SEL-2523

Annunciator Panel

Instruction Manual

20221007

SCHWEITZER ENGINEERING LABORATORIES, INC.

PM2523-01

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Preface

Manual Overview

The SEL-2523 Annunciator Panel instruction manual provides specifications and describes installation, setting, testing and operation of the SEL-2523. 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-2523, and lists the specifications.

Section 2: Installation. Describes how to mount and wire the SEL-2523, and illustrates wiring connections.

Section 3: PC Software. Describes how to get started with ACSELERATOR QuickSet® SEL-5030 Software, a powerful setting, event analysis, and viewing tool that aids using and applying the SEL-2523.

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-2523 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-2523 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 DNP3 protocol support provided by the SEL-2523.

Appendix E: Modbus RTU Communications Protocol. Describes the Modbus® protocol support provided by the SEL-2523.

Appendix F: MIRRORED BITS Communications. Describes how the SEL-2523 can directly exchange information quietly, securely, and with minimum cost.

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

SEL-2523 Command Summary. Describes the serial port commands that are fully described in *ASCII Commands on page 7.10*.

Safety Information

Dangers, Warnings, and Cautions

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

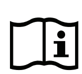
⚠DANGER
Indicates an imminently hazardous situation that, if not avoided, **will** result in death or serious injury.

⚠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.

	**⚠CAUTION** Refer to accompanying documents.	**⚠ATTENTION** 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

⚠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.	⚠ATTENTION 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: 0.6–0.8 Nm (5–7 in-lb)	Couple de serrage Borniers et ports série : 0,6–0,8 Nm (5–7 livres-pouce)

Other Safety Marks (Sheet 1 of 2)

⚠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.	⚠DANGER 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.
⚠DANGER Contact with instrument terminals can cause electrical shock that can result in injury or death.	⚠DANGER Tout contact avec les bornes de l'appareil peut causer un choc électrique pouvant entraîner des blessures ou la mort.
⚠WARNING Use of this equipment in a manner other than specified in this manual can impair operator safety safeguards provided by this equipment.	⚠AVERTISSEMENT 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.
⚠WARNING 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.	⚠AVERTISSEMENT 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.
⚠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.	⚠AVERTISSEMENT 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 á l'équipement peut être possible. SEL décline toute responsabilité pour tout dommage résultant de cet accès non-autorisé.
⚠WARNING To install an option card, the relay must be de-energized and then reenergized. When reenergized, the relay will reboot. Therefore, de-energize the protected equipment before installing the option card to prevent damage to the equipment.	⚠AVERTISSEMENT 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.
⚠WARNING Do not look into the fiber ports/connectors.	⚠AVERTISSEMENT Ne pas regarder vers les ports ou connecteurs de fibres optiques.

Other Safety Marks (Sheet 2 of 2)

⚠WARNING Do not look into the end of an optical cable connected to an optical output.	⚠AVERTISSEMENT Ne pas regarder vers l'extrémité d'un câble optique raccordé à une sortie optique.
⚠WARNING During installation, maintenance, or testing of the optical ports, use only test equipment qualified for Class 1 laser products.	⚠AVERTISSEMENT 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.
⚠CAUTION 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.	⚠ATTENTION 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 oules connecteurs de cloison peut entraîner une exposition à des rayonnements dangereux.
⚠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.	⚠ATTENTION Les composants de cet équipement sont sensibles aux décharges électrostatiques (DES). Des dommages permanents non-décelables 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.
⚠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.	⚠ATTENTION 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.
⚠CAUTION Use of controls or adjustments, or performance of procedures other than those specified herein, may result in hazardous radiation exposure.	⚠ATTENTION 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	Up to ±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^2)	10 AWG (4 mm^2)
Contact I/O	18 AWG (0.8 mm^2)	14 AWG (2.5 mm^2)
Other Connection	18 AWG (0.8 mm^2)	14 AWG (2.5 mm^2)

Instructions for Cleaning and Decontamination

Use care when cleaning the SEL-2523. 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
Email: info@selinc.com

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Section 1
Introduction and Specifications

Overview

The SEL-2523 Annunciator Panel 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 36 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-2523 Annunciator Panel. You need not review this entire manual in order to perform specific tasks.

Features

Standard Features

- ISA-18.1 annunciator sequences: A, M, M-1, R, R-1, F1A, F2M-1, F3A
- Forty-two digital inputs with orderable voltage ranges
- Eleven digital contact outputs
- Thirty-six 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

- Sequential Events Recorder (SER) report with ±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 up to 1024 entries in nonvolatile memory

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

- Communications
  - Transmission speed between 300 and 38400 bps (effective 9600 or better)
  - One nonisolated EIA-232 front-panel port and two nonisolated EIA-232 rear-panel ports (DB-9 connectors)
  - Optional fiber-optic rear serial port
  - Optional communications card (jumper-select either EIA-232 or EIA-485)
- IRIG-B connection (standard feature)

Communications Protocols

- 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

Automation and Control

- 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

Models, Options, and Accessories

Models

Complete ordering information is not provided in this instruction manual; please see the latest SEL-2523 Model Option Table at selinc.com. Options and accessories are listed below.

Options

The Annunciator contains nine card slots. Only the EIA-232/EIA-485 card in position two is optional; all other cards must be present. Cards 3 through 9, which contain inputs, are only configured for selecting the correct contact input voltage. The main board and power supply cannot be removed. The main board also includes an optional ST fiber-optic serial port (**PORT 2**).

The Annunciator can be ordered as a horizontal rack mount unit or horizontal panel mount. Either option provides easy access to rear connections. The rack mount option is designed for installations on a 19" rack. The panel-mount option has a larger lip around the front with studs to fit and cover the holes cut in a panel. See *Section 2: Installation* for more information on these dimensions.

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-2523:

- SEL-2523 Configurable Labels (part 9260040)
- SEL-2810, SEL-2812, or SEL-2814 Fiber-Optic Transceivers
- Precise timing with the SEL-2407 Satellite-Synchronized Clock
- Secure communications with the SEL-3025 Serial Shield®

Applications

Advanced Annunciator Panel

The following applications represent examples of typical alarm panel installations. Use the SEL-2523 Annunciator Panel 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

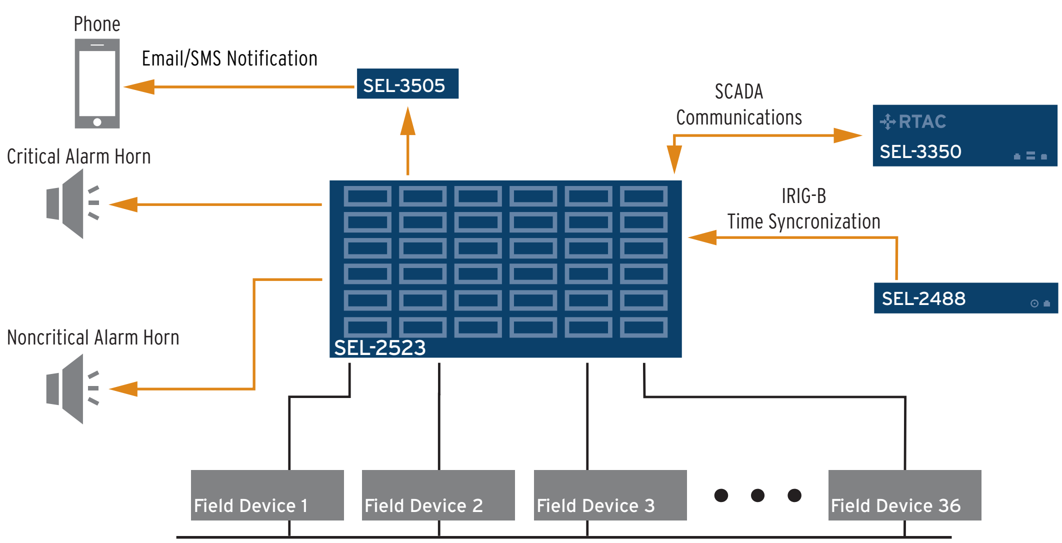

Figure 1.1 SEL-2523 Annunciator Panel

Hardware Connection Features

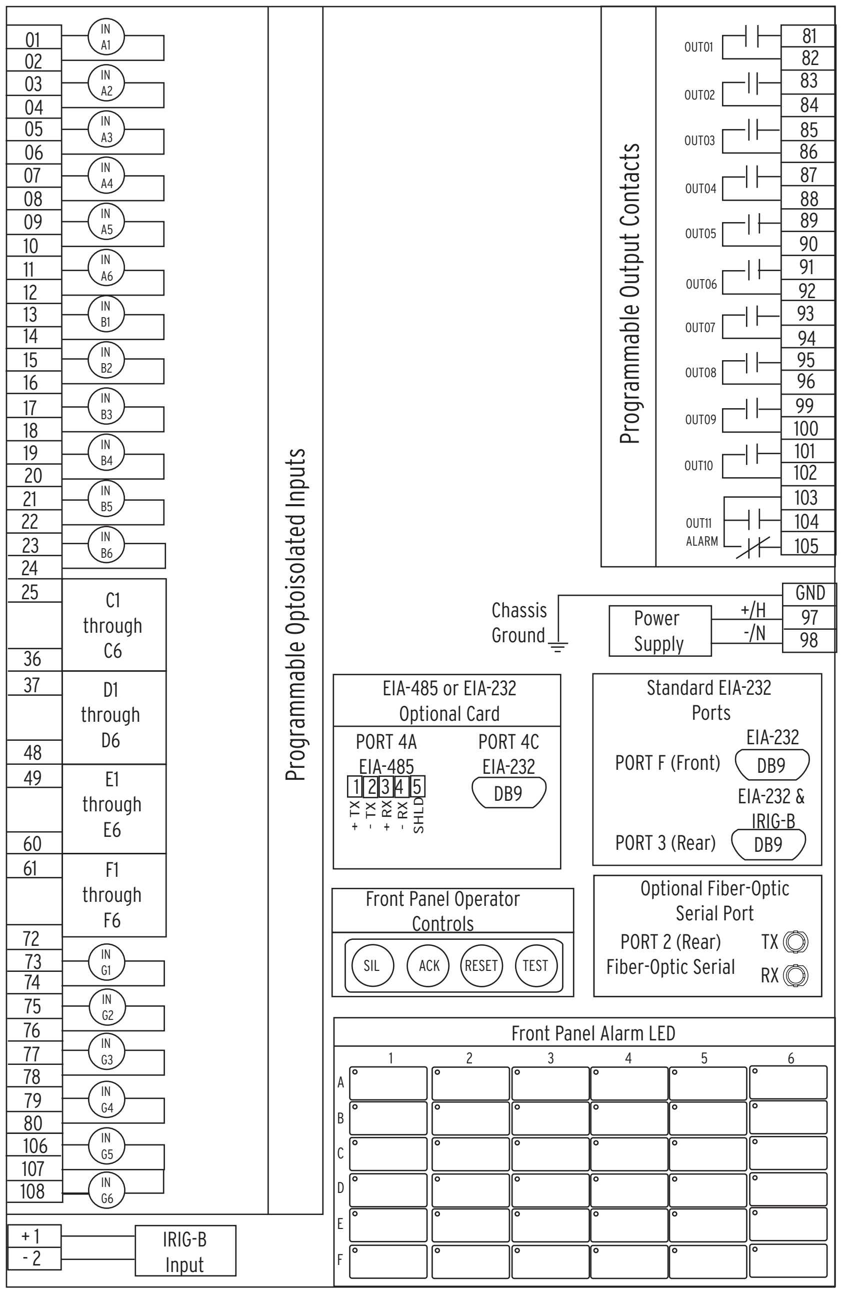

Figure 1.2 Inputs, Outputs, and Communications Ports

Optoisolated Inputs

Each digital input is optoisolated from ground potential. The SEL-2523 comes with 42 inputs that are orderable as 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 SEL-2523 comes with 11 dry contacts. Ten contacts are Form A contacts and one contact is a Form C contact. OUT11 is set for use as an alarm contact by default. See *Optoisolated Control Inputs on page 1.9* for more information.

Power Supply

The SEL-2523 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-2523 comes with one front and one rear EIA-232 port. The SEL-2523 also has an optional ST fiber-optic serial port and an optional communications card that supports an EIA-232 or EIA-485 port.

Time Synchronization

The SEL-2523 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 DNP3 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-2523 Annunciator Panel 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 97) and the **–/N** (terminal 98) 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. Connect the PC and the Annunciator using the serial communications cable.

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-2523 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-2523                   Date:  01/29/2002                  Time: 17:12:29
Device

Level 1

=>2AC <Enter>

SEL-2523                   Date:   01/29/2002                  Time: 17:12:31
Device

Level 2

=>QUIT <Enter>

SEL-2523                   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-2523                                Date: 3/17/2008   Time: 16:23:36
DEVICE

Serial Num = 2008036022
FID = SEL-2523-R100-V0-Z001001-D20071212               CID = A476
Part Num = 252301H13A0AXXX

SELF TESTS (W=Warn)
  FPGA  GPSB  HMI   RAM   ROM   CR_RAM  NON_VOL  CLOCK  +3.3V  +5.0V  +2.5V
  OK    OK    OK    OK    OK    OK      OK       OK     3.28   4.95   2.48

  +3.75V  -1.25V  BATT
  3.77    -1.24   3.35

I/O Cards
  CARD_2  CARD_3  CARD_4  CARD_5  CARD_6  CARD_7  CARD_8
  OK      OK      OK      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_e) 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_e):	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:	≤8 ms (coil energization to contact closure)
Electrical Durability Make VA Rating:	3600 VA, cosϕ = 0.3
Electrical Durability Break VA Rating:	360 VA, cosϕ = 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 µm
Approximate Range:	~2 km with 62.5 µm, ~1 km with 200 µm
Data Rate:	5 Mbps
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 unsolicited write

SEL Fast Message read request

SEL Event Messenger Points

Maximum Concurrent Connections

DNP3 Level 2 Outstation:	3
Modbus RTU Slave:	3

Power Supply

Rated Supply Voltage

Low-Voltage Model:	24/48 Vdc
High-Voltage Model:	110/250 Vdc 110/240 Vac, 50/60 Hz

Input Voltage Range

Low-Voltage Model:	19.2–62.8 Vdc
High-Voltage Model:	85–275 Vdc 85–264 Vac

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 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 61000-4-3:2006, 10 V/m IEEE C37.90.2-2004, 35 V/m
Fast Transient, Burst Immunity:	IEC 61000-4-4:2004 + CRGD IEC 60255-22-4:2002 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 1 kV common-mode on comm. ports IEEE C37.90.1-2002 2.5 kV oscillatory 4 kV fast transient
Conducted RF Immunity:	IEC 61000-4-6:2006, 10 Vrms
Magnetic Field Immunity:	IEC 61000-4-8:2001 1000 A/m for 3 seconds 100 A/m for 1 minute

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
Sequence M-1—Manual Reset With Silence
Sequence R—Ringback
Sequence R-1—Ringback With Options
Sequence A—Automatic Reset
Sequence F1A—Automatic Reset First Out With no Subsequent Alarm State
Sequence F2M-1—Manual Reset First Out With no Alarm Flashing and Silence Pushbutton
Sequence F3A—Automatic Reset First Out With First Out Flashing and Reset Pushbutton

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Section 2
Installation

Overview

This section describes common installation features, requirements, and I/O options for the SEL-2523 Annunciator Panel.

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-2523 Annunciator Panel 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 1.9*. For EN 61010 certification, the Annunciator rating is 2000 m (6560 ft) above mean sea level.

Device Mounting

The rack mount is a 5U chassis designed to fit in standard 19" racks, as shown in *Figure 2.1*.

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 panel mount.

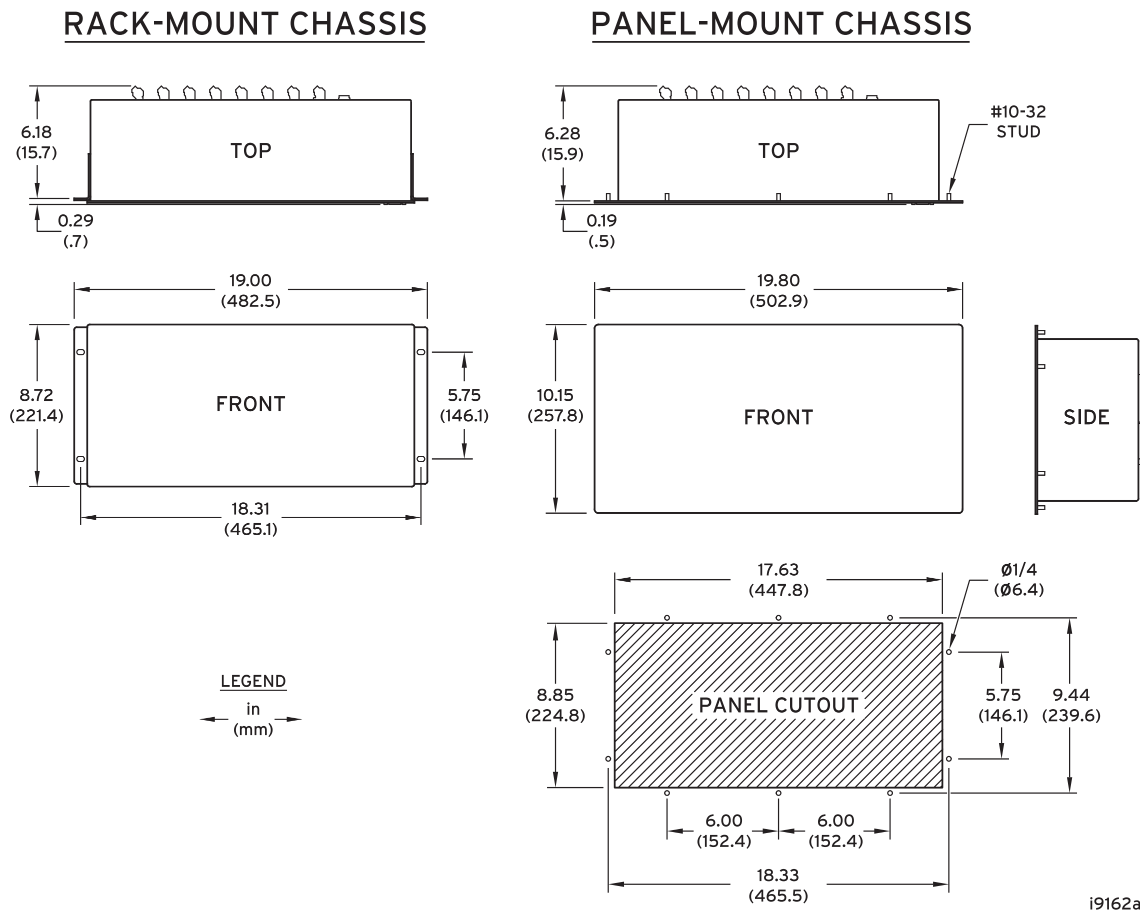


Figure 2.1 SEL-2523 Annunciator Panel Rack-Mount and Panel-Mount Dimensions

Card Configurations

The SEL-2523 Annunciator Panel has nine card slots, eight of which are fixed. Card 2 is the only configurable slot, allowing an extra EIA-232 or EIA-485 port. The Annunciator will not function properly if the cards are not in their default position.

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-3010 Event Messenger

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

Communications Card (SELECT EIA-232/ EIA-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

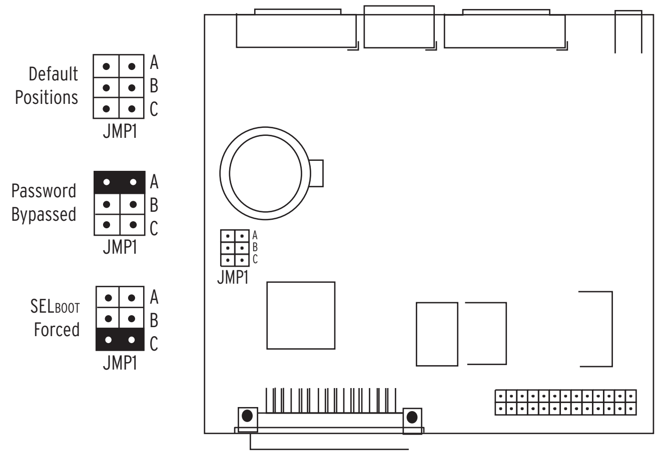
Port	Interface	Connectors
4C	EIA-232	D-sub
4A	EIA-485	5-pin Euro

The communications card supports the following protocols:

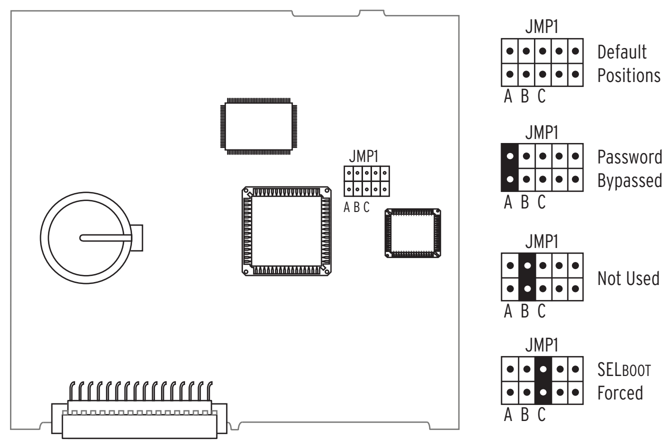
- Modbus RTU Slave
- DNP3 Level 2 Outstation
- SEL ASCII and Compressed ASCII Protocols
- SEL Fast Meter
- SEL Fast Operate
- SEL Fast SER
- SEL Fast Message
- SEL Settings File Transfer
- SEL MIRRORED BITS (MBA, MBB, MB8A, MB8B)
- SEL-3010 Event Messenger

Password and SELBOOT Jumper Selection

Figure 2.2 shows the major components of Card 1 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

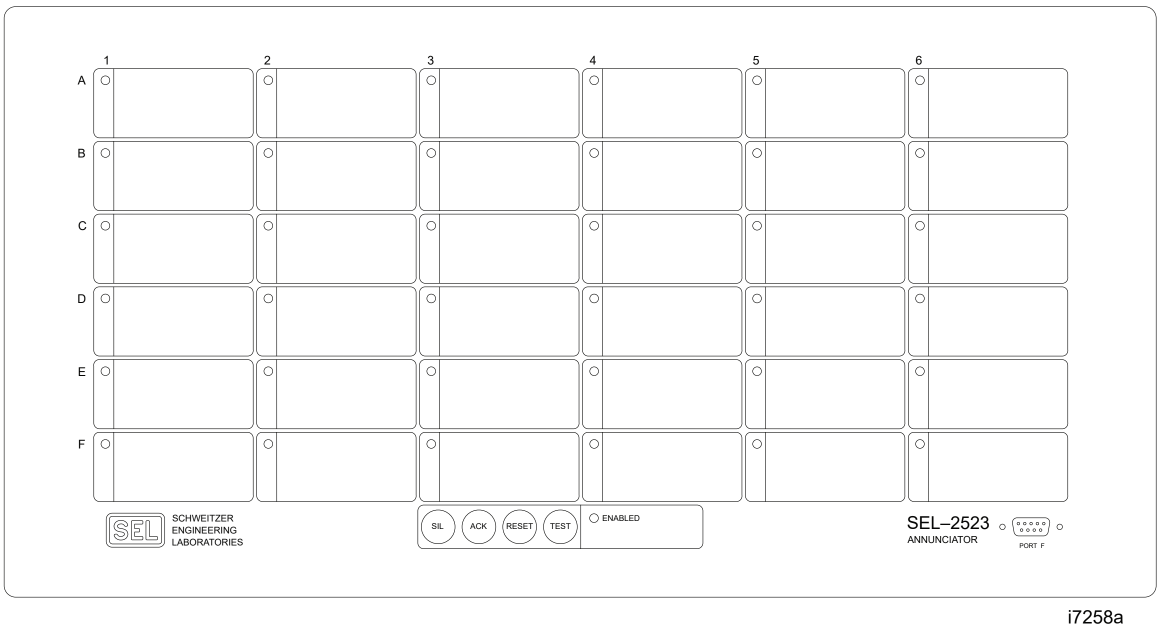


Figure 2.3 SEL-2523 Panel Mount

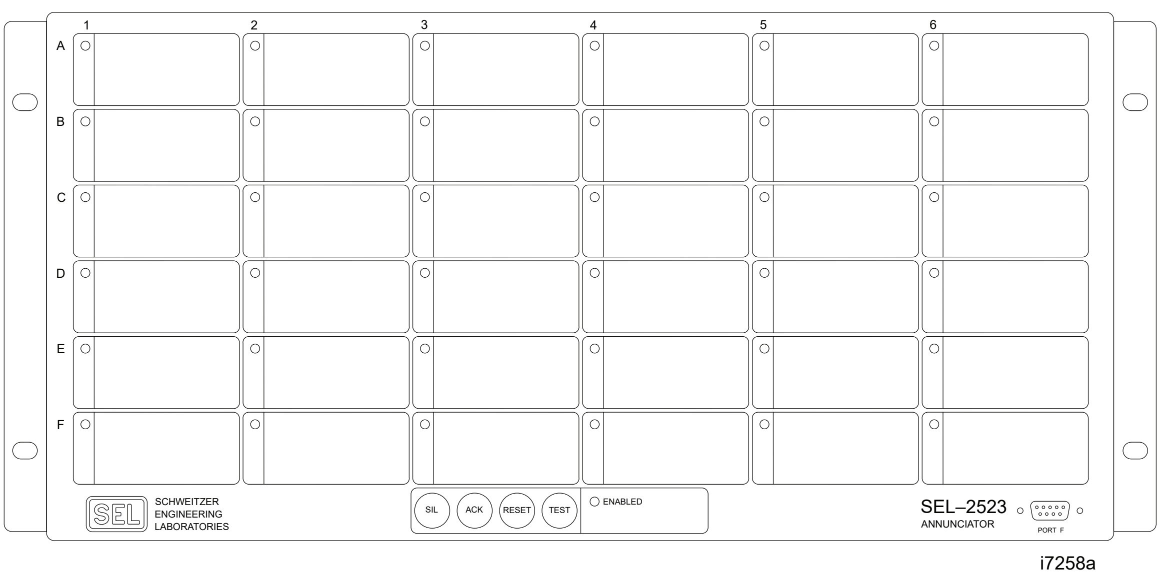


Figure 2.4 SEL-2523 Rack Mount

Figure 2.5 shows the physical layout of the connectors on the rear panel diagram with the optional EIA-232/EIA-485 card.

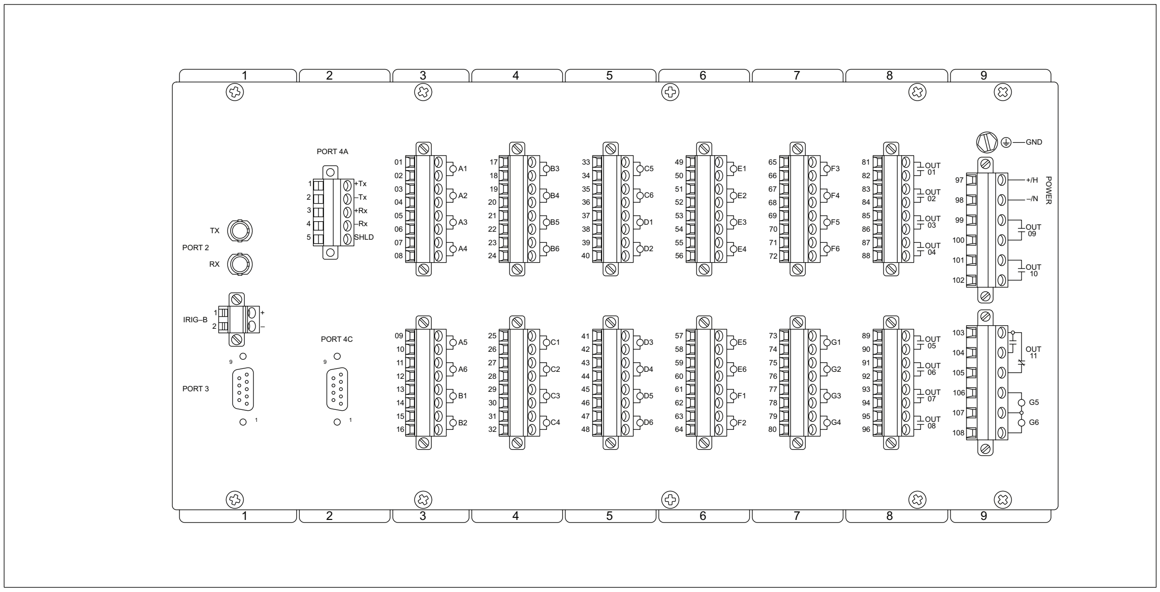


Figure 2.5 SEL-2523 Configured With the Optional EIA-232/EIA-485 Card and Optional Serial Fiber-Optic Port

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 (**97(+/H)** and (**98(—/N)**) must connect to 110–240 Vac, 110–250 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^2) to 16 AWG (1.5 mm^2) 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

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^2) wire less than 2 m (6.6 feet) in length for the ground connection.

Output Contacts

The base unit has standard output contacts only (ten Form A and one Form C). Refer to *Specifications on page 1.9* for output contact ratings. Standard output contacts are not polarity-dependent.

Optoisolated Inputs

The Annunciator 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_G4D.

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-2523 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-2523 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-2523 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 2.6 shows an example connections system for your SEL-2523. The Annunciator comes with 36 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-2523 and cause an alarm indication. Refer to *Specifications on page 1.9* for information on the digital input assertion/deassertion levels.

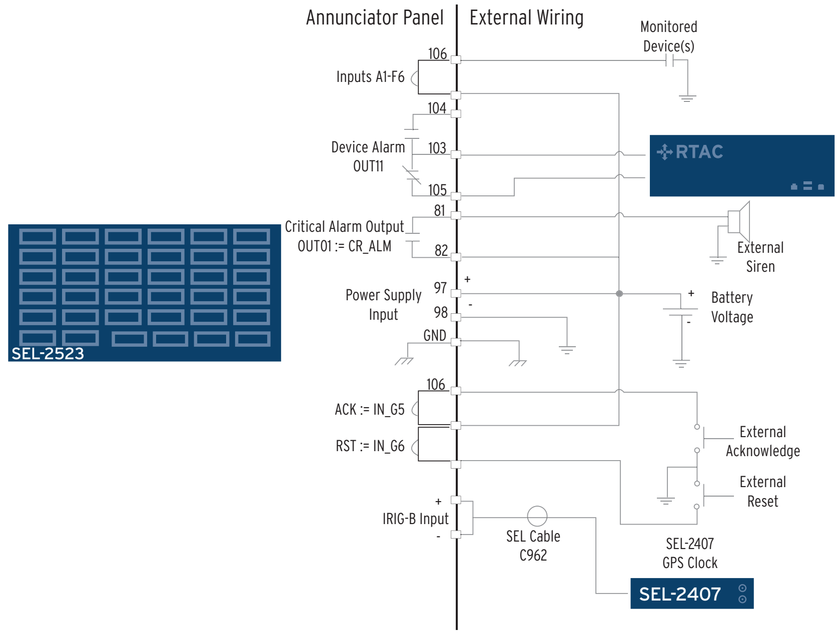


Figure 2.6 SEL-2523 Connection Diagram for External Devices

All of the output contacts are dry Form A contacts that need to be wetted properly in order to drive the external device. OUT11 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 Annunciator or from digital inputs G5 and G6 externally wired to a manual switch.

