	Function Code (04h)
2 bytes	Starting Register Address
2 bytes	Number of Registers to Read
2 bytes	CRC-16
A successful response from the slave will have the following format:	
1 byte	Slave Address
1 byte	Function Code (04h)
1 byte	Bytes of Data ( <i>n</i> )
<i>n</i> bytes	Data (2–250)
2 bytes	CRC-16

The device responses to errors in the query are shown in *Table E.13*.

**Table E.13 Responses to 04h Read Holding Registry Query Errors**

Error	Error Code Returned	Communication Counter Increments
Invalid register to read	Illegal Data Address (02h)	Invalid Address
Invalid number of registers to read	Illegal Data Value (03h)	Illegal Register
Format Error	Illegal Data Value (03h)	Bad Packet Format

## 05h Force Single Coil Command

Use function code 05h to set or clear a coil. In *Table E.14*, the command response is identical to the command request.

**Table E.14 05h Force Single Coil Command**

Bytes	Field
Requests from the master must have the following format:	
1 byte	Slave Address
1 byte	Function Code (05h)
2 bytes	Coil Reference
1 byte	Operation Code (FF for bit set, 00 for bit clear)
1 byte	Placeholder (00)
2 bytes	CRC-16

*Table E.15* lists the coil numbers supported by the SEL-2533. The physical coils (coils 1–14) are self-resetting. Pulsing a Set remote bit (decimal address 55 through 94) causes the remote bit to be cleared at the end of the pulse.

**Table E.15 05 Force Single Coil Command (Sheet 1 of 3)**

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description
0	0	05h	Pulse OUT01 1 second
1	1	05h	Pulse OUT02 1 second
2	2	05h	Pulse OUT03 1 second
3	3	05h	Pulse OUT04 1 second
4	4	05h	Pulse OUT05 1 second
5	5	05h	Pulse OUT06 1 second
6	6	05h	Pulse OUT07 1 second
7	7	05h	Pulse OUT08 1 second
8	8	05h	Pulse OUT09 1 second
9	9	05h	Pulse OUT10 1 second
10	A	05h	Pulse OUT11 1 second
11	B	05h	Pulse OUT12 1 second
12	C	05h	Pulse OUT13 1 second
13	D	05h	Pulse OUT14 1 second
14	E	05h	Pulse OUT15 1 second
15	F	05h	RB_SIL (1 SELOGIC Processing Interval)
16	10	05h	RB_ACK (1 SELOGIC Processing Interval)
17	11	05h	RB_RST (1 SELOGIC Processing Interval)
18	12	05h	RB_CON1 (1 SELOGIC Processing Interval)
19	13	05h	RB01
20	14	05h	RB02
21	15	05h	RB03
22	16	05h	RB04
23	17	05h	RB05
24	18	05h	RB06
25	19	05h	RB07
26	1A	05h	RB08
27	1B	05h	RB09
28	1C	05h	RB10
29	1D	05h	RB11
30	1E	05h	RB12
31	1F	05h	RB13
32	20	05h	RB14
33	21	05h	RB15
34	22	05h	RB16
35	23	05h	RB17
36	24	05h	RB18
37	25	05h	RB19

**Table E.15 05 Force Single Coil Command (Sheet 2 of 3)**

<b>Coil Address in Decimal</b>	<b>Coil Address in Hex</b>	<b>Function Code Supported</b>	<b>Coil Description</b>
38	26	05h	RB20
39	27	05h	RB21
40	28	05h	RB22
41	29	05h	RB23
42	2A	05h	RB24
43	2B	05h	RB25
44	2C	05h	RB26
45	2D	05h	RB27
46	2E	05h	RB28
47	2F	05h	RB29
48	30	05h	RB30
49	31	05h	RB31
50	32	05h	RB32
51	33	05h	RB33
52	34	05h	RB34
53	35	05h	RB35
54	36	05h	RB36
55	37	05h	RB37
56	38	05h	RB38
57	39	05h	RB39
58	3A	05h	RB40
59	3B	05h	RB01 (1 SELOGIC Processing Interval)
60	3C	05h	RB02 (1 SELOGIC Processing Interval)
61	3D	05h	RB03 (1 SELOGIC Processing Interval)
62	3E	05h	RB4 (1 SELOGIC Processing Interval)
63	3F	05h	RB05 (1 SELOGIC Processing Interval)
64	40	05h	RB06 (1 SELOGIC Processing Interval)
65	41	05h	RB07 (1 SELOGIC Processing Interval)
66	42	05h	RB08 (1 SELOGIC Processing Interval)
67	43	05h	RB09 (1 SELOGIC Processing Interval)
68	44	05h	RB10 (1 SELOGIC Processing Interval)
69	45	05h	RB11 (1 SELOGIC Processing Interval)
70	46	05h	RB12 (1 SELOGIC Processing Interval)
71	47	05h	RB13 (1 SELOGIC Processing Interval)
72	48	05h	RB14 (1 SELOGIC Processing Interval)
73	49	05h	RB15 (1 SELOGIC Processing Interval)
74	4A	05h	RB16 (1 SELOGIC Processing Interval)
75	4B	05h	RB17 (1 SELOGIC Processing Interval)
76	4C	05h	RB18 (1 SELOGIC Processing Interval)
77	4D	05h	RB19 (1 SELOGIC Processing Interval)

**Table E.15 05 Force Single Coil Command (Sheet 3 of 3)**

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description
78	4E	05h	RB20 (1 SELOGIC Processing Interval)
79	4F	05h	RB21 (1 SELOGIC Processing Interval)
80	50	05h	RB22 (1 SELOGIC Processing Interval)
81	51	05h	RB23 (1 SELOGIC Processing Interval)
82	52	05h	RB24 (1 SELOGIC Processing Interval)
83	53	05h	RB25 (1 SELOGIC Processing Interval)
84	54	05h	RB26 (1 SELOGIC Processing Interval)
85	55	05h	RB27 (1 SELOGIC Processing Interval)
86	56	05h	RB28 (1 SELOGIC Processing Interval)
87	57	05h	RB29 (1 SELOGIC Processing Interval)
88	58	05h	RB30 (1 SELOGIC Processing Interval)
89	59	05h	RB31 (1 SELOGIC Processing Interval)
90	5A	05h	RB32 (1 SELOGIC Processing Interval)
91	5B	05h	RB33 (1 SELOGIC Processing Interval)
92	5C	05h	RB34 (1 SELOGIC Processing Interval)
93	5D	05h	RB35 (1 SELOGIC Processing Interval)
94	5E	05h	RB36 (1 SELOGIC Processing Interval)
95	5F	05h	RB37 (1 SELOGIC Processing Interval)
96	60	05h	RB38 (1 SELOGIC Processing Interval)
97	61	05h	RB39 (1 SELOGIC Processing Interval)
98	62	05h	RB40 (1 SELOGIC Processing Interval)

Coil addresses start at 0000 (i.e., Coil 1 is located at Coil address 0000). If the device is disabled or the breaker jumper is not installed, it will respond with error code 4 (Device Error). In addition to Error Code 4, the device responses to errors in the query are shown in *Table E.16*.

**Table E.16 Responses to 05h Force Single Coil Query Errors**

Error	Error Code Returned	Communication Counter Increments
Invalid bit (coil) to read	Illegal Data Address (02h)	Invalid Address
Invalid bit state requested	Illegal Data Value (03h)	Illegal Register
Format Error	Illegal Data Value (03h)	Bad Packet Format

## 06h Preset Single Register Command

The SEL-2533 uses this function to allow a Modbus master to write directly to a database register. Refer to the Modbus Register Map in *Table E.25* under the Date/Time Set and Command Region for a list of registers that can be written by using this function code. If you are accustomed to 4X references with this function code, for six-digit addressing, add 40001 to the standard database addresses. In *Table E.17*, the command response is identical to the command required by the master.

**Table E.17 06h Preset Single Register Command**

Bytes	Field
Queries from the master must have the following format:	
1 byte	Slave Address
1 byte	Function Code (06h)
2 bytes	Register Address
2 bytes	Data
2 bytes	CRC-16

The device responses to errors in the query are shown in *Table E.18*.

**Table E.18 Responses to 06h Preset Single Register Query Errors**

Error	Error Code Returned	Communication Counter Increments
Invalid register address	Illegal Data Address (02h)	Invalid Address Illegal Write
Illegal register value	Illegal Data Value (03h)	Illegal Write
Format Error	Illegal Data Value (03h)	Bad Packet Format

## 10h Preset Multiple Registers Command

This function code, shown in *Table E.19*, works much like code 06h, except that it allows you to write multiple registers at once, as many as 100 per operation. If you are accustomed to 4X references with the function code, for six-digit addressing, simply add 40001 to the standard database addresses.

**Table E.19 10h Preset Multiple Registers Command**

Bytes	Field
Requests from the master must have the following format:	
1 byte	Slave Address
1 byte	Function Code (10h)
2 bytes	Starting Register Address
2 bytes	Number of Registers to Write
1 byte	Number of Bytes of Data ( $n$ )
$n$ bytes	Data
2 bytes	CRC-16
A successful response from the slave will have the following format:	
1 byte	Slave Address
1 byte	Function Code (10h)
2 bytes	Starting Address
2 bytes	Number of Registers
2 bytes	CRC-16

The device responds to errors in the query as shown in *Table E.20*.

**Table E.20 10h Preset Multiple Register Query Error Messages**

Error	Error Code Returned	Communication Counter Increments
Illegal register to set	Illegal Data Address (02h)	Invalid Address Illegal Write
Illegal number of registers to set	Illegal Data Value (03h)	Illegal Register Illegal Write
Incorrect number of bytes in query data region	Illegal Data Value (03h)	Bad Packet Format Illegal Write
Invalid register data value	Illegal Data Value (03h)	Illegal Write

## Controlling Output Contacts and Remote Bits Using Modbus

The SEL-2533 Modbus Register Map (*Table E.25*) includes three fields that allow a Modbus master to force the device to perform a variety of operations. Use Modbus function codes 06h or 10h to write the appropriate command codes and parameters into the registers shown in *Table E.21*. If function code 06h is used to write to a command code that has parameters, the parameters must be written before the command code. After issuing a command, parameters 1 and 2 are cleared and must be rewritten prior to the next command. *Table E.21* defines the command codes in decimal and hex and their functions and associated parameter(s).

**Table E.21 Device Outputs (Sheet 1 of 2)**

Command Code in Decimal	Command Code In Hex	Function	Parameter 1	Parameter 2
1	1	Reserved	N/A	N/A
2	2	Reserved	N/A	N/A
3	3	Pulse OUT01	1–30 seconds Duration (Defaults to 1 second)	N/A
4	4	Pulse OUT02	1–30 seconds Duration (Defaults to 1 second)	N/A
5	5	Pulse OUT03	1–30 seconds Duration (Defaults to 1 second)	N/A
6	6	Pulse OUT04	1–30 seconds Duration (Defaults to 1 second)	N/A
7	7	Pulse OUT05	1–30 seconds Duration (Defaults to 1 second)	N/A
8	8	Pulse OUT06	1–30 seconds Duration (Defaults to 1 second)	N/A
9	9	Pulse OUT07	1–30 seconds Duration (Defaults to 1 second)	N/A
10	A	Pulse OUT08	1–30 seconds Duration (Defaults to 1 second)	N/A
11	B	Pulse OUT09	1–30 seconds Duration (Defaults to 1 second)	N/A
12	C	Pulse OUT10	1–30 seconds Duration (Defaults to 1 second)	N/A
13	D	Pulse OUT11	1–30 seconds Duration (Defaults to 1 second)	N/A
14	E	Pulse OUT12	1–30 seconds Duration (Defaults to 1 second)	N/A
15	F	Pulse OUT13	1–30 seconds Duration (Defaults to 1 second)	N/A
16	10	Pulse OUT14	1–30 seconds Duration (Defaults to 1 second)	N/A
17	11	Pulse OUT15	1–30 seconds Duration (Defaults to 1 second)	N/A
18	12	Pulse RB_SIL	N/A	N/A
19	13	Pulse RB_ACK	N/A	N/A
20	14	Pulse RB_RST	N/A	N/A
21	15	Pulse RB_CON1	N/A	N/A
22	16	Reset Data Regions	01 - Modbus Communication Counters	N/A

**Table E.21 Device Outputs (Sheet 2 of 2)**

<b>Command Code in Decimal</b>	<b>Command Code In Hex</b>	<b>Function</b>	<b>Parameter 1</b>	<b>Parameter 2</b>
23	17	Control Remote Bits 1–16	1 - Set 2 - Clear 3 - Pulse (1 SELOGIC Processing Interval)	See Below
24	18	Control Remote Bits 17–32	1 - Set 2 - Clear 3 - Pulse (1 SELOGIC Processing Interval)	See Below
25	19	Control Remote Bits 33–40	1 - Set 2 - Clear 3 - Pulse (1 SELOGIC Processing Interval)	See Below

Command Code 19 controls Remote bits RB01 through RB16, Command Code 20 controls Remote bits RB17 through RB32, and Command Code 21 controls Remote Bits RB33 through RB40, as shown in *Table E.22*. Command Codes 19, 20, and 21 have the following two parameters:

- Parameter 1 determines the type of operation (set, clear, or pulse), with the following values:
  - 1 Set
  - 2 Clear
  - 3 Pulse (one processing interval)
- Parameter 2 is bitmasked for the remote bits. If more than one bit occurs in the parameter, then the highest numbered bit will be controlled. For example, for a parameter 2 value of 0003h, only RB02 will be controlled.

