SEL-2410 Relay

I/O Processor

Instruction Manual

20120907

SCHWEITZER ENGINEERING LABORATORIES, INC.

⚠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
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
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.

⚠WARNING
Clearly mark the circuit breaker that interrupts power to the I/O Processor to identify that circuit breaker as the means for disconnecting power to the I/O processor.

⚠AVERTISSEMENT
Identifier clairement l'interrupteur qui commande l'arrivée de l'alimentation au processeur des entrées-sorties de façon à indiquer comment interrompre l'alimentation.

⚠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
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.

⚠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 blessuers ou la mort.

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

This product is covered by the standard SEL 10-year warranty. For warranty details, visit www.selinc.com or contact your customer service representative.

PM2410-01

Table of Contents

Appendix A: Firmware and Manual Versions

Appendix B: Firmware Upgrade Instructions

Appendix C: SEL Communications Processors

Appendix D: I/O Processor Word Bits

Glossary

Index

SEL-2410 Command Summary

List of Tables

List of Figures

Preface

Manual Overview

The SEL-2410 I/O Processor Instruction Manual provides specification for and describes installation, setting, testing and operation of the I/O processor. It also includes detailed information about settings and serial port and front-panel 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-2410, and lists the specifications.

Section 2: Installation. Describes how to mount and wire the SEL-2410; illustrates wiring connections.

Section 3: Settings. Describes SET/SHOW ASCII commands, explains Group, Logic, Global, Port, Front panel and Report settings; discusses optoisolated and remote inputs; includes SEL-2410 setting sheets.

Section 4: Communications. Explains the physical interfaces of the SEL-2410. Describes how to connect the SEL-2410 to a PC for communication; shows serial port pinouts.

Section 5: Front-Panel Operations. Explains the features and use of the front panel, including front-panel command menus, default displays, target LEDs, and configurable front-panel LED labels.

Section 6: Analyzing Events. Explains SER accuracy, shows SER report format and triggering.

Section 6: Analyzing Events. Lists testing tools and troubleshooting instructions.

Appendix A: Firmware and Manual Versions. Lists the current firmware versions and details differences between the current and previous 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: I/O Processor Word Bits. Lists and describes the Device Word bits.

SEL-2410 Command Summary. Briefly describes the serial port commands that are fully described in *ASCII Commands on page 4.9*.

Conventions

Typographic Conventions

There are two ways to communicate with the SEL-2410:

- Using a command line interface on a PC terminal emulation window.
- Using the front-panel menus and pushbuttons.

The instructions in this manual indicate these options with specific font and formatting attributes. The following table lists these conventions:

Typographic Conventions

Example	Description
STATUS	Commands typed at a command line interface on a PC.
<Enter>	Single keystroke on a PC keyboard.
<Ctrl+D>	Multiple/combination keystroke on a PC keyboard.
Start > Settings	PC software dialog boxes and menu selections. The > character indicates submenus.
CLOSE	Relay front-panel pushbuttons.
ENABLE	Relay front- or rear-panel labels.
MAIN > METER	Relay front-panel LCD menus and relay responses visible on the PC screen. The > character indicates submenus.

Cross-References

Cross-references are formatted as described below in both the hard copy and electronic documentation for the SEL-2410. In the electronic documentation, clicking with the mouse on cross-references takes you to the referenced location.

- References to figures, tables, examples, and equations include only the referenced item:
  - *Table 3.1* (*3* indicates the section number)
  - *Figure 4.5* (*4* indicates the section number)
- References to headings on another page include the heading title and the page number:
  - *Disconnect Monitoring on page 3.8*

Examples

This instruction manual uses several example illustrations and instructions to explain how to effectively operate the SEL-2410. These examples are for demonstration purposes only; the firmware identification information or settings values included in these examples may not necessarily match those in the current version of your SEL-2410.

Safety and General Information

Safety Information

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

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

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

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

Symbols

The following symbols from EN 61010-1 are often marked on SEL products.