The SEL-2523 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 Annunciator 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-2523 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. On Card 9, remove the two rear-panel screws, ground screw, plug-in connectors, and the rear panel.

Step 3. Remove Card 9 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 9.

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. On Card 1, remove the two rear-panel screws, serial ports, plug-in connectors, and the rear panel.

Step 3. Remove the Card 1 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-2523 Annunciator Panel 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 *Table 3.2*
SEL-5031	ACSELERATOR QuickSet Designer® SEL-5031 Software	Customizes SEL-2523 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-2523 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-2523. *Table 3.2* shows the suite of ACSELERATOR QuickSet applications provided for the SEL-2523.

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-2523 for use. Perform the following steps to initiate communications:

Step 1. Connect the appropriate communications cable between the SEL-2523 and the PC.

Step 2. Apply power to the SEL-2523.

Step 3. Start ACSELERATOR QuickSet.

Communications

ACSELERATOR QuickSet uses device communications Port **F** (front panel) to communicate with the SEL-2523. 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*.

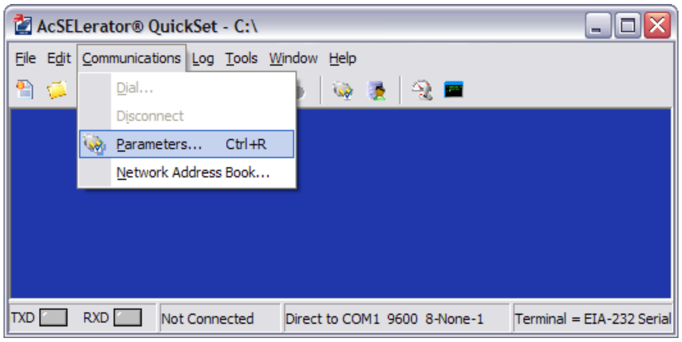


Figure 3.1 Serial Port Communications Menu

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

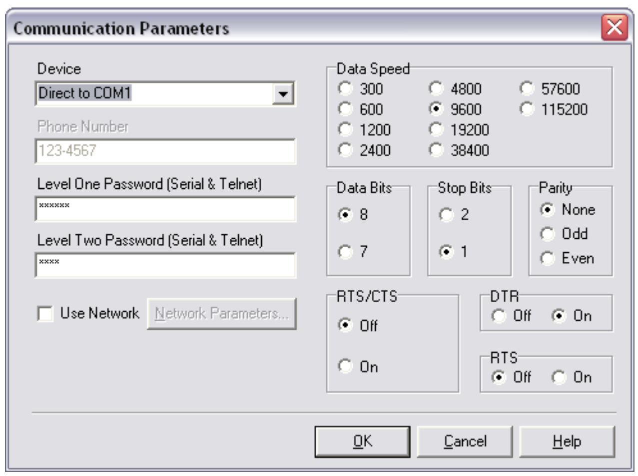


Figure 3.2 Serial Port Communication Parameters Dialog Box

Step 3. Configure the PC port to match the device communications settings.

Step 4. Configure ACSELERATOR QuickSet to match the SEL-2523 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 relay 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*.

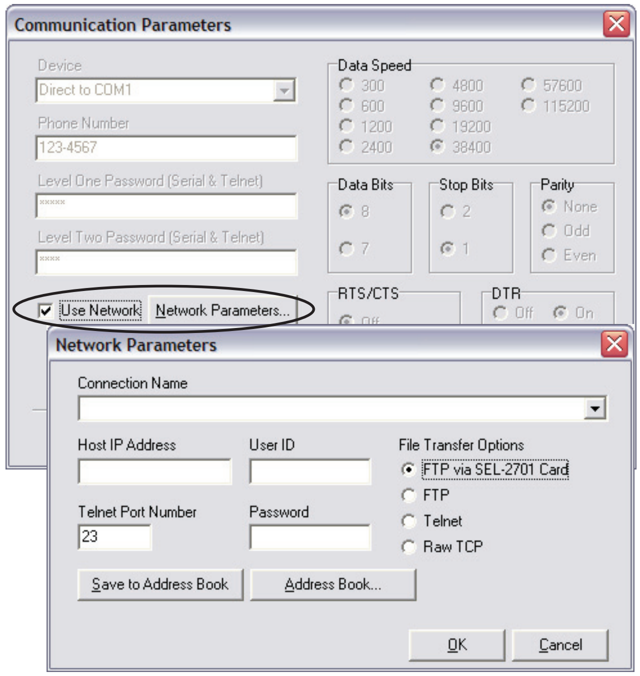


Figure 3.3 Network Parameters Dialog Box

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*.

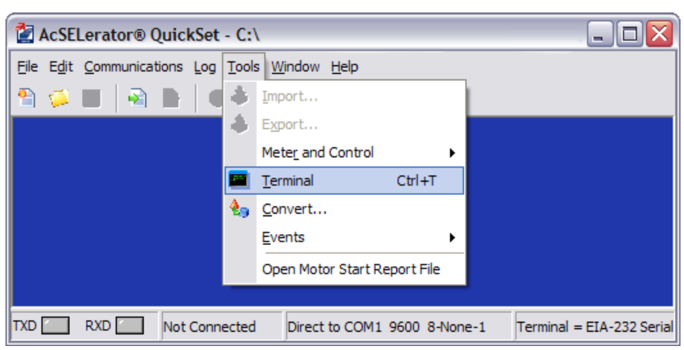


Figure 3.4 Tools Menu

The terminal window is an ASCII interface with the relay. 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 relay 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 relay, 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 relay at Access Level 1. Issue the **ID** command to receive an identification report, as shown in *Figure 3.5*.

```
=>>ID <Enter>

"FID=SEL-2523-R100-V0-Z001001-D20080418","08D5"
"BFID=SEL-2523-R100-V0-Z000000-D20080418","091D"
"CID=A476","025F"
"DEVID=SEL-2523","03F6"
"DEVCODE=70","030E"
"PARTNO=252301H13A0AXXX","0614"
"CONFIG=00000000","03E3"

=>>
```

Figure 3.5 Device Response to the ID Command

Locate and record the Z number (Z001001) in the FID string. The first portion of the Z number (Z001…) determines the ACSELERATOR QuickSet relay settings driver version when you are creating or editing relay 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=2523XXXXXXXXXXX) with the Model Option Table (MOT) to ensure correct relay configuration.

Settings Database Management and Drivers

ACSELERATOR QuickSet uses a database to save relay settings and contain sets of all settings files for each relay 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 relay in the database in the **Database Description** and **Settings Description** dialog boxes.

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

Step 4. Highlight one of the relays 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 relay 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-2523 relays. Store existing relay settings downloaded from SEL-2523 relays with ACSELERATOR QuickSet, thus creating a library of relay settings, and then modify and upload these settings from the settings library to an SEL-2523. ACSELERATOR QuickSet makes setting the relay easy and efficient. However, you do not have to use ACSELERATOR QuickSet to configure the SEL-2523; 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 relay settings in categories that are easy to understand. The SEL-2523 settings structure makes setting the relay easy and efficient. Settings are grouped logically, and relay 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 relay settings. Each unique relay has its own record of settings. Use the **File** menu to open an existing record, create and open a new record, read relay settings from a connected SEL-2523 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-2523 settings with the **Device Editor (Editor Mode)**, select **Settings > New** from the main menu bar, and SEL-2523 and **001** from the **Settings Editor Selection** window as shown in *Figure 3.6*.

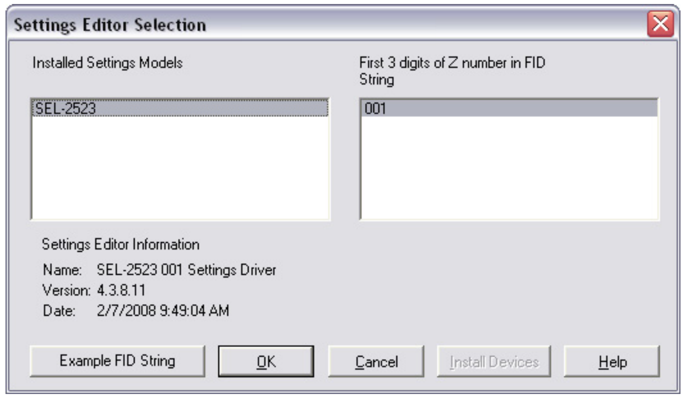


Figure 3.6 Driver Selection

After selecting the relay 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.

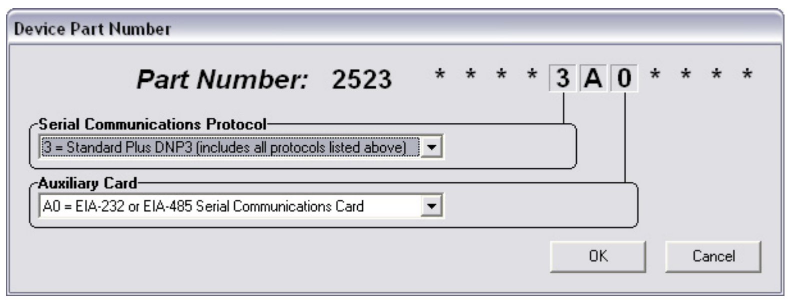


Figure 3.7 Update Part Number

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.

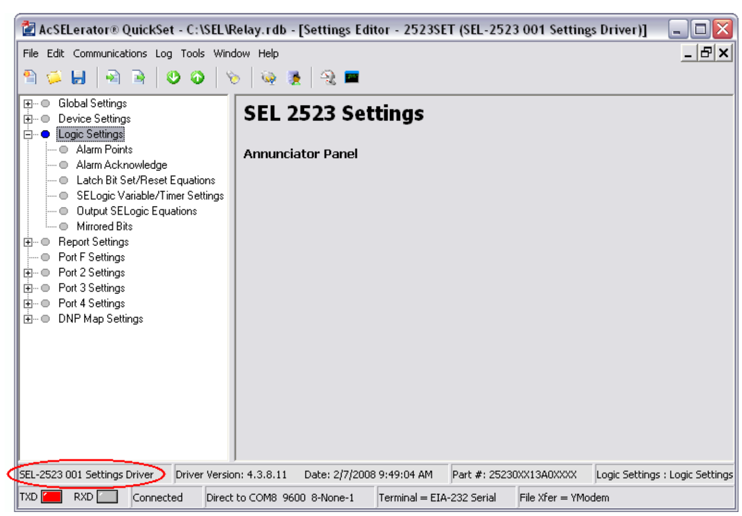


Figure 3.8 New Setting Screen

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*.

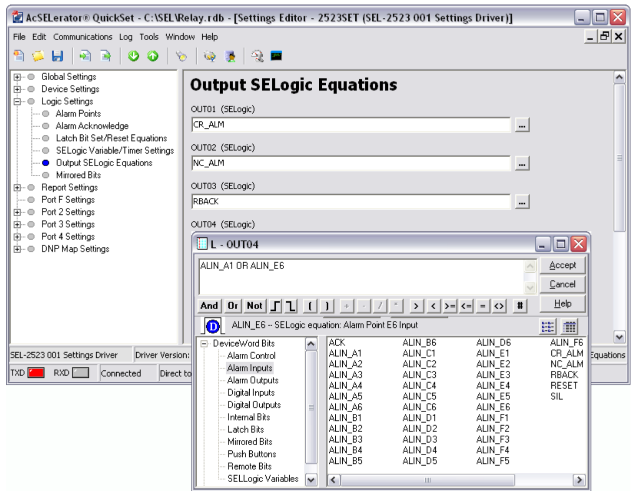


Figure 3.9 Expressions Created With Expression Builder

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-2523.

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-2523 and coordinate with local crews. The software allows customization and setting of each of the 36 alarm point windows to match what is displayed on the SEL-2523. 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.

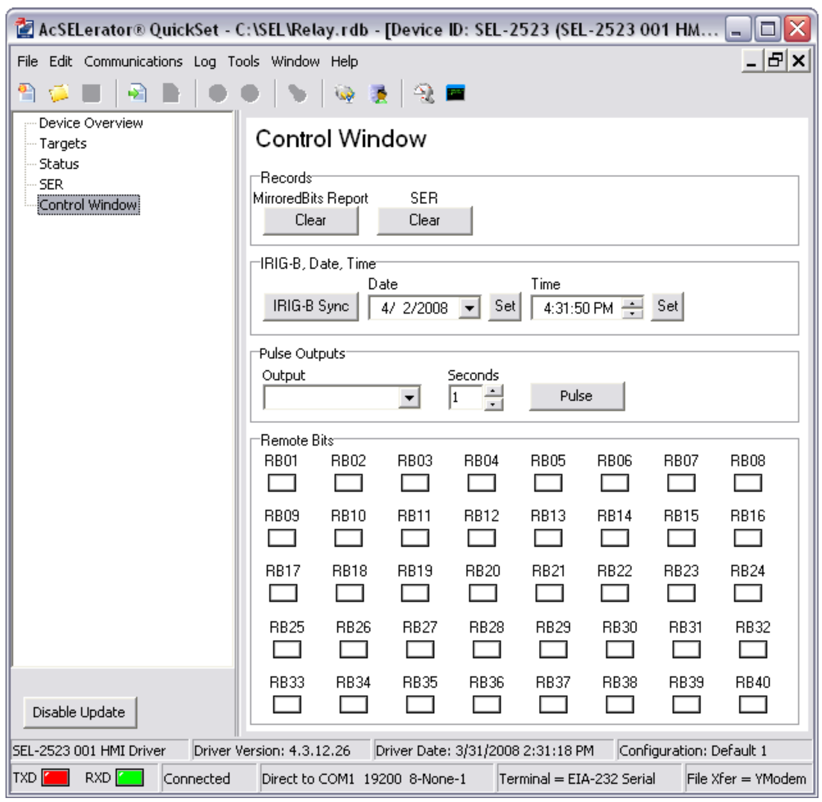


Figure 3.10 Device Overview Screen

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® report and trigger events. You can also reset the targets, synchronize with IRIG, and set the time and date.

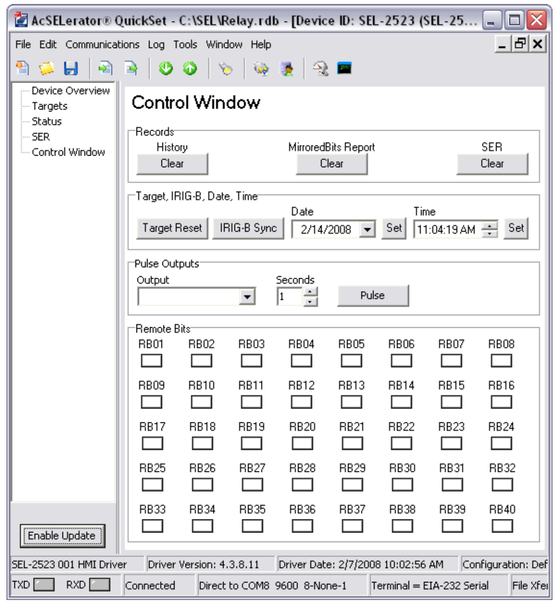


Figure 3.11 Control Screen

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

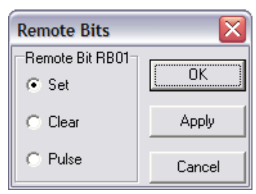


Figure 3.12 Remote Operation Selection

Help

Various forms of ACSELERATOR 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 ACSELERATOR QuickSet	Select **Help** from the main menu bar
Device Editor	Select **SEL-5030 Editor Help** from the **Device Editor** menu bar
SEL-2523 Settings	Select **Settings Help** from the **Device Editor** menu bar.
Database Manager	Select **Help** from the bottom of the **Database Manager** window

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Section 4
Logic Functions

Overview

For ease of setting the SEL-2523 Annunciator Panel, 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, 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-2523 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).

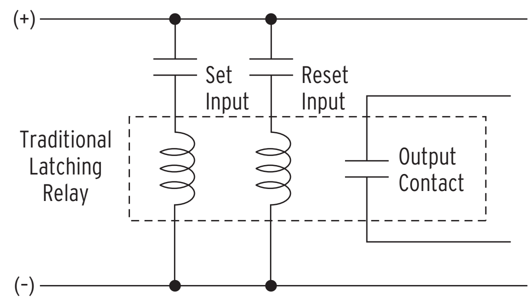


Figure 4.1 Schematic Diagram of a Traditional Latching Device

Thirty-two latch control switches in the SEL-2523 provide latching device functionality. *Figure 4.2* shows the logic diagram of a latch switch. The output of the latch control switch is a Relay Word bit LT*n* (*n* = 01 through 32), called a latch bit.

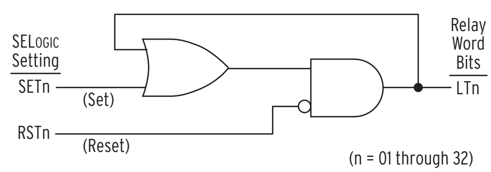


Figure 4.2 Logic Diagram of a Latch Switch

If setting SET*n* asserts to logical 1, latch bit LT*n* asserts to logical 1. If setting RST*n* asserts to logical 1, latch bit LT*n* deasserts to logical 0. If both settings SET*n* and RST*n* assert to logical 1, setting RST*n* has priority and latch bit LT*n* deasserts to logical 0. You can use these latch bits in SELOGIC control equations to create custom logic for your application.

The SEL-2523 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 (Relay 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).

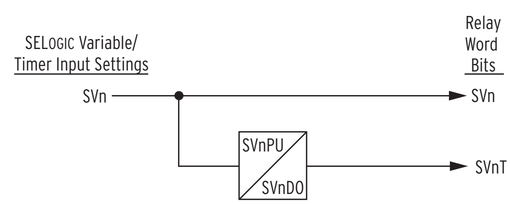


Figure 4.3 SELOGIC Control Equation Variable/Timers SV01/SV01T–SV40T

You can enter up to 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-2523 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_TRIG	Rising-edge trigger/detect
F_TRIG	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 up to 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 Relay Word bit and to multiple elements (within parentheses).

An example of a single Relay 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 Relay Word bits only; you cannot apply R_TRIG to groups of elements within parentheses. When any Relay 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 Relay 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 Relay Word bit deassertion (elements going from logical 1 to logical 0) instead of Relay Word bit assertion. When the Relay 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*.

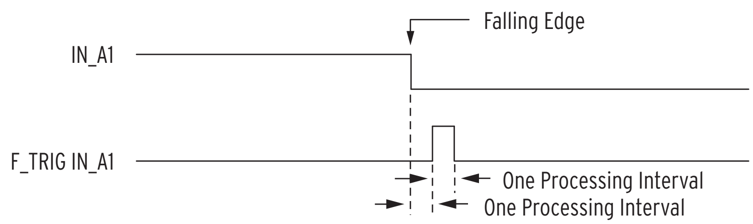


Figure 4.4 Result of Falling-Edge Operator on a Deasserting Input

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. Relay Word bits SV*n* and SV*n*T (*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 Relay Word bit SV07 (SELOGIC control equation variable SV07) in SELOGIC control equation SV07:

SV07 = **(SV07 OR OUT01) AND (OUT02 OR OUT05)**

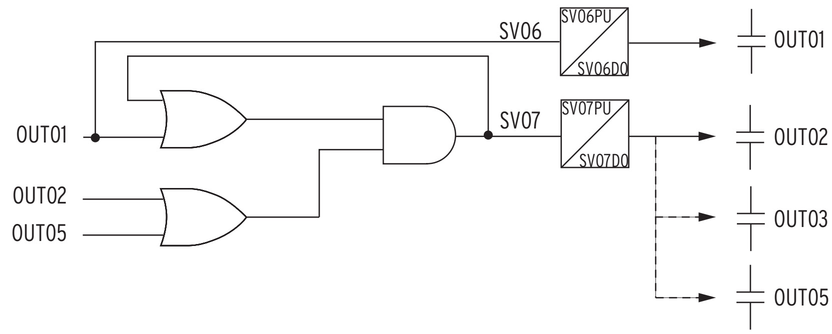


Figure 4.5 Example Use of SELogic Variables/Timers

SV/Timers Settings

The SEL-2523 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-2523 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	0
OUT02	SV	0
•	•	•
•	•	•
•	•	•

Section 5
Annunciator Sequences

Overview

The SEL-2523 supports eight of the most popular ISA-18.1 Alarm Sequences: A, F1A, F2M-1, F3A, M, M-1, R, and R-1.

The SEL-2523 is an excellent choice for alarm annunciation and event operation. The SEL-2523 indicates the status of up to 36 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-2523 to be installed in virtually any system.

The SEL-2523 stores the current state of each alarm point in nonvolatile memory. If power is ever lost, the SEL-2523 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 figures show the alarm sequences supported by the SEL-2523. 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

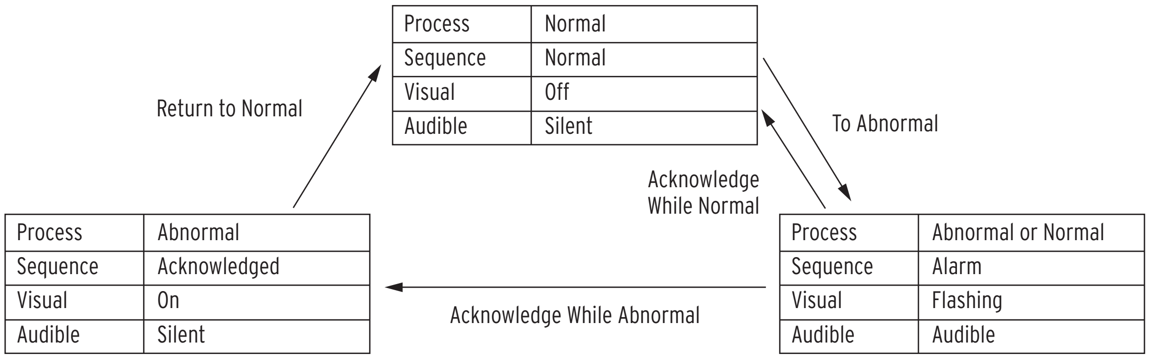


Figure 5.1 Sequence A State Diagram

Table 5.1 Sequence A Table[a]

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	Acknowledged	On	Silent	Maintained Alarm
3b	Normal	Acknowledge	To Line 4			Momentary Alarm
4	Normal	—	Normal	Off	Silent	Automatic Reset

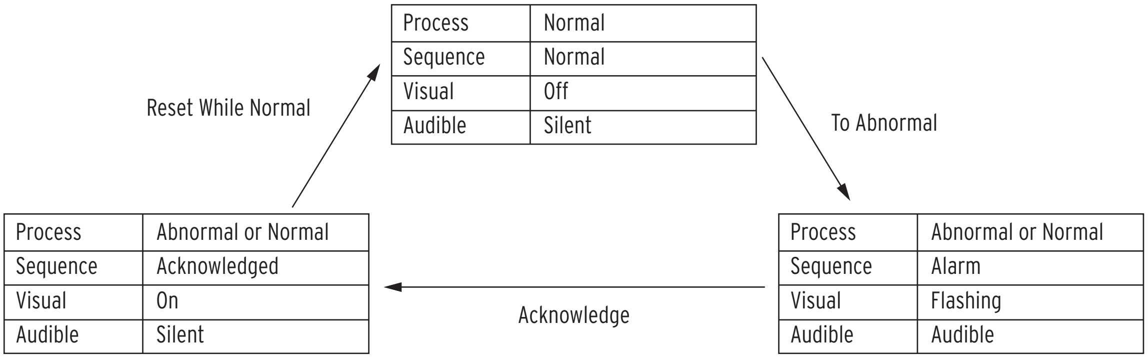
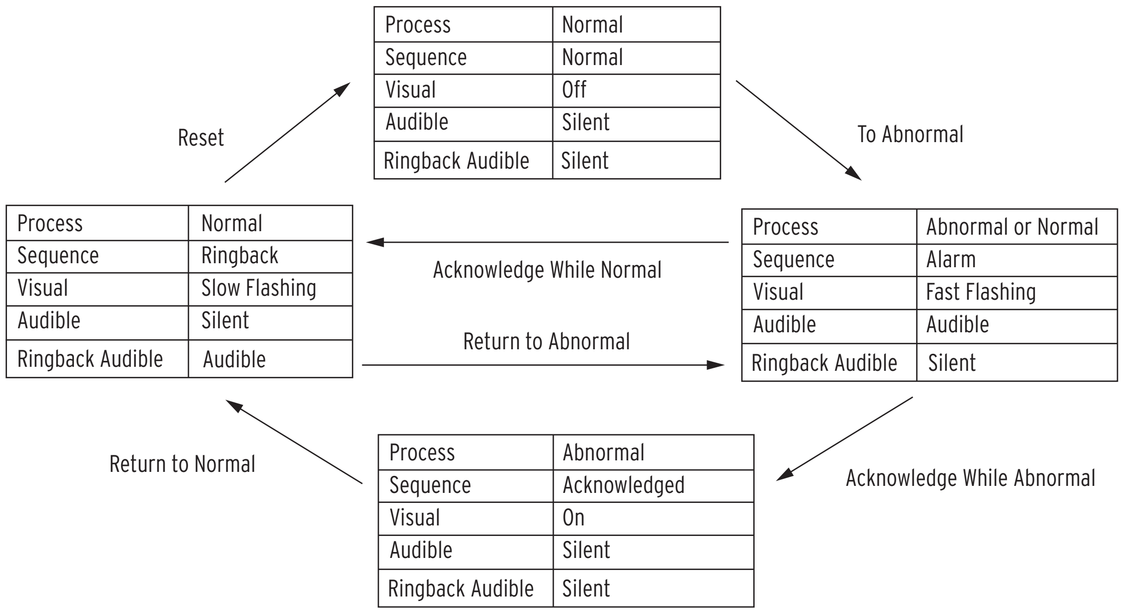


Figure 5.2 Sequence M State Diagram

NOTE: M-1 adds manual silence to the sequence.