**Table E.22 SEL-2533 Modbus Command Region**

<b>Parameter 2 for Command Code 19</b>	<b>Parameter 2 for Command Code 20</b>	<b>Parameter 2 for Command Code 21</b>
0000 0000 0000 0001—RB01	0000 0000 0000 0001—RB17	0000 0000 0000 0001—RB33
0000 0000 0000 0010—RB02	0000 0000 0000 0010—RB18	0000 0000 0000 0010—RB34
0000 0000 0000 0100—RB03	0000 0000 0000 0100—RB19	0000 0000 0000 0100—RB35
0000 0000 0000 1000—RB04	0000 0000 0000 1000—RB20	0000 0000 0000 1000—RB36
0000 0000 0001 0000—RB05	0000 0000 0001 0000—RB21	0000 0000 0001 0000—RB37
0000 0000 0010 0000—RB06	0000 0000 0010 0000—RB22	0000 0000 0010 0000—RB38
0000 0000 0100 0000—RB07	0000 0000 0100 0000—RB23	0000 0000 0100 0000—RB39
0000 0000 1000 0000—RB08	0000 0000 1000 0000—RB24	0000 0000 1000 0000—RB40
0000 0001 0000 0000—RB09	0000 0001 0000 0000—RB25	
0000 0010 0000 0000—RB10	0000 0010 0000 0000—RB26	
0000 0100 0000 0000—RB11	0000 0100 0000 0000—RB27	
0000 1000 0000 0000—RB12	0000 1000 0000 0000—RB28	
0001 0000 0000 0000—RB13	0001 0000 0000 0000—RB29	
0010 0000 0000 0000—RB14	0010 0000 0000 0000—RB30	
0100 0000 0000 0000—RB15	0100 0000 0000 0000—RB31	
1000 0000 0000 0000—RB16	1000 0000 0000 0000—RB32	

*Table E.23* shows the Modbus Command Region.

**Table E.23 SEL-2533 Modbus Command Region**

Decimal Address	HEX Address	Function Code Supported	Field
550	226	06h, 10h	Parameter 2
551	227	06h, 10h	Parameter 1
552	228	06h, 10h	Command Code

## Conversion Table

One way to present data in a suitable range and resolution is to scale the data before transmission, normally by dividing or multiplying by powers of 10. Use the information in *Table E.24* to convert the units of the received data into the appropriate scale for further processing or display.

**Table E.24 Conversion Table**

Index <sup>a</sup>	Type	Multiply	Divide	Offset	Base
0	Boolean	1	1	0	1
1	Unsigned Integer	1	1	0	1
2	Unsigned Integer	1	10	0	1
3	Unsigned Integer	1	100	0	1
4	HEX	1	1000	0	1
5	Integer	1	1	0	1
6	Integer	1	1	0	1
7	Integer	1	10	0	1
8	Integer	1	100	0	1
9	Integer	1	1000	0	1
10	Enumeration	1	1	0	1
11	Bit Enumeration	1	1	0	1
12	Two 8 bit ASCII characters	1	1	0	1
13	Long Integer	1	1	0	1
14	Long Integer	1	10	0	1
15	Long Integer	1	100	0	1
16	Long Integer	1	1000	0	1

<sup>a</sup> Refers to the conversion column in Table E.25.

# Modbus Register Map

---

Table E.25 Modbus Register Map (Sheet 1 of 12)

Address in Decimal	Function Code Supported	Conv	Min	Max	Default	Name/Enums	Units	LABEL
<b>Device ID</b>								
0	3,4	12	na	na		FID Char (1,2)		
1	3,4	12	na	na		FID Char (3,4)		
2	3,4	12	na	na		FID Char (5,6)		
3	3,4	12	na	na		FID Char (7,8)		
4	3,4	12	na	na		FID Char (9,10)		
5	3,4	12	na	na		FID Char (11,12)		
6	3,4	12	na	na		FID Char (13,14)		
7	3,4	12	na	na		FID Char (15,16)		
8	3,4	12	na	na		FID Char (17,18)		
9	3,4	12	na	na		FID Char (19,20)		
10	3,4	12	na	na		FID Char (21,22)		
11	3,4	12	na	na		FID Char (23,24)		
12	3,4	12	na	na		FID Char (25,26)		
13	3,4	12	na	na		FID Char (27,28)		
14	3,4	12	na	na		FID Char (29,30)		
15	3,4	12	na	na		FID Char (31,32)		
16	3,4	12	na	na		FID Char (33,34)		
17	3,4	12	na	na		FID Char (35,36)		
18	3,4	12	na	na		FID Char (37,38)		
19	3,4	12	na	na		FID Char (39,40)		
20	3,4	12	na	na		FID Char (41,42)		
21	3,4	12	na	na		FID Char (43,44)		
22	3,4	12	na	na		BFID Char (1,2)		
23	3,4	12	na	na		BFID Char (3,4)		
24	3,4	12	na	na		BFID Char (5,6)		
25	3,4	12	na	na		BFID Char (7,8)		
26	3,4	12	na	na		BFID Char (9,10)		
27	3,4	12	na	na		BFID Char (11,12)		
28	3,4	12	na	na		BFID Char (13,14)		
29	3,4	12	na	na		BFID Char (15,16)		
30	3,4	12	na	na		BFID Char (17,18)		
31	3,4	12	na	na		BFID Char (19,20)		
32	3,4	12	na	na		BFID Char (21,22)		
33	3,4	12	na	na		BFID Char (23,24)		
34	3,4	12	na	na		BFID Char (25,26)		
35	3,4	12	na	na		BFID Char (27,28)		

**Table E.25 Modbus Register Map (Sheet 2 of 12)**

<b>Address in Decimal</b>	<b>Function Code Supported</b>	<b>Conv</b>	<b>Min</b>	<b>Max</b>	<b>Default</b>	<b>Name/Enums</b>	<b>Units</b>	<b>LABEL</b>
36	3,4	12	na	na		BFID Char (29,30)		
37	3,4	12	na	na		BFID Char (31,32)		
38	3,4	12	na	na		BFID Char (33,34)		
39	3,4	12	na	na		BFID Char (35,36)		
40	3,4	12	na	na		BFID Char (37,38)		
41	3,4	12	na	na		BFID Char (39,40)		
42	3,4	12	na	na		BFID Char (41,42)		
43	3,4	12	na	na		BFID Char (43,44)		
44	3,4	12	na	na		CID Char (1,2)		CID
45	3,4	12	na	na		CID Char (3,4)		
46	3,4	12	na	na		DEVID Char (1,2)		DEVID
47	3,4	12	na	na		DEVID Char (3,4)		
48	3,4	12	na	na		DEVID Char (5,6)		
49	3,4	12	na	na		DEVID Char (7,8)		
50	3,4	12	na	na		DEVID Char (9,10)		
51	3,4	12	na	na		DEVID Char (11,12)		
52	3,4	12	na	na		DEVID Char (13,14)		
53	3,4	12	na	na		DEVID Char (15,16)		
54	3,4	1	na	na		DEVCODE		DEVCODE
55	3,4	12	na	na		Part Number Char (1,2)		PARTNO
56	3,4	12	na	na		Part Number Char (3,4)		
57	3,4	12	na	na		Part Number Char (5,6)		
58	3,4	12	na	na		Part Number Char (7,8)		
59	3,4	12	na	na		Part Number Char (9,10)		
60	3,4	12	na	na		Part Number Char (11,12)		
61	3,4	12	na	na		Part Number Char (13,14)		
62	3,4	12	na	na		Part Number Char (15)		
63	3,4	12	na	na		Config (1,2)		CONFIG
64	3,4	12	na	na		Config (3,4)		
65	3,4	12	na	na		Config (5,6)		
66	3,4	12	na	na		Config (7,8)		
<b>Reserved Area 1</b>								
67	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
68	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
69	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
70	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
71	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
72	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
73	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
74	3,4	5	8000	8000	8000	Reserved = 8000 Hex		

**Table E.25 Modbus Register Map (Sheet 3 of 12)**

<b>Address in Decimal</b>	<b>Function Code Supported</b>	<b>Conv</b>	<b>Min</b>	<b>Max</b>	<b>Default</b>	<b>Name/Enums</b>	<b>Units</b>	<b>LABEL</b>
75	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
76	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
77	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
78	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
79	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
80	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
81	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
82	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
83	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
84	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
85	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
86	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
87	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
88	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
89	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
90	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
91	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
92	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
93	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
94	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
95	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
96	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
97	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
98	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
99	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
100	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
101	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
102	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
103	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
104	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
105	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
106	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
107	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
108	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
109	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
110	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
111	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
112	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
113	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
114	3,4	5	8000	8000	8000	Reserved = 8000 Hex		

**Table E.25 Modbus Register Map (Sheet 4 of 12)**

<b>Address in Decimal</b>	<b>Function Code Supported</b>	<b>Conv</b>	<b>Min</b>	<b>Max</b>	<b>Default</b>	<b>Name/Enums</b>	<b>Units</b>	<b>LABEL</b>
115	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
116	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
117	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
118	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
119	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
120	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
121	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
122	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
123	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
124	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
125	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
126	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
127	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
128	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
129	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
130	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
131	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
132	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
133	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
134	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
135	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
136	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
137	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
138	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
139	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
140	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
141	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
142	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
143	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
144	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
145	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
146	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
147	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
148	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
149	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
<b>Device Status</b>								
150	3,4	10	0	2	0	FPGA STATUS 0 - OK 2 - FAIL		FPGA
151	3,4	10	0	2	0	GPSB STATUS		GPSB

**Table E.25 Modbus Register Map (Sheet 5 of 12)**

<b>Address in Decimal</b>	<b>Function Code Supported</b>	<b>Conv</b>	<b>Min</b>	<b>Max</b>	<b>Default</b>	<b>Name/Enums</b>	<b>Units</b>	<b>LABEL</b>
152	3,4	10	0	2	0	0 - OK 2 - FAIL HMI STATUS 0 - OK 2 - FAIL		HMI
153	3,4	10	0	2	0	RAM STATUS 0 - OK 2 - FAIL		RAM
154	3,4	10	0	2	0	ROM STATUS 0 - OK 2 - FAIL		ROM
155	3,4	10	0	2	0	CR_RAM STATUS 0 - OK 2 - FAIL		CR_RAM
156	3,4	10	0	2	0	NON_VOL STATUS 0 - OK 2 - FAIL		NON_VOL
157	3,4	10	0	2	0	CLK_BAT STATUS 0 - OK 1 - WARN		CLKBAT
158	3,4	10	0	2	0	CLOCK STATUS 0 - OK 1 - WARN		CLKSTS
159	3,4	10	0	2	0	CARD C STATUS 0 - OK 1 - ABSENT 2 - FAIL		CARD_C
160	3,4	10	0	2	0	CARD D STATUS 0 - OK 1 - ABSENT 2 - FAIL		CARD_D
161	3,4	10	0	2	0	CARD E STATUS 0 - OK 1 - ABSENT 2 - FAIL		CARD_E
162	3,4	10	0	2	0	CARD F STATUS 0 - OK 1 - ABSENT 2 - FAIL		CARD_F
163	3,4	10	0	1	0	DEVICE STATUS		DEVSTS

Table E.25 Modbus Register Map (Sheet 6 of 12)

Address in Decimal	Function Code Supported	Conv	Min	Max	Default	Name/Enums	Units	LABEL
164	3,4	5	8000	8000	8000	0 - ENABLED 1 - DISABLED Reserved = 8000 Hex		CID_FILE
165	3,4	10	0	2	0	+3.3V STATUS 0 - OK 1 - WARN 2 - FAIL		P3P3PS
166	3,4	10	0	2	0	+5.0V STATUS 0 - OK 1 - WARN 2 - FAIL		P5PS
167	3,4	10	0	2	0	+2.5V STATUS 0 - OK 1 - WARN 2 - FAIL		P2P5PS
168	3,4	10	0	2	0	+3.75V STATUS 0 - OK 1 - WARN 2 - FAIL		P3P75PS
169	3,4	10	0	2	0	-1.25V STATUS 0 - OK 1 - WARN 2 - FAIL		N1P25PS
<b>Reserved Area 2</b>								
170	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
171	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
172	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
173	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
174	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
175	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
176	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
177	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
178	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
179	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
180	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
181	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
182	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
183	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
184	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
185	3,4	5	8000	8000	8000	Reserved = 8000 Hex		

**Table E.25 Modbus Register Map (Sheet 7 of 12)**

<b>Address in Decimal</b>	<b>Function Code Supported</b>	<b>Conv</b>	<b>Min</b>	<b>Max</b>	<b>Default</b>	<b>Name/Enums</b>	<b>Units</b>	<b>LABEL</b>
186	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
187	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
188	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
189	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
190	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
191	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
192	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
193	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
194	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
195	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
196	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
197	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
198	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
199	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
<b>Date/Time Set</b>								
200	3,4,6,10	1	0	59	0	SET SEC		SEC
201	3,4,6,10	1	0	59	0	SET MIN		MIN
202	3,4,6,10	1	0	23	0	SET HOUR		HOUR
203	3,4,6,10	1	1	31	1	SET DAY		DAY
204	3,4,6,10	1	1	12	1	SET MONTH		MONTH
205	3,4,6,10	1	00 or 2000	99 or 2099	2000	SET YEAR	00–99 are interpreted as 2000–2099	YEAR
<b>Reserved Area 3</b>								
206	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
207	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
208	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
209	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
210	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
211	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
212	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
213	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
214	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
215	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
216	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
217	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
218	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
219	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
220	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
221	3,4	5	8000	8000	8000	Reserved = 8000 Hex		

Table E.25 Modbus Register Map (Sheet 8 of 12)

Address in Decimal	Function Code Supported	Conv	Min	Max	Default	Name/Enums	Units	LABEL
222	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
223	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
224	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
225	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
226	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
227	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
228	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
229	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
230	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
231	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
232	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
233	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
234	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
235	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
236	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
237	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
238	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
239	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
240	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
241	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
242	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
243	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
244	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
245	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
246	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
247	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
248	3,4	5	8000	8000	8000	Reserved = 8000 Hex		
249	3,4	5	8000	8000	8000	Reserved = 8000 Hex		

**Device Elements**

Only a few Device Element rows have bit enumerations specific to that row. Other Device Element rows have generic bit enumerations as shown for row 3. See Device Word SRS for element information in these rows.