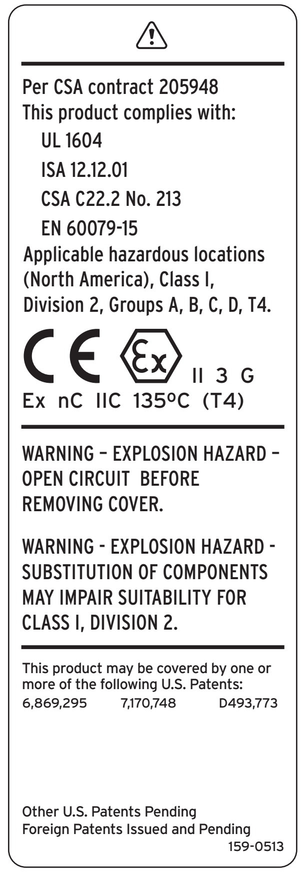
Symbol 14		Consult Documentation for Additional Information
Symbol 6		Protective (Safety) Ground Conductor Terminal
Symbol 1		Direct Current
Symbol 2		Alternating Current
Symbol 3		Direct and Alternating Current
Symbol 5		Earth (Ground) Terminal

Hazardous Locations Approvals

The SEL-2410 complies with UL 1604, ISA 12.12.01, CSA 22.2 No. 213 and EN 60079-15. In North America, the relay is approved for Class 1, Division 2, Groups A, B, C, D, and T4 in the –40° to +70°C temperature range.

To comply with the requirements of the European ATEX directive for hazardous locations, the SEL-2410 must be installed in an enclosure that meets the requirements of an Ex n enclosure rated IP54 or better. The enclosure should be certified to these requirements or be tested for compliance as part of the complete assembly.

The following figure shows the compliance label that is located on the left side of the device.



Product Compliance Label for Hazardous Locations Approval

Environmental Conditions and Voltage Information

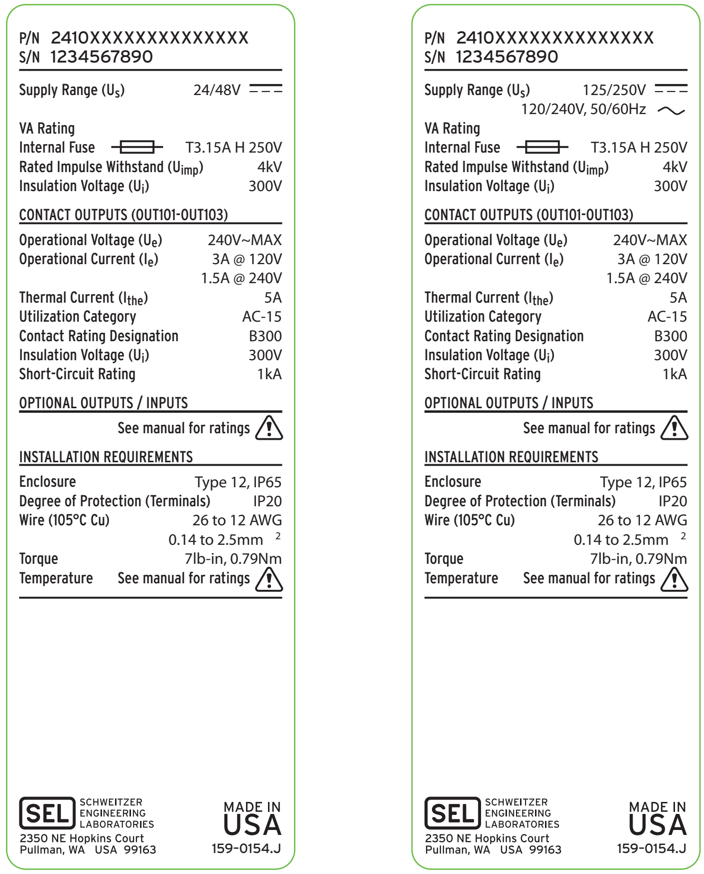
The following table lists important environmental and voltage information.

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
UL/CSA Safety Rating	–40 to +70°C
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

Laser/LED Emitter

The SEL-2410 is a Class 1 LED Product and complies with IEC 60825 1:1993 + A1:1997 + A2:2001. The following figure shows the compliance label that is located on the left side of the device (when facing the front of the device).