Table 5.2 Sequence M Table[a]

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	Acknowledged	On	Silent	Manual Reset
4a	Abnormal	Reset	To Line 3			
4b	Normal	Reset	Normal	Off	Silent	Manual Reset



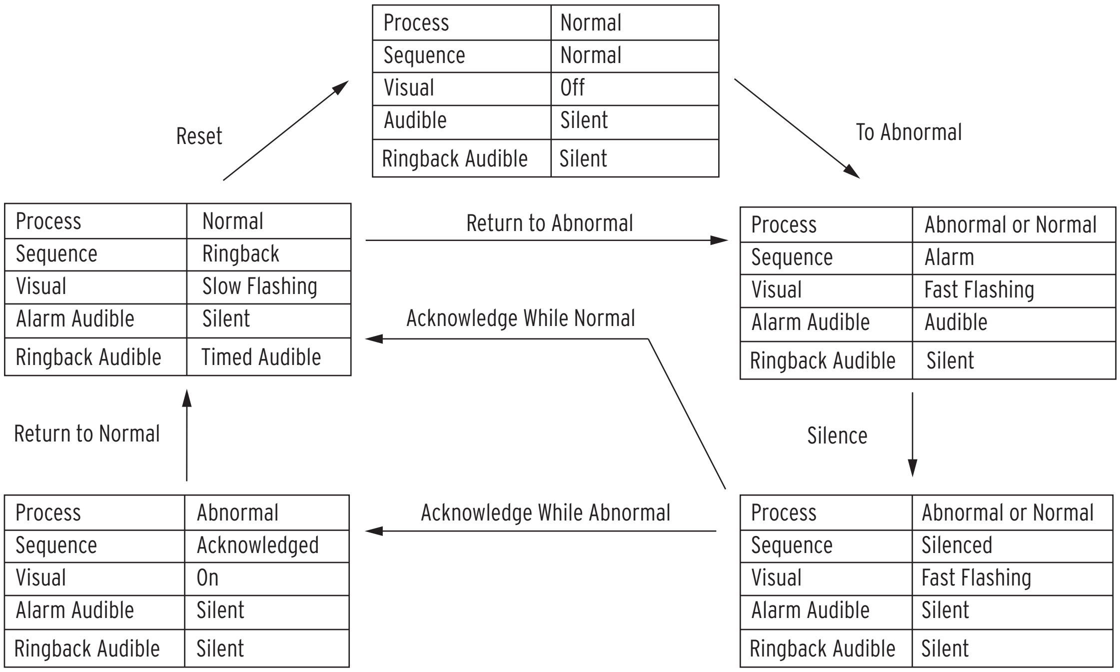
Note: Ringback Audible and Alarm Audible Use the Same Internal Alarm Horn

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

Figure 5.3 Sequence R State Diagram

Table 5.3 Sequence R Table[a]

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



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

Ringback Sequence Features
1) Silence, Acknowledge, Reset, and Test Pushbuttons
2) Alarm and Ringback Audible Devices
3) Lock-In of Momentary Alarms Until Acknowledged
4) Option 1: Silence Pushbuttons to Silence the Alarm Audible Device While Retaining Fast Flashing Indications
5) Option 2: Silence Interlock to Require Operation of the Silence Pushbutton Before the Acknowledge Pushbutton
6) Ringback Visual and Audible Indications When Process Conditions Return to Normal
7) Manual Reset of Ringback Indications
8) Operational Test

Figure 5.4 Sequence R-1 State Diagram

Table 5.4 Sequence R-1 Table[a]

Line	Process Condition	Pushbutton Operation	Sequence State	Visual Display	Alarm Audible Device	Ringback Audible Device	Remarks
1	Normal	—	Normal	Off	Silent	Silent	—
2	Abnormal	—	Alarm	Fast Flashing	Audible	Silent	Lock-In
3	Abnormal or Normal	Silence	Silenced	Fast Flashing	Silent	Silent	Lock-In
4a	Abnormal	Acknowledge	Acknowledged	On	Silent	Silent	Maintained Alarm
4b	Normal	Acknowledge	To Line 5				Momentary Alarm
5	Normal	—	Ringback	Slow Flashing	Silent	Timed Audible	Manual Reset Required
6	Abnormal	—	To Line 2				Return to Abnormal
7	Normal	Reset	Normal	Off	Silent	Silent	Manual Reset

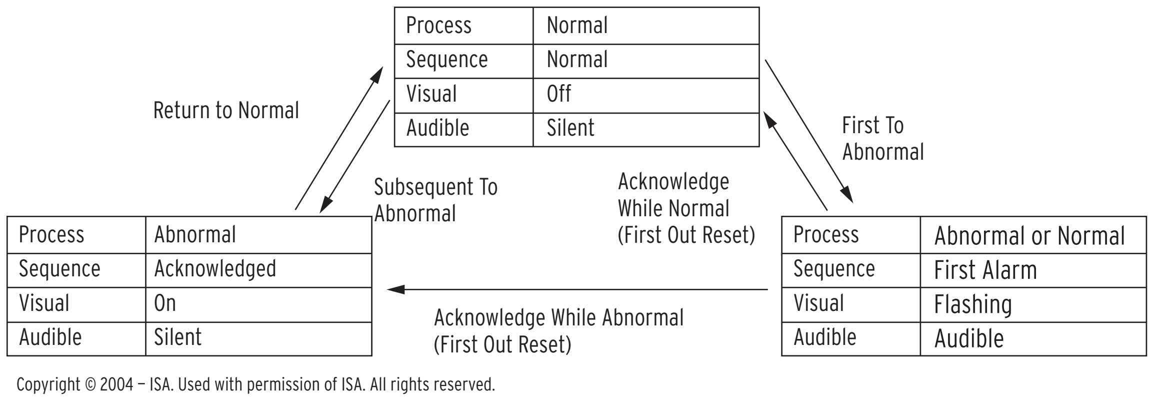
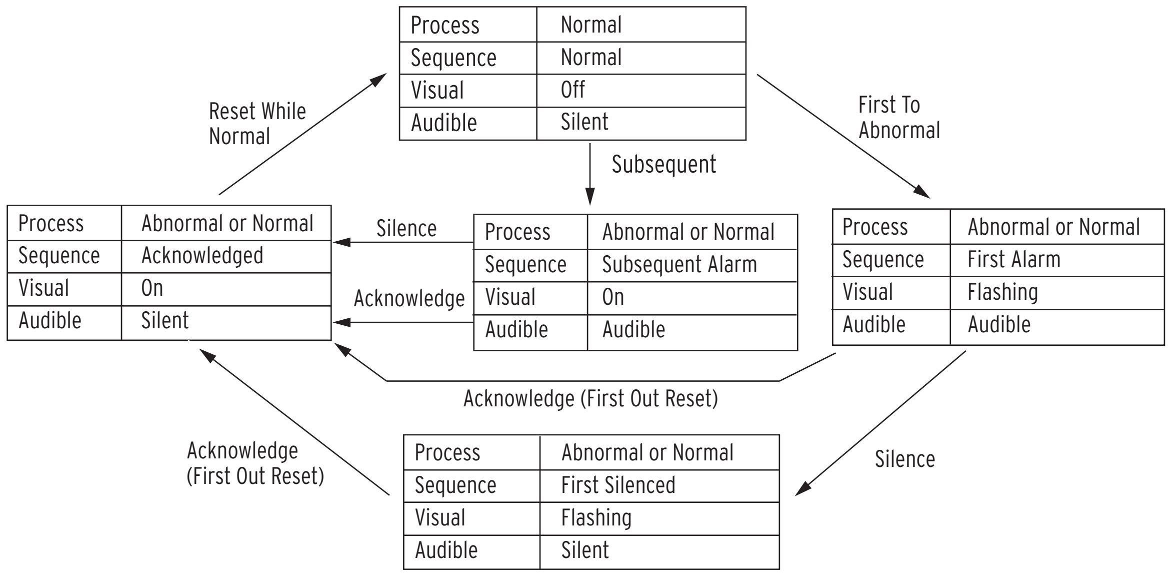


Figure 5.5 Sequence F1A State Diagram

Table 5.5 Sequence F1A Table[a]

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	—	Acknowledged	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



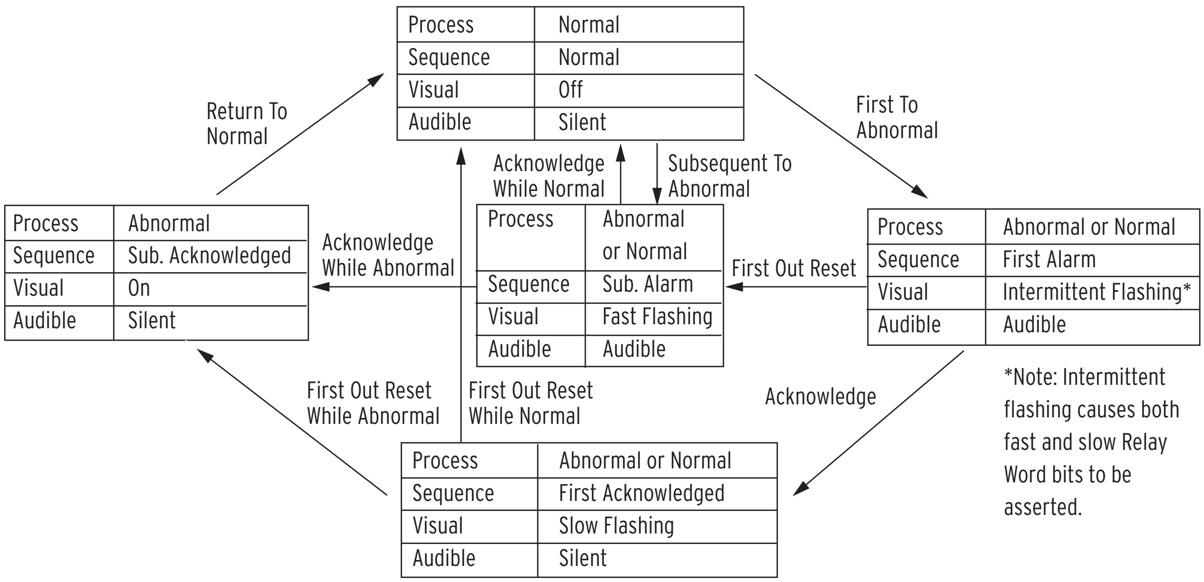
Note: Ringback Audible and Alarm Audible Use the Same Internal Alarm Horn

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

Figure 5.6 Sequence F2M-1 State Diagram

Table 5.6 Sequence F2M-1 Table[a]

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 or Normal	—	Subsequent Alarm	On	Audible	Latched
4	First	Abnormal or Normal	Acknowledge Before Silence	To Line 7			First Out Reset
5	Sub.	Abnormal or Normal					
6	First	Abnormal or Normal	Silence	First Silenced	Flashing	Silent	
7	Sub.	Abnormal or Normal	Silence	Acknowledged	On	Silent	Manual Reset
8	First	Abnormal or Normal	Acknowledge After Silence	To Line 7			First Out Reset
9	Normal		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

Figure 5.7 Sequence F3A State Diagram

Table 5.7 Sequence F3A Table[a]

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. Acknowledged	On	Silent	Maintained Alarm
6B	Sub.	Normal		To Line 8			Momentary Alarm
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

Sequence State Flow Diagrams

Figure 5.1 through *Figure 5.7* show the standard alarm sequences that come in the SEL-2523. All of these sequences follow the ISA-18.1 standard for Annunciator Sequences and Specifications. The SEL-2523 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-2523.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-2523 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 DNP3, 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-2523.

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 deenergized, the process is normal. Most traditional alarm annunciators use contact inputs to relay process information as normal or abnormal. The SEL-2523 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-2523. 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-2523 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.

NOTE: Intermittent flashing causes both fast and slow Relay Word bits to be asserted.

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-2523 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-2523 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-2523.

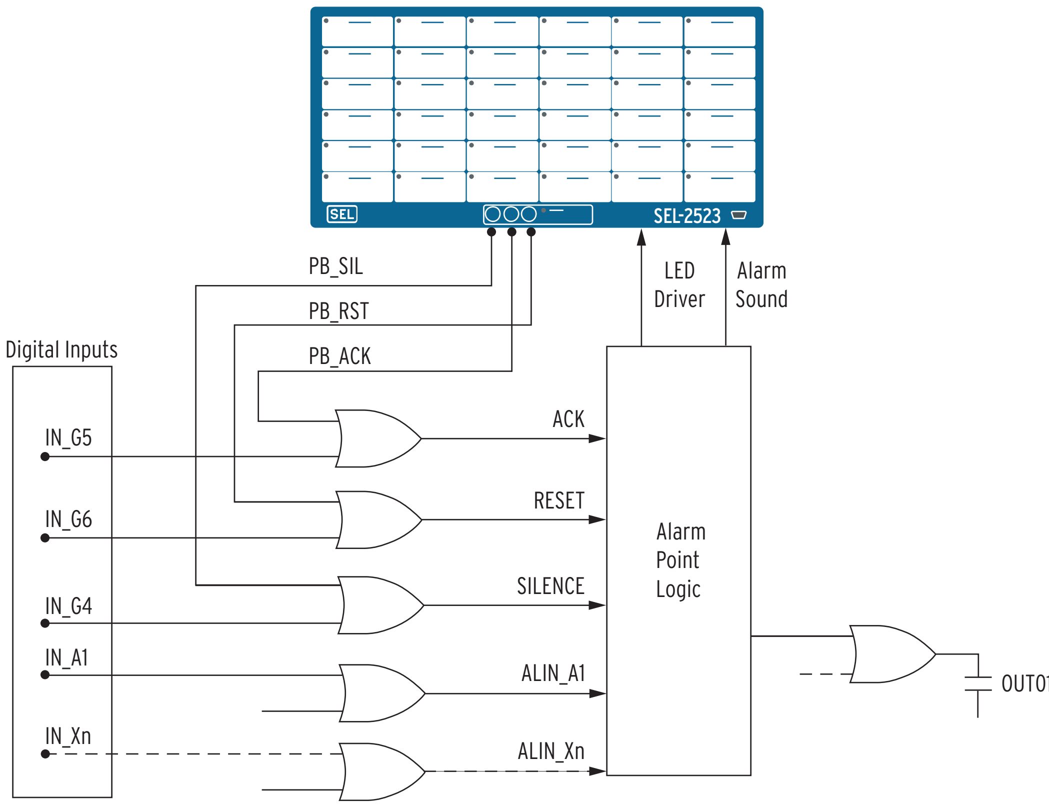


Figure 5.8 Default Logic Routing

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 5.7*). The SEL-2523 is set to the manual sequence by default. The manual sequence only uses the Acknowledge and Reset functions.

As shown in *Figure 5.8*, 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-2523 perform the first method of alarm acknowledgment. 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_G5 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_G5

RESET := PB_RST OR IN_G6

The alarm points are all triggered by the logic equations corresponding to the alarm point. In *Figure 5.8*, 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_X*n* corresponds to the entire series of digital inputs IN_A1 through IN_F6 and alarm point input ALIN_X*n* corresponds to alarm point series ALIN_A1 through ALIN_F6. 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_A3

•

•

•

ALIN_F6 := IN_F6

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_F6. 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 5.9* is set to close upon any critical alarm point assertion.

OUT01 := CR_ALM

Advanced Annunciator Logic Routing

The ACK and RESET equations used in the previous example show triggering from front-panel pushbuttons or from a contact. *Figure 5.9* shows an advanced example of different methods of triggering the ACK, RESET, and alarm points through Device Word bits available in the SEL-2523. The RB_ACK and RB_RST Remote bits allow you to acknowledge and reset an alarm from various communications devices. *Figure 5.9* demonstrates each method used in triggering the ACK, RESET, and alarm point inputs.

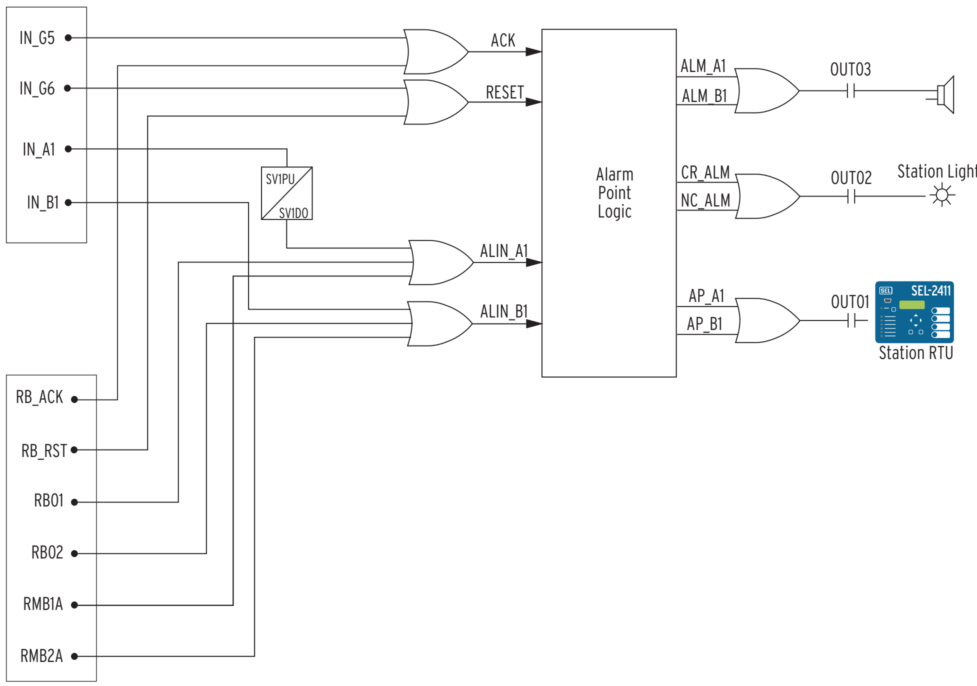


Figure 5.9 Example of Advanced Annunciator Logic Routing

Figure 5.10 shows four ways to remotely trigger RB_ACK through communications. Using any of these routes will cause the ACK equation to assert.

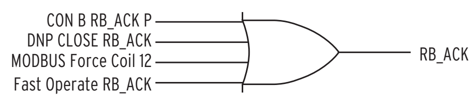


Figure 5.10 RB_ACK Trigger Options

Figure 5.11 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 5.11* shows the logic that drives ALIN_A1.

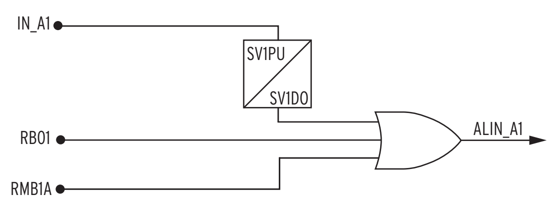


Figure 5.11 ALIN_A1 Logic

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 5.10*. You can use Modbus, DNP3, 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-2523 using MIRRORED BITS and trigger RMB1A.

The SEL-2523 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

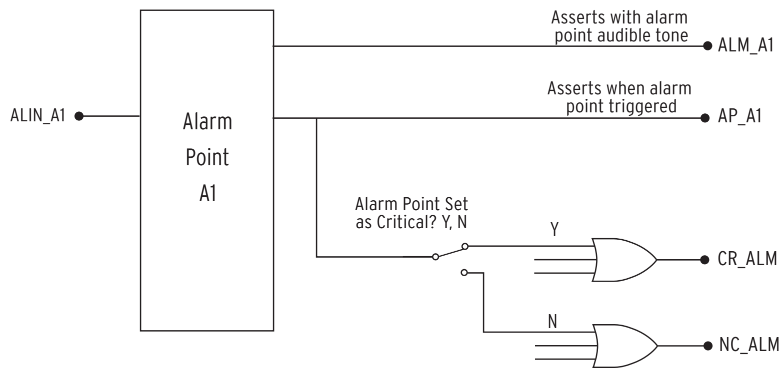


Figure 5.12 Alarm Point Logic Outputs

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Section 6
Settings

Overview

The SEL-2523 Annunciator Panel 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
- DNP3

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

	Serial Port Commands[a]	ACSELERATOR QuickSet® SEL-5030 Software[b]
Display Settings	All settings (**SHO** command)	All settings
Change Settings	All settings (**SET** command)	All settings

[a] Refer to Section 7: Communications for detailed information on set-up and use of the serial communications port.
[b] 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-2523 Settings Sheets* at the end of this section list all SEL-2523 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
SHO	Show device settings	1
SHO L	Show logic settings	1
SHO G	Show global settings	1
SHO P *n*	Show serial port settings, *n* specifies either PORT F or PORT 2 through PORT 4; defaults to the active port if not listed	1
SHO R	Show report settings such as Sequential Events Recorder (SER)	1
SHO DNP	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
SET	Set device settings	2
SET L	Set logic settings	2
SET G	Set global settings	2
SET P *n*	Set serial port settings, depending on the device configuration, *n* specifies either PORT F or PORT 2 through PORT 4; defaults to the active port if not listed	2
SET R	Set SER report settings	2
SET DNP	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-2523 displays the Device and Terminal Identifier strings at the top of the responses to serial port commands, identifying messages from individual devices. Enter up to 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-2523
Terminal ID	16 Characters	TID := DEVICE

Alarm Group Settings

The SEL-2523 comes standard with four groups of alarm sequences. The user can set any of the eight alarm sequences to any of the four alarm groups. Each alarm group has settings for any of the 36 individual alarm points.

Table 6.6 Alarm Group Settings (Sheet 1 of 2)

Setting Prompt	Setting Range	Setting Name := Factory Default
Number of Alarm Groups	1–4	EALG := 1
Alarm Sequence	A, F1A, F2M1, F3A, M, M-1, R, R-1	GR*x*[a]_SEQ := M

Table 6.6 Alarm Group Settings (Sheet 2 of 2)

Setting Prompt	Setting Range	Setting Name := Factory Default
Critical Alarm	Y, N	GR*x*_TYPE := Y
Alarm Point List	A1–F6, NONE	GR*x*_ALPT := A1–F6

[a] x = 1–4 depending on EALG setting.

Critical Alarms have higher priority than Noncritical Alarms. Noncritical Alarms have higher priority than the Ringback Chime.

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 GR*x*_SEQ identifies which alarm sequences is used in the alarm panel. See *Section 5: Annunciator Sequences* for more information on available alarm sequences and flow diagrams.

The GR*x*_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.

The alarm point setting GR*x*_ALPT assigns up to 36 alarm points to the alarm group. GR*x*_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, C6, D1–F6

➤ GR2_ALPT := B3–B6, C2–C5

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-2523. 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-B input. The SEL-2411 accepts IRIG-B input from either PORT 2 or PORT 3. If the IRIG 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-2523 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-2523 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-2523 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).

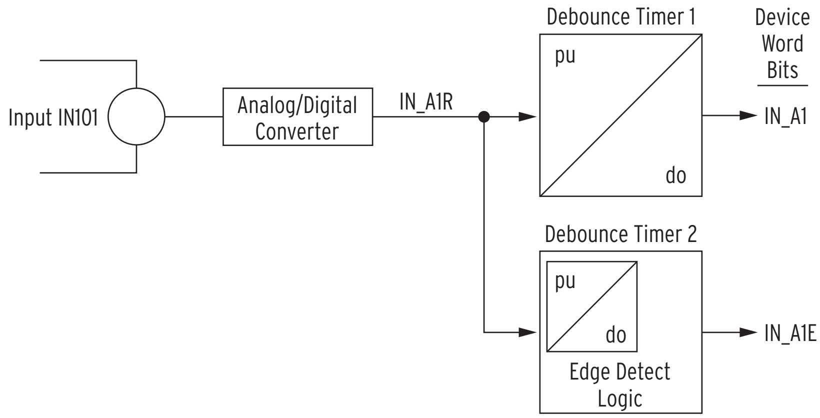

Figure 6.1 DC Mode Processing

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:

- Relay 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 Relay Word bit IN_A1E in the SER (see *Report Settings (SET R Command)*). During the time when Debounce Timer 2 runs, the relay ignores all edge changes. At the end of this timing period, the relay evaluates the status of IN_A1R (either logical 0 or logical 1), and sets Relay Word bit IN_A1E to this value. In *Figure 6.2*, IN_A1R has a status of logical 1 and Relay Word bit IN_A1E remains at logical 1.

Relay 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*.

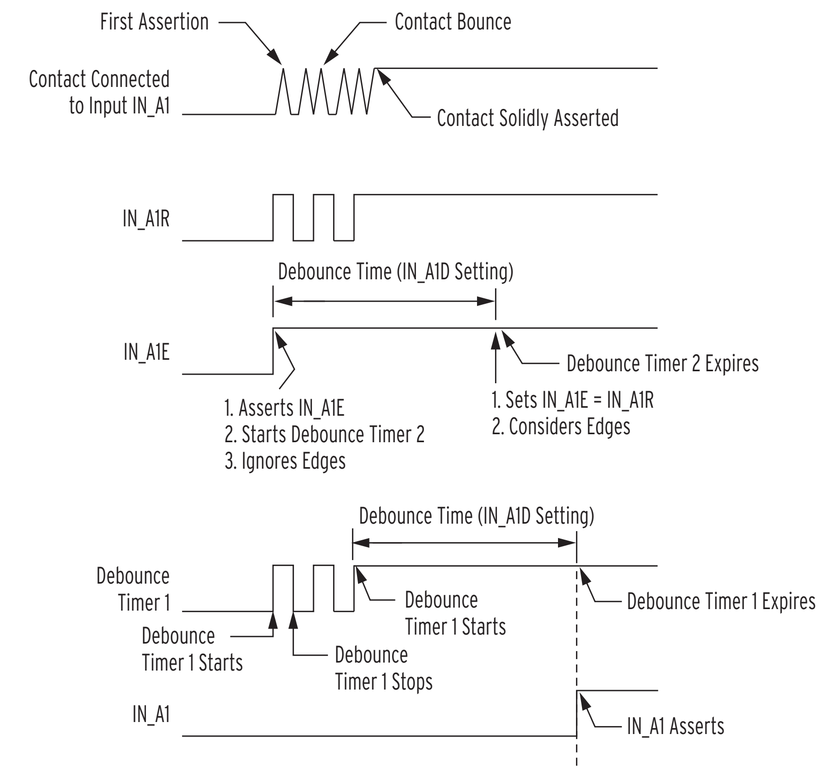

Figure 6.2 Timing Diagram When IN_A1R Changes From the Deasserted State to the Asserted State

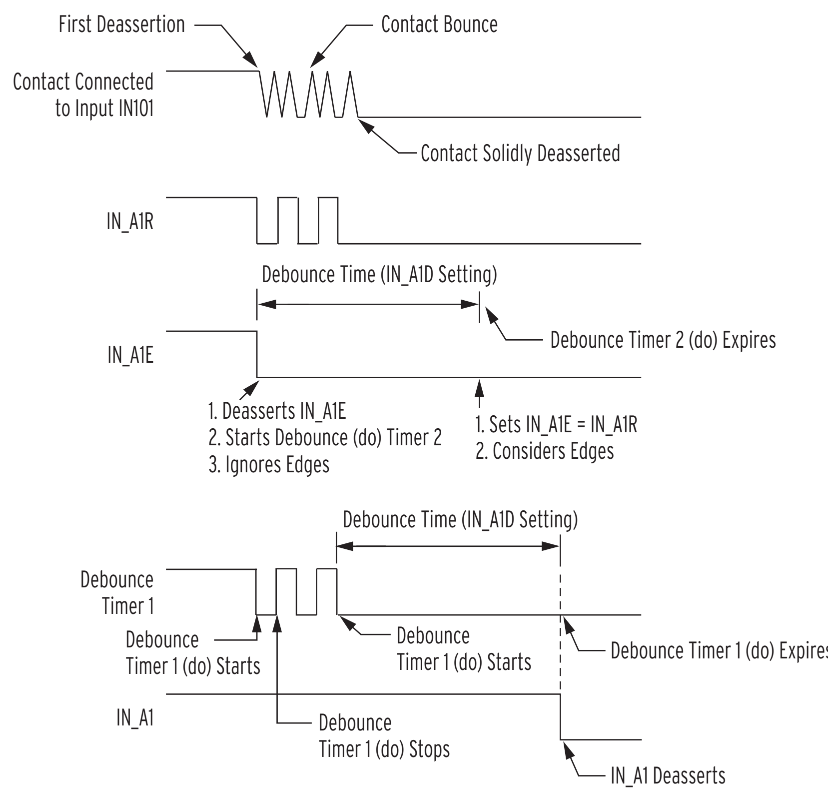

Figure 6.3 Timing Diagram When Input IN_A1 Changes From the Asserted State to the Deasserted State

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.

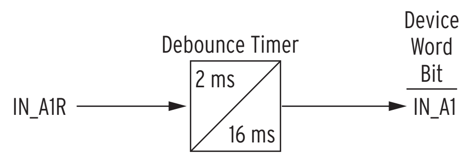

Figure 6.4 AC Mode Processing

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, Relay 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 Relay Word bit IN_A1 asserts to a logical 1.

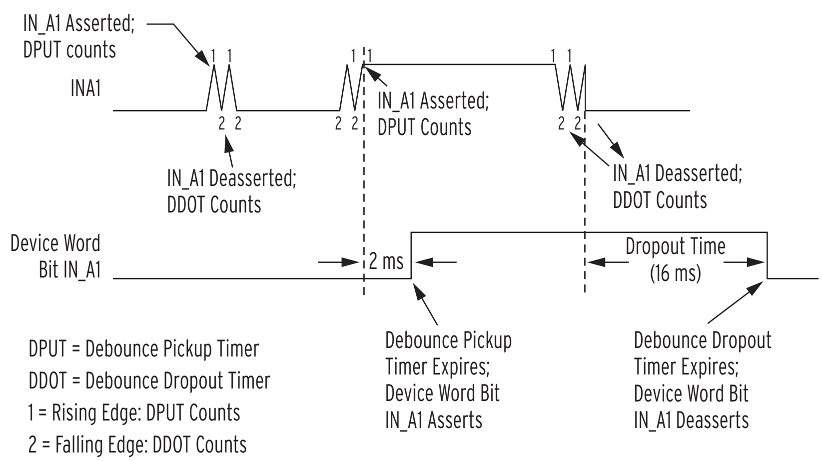

Figure 6.5 Timing Diagram for Debounce Timer Operation When Operating in AC Mode

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 := 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_A6 Debounce	AC, 0–20000 ms	IN_A*x*[a]D := 10
IN_B1–IN_B6 Debounce	AC, 0–20000 ms	IN_B*x*D := 10

Table 6.9 General Global Settings (Sheet 2 of 2)

Setting Prompt	Setting Range	Setting Name := Factory Default
IN_C1–IN_C6 Debounce	AC, 0–20000 ms	IN_C*x*D := 10
IN_D1–IN_D6 Debounce	AC, 0–20000 ms	IN_D*x*D := 10
IN_E1–IN_E6 Debounce	AC, 0–20000 ms	IN_E*x*D := 10
IN_F1–IN_F6 Debounce	AC, 0–20000 ms	IN_F*x*D := 10
IN_G1_IN_G6 Debounce	AC, 0–20000 ms	IN_G*x*D := 10

[a] x = 1–6.