250	3,4	11	0	65281	0 Bit 0 = 1 if any bits 1–15 are asserted Bits 1–7 = 0 Bit 8 Bit 9 Bit 10 Bit 11 Bit 12	ROW 0 * * * *		ROW_0
-----	-----	----	---	-------	--	---------------------------	--	-------

Table E.25 Modbus Register Map (Sheet 9 of 12)

Address in Decimal	Function Code Supported	Conv	Min	Max	Default	Name/Enums	Units	LABEL
251	3,4	11	0	65281	Bit 13 Bit 14 Bit 15 0 Bit 0 = 1 if any bits 1–15 are asserted Bits1–7 = 0 Bit 8 Bit 9 Bit 10 Bit 11 Bit 12 Bit 13 Bit 14 Bit 15	*		
252	3,4	11	0	65281	0 Bit 0 = 1 if any bits 1–15 are asserted Bits1–7 = 0 Bit 8 Bit 9 Bit 10 Bit 11 Bit 12 Bit 13 Bit 14 Bit 15	ROW 1 RBACK RESET ACK SIL NC_ALM CR_ALM HALARM SALARM ROW 2		ROW_1
253	3,4	11	0	65281	0	ROW 3		ROW_2
254	3,4	11	0	65281	0	ROW 4		ROW_3
255	3,4	11	0	65281	0	ROW 5		ROW_4
256	3,4	11	0	65281	0	ROW 6		ROW_5
257	3,4	11	0	65281	0	ROW 7		ROW_6
258	3,4	11	0	65281	0	ROW 8		ROW_7
259	3,4	11	0	65281	0	ROW 9		ROW_8
260	3,4	11	0	65281	0	ROW 10		ROW_9
261	3,4	11	0	65281	0	ROW 11		ROW_10
262	3,4	11	0	65281	0	ROW 12		ROW_11
263	3,4	11	0	65281	0	ROW 13		ROW_12
264	3,4	11	0	65281	0	ROW 14		ROW_13

**Table E.25 Modbus Register Map (Sheet 10 of 12)**

Address in Decimal	Function Code Supported	Conv	Min	Max	Default	Name/Enums	Units	LABEL
265	3,4	11	0	65281	0	ROW 15		ROW_15
266	3,4	11	0	65281	0	ROW 16		ROW_16
267	3,4	11	0	65281	0	ROW 17		ROW_17
268	3,4	11	0	65281	0	ROW 18		ROW_18
269	3,4	11	0	65281	0	ROW 19		ROW_19
270	3,4	11	0	65281	0	ROW 20		ROW_20
271	3,4	11	0	65281	0	ROW 21		ROW_21
272	3,4	11	0	65281	0	ROW 22		ROW_22
273	3,4	11	0	65281	0	ROW 23		ROW_23
274	3,4	11	0	65281	0	ROW 24		ROW_24
275	3,4	11	0	65281	0	ROW 25		ROW_25
276	3,4	11	0	65281	0	ROW 26		ROW_26
277	3,4	11	0	65281	0	ROW 27		ROW_27
278	3,4	11	0	65281	0	ROW 28		ROW_28
279	3,4	11	0	65281	0	ROW 29		ROW_29
280	3,4	11	0	65281	0	ROW 30		ROW_30
281	3,4	11	0	65281	0	ROW 31		ROW_31
282	3,4	11	0	65281	0	ROW 32		ROW_32
283	3,4	11	0	65281	0	ROW 33		ROW_33
284	3,4	11	0	65281	0	ROW 34		ROW_34
285	3,4	11	0	65281	0	ROW 35		ROW_35
286	3,4	11	0	65281	0	ROW 36		ROW_36
287	3,4	11	0	65281	0	ROW 37		ROW_37
288	3,4	11	0	65281	0	ROW 38		ROW_38
289	3,4	11	0	65281	0	ROW 39		ROW_39
290	3,4	11	0	65281	0	ROW 40		ROW_40
291	3,4	11	0	65281	0	ROW 41		ROW_41
292	3,4	11	0	65281	0	ROW 42		ROW_42
293	3,4	11	0	65281	0	ROW 43		ROW_43
294	3,4	11	0	65281	0	ROW 44		ROW_44
295	3,4	11	0	65281	0	ROW 45		ROW_45
296	3,4	11	0	65281	0	ROW 46		ROW_46
297	3,4	11	0	65281	0	ROW 47		ROW_47
298	3,4	11	0	65281	0	ROW 48		ROW_48
299	3,4	11	0	65281	0	ROW 49		ROW_49
300	3,4	11	0	65281	0	ROW 50		ROW_50
301	3,4	11	0	65281	0	ROW 51		ROW_51
302	3,4	11	0	65281	0	ROW 52		ROW_52
303	3,4	11	0	65281	0	ROW 53		ROW_53
304	3,4	11	0	65281	0	ROW 54		ROW_54

**Table E.25 Modbus Register Map (Sheet 11 of 12)**

<b>Address in Decimal</b>	<b>Function Code Supported</b>	<b>Conv</b>	<b>Min</b>	<b>Max</b>	<b>Default</b>	<b>Name/Enums</b>	<b>Units</b>	<b>LABEL</b>
305	3,4	11	0	65281	0	ROW 55		ROW_55
306	3,4	11	0	65281	0	ROW 56		ROW_56
307	3,4	11	0	65281	0	ROW 57		ROW_57
308	3,4	11	0	65281	0	ROW 58		ROW_58
309	3,4	11	0	65281	0	ROW 59		ROW_59
310	3,4	11	0	65281	0	ROW 60		ROW_60
311	3,4	11	0	65281	0	ROW 61		ROW_61
312	3,4	11	0	65281	0	ROW 62		ROW_62
313	3,4	11	0	65281	0	ROW 63		ROW_63
314	3,4	11	0	65281	0	ROW 64		ROW_64
315	3,4	11	0	65281	0	ROW 65		ROW_65
316	3,4	11	0	65281	0	ROW 66		ROW_66
317	3,4	11	0	65281	0	ROW 67		ROW_67
318	3,4	11	0	65281	0	ROW 68		ROW_68
319	3,4	11	0	65281	0	ROW 69		ROW_69
320	3,4	11	0	65281	0	ROW 70		ROW_70
321	3,4	11	0	65281	0	ROW 71		ROW_71
322	3,4	11	0	65281	0	ROW 72		ROW_72
323	3,4	11	0	65281	0	ROW 73		ROW_73
324	3,4	11	0	65281	0	ROW 74		ROW_74
325	3,4	11	0	65281	0	ROW 75		ROW_75
326	3,4	11	0	65281	0	ROW 76		ROW_76
327	3,4	11	0	65281	0	ROW 77		ROW_77
328	3,4	11	0	65281	0	ROW 78		ROW_78
329	3,4	11	0	65281	0	ROW 79		ROW_79
330	3,4	11	0	65281	0	ROW 80		ROW_80
331	3,4	11	0	65281	0	ROW 81		ROW_81
332	3,4	11	0	65281	0	ROW 82		ROW_82
333	3,4	11	0	65281	0	ROW 83		ROW_83
334	3,4	11	0	65281	0	ROW 84		ROW_84
335	3,4	11	0	65281	0	ROW 85		ROW_85
336	3,4	11	0	65281	0	ROW 86		ROW_86
337	3,4	11	0	65281	0	ROW 87		ROW_87
338	3,4	11	0	65281	0	ROW 88		ROW_88
339	3,4	11	0	65281	0	ROW 89		ROW_89
340	3,4	11	0	65281	0	ROW 90		ROW_90
341	3,4	11	0	65281	0	ROW 91		ROW_91
342	3,4	11	0	65281	0	ROW 92		ROW_92
343	3,4	11	0	65281	0	ROW 93		ROW_93
344	3,4	11	0	65281	0	ROW 94		ROW_94

**Table E.25 Modbus Register Map (Sheet 12 of 12)**

<b>Address in Decimal</b>	<b>Function Code Supported</b>	<b>Conv</b>	<b>Min</b>	<b>Max</b>	<b>Default</b>	<b>Name/Enums</b>	<b>Units</b>	<b>LABEL</b>
345	3,4	11	0	65281	0	ROW 95		ROW_95
346	3,4	11	0	65281	0	ROW 96		ROW_96
<b>Comm Counters</b>								
500	3	1	0	65535	0	NUM MSG RCVD		NUMRCV
501	3	1	0	65535	0	NUM OTHER MSG		NUMOTH
502	3	1	0	65535	0	INVALID ADDR		INVADR
503	3	1	0	65535	0	BAD CRC		BADCRC
504	3	1	0	65535	0	UART ERROR		UARTERR
505	3	1	0	65535	0	ILLEGAL FUNCTION		ILLFUNC
506	3	1	0	65535	0	ILLEGAL REGISTER		ILLREG
507	3	1	0	65535	0	ILLEGAL WRITE		ILLWR
508	3	1	0	65535	0	BAD PKT FORMAT		BADPKTF
509	3	1	0	65535	0	BAD PKT LENGTH		BADPKTL
<b>Command Region</b>								
550	3,4,6,10	11				Parameter 2		PARAM2
551	3,4,6,10	11				Parameter 1		PARAM1
552	3,4,6,10	11				Command Code		COMMAND

# Appendix F

## MIRRORED BITS Communications

### Overview

---

MIRRORED BITS® is a direct device-to-device communications protocol that allows IEDs to exchange information quickly, securely, and with minimal expense. Use MIRRORED BITS for functions such as remote control and remote sensing. The SEL-2533 Announcer supports two MIRRORED BITS communications channels, designated A and B. Use the port setting PROTO to assign one of the MIRRORED BITS communications channels to a serial port; PROTO := MBA for MIRRORED BITS communications Channel A or PROTO := MBB for MIRRORED BITS communications Channel B. MIRRORED BITS are either Transmit MIRRORED BITS (TMB) or Received MIRRORED BITS (RMB). Transmit MIRRORED BITS include TMB1A–TMB8A (channel A) and TMB1B–TMB8B (channel B). The last letter (A or B) designates with which channel the bits are associated. Received bits include RMB1A–RMB8A and RMB1B–RMB8B. Control the transmit MIRRORED BITS in SELOGIC® control equations. Use the received MIRRORED BITS as arguments in SELOGIC control equations. The channel status bits are ROKA, RBADA, CBADA, LBOKA, ROKB, RBADB, CBADB, and LBOKB. You can also use these channel status bits as arguments in SELOGIC control equations. Use the **COM** command (see *Section 7: Communications*) for additional channel status information.

Because of different applications, the SEL product range supports several variations of the MIRRORED BITS communications protocol. Through port settings, you can set the SEL-2533 for compatible operation with SEL-300 series devices, SEL-2505 Remote I/O Modules, and SEL-2100 Logic Processors. When communicating with an SEL-400 series relay, be sure to set the transmission mode setting in the SEL-400 series relay to paced transmission (TXMODE := P).

### Operation

#### Message Transmission

In the SEL-2533, the MIRRORED BITS transmission rate is a function of the baud rate. At baud rates below 9600, the SEL-2533 transmits MIRRORED BITS as fast as possible for the given baud. At rates at and above 9600 baud the SEL-2533 self-paces, using a technique similar to the SEL-400 series pacing mode. There are no settings to enable or disable the self-pacing mode; the SEL-2533 automatically enters the self-pacing mode at baud rates of 9600, 19200, and 38400. *Table F.1* shows the transmission rates of the MIRRORED BITS messages at different baud.