(for low voltage supply) (for high voltage supply)

(located on the side)

Class 1 LED Product Compliance Label and Location

Safety Warnings and Precautions

⚠CAUTION
Use of controls or adjustments, or performance of procedures other than those specified herein, may result in hazardous radiation exposure.

Do not perform any procedures or adjustments that are not described in this manual.

Wire Sizes and Insulation

Wire sizes for grounding (earthing), current, voltage, 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)
Current Connection	16 AWG (1.5 mm^2)	10 AWG (4 mm^2)
Potential (Voltage) Connection	18 AWG (0.8 mm^2)	14 AWG (2.5 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)

You should use wire with 0.4 mm thick insulation for high voltage connections to allow for contact between adjacent wires. If possible, use 0.4 mm insulated wires for all connections.

Instructions for Cleaning and Decontamination

Use care when cleaning the SEL-2410. 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 USA
Phone: +1.509.332.1890
Fax: +1.509.332.7990
Internet: www.selinc.com
E-mail: info@selinc.com

Section 1
Introduction and Specifications

Overview

The SEL-2410 I/O Processor provides digital and analog inputs (transducer inputs) and output contacts for many diverse I/O applications. For smaller applications select the base unit only (two digital inputs and three contact outputs), or add up to four additional input/output cards to tailor the SEL-2410 to specific applications. Combine the additional input/output cards in any combination (maximum one analog card) in four available slots. Each digital input card contains eight digital inputs, the analog input card contains eight transducer inputs, and each output card contains eight normally open (Form-A) contact outputs. Jumper select the eight analog inputs on the analog input card in any combination for either current measurement (±1, 2.5, 5, 10 and 20 mA, or 4–20 mA), or voltage (±1, 2.5, 5, or 10 V) measurement.

Use SELOGIC® control equations to program and configure your SEL-2410. SELOGIC control cquations provide a range of operators, including boolean functions.

This manual contains information necessary to install, test, operate and maintain any SEL-2410. It is not necessary to review the entire manual to perform specific tasks.

Features

Standard Features

- Base unit with two isolated dry inputs, two Form-A outputs, and one Form-C output
- Expandable I/O (Select from three types of I/O)
- Programmable Logic
- Human-Machine-Interface with illuminated multiline display
- One front serial port and one rear serial port
- IRIG-B input
- Password protection on all communication levels
- Digital inputs sampled and debounced at a rate of 2 kHz
- Analog inputs sampled at 250 Hz
- Analog inputs includes two warning levels above setting and two warning levels below setting
- Contact outputs updated at a rate of 2 kHz

Reporting/Monitoring Features

- Sequential Event Report (SER) with ±1 ms time tag resolution
- Records the instant when detecting the first change of status
- Ability to identify and remove chattering inputs from the SER
- 96 settable trigger conditions
- Stores up to 512 entries in nonvolatile memory

Communications

- One non-isolated EIA-232 front-panel port and one non-isolated EIA-232 rear port (DB-9 connectors)
- Transmission speed between 300 and 38400 bps (effective 9600 or better)
- Xmodem file transfer on the front port
- Ymodem file transfer on the front and rear port
- IRIG-B supported on the rear port
- Fast Meter, Fast SER, and Fast Operate protocols supported (rear port)

Automation and Control

- Programmable Boolean operators (such as AND, OR and parentheses)
- Programmable logic functions (such as timers and latches)
- Contact output logic to assign outputs from I/O processor logic to I/O processor contact outputs
- Remote control to close output contacts and reset targets from remote locations

Models, Options and Accessories

Models

This manual does not provide complete ordering information. For complete information, see the latest SEL-2410 Model Option Table (MOT) at www.selinc.com, under SEL Literature, Ordering Information (Model Option Tables).

Options

- Input card with eight digital inputs
- Output card with eight contact outputs
- Analog (transducer) input card with eight inputs

Accessories

SEL-2410 Configurable Labels

Specifications

General

Power Supply

Rated Supply Voltage

Low-Voltage Model:	24/48 Vdc
High-Voltage Model:	125/250 Vdc 120/240 Vac, 50/60 Hz

Input Voltage Range

Low-Voltage Model:	18–60 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

Digital Output

See *Table 1.1* for derating.