Event Messenger Points

The SEL-2523 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 := Noncritical 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-2523 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. On the optional communications card, you can select EIA-485 or EIA-232 functionality (not both) by means of the COMMINF setting for PORT 4 (see *Communications Card (SELECT EIA-232/EIA-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 (1–30 min for DNP3)	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

Setting Prompt	Setting Range	Setting Name := Factory Default
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	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 (1–30 min for DNP3)	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

Setting Prompt	Setting Range	Setting Name := Factory Default
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	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 (1–30 min for DNP3)	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

Setting Prompt	Setting Range	Setting Name := Factory Default
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	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 (1–30 min for DNP3)	T_OUT := 5
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: Relay 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

Settings Prompt	Setting Range	Setting Name := Factory Default
Auto-Removal Enable	Y, N	ESERDEL := N
Number of Counts	2–20	SRDLNCNT := 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 up to 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[a] Trigger Settings

Setting Prompt	Setting Name := Factory Default
SER1	SER1 := SIL ACK RESET
SER2	SER2 := ALIN_A1 ALIN_A2 ALIN_A3 ALIN_A4 ALIN_A5 ALIN_A6 ALIN_B1ALIN_B2 ALIN_B3 ALIN_B4 ALIN_B5 ALIN_B6 ALIN_C1 ALIN_C2 ALIN_C3 ALIN_C4 ALIN_C5 ALIN_C6 ALIN_D1 ALIN_D2 ALIN_D3 ALIN_D4 ALIN_D5 ALIN_D6
SER3	SER3 := ALIN_E1 ALIN_E2 ALIN_E3 ALIN_E4 ALIN_E5 ALIN_E6 ALIN_F1 ALIN_F2 ALIN_F3 ALIN_F4 ALIN_F5 ALIN_F6 AP_A1 AP_A2 AP_A3 AP_A4 AP_A5 AP_A6 AP_B1 AP_B2 AP_B3 AP_B4 AP_B5 AP_B6
SER4	SER4 := AP_C1 AP_C2 AP_C3 AP_C4 AP_C5 AP_C6 AP_D1 AP_D2 AP_D3 AP_D4 AP_D5 AP_D6 AP_E1 AP_E2 AP_E3 AP_E4 AP_E5 AP_E6 AP_F1 AP_F2 AP_F3 AP_F4 AP_F5 AP_F6

[a] Use up to 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 up to 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			

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SEL-2523 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, F1A, F2M1, F3A, M, M-1, R, R-1)	**GR1_SEQ**	:= ________________
Group 1 Critical Alarm (Y, N)	**GR1_TYPE**	:= ________________
Group 1 Alarm Point List (A1–F6, NONE)	**GR1_ALPT**	:= ________________

Alarm Group 2

Group 2 Alarm Sequence (A, F1A, F2M1, F3A, M, M-1, R, R-1)	**GR2_SEQ**	:= ________________
Group 2 Critical Alarm (Y, N)	**GR2_TYPE**	:= ________________
Group 2 Alarm Point List (A1–F6, NONE)	**GR2_ALPT**	:= ________________

Alarm Group 3

Group 3 Alarm Sequence (A, F1A, F2M1, F3A, M, M-1, R, R-1)	**GR3_SEQ**	:= ________________
Group 3 Critical Alarm (Y, N)	**GR3_TYPE**	:= ________________
Group 3 Alarm Point List (A1–F6, NONE)	**GR3_ALPT**	:= ________________

Alarm Group 4

Group 4 Alarm Sequence (A, F1A, F2M1, F3A, M, M-1, R, R-1)	**GR4_SEQ**	:= ________________
Group 4 Critical Alarm (Y, N)	**GR4_TYPE**	:= ________________
Group 4 Alarm Point List (A1–F6, 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 A3	**ALIN_A3**	:=
Alarm Point Input A4	**ALIN_A4**	:=
Alarm Point Input A5	**ALIN_A5**	:=
Alarm Point Input A6	**ALIN_A6**	:=
Alarm Point Input B1	**ALIN_B1**	:=
Alarm Point Input B2	**ALIN_B2**	:=
Alarm Point Input B3	**ALIN_B3**	:=
Alarm Point Input B4	**ALIN_B4**	:=
Alarm Point Input B5	**ALIN_B5**	:=
Alarm Point Input B6	**ALIN_B6**	:=
Alarm Point Input C1	**ALIN_C1**	:=
Alarm Point Input C2	**ALIN_C2**	:=
Alarm Point Input C3	**ALIN_C3**	:=
Alarm Point Input C4	**ALIN_C4**	:=
Alarm Point Input C5	**ALIN_C5**	:=
Alarm Point Input C6	**ALIN_C6**	:=
Alarm Point Input D1	**ALIN_D1**	:=
Alarm Point Input D2	**ALIN_D2**	:=
Alarm Point Input D3	**ALIN_D3**	:=
Alarm Point Input D4	**ALIN_D4**	:=
Alarm Point Input D5	**ALIN_D5**	:=
Alarm Point Input D6	**ALIN_D6**	:=
Alarm Point Input E1	**ALIN_E1**	:=
Alarm Point Input E2	**ALIN_E2**	:=
Alarm Point Input E3	**ALIN_E3**	:=

Alarm Point Input E4	**ALIN_E4**	:= ____________
Alarm Point Input E5	**ALIN_E5**	:= ____________
Alarm Point Input E6	**ALIN_E6**	:= ____________
Alarm Point Input F1	**ALIN_F1**	:= ____________
Alarm Point Input F2	**ALIN_F2**	:= ____________
Alarm Point Input F3	**ALIN_F3**	:= ____________
Alarm Point Input F4	**ALIN_F4**	:= ____________
Alarm Point Input F5	**ALIN_F5**	:= ____________
Alarm Point Input F6	**ALIN_F6**	:= ____________

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)	**SV07PU**	:=	________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV07DO**	:=	________
SELOGIC Variable Input (SV)	**SV08**	:=	________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV08PU**	:=	________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV08DO**	:=	________
SELOGIC Variable Input (SV)	**SV09**	:=	________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV09PU**	:=	________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV09DO**	:=	________

SELOGIC Variable Input (SV)	**SV10**	:= ____________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV10PU**	:= ____________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV10DO**	:= ____________
SELOGIC Variable Input (SV)	**SV11**	:= ____________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV11PU**	:= ____________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV11DO**	:= ____________
SELOGIC Variable Input (SV)	**SV12**	:= ____________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV12PU**	:= ____________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV12DO**	:= ____________
SELOGIC Variable Input (SV)	**SV13**	:= ____________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV13PU**	:= ____________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV13DO**	:= ____________
SELOGIC Variable Input (SV)	**SV14**	:= ____________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV14PU**	:= ____________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV14DO**	:= ____________
SELOGIC Variable Input (SV)	**SV15**	:= ____________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV15PU**	:= ____________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV15DO**	:= ____________
SELOGIC Variable Input (SV)	**SV16**	:= ____________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV16PU**	:= ____________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV16DO**	:= ____________
SELOGIC Variable Input (SV)	**SV17**	:= ____________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV17PU**	:= ____________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV17DO**	:= ____________
SELOGIC Variable Input (SV)	**SV18**	:= ____________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV18PU**	:= ____________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV18DO**	:= ____________
SELOGIC Variable Input (SV)	**SV19**	:= ____________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV19PU**	:= ____________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV19DO**	:= ____________
SELOGIC Variable Input (SV)	**SV20**	:= ____________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV20PU**	:= ____________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV20DO**	:= ____________

SELOGIC Variable Input (SV)	**SV21**	**:=**
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV21PU**	**:=**
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV21DO**	**:=**
SELOGIC Variable Input (SV)	**SV22**	**:=**
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV22PU**	**:=**
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV22DO**	**:=**
SELOGIC Variable Input (SV)	**SV23**	**:=**
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV23PU**	**:=**
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV23DO**	**:=**
SELOGIC Variable Input (SV)	**SV24**	**:=**
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV24PU**	**:=**
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV24DO**	**:=**
SELOGIC Variable Input (SV)	**SV25**	**:=**
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV25PU**	**:=**
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV25DO**	**:=**
SELOGIC Variable Input (SV)	**SV26**	**:=**
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV26PU**	**:=**
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV26DO**	**:=**
SELOGIC Variable Input (SV)	**SV27**	**:=**
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV27PU**	**:=**
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV27DO**	**:=**
SELOGIC Variable Input (SV)	**SV28**	**:=**
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV28PU**	**:=**
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV28DO**	**:=**
SELOGIC Variable Input (SV)	**SV29**	**:=**
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV29PU**	**:=**
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV29DO**	**:=**
SELOGIC Variable Input (SV)	**SV30**	**:=**
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV30PU**	**:=**
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV30DO**	**:=**
SELOGIC Variable Input (SV)	**SV31**	**:=**
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV31PU**	**:=**
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV31DO**	**:=**

SELOGIC Variable Input (SV)	**SV32**	**:=**__________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV32PU**	**:=**__________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV32DO**	**:=**__________
SELOGIC Variable Input (SV)	**SV33**	**:=**__________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV33PU**	**:=**__________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV33DO**	**:=**__________
SELOGIC Variable Input (SV)	**SV34**	**:=**__________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV34PU**	**:=**__________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV34DO**	**:=**__________
SELOGIC Variable Input (SV)	**SV35**	**:=**__________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV35PU**	**:=**__________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV35DO**	**:=**__________
SELOGIC Variable Input (SV)	**SV36**	**:=**__________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV36PU**	**:=**__________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV36DO**	**:=**__________
SELOGIC Variable Input (SV)	**SV37**	**:=**__________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV37PU**	**:=**__________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV37DO**	**:=**__________
SELOGIC Variable Input (SV)	**SV38**	**:=**__________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV38PU**	**:=**__________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV38DO**	**:=**__________
SELOGIC Variable Input (SV)	**SV39**	**:=**__________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV39PU**	**:=**__________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV39DO**	**:=**__________
SELOGIC Variable Input (SV)	**SV40**	**:=**__________
SELOGIC Variable Timer Pickup (0.000–16000.000 s)	**SV40PU**	**:=**__________
SELOGIC Variable Timer Dropout (0.000–16000.00 s)	**SV40DO**	**:=**__________

Output SELOGIC Equations

OUT01 :=________________

OUT02 :=________________

OUT03 :=________________

OUT04 :=________________

OUT05 :=________________

OUT06 :=________________

OUT07 :=________________

OUT08 :=________________

OUT09 :=________________

OUT10 :=________________

OUT11 :=________________

MIRRORED BITS

TMB1A :=________________

TMB2A :=________________

TMB3A :=________________

TMB4A :=________________

TMB5A :=________________

TMB6A :=________________

TMB7A :=________________

TMB8A :=________________

TMB1B :=________________

TMB2B :=________________

TMB3B :=________________

TMB4B :=________________

TMB5B :=________________

TMB6B :=________________

TMB7B :=________________

TMB8B :=________________

Date____________

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 A3 Debounce (AC, 0–20000 ms)	**IN_A3D**	:= ____________
Input A4 Debounce (AC, 0–20000 ms)	**IN_A4D**	:= ____________
Input A5 Debounce (AC, 0–20000 ms)	**IN_A5D**	:= ____________
Input A6 Debounce (AC, 0–20000 ms)	**IN_A6D**	:= ____________
Input B1 Debounce (AC, 0–20000 ms)	**IN_B1D**	:= ____________
Input B2 Debounce (AC, 0–20000 ms)	**IN_B2D**	:= ____________
Input B3 Debounce (AC, 0–20000 ms)	**IN_B3D**	:= ____________
Input B4 Debounce (AC, 0–20000 ms)	**IN_B4D**	:= ____________
Input B5 Debounce (AC, 0–20000 ms)	**IN_B5D**	:= ____________
Input B6 Debounce (AC, 0–20000 ms)	**IN_B6D**	:= ____________
Input C1 Debounce (AC, 0–20000 ms)	**IN_C1D**	:= ____________
Input C2 Debounce (AC, 0–20000 ms)	**IN_C2D**	:= ____________
Input C3 Debounce (AC, 0–20000 ms)	**IN_C3D**	:= ____________
Input C4 Debounce (AC, 0–20000 ms)	**IN_C4D**	:= ____________
Input C5 Debounce (AC, 0–20000 ms)	**IN_C5D**	:= ____________
Input C6 Debounce (AC, 0–20000 ms)	**IN_C6D**	:= ____________
Input D1 Debounce (AC, 0–20000 ms)	**IN_D1D**	:= ____________
Input D2 Debounce (AC, 0–20000 ms)	**IN_D2D**	:= ____________
Input D3 Debounce (AC, 0–20000 ms)	**IN_D3D**	:= ____________
Input D4 Debounce (AC, 0–20000 ms)	**IN_D4D**	:= ____________

Input D5 Debounce (AC, 0–20000 ms)	**IN_D5D**	:= ____________
Input D6 Debounce (AC, 0–20000 ms)	**IN_D6D**	:= ____________
Input E1 Debounce (AC, 0–20000 ms)	**IN_E1D**	:= ____________
Input E2 Debounce (AC, 0–20000 ms)	**IN_E2D**	:= ____________
Input E3 Debounce (AC, 0–20000 ms)	**IN_E3D**	:= ____________
Input E4 Debounce (AC, 0–20000 ms)	**IN_E4D**	:= ____________
Input E5 Debounce (AC, 0–20000 ms)	**IN_E5D**	:= ____________
Input E6 Debounce (AC, 0–20000 ms)	**IN_E6D**	:= ____________
Input F1 Debounce (AC, 0–20000 ms)	**IN_F1D**	:= ____________
Input F2 Debounce (AC, 0–20000 ms)	**IN_F2D**	:= ____________
Input F3 Debounce (AC, 0–20000 ms)	**IN_F3D**	:= ____________
Input F4 Debounce (AC, 0–20000 ms)	**IN_F4D**	:= ____________
Input F5 Debounce (AC, 0–20000 ms)	**IN_F5D**	:= ____________
Input F6 Debounce (AC, 0–20000 ms)	**IN_F6D**	:= ____________
Input G1 Debounce (AC, 0–20000 ms)	**IN_G1D**	:= ____________
Input G2 Debounce (AC, 0–20000 ms)	**IN_G2D**	:= ____________
Input G3 Debounce (AC, 0–20000 ms)	**IN_G3D**	:= ____________
Input G4 Debounce (AC, 0–20000 ms)	**IN_G4D**	:= ____________
Input G5 Debounce (AC, 0–20000 ms)	**IN_G5D**	:= ____________
Input G6 Debounce (AC, 0–20000 ms)	**IN_G6D**	:= ____________

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)	**MPTX03**	:= ____________
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR04**	:= ____________
MESSENGER POINT TEXT (148 characters)	**MPTX04**	:= ____________
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR05**	:= ____________
MESSENGER POINT TEXT (148 characters)	**MPTX05**	:= ____________

MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR06**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX06**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR07**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX07**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR08**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX08**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR09**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX09**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR10**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX10**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR11**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX11**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR12**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX12**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR13**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX13**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR14**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX14**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR15**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX15**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR16**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX16**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR17**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX17**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR18**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX18**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR19**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX19**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR20**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX20**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR21**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX21**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR22**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX22**	:=

MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR23**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX23**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR24**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX24**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR25**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX25**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR26**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX26**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR27**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX27**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR28**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX28**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR29**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX29**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR30**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX30**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR31**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX31**	:=
MESSENGER POINT TRIGGER (Off, 1 Device Word bit)	**MPTR32**	:=
MESSENGER POINT TEXT (148 characters)	**MPTX32**	:=

Port Settings (SET P Command)

Port F

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 (0–30 min, 1–30 min for DNP3)	**T_OUT**	:=
Send Auto Messages to Port (Y, N)	**AUTO**	:=
Fast Operate Enable (Y, N)	**FASTOP**	:=

Port 2

Enable Port (Y, N)	**EPORT**	:=
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 (0–30 min, 1–30 min for DNP3)	**T_OUT**	:=
Send Auto Messages to Port (Y, N)	**AUTO**	:=
Fast Operate Enable (Y, N)	**FASTOP**	:=

Port 3

Enable Port (Y, N)	**EPORT**	:=
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 (0–30 min, 1–30 min for DNP3)	**T_OUT**	:=

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 (0–30 min, 1–30 min for DNP3)	**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)	**RMB7PU**	:= ____________
RMB7 Dropout Debounce Messages (1–8)	**RMB7DO**	:= ____________
RMB8 Pickup Debounce Messages (1–8)	**RMB8PU**	:= ____________
RMB8 Dropout Debounce Messages (1–8)	**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 up to 24 Device Word elements separated by spaces or commas in each of the four lists. Use NA to disable settings.

SER1 := ________

SER2 := ________

SER3 := ________

SER4 := ________

Relay Word Bit Aliases

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

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

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

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

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-2523 Annunciator Panel. 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-2523 Port Description(Sheet 1 of 2)

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

Table 7.1 SEL-2523 Port Description(Sheet 2 of 2)

Port	Communication Port Interface	Location/Comment
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-2523. 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 ≤15 m (50 feet) in low-noise environments. Use the optimal EIA-485 port for communications distances of ≤1200 m (4000 feet) 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

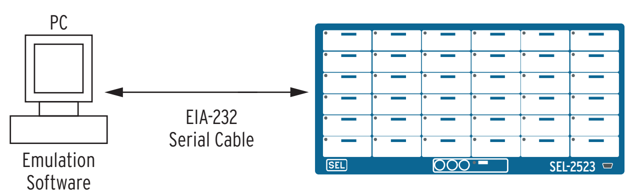

Figure 7.1 Connection Between PC Serial Port and SEL-2523 Front-Panel Serial Port

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

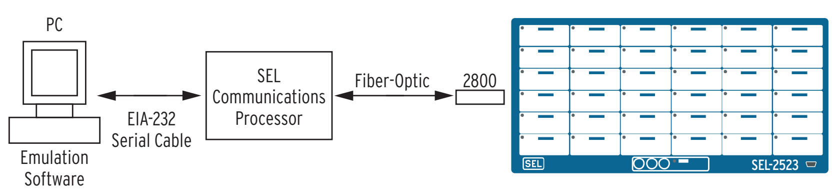

Figure 7.2 Connection When Installation Includes Other SEL Devices

A variety of terminal emulation programs for PCs can communicate with the device, e.g., ACSELERATOR 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 primary 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-2523 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.

For best performance, keep the length of the SEL-C234A cable >15m (50 feet). 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-2523.

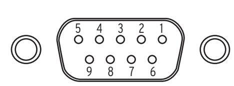

Figure 7.3 EIA-232 DB-9 Connector Pin Numbers

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

Table 7.2 EIA Serial Port Pin Functions

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

[a] 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-2523 to other devices. These and other cables are available from SEL.

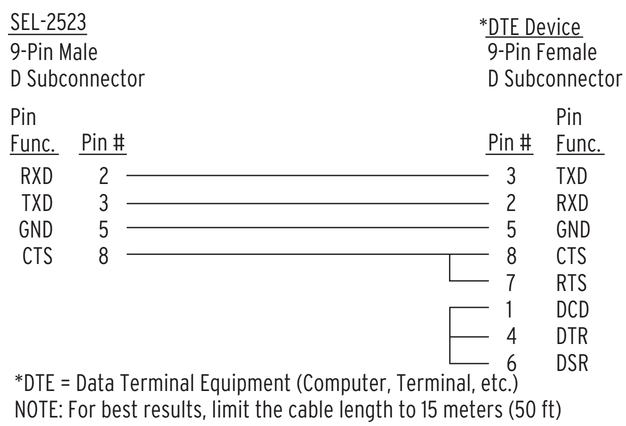

Figure 7.4 SEL Cable SEL-C234A—SEL-2523 to DTE Device

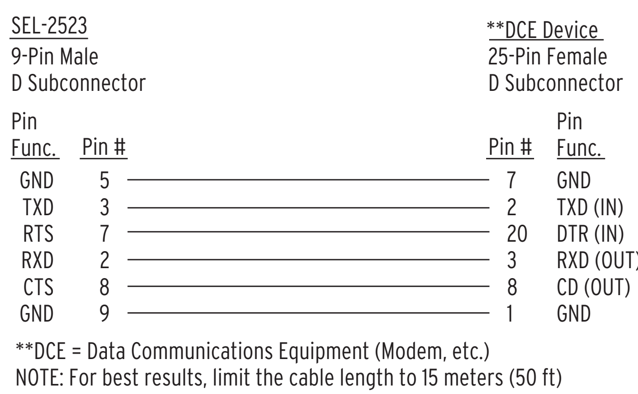

Figure 7.5 SEL Cable SEL-C222—SEL-2523 to Modem

SEL Communications Processor 9-Pin Male D Subconnector		SEL-2523 9-Pin Male D Subconnector	
Pin Func.	Pin #	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-2523 to SEL Communications Processor (Without IRIG-B Signal)

SEL Communications Processor 9-Pin Male D Subconnector		SEL-2523 9-Pin Male D Subconnector	
Pin Func.	Pin #	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-2523 to SEL Communications Processor (With IRIG-B Signal)

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

SEL-3010 9-Pin Male D Subconnector		SEL-2523 9-Pin Male D Subconnector	
Pin Func.	Pin #	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-2523 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-2523 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 PORT 3 PORT 4A, 4C	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)

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*.

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

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

MIRRORED BITS Protocol

The SEL-2523 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-2523 provides Modbus RTU support. Modbus is described in *Appendix E: Modbus RTU Communications Protocol*.

DNP3 (Distributed Network Protocol)

The SEL-2523 provides DNP3 support. DNP3 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:

```
SEL-2523                                 Date: 04/30/2005      Time: 11:14:10:736
DEVICE
```

Table 7.4 lists the header item definitions.

Table 7.4 Command Response Header

Item	Definition
DID Setting (SEL-2523)	This is the DID (Device Identifier) setting. The device is shipped with the default settings `DID = SEL-2523`; 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-2523 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-2523, 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-2523 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-2523 to Access Level 1. See *Access Commands (ACCESS and 2ACCESS) on page 7.9* for more detail.

Access Level 1

When the SEL-2523 is in Access Level 1, the device sends the following prompt:

```
=>
```

See the *SEL-2523 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-2523 sends the prompt:

```
=>>
```

See the *SEL-2523 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-2523 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-2523 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
ACC	Moves from Access Level 0 to Access Level 1. Moves from Access Level 2 to Access Level 1.	0 2
2AC	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]                              Date: mm/dd/yyyy  Time: hh:mm:ss.sss
[TID Setting]                              Time Source: external
Level 1
=>
```

The SEL-2523 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]                              Date: mm/dd/yyyy  Time: hh:mm:ss.sss
[TID Setting]
Level 1
=>
```

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-2523.

BNAMES 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 BNA Command

Command	Description	Access Level

BNA	Displays names of all device status bits, as shown below:
	`=BNA <Enter>`
	`"*","*","*","*","*","PWRUP","STSET","07AD"`
		0

CAL 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

CASCII 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 CASCII 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 COMMUNICATIONS Command

Command	Description	Access Level
COM A	Return a summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel A.	1
COM B	Return a summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel B.	1
COM L A	Appends a long report to the summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel A.	1
COM L 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
COM C	Clears all communications records. If both MIRRORED BITS channels are enabled, omitting the channel specifier (A or B) clears both channels.	1
COM C A	Clears all communications records for Channel A.	1
COM C 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
CON BUTTONS	This command will allow you to remotely control the **ACK**, **RESET**, and **SIL** pushbuttons.	2
CON OUTPUTS	This command will allow you to override the functionality of the outputs and pulse for a defined period of time.	
CON REMOTE BITS	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-2523.

Table 7.11 CONTROL BUTTONS Command

Command	Description	Access Level
CON B RB_*x* P	Remotely actuate pushbuttons where *x* = 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 Command

Command	Description	Access Level
CON O *n m*	Remotely pulse outputs where *n* = 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 Command

Subcommand	Description	Access Level
CON RB*n m*	Control Remote Bits where *n* = 01–40 and *m* = 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 DAT 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-2523 and receive settings from the device, as shown in *Table 7.16*.

Table 7.16 FILE Command

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

ID	Return a list of device identification codes, as shown below:
	`=ID <Enter>`
	`"FID=SEL-2523-R100-V0-Z001001-D20071212," "0805"`
	`"BFID=SEL-2523-R100-V0-Z000000-D20070928," "091D"`
	`"CID=A476," "025F"`
	`"DEVID=SEL-2523," "03F6"`
	`"DEVCODE=70," "030E"`
	`"PARTNO=252301H13A0AXXX," "0614"`
	`"CONFIG=00000000," "03E3"`
		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
IRI	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-2523                              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
L_D	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 LOOPBACK Command

Command	Description	Access Level
LOO	Enable loopback testing of MIRRORED BITS channels.	2
LOO A	Enable loopback on MIRRORED BITS Channel A for the next five minutes.	2
LOO 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 **SHO DNP** command. However, unlike the **SHO 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
MAP *port*	Show the serial DNP3 settings for port *port* (similar to **SHO DNP**).	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
PAS *level*[a]	Set a password for *new password* for Access Level *level*.	2

[a] 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.

➤ #0t3579!
➤ $A24.68&
➤ (Ih2dcs)
➤ *4u-Iwg+

Table 7.24 Valid Password Characters

Alpha	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
Numeric	0 1 2 3 4 5 6 7 8 9
Special	! " # $ % & ' ( ) * + , - . / : ; < = > ? @ [\ ] ^ _ ` { | } ~

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 Card 1 rear plate and remove the processor card.
➤ Disable the password function by locating Jumper JMP1 on the Card 2 (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 Card 1 rear plate and card, 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

PUL ***n***	Pulse output contact *n* for 1 second, as shown below:
	`=>PUL OUT01 <Enter>`
	`PULSE OUTPUT`
	`Are you sure (Y,N)? Y <Enter>`
	`=>>`
		2

QUIT Command

Use the **QUI** 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
QUI	Go to Access Level 0.	0

Access Level 0 is the lowest access level; the SEL-2523 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
SER	Use the **SER** command to display a chronological progression of all available SER rows (up to 1012 rows); row 1 is the most recent triggered row and row 1012 is the oldest.	1
SER ***row 1*** **SER** ***row 1 row 2*** **SER** ***date 1*** **SER** ***date 1 date 2***	Use the **SER** command with parameters (*row* or *date*) to display a chronological or reverse chronological subset of the SER rows, see below.	1
SER C	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 (Sheet 1 of 2)

Parameter	Description
row1	Append *row 1* to return a chronological progression of the first *row 1* rows, e.g., use **SER 5** to return the first five rows.
row1 row2	Append *row 1* and *row 2* to return all rows between *row 1* and *row 2*, beginning with *row 1* and ending with *row 2*. 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 **SER 1 10** to return the first 10 rows in numeric order or **SER 10 1** to return these same items in reverse numeric order.

Table 7.28 SER Command Format (Sheet 2 of 2)

Parameter	Description
date1	Append *date 1* to return all rows with this date, e.g., use **SER 1/1/2005** to return all records for January 1, 2005.
date1 date2	Append *date 1* and *date 2* to return all rows between *date 1* and *date 2* beginning with *date 1* and ending with *date 2*. 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 **SER 1/5/2005 1/7/2005** 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
SET ***s***	Set Device settings.	2
SET L ***s***	Set Logic settings.	2
SET G ***s***	Set Global settings.	2
SET POR ***n s***	Set serial port settings, depending on the device configuration, *n* specifies either PORT F or PORT 2 through PORT 4; defaults to the active port if not listed.	2
SET R ***s***	Set SER report settings.	2
SET DN ***s***	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

Press Key	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.

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 using the **SHO** command, 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 SHOW Command

Command	Description	Access Level
SHO ***s***	Show Device settings.	1
SHO L ***s***	Show Logic settings.	1
SHO G ***s***	Show Global settings.	1
SHO POR ***n s***	Show serial port settings. *n* specifies either PORT F or PORT 2 through PORT 4; defaults to the active port if not listed.	1
SHO R ***s***	Show report settings Sequential Events Recorder (SER) and Alias settings.	1
SHO DNP ***s***	Show DNP3 settings.	1