**Table F.1 Number of MIRRORED BITS Messages for Different Baud**

Baud Rate	Transmission Rate of MIRRORED BITS Packets
2400	15ms
4800	7.5ms
9600	4ms
19200	4ms
38400	4ms

Transmitting at longer intervals for baud rates above 9600 avoids overflowing devices that receive MIRRORED BITS at a slower rate.

## Message Reception Overview

During synchronized MIRRORED BITS communications with the communications channel in normal state, the device decodes and checks each received message. If the message is valid, the device sends each received logic bit ( $RMBn$ , where  $n = 1$  through 8) to the corresponding pickup and dropout security counters, that in turn set or clear the  $RMBnA$  and  $RMBnB$  device element bits.

## Message Decoding and Integrity Checks

Set the RX\_ID of the local SEL-2533 to match the TX\_ID of the remote MIRRORED BITS device. The SEL-2533 provides indication of the status of each MIRRORED BITS communications channel with Device Word bits ROKA (receive OK) and ROKB. During normal operation, the device sets the  $ROKc$  ( $c = A$  or  $B$ ). Upon detecting any of the following conditions, the device clears the  $ROKc$  bit:

- The device is disabled
- MIRRORED BITS are not enabled
- Parity, framing, or overrun errors
- Receive message identification error
- No message received in the time three messages have been sent when  $PROTO = MBc$ , or seven messages have been sent when  $PROTO = MB8c$
- Loopback is enabled

The device asserts  $ROKc$  only after successful synchronization as described below and two consecutive messages pass all of the data checks described above. After  $ROKc$  is reasserted, received data may be delayed while passing through the security counters described below.

While  $ROKc$  is deasserted, the device does not transfer new RMB data to the pickup-dropout security counters described below. Instead, the device sends one of the user-definable default values to the security counter inputs. For each  $RMBn$ , use the RXDFLT setting to determine the default state the MIRRORED BITS should use in place of received data if an error condition is detected. The setting is a mask of 1s, 0s, and/or Xs (for  $RMB1A-RMB8A$ ), where X represents the most recently received valid value. The positions of the 1s and 0s correspond to the respective positions of the MIRRORED BITS in the Device Word bits (see *Appendix G: Device Word Bits*). *Table F.2* is an extract of *Appendix G: Device Word Bits*, showing the positions of the MIRRORED BITS.

**Table F.2 Positions of the MIRRORED BITS**

Bit/ Row	7	6	5	4	3	2	1	0
33	RMB8A	RMB7A	RMB6A	RMB5A	RMB4A	RMB3A	RMB2A	RMB1A
35	RMB8B	RMB7B	RMB6B	RMB5B	RMB4B	RMB3B	RMB2B	RMB1B

**Table F.3 MIRRORED BITS Values for a RXDFLT Setting of 10100111**

Bit/ Row	7	6	5	4	3	2	1	0
33	1	0	1	0	0	1	1	1

*Table F.3* shows an example of the values of the MIRRORED BITS for a RXDFLT setting of 10100111.

Individual pickup and dropout security counters supervise the movement of each received data bit into the corresponding RMB $n$  element. You can set each pickup/dropout security counter from 1 to 8. A setting of 1 causes a security counter to pass every occurrence, while a setting of 8 causes a counter to wait for eight consecutive occurrences in the received data before updating the data bits. The pickup and dropout security count settings are separate. Control the security count settings with the settings RMB $n$ PU and RMB $n$ DO.

A pickup/dropout security counter operates identically to a pickup/dropout timer, except that the counter uses units of counted received messages instead of time. Select a setting for the security counter in accordance with the transmission rate (see *Table F.1*). For example, when transmitting at 2400 baud, a security counter set to 2 counts delays a bit by about 30 ms. However, when operating at 9600 baud, a setting of 2 counts delays a bit by about 8.5 ms.

## Channel Synchronization

When an SEL-2533 detects a communications error, it deasserts ROKA or ROKB. If an SEL-2533 detects two consecutive communications errors, it transmits an attention message, which includes the TXID setting. The device transmits an attention message until it receives an attention message that includes a match to the TXID setting value. If the attention message is successful, the device has properly synchronized and data transmission resumes. If the attention message is not successful, the device repeats the attention message until it is successful.

In summary, when a device detects an error, it transmits an attention message until it receives an attention message with its own TX\_ID included. If three or four devices are connected in a ring topology, the attention message will go all the way around the loop until the originating device receives it. The message then dies and data transmission resumes. This method of synchronization allows the devices to reliably determine which byte is the first byte of the message. It also forces unsynchronized UARTs to become resynchronized. On the down side, this method takes down the entire loop for a receive error at any device in the loop. This decreases availability. It also makes one-way communications impossible.

## Loopback Testing

Use the **LOOP** command to enable loopback testing. In the loopback mode, you loop the transmit port to the receive port of the same device to verify transmission messages. While in loopback mode, ROKC is deasserted, and another user

accessible Device Word bit, LBOK<sub>c</sub> (Loop Back OK) asserts and deasserts based on the received data checks (see the *Section 7: Communications* for the ASCII commands).

## Channel Monitoring

Based on the results of data checks (described above), the device collects information regarding the 255 most recent communications errors. Each record contains at least the following fields:

- DATE: Date when the dropout occurred
- TIME: Time when the dropout occurred
- RECOVERY\_DATE: Date when the channel returned to service (if the channel is currently failed, it is displayed and included in the calculations, as if its recovery were to occur at the time the report was requested)
- RECOVERY\_TIME: Time when the channel returned to service (if the channel is currently failed, it is displayed and included in the calculations, as if its recovery were to occur at the time the report was requested)
- DURATION: Time elapsed during dropout
- CAUSE: Reason for dropout (see *Message Decoding and Integrity Checks* on page F.2)

There is a single record for each outage, but an outage can evolve. For example, the initial cause could be a data disagreement, but framing errors can extend the outage. If the channel is currently failed, it is displayed and included in the calculations, as if its recovery were to occur at the time the report was requested.

---

**NOTE:** Combine error conditions including RBADA, RBADB, CBADA, and CBADB with other alarm conditions using SELogic control equations. You can use these alarm conditions to program the device to take appropriate action when it detects a communications channel failure.

When the duration of an outage on Channel A or B exceeds a user-definable threshold, the device asserts a user-accessible Device Word bit, RBADA or RBADB. When channel unavailability exceeds a user-definable threshold for Channel A or B, the device asserts a user-accessible Device Word bit, CBADA or CBADB. Use the **COM L (A or B)** command to generate a long or summary report of the communications errors.

Use the RBADPU setting to determine how long a channel error must last before the meter element RBADA is asserted. RBADA is deasserted when the channel error is corrected. RBADPU is accurate to  $\pm 1$  second.

Use the CBADPU setting to determine the ratio of channel down time to the total channel time before the meter element CBADA is asserted. The times used in the calculation are those that are available in the COM records. See the *COMMUNICATIONS Command* on page 7.11 for more information.

## Settings

Set PROTO = MBA or MB8A to enable the MIRRORED BITS protocol channel A on this port. Set PROTO = MBB or MB8B to enable the MIRRORED BITS protocol channel B on this port. The standard MIRRORED BITS protocols MBA and MBB use a 6-data bit format for data encoding. The MB8 protocols MB8A and MB8B use an 8-data bit format, which allows MIRRORED BITS to operate on communication channels requiring an 8-data bit format. For the remainder of this section, PROTO = MBA is assumed. *Table F.4* shows the MIRRORED BITS protocol port settings, ranges, and default settings for PORT F, PORT 3, and PORT 4.

**Table F.4 MIRRORED BITS Protocol Settings**

<b>Setting Prompt</b>	<b>Setting Description</b>	<b>Factory Default Setting</b>
TXID	MIRRORED BITS ID of This Device (1–4)	2
RXID	MIRRORED BITS ID of Device Receiving From (1–4)	1
RBADPU	Outage Duration to Set RBAD (0–10000 seconds)	60
CBADPU	Channel Unavailability to Set CBAD (1–10000 ppm)	1000
RXDFLT	8 char string of 1s, 0s, or Xs	XXXXXXXX
RMB1PU	RMB1 Pickup Debounce Messages (1–8 messages)	1
RMB1DO	RMB1 Dropout Debounce Messages (1–8 messages)	1
RMB2PU	RMB2 Pickup Debounce Messages (1–8 messages)	1
RMB2DO	RMB2 Dropout Debounce Messages (1–8 messages)	1
RMB3PU	RMB3 Pickup Debounce Messages (1–8 messages)	1
RMB3DO	RMB3 Dropout Debounce Messages (1–8 messages)	1
RMB4PU	RMB4 Pickup Debounce Messages (1–8 messages)	1
RMB4DO	RMB4 Dropout Debounce Messages (1–8 messages)	1
RMB5PU	RMB5 Pickup Debounce Messages (1–8 messages)	1
RMB5DO	RMB5 Dropout Debounce Messages (1–8 messages)	1
RMB6PU	RMB6 Pickup Debounce Messages (1–8 messages)	1
RMB6DO	RMB6 Dropout Debounce Messages (1–8 messages)	1
RMB7PU	RMB7 Pickup Debounce Messages (1–8 messages)	1
RMB7DO	RMB7 Dropout Debounce Messages (1–8 messages)	1
RMB8PU	RMB8 Pickup Debounce Messages (1–8 messages)	1
RMB8DO	RMB8 Dropout Debounce Messages (1–8 messages)	1

**This page intentionally left blank**

# Appendix G

## Device Word Bits

### Overview

---

The device element results are represented by Device Word bits in the SEL-2533. Each Device Word bit has a label name and can be in either of the following states:

- 1 (logical 1)
- 0 (logical 0)

Logical 1 represents an element being picked up or otherwise asserted. Logical 0 represents an element being dropped out or otherwise deasserted. *Table G.1* and *Table G.2* show a list of Device Word bits and corresponding descriptions. The Device Word bit row numbers correspond to the row numbers used in the **TAR** command (see *TARGET Command (Display Relay Word Bit Status) on page 7.22*).

Use any Device Word bit (except Row 0) in SELOGIC® control equations (see *Section 4: Logic Functions*) and the Sequential Events Recorder (SER) trigger list settings (see *Section 9: Analyzing SER Events*).

**Table G.1 SEL-2533 Device Word Bits (Sheet 1 of 4)**

Bit/ Row	Device Word Bits							
	7	6	5	4	3	2	1	0
0	ENABLED	*	*	*	*	*	*	*
1	SALARM	HALARM	CR_ALM	NC_ALM	SIL	ACK	RESET	RBACK
2	*	*	ALIN_A1	ALIN_A2	*	*	*	*
3	*	*	ALIN_B1	ALIN_B2	*	*	*	*
4	*	*	ALIN_C1	ALIN_C2	*	*	*	*
5	*	*	ALIN_D1	ALIN_D2	*	*	*	*
6	*	*	ALIN_E1	ALIN_E2	*	*	*	*
7	*	*	*	*	*	*	*	*
8	*	*	AP_A1	AP_A2	*	*	*	*
9	*	*	AP_B1	AP_B2	*	*	*	*
10	*	*	AP_C1	AP_C2	*	*	*	*
11	*	*	AP_D1	AP_D2	*	*	*	*
12	*	*	AP_E1	AP_E2	*	*	*	*
13	*	*	*	*	*	*	*	*
14	*	*	ALM_A1	ALM_A2	*	*	*	*
15	*	*	ALM_B1	ALM_B2	*	*	*	*