Conventional Enclosed Thermal Current (I_{the}) Rating:	5 A
Operational Current (I_e) Rating:	3 A @ 120 Vac 1.5 A @ 240 Vac
Utilization Category:	AC-15
Contact Rating Designation:	B300
Operational Voltage (U_e) Rating:	240 Vac
Insulation Voltage (U_i) Rating:	300 Vac
Rated Impulse Withstand Voltage (U_{imp}):	4000 V

Digital Inputs

Rated Operating Voltage (U_e) [External Wetting Voltage] and Current Drawn:	24 Vac/Vdc (10 mA) 48 Vac/Vdc (4 mA) 110 Vac/Vdc (4 mA) 120 Vac/Vdc (4 mA) 220 Vac/Vdc (2 mA) 250 Vac/Vdc (2 mA)

Assertion/Deassertion

Nominal Rating (Vdc)	Deassertion (Vdc) /	Assertion (Vdc)
24 V	< 5.0	15.0–30.0
48 V	< 28.8	38.4–52.8
110 V	< 66.0	88.0–121.0
125 V	< 75.0	100.0–137.5
220 V	< 132.0	176.0–242.0
250 V	< 150.0	200.0–275.0

Nominal Rating (Vac)	Deassertion (Vac) /	Assertion (Vac)
24 V	< 5.00	14.00–27.00
48 V	< 20.16	32.64–57.60
110 V	< 46.20	74.80–132.00
125 V	< 52.50	85.00–150.00
220 V	< 92.40	149.60–264.00
250 V	< 105.00	170.00–300.00

Rated Insulation Voltage (U_i):	300 Vac/Vdc
Rated Impulse Withstand Voltage (U_{imp}):	4000 V

Analog Inputs

Input Impedance

Current Mode:	200 Ω
Voltage Mode:	>10 kΩ

Input Ranges

Current Mode:	±20 mA
Voltage Mode:	±10 V
Sampling Rate:	At least 4 ms

Accuracy at 25°C:

ADC:	16 bit
With User Calibration:	0.05% of full scale (current mode) 0.025% of full scale (voltage mode)
Without Calibration:	Better than 0.5% of full scale at 25°C

Accuracy Variation With Temperature:

±0.015% per °C of full scale (±20 mA or ±10 V)

Communications Ports

Standard EIA-232 (2 ports)

Location:	Front Panel Rear Panel
Data Speed:	300–38400 bps

Operating Temperature Range

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

UL/CSA Safety Rating:	+70°C (158°F) maximum
UL CSA Conformal Coated:	–40° to +70°C (–40° to +158°F)

Operating Environment

Pollution Degree:	2
Overvoltage Category:	II

Dimensions

Refer to *Figure 2.1* for I/O processor dimensions.

Weight

2.0 kg (4.4 lbs)

Type Tests

Environmental Tests

Enclosure Protection: IEC 60529:2001
IP65 enclosed in panel
IP20 for 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 60068-2-1:1990
–40°C, 16 hours

Damp Heat, Steady State: IEC 60068-2-78:2001
40°C, 93% relative humidity, 4 days

Damp Heat, Cyclic: IEC 60068-2-30:1980
25–55°C, 6 cycles,
95% relative humidity

Dry Heat: IEC 60068-2-2:1993
85°C, 16 hours

Dielectric Strength and Impulse Tests

Dielectric (HIPOT): IEC 60255-5:2000
IEEE C37.90-1989
2.0 kVac on analog inputs, digital I/O
2.83 kVdc on power supply

Impulse: IEC 60255-5:2000
0.5 J, 4.7 kV on power supply, digital 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

Radiated RF Immunity: IEC 61000-4-3:2002, 10 V/m
IEEE C37.90.2-1995, 35 V/m

Fast Transient, Burst Immunity: IEC 61000-4-4:2001
4 kV @ 2.5 kHz
2 kV @ 5.0 kHz for comm. ports
IEEE C37.90.1-1989, 5 kV

Surge Immunity: IEC 61000-4-5:2001
2 kV line-to-line
4 kV line-to-earth

Surge Withstand Capability Immunity: IEC 60255-22-1:1988
2.5 kV common-mode
2.5 kV differential-mode
1 kV common-mode on comm. ports
IEEE C37.90.1-1989
3 kV oscillatory
5 kV fast transient