Append *s* and the specific settings name you want to view in the **SHO** 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
SNS	The **SNS** command displays the SER trigger elements (entered with the **SET R SER*n*** (*n* = 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”, “TEST”, “ALIN_A1”, “ALIN_A2”, “ALIN_A3”, “ALIN_A4”,
“ALIN_A5”, “108D”
“ALIN_A6”, “ALIN_B1”, “ALIN_B3”, “ALIN_B4”,”ALIN_B5”,”ALIN_B6”, “ALIN_C1”, “1344”
“ALIN_C2”, “ALIN_C3”, “ALIN_C4”, “ALIN_C5”, “ALIN_C6”, “ALIN_D1”, “ALIN_D2”,
“ALIN_D3”, “134D”,“ALIN_D4”, “ALIN_D5”, “ALIN_D6”, “ALIN_E1”, “ALIN_E2”, “ALIN_E3”,
“ALIN_E4”, “ALIN_E5”, “135B”, “ALIN_E6”, “ALIN_F1”, “ALIN_F2”, “ALIN_F3”, “ALIN_F4”,
“ALIN_F5”, “ALIN_F6”, “AP_A1”, “12CB”
“AP_A2”, “AP_A3”, “AP_A4”, “AP_A5”, “AP_A6”, “AP_B1”, “AP_B1”, “AP_B2”, “AP_B3”,
“AP_B4”, “AP_B5”, “AP_B6”, “AP_C1”, “AP_C2”, “AP_C3”, “AP_C4”, “AP_C5”, “0EB3”
“AP_C6”, “AP_D2”, “AP_D3”, “AP_D4”, “AP_D5”, “AP_D6”, “AP_E1”, “0EBC”
“AP_E2”, “AP_E3”, “AP_E4”, “AP_E5”, “AP_E6”, “AP_F1”, “AP_F2”, “AP_F3”, “0EC5”
“AP_F4”, “AP_F5”, “AP_F6”, 0591
```

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
STA *n*	Displays the device self-test information *n* times (*n* = 1–32767). Defaults to 1 if *n* is not specified.	1
STA S	Displays the memory and execution utilization for the SELOGIC® control equations.	1
STA R	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-2523                                   Date: 04/19/2008 Time: 14:50:17
DEVICE

Serial Num = 2008036022
FID = SEL-2523-R100-V0-Z001001-D20071212 CID = A476
PART NUM = 252301H13A0AXXX

SELF TESTS (W=Warn)
  FPGA  GPSB  HMI   RAM   ROM CR_RAM  NON_VOL  CLOCK  +3.3V  +5.0V  +2.5V
  OK    OK    OK    OK    OK    OK      OK       OK   3.28   4.95   2.46

  +3.75V  -1.25V BATT
  3.77    -1.24  3.07

I/O Cards
  CARD_2  CARD_3  CARD_4  CARD_5 CARD_6  CARD_7  CARD_8
  OK      OK      OK      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-2523 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 STATUS 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
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

Table 7.34 STATUS Command Definitions (Sheet 2 of 2)

STATUS Report Designator	Definition	Message Format
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_2	Integrity of Card 2	OK/FAIL
CARD_3	Integrity of Card 3	OK/FAIL
CARD_4	Integrity of Card 4	OK/FAIL
CARD_5	Integrity of Card 5	OK/FAIL
CARD_6	Integrity of Card 6	OK/FAIL
CARD_7	Integrity of Card 7	OK/FAIL
CARD_8	Integrity of Card 8	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 TARGET Command

Command	Description	Access Level
TAR	Use TARGET without parameters to display Device Word row 0, or the most recently viewed target row.	1
TAR *n k*	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 *Appendix G: Relay Word Bits* for the Device Word bit table.	1
TAR R	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: Relay Word Bits*. Device Word bits are used in SELOGIC control equations.

TIME Command (View/Change Time)

The **TIM** command returns information about the SEL-2523 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 TIME Command

Command	Description	Access Level
TIM	Display the present internal clock time.	1

Table 7.36 TIME Command

Command	Description	Access Level
TIM *hh:mm*	Set the internal clock to *hh:mm*.	2
TIM *hh:mm:ss*	Set the internal clock to *hh:mm:ss*.	2

Use the **TIM *hh:mm*** and **TIM *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 relay updates, saves the time in nonvolatile memory, and displays the time entered. If you enter an invalid time, the SEL-2523 responds with `Invalid Time`.

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Section 8
Front-Panel Operations and Custom Labeling

Overview

The SEL-2523 front panel makes alarm status and acknowledgment 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 relay 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

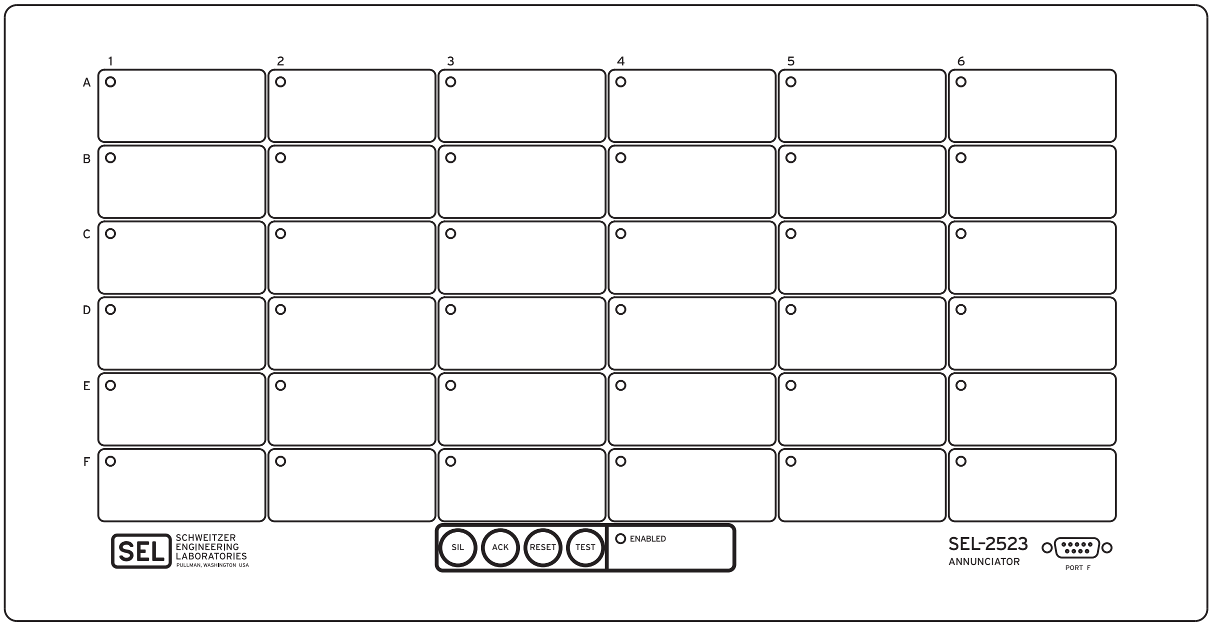


Figure 8.1 Front-Panel Overview

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-2523 Product Literature CD and on the SEL website at selinc.com.

Alarm Point LEDs and Test Pushbuttons

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-2523 provides quick confirmation of device conditions via alarm point LEDs. All of the 36 front-panel alarm point LEDs are driven from alarm sequences. See *Section 5: Annunciator Sequences* for information on alarm sequences and setting alarm points.

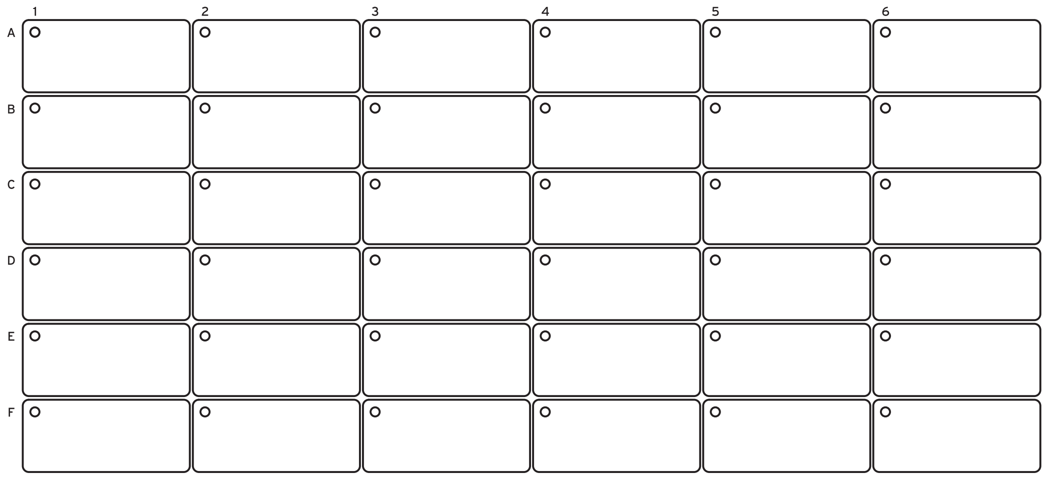


Figure 8.2 SEL-2523 Front-Panel LEDs

The front-panel alarm point LEDs have a matrix labeled on each window that ranges from A1 to F6. 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 36 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-2523 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-2523 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.

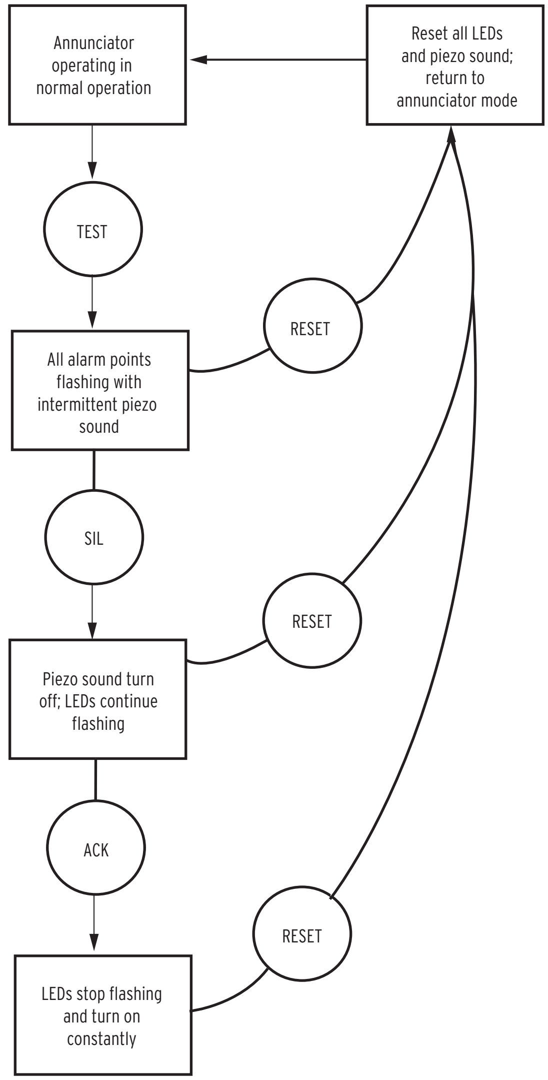


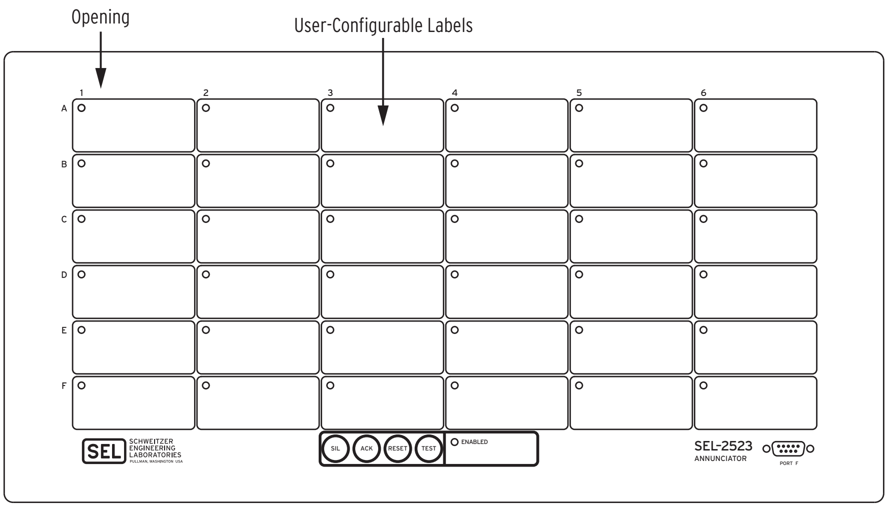
Figure 8.3 TEST Pushbutton Flow Chart

Alarm Window Labels

The SEL-2523 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-2523. 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 9260040. Contact your Technical Service Center or the SEL factory to obtain these kits.



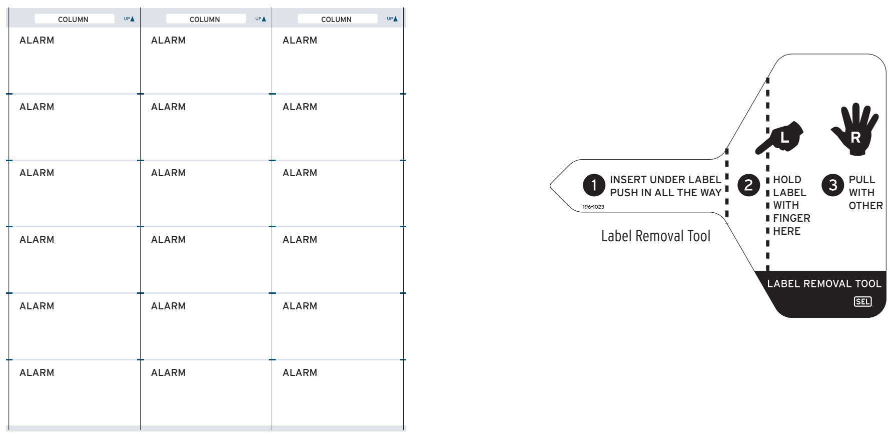


Figure 8.4 Blank Slide-In Label Set and Label Removal Tool

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. 9260040)

Content Descriptions	Quantity	Part Number
Blank Customer Label Templates on perforated paper for laser printing	Five sets— three labels for each set	196-1061
Label Removal Tool	One	196-1023
SEL-2523 Product Literature CD-ROM	One	PM2523-01-CD

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). In addition, the label template files are included on the SEL-2523 relay 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.

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.

NOTE: You can adjust the font size to accommodate more text within the cell.

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.

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 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-2523 Annunciator Panel provides the following tool to analyze the cause of device operations:

Sequential Events Recorder Report

- ➤ Resolution: 0.1 ms
- ➤ Accuracy: ±1 ms

Sequential Events Recorder (SER)

The SEL-2523 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 up to 1024 state changes of up to 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-2523 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-2523                               DATE: 4/19/2008         TIME: 17:11:21
DEVICE

Serial No = 2007032022
FID = SEL-2523-R100-V0-Z001001-D20080418  CID = A476

#     DATE          TIME          ELEMENT          STATE
17  12/19/2007  14:44:16.3927    AP_C4              Deasserted
16  12/19/2007  14:44:16.3927    AP_C3              Deasserted
15  12/19/2007  14:44:16.3927    AP_C2              Deasserted
14  12/19/2007  14:44:16.3927    AP_B6              Deasserted
13  12/19/2007  14:44:16.3927    AP_B5              Deasserted
12  12/19/2007  14:44:16.3927    AP_B4              Deasserted
11  12/19/2007  14:44:16.3927    AP_B2              Deasserted
10  12/19/2007  14:44:16.3389    ACKNOWLEDGE               OFF
9   12/19/2007  14:44:20.1724    RESET                      ON
8   12/19/2007  14:44:20.1724    AP_F6              Deasserted
7   12/19/2007  14:44:20.1724    AP_F5              Deasserted
6   12/19/2007  14:44:20.1724    AP_F4              Deasserted
5   12/19/2007  14:44:20.2861    RESET                     OFF
4   12/19/2007  15:28:15.0902    ALIN_A2              Asserted
3   12/19/2007  15:28:15.0902    AP_A2                Asserted
2   12/19/2007  15:28:26.7949    ACKNOWLEDGE                ON
1   12/19/2007  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 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

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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-2523 Annunciator Panel. Because the SEL-2523 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 Event Recorder Report)

Command	Description	Access Level
SER	Use the **SER** command to display a chronological progression of all available SER rows (up to 1024 rows); row 1 is the most recent triggered row and row 1024 is the oldest.	1
SER ***row 1*** **SER** ***row 1 row 2*** **SER** ***date 1*** **SER** ***date 1 date 2***	Use the **SER** parameters (row or date) to display a chronological or reverse chronological subset of the SER rows (see *Table 7.27*).	1
SER C	Use this command to clear/reset the SER records.	1
SER D	Use this command to see elements that are presently removed from the SER records due to chattering.	1

TARGET Command

Use the **TAR** 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 **TAR** command is available at the serial ports and the front panel.

Table 10.2 TARGET Command Definitions

Command	Description	Access Level
TAR	Use TARGET without parameters to display Device Word row 0, or the most recently viewed target row.	1
TAR *n k*	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 *Appendix G: Relay Word Bits* for the Device Word bit table.	1
TAR R	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: Relay Word Bits*.

Periodic Tests (Routine Maintenance)

Because the SEL-2523 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-2523 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 21–26 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-2523 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	+3.3V WARN (#.##W)
+3.3 V Fail	Monitor +3.3 V power supply	3.07–3.53 V	Yes	Latched	+3.3V FAIL (#.##F)
+5 V Warn	Monitor +5 V power supply	4.75–5.25 V	No	Pulse, 5 sec	+5.0V 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	+5V FAIL (#.##F)
+2.5 V Warn	Monitor +2.5 V power supply	2.40–2.6 V	No	Pulse, 5 sec	+2.5V WARN (#.##W)
+2.5 V Fail	Monitor +2.5 V power supply	2.32–2.68 V	Yes	Latched	+2.5V FAIL (#.##F)
+3.75 V Warn	Monitor +3.75 V power supply	3.6–3.9 V	No	Pulse, 5 sec	+3.75V WARN (#.##W)
+3.75 V Fail	Monitor +3.75 V power supply	3.48–4.02 V	Yes	Latched	+3.75V FAIL (#.##F)
–1.25 V Warn	Monitor –1.25 V power supply	–1.2 to –1.30 V	No	Pulse, 5 sec	-1.25V WARN (#.##W)
–1.25 V Fail	Monitor –1.25 V power supply	–1.16 to –1.34 V	Yes	Latched	-1.25V 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 April 18, 2008:

FID=SEL-2523-R100-V0-Z001001-D20080418

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 R300 Series Firmware Revision History

Firmware Identification (FID) Number	Summary of Revisions	Manual Date Code
SEL-2523-R300-V0-Z004002-D20221007	➤ 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 (PORT 2). Previous versions cannot be upgraded to R300-V0. ➤ Modified the setting range for IRIG time source (TIME_SRC). ➤ Resolved an issue where Modbus communications may not work properly when enabled on PORT 2 and PORT 4 simultaneously. ➤ 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.	20221007

Table A.2 R200 Series Firmware Revision History (Sheet 1 of 2)

Firmware Identification (FID) Number	Summary of Revisions	Manual Date Code
SEL-2523-R202-V0-Z003002-D20170224	➤ Added support for ISA Alarm Sequence M-1. **Note**: Upgrading to firmware version R202 from R200 will result in loss of device settings. If you plan to upgrade from R200, save device settings through use of ACSELERATOR QuickSet SEL-5030 Software before beginning the firmware upgrade process.	20170224
SEL-2523-R201-V0-Z002001-D20150630	➤ Added support for ISA Alarm Sequence R-1.	20150630

Table A.2 R200 Series Firmware Revision History (Sheet 2 of 2)

Firmware Identification (FID) Number	Summary of Revisions	Manual Date Code
SEL-2523-R200-V0-Z001001-D20100629	➤ No functional changes. Revised firmware for processor update. Previous versions cannot be upgraded to R200.	20100629
SEL-2523-R100-V0-Z001001-D20080418	➤ Initial version.	20080418

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 revision is listed at the top.

Table A.3 Instruction Manual Revision History (Sheet 1 of 2)

Date Code	Summary of Revisions
20221007	Section 1 ➤ Updated *Features*. ➤ Updated *Models, Options, and Accessories*. ➤ Updated *Figure 1.1: SEL-2523 Annunciator Panel* and *Figure 1.2: Inputs, Outputs, and Communications Ports*. ➤ Updated *Communications*. ➤ Updated *Establishing Communication*. ➤ Updated *Specifications*. Section 2 ➤ Updated *Table 2.1: Communications Ports*. ➤ Updated *Communications Card (SELect EIA-232/EIA-485)*. ➤ Updated *Figure 2.5: SEL-2523 Configured With the Optional EIA-232/EIA-485 Card and Optional Serial Fiber-Optic Port*. ➤ Updated *IRIG-B Time-Code Input*. ➤ Added *Fiber-Optic Serial Port*. ➤ Added *Cables*. ➤ Updated *Figure 2.6: SEL-2523 Connection Diagram for External Devices*. Section 6 ➤ Updated *Time-Synchronization Source*. ➤ Updated *Port Settings (SET P Command)*. ➤ Updated *Table 6.12: Rear-Panel Fiber-Optic Serial Port Settings*. Section 7 ➤ Updated *Communications Ports*. ➤ Updated *IRIG-B*. Appendix A ➤ Updated for firmware version R300.
20220520	Section 2 ➤ Updated *Power Connections*.
20210923	Section 1 ➤ Added Canada ICES-001 (A) / NMB-001 (A) to *EMC Emissions* in *Specifications*.
20210702	Section 1 ➤ Updated *Dielectric Strength and Impulse Tests* in *Specifications*.

Table A.3 Instruction Manual Revision History (Sheet 2 of 2)

Date Code	Summary of Revisions
20170526	**Section 1** ➤ Updated *Compliance* in *Specifications*.
20170224	**Section 5** ➤ Added a note that selecting M-1 adds silence to the M sequence. **Appendix A** ➤ Updated for firmware version R202.
20150630	**Section 5** ➤ Added *Figure 5.4: Sequence R-1 State Diagram.* ➤ Added *Table 5.4: Sequence R-1 Table*. **Appendix A** ➤ Updated for firmware version R201.
20150123	**Preface** ➤ Updated *Safety Information*. **Section 1** ➤ Updated *Compliance* section of *Specifications*.
20140603	**Section 7** ➤ Updated *Figure 7.2: Connection When Installation Includes Other SEL Devices*.
20130423	**Section 1** ➤ Updated *Type Tests* in *Specifications*.
20120203	**Section 7** ➤ Added **CAL** command description and password.
20110622	**Section 1** ➤ Updated for 24 V Power Supply UL certification. **Section 2** ➤ Updated *Figure 2.2: Pins for Password Jumper and SELboot Jumper*.
20100902	**Section 1** ➤ Updated photograph in *Figure 1.1: SEL-2523 Annunciator Panel*. ➤ Updated *Compliance* section of *Specifications*.
20100629	Updated all sections with DNP3 Level 2 Slave to DNP3 Level 2 Outstation. **Section 1** ➤ Added specifications for new 24Vdc power supply option. ➤ Added specifications for output contacts when used with AC. ➤ Added UL listing. **Section 5** ➤ Fixed *Figure 5.7: Default Logic Routing* with correct input names. **Section 7** ➤ Removed support for SEL Fast Message Unsolicited Write. **Appendix A** ➤ Updated new R200 firmware release. **Appendix E** ➤ Corrected function code and conversion in the Modbus register map.
20080418	Initial version.

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Appendix B
Firmware Upgrade Instructions

Overview

SEL will offer firmware upgrades to improve the performance of your device. Because the SEL-2523 Annunciator Panel 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 cable SEL-C234A or equivalent, or a null-modem cable)
- ➤ Disk containing the firmware file (e.g., r1012523.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., r1012523.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.

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Appendix C
SEL Communications Processors

SEL Communications Protocols

The SEL-2523 Annunciator Panel 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-2523 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
CASCII	Configuration data of all Compressed ASCII commands available at Access Level 1 or higher	0
CSTATUS	Relay status	1
ID	Relay identification	0
SNS	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-2523 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-2523 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*.

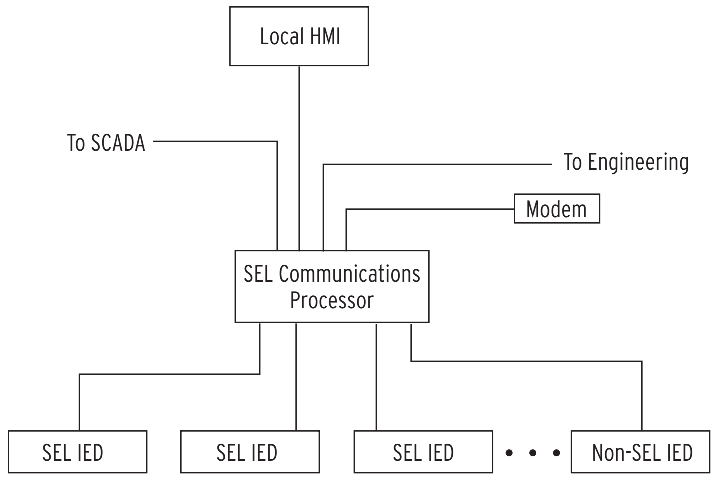

Figure C.1 SEL Communications Processor Star Integration Network

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 multitiered solution as shown in *Figure C.2*. In this multitiered 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.

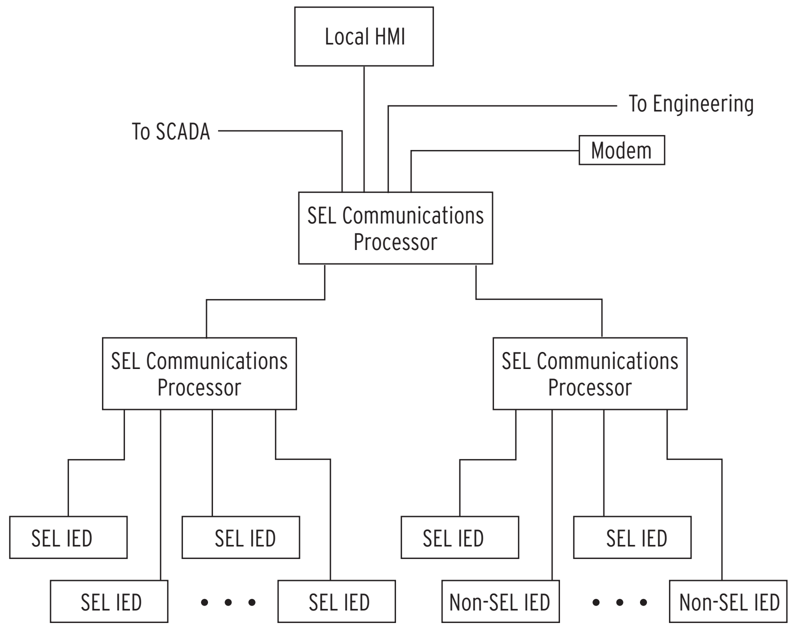

Figure C.2 Multitiered SEL Communications Processor Architecture

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
DNP3 Level 2 Outstation	DNP3 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-2523 and an SEL communications processor. In this architecture, the SEL communications processor collects data from the SEL-2523 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

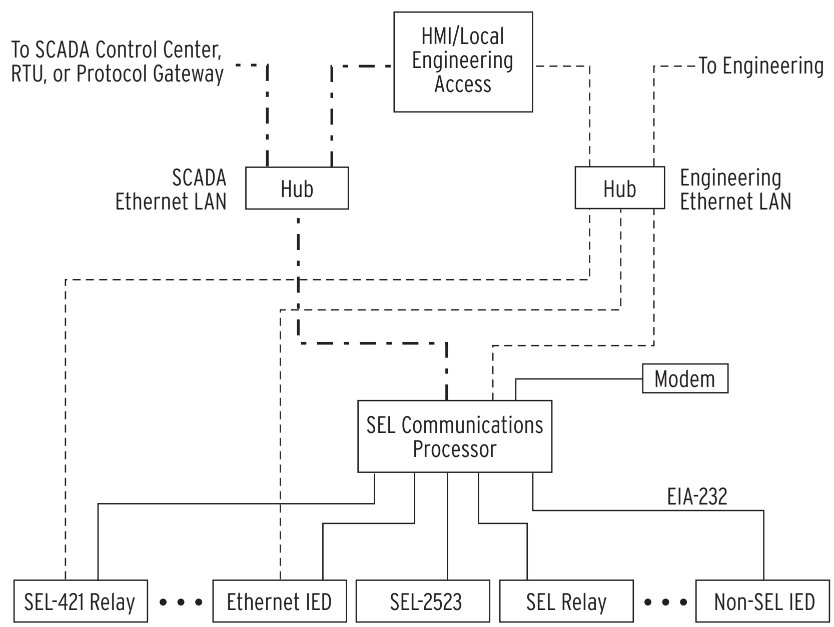

Figure C.3 Enhancing Multidrop Networks With SEL Communications Processors

SEL Communications Processor Example

This example demonstrates the data and control points available in the SEL communications processor when you connect an SEL-2523. The physical configuration used in this example is shown in *Figure C.4*.

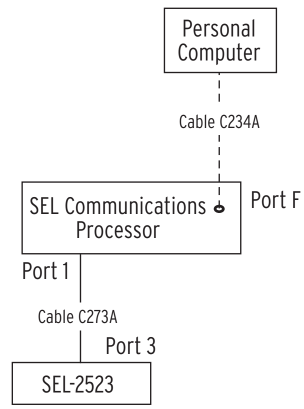

Figure C.4 Example of SEL Device and SEL Communications Processor

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
PORTID	*Device 1*	Name of connected device[a]
BAUD	19200	Channel speed of 19200 bits per second[a]
DATABIT	8	Eight data bits[a]
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

[a] Automatically collected by the SEL communications processor during autoconfiguration.

Data Collection

The SEL communications processor is configured to collect data from the SEL-2523, 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-2523.

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-2523. 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-2523 (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-2523 (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	Relay 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-2523. You must enable Fast Operate messages by using the FASTOP setting in the SEL-2523 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 **PORT 1** in the SEL communications processor, it automatically sets RB01 in the SEL-2523.

The four breaker bits supported by the SEL-2523 are RB_SIL, RB_ACK, RB_RST, and RB_CON1.

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Appendix D
DNP3 Communications

Overview

The SEL-2523 Annunciator Panel 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-2523
- ➤ DNP3 Documentation, Object Tables, and Data Maps

Introduction to DNP3

A supervisory Control and Data Acquisition (SCADA) manufacturer developed the first versions of DNP3 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, 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

Level	Description	Equipment Types
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 trade-offs, 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-2523.

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, DNP3 includes a collision avoidance feature. Before sending a message, a DNP3 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-2523

The SEL-2523 is a DNP3 Level 2 remote (outstation) device.

Data Access

Table D.4 lists DNP3 data access methods along with corresponding SEL-2523 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-2523 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-2523, 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-2523 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-2523 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-2523 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-2523 pauses UTIMEO1 seconds and then transmits the unsolicited data again. *Figure D.1* provides an example with URETRY1 = 2.

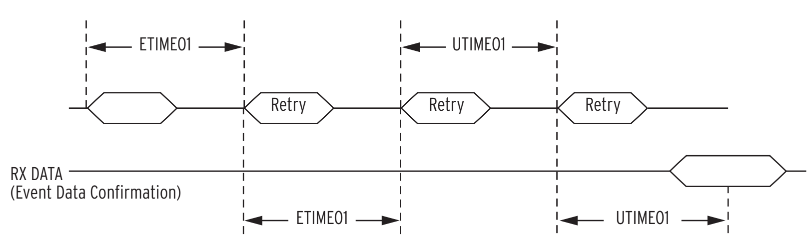

Figure D.1 Application Confirmation Timing with URETRYn = 2

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-2523 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-2523 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-2523 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*).

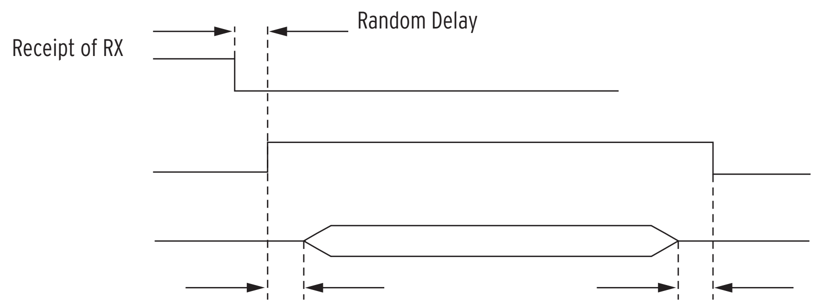

Figure D.2 Message Transmission Timing

Transmission Control

If you use a media transceiver (for example, EIA-232 to EIA-485) or a radio system for your DNP3 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

DNP3 event data objects contain change-of-state and time-stamp information that the SEL-2523 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 DNP3 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 DNP3 map is scanned approximately once per second to generate events. You can configure the SEL-2523 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 DNP3 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-2523.

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-2523 uses the NUMEVE*n* and AGEEVE*n* 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*n*. The device also sends an unsolicited report if the age of the oldest event in the master n buffer exceeds AGEEVE*n*. The SEL-2523 has the buffer capacities listed in *Table D.5*.

Table D.5 SEL-2523 Event Buffer Capacity

Type	Maximum Number of Events
Binary	1024

Binary Controls

The SEL-2523 provides more than one way to control individual points. The SEL-2523 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-2523.

A DNP3 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 DNP3 message to specify operation of the points shown in *Control Point Operation on page D.18*.

Time Synchronization

The accuracy of DNP3 time synchronization is insufficient for most protection and oscillography needs. DNP3 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*n* setting and then use Object 50, Variation 1, and Object 52, Variation 2, to set the time via the Session *n* DNP3 master.

By default, the SEL-2523 accepts and ignores time set requests (TIMERQ1=I). (This mode allows the SEL-2523 to use a high accuracy, IRIG time source, but still interoperate with DNP3 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-2523 DNP3 implementation includes modem support for serial ports. Your DNP3 master can dial-in to the SEL-2523 and establish a DNP3 connection. The SEL-2523 can automatically dial out and deliver unsolicited DNP3 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 DNP3 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-2523 to other devices.

You can either connect the modem to a computer and configure it before connecting it to the SEL-2523, 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-2523 to call. The SEL-2523 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-2523 tries to dial PH_NUM1 before dialing PH_NUM2. Similarly, the RETRY2 setting is the number of attempts the SEL-2523 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 DNP3 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

DNP3 Settings

The DNP3 port configuration settings available on the SEL-2523 are shown in *Table D.6*. You can enable DNP3 on serial **PORT 2** through **PORT 4**, up to a maximum of three concurrent DNP3 sessions. Each session defines the characteristics of the connected DNP3.

Table D.6 Port DNP3 Protocol Settings (Sheet 1 of 2)

Name	Description	Range	Default
DNPADR	Device DNP3 address	0–65534	0
REPADR1	DNP3 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
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[a]	Number of events to transmit on	1–200	10
AGEEVE1[a]	Oldest event to transmit on, seconds	0.0–99999.0	2.0
URETRY1[a]	Unsolicited messages maximum retry attempts	2–10	3
UTIMEO1[a]	Unsolicited messages offline timeout, seconds	1–5000	60

Table D.6 Port DNP3 Protocol Settings (Sheet 2 of 2)

Name	Description	Range	Default
Serial Port Settings			
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

[a] Hidden if UNSOLn set to N.

The modem settings in *Table D.7* are available on any DNP3 serial port sessions.

Table D.7 Serial Port DNP3 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	"E0X0 &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-2523 implementation is the ability to remap DNP3. Remapping is the process of selecting data from the reference map and organizing it into a data subset optimized for your application. The SEL-2523 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 DNP3 maps with up to three unique DNP3 masters. The map is initially populated with default data points, as described in *Default Data Map on page D.15*. You may remap the points in a default map to create a custom map with up to:

- ➤ 200 Binary Inputs
- ➤ 63 Binary Outputs

You can use the **SHO DNP** command to view the DNP3 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_A3
...
BI_173 := SIL
BI_174 := ACK
BI_175 := RESET
...
Binary Output Map
BO_00 := RB01
BO_01 := RB02
BO_02 := RB03
...
BO_29 := RB30
BO_30 := RB31
BO_31 := RB32
...
=>>
```