**Table G.1 SEL-2533 Device Word Bits (Sheet 2 of 4)**

Bit/ Row	Device Word Bits							
	7	6	5	4	3	2	1	0
<b>16</b>	*	*	ALM_C1	ALM_C2	*	*	*	*
<b>17</b>	*	*	ALM_D1	ALM_D2	*	*	*	*
<b>18</b>	*	*	ALM_E1	ALM_E2	*	*	*	*
<b>19</b>	*	*	*	*	*	*	*	*
<b>20</b>	*	*	*	*	*	*	*	*
<b>21</b>	IN_A1	IN_A2	IN_B1	IN_B2	IN_C1	IN_C2	IN_D1	IN_D2
<b>22</b>	IN_E1	IN_E2	IN_F1	IN_F2	*	*	*	*
<b>23</b>	*	*	*	*	PB_SIL	PB_ACK	PB_RST	PB_TST
<b>24</b>	IN_G1	IN_G2	*	*	*	*	*	*
<b>25</b>	IN_A1E	IN_A2E	IN_B1E	IN_B2E	IN_C1E	IN_C2E	IN_D1E	IN_D2E
<b>26</b>	IN_E1E	IN_E2E	IN_F1E	IN_F2E	*	*	*	*
<b>27</b>	*	*	*	*	PB_SIPL	PB_ACKP	PB_RSTP	PB_TSTP
<b>28</b>	IN_G1E	IN_G2E	*	*	*	*	*	*
<b>29</b>	OUT01	OUT02	OUT03	*	*	*	*	*
<b>30</b>	OUT04	OUT05	OUT06	OUT07	*	*	*	*
<b>31</b>	OUT08	OUT09	OUT10	OUT11	OUT12	OUT13	OUT14	OUT15
<b>32</b>	*	*	*	*	*	*	TEST	IRIGOK
<b>33</b>	RMB8A	RMB7A	RMB6A	RMB5A	RMB4A	RMB3A	RMB2A	RMB1A
<b>34</b>	TMB8A	TMB7A	TMB6A	TMB5A	TMB4A	TMB3A	TMB2A	TMB1A
<b>35</b>	RMB8B	RMB7B	RMB6B	RMB5B	RMB4B	RMB3B	RMB2B	RMB1B
<b>36</b>	TMB8B	TMB7B	TMB6B	TMB5B	TMB4B	TMB3B	TMB2B	TMB1B
<b>37</b>	LBOKB	CBADB	RBADB	ROKB	LBOKA	CBADA	RBADA	ROKA
<b>38</b>	*	*	*	*	*	*	*	*
<b>39</b>	*	*	*	*	*	*	*	*
<b>40</b>	*	*	*	*	*	*	*	*
<b>41</b>	*	*	FRST_A1	FRST_A2	*	*	*	*
<b>42</b>	*	*	FRST_B1	FRST_B2	*	*	*	*
<b>43</b>	*	*	FRST_C1	FRST_C2	*	*	*	*
<b>44</b>	*	*	FRST_D1	FRST_D2	*	*	*	*
<b>45</b>	*	*	FRST_E1	FRST_E2	*	*	*	*
<b>46</b>	*	*	*	*	*	*	*	*
<b>47</b>	FIRST1	FIRST2	FIRST3	FIRST4	*	*	*	*
<b>48</b>	FRSTOP1	FRSTOP2	FRSTOP3	FRSTOP4	*	*	*	*
<b>49</b>	LT01	LT02	LT03	LT04	LT05	LT06	LT07	LT08
<b>50</b>	LT09	LT10	LT11	LT12	LT13	LT14	LT15	LT16
<b>51</b>	LT17	LT18	LT19	LT20	LT21	LT22	LT23	LT24
<b>52</b>	LT25	LT26	LT27	LT28	LT29	LT30	LT31	LT32
<b>53</b>	RB01	RB02	RB03	RB04	RB05	RB06	RB07	RB08
<b>54</b>	RB09	RB10	RB11	RB12	RB13	RB14	RB15	RB16
<b>55</b>	RB17	RB18	RB19	RB20	RB21	RB22	RB23	RB24

**Table G.1 SEL-2533 Device Word Bits (Sheet 3 of 4)**

Bit/ Row	Device Word Bits							
	7	6	5	4	3	2	1	0
<b>56</b>	RB25	RB26	RB27	RB28	RB29	RB30	RB31	RB32
<b>57</b>	RB33	RB34	RB35	RB36	RB37	RB38	RB39	RB40
<b>58</b>	*	*	*	*	RB_SIL	RB_ACK	RB_RST	RB_CON1
<b>59</b>	*	*	*	*	*	*	*	*
<b>60</b>	*	*	*	*	*	*	*	*
<b>61</b>	SV01	SV02	SV03	SV04	SV05	SV06	SV07	SV08
<b>62</b>	SV01T	SV02T	SV03T	SV04T	SV05T	SV06T	SV07T	SV08T
<b>63</b>	SV09	SV10	SV11	SV12	SV13	SV14	SV15	SV16
<b>64</b>	SV09T	SV10T	SV11T	SV12T	SV13T	SV14T	SV15T	SV16T
<b>65</b>	SV17	SV18	SV19	SV20	SV21	SV22	SV23	SV24
<b>66</b>	SV17T	SV18T	SV19T	SV20T	SV21T	SV22T	SV23T	SV24T
<b>67</b>	SV25	SV26	SV27	SV28	SV29	SV30	SV31	SV32
<b>68</b>	SV25T	SV26T	SV27T	SV28T	SV29T	SV30T	SV31T	SV32T
<b>69</b>	SV33	SV34	SV35	SV36	SV37	SV38	SV39	SV40
<b>70</b>	SV33T	SV34T	SV35T	SV36T	SV37T	SV38T	SV39T	SV40T
<b>71</b>	SET01	SET02	SET03	SET04	SET05	SET06	SET07	SET08
<b>72</b>	RST01	RST02	RST03	RST04	RST05	RST06	RST07	RST08
<b>73</b>	SET09	SET10	SET11	SET12	SET13	SET14	SET15	SET16
<b>74</b>	RST09	RST10	RST11	RST12	RST13	RST14	RST15	RST16
<b>75</b>	SET17	SET18	SET19	SET20	SET21	SET22	SET23	SET24
<b>76</b>	RST17	RST18	RST19	RST20	RST21	RST22	RST23	RST24
<b>77</b>	SET25	SET26	SET27	SET28	SET29	SET30	SET31	SET32
<b>78</b>	RST25	RST26	RST27	RST28	RST29	RST30	RST31	RST32
<b>79</b>	*	*	FAST_A1	FAST_A2	*	*	*	*
<b>80</b>	*	*	FAST_B1	FAST_B2	*	*	*	*
<b>81</b>	*	*	FAST_C1	FAST_C2	*	*	*	*
<b>82</b>	*	*	FAST_D1	FAST_D2	*	*	*	*
<b>83</b>	*	*	FAST_E1	FAST_E2	*	*	*	*
<b>84</b>	*	*	*	*	*	*	*	*
<b>85</b>	*	*	SLOW_A1	SLOW_A2	*	*	*	*
<b>86</b>	*	*	SLOW_B1	SLOW_B2	*	*	*	*
<b>87</b>	*	*	SLOW_C1	SLOW_C2	*	*	*	*
<b>88</b>	*	*	SLOW_D1	SLOW_D2	*	*	*	*
<b>89</b>	*	*	SLOW_E1	SLOW_E2	*	*	*	*
<b>90</b>	*	*	*	*	*	*	*	*
<b>91</b>	*	*	COL_A1	COL_A2	*	*	*	*
<b>92</b>	*	*	COL_B1	COL_B2	*	*	*	*
<b>93</b>	*	*	COL_C1	COL_C2	*	*	*	*
<b>94</b>	*	*	COL_D1	COL_D2	*	*	*	*
<b>95</b>	*	*	COL_E1	COL_E2	*	*	*	*

**Table G.1 SEL-2533 Device Word Bits (Sheet 4 of 4)**

Bit/ Row	Device Word Bits							
	7	6	5	4	3	2	1	0
<b>96</b>	*	*	*	*	*	*	*	*
<b>97</b>	*	*	RING_A1	RING_A2	*	*	*	*
<b>98</b>	*	*	RING_B1	RING_B2	*	*	*	*
<b>99</b>	*	*	RING_C1	RING_C2	*	*	*	*
<b>100</b>	*	*	RING_D1	RING_D2	*	*	*	*
<b>101</b>	*	*	RING_E1	RING_E2	*	*	*	*
<b>102</b>	*	*	*	*	*	*	*	*
<b>103</b>	IN_A1R	IN_A2R	IN_B1R	IN_B2R	IN_C1R	IN_C2R	IN_D1R	IN_D2R
<b>104</b>	IN_E1R	IN_E2R	IN_F1R	IN_F2R	*	*	*	*
<b>105</b>	*	*	*	*	PB_SILR	PB_ACKR	PB_RSTTR	PB_TSTR
<b>106</b>	IN_G1R	IN_G2R	*	*	*	*	*	*
<b>107</b>	*	*	*	*	*	*	*	*
<b>108</b>	DSABL_SET	MATH_ERR	*	DIS_PB	SIL_TST	ACK_TST	RST_TST	*

## Definitions

---

**Table G.2 Device Word Bit Definitions (Sheet 1 of 22)**

Row	Bit	Definition
0	Enabled	Device Enabled
	*	Reserved
1	SALARM	Software Alarms: invalid password, changing access levels, settings changes
	HALARM	Diagnostics Failure
	CR_ALM	SELOGIC equation: Critical Alarm
	NC_ALM	SELOGIC equation: Non-critical Alarm
	SIL	SELOGIC equation: SIL input to all Alarm Points
	ACK	SELOGIC equation: ACK input to all Alarm Points
	RESET	SELOGIC equation: RESET input to all Alarm Points
	RBACK	SELOGIC equation: Ringback Sound
2	*	Reserved
	*	Reserved
	ALIN_A1	SELOGIC equation: Alarm Point A1 Input
	ALIN_A2	SELOGIC equation: Alarm Point A2 Input

**Table G.2 Device Word Bit Definitions (Sheet 2 of 22)**

<b>Row</b>	<b>Bit</b>	<b>Definition</b>
3	*	Reserved
	ALIN_B1	SELOGIC equation: Alarm Point B1 Input
	ALIN_B2	SELOGIC equation: Alarm Point B2 Input
	*	Reserved
	*	Reserved
4	*	Reserved
	*	SELOGIC equation: Alarm Point C1 Input
	ALIN_C1	SELOGIC equation: Alarm Point C2 Input
	ALIN_C2	Reserved
	*	Reserved
5	*	Reserved
	*	Reserved
	ALIN_D1	SELOGIC equation: Alarm Point D1 Input
	ALIN_D2	SELOGIC equation: Alarm Point D2 Input
	*	Reserved
6	*	Reserved
	*	Reserved
	ALIN_E1	SELOGIC equation: Alarm Point E1 Input
	ALIN_E2	SELOGIC equation: Alarm Point E2 Input
	*	Reserved
7	*	Reserved
	*	Reserved

**Table G.2 Device Word Bit Definitions (Sheet 3 of 22)**

Row	Bit	Definition
	*	Reserved
	*	Reserved
	*	Reserved
8	*	Reserved
	*	Reserved
	AP_A1	Alarm Point A1 Visual Output
	AP_A2	Alarm Point A2 Visual Output
	*	Reserved
9	*	Reserved
	*	Reserved
	AP_B1	Alarm Point B1 Visual Output
	AP_B2	Alarm Point B2 Visual Output
	*	Reserved
10	*	Reserved
	*	Reserved
	AP_C1	Alarm Point C1 Visual Output
	AP_C2	Alarm Point C2 Visual Output
	*	Reserved
11	*	Reserved
	*	Reserved
	AP_D1	Alarm Point D1 Visual Output
	AP_D2	Alarm Point D2 Visual Output
	*	Reserved
12	*	Reserved
	*	Reserved
	AP_E1	Alarm Point E1 Visual Output
	AP_E2	Alarm Point E2 Visual Output
	*	Reserved
	*	Reserved

**Table G.2 Device Word Bit Definitions (Sheet 4 of 22)**

Row	Bit	Definition
13	*	Reserved
	*	Reserved
14	*	Reserved
	*	Reserved
	ALM_A1	Alarm Point A1 alarm sound output
	ALM_A2	Alarm Point A2 alarm sound output
	*	Reserved
15	*	Reserved
	*	Reserved
	ALM_B1	Alarm Point B1 alarm sound output
	ALM_B2	Alarm Point B2 alarm sound output
	*	Reserved
	*-	Reserved
	*	Reserved
	*	Reserved
16	*	Reserved
	*	Reserved
	ALM_C1	Alarm Point C1 alarm sound output
	ALM_C2	Alarm Point C2 alarm sound output
	*	Reserved
17	*	Reserved
	*	Reserved
	ALM_D1	Alarm Point D1 alarm sound output
	ALM_D2	Alarm Point D2 alarm sound output
	*	Reserved
	*	Reserved
	*	Reserved

**Table G.2 Device Word Bit Definitions (Sheet 5 of 22)**

Row	Bit	Definition
18	*	Reserved
	*	Reserved
	*	Reserved
	ALM_E1	Alarm Point E1 alarm sound output
	ALM_E2	Alarm Point E2 alarm sound output
	*	Reserved
19	*	Reserved
	*	Reserved
20	*	Reserved
	*	Reserved
21	IN_A1	Digital Input - Card D, 01-02
	IN_A2	Digital Input - Card D, 03-04
	IN_B1	Digital Input - Card D, 05-06
	IN_B2	Digital Input - Card D, 07-08
	IN_C1	Digital Input - Card D, 09-10
	IN_C2	Digital Input - Card D, 11-12
	IN_D1	Digital Input - Card D, 13-14
	IN_D2	Digital Input - Card D, 15-16
22	IN_E1	Digital Input - Card E, 09-10
	IN_E2	Digital Input - Card E, 11-12
	IN_F1	Digital Input - Card E, 13-14
	IN_F2	Digital Input - Card E, 15-16
	*	Reserved