Conducted RF Immunity: IEC 61000-4-6:2003, 10 Vrms

Magnetic Field Immunity: IEC 61000-4-8:2001
1000 A/m for 3 seconds
100 A/m for 1 minute

EMC Emissions

Conducted Emissions: EN 55011:1998, Class A

Radiated Emissions: EN 55011:1998, Class A

Electromagnetic Compatibility

Product Specific: EN 50263:1999
EN 60947-4-1:2001
EN 60947-5-1:1997

Certifications

ISO 9001: This product was designed and manufactured under an ISO 9001 certified quality management system.

UL/CSA: UL 61010-1 and CAN/CSA 22.2 No. 1010-1-03

CE: CE Mark–EMC Directive
Low Voltage Directive
EN 61010-1:2001

Hazardous Locations Approvals: Complies with UL1604, ISA 12.12.01, CSA 22.2 No. 213, and EN 60079-15.

Processing Specifications

Digital inputs sampled and debounced every 0.5 ms.
Analog (Transducer) inputs sampled every 4 ms.
Timers (SELOGIC control equations) sampled every 4 ms.

Table 1.1 UL/CSA Output Contact Temperature Derating for Operating at Elevated Temperatures

Number of Digital Output (DO) Cards Installed	Operating Ambient	Maximum Value of Current (I_{the})	Duty Factor	Special Conditions
1–3	less than or equal to 65°C	5.0 A	Continuous	N/A
1–3	between 65° and 80°C	2.5 A	Continuous	OUT101–OUT103 deasserted and carrying no current
4	less than or equal to 60°C	5.0 A	Continuous	N/A
4	between 60° and 70°C	2.5 A	Continuous	OUT101–OUT103 deasserted and carrying no current

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Section 2
Installation

Overview

The first steps in applying the SEL-2410 I/O Processor are installing and connecting the I/O processor. This section describes common installation features and requirements and I/O options. To install and connect the I/O processor safely and effectively, you must be familiar with I/O processor configuration features and options. You should carefully plan I/O processor placement, cable connections, and I/O processor communication. This section contains drawings of typical ac and dc connections to the SEL-2410. Use these drawings as a starting point for planning your particular I/O processor application.

I/O Processor Placement

Proper placement of the SEL-2410 I/O Processor helps make certain that you receive years of trouble-free service. Use the following guidelines for proper physical installation of the SEL-2410.

Physical Location

You can mount the SEL-2410 in a sheltered indoor environment (a building or an enclosed cabinet) that does not exceed the temperature and humidity ratings for the I/O processor. The I/O processor is IEC EN61010-1 rated at Installation/ Overvoltage Category II and Pollution Degree 2. This rating allows mounting of the I/O processor indoors or in an outdoor (extended) enclosure where the I/O processor is protected against exposure to direct sunlight, precipitation, and full wind pressure, but neither temperature nor humidity are controlled. You can place the I/O processor in extreme temperature and humidity locations. (See *Specifications on page 1.4*). For EN 61010 certification, the SEL-2410 rating is 2000 m (6560 feet) above mean sea level.

To comply with the requirements of the European ATEX standard for hazardous locations, the SEL-2410 must be installed in an enclosure that meets the requirements of an Ex n enclosure rated IP54 or better. The enclosure should be certified to these requirements or be tested for compliance as part of the complete assembly. In North America, the relay is approved for Class 1, Division 2, Groups A, B, C, D, and T4 hazardous locations.

I/O Processor Mounting

To flush mount the SEL-2410 in a panel, cut a rectangular hole with the dimensions shown in *Figure 2.1*.