Figure D.3 Sample Response to SHO DNP Command

You can also use the **MAP *y* <Enter>** command to display DNP3 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-2523 Date: 1/16/2008 Time: 10:36:46
DEVICE

Map                          1
Device DNP Address           15
Master DNP Address           0

Binary Inputs
--------------------------------------------------------------------------------
  INDEX  POINT LABEL  EVENT CLASS  SER TIMESTAMP
  0      ENABLED       1           Yes
  1      AP_A1         1           Yes
  2      AP_A2         1           Yes
  3      AP_A3         1           Yes
…
  173    SIL           1           Yes
  174    ACK           1           Yes
  175    RESET         1           Yes

Binary Outputs
--------------------------------------------------------------------------------
  INDEX  POINT LABEL
  0      RB01
  1      RB02
  2      RB03
...
  29     RB30
  30     RB31
  31     RB32

=>>
```

Figure D.4 Port MAP Command

You can use the command **SET DNP** to edit or create a custom DNP3 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 DNP3 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 the ACSELERATOR QuickSet software 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 SEL-5030 Software to enter the BO map settings as shown in the screen capture in *Figure D.6*.

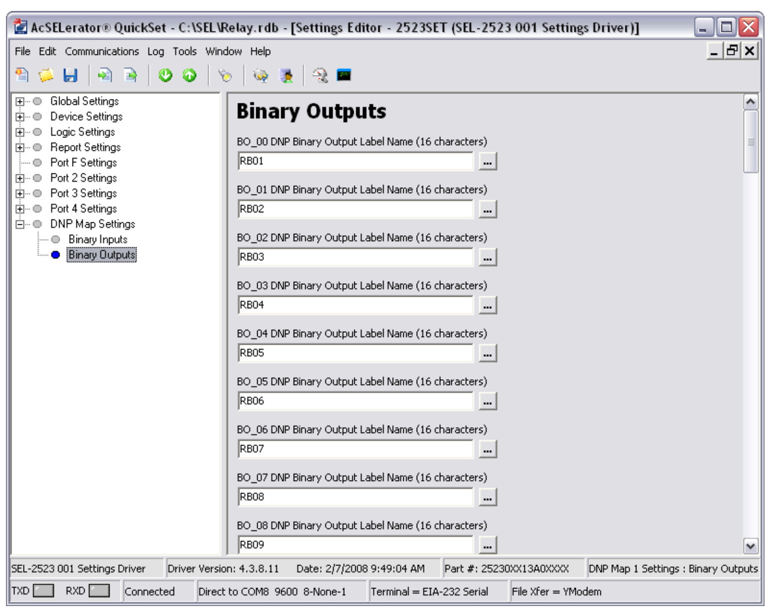

Figure D.6 Binary Output Map Entry in ACSELERATOR QuickSet Software

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 DNP3 device profile information. Rather than check boxes in the example Device Profile in the DNP3 Subset Definitions, only the relevant selections are shown.

Table D.8 SEL-2523 DNP3 Device Profile

Parameter	Value
Vendor name	Schweitzer Engineering Laboratories
Device name	SEL-2523
Highest DNP3 request level	Level 2
Highest DNP3 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-2523 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-2523. The list of supported objects conforms to the format laid out in the DNP3 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-2523 DNP3 Object List (Sheet 1 of 2)

Obj.	Var.	Description	Request[a]		Response[b]	
			Funct. Codes[c]	Qual. Codes[d]	Funct. Codes[c]	Qual. Codes[d]
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[e]	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[e]	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[e]	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-2523 DNP3 Object List (Sheet 2 of 2)

Obj.	Var.	Description	Request[a]		Response[b]	
			Funct. Codes[c]	Qual. Codes[d]	Funct. Codes[c]	Qual. Codes[d]
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		

[a] Supported in requests from master
[b] May generate in response to master
[c] Decimal
[d] Hexadecimal
[e] Default variation

Reference Data Map

Table D.10 shows the SEL-2523 reference data map. The reference map shows the data available to a DNP3 master. You can use the default map or the custom DNP3 mapping functions of the SEL-2523 to retrieve only the points required by your application.

NOTE: Although not shown as part of the reference maps you may use any Relay Word bit label when creating custom maps.

Table D.10 DNP3 Reference Data Map

Object	Labels	Description
Binary Inputs		
01, 02	STFAIL	Device Diagnostic Failure
	STWARN	Device Diagnostic Warning
	Enabled	Device Enabled
	SALARM–SLOW_F6	Relay Word Elements (see *Table G.1*)
	STSET	Settings Changed
Binary Outputs		
10, 12	RB*xx*	Remote Bits (*xx* = 01–40)
	RB_SIL	Silence Button
	RB_ACK	Acknowledge Pushbutton
	RB_RST	Reset Pushbutton
	RB_CON1	Auxiliary Control Bit

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-2523 part number. *Table D.11* shows the SEL-2523 default data map. If the default maps are not appropriate, you can also use the custom DNP3 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 3)

Object	Default Index	Point Label
01, 02	0	ENABLED
	1	AP_A1
	2	AP_A2
	3	AP_A3
	4	AP_A4

Table D.11 DNP3 Default Data Map (Sheet 2 of 3)

Object	Default Index	Point Label
	5	AP_A5
	6	AP_A6
	7	AP_B1
	8	AP_B2
	9	AP_B3
	10	AP_B4
	11	AP_B5
	12	AP_B6
	13	AP_C1
	14	AP_C2
	15	AP_C3
	16	AP_C4
	17	AP_C5
	18	AP_C6
	19	AP_D1
	20	AP_D2
	21	AP_D3
	22	AP_D4
	23	AP_D5
	24	AP_D6
	25	AP_E1
	26	AP_E2
	27	AP_E3
	28	AP_E4
	29	AP_E5
	30	AP_E6
	31	AP_F1
	32	AP_F2
	33	AP_F3
	34	AP_F4
	35	AP_F5
	36	AP_F6
	37	ALIN_A1
	38	ALIN_A2
	39	ALIN_A3
	40	ALIN_A4
	41	ALIN_A5
	42	ALIN_A6
	43	ALIN_B1
	44	ALIN_B2
	45	ALIN_B3

Table D.11 DNP3 Default Data Map (Sheet 3 of 3)

Object	Default Index	Point Label
	46	ALIN_B4
	47	ALIN_B5
	48	ALIN_B6
	49	ALIN_C1
	50	ALIN_C2
	51	ALIN_C3
	52	ALIN_C4
	53	ALIN_C5
	54	ALIN_C6
	55	ALIN_D1
	56	ALIN_D2
	57	ALIN_D3
	58	ALIN_D4
	59	ALIN_D5
	60	ALIN_D6
	61	ALIN_E1
	62	ALIN_E2
	63	ALIN_E3
	64	ALIN_E4
	65	ALIN_E5
	66	ALIN_E6
	67	ALIN_F1
	68	ALIN_F2
	69	ALIN_F3
	70	ALIN_F4
	71	ALIN_F5
	72	ALIN_F6
	73	SIL
	74	ACK
	75	RESET
	76	PB_SIL
	77	PB_ACK
	78	PB_RST
	79	RB_SIL
	80	RB_ACK
	81	RB_RST
10, 12	0–39	RB01–RB40 Remote Bits
	40	RB_SIL Remote Silence Pushbutton
	41	RB_ACK Remote Acknowledge Pushbutton
	42	RB_RST Remote Reset Pushbutton

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-2523 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-2523 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-2523.

Complete specifications for the Modbus protocol are available from the Modbus website at 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-2523 Modbus communication allows a Modbus master to do the following:

- ➤ Acquire metering and monitoring from the device
- ➤ Control SEL-2523 output contacts and acknowledge alarms
- ➤ Read the SEL-2523 self-test status (Note: RTS/CTS flow control will not work on **PORT 2** when the protocol is set to MODBUS.)

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-2523 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-2523 supports the Modbus function codes shown in *Table E.2*.

Table E.2 SEL-2523 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[a]	Force Single Coil	Control the status of the digital outputs and remote bits
06h[a]	Preset Single Register	Write data directly to a single register in the Modbus map
08h	Diagnostic Command	Test the Modbus communications channel
10h[a]	Preset Multiple Register	Preset Multiple Register

[a] The SEL-2523 supports the Broadcast function on these functions.

Modbus Exception Responses

The SEL-2523 sends an exception code under the conditions described in *Table E.3*.

Table E.3 SEL-2523 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-2523 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-2523 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-2523, 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-2523 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-2523 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 (*n*)
n bytes	Data
2 bytes	CRC-16

To build the response, the SEL-2523 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 zeros 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-2523 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	

Table E.5 01h SEL-2523 Outputs (Sheet 2 of 4)

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description	Note
3	3	01h	OUT04	
4	4	01h	OUT05	
5	5	01h	OUT06	
6	6	01h	OUT07	
7	7	01h	OUT08	
8	8	01h	OUT09	
9	9	01h	OUT10	
10	A	01h	OUT11	
11	B	01h	Pulse RB_SIL	1 SELOGIC Processing Interval
12	C	01h	Pulse RB_ACK	1 SELOGIC Processing Interval
13	D	01h	Pulse RB_RST	1 SELOGIC Processing Interval
14	E	01h	Pulse RB_CON1	1 SELOGIC Processing Interval
15	F	01h	RB01	
16	10	01h	RB02	
17	11	01h	RB03	
18	12	01h	RB04	
19	13	01h	RB05	
20	14	01h	RB06	
21	15	01h	RB07	
22	16	01h	RB08	
23	17	01h	RB09	
24	18	01h	RB10	
25	19	01h	RB11	
26	1A	01h	RB12	
27	1B	01h	RB13	
28	1C	01h	RB14	
29	1D	01h	RB15	
30	1E	01h	RB16	
31	1F	01h	RB17	
32	20	01h	RB18	
33	21	01h	RB19	
34	22	01h	RB20	
35	23	01h	RB21	
36	24	01h	RB22	
37	25	01h	RB23	
38	26	01h	RB24	
39	27	01h	RB25	
40	28	01h	RB26	
41	29	01h	RB27	
42	2A	01h	RB28	

Table E.5 01h SEL-2523 Outputs (Sheet 3 of 4)

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description	Note
43	2B	01h	RB29	
44	2C	01h	RB30	
45	2D	01h	RB31	
46	2E	01h	RB32	
47	2F	01h	RB33	
48	30	01h	RB34	
49	31	01h	RB35	
50	32	01h	RB36	
51	33	01h	RB37	
52	34	01h	RB38	
53	35	01h	RB39	
54	36	01h	RB40	
55	37	01h	Pulse RB01	1 SELOGIC Processing Interval
56	38	01h	Pulse RB02	1 SELOGIC Processing Interval
57	39	01h	Pulse RB03	1 SELOGIC Processing Interval
58	3A	01h	Pulse RB04	1 SELOGIC Processing Interval
59	3B	01h	Pulse RB05	1 SELOGIC Processing Interval
60	3C	01h	Pulse RB06	1 SELOGIC Processing Interval
61	3D	01h	Pulse RB07	1 SELOGIC Processing Interval
62	3E	01h	Pulse RB08	1 SELOGIC Processing Interval
63	3F	01h	Pulse RB09	1 SELOGIC Processing Interval
64	40	01h	Pulse RB10	1 SELOGIC Processing Interval
65	41	01h	Pulse RB11	1 SELOGIC Processing Interval
66	42	01h	Pulse RB12	1 SELOGIC Processing Interval
67	43	01h	Pulse RB13	1 SELOGIC Processing Interval
68	44	01h	Pulse RB14	1 SELOGIC Processing Interval
69	45	01h	Pulse RB15	1 SELOGIC Processing Interval
70	46	01h	Pulse RB16	1 SELOGIC Processing Interval
71	47	01h	Pulse RB17	1 SELOGIC Processing Interval
72	48	01h	Pulse RB18	1 SELOGIC Processing Interval
73	49	01h	Pulse RB19	1 SELOGIC Processing Interval
74	4A	01h	Pulse RB20	1 SELOGIC Processing Interval
75	4B	01h	Pulse RB21	1 SELOGIC Processing Interval
76	4C	01h	Pulse RB22	1 SELOGIC Processing Interval
77	4D	01h	Pulse RB23	1 SELOGIC Processing Interval
78	4E	01h	Pulse RB24	1 SELOGIC Processing Interval
79	4F	01h	Pulse RB25	1 SELOGIC Processing Interval
80	50	01h	Pulse RB26	1 SELOGIC Processing Interval
81	51	01h	Pulse RB27	1 SELOGIC Processing Interval
82	52	01h	Pulse RB28	1 SELOGIC Processing Interval

Table E.5 01h SEL-2523 Outputs (Sheet 4 of 4)

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description	Note
83	53	01h	Pulse RB29	1 SELOGIC Processing Interval
84	54	01h	Pulse RB30	1 SELOGIC Processing Interval
85	55	01h	Pulse RB31	1 SELOGIC Processing Interval
86	56	01h	Pulse RB32	1 SELOGIC Processing Interval
87	57	01h	Pulse RB33	1 SELOGIC Processing Interval
88	58	01h	Pulse RB34	1 SELOGIC Processing Interval
89	59	01h	Pulse RB35	1 SELOGIC Processing Interval
90	5A	01h	Pulse RB36	1 SELOGIC Processing Interval
91	5B	01h	Pulse RB37	1 SELOGIC Processing Interval
92	5C	01h	Pulse RB38	1 SELOGIC Processing Interval
93	5D	01h	Pulse RB39	1 SELOGIC Processing Interval
94	5E	01h	Pulse 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 (Sheet 1 of 2)

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 (*n*)

Table E.7 02h Read Input Status Command (Sheet 2 of 2)

Bytes	Field
n 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 (Relay 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: Relay Word Bits*.

Table E.8 SEL-2523 Inputs (Sheet 1 of 4)

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description	Notes
0–7	0–7	02h	Device Element Status Row 0	The input numbers are assigned from the right-most input to the left-most input in the device row as shown in an example below. Address 8 = Enabled Address 7 = * Address 6 = * Address 5 = * Address 4 = * Address 3 = * Address 2 = * Address 1 = *
8–15	8–F	02h	Device Element Status Row 1	The input numbers are assigned from the right-most input to the left-most input in the device row as shown 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	Device Element Status Row 2	
24–31	18–1F	02h	Device Element Status Row 3	
32–39	20–27	02h	Device Element Status Row 4	
40–47	28–2F	02h	Device Element Status Row 5	
48–55	30–37	02h	Device Element Status Row 6	
56–63	38–3F	02h	Device Element Status Row 7	
64–71	40–47	02h	Device Element Status Row 8	

Table E.8 SEL-2523 Inputs (Sheet 2 of 4)

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description	Notes
72–79	48–4F	02h	Device Element Status Row 9	
80–87	50–57	02h	Device Element Status Row 10	
88–95	58–5F	02h	Device Element Status Row 11	
96–103	60–67	02h	Device Element Status Row 12	
104–111	68–6F	02h	Device Element Status Row 13	
112–119	70–77	02h	Device Element Status Row 14	
120–127	78–7F	02h	Device Element Status Row 15	
128–135	80–87	02h	Device Element Status Row 16	
136–143	88–8F	02h	Device Element Status Row 17	
144–151	90–97	02h	Device Element Status Row 18	
152–159	98–9F	02h	Device Element Status Row 19	
160–167	A0–A7	02h	Device Element Status Row 20	
168–175	A8–AF	02h	Device Element Status Row 21	
176–183	B0–B7	02h	Device Element Status Row 22	
184–191	B8–BF	02h	Device Element Status Row 23	
192–199	C0–C7	02h	Device Element Status Row 24	
200–207	C8–CF	02h	Device Element Status Row 25	
208–215	D0–D7	02h	Device Element Status Row 26	
216–223	D8–DF	02h	Device Element Status Row 27	
224–231	E0–E7	02h	Device Element Status Row 28	
232–239	E8–EF	02h	Device Element Status Row 29	
240–247	F0–F7	02h	Device Element Status Row 30	
248–255	F8–FF	02h	Device Element Status Row 31	
256–263	100–107	02h	Device Element Status Row 32	
264–271	108–10F	02h	Device Element Status Row 33	
272–279	110–117	02h	Device Element Status Row 34	
280–287	118–11F	02h	Device Element Status Row 35	
288–295	120–127	02h	Device Element Status Row 36	
296–303	128–12F	02h	Device Element Status Row 37	
304–311	130–137	02h	Device Element Status Row 38	
312–319	138–13F	02h	Device Element Status Row 39	
320–327	140–147	02h	Device Element Status Row 40	
328–335	148–14F	02h	Device Element Status Row 41	
336–343	150–157	02h	Device Element Status Row 42	
344–351	158–15F	02h	Device Element Status Row 43	
352–359	160–167	02h	Device Element Status Row 44	
360–367	168–16F	02h	Device Element Status Row 45	
368–375	170–177	02h	Device Element Status Row 46	
376–383	178–17F	02h	Device Element Status Row 47	
384–391	180–187	02h	Device Element Status Row 48	

Table E.8 SEL-2523 Inputs (Sheet 3 of 4)

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description	Notes
392–399	188–18F	02h	Device Element Status Row 49	
400–407	190–197	02h	Device Element Status Row 50	
408–415	198–19F	02h	Device Element Status Row 51	
416–423	1A0–1A7	02h	Device Element Status Row 52	
424–431	1A8–1AF	02h	Device Element Status Row 53	
432–439	1B0–1B7	02h	Device Element Status Row 54	
440–447	1B8–1BF	02h	Device Element Status Row 55	
448–455	1C0–1C7	02h	Device Element Status Row 56	
456–463	1C8–1CF	02h	Device Element Status Row 57	
464–471	1D0–1D7	02h	Device Element Status Row 58	
472–479	1D8–1DF	02h	Device Element Status Row 59	
480–487	1E0–1E7	02h	Device Element Status Row 60	
488–495	1E8–1EF	02h	Device Element Status Row 61	
496–503	1F0–1F7	02h	Device Element Status Row 62	
504–511	1F8–1FF	02h	Device Element Status Row 63	
512–519	200–207	02h	Device Element Status Row 64	
520–527	208–20F	02h	Device Element Status Row 65	
528–535	210–217	02h	Device Element Status Row 66	
536–543	218–21F	02h	Device Element Status Row 67	
544–551	220–227	02h	Device Element Status Row 68	
552–559	228–22F	02h	Device Element Status Row 69	
560–567	230–237	02h	Device Element Status Row 70	
568–575	238–23F	02h	Device Element Status Row 71	
576–583	240–247	02h	Device Element Status Row 72	
584–591	248–24F	02h	Device Element Status Row 73	
592–599	250–257	02h	Device Element Status Row 74	
600–607	258–25F	02h	Device Element Status Row 75	
608–615	260–267	02h	Device Element Status Row 76	
616–623	268–26F	02h	Device Element Status Row 77	
624–631	270–277	02h	Device Element Status Row 78	
632–639	278–27F	02h	Device Element Status Row 79	
640–647	280–287	02h	Device Element Status Row 80	
648–655	288–28F	02h	Device Element Status Row 81	
656–663	290–297	02h	Device Element Status Row 82	
664–671	298–29F	02h	Device Element Status Row 83	
672–679	2A0–2A7	02h	Device Element Status Row 84	
680–687	2A8–2AF	02h	Device Element Status Row 85	
688–695	2B0–2B7	02h	Device Element Status Row 86	
696–703	2B8–2BF	02h	Device Element Status Row 87	
704–711	2C0–2C7	02h	Device Element Status Row 88	

Table E.8 SEL-2523 Inputs (Sheet 4 of 4)

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description	Notes
712–719	2C8–2CF	02h	Device Element Status Row 89	
720–727	2D0–2D7	02h	Device Element Status Row 90	
728–735	2D8–2DF	02h	Device Element Status Row 91	
736–743	2E0–2E7	02h	Device Element Status Row 92	

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 (*n*)
n 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 (*n*)
n 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-2523. 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 4)

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 OUT051 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 RB_SIL (1 SELOGIC Processing Interval)
12	C	05h	Pulse RB_ACK (1 SELOGIC Processing Interval)
13	D	05h	Pulse RB_RST (1 SELOGIC Processing Interval)
14	E	05h	Pulse RB_CON1 (1 SELOGIC Processing Interval)
15	F	05h	RB01
16	10	05h	RB02
17	11	05h	RB03
18	12	05h	RB04
19	13	05h	RB05
20	14	05h	RB06
21	15	05h	RB07
22	16	05h	RB08
23	17	05h	RB09
24	18	05h	RB10
25	19	05h	RB11
26	1A	05h	RB12
27	1B	05h	RB13
28	1C	05h	RB14
29	1D	05h	RB15
30	1E	05h	RB16
31	1F	05h	RB17
32	20	05h	RB18
33	21	05h	RB19
34	22	05h	RB20
35	23	05h	RB21
36	24	05h	RB22

Table E.15 05 Force Single Coil Command (Sheet 2 of 4)

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description
37	25	05h	RB23
38	26	05h	RB24
39	27	05h	RB25
40	28	05h	RB26
41	29	05h	RB27
42	2A	05h	RB28
43	2B	05h	RB29
44	2C	05h	RB30
45	2D	05h	RB31
46	2E	05h	RB32
47	2F	05h	RB33
48	30	05h	RB34
49	31	05h	RB35
50	32	05h	RB36
51	33	05h	RB37
52	34	05h	RB38
53	35	05h	RB39
54	36	05h	RB40
55	37	05h	Pulse RB01 (1 SELOGIC Processing Interval)
56	38	05h	Pulse RB02 (1 SELOGIC Processing Interval)
57	39	05h	Pulse RB03 (1 SELOGIC Processing Interval)
58	3A	05h	Pulse RB04 (1 SELOGIC Processing Interval)
59	3B	05h	Pulse RB05 (1 SELOGIC Processing Interval)
60	3C	05h	Pulse RB06 (1 SELOGIC Processing Interval)
61	3D	05h	Pulse RB07 (1 SELOGIC Processing Interval)
62	3E	05h	Pulse RB08 (1 SELOGIC Processing Interval)
63	3F	05h	Pulse RB09 (1 SELOGIC Processing Interval)
64	40	05h	Pulse RB10 (1 SELOGIC Processing Interval)
65	41	05h	Pulse RB11 (1 SELOGIC Processing Interval)
66	42	05h	Pulse RB12 (1 SELOGIC Processing Interval)
67	43	05h	Pulse RB13 (1 SELOGIC Processing Interval)

Table E.15 05 Force Single Coil Command (Sheet 3 of 4)

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description
68	44	05h	Pulse RB14 (1 SELOGIC Processing Interval)
69	45	05h	Pulse RB15 (1 SELOGIC Processing Interval)
70	46	05h	Pulse RB16 (1 SELOGIC Processing Interval)
71	47	05h	Pulse RB17 (1 SELOGIC Processing Interval)
72	48	05h	Pulse RB18 (1 SELOGIC Processing Interval)
73	49	05h	Pulse RB19 (1 SELOGIC Processing Interval)
74	4A	05h	Pulse RB20 (1 SELOGIC Processing Interval)
75	4B	05h	Pulse RB21 (1 SELOGIC Processing Interval)
76	4C	05h	Pulse RB22 (1 SELOGIC Processing Interval)
77	4D	05h	Pulse RB23 (1 SELOGIC Processing Interval)
78	4E	05h	Pulse RB24 (1 SELOGIC Processing Interval)
79	4F	05h	Pulse RB25 (1 SELOGIC Processing Interval)
80	50	05h	Pulse RB26 (1 SELOGIC Processing Interval)
81	51	05h	Pulse RB27 (1 SELOGIC Processing Interval)
82	52	05h	Pulse RB28 (1 SELOGIC Processing Interval)
83	53	05h	Pulse RB29 (1 SELOGIC Processing Interval)
84	54	05h	Pulse RB30 (1 SELOGIC Processing Interval)
85	55	05h	Pulse RB31 (1 SELOGIC Processing Interval)
86	56	05h	Pulse RB32 (1 SELOGIC Processing Interval)
87	57	05h	Pulse RB33 (1 SELOGIC Processing Interval)
88	58	05h	Pulse RB34 (1 SELOGIC Processing Interval)
89	59	05h	Pulse RB35 (1 SELOGIC Processing Interval)
90	5A	05h	Pulse RB36 (1 SELOGIC Processing Interval)
91	5B	05h	Pulse RB37 (1 SELOGIC Processing Interval)

Table E.15 05 Force Single Coil Command (Sheet 4 of 4)

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description
92	5C	05h	Pulse RB38 (1 SELOGIC Processing Interval)
93	5D	05h	Pulse RB39 (1 SELOGIC Processing Interval)
94	5E	05h	Pulse 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-2523 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, up to 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-2523 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

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 RB_SIL	N/A	N/A
15	F	Pulse RB_ACK	N/A	N/A
16	10	Pulse RB_RST	N/A	N/A
17	11	Pulse RB_CON1	N/A	N/A
18	12	Reset Data Regions	01 - Modbus Communications Counters	N/A
19	13	Control Remote Bits 1–16	1 - Set 2 - Clear 3 - Pulse (1 SELOGIC Processing Interval)	See Below
20	14	Control Remote Bits 17–32	1 - Set 2 - Clear 3 - Pulse (1 SELOGIC Processing Interval)	See Below
21	15	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-2523 Modbus Command Region

Parameter 2 for Command Code 19	Parameter 2 for Command Code 20	Parameter 2 for Command Code 21
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-2523 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 (Sheet 1 of 2)

Index[a]	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

Table E.24 Conversion Table (Sheet 2 of 2)

Index[a]	Type	Multiply	Divide	Offset	Base
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

[a] Refers to the conversion column in *Table E.25*.

Modbus Register Map

Table E.25 Modbus Register Map (Sheet 1 of 8)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
Device ID								
0	0	03h, 04h	12				FID Char (1, 2)	
1	1	03h, 04h	12				FID Char (3, 4)	
2	2	03h, 04h	12				FID Char (5, 6)	
3	3	03h, 04h	12				FID Char (7, 8)	
4	4	03h, 04h	12				FID Char (9, 10)	
5	5	03h, 04h	12				FID Char (11, 12)	
6	6	03h, 04h	12				FID Char (13, 14)	
7	7	03h, 04h	12				FID Char (15, 16)	
8	8	03h, 04h	12				FID Char (17, 18)	
9	9	03h, 04h	12				FID Char (19, 20)	
10	A	03h, 04h	12				FID Char (21, 22)	
11	B	03h, 04h	12				FID Char (23, 24)	
12	C	03h, 04h	12				FID Char (25, 26)	
13	D	03h, 04h	12				FID Char (27, 28)	
14	E	03h, 04h	12				FID Char (29, 30)	
15	F	03h, 04h	12				FID Char (31, 32)	
16	10	03h, 04h	12				FID Char (33, 34)	
17	11	03h, 04h	12				FID Char (35, 36)	
18	12	03h, 04h	12				FID Char (37, 38)	
19	13	03h, 04h	12				FID Char (39, 40)	
20	14	03h, 04h	12				FID Char (41, 42)	
21	15	03h, 04h	12				FID Char (43, 44)	
22	16	03h, 04h	12				BFID Char (1, 2)	
23	17	03h, 04h	12				BFID Char (3, 4)	

Table E.25 Modbus Register Map (Sheet 2 of 8)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
24	18	03h, 04h	12				BFID Char (5, 6)	
25	19	03h, 04h	12				BFID Char (7, 8)	
26	1A	03h, 04h	12				BFID Char (9, 10)	
27	1B	03h, 04h	12				BFID Char (11, 12)	
28	1C	03h, 04h	12				BFID Char (13, 14)	
29	1D	03h, 04h	12				BFID Char (15, 16)	
30	1E	03h, 04h	12				BFID Char (17, 18)	
31	1F	03h, 04h	12				BFID Char (19, 20)	
32	20	03h, 04h	12				BFID Char (21, 22)	
33	21	03h, 04h	12				BFID Char (23, 24)	
34	22	03h, 04h	12				BFID Char (25, 26)	
35	23	03h, 04h	12				BFID Char (27, 28)	
36	24	03h, 04h	12				BFID Char (29, 30)	
37	25	03h, 04h	12				BFID Char (31, 32)	
38	26	03h, 04h	12				BFID Char (33, 34)	
39	27	03h, 04h	12				BFID Char (35, 36)	
40	28	03h, 04h	12				BFID Char (37, 38)	
41	29	03h, 04h	12				BFID Char (39, 40)	
42	2A	03h, 04h	12				BFID Char (41, 42)	
43	2B	03h, 04h	12				BFID Char (43, 44)	
44	2C	03h, 04h	12				CID Char (1, 2)	
45	2D	03h, 04h	12				CID Char (3, 4)	
46	2E	03h, 04h	12				DEVID Char (1, 2)	
47	2F	03h, 04h	12				DEVID Char (3, 4)	
48	30	03h, 04h	12				DEVID Char (5, 6)	
49	31	03h, 04h	12				DEVID Char (7, 8)	
50	32	03h, 04h	12				DEVID Char (9, 10)	
51	33	03h, 04h	12				DEVID Char (11, 12)	
52	34	03h, 04h	12				DEVID Char (13, 14)	
53	35	03h, 04h	12				DEVID Char (15, 16)	
54	36	03h, 04h	1				DEVCODE	
55	37	03h, 04h	12				Part Number Char (1, 2)	
56	38	03h, 04h	12				Part Number Char (3, 4)	
57	39	03h, 04h	12				Part Number Char (5, 6)	
58	3A	03h, 04h	12				Part Number Char (7, 8)	
59	3B	03h, 04h	12				Part Number Char (9, 10)	

Table E.25 Modbus Register Map (Sheet 3 of 8)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