**Table G.2 Device Word Bit Definitions (Sheet 6 of 22)**

<b>Row</b>	<b>Bit</b>	<b>Definition</b>
23	*	Reserved
	PB_SIL	SIL pushbutton
	PB_ACK	ACK pushbutton
	PB_RST	RESET pushbutton
	PB_TST	TEST pushbutton
24	IN_G1	Digital Input - Card A, 10-11
	IN_G2	Digital Input - Card A, 11-12
	*	Reserved
25	IN_A1E	Digital Input A1 Edge
	IN_A2E	Digital Input A2 Edge
	IN_B1E	Digital Input B1 Edge
	IN_B2E	Digital Input B2 Edge
	IN_C1E	Digital Input C1 Edge
	IN_C2E	Digital Input C2 Edge
	IN_D1E	Digital Input D1 Edge
	IN_D2E	Digital Input D2 Edge
26	IN_E1E	Digital Input E1 Edge
	IN_E2E	Digital Input E2 Edge
	IN_F1E	Digital Input F1 Edge
	IN_F2E	Digital Input F2 Edge
	*	Reserved
27	*	Reserved
	PB_SILP	SILence pushbutton Pulse (asserted for one processing interval when SIL is pressed)
	PB_ACKP	ACK pushbutton Pulse (asserted for one processing interval when ACK is pressed)
	PB_RSTP	RESET pushbutton Pulse (asserted for one processing interval when RESET is pressed)
	PB_TSTP	TEST pushbutton Pulse (asserted for one processing interval when TEST is pressed)
28	IN_G1E	Digital Input G1 Edge

**Table G.2 Device Word Bit Definitions (Sheet 7 of 22)**

Row	Bit	Definition
	IN_G2E	Digital Input G2 Edge
	*	Reserved
29	OUT01	Digital Output - Card A, 03-04
	OUT02	Digital Output - Card A, 05-06
	OUT03	Digital Output - Card A, Form C, 07-08-09
	*	Reserved
30	OUT04	Digital Output - Card E, 01-02
	OUT05	Digital Output - Card E, 03-04
	OUT06	Digital Output - Card E, 05-06
	OUT07	Digital Output - Card E, 07-08
	*	Reserved
31	OUT08	Digital Output - Card F, 01-02
	OUT09	Digital Output - Card F, 03-04
	OUT10	Digital Output - Card F, 05-06
	OUT11	Digital Output - Card F, 07-08
	OUT12	Digital Output - Card F, 09-10
	OUT13	Digital Output - Card F, 11-12
	OUT14	Digital Output - Card F, 13-14
	OUT15	Digital Output - Card F, 15-16
32	*	Reserved
	TEST	TEST SELOGIC Equation
	IRIGOK	IRIG-B Time Synch Input Data is valid
33	RMB8A	Channel A receive mirror bits RMB1A through RMB8A
	RMB7A	

**Table G.2 Device Word Bit Definitions (Sheet 8 of 22)**

<b>Row</b>	<b>Bit</b>	<b>Definition</b>
34	RMB6A	
	RMB5A	
	RMB4A	
	RMB3A	
	RMB2A	
	RMB1A	
	TMB8A	Channel A transmit mirror bits TMB1A through TMB8A
	TMB7A	
	TMB6A	
	TMB5A	
35	TMB4A	
	TMB3A	
	TMB2A	
	TMB1A	
	RMB8B	Channel B receive mirror bits RMB1B through RMB8B
	RMB7B	
	RMB6B	
	RMB5B	
36	RMB4B	
	RMB3B	
	RMB2B	
	RMB1B	
	TMB8B	Channel B transmit mirror bits TMB1B through TMB8B
	TMB7B	
	TMB6B	
	TMB5B	
37	TMB4B	
	TMB3B	
	TMB2B	
	TMB1B	
	LBOKB	Channel B, looped back ok
	CBADB	Channel B, channel unavailability over threshold
	RBADB	Channel B, outage duration over threshold
	ROKB	Channel B, received data ok
38	LBOKA	Channel A, looped back ok
	CBADA	Channel A, channel unavailability over threshold
	RBADA	Channel A, outage duration over threshold
	ROKA	Channel A, received data ok
	*	Reserved
	*	Reserved
	*	Reserved

**Table G.2 Device Word Bit Definitions (Sheet 9 of 22)**

<b>Row</b>	<b>Bit</b>	<b>Definition</b>
39	*	Reserved
	*	Reserved
40	*	Reserved
	*	Reserved
41	*	Reserved
	*	Reserved
42	FRST_A1	Alarm Point A1 First-Out
	FRST_A2	Alarm Point A2 First-Out
	*	Reserved
	FRST_B1	Alarm Point B1 First-Out
	FRST_B2	Alarm Point B2 First-Out
43	*	Reserved
	FRST_C1	Alarm Point C1 First-Out
	FRST_C2	Alarm Point C2 First-Out

**Table G.2 Device Word Bit Definitions (Sheet 10 of 22)**

Row	Bit	Definition
44	*	Reserved
	FRST_D1	Alarm Point D1 First-Out
	FRST_D2	Alarm Point D2 First-Out
	*	Reserved
	*	Reserved
45	*	Reserved
	FRST_E1	Alarm Point E1 First-Out
	FRST_E2	Alarm Point E2 First-Out
	*	Reserved
	*	Reserved
46	*	Reserved
	FIRST1	Alarm Group 1, First-out Input SELOGIC equation (automatically generated)
47	FIRST2	Alarm Group 2, First-out Input SELOGIC equation (automatically generated)
	FIRST3	Alarm Group 3, First-out Input SELOGIC equation (automatically generated)
	FIRST4	Alarm Group 4, First-out Input SELOGIC equation (automatically generated)
	*	Reserved
	FRSTOP1	Alarm Group 1, First-out Output SELOGIC equation (automatically generated)
48	FRSTOP2	Alarm Group 2, First-out Output SELOGIC equation (automatically generated)
	FRSTOP3	Alarm Group 3, First-out Output SELOGIC equation (automatically generated)
	FRSTOP4	Alarm Group 4, First-out Output SELOGIC equation (automatically generated)
	*	Reserved

**Table G.2 Device Word Bit Definitions (Sheet 11 of 22)**

<b>Row</b>	<b>Bit</b>	<b>Definition</b>
	*	Reserved
	*	Reserved
	*	Reserved
49	LT01	Latch bit variables LT01 through LT08
	LT02	
	LT03	
	LT04	
	LT05	
	LT06	
	LT07	
	LT08	
50	LT09	Latch bit variables LT09 through LT16
	LT10	
	LT11	
	LT12	
	LT13	
	LT14	
	LT15	
	LT16	
51	LT17	Latch bit variables LT17 through LT24
	LT18	
	LT19	
	LT20	
	LT21	
	LT22	
	LT23	
	LT24	
52	LT25	Latch bit variables LT25 through LT32
	LT26	
	LT27	
	LT28	
	LT29	
	LT30	
	LT31	
	LT32	
53	RB01	Remote Bits RB01 through RB08
	RB02	
	RB03	
	RB04	
	RB05	
	RB06	

**Table G.2 Device Word Bit Definitions (Sheet 12 of 22)**

Row	Bit	Definition
54	RB07	
	RB08	
	RB09	Remote Bits RB09 through RB16
	RB10	
	RB11	
	RB12	
	RB13	
	RB14	
55	RB15	
	RB16	
	RB17	Remote Bits RB17 through RB24
	RB18	
	RB19	
	RB20	
	RB21	
	RB22	
56	RB23	
	RB24	
	RB25	Remote Bits RB25 through RB32
	RB26	
	RB27	
	RB28	
	RB29	
	RB30	
57	RB31	
	RB32	
	RB33	Remote Bits RB33 through RB40
	RB34	
	RB35	
	RB36	
	RB37	
	RB38	
58	RB39	
	RB40	
	*	Reserved
	RB_SIL	Remote Bit: SILENCE pushbutton
	RB_ACK	Remote Bit: ACKNOWLEDGE pushbutton
	RB_RST	Remote Bit: RESET pushbutton

**Table G.2 Device Word Bit Definitions (Sheet 13 of 22)**

<b>Row</b>	<b>Bit</b>	<b>Definition</b>
	RB_CON1	Remote Bit: TEST pushbutton
59	*	Reserved
	*	Reserved
60	*	Reserved
	*	Reserved
61	SV01	SELOGIC Control equation variables SV01 through SV08
	SV02	
	SV03	
	SV04	
	SV05	
	SV06	
	SV07	
	SV08	
62	SV01T	SELOGIC control equation variables SV01T through SV08T with Settable pickup and drop-out time delay
	SV02T	
	SV03T	
	SV04T	
	SV05T	
	SV06T	
	SV07T	
	SV08T	
63	SV09	SELOGIC Control equation variables SV09 through SV16
	SV10	
	SV11	
	SV12	
	SV13	
	SV14	
	SV15	

**Table G.2 Device Word Bit Definitions (Sheet 14 of 22)**

<b>Row</b>	<b>Bit</b>	<b>Definition</b>
	SV16	
64	SV09T	SELOGIC control equation variables SV09T through SV16T with Settable pickup and drop-out time delay
	SV10T	
	SV11T	
	SV12T	
	SV13T	
	SV14T	
	SV15T	
	SV16T	
65	SV17	SELOGIC Control equation variables SV17 through SV24
	SV18	
	SV19	
	SV20	
	SV21	
	SV22	
	SV23	
	SV24	
66	SV17T	SELOGIC control equation variables SV17T through SV24T with Settable pickup and drop-out time delay
	SV18T	
	SV19T	
	SV20T	
	SV21T	
	SV22T	
	SV23T	
	SV24T	
67	SV25	SELOGIC Control equation variables SV25 through SV32
	SV26	
	SV27	
	SV28	
	SV29	
	SV30	
	SV31	
	SV32	
68	SV25T	SELOGIC control equation variables SV25T through SV32T with Settable pickup and drop-out time delay
	SV26T	
	SV27T	
	SV28T	
	SV29T	
	SV30T	

**Table G.2 Device Word Bit Definitions (Sheet 15 of 22)**

<b>Row</b>	<b>Bit</b>	<b>Definition</b>
69	SV31T	
	SV32T	
	SV33	SELOGIC Control equation variables SV33 through SV40
	SV34	
	SV35	
	SV36	
	SV37	
	SV38	
	SV39	
	SV40	
70	SV33T	SELOGIC control equation variables SV33T through SV40T with Settable pickup and drop-out time delay
	SV34T	
	SV35T	
	SV36T	
	SV37T	
	SV38T	
	SV39T	
	SV40T	
	SET01	SELOGIC Set latch bit variables SET01 through SET08
	SET02	
71	SET03	
	SET04	
	SET05	
	SET06	
	SET07	
	SET08	
	RST01	SELOGIC Reset latch bit variables RST01 through RST08
	RST02	
72	RST03	
	RST04	
	RST05	
	RST06	
	RST07	
	RST08	
	SET09	SELOGIC Set latch bit variables SET09 through SET16
	SET10	
73	SET11	
	SET12	
	SET13	
	SET14	

**Table G.2 Device Word Bit Definitions (Sheet 16 of 22)**

<b>Row</b>	<b>Bit</b>	<b>Definition</b>
74	SET15	
	SET16	
	RST09	SELOGIC Reset latch bit variables RST09 through RST16
	RST10	
	RST11	
	RST12	
	RST13	
	RST14	
75	RST15	
	RST16	
	SET17	SELOGIC Set latch bit variables SET17 through SET24
	SET18	
	SET19	
	SET20	
	SET21	
	SET22	
76	SET23	
	SET24	
	RST17	SELOGIC Reset latch bit variables RST17 through RST24
	RST18	
	RST19	
	RST20	
	RST21	
	RST22	
77	RST23	
	RST24	
	SET25	SELOGIC Set latch bit variables SET25 through SET32
	SET26	
	SET27	
	SET28	
	SET29	
	SET30	
78	SET31	
	SET32	
	RST25	SELOGIC Reset latch bit variables RST25 through RST32
	RST26	
	RST27	
	RST28	
	RST29	
	RST30	
	RST31	

**Table G.2 Device Word Bit Definitions (Sheet 17 of 22)**

<b>Row</b>	<b>Bit</b>	<b>Definition</b>
	RST32	
79	*	Reserved
	*	Reserved
	FAST_A1	FAST flash selection for Alarm Point A1
	FAST_A2	FAST flash selection for Alarm Point A2
	*	Reserved
80	*	Reserved
	*	Reserved
	FAST_B1	FAST flash selection for Alarm Point B1
	FAST_B2	FAST flash selection for Alarm Point B2
	*	Reserved
81	*	Reserved
	*	Reserved
	FAST_C1	FAST flash selection for Alarm Point C1
	FAST_C2	FAST flash selection for Alarm Point C2
	*	Reserved
82	*	Reserved
	*	Reserved
	FAST_D1	FAST flash selection for Alarm Point D1
	FAST_D2	FAST flash selection for Alarm Point D2
	*	Reserved
83	*	Reserved
	*	Reserved
	FAST_E1	FAST flash selection for Alarm Point E1
	FAST_E2	FAST flash selection for Alarm Point E2
	*	Reserved

**Table G.2 Device Word Bit Definitions (Sheet 18 of 22)**

<b>Row</b>	<b>Bit</b>	<b>Definition</b>
84	*	Reserved
	*	Reserved
85	*	Reserved
	*	Reserved
	SLOW_A1	SLOW flash selection for Alarm Point A1
	SLOW_A2	SLOW flash selection for Alarm Point A2
	*	Reserved
86	*	Reserved
	*	Reserved
	SLOW_B1	SLOW flash selection for Alarm Point B1
	SLOW_B2	SLOW flash selection for Alarm Point B2
	*	Reserved
87	*	Reserved
	*	Reserved
	SLOW_C1	SLOW flash selection for Alarm Point C1
	SLOW_C2	SLOW flash selection for Alarm Point C2
	*	Reserved
88	*	Reserved
	*	Reserved
	SLOW_D1	SLOW flash selection for Alarm Point D1
	SLOW_D2	SLOW flash selection for Alarm Point D2
	*	Reserved
89	*	Reserved