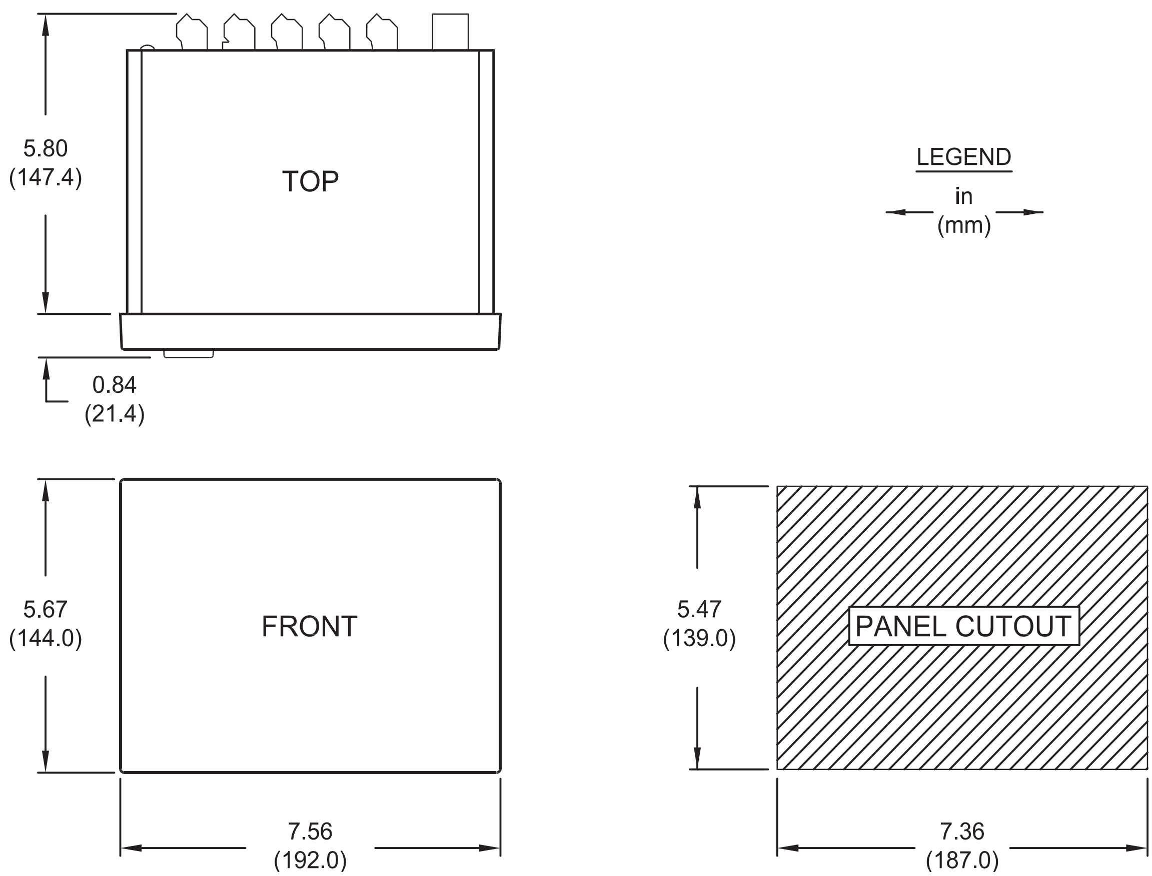

Figure 2.1 I/O Processor Panel-Mount Dimensions

I/O Configuration

> **⚠WARNING**
> After any change, be sure to thoroughly test the I/O processor settings.

> **⚠WARNING**
> Power down the SEL-2410 before changing any cards.

Your SEL-2410 offers complete flexibility in tailoring I/O to your specific application. In total, the SEL-2410 has six rear-panel slots, labeled as Slots **A**, **B**, **C**, **D**, **E** and **Z**. Slots **A** and **B** are fixed (base unit), but you can apply any of the following three types of I/O cards in any combination in Slot **C** through Slot **Z**:

- ➤ Analog input card with eight analog (transducer) inputs
- ➤ Digital input card with eight digital inputs
- ➤ Output card with eight contact outputs

There is only one input limitation: the I/O processor accepts only one analog (transducer) card. However, you can install up to four digital I/O cards (total 32 inputs) or up to four digital output cards (total 32 outputs). Changing card positions, or expanding on the initial number of cards, requires no card programming; the I/O processor detects the new hardware and updates the software accordingly. (You still have to program the I/O using the **SET** command).

Analog Inputs Card Voltage/Current Jumper Selection

Figure 2.2 shows the circuit board of an analog input board. Jumper