60	3C	03h, 04h	12				Part Number Char (11, 12)	
61	3D	03h, 04h	12				Part Number Char (13, 14)	
62	3E	03h, 04h	12				Part Number Char (15)	
63	3F	03h, 04h	12				Config (1, 2)	
64	40	03h, 04h	12				Config (3, 4)	
65	41	03h, 04h	12				Config (5, 6)	
66	42	03h, 04h	12				Config (7, 8)	
67–149	43–95	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
Device Status								
150	96	03h, 04h	10	0	2	0	FPGA STATUS 0 - OK 2 - FAIL	
151	97	03h, 04h	10	0	2	0	GPSB STATUS 0 - OK 2 - FAIL	
152	98	03h, 04h	10	0	2	0	HMI STATUS 0 - OK 2 - FAIL	
153	99	03h, 04h	10	0	2	0	RAM STATUS 0 - OK 2 - FAIL	
154	9A	03h, 04h	10	0	2	0	ROM STATUS 0 - OK 2 - FAIL	
155	9B	03h, 04h	10	0	2	0	CR_RAM STATUS 0 - OK 2 - FAIL	
156	9C	03h, 04h	10	0	2	0	NON_VOL STATUS 0 - OK 2 - FAIL	
157	9D	03h, 04h	10	0	2	0	CLK_BAT STATUS 0 - OK 1 - WARN	
158	9E	03h, 04h	10	0	2	0	CLOCK STATUS 0 - OK 1 - WARN	
159	9F	03h, 04h	10	0	2	0	CARD 2 STATUS 0 - OK 2 - FAIL	
160	A0	03h, 04h	10	0	2	0	CARD 3 STATUS 0 - OK 2 - FAIL	

Table E.25 Modbus Register Map (Sheet 4 of 8)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
161	A1	03h, 04h	10	0	2	0	CARD 4 STATUS 0 - OK 2 - FAIL	
162	A2	03h, 04h	10	0	2	0	CARD 5 STATUS 0 - OK 2 - FAIL	
163	A3	03h, 04h	10	0	2	0	CARD 6 STATUS 0 - OK 2 - FAIL	
164	A4	03h, 04h	10	0	2	0	CARD 7 STATUS 0 - OK 2 - FAIL	
165	A5	03h, 04h	10	0	2	0	CARD 8 STATUS 0 - OK 2 - FAIL	
166	A6	03h, 04h	10	0	1	0	DEVICE STATUS 0 - ENABLED 1- DISABLED	
167	A7	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
168	A8	03h, 04h	10	0	2	0	+3.3V STATUS 0 - OK 1 - WARN 2 - FAIL	
169	A9	03h, 04h	10	0	2	0	+5.0V STATUS 0 - OK 1 - WARN 2 - FAIL	
170	AA	03h, 04h	10	0	2	0	+2.5V STATUS 0 - OK 1 - WARN 2 - FAIL	
171	AB	03h, 04h	10	0	2	0	+3.75V STATUS 0 - OK 1 - WARN 2 - FAIL	
172	AC	03h, 04h	10	0	2	0	-1.25V STATUS 0 - OK 1 - WARN 2 - FAIL	
173-199	AE-C7	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
Date/Time Set								
200	C8	03h, 04h, 06h, 10h	1	0	59		ss seconds	
201	C9	03h, 04h, 06h, 10h	1	0	59		mm minute	
202	CA	03h, 04h, 06h, 10h	1	0	23		HH hour	

Table E.25 Modbus Register Map (Sheet 5 of 8)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
203	CB	03h, 04h, 06h, 10h	1	1	31		DD day	
204	CC	03h, 04h, 06h, 10h	1	1	12		MM month	
205	CD	03h, 04h, 06h, 10h	1	2000	2999		YY year	
206-249	CE-F9	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
Device Elements								
250	FA	03h, 04h	11	0	65281		ROW 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 = * Bit 13 = * Bit 14 = * Bit 15 ENABLED	
251	FB	03h, 04h	11	0	65281		ROW 1 Bit 0 = 1 if any bits 1-15 are asserted Bits 1-7 =0 Bit 8 = RBACK Bit 9 = RESET Bit 10 = ACK Bit 11 = SIL Bit 12 = NC_ALM Bit 13 = CR_ALM Bit 14 = HALARM Bit 15 = SALARM	
252	FC	03h, 04h	11	0	65281		ROW 2 Bit 0 = 1 if any bits 1-15 are asserted Bits 1-7 =0 Bit 8 = ALIN_A6 Bit 9 = ALIN_A5 Bit 10 = ALIN_A4 Bit 11 = ALIN_A3 Bit 12 = ALIN_A2 Bit 13 = ALIN_1 Bit 14 = * Bit 15 = *	
253	FD	03h, 04h	11	0	65281		ROW 3	
254	FE	03h, 04h	11	0	65281		ROW 4	
255	FF	03h, 04h	11	0	62581		ROW 5	
256	100	03h, 04h	11	0	62581		ROW 6	
257	101	03h, 04h	11	0	65281		ROW 7	

Table E.25 Modbus Register Map (Sheet 6 of 8)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
258	102	03h, 04h	11	0	65281		ROW 8	
259	103	03h, 04h	11	0	65281		ROW 9	
260	104	03h, 04h	11	0	65281		ROW 10	
261	105	03h, 04h	11	0	65281		ROW 11	
262	106	03h, 04h	11	0	65281		ROW 12	
263	107	03h, 04h	11	0	65281		ROW 13	
264	108	03h, 04h	11	0	65281		ROW 14	
265	109	03h, 04h	11	0	65281		ROW 15	
266	10A	03h, 04h	11	0	65281		ROW 16	
267	10B	03h, 04h	11	0	65281		ROW 17	
268	10C	03h, 04h	11	0	65281		ROW 18	
269	10D	03h, 04h	11	0	65281		ROW 19	
270	10E	03h, 04h	11	0	65281		ROW 20	
271	10F	03h, 04h	11	0	65281		ROW 21	
272	110	03h, 04h	11	0	65281		ROW 22	
273	111	03h, 04h	11	0	65281		ROW 23	
274	112	03h, 04h	11	0	65281		ROW 24	
275	113	03h, 04h	11	0	65281		ROW 25	
276	114	03h, 04h	11	0	65281		ROW 26	
277	115	03h, 04h	11	0	65281		ROW 27	
278	116	03h, 04h	11	0	65281		ROW 28	
279	117	03h, 04h	11	0	65281		ROW 29	
280	118	03h, 04h	11	0	65281		ROW 30	
281	119	03h, 04h	11	0	65281		ROW 31	
282	11A	03h, 04h	11	0	65281		ROW 32	
283	11B	03h, 04h	11	0	65281		ROW 33	
284	11C	03h, 04h	11	0	65281		ROW 34	
285	11D	03h, 04h	11	0	65281		ROW 35	
286	11E	03h, 04h	11	0	65281		ROW 36	
287	11F	03h, 04h	11	0	65281		ROW 37	
288	120	03h, 04h	11	0	65281		ROW 38	
289	121	03h, 04h	11	0	65281		ROW 39	
290	122	03h, 04h	11	0	65281		ROW 40	
291	123	03h, 04h	11	0	65281		ROW 41	
292	124	03h, 04h	11	0	65281		ROW 42	
293	125	03h, 04h	11	0	65281		ROW 43	
294	126	03h, 04h	11	0	65281		ROW 44	
295	127	03h, 04h	11	0	65281		ROW 45	
296	128	03h, 04h	11	0	65281		ROW 46	
297	129	03h, 04h	11	0	65281		ROW 47	

Table E.25 Modbus Register Map (Sheet 7 of 8)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
298	12A	03h, 04h	11	0	65281		ROW 48	
299	12B	03h, 04h	11	0	65281		ROW 49	
300	12C	03h, 04h	11	0	65281		ROW 50	
301	12D	03h, 04h	11	0	65281		ROW 51	
302	12E	03h, 04h	11	0	65281		ROW 52	
303	12F	03h, 04h	11	0	65281		ROW 53	
304	130	03h, 04h	11	0	65281		ROW 54	
305	131	03h, 04h	11	0	65281		ROW 55	
306	132	03h, 04h	11	0	65281		ROW 56	
307	133	03h, 04h	11	0	65281		ROW 57	
308	134	03h, 04h	11	0	65281		ROW 58	
309	135	03h, 04h	11	0	65281		ROW 59	
310	136	03h, 04h	11	0	65281		ROW 60	
311	137	03h, 04h	11	0	65281		ROW 61	
312	138	03h, 04h	11	0	65281		ROW 62	
313	139	03h, 04h	11	0	65281		ROW 63	
314	13A	03h, 04h	11	0	65281		ROW 64	
315	13B	03h, 04h	11	0	65281		ROW 65	
316	13C	03h, 04h	11	0	65281		ROW 66	
317	13D	03h, 04h	11	0	65281		ROW 67	
318	13E	03h, 04h	11	0	65281		ROW 68	
319	13F	03h, 04h	11	0	65281		ROW 69	
320	140	03h, 04h	11	0	65281		ROW 70	
321	141	03h, 04h	11	0	65281		ROW 71	
322	142	03h, 04h	11	0	65281		ROW 72	
323	143	03h, 04h	11	0	65281		ROW 73	
324	144	03h, 04h	11	0	65281		ROW 74	
325	145	03h, 04h	11	0	65281		ROW 75	
326	146	03h, 04h	11	0	65281		ROW 76	
327	147	03h, 04h	11	0	65281		ROW 77	
328	148	03h, 04h	11	0	65281		ROW 78	
329	149	03h, 04h	11	0	65281		ROW 79	
330	14A	03h, 04h	11	0	65281		ROW 80	
331	14B	03h, 04h	11	0	65281		ROW 81	
332	14C	03h, 04h	11	0	65281		ROW 82	
333	14D	03h, 04h	11	0	65281		ROW 83	
334	14E	03h, 04h	11	0	65281		ROW 84	
335	14F	03h, 04h	11	0	65281		ROW 85	
336	150	03h, 04h	11	0	65281		ROW 86	
337	151	03h, 04h	11	0	65281		ROW 87	

Table E.25 Modbus Register Map (Sheet 8 of 8)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
338	152	03h, 04h	11	0	65281		ROW 88	
339	153	03h, 04h	11	0	65281		ROW 89	
340	154	03h, 04h	11	0	65281		ROW 90	
341	155	03h, 04h	11	0	65281		ROW 91	
342	156	03h, 04h	11	0	65281		ROW 92	
343-499	157-1F3	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
Modbus Communications Counters								
500	1F4	03h	1	0	65535		Number of Messages Received	
501	1F5	03h	1	0	65535		Number of Messages to other devices	
502	1F6	03h	1	0	65535		Invalid Address	
503	1F7	03h	1	0	65535		Bad CRC	
504	1F8	03h	1	0	65535		UART Error	
505	1F9	03h	1	0	65535		Illegal Function	
506	1FA	03h	1	0	65535		Illegal Register	
507	1FB	03h	1	0	65535		Illegal Write	
508	1FC	03h	1	0	65535		Bad Packet Format	
509	1FD	03h	1	0	65535		Bad Packet Length	
510-549	1FE-225	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
Command Region								
550	226	03h, 04h 06h,10h	11				Parameter 2	
551	227	03h, 04h 06h,10h	11				Parameter 1	
552	228	03h, 04h 06h,10h	11				Command Code	
553-65535	229-FFFF	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	

Appendix F
Mirrored Bits Communications

Overview

Mirrored Bits® is a direct relay-to-relay 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-2523 Annunciator Panel 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.

IMPORTANT: Be sure to configure the port before connecting to a Mirrored Bits device. If you connect an unconfigured port to a Mirrored Bits device, the device will appear to be locked up.

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-2523 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-2523, the Mirrored Bits transmission rate is a function of the baud rate. At baud rates below 9600, the SEL-2523 transmits Mirrored Bits as fast as possible for the given baud. At rates at and above 9600 baud the SEL-2523 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-2523 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	15 ms
4800	7.5 ms
9600	4 ms
19200	4 ms
38400	4 ms

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 (RMB*n*, where *n* = 1 through 8) to the corresponding pickup and dropout security counters, that in turn set or clear the RMB*n*A and RMB*n*B device element bits.

Message Decoding and Integrity Checks

Set the RX_ID of the local SEL-2523 to match the TX_ID of the remote MIRRORED BITS device. The SEL-2523 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 ROK*c* (*c* = A or B). Upon detecting any of the following conditions, the device clears the ROK*c* 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 = MB*c*, or seven messages have been sent when PROTO = MB8*c*
- Loopback is enabled

The device asserts ROK*c* only after successful synchronization as described below and two consecutive messages pass all of the data checks described above. After ROK*c* is reasserted, received data may be delayed while passing through the security counters described below.

While ROK*c* 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 RMB*n*, 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 *X*s (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: Relay Word Bits*). *Table F.2* is an extract of *Appendix G: Relay 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
37	RMB8A	RMB7A	RMB6A	RMB5A	RMB4A	RMB3A	RMB2A	RMB1A
39	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
37	1	0	1	0	0	1	1	1

Table F.3 shows an example of the values of the MIRRORED BITS for an 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-2523 detects a communications error, it deasserts ROKA or ROKB. If an SEL-2523 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, ROK*c* is deasserted, and another user accessible Device Word bit, LBOK*c* (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 ±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

Setting Prompt	Setting Description	Factory Default Setting
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

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Appendix G
Relay Word Bits

Overview

The device element results are represented by Relay Word bits in the SEL-2523. Each Relay 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 Relay Word bits and corresponding descriptions. The Relay 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 Relay 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-2523 Relay Word Bits (Sheet 1 of 3)

Bit/ Row	Relay Word Bits							
	7	6	5	4	3	2	1	0
TAR 0	ENABLED	*	*	*	*	*	*	*
1	SALARM	HALARM	CR_ALM	NC_ALM	SIL	ACK	RESET	RBACK
2	*	*	ALIN_A1	ALIN_A2	ALIN_A3	ALIN_A4	ALIN_A5	ALIN_A6
3	*	*	ALIN_B1	ALIN_B2	ALIN_B3	ALIN_B4	ALIN_B5	ALIN_B6
4	*	*	ALIN_C1	ALIN_C2	ALIN_C3	ALIN_C4	ALIN_C5	ALIN_C6
5	*	*	ALIN_D1	ALIN_D2	ALIN_D3	ALIN_D4	ALIN_D5	ALIN_D6
6	*	*	ALIN_E1	ALIN_E2	ALIN_E3	ALIN_E4	ALIN_E5	ALIN_E6
7	*	*	ALIN_F1	ALIN_F2	ALIN_F3	ALIN_F4	ALIN_F5	ALIN_F6
8	*	*	AP_A1	AP_A2	AP_A3	AP_A4	AP_A5	AP_A6
9	*	*	AP_B1	AP_B2	AP_B3	AP_B4	AP_B5	AP_B6
10	*	*	AP_C1	AP_C2	AP_C3	AP_C4	AP_C5	AP_C6
11	*	*	AP_D1	AP_D2	AP_D3	AP_D4	AP_D5	AP_D6
12	*	*	AP_E1	AP_E2	AP_E3	AP_E4	AP_E5	AP_E6
13	*	*	AP_F1	AP_F2	AP_F3	AP_F4	AP_F5	AP_F6
14	*	*	ALM_A1	ALM_A2	ALM_A3	ALM_A4	ALM_A5	ALM_A6
15	*	*	ALM_B1	ALM_B2	ALM_B3	ALM_B4	ALM_B5	ALM_B6

Table G.1 SEL-2523 Relay Word Bits (Sheet 2 of 3)

Bit/ Row	Relay Word Bits							
	7	6	5	4	3	2	1	0
16	*	*	ALM_C1	ALM_C2	ALM_C3	ALM_C4	ALM_C5	ALM_C6
17	*	*	ALM_D1	ALM_D2	ALM_D3	ALM_D4	ALM_D5	ALM_D6
18	*	*	ALM_E1	ALM_E2	ALM_E3	ALM_E4	ALM_E5	ALM_E6
19	*	*	ALM_F1	ALM_F2	ALM_F3	ALM_F4	ALM_F5	ALM_F6
20	*	*	*	*	*	*	*	*
21	IN_A1	IN_A2	IN_A3	IN_A4	IN_A5	IN_A6	IN_B1	IN_B2
22	IN_B3	IN_B4	IN_B5	IN_B6	IN_C1	IN_C2	IN_C3	IN_C4
23	IN_C5	IN_C6	IN_D1	IN_D2	IN_D3	IN_D4	IN_D5	IN_D6
24	IN_E1	IN_E2	IN_E3	IN_E4	IN_E5	IN_E6	IN_F1	IN_F2
25	IN_F3	IN_F4	IN_F5	IN_F6	IN_G1	IN_G2	IN_G3	IN_G4
26	IN_G5	IN_G6	*	*	*	*	*	*
27	*	*	*	*	PB_SIL	PB_ACK	PB_RST	PB_TST
28	*	*	*	*	*	*	*	*
29	IN_A1E	IN_A2E	IN_A3E	IN_A4E	IN_A5E	IN_A6E	IN_B1E	IN_B2E
30	IN_B3E	IN_B4E	IN_B5E	IN_B6E	IN_C1E	IN_C2E	IN_C3E	IN_C4E
31	IN_C5E	IN_C6E	IN_D1E	IN_D2E	IN_D3E	IN_D4E	IN_D5E	IN_D6E
32	IN_E1E	IN_E2E	IN_E3E	IN_E4E	IN_E5E	IN_E6E	IN_F1E	IN_F2E
33	IN_F3E	IN_F4E	IN_F5E	IN_F6E	IN_G1E	IN_G2E	IN_G3E	IN_G4E
34	IN_G5E	IN_G6E	*	*	*	*	*	*
35	*	*	*	*	PB_SILP	PB_ACKP	PB_RSTP	PB_TSTP
36	*	*	*	*	*	*	*	*
37	RMB8A	RMB7A	RMB6A	RMB5A	RMB4A	RMB3A	RMB2A	RMB1A
38	TMB8A	TMB7A	TMB6A	TMB5A	TMB4A	TMB3A	TMB2A	TMB1A
39	RMB8B	RMB7B	RMB6B	RMB5B	RMB4B	RMB3B	RMB2B	RMB1B
40	TMB8B	TMB7B	TMB6B	TMB5B	TMB4B	TMB3B	TMB2B	TMB1B
41	LBOKB	CBADB	RBADB	ROKB	LBOKA	CBADA	RBADA	ROKA
42	*	*	*	*	*	*	TEST	IRIGOK
43	OUT01	OUT02	OUT03	OUT04	OUT05	OUT06	OUT07	OUT08
44	OUT09	OUT10	OUT11	*	*	*	*	*
45	LT01	LT02	LT03	LT04	LT05	LT06	LT07	LT08
46	LT09	LT10	LT11	LT12	LT13	LT14	LT15	LT16
47	LT17	LT18	LT19	LT20	LT21	LT22	LT23	LT24
48	LT25	LT26	LT27	LT28	LT29	LT30	LT31	LT32
49	*	*	FRST_A1	FRST_A2	FRST_A3	FRST_A4	FRST_A5	FRST_A6
50	*	*	FRST_B1	FRST_B2	FRST_B3	FRST_B4	FRST_B5	FRST_B6
51	*	*	FRST_C1	FRST_C2	FRST_C3	FRST_C4	FRST_C5	FRST_C6
52	*	*	FRST_D1	FRST_D2	FRST_D3	FRST_D4	FRST_D5	FRST_D6
53	*	*	FRST_E1	FRST_E2	FRST_E3	FRST_E4	FRST_E5	FRST_E6
54	*	*	FRST_F1	FRST_F2	FRST_F3	FRST_F4	FRST_F5	FRST_F6
55	*	*	*	*	*	*	*	*

Table G.1 SEL-2523 Relay Word Bits (Sheet 3 of 3)

Bit/ Row	Relay Word Bits							
	7	6	5	4	3	2	1	0
56	*	*	*	*	*	*	*	*
57	RBO1	RBO2	RBO3	RBO4	RBO5	RBO6	RBO7	RBO8
58	RBO9	RB10	RB11	RB12	RB13	RB14	RB15	RB16
59	RB17	RB18	RB19	RB20	RB21	RB22	RB23	RB24
60	RB25	RB26	RB27	RB28	RB29	RB30	RB31	RB32
61	RB33	RB34	RB35	RB36	RB37	RB38	RB39	RB40
62	*	*	*	*	RB_SIL	RB_ACK	RB_RST	RB_CON1
63	SV01	SV02	SV03	SV04	SV05	SV06	SV07	SV08
64	SVO1T	SVO2T	SVO3T	SVO4T	SVO5T	SVO6T	SVO7T	SVO8T
65	SV09	SV10	SV11	SV12	SV13	SV14	SV15	SV16
66	SV09T	SV10T	SV11T	SV12T	SV13T	SV14T	SV15T	SV16T
67	SV17	SV18	SV19	SV20	SV21	SV22	SV23	SV24
68	SV17T	SV18T	SV19T	SV20T	SV21T	SV22T	SV23T	SV24T
69	SV25	SV26	SV27	SV28	SV29	SV30	SV31	SV32
70	SV25T	SV26T	SV27T	SV28T	SV29T	SV30T	SV31T	SV32T
71	SV33	SV34	SV35	SV36	SV37	SV38	SV39	SV40
72	SV33T	SV34T	SV35T	SV36T	SV37T	SV38T	SV39T	SV40T
73	SET01	SET02	SET03	SET04	SET05	SET06	SET07	SET08
74	RST01	RST02	RST03	RST04	RST05	RST06	RST07	RST08
75	SET09	SET10	SET11	SET12	SET13	SET14	SET15	SET16
76	RST09	RST10	RST11	RST12	RST13	RST14	RST15	RST16
77	SET17	SET18	SET19	SET20	SET21	SET22	SET23	SET24
78	RST17	RST18	RST19	RST20	RST21	RST22	RST23	RST24
79	SET25	SET26	SET27	SET28	SET29	SET30	SET31	SET32
80	RST25	RST26	RST27	RST28	RST29	RST30	RST31	RST32
81	*	*	FAST_A1	FAST_A2	FAST_A3	FAST_A4	FAST_A5	FAST_A6
82	*	*	FAST_B1	FAST_B2	FAST_B3	FAST_B4	FAST_B5	FAST_B6
83	*	*	FAST_C1	FAST_C2	FAST_C3	FAST_C4	FAST_C5	FAST_C6
84	*	*	FAST_D1	FAST_D2	FAST_D3	FAST_D4	FAST_D5	FAST_D6
85	*	*	FAST_E1	FAST_E2	FAST_E3	FAST_E4	FAST_E5	FAST_E6
86	*	*	FAST_F1	FAST_F2	FAST_F3	FAST_F4	FAST_F5	FAST_F6
87	*	*	SLOW_A1	SLOW_A2	SLOW_A3	SLOW_A4	SLOW_A5	SLOW_A6
88	*	*	SLOW_B1	SLOW_B2	SLOW_B3	SLOW_B4	SLOW_B5	SLOW_B6
89	*	*	SLOW_C1	SLOW_C2	SLOW_C3	SLOW_C4	SLOW_C5	SLOW_C6
90	*	*	SLOW_D1	SLOW_D2	SLOW_D3	SLOW_D4	SLOW_D5	SLOW_D6
91	*	*	SLOW_E1	SLOW_E2	SLOW_E3	SLOW_E4	SLOW_E5	SLOW_E6
92	*	*	SLOW_F1	SLOW_F2	SLOW_F3	SLOW_F4	SLOW_F5	SLOW_F6

Definitions

Table G.2 Relay Word Bit Definitions (Sheet 1 of 19)

Row	Bit	Definition
0	ENABLED	Device Enabled
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
1	SALARM	Software Alarms; invalid password, changing access levels, settings changes
	HALARM	Diagnostics Failure
	CR_ALM	SELOGIC Equation: Critical Alarm Output for Set Alarm Points
	NC_ALM	SELOGIC Equation: Non-critical Alarm Output for Set Alarm Points
	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
	ALIN_A3	SELOGIC Equation: Alarm Point A3 Input
	ALIN_A4	SELOGIC Equation: Alarm Point A4 Input
	ALIN_A5	SELOGIC Equation: Alarm Point A5 Input
	ALIN_A6	SELOGIC Equation: Alarm Point A6 Input
3	*	Reserved
	*	Reserved
	ALIN_B1	SELOGIC Equation: Alarm Point B1 Input
	ALIN_B2	SELOGIC Equation: Alarm Point B2 Input
	ALIN_B3	SELOGIC Equation: Alarm Point B3 Input
	ALIN_B4	SELOGIC Equation: Alarm Point B4 Input
	ALIN_B5	SELOGIC Equation: Alarm Point B5 Input
	ALIN_B6	SELOGIC Equation: Alarm Point B6 Input
4	*	Reserved
	*	Reserved
	ALIN_C1	SELOGIC Equation: Alarm Point C1 Input
	ALIN_C2	SELOGIC Equation: Alarm Point C2 Input
	ALIN_C3	SELOGIC Equation: Alarm Point C3 Input
	ALIN_C4	SELOGIC Equation: Alarm Point C4 Input

Table G.2 Relay Word Bit Definitions (Sheet 2 of 19)

Row	Bit	Definition
	ALIN_C5	SELOGIC Equation: Alarm Point C5 Input
	ALIN_C6	SELOGIC Equation: Alarm Point C6 Input
5	*	Reserved
	*	Reserved
	ALIN_D1	SELOGIC Equation: Alarm Point D1 Input
	ALIN_D2	SELOGIC Equation: Alarm Point D2 Input
	ALIN_D3	SELOGIC Equation: Alarm Point D3 Input
	ALIN_D4	SELOGIC Equation: Alarm Point D4 Input
	ALIN_D5	SELOGIC Equation: Alarm Point D5 Input
	ALIN_D6	SELOGIC Equation: Alarm Point D6 Input
6	*	Reserved
	*	Reserved
	ALIN_E1	SELOGIC Equation: Alarm Point E1 Input
	ALIN_E2	SELOGIC Equation: Alarm Point E2 Input
	ALIN_E3	SELOGIC Equation: Alarm Point E3 Input
	ALIN_E4	SELOGIC Equation: Alarm Point E4 Input
	ALIN_E5	SELOGIC Equation: Alarm Point E5 Input
	ALIN_E6	SELOGIC Equation: Alarm Point E6 Input
7	*	Reserved
	*	Reserved
	ALIN_F1	SELOGIC Equation: Alarm Point F1 Input
	ALIN_F2	SELOGIC Equation: Alarm Point F2 Input
	ALIN_F3	SELOGIC Equation: Alarm Point F3 Input
	ALIN_F4	SELOGIC Equation: Alarm Point F4 Input
	ALIN_F5	SELOGIC Equation: Alarm Point F5 Input
	ALIN_F6	SELOGIC Equation: Alarm Point F6 Input
8	*	Reserved
	*	Reserved
	AP_A1	Alarm Point A1 Output
	AP_A2	Alarm Point A2 Output
	AP_A3	Alarm Point A3 Output
	AP_A4	Alarm Point A4 Output
	AP_A5	Alarm Point A5 Output
	AP_A6	Alarm Point A6 Output
9	*	Reserved
	*	Reserved
	AP_B1	Alarm Point B1 Output
	AP_B2	Alarm Point B2 Output
	AP_B3	Alarm Point B3 Output
	AP_B4	Alarm Point B4 Output

Table G.2 Relay Word Bit Definitions (Sheet 3 of 19)

Row	Bit	Definition
	AP_B5	Alarm Point B5 Output
	AP_B6	Alarm Point B6 Output
10	*	Reserved
	*	Reserved
	AP_C1	Alarm Point C1 Output
	AP_C2	Alarm Point C2 Output
	AP_C3	Alarm Point C3 Output
	AP_C4	Alarm Point C4 Output
	AP_C5	Alarm Point C5 Output
	AP_C6	Alarm Point C6 Output
11	*	Reserved
	*	Reserved
	AP_D1	Alarm Point D1 Output
	AP_D2	Alarm Point D2 Output
	AP_D3	Alarm Point D3 Output
	AP_D4	Alarm Point D4 Output
	AP_D5	Alarm Point D5 Output
	AP_D6	Alarm Point D6 Output
12	*	Reserved
	*	Reserved
	AP_E1	Alarm Point E1 Output
	AP_E2	Alarm Point E2 Output
	AP_E3	Alarm Point E3 Output
	AP_E4	Alarm Point E4 Output
	AP_E5	Alarm Point E5 Output
	AP_E6	Alarm Point E6 Output
13	*	Reserved
	*	Reserved
	AP_F1	Alarm Point F1 Output
	AP_F2	Alarm Point F2 Output
	AP_F3	Alarm Point F3 Output
	AP_F4	Alarm Point F4 Output
	AP_F5	Alarm Point F5 Output
	AP_F6	Alarm Point F6 Output
14	*	Reserved
	*	Reserved
	ALM_A1	Alarm Point A1 alarm sound output
	ALM-A2	Alarm Point A2 alarm sound output
	ALM_A3	Alarm Point A3 alarm sound output
	ALM_A4	Alarm Point A4 alarm sound output

Table G.2 Relay Word Bit Definitions (Sheet 4 of 19)

Row	Bit	Definition
	ALM_A5	Alarm Point A5 alarm sound output
	ALM_A6	Alarm Point A6 alarm sound output
15	*	Reserved
	*	Reserved
	ALM_B1	Alarm Point B1alarm sound output
	ALM_B2	Alarm Point B2 alarm sound output
	ALM_B3	Alarm Point B3 alarm sound output
	ALM_B4	Alarm Point B4 alarm sound output
	ALM_B5	Alarm Point B5 alarm sound output
	ALM_B6	Alarm Point B6 alarm sound output
16	*	Reserved
	*	Reserved
	ALM_C1	Alarm Point C1 alarm sound output
	ALM_C2	Alarm Point C2 alarm sound output
	ALM_C3	Alarm Point C3 alarm sound output
	ALM_C4	Alarm Point C4 alarm sound output
	ALM_C5	Alarm Point C5 alarm sound output
	ALM_C6	Alarm Point C6 alarm sound output
17	*	Reserved
	*	Reserved
	ALM_D1	Alarm Point D1 alarm sound output
	ALM_D2	Alarm Point D2 alarm sound output
	ALM_D3	Alarm Point D3 alarm sound output
	ALM_D4	Alarm Point D4 alarm sound output
	ALM_D5	Alarm Point D5 alarm sound output
	ALM_D6	Alarm Point D6 alarm sound output
18	*	Reserved
	*	Reserved
	ALM_E1	Alarm Point E1 alarm sound output
	ALM_E2	Alarm Point E2 alarm sound output
	ALM_E3	Alarm Point E3 alarm sound output
	ALM_E4	Alarm Point E4 alarm sound output
	ALM_E5	Alarm Point E5 alarm sound output
	ALM_E6	Alarm Point E6 alarm sound output
19	*	Reserved
	*	Reserved
	ALM_F1	Alarm Point F1 alarm sound output
	ALM_F2	Alarm Point F2 alarm sound output
	ALM_F3	Alarm Point F3 alarm sound output
	ALM_F4	Alarm Point F4 alarm sound output

Table G.2 Relay Word Bit Definitions (Sheet 5 of 19)

Row	Bit	Definition
	ALM_F5	Alarm Point F5 alarm sound output
	ALM_F6	Alarm Point F6 alarm sound output
20	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
21	IN_A1	Digital Input—Card 3, Terminals 01–02
	IN_A2	Digital Input—Card 3, Terminals 03–04
	IN_A3	Digital Input—Card 3, Terminals 05–06
	IN_A4	Digital Input—Card 3, Terminals 07–08
	IN_A5	Digital Input—Card 3, Terminals 09–10
	IN_A6	Digital Input—Card 3, Terminals 11–12
	IN_B1	Digital Input—Card 3, Terminals 13–14
	IN_B2	Digital Input—Card 3, Terminals 15–16
22	IN_B3	Digital Input—Card 4, Terminals 17–18
	IN_B4	Digital Input—Card 4, Terminals 19–20
	IN_B5	Digital Input—Card 4, Terminals 21–22
	IN_B6	Digital Input—Card 4, Terminals 23–24
	IN_C1	Digital Input—Card 4, Terminals 25–26
	IN_C2	Digital Input—Card 4, Terminals 27–28
	IN_C3	Digital Input—Card 4, Terminals 29–30
	IN_C4	Digital Input—Card 4, Terminals 31–32
23	IN_C5	Digital Input—Card 5, Terminals 33–34
	IN_C6	Digital Input—Card 5, Terminals 35–36
	IN_D1	Digital Input—Card 5, Terminals 37–38
	IN_D2	Digital Input—Card 5, Terminals 39–40
	IN_D3	Digital Input—Card 5, Terminals 41–42
	IN_D4	Digital Input—Card 5, Terminals 43–44
	IN_D5	Digital Input—Card 5, Terminals 45–46
	IN_D6	Digital Input—Card 5, Terminals 47–48
24	IN_E1	Digital Input—Card 6, Terminals 49–50
	IN_E2	Digital Input—Card 6, Terminals 51–52
	IN_E3	Digital Input—Card 6, Terminals 53–54
	IN_E4	Digital Input—Card 6, Terminals 55–56
	IN_E5	Digital Input—Card 6, Terminals 57–58
	IN_E6	Digital Input—Card 6, Terminals 59–60

Table G.2 Relay Word Bit Definitions (Sheet 6 of 19)

Row	Bit	Definition
	IN_F1	Digital Input—Card 6, Terminals 61–62
	IN_F2	Digital Input—Card 6, Terminals 63–64
25	IN_F3	Digital Input—Card 7, Terminals 65–66
	IN_F4	Digital Input—Card 7, Terminals 67–68
	IN_F5	Digital Input—Card 7, Terminals 69–70
	IN_F6	Digital Input—Card 7, Terminals 71–72
	IN_G1	Digital Input—Card 7, Terminals 73–74
	IN_G2	Digital Input—Card 7, Terminals 75–76
	IN_G3	Digital Input—Card 7, Terminals 77–78
	IN_G4	Digital Input—Card 7, Terminals 79–80
26	IN_G5	Digital Input—Card 9, Terminals 106–107
	IN_G6	Digital Input—Card 9, Terminals 107–108
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
27	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	PB_SIL	**SIL** pushbutton
	PB_ACK	**ACK** pushbutton
	PB_RST	**RESET** pushbutton
	PB_TST	**TEST** pushbutton
28	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
29	IN_A1E	Digital Input A1 Edge Detect
	IN_A2E	Digital Input A2 Edge Detect
	IN_A3E	Digital Input A3 Edge Detect
	IN_A4E	Digital Input A4 Edge Detect
	IN_A5E	Digital Input A5 Edge Detect
	IN_A6E	Digital Input A6 Edge Detect

Table G.2 Relay Word Bit Definitions (Sheet 7 of 19)

Row	Bit	Definition
	IN_B1E	Digital Input B1 Edge Detect
	IN_B2E	Digital Input B2 Edge Detect
30	IN_B3E	Digital Input B3 Edge Detect
	IN_B4E	Digital Input B4 Edge Detect
	IN_B5E	Digital Input B5 Edge Detect
	IN_B6E	Digital Input B6 Edge Detect
	IN_C1E	Digital Input C1 Edge Detect
	IN_C2E	Digital Input C2 Edge Detect
	IN_C3E	Digital Input C3 Edge Detect
	IN_C4E	Digital Input C4 Edge Detect