**Table G.2 Device Word Bit Definitions (Sheet 19 of 22)**

<b>Row</b>	<b>Bit</b>	<b>Definition</b>
	*	Reserved
	SLOW_E1	SLOW flash selection for Alarm Point E1
	SLOW_E2	SLOW flash selection for Alarm Point E2
	*	Reserved
90	*	Reserved
	*	Reserved
91	*	Reserved
	*	Reserved
	COL_A1	COLOR selection for Alarm Point A1
	COL_A2	COLOR selection for Alarm Point A2
	*	Reserved
92	*	Reserved
	*	Reserved
	COL_B1	COLOR selection for Alarm Point B1
	COL_B2	COLOR selection for Alarm Point B2
	*	Reserved
93	*	Reserved
	*	Reserved
	COL_C1	COLOR selection for Alarm Point C1
	COL_C2	COLOR selection for Alarm Point C2
	*	Reserved
94	*	Reserved
	*	Reserved

**Table G.2 Device Word Bit Definitions (Sheet 20 of 22)**

<b>Row</b>	<b>Bit</b>	<b>Definition</b>
95	COL_D1	COLOR selection for Alarm Point D1
	COL_D2	COLOR selection for Alarm Point D2
	*	Reserved
	COL_E1	COLOR selection for Alarm Point E1
	COL_E2	COLOR selection for Alarm Point E2
96	*	Reserved
	*	Reserved
97	*	Reserved
	*	Reserved
	RING_A1	RINGback sound for Alarm Point A1
	RING_A2	RINGback sound for Alarm Point A2
	*	Reserved
98	*	Reserved
	*	Reserved
	RING_B1	RINGback sound for Alarm Point B1
	RING_B2	RINGback sound for Alarm Point B2
	*	Reserved
99	*	Reserved
	*	Reserved
	RING_C1	RINGback sound for Alarm Point C1

**Table G.2 Device Word Bit Definitions (Sheet 21 of 22)**

<b>Row</b>	<b>Bit</b>	<b>Definition</b>
	RING_C2	RINGback sound for Alarm Point C2
	*	Reserved
100	*	Reserved
	*	Reserved
	RING_D1	RINGback sound for Alarm Point D1
	RING_D2	RINGback sound for Alarm Point D2
	*	Reserved
101	*	Reserved
	*	Reserved
	RING_E1	RINGback sound for Alarm Point E1
	RING_E2	RINGback sound for Alarm Point E2
	*	Reserved
102	*	Reserved
	*	Reserved
103	IN_A1R	Raw Digital Input - Card D, 01-02
	IN_A2R	Raw Digital Input - Card D, 03-04
	IN_B1R	Raw Digital Input - Card D, 05-06
	IN_B2R	Raw Digital Input - Card D, 07-08
	IN_C1R	Raw Digital Input - Card D, 09-10
	IN_C2R	Raw Digital Input - Card D, 11-12
	IN_D1R	Raw Digital Input - Card D, 13-14
	IN_D2R	Raw Digital Input - Card D, 15-16
104	IN_E1R	Raw Digital Input - Card E, 09-10
	IN_E2R	Raw Digital Input - Card E, 11-12
	IN_F1R	Raw Digital Input - Card E, 13-14
	IN_F2R	Raw Digital Input - Card E, 15-16

**Table G.2 Device Word Bit Definitions (Sheet 22 of 22)**

<b>Row</b>	<b>Bit</b>	<b>Definition</b>
105	*	Reserved
	*	Raw SIL pushbutton
	PB_ACKR	Raw ACK pushbutton
	PB_RSTR	Raw RESET pushbutton
	PB_TSTR	Raw TEST pushbutton
	IN_G1R	Raw Digital Input - Card A, 10-11
106	IN_G2R	Raw Digital Input - Card A, 11-12
	*	Reserved
107	*	Reserved
	*	Reserved
108	DSABLSET	Disable settings change - provided for software compatibility only
	MATH_ERR	SELOGIC math error - provided for software compatibility only
	*	Reserved
	DIS_PB	Disable Pushbutton inputs
	SIL_TST	SILence pushbutton Test
	ACK_TST	ACKnowledge pushbutton Test
	RST_TST	RESET pushbutton Test
	*	Reserved
	*	Reserved
	*	Reserved

**This page intentionally left blank**

# Glossary

---

<b>ACCELERATOR QuickSet® SEL-5030 Software</b>	A Windows®-based program that simplifies settings and provides analysis support.
<b>ASCII</b>	Abbreviation for American Standard Code for Information Interchange. Defines a standard way to communicate text characters between two electronic devices. The SEL-2533 uses ASCII text characters to communicate using the device front- and rear-panel EIA-232 serial ports.
<b>Assert</b>	To activate; to fulfill the logic or electrical requirements needed to operate a device. To apply a short-circuit or closed contact to an SEL-2533 input. To set a logic condition to the true state (logical 1). To close a normally open output contact. To open a normally closed output contact.
<b>Checksum</b>	A numeric identifier of the firmware in the device. Calculated by the result of a mathematical sum of the device code.
<b>CID</b>	Abbreviation for Checksum Identifier. The checksum of the specific firmware installed in the device.
<b>CR_RAM</b>	Abbreviation for Critical RAM. Refers to the area of device Random Access Memory (RAM) where the device stores mission critical data.
<b>Deassert</b>	To deactivate; to remove the logic or electrical requirements needed to operate a device. To remove a short-circuit or closed contact from an SEL-2533 input. To clear a logic condition to the false state (logical 0). To open a normally open output contact. To close a normally closed output contact.
<b>Dropout Time</b>	The time measured from the removal of an input signal until the output signal deasserts. The time can be settable, as in the case of a logic variable timer, or can be a result of the characteristics of an element algorithm, as in the case of an overcurrent element dropout time.
<b>Device Word</b>	The collection of device element and logic results. Each element or result is represented by a unique identifier, known as a Device Word bit.
<b>Device Word Bit</b>	A single device element or logic result that the device updates once each processing interval. A Device Word bit can be equal to either logical 1 or logical 0. Logical 1 represents a true logic condition, picked up element, or asserted contact input or contact output. Logical 0 represents a false logic condition, dropped out element, or deasserted contact input or contact output. You can use Device Word bits in SELOGIC® control equations to control event triggering, output contacts, as well as other functions.
<b>EEPROM</b>	Abbreviation for Electrically Erasable Programmable Read-Only Memory. Nonvolatile memory where device settings, event reports, SER records, and other nonvolatile data are stored.
<b>EIA-232</b>	Electrical definition for point-to-point serial data communications interfaces, based on the standard EIA/TIA-232. Formerly known as RS-232.
<b>EIA-485</b>	Electrical standard for multidrop serial data communications interfaces, based on the standard EIA/TIA-485. Formerly known as RS-485.

<b>Fast Meter, Fast Operate</b>	Binary serial port commands that the device recognizes at the device front-and rear-panel EIA-232 serial ports. These commands and the responses from the device make device data collection by a communications processor faster and more efficient than transfer of the same data through use of formatted ASCII text commands and responses.
<b>FID</b>	Device firmware identification string. Lists the device model, firmware version and date code, and other information that uniquely identifies the firmware installed in a particular device.
<b>Firmware</b>	The nonvolatile program stored in the device that defines device operation.
<b>Flash</b>	A type of nonvolatile device memory used for storing large blocks of nonvolatile data, such as load profile records.
<b>IRIG-B</b>	A time code input that the device can use to set the internal device clock.
<b>LED</b>	Abbreviation for Light-Emitting Diode. Used as indicator lamps on the device front panel.
<b>NEMA</b>	Abbreviation for National Electrical Manufacturers Association.
<b>Nonvolatile Memory</b>	Device memory that is able to correctly maintain data it is storing even when the device is de-energized.
<b>Pickup Time</b>	The time measured from the application of an input signal until the output signal asserts. The time can be settable, as in the case of a logic variable timer, or can be a result of the characteristics of an element algorithm, as in the case of an overcurrent element pickup time.
<b>Pinout</b>	The definition or assignment of each electrical connection at an interface. Typically refers to a cable, connector, or jumper.
<b>RAM</b>	Abbreviation for Random Access Memory. Volatile memory where the device stores intermediate calculation results, Device Word bits, and other data that are updated every processing interval.
<b>Remote Bit</b>	A Device Word bit for which state is controlled by serial port commands, including the CONTROL command, binary Fast Operate command, or Modbus® RTU, or DNP 3.00.
<b>ROM</b>	Abbreviation for Read-Only Memory. Nonvolatile memory where the device firmware is stored.
<b>Self-Test</b>	A function that verifies the correct operation of a critical device subsystem and indicates if an out-of-tolerance condition is detected. The SEL-2533 is equipped with self-tests that validate the device power supply, microprocessor, memory, and other critical systems.
<b>SELOGIC Control Equation</b>	A device setting that allows you to control a device function (such as an output contact) by using a logical combination of device element outputs and fixed logic outputs. Logical AND, OR, rising edge [/], and falling edge [\\] operators, plus a single level of parentheses are available to use in each control equation setting.
<b>Sequential Events Recorder</b>	A device function that stores a record of the date and time of each assertion and deassertion of every Device Word bit in a settable list. Provides a useful way to determine the order and timing of events following a device operation.

<b>SER</b>	Abbreviation for Sequential Events Recorder or the device serial port command to request a report of the latest 1024 sequential events.
<b>Terminal Emulation Software</b>	Personal computer (PC) software that can be used to send and receive ASCII text messages via the PC serial port.
<b>Z-number</b>	That portion of the device RID string that identifies the proper ACCELERATOR QUICKSET software device driver version when creating or editing device settings files.

**This page intentionally left blank**

# Index

Page numbers appearing in bold mark the location of the topic's primary discussion.

## A

ASCII Protocol E.1

## B

Base Unit  
communications ports **2.2**

Battery, Clock **2.8**

## C

Cleaning .xiii

Commands  
**COPY 7.16**  
**DATE 1.7**  
**QUIT 7.18**  
**SHOW 7.20**

Commissioning Tests  
See Testing

Communications  
connector pinout 7.3  
establishing communications  
procedure 1.5, 7.2  
factory default settings 1.6  
port power, rear 7.3  
SEL protocols 7.6, **C.1**  
set device 6.2

Communications Cables and Connections  
**7.4**

EIA-232 7.3  
EIA-485 7.3  
PC-to-device cable pinout 7.4

Compressed ASCII **C.1**

Configurable Label Kit **8.5**

Configuration  
part number **3.7**

Contact Outputs **4.6**  
factory defaults 4.6

## D

Device Word Bits **G.1**  
definitions **G.4–G.25**  
per row **G.1–G.4**

Dimensions  
mechanical **2.2**

Display  
HMI (SEL-5030) **3.10**

## E

Earthing  
See Grounding

EIA-232  
description **7.1–7.2**  
interface **7.2**  
pinout **7.3–7.5**

See also Communications Cables and Connections

EIA-485  
description **7.1–7.2**  
interface **7.2**  
pinout **7.3–7.5**

See also Communications Cables and Connections

Event  
nonvolatile **9.1**

## F

Factory Assistance .xiii

Fast Binary Messages **C.2**

Fast Meter **C.2**

Fast Operate **C.2**

Fast SER **C.2**

Firmware  
upgrade instructions **B.1–B.3**  
versions **A.1**

Front Panel **8.1–8.2**  
configurable labels **8.5**

Functional Overview **1.1**

Fuse  
rating **2.8**  
replacement **2.8**

## G

Grounding **2.6**

## H

Help  
SEL-5030 3.12

## I

Installation **2.1–2.8**  
accessories 1.3  
environmental conditions **xii**  
physical location **2.1**  
power supply 1.5, **2.6**

Instruction Manual Versions **A.2**

IRIG-B Time Synchronization **7.3**  
via communications processor **C.3**

## J

Jumpers  
password **2.4**

## L

Labels  
configurable **8.5**

Latch Bits **4.2**  
nonvolatile state **4.3**

Logic Settings  
output contacts **4.6**

## M

Maintenance Testing  
See also Testing

MIRRORED BITS **F.1–F.5**

Modbus **D.1**  
Modbus RTU **E.1**

## N

Network Parameters **3.3**  
Nonisolated EIA-232 Serial Port **2.3**

## O

Output Contacts  
See Contact Outputs

## P

Password  
jumper **2.4**

Pushbuttons **8.1–8.4**

## R

Rack Mounting Accessory **1.3**

## S

Schweitzer Engineering Laboratories  
contact information .xiii

SEL ASCII Protocol **C.1**

SEL Binary Protocols **C.2**

SEL Communications Processor **C.3–C.9**

SEL-2533 Annunciator  
features **1.1**  
options **1.2**

SELBOOT **2.4**  
Self-Test  
See Testing; Troubleshooting  
SELOGIC Control Equations **4.3**  
operators **4.3–4.5**  
timers **4.5**  
Sequential Events Recorder (SER) **9.1**  
example report 9.3  
SER (Sequential Events Recorder) 6.6  
Serial Port Commands  
See Commands  
Serial Ports  
See also Communications  
Set Device  
editing keystrokes 6.3  
serial communications port 6.2–6.3  
settings sheets **SET.1–SET.18**  
Settings **6.1–6.13**  
See also Front-Panel  
error messages **6.3**  
instances 6.1  
Logic Settings (SET L Command)  
**4.1–4.6**  
serial communications port 6.2–6.3  
settings sheets **SET.1–SET.18**  
Software (ACCELERATOR QuickSet) **3.1**  
databases **3.4**  
device editor **3.8**  
expression builder **3.8**  
Human Machine Interface (HMI)  
**3.10**  
settings editor **3.6**  
Specifications ??–**1.8**  
Status, Device  
serial communication port 1.6

**T**

Technical Service Center **xiii**  
Testing **10.1–10.4**  
Time Code  
See IRIG-B Time Synchronization  
Time Inputs  
See IRIG-B Time Synchronization  
Timers  
See SELOGIC Control Equations  
Trigger  
See Event  
Trip Contact  
See Contact Outputs  
Troubleshooting  
setting error messages 6.3

**U**

Upgrade  
See Firmware, upgrade instructions

**Z**

Z-number 3.7, **A.1**

# SEL-2533 Command Summary

The table below lists the front serial port ASCII commands associated with particular activities. The commands are shown in uppercase letters, but they can also be entered using lowercase letters.

Serial Port Command	Command Description
<b>Access Level 0 Commands</b>	
<b>ACC</b>	Go to Access Level 1
<b>ID</b>	Device identification code
<b>QUI</b>	Go to Access Level 0
<b>Access Level 1 Commands</b>	
<b>2AC</b>	Go to Access Level 2
<b>COM A</b>	Return a summary report of the last 255 records in the communications buffer for MIRRORED BITS® communications Channel A
<b>COM B</b>	Return a summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel B
<b>COM C</b>	Clears all communications records. If both MIRRORED BITS channels are enabled, omitting the channel specifier (A or B) clears both channels
<b>COM C A</b>	Clears all communications records for Channel A
<b>COM C B</b>	Clears all communications records for Channel B
<b>COM L A</b>	Appends a long report to the summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel A
<b>COM L B</b>	Appends a long report to the summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel B
<b>DAT</b>	View the date
<b>DAT dd/mm/yyyy</b>	Enter date in DMY format
<b>DAT mm/dd/yyyy</b>	Enter date in MDY format if DATE_F setting is MDY
<b>DAT yyyy/mm/dd</b>	Enter date in YMD format if DATE_F setting is YMD
<b>FIL DIR</b>	Return a list of files
<b>FIL READ <i>filename</i></b>	Transfer settings file <i>filename</i> from the relay to the PC
<b>FIL SHOW <i>filename</i></b>	Filename 1 displays contents of the file <i>filename</i>
<b>GRO</b>	Display active group setting
<b>HEL</b>	Display a short description of selected commands
<b>IRIG</b>	Force synchronization of internal control clock to IRIG-B time-code input
<b>MAP <i>x</i></b>	Display DNP3 map for port <i>x</i>
<b>SER</b>	Display all Sequential Events Recorder (SER) data
<b>SER <i>date 1</i></b>	Display all SER records made on <i>date 1</i>
<b>SER <i>date 1</i> <i>date 2</i></b>	Display all SER records made from <i>date 2</i> to <i>date 1</i> , inclusive, starting with <i>date 2</i>
<b>SER <i>row 1</i></b>	Display the <i>n</i> most recent SER records starting with record <i>n</i>
<b>SER <i>row 1</i> <i>row 2</i></b>	Display SER records <i>n2</i> to <i>n1</i> , starting with <i>n2</i>
<b>SER C or R</b>	Clear SER data
<b>SER D</b>	Display removed SER data
<b>SHO</b>	Display relay settings
<b>SHO DN</b>	Show DNP3 settings

<b>Serial Port Command</b>	<b>Command Description</b>
<b>SHO G</b>	Display global settings
<b>SHO L</b>	Display general logic settings
<b>SHO P <i>n</i></b>	Display port settings, where <i>n</i> specifies the port (2, 3, 4, or F); <i>n</i> defaults to the active port if not listed
<b>SHO R</b>	Display report settings
<b>STA</b>	Display relay self-test status
<b>STA S</b>	Display SELOGIC usage status report
<b>TAR</b>	Display default target row or the most recently viewed target row
<b>TAR <i>n k</i></b>	Display target row <i>n</i> ; Repeat display of row <i>n</i> for repeat count <i>k</i>
<b>TAR <i>name k</i></b>	Display the target row with target name in the row; Repeat display of this row for repeat count <i>k</i>
<b>TAR ... ROW</b>	Adding ROW to the command displays the Device Word Row number at the start of each line
<b>TIM</b>	View time
<b>TIM <i>hh:mm:ss</i></b>	Set time by entering <b>TIM</b> followed by hours, minutes, and seconds, as shown (24-hour clock)
<b>Access Level 2 Commands</b>	
<b>CAL</b>	Go to Access Level C.
<b>CON B RB_xxP</b>	Pulse the following bits that simulate remote pushbutton operation of RB_SIL, RB_ACK, or RB_RST
<b>CON O <i>n m</i></b>	Close output contact <i>n</i> can be set from OUT01 to OUT11 for <i>m</i> seconds, <i>m</i> can be set from 1 through 30 seconds, default is 1 second if unspecified
<b>CON RB<i>n m</i></b>	Set, clear, or pulse a Remote Bit where <i>n</i> is remote bit number 1 through 40 and <i>m</i> is either s for set, p for pulse, or c for clear
<b>FIL WRITE <i>filename</i></b>	Transfer settings file <i>filename</i> from the PC to the relay
<b>L_D</b>	Load new firmware
<b>LOO</b>	Enables loopback testing of MIRRORED BITS channels
<b>LOO A</b>	Enable loopback on MIRRORED BITS Channel A for the next 5 minutes
<b>LOO B</b>	Enable loopback on MIRRORED BITS Channel B for the next 5 minutes
<b>PAS</b>	Show existing Access Level 1 and Level 2 passwords
<b>PAS 1</b>	Change Access Level 1 password
<b>PAS 2</b>	Change Access Level 2 password
<b>PUL <i>n</i></b>	Pulse Output Contact <i>n</i> ( <i>n</i> = OUT01...OUT11) for 1 seconds
<b>SET</b>	Modify relay settings
<b>SET DN</b>	Enter/change DNP3 settings
<b>SET G</b>	Modify global settings
<b>SET L</b>	Modify SELOGIC variable and timer settings
<b>SET <i>name</i></b>	For all <b>SET</b> commands, jump ahead to a specific setting by entering the setting name
<b>SET P <i>n</i></b>	Modify port <i>n</i> settings ( <i>n</i> = 2, 3, 4, or F; if not specified, the default is the active port)
<b>SET R</b>	Modify report settings
<b>SET ... TERSE</b>	For all <b>SET</b> commands, <b>TERSE</b> disables the automatic <b>SHO</b> command after the settings entry
<b>STA R or C</b>	Clear self-test status and restart relay

# SEL-2533 Command Summary

The table below lists the front serial port ASCII commands associated with particular activities. The commands are shown in uppercase letters, but they can also be entered using lowercase letters.

Serial Port Command	Command Description
<b>Access Level 0 Commands</b>	
<b>ACC</b>	Go to Access Level 1
<b>ID</b>	Device identification code
<b>QUI</b>	Go to Access Level 0
<b>Access Level 1 Commands</b>	
<b>2AC</b>	Go to Access Level 2
<b>COM A</b>	Return a summary report of the last 255 records in the communications buffer for MIRRORED BITS® communications Channel A
<b>COM B</b>	Return a summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel B
<b>COM C</b>	Clears all communications records. If both MIRRORED BITS channels are enabled, omitting the channel specifier (A or B) clears both channels
<b>COM C A</b>	Clears all communications records for Channel A
<b>COM C B</b>	Clears all communications records for Channel B
<b>COM L A</b>	Appends a long report to the summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel A
<b>COM L B</b>	Appends a long report to the summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel B
<b>DAT</b>	View the date
<b>DAT dd/mm/yyyy</b>	Enter date in DMY format
<b>DAT mm/dd/yyyy</b>	Enter date in MDY format if DATE_F setting is MDY
<b>DAT yyyy/mm/dd</b>	Enter date in YMD format if DATE_F setting is YMD
<b>FIL DIR</b>	Return a list of files
<b>FIL READ <i>filename</i></b>	Transfer settings file <i>filename</i> from the relay to the PC
<b>FIL SHOW <i>filename</i></b>	Filename 1 displays contents of the file <i>filename</i>
<b>GRO</b>	Display active group setting
<b>HEL</b>	Display a short description of selected commands
<b>IRIG</b>	Force synchronization of internal control clock to IRIG-B time-code input
<b>MAP <i>x</i></b>	Display DNP3 map for port <i>x</i>
<b>SER</b>	Display all Sequential Events Recorder (SER) data
<b>SER <i>date 1</i></b>	Display all SER records made on <i>date 1</i>
<b>SER <i>date 1</i> <i>date 2</i></b>	Display all SER records made from <i>date 2</i> to <i>date 1</i> , inclusive, starting with <i>date 2</i>
<b>SER <i>row 1</i></b>	Display the <i>n</i> most recent SER records starting with record <i>n</i>
<b>SER <i>row 1</i> <i>row 2</i></b>	Display SER records <i>n2</i> to <i>n1</i> , starting with <i>n2</i>
<b>SER C or R</b>	Clear SER data
<b>SER D</b>	Display removed SER data
<b>SHO</b>	Display relay settings
<b>SHO DN</b>	Show DNP3 settings

Serial Port Command	Command Description
<b>SHO G</b>	Display global settings
<b>SHO L</b>	Display general logic settings
<b>SHO P <i>n</i></b>	Display port settings, where <i>n</i> specifies the port (2, 3, 4, or F); <i>n</i> defaults to the active port if not listed
<b>SHO R</b>	Display report settings
<b>STA</b>	Display relay self-test status
<b>STA S</b>	Display SELOGIC usage status report
<b>TAR</b>	Display default target row or the most recently viewed target row
<b>TAR <i>n k</i></b>	Display target row <i>n</i> ; Repeat display of row <i>n</i> for repeat count <i>k</i>
<b>TAR <i>name k</i></b>	Display the target row with target name in the row; Repeat display of this row for repeat count <i>k</i>
<b>TAR ... ROW</b>	Adding ROW to the command displays the Device Word Row number at the start of each line
<b>TIM</b>	View time
<b>TIM <i>hh:mm:ss</i></b>	Set time by entering <b>TIM</b> followed by hours, minutes, and seconds, as shown (24-hour clock)
<b>Access Level 2 Commands</b>	
<b>CAL</b>	Go to Access Level C.
<b>CON B RB_xxP</b>	Pulse the following bits that simulate remote pushbutton operation of RB_SIL, RB_ACK, or RB_RST
<b>CON O <i>n m</i></b>	Close output contact <i>n</i> can be set from OUT01 to OUT11 for <i>m</i> seconds, <i>m</i> can be set from 1 through 30 seconds, default is 1 second if unspecified
<b>CON RB<i>n m</i></b>	Set, clear, or pulse a Remote Bit where <i>n</i> is remote bit number 1 through 40 and <i>m</i> is either s for set, p for pulse, or c for clear
<b>FIL WRITE <i>filename</i></b>	Transfer settings file <i>filename</i> from the PC to the relay
<b>L_D</b>	Load new firmware
<b>LOO</b>	Enables loopback testing of MIRRORED BITS channels
<b>LOO A</b>	Enable loopback on MIRRORED BITS Channel A for the next 5 minutes
<b>LOO B</b>	Enable loopback on MIRRORED BITS Channel B for the next 5 minutes
<b>PAS</b>	Show existing Access Level 1 and Level 2 passwords
<b>PAS 1</b>	Change Access Level 1 password
<b>PAS 2</b>	Change Access Level 2 password
<b>PUL <i>n</i></b>	Pulse Output Contact <i>n</i> ( <i>n</i> = OUT01...OUT11) for 1 seconds
<b>SET</b>	Modify relay settings
<b>SET DN</b>	Enter/change DNP3 settings
<b>SET G</b>	Modify global settings
<b>SET L</b>	Modify SELOGIC variable and timer settings
<b>SET <i>name</i></b>	For all <b>SET</b> commands, jump ahead to a specific setting by entering the setting name
<b>SET P <i>n</i></b>	Modify port <i>n</i> settings ( <i>n</i> = 2, 3, 4, or F; if not specified, the default is the active port)
<b>SET R</b>	Modify report settings
<b>SET ... TERSE</b>	For all <b>SET</b> commands, <b>TERSE</b> disables the automatic <b>SHO</b> command after the settings entry
<b>STA R or C</b>	Clear self-test status and restart relay