31	IN_C5E	Digital Input C5 Edge Detect
	IN_C6E	Digital Input C6 Edge Detect
	IN_D1E	Digital Input D1 Edge Detect
	IN_D2E	Digital Input D2 Edge Detect
	IN_D3E	Digital Input D3 Edge Detect
	IN_D4E	Digital Input D4 Edge Detect
	IN_D5E	Digital Input D5 Edge Detect
	IN_D6E	Digital Input D6 Edge Detect
32	IN_E1E	Digital Input E1 Edge Detect
	IN_E2E	Digital Input E2 Edge Detect
	IN_E3E	Digital Input E3 Edge Detect
	IN_E4E	Digital Input E4 Edge Detect
	IN_E5E	Digital Input E5 Edge Detect
	IN_E6E	Digital Input E6 Edge Detect
	IN_F1E	Digital Input F1 Edge Detect
	IN_F2E	Digital Input F2 Edge Detect
33	IN_F3E	Digital Input F3 Edge Detect
	IN_F4E	Digital Input F4 Edge Detect
	IN_F5E	Digital Input F5 Edge Detect
	IN_F6E	Digital Input F6 Edge Detect
	IN_G1E	Digital Input G1 Edge Detect
	IN_G2E	Digital Input G2 Edge Detect
	IN_G3E	Digital Input G3 Edge Detect
	IN_G4E	Digital Input G4 Edge Detect
34	IN_G5E	Digital Input G5 Edge Detect
	IN_G6E	Digital Input G6 Edge Detect
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved

Table G.2 Relay Word Bit Definitions (Sheet 8 of 19)

Row	Bit	Definition
	*	Reserved
	*	Reserved
35	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	PB_SILP	SILence pushbutton Pulse (asserted for one processing interval when pushbutton **SIL** is pressed)
	PB_ACKP	ACK pushbutton Pulse (asserted for one processing interval when pushbutton **ACK** is pressed)
	PB_RSTP	RESET pushbutton Pulse (asserted for one processing interval when pushbutton **RST** is pressed)
	PB_TSTP	TEST pushbutton Pulse (asserted for one processing interval when pushbutton **TEST** is pressed)
36	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
37	RMB8A	Channel A receive mirror bits RMB1A through RMB8A
	RMB7A	
	RMB6A	
	RMB5A	
	RMB4A	
	RMB3A	
	RMB2A	
	RMB1A	
38	TMB8A	Channel A transmit mirror bits TMB1A through TMB8A
	TMB7A	
	TMB6A	
	TMB5A	
	TMB4A	
	TMB3A	
	TMB2A	
	TMB1A	
39	RMB8B	Channel B receive mirror bits RMB1B through RMB8B
	RMB7B	
	RMB6B	
	RMB5B	
	RMB4B	
	RMB3B	

Table G.2 Relay Word Bit Definitions (Sheet 9 of 19)

Row	Bit	Definition
	RMB2B	
	RMB1B	
40	TMB8B	Channel B transmit mirror bits TMB1B through TMB8B
	TMB7B	
	TMB6B	
	TMB5B	
	TMB4B	
	TMB3B	
	TMB2B	
	TMB1B	
41	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
	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
42	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	TEST	Test SELOGIC Equation
	IRIGOK	IRIG-B Time Synch Input Data is Valid
43	OUT01	Digital Output—Card 8, Terminals 81–82
	OUT02	Digital Output—Card 8, Terminals 83–84
	OUT03	Digital Output—Card 8, Terminals 85–86
	OUT04	Digital Output—Card 8, Terminals 87–88
	OUT05	Digital Output—Card 8, Terminals 89–90
	OUT06	Digital Output—Card 8, Terminals 91–92
	OUT07	Digital Output—Card 8, Terminals 93–94
	OUT08	Digital Output—Card 8, Terminals 95–96
44	OUT09	Digital Output—Card 9, Terminals 99–100
	OUT10	Digital Output—Card 9, Terminals 101–102
	OUT11	Digital Output—Card 9, Form C, Terminals 103, 104, 105
	*	Reserved
	*	Reserved
	*	Reserved

Table G.2 Relay Word Bit Definitions (Sheet 10 of 19)

Row	Bit	Definition
	*	Reserved
	*	Reserved
45	LT01	Latch bit variables LT01 through LT08
	LT02	
	LT03	
	LT04	
	LT05	
	LT06	
	LT07	
	LT08	
46	LT09	Latch bit variables LT09 through LT16
	LT10	
	LT11	
	LT12	
	LT13	
	LT14	
	LT15	
	LT16	
47	LT17	Latch bit variables LT17 through LT24
	LT18	
	LT19	
	LT20	
	LT21	
	LT22	
	LT23	
	LT24	
48	LT25	Latch bit variables LT25 through LT32
	LT26	
	LT27	
	LT28	
	LT29	
	LT30	
	LT31	
	LT32	
49	*	Reserved
	*	Reserved
	FRST_A1	Alarm Point A1 First Out
	FRST_A2	Alarm Point A2 First Out
	FRST_A3	Alarm Point A3 First Out
	FRST_A4	Alarm Point A4 First Out

Table G.2 Relay Word Bit Definitions (Sheet 11 of 19)

Row	Bit	Definition
	FRST_A5	Alarm Point A5 First Out
	FRST_A6	Alarm Point A6 First Out
50	*	Reserved
	*	Reserved
	FRST_B1	Alarm Point B1 First Out
	FRST_B2	Alarm Point B2 First Out
	FRST_B3	Alarm Point B3 First Out
	FRST_B4	Alarm Point B4 First Out
	FRST_B5	Alarm Point B5 First Out
	FRST_B6	Alarm Point B6 First Out
51	*	Reserved
	*	Reserved
	FRST_C1	Alarm Point C1 First Out
	FRST_C2	Alarm Point C2 First Out
	FRST_C3	Alarm Point C3 First Out
	FRST_C4	Alarm Point C4 First Out
	FRST_C5	Alarm Point C5 First Out
	FRST_C6	Alarm Point C6 First Out
52	*	Reserved
	*	Reserved
	FRST_D1	Alarm Point D1 First Out
	FRST_D2	Alarm Point D2 First Out
	FRST_D3	Alarm Point D3 First Out
	FRST_D4	Alarm Point D4 First Out
	FRST_D5	Alarm Point D5 First Out
	FRST_D6	Alarm Point D6 First Out
53	*	Reserved
	*	Reserved
	FRST_E1	Alarm Point E1 First Out
	FRST_E2	Alarm Point E2 First Out
	FRST_E3	Alarm Point E3 First Out
	FRST_E4	Alarm Point E4 First Out
	FRST_E5	Alarm Point E5 First Out
	FRST_E6	Alarm Point E6 First Out
54	*	Reserved
	*	Reserved
	FRST_F1	Alarm Point F1 First Out
	FRST_F2	Alarm Point F2 First Out
	FRST_F3	Alarm Point F3 First Out
	FRST_F4	Alarm Point F4 First Out

Table G.2 Relay Word Bit Definitions (Sheet 12 of 19)

Row	Bit	Definition
	FRST_F5	Alarm Point F5 First Out
	FRST_F6	Alarm Point F6 First Out
55	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
56	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
57	RB01	Remote Bits RB01 through RB08
	RB02	
	RB03	
	RB04	
	RB05	
	RB06	
	RB07	
	RB08	
58	RB09	Remote Bits RB09 through RB16
	RB10	
	RB11	
	RB12	
	RB13	
	RB14	
	RB15	
	RB16	
59	RB17	Remote Bits BR17 through RB24
	RB18	
	RB19	
	RB20	
	RB21	
	RB22	
	RB23	

Table G.2 Relay Word Bit Definitions (Sheet 13 of 19)

Row	Bit	Definition
	RB24	
60	RB25	Remote Bits RB25 through RB32
	RB26	
	RB27	
	RB28	
	RB29	
	RB30	
	RB31	
	RB32	
61	RB33	Remote Bits RB33 through RB40
	RB34	
	RB35	
	RB36	
	RB37	
	RB38	
	RB39	
	RB40	
62	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	RB_SIL	Remote Bit: SILence Control Bit
	RB_ACK	Remote Bit: ACKnowledge Control Bit
	RB_RST	Remote Bit: RESet Control Bit
	RB_CON1	Remote Bit: Auxiliary Control Bit
63	SV01	SELOGIC Control Equation Variables SV01 through SV08
	SV02	
	SV03	
	SV04	
	SV05	
	SV06	
	SV07	
	SV08	
64	SV01T	SELOGIC Control Equation Variables SV01T through SV08T with Settable Pickup and Dropout Time Delay
	SV02T	
	SV03T	
	SV04T	
	SV05T	
	SV06T	

Table G.2 Relay Word Bit Definitions (Sheet 14 of 19)

Row	Bit	Definition
	SV07T	
	SV08T	
65	SV09	SELOGIC Control Equation Variables SV09 through SV016
	SV10	
	SV11	
	SV12	
	SV13	
	SV14	
	SV15	
	SV16	
66	SV09T	SELOGIC Control Equation Variables SV09T through SV016T with Settable Pickup and Dropout Time Delay
	SV10T	
	SV11T	
	SV12T	
	SV13T	
	SV14T	
	SV15T	
	SV16T	
67	SV17	SELOGIC Control Equation Variables SV17 through SV024
	SV18	
	SV19	
	SV20	
	SV21	
	SV22	
	SV23	
	SV24	
68	SV17T	SELOGIC Control Equation Variables SV17T through SV024T with Settable Pickup and Dropout Time Delay
	SV18T	
	SV19T	
	SV20T	
	SV21T	
	SV22T	
	SV23T	
	SV24T	
69	SV25	SELOGIC Control Equation Variables SV25 through SV032
	SV26	
	SV27	
	SV28	
	SV29	
	SV30	

Table G.2 Relay Word Bit Definitions (Sheet 15 of 19)

Row	Bit	Definition
	SV31	
	SV32	
70	SV25T	SELOGIC Control Equation Variables SV25T through SV032T with Settable Pickup and Dropout Time Delay
	SV26T	
	SV27T	
	SV28T	
	SV29T	
	SV30T	
	SV31T	
	SV32T	
71	SV33	SELOGIC Control Equation Variables SV33 through SV040
	SV34	
	SV35	
	SV36	
	SV37	
	SV38	
	SV39	
	SV40	
72	SV33T	SELOGIC Control Equation Variables SV33T through SV040T with Settable Pickup and Dropout Time Delay
	SV34T	
	SV35T	
	SV36T	
	SV37T	
	SV38T	
	SV39T	
	SV40T	
73	SET01	SELOGIC Set Latch Bit Variables SET01 through SET08
	SET02	
	SET03	
	SET04	
	SET05	
	SET06	
	SET07	
	SET08	
74	RST01	SELOGIC Reset Latch Bit Variables RST01 through RST08
	RST02	
	RST03	
	RST04	
	RST05	
	RST06	

Table G.2 Relay Word Bit Definitions (Sheet 16 of 19)

Row	Bit	Definition
	RST07	
	RST08	
75	SET 09	SELOGIC Set Latch Bit Variables SET09 through SET16
	SET10	
	SET11	
	SET12	
	SET13	
	SET14	
	SET15	
	SET16	
76	RST09	SELOGIC Reset Latch Bit Variables RST09 through RST16
	RST10	
	RST11	
	RST12	
	RST13	
	RST14	
	RST15	
	RST16	
77	SET17	SELOGIC Set Latch Bit Variables SET17 through SET24
	SET18	
	SET19	
	SET20	
	SET21	
	SET22	
	SET23	
	SET24	
78	RST17	SELOGIC Reset Latch Bit Variables RST17 through RST24
	RST18	
	RST19	
	RST20	
	RST21	
	RST22	
	RST23	
	RST24	
79	SET25	SELOGIC Set Latch Bit Variables SET25 through SET32
	SET26	
	SET27	
	SET28	
	SET29	
	SET30	
	SET31	

Table G.2 Relay Word Bit Definitions (Sheet 17 of 19)

Row	Bit	Definition
	SET32	
80	RST25	SELOGIC Reset Latch Bit Variables RST25 through RST32
	RST26	
	RST27	
	RST28	
	RST29	
	RST30	
	RST31	
	RST32	
81	*	Reserved
	*	Reserved
	FAST_A1	FAST flash selection for Alarm Point A1
	FAST_A2	FAST flash selection for Alarm Point A2
	FAST_A3	FAST flash selection for Alarm Point A3
	FAST_A4	FAST flash selection for Alarm Point A4
	FAST_A5	FAST flash selection for Alarm Point A5
	FAST_A6	FAST flash selection for Alarm Point A6
82	*	Reserved
	*	Reserved
	FAST_B1	FAST flash selection for Alarm Point B1
	FAST_B2	FAST flash selection for Alarm Point B2
	FAST_B3	FAST flash selection for Alarm Point B3
	FAST_B4	FAST flash selection for Alarm Point B4
	FAST_B5	FAST flash selection for Alarm Point B5
	FAST_B6	FAST flash selection for Alarm Point B6
83	*	Reset
	*	Reset
	FAST_C1	FAST flash selection for Alarm Point C1
	FAST_C2	FAST flash selection for Alarm Point C2
	FAST_C3	FAST flash selection for Alarm Point C3
	FAST_C4	FAST flash selection for Alarm Point C4
	FAST_C5	FAST flash selection for Alarm Point C4
	FAST_C6	FAST flash selection for Alarm Point C6
84	*	Reset
	*	Reset
	FAST_D1	FAST flash selection for Alarm Point D1
	FAST_D2	FAST flash selection for Alarm Point D2
	FAST_D3	FAST flash selection for Alarm Point D3
	FAST_D4	FAST flash selection for Alarm Point D4
	FAST_D5	FAST flash selection for Alarm Point D5
	FAST_D6	FAST flash selection for Alarm Point D6

Table G.2 Relay Word Bit Definitions (Sheet 18 of 19)

Row	Bit	Definition
85	*	Reserved
	*	Reserved
	FAST_E1	FAST flash selection for Alarm Point E1
	FAST_E2	FAST flash selection for Alarm Point E2
	FAST_E3	FAST flash selection for Alarm Point E3
	FAST_E4	FAST flash selection for Alarm Point E4
	FAST_E5	FAST flash selection for Alarm Point E5
	FAST_E6	FAST flash selection for Alarm Point E6
86	*	Reserved
	*	Reserved
	FAST_F1	FAST flash selection for Alarm Point F1
	FAST_F2	FAST flash selection for Alarm Point F2
	FAST_F3	FAST flash selection for Alarm Point F3
	FAST_F4	FAST flash selection for Alarm Point F4
	FAST_F5	FAST flash selection for Alarm Point F5
	FAST_F6	FAST flash selection for Alarm Point F6
87	*	Reserved
	*	Reserved
	SLOW_A1	SLOW flash selection for Alarm Point A1
	SLOW_A2	SLOW flash selection for Alarm Point A2
	SLOW_A3	SLOW flash selection for Alarm Point A3
	SLOW_A4	SLOW flash selection for Alarm Point A4
	SLOW_A5	SLOW flash selection for Alarm Point A5
	SLOW_A6	SLOW flash selection for Alarm Point A6
88	*	Reserved
	*	Reserved
	SLOW_B1	SLOW flash selection for Alarm Point B1
	SLOW_B2	SLOW flash selection for Alarm Point B2
	SLOW_B3	SLOW flash selection for Alarm Point B3
	SLOW_B4	SLOW flash selection for Alarm Point B4
	SLOW_B5	SLOW flash selection for Alarm Point B5
	SLOW_B6	SLOW flash selection for Alarm Point B6
89	*	Reserved
	*	Reserved
	SLOW_C1	SLOW flash selection for Alarm Point C1
	SLOW_C2	SLOW flash selection for Alarm Point C2
	SLOW_C3	SLOW flash selection for Alarm Point C3
	SLOW_C4	SLOW flash selection for Alarm Point C4
	SLOW_C5	SLOW flash selection for Alarm Point C5
	SLOW_C6	SLOW flash selection for Alarm Point C6

Table G.2 Relay Word Bit Definitions (Sheet 19 of 19)

Row	Bit	Definition
90	*	Reserved
	*	Reserved
	SLOW_D1	SLOW flash selection for Alarm Point D1
	SLOW_D2	SLOW flash selection for Alarm Point D2
	SLOW_D3	SLOW flash selection for Alarm Point D3
	SLOW_D4	SLOW flash selection for Alarm Point D4
	SLOW_D5	SLOW flash selection for Alarm Point D5
	SLOW_D6	SLOW flash selection for Alarm Point D6
91	*	Reserved
	*	Reserved
	SLOW_E1	SLOW flash selection for Alarm Point E1
	SLOW_E2	SLOW flash selection for Alarm Point E2
	SLOW_E3	SLOW flash selection for Alarm Point E3
	SLOW_E4	SLOW flash selection for Alarm Point E4
	SLOW_E5	SLOW flash selection for Alarm Point E5
	SLOW_E6	SLOW flash selection for Alarm Point E6
92	*	Reserved
	*	Reserved
	SLOW_F1	SLOW flash selection for Alarm Point F1
	SLOW_F2	SLOW flash selection for Alarm Point F2
	SLOW_F3	SLOW flash selection for Alarm Point F3
	SLOW_F4	SLOW flash selection for Alarm Point F4
	SLOW_F5	SLOW flash selection for Alarm Point F5
	SLOW_F6	SLOW flash selection for Alarm Point F6

Glossary

ACSELERATOR QuickSet® SEL-5030 Software — A Windows®-based program that simplifies settings and provides analysis support.

ASCII — Abbreviation for American Standard Code for Information Interchange. Defines a standard way to communicate text characters between two electronic devices. The SEL-2523 uses ASCII text characters to communicate using the relay front- and rear-panel EIA-232 serial ports.

Assert — 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-2523 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.

Checksum — A numeric identifier of the firmware in the relay. Calculated by the result of a mathematical sum of the relay code.

CID — Abbreviation for Checksum Identifier. The checksum of the specific firmware installed in the relay.

CR_RAM — Abbreviation for Critical RAM. Refers to the area of relay Random Access Memory (RAM) where the relay stores mission critical data.

Deassert — 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-2523 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.

Dropout Time — 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.

Device Word — The collection of device element and logic results. Each element or result is represented by a unique identifier, known as a Device Word bit.

Device Word Bit — A single relay element or logic result that the relay 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.

EEPROM — Abbreviation for Electrically Erasable Programmable Read-Only Memory. Nonvolatile memory where relay settings, event reports, SER records, and other nonvolatile data are stored.

EIA-232 — Electrical definition for point-to-point serial data communications interfaces, based on the standard EIA/TIA-232. Formerly known as RS-232.

EIA-485 — Electrical standard for multidrop serial data communications interfaces, based on the standard EIA/TIA-485. Formerly known as RS-485.

Fast Meter, Fast Operate Binary serial port commands that the relay recognizes at the relay front-and rear-panel EIA-232 serial ports. These commands and the responses from the relay make relay 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.

FID Device firmware identification string. Lists the relay model, firmware version and date code, and other information that uniquely identifies the firmware installed in a particular relay.

Firmware The nonvolatile program stored in the relay that defines relay operation.

Flash A type of nonvolatile relay memory used for storing large blocks of nonvolatile data, such as load profile records.

IRIG-B A time code input that the device can use to set the internal device clock.

LED Abbreviation for Light-Emitting Diode. Used as indicator lamps on the relay front panel.

NEMA Abbreviation for National Electrical Manufacturers Association.

Nonvolatile Memory Device memory that is able to correctly maintain data it is storing even when the relay is de-energized.

Pickup Time 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.

Pinout The definition or assignment of each electrical connection at an interface. Typically refers to a cable, connector, or jumper.

RAM Abbreviation for Random Access Memory. Volatile memory where the relay stores intermediate calculation results, Device Word bits, and other data that are updated every processing interval.

Remote Bit 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 DNP3.

ROM Abbreviation for Read-Only Memory. Nonvolatile memory where the relay firmware is stored.

Self-Test A function that verifies the correct operation of a critical device subsystem and indicates if an out-of-tolerance condition is detected. The SEL-2523 is equipped with self-tests that validate the relay power supply, microprocessor, memory, and other critical systems.

SELOGIC Control Equation A relay setting that allows you to control a relay function (such as an output contact) by using a logical combination of relay 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.

Sequential Events Recorder A relay 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 relay operation.

SER Abbreviation for Sequential Events Recorder or the device serial port command to request a report of the latest 1024 sequential events.

Terminal Emulation Software Personal computer (PC) software that can be used to send and receive ASCII text messages via the PC serial port.

Z number That portion of the relay RID string that identifies the proper ACSELERATOR QuickSet software relay driver version when creating or editing relay settings files.

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Page numbers appearing in bold mark the location of the topic's primary discussion.

SEL-2523 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
Access Level 0 Commands	
ACC	Go to Access Level 1
ID	Relay identification code
QUI	Go to Access Level 0
Access Level 1 Commands	
2AC	Go to Access Level 2
COM A	Return a summary report of the last 255 records in the communications buffer for MIRRORED BITS® communications Channel A
COM B	Return a summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel B
COM C	Clears all communications records. If both MIRRORED BITS channels are enabled, omitting the channel specifier (A or B) clears both channels
COM C A	Clears all communications records for Channel A
COM C B	Clears all communications records for Channel B
COM L A	Appends a long report to the summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel A
COM L B	Appends a long report to the summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel B
DAT	View the date
DAT *dd/mm/yyyy*	Enter date in DMY format
DAT *mm/dd/yyyy*	Enter date in MDY format if DATE_F setting is MDY
DAT *yyyy/mm/dd*	Enter date in YMD format if DATE_F setting is YMD
FIL DIR	Return a list of files
FIL READ *filename*	Transfer settings file *filename* from the relay to the PC
FIL SHOW *filename*	Filename 1 displays contents of the file filename
GRO	Display active group setting
HEL	Display a short description of selected commands
IRI	Force synchronization of internal control clock to IRIG-B time-code input
MAP *x*	Display DNP3 map for port *x*
SER	Display all Sequential Events Recorder (SER) data
SER *date 1*	Display all SER records made on *date 1*
SER *date 1 date 2*	Display all SER records made from *date 2* to *date 1*, inclusive, starting with *date 2*
SER *row 1*	Display the *n* most recent SER records starting with record *n*
SER *row 1 row 2*	Display SER records *n2* to *n1*, starting with *n2*
SER C or R	Clear SER data
SER D	Display removed SER data
SHO	Display relay settings

Serial Port Command	Command Description
SHO DNP	Show DNP3 settings
SHO G	Display global settings
SHO L	Display general logic settings
SHO P *n*	Display port settings, where *n* specifies the port (2, 3, 4, or F); *n* defaults to the active port if not listed
SHO R	Display report settings
STA	Display relay self-test status
STA S	Display SELOGIC usage status report
TAR	Use TARGET without parameters to display Device Word row 0, or the most recently viewed target row
TAR *n k*	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)
TAR R	Displays Device Word row 0
TIM	View time
TIM *hh:mm:ss*	Set time by entering **TIM** followed by hours, minutes, and seconds, as shown (24-hour clock)
Access Level 2 Commands	
CAL	Go to Access Level C.
CON B RB_*xx*P	Pulse the following bits that simulate remote pushbutton operation of RB_SIL, RB_ACK, or RB_RST
CON O *n m*	Close output contact *n* can be set from OUT01 to OUT11 for *m* seconds, *m* can be set from 1 through 30 seconds, default is 1 second if unspecified
CON RB*n m*	Set, clear, or pulse a Remote Bit where *n* is remote bit number 1 through 40 and *m* is either s for set, p for pulse, or c for clear
FIL WRITE *filename*	Transfer settings file *filename* from the PC to the relay
L_D	Load new firmware
LOO	Enables loopback testing of MIRRORED BITS channels
LOO A	Enable loopback on MIRRORED BITS Channel A for the next 5 minutes
LOO B	Enable loopback on MIRRORED BITS Channel B for the next 5 minutes
PAS	Show existing Access Level 1 and Level 2 passwords
PAS 1	Change Access Level 1 password
PAS 2	Change Access Level 2 password
PUL *n*	Pulse Output Contact *n* (*n* = OUT01…OUT11) for 1 seconds
SET	Modify relay settings
SET DN	Enter/change DNP3 settings
SET G	Modify global settings
SET L	Modify SELOGIC variable and timer settings
SET *name*	For all **SET** commands, jump ahead to a specific setting by entering the setting name
SET P *n*	Modify port *n* settings (*n* = 2, 3, 4, or F; if not specified, the default is the active port)
SET R	Modify report settings
SET … TERSE	For all **SET** commands, **TERSE** disables the automatic **SHO** command after the settings entry
STA R or C	Clear self-test status and restart relay

SEL-2523 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
Access Level 0 Commands	
ACC	Go to Access Level 1
ID	Relay identification code
QUI	Go to Access Level 0
Access Level 1 Commands	
2AC	Go to Access Level 2
COM A	Return a summary report of the last 255 records in the communications buffer for MIRRORED BITS® communications Channel A
COM B	Return a summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel B
COM C	Clears all communications records. If both MIRRORED BITS channels are enabled, omitting the channel specifier (A or B) clears both channels
COM C A	Clears all communications records for Channel A
COM C B	Clears all communications records for Channel B
COM L A	Appends a long report to the summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel A
COM L B	Appends a long report to the summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel B
DAT	View the date
DAT *dd/mm/yyyy*	Enter date in DMY format
DAT *mm/dd/yyyy*	Enter date in MDY format if DATE_F setting is MDY
DAT *yyyy/mm/dd*	Enter date in YMD format if DATE_F setting is YMD
FIL DIR	Return a list of files
FIL READ *filename*	Transfer settings file *filename* from the relay to the PC
FIL SHOW *filename*	Filename 1 displays contents of the file filename
GRO	Display active group setting
HEL	Display a short description of selected commands
IRI	Force synchronization of internal control clock to IRIG-B time-code input
MAP *x*	Display DNP3 map for port *x*
SER	Display all Sequential Events Recorder (SER) data
SER *date 1*	Display all SER records made on *date 1*
SER *date 1 date 2*	Display all SER records made from *date 2* to *date 1*, inclusive, starting with *date 2*
SER *row 1*	Display the *n* most recent SER records starting with record *n*
SER *row 1 row 2*	Display SER records *n2* to *n1*, starting with *n2*
SER C or R	Clear SER data
SER D	Display removed SER data
SHO	Display relay settings

Serial Port Command	Command Description
SHO DNP	Show DNP3 settings
SHO G	Display global settings
SHO L	Display general logic settings
SHO P *n*	Display port settings, where *n* specifies the port (2, 3, 4, or F); *n* defaults to the active port if not listed
SHO R	Display report settings
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SET R	Modify report settings
SET … TERSE	For all **SET** commands, **TERSE** disables the automatic **SHO** command after the settings entry
STA R or C	Clear self-test status and restart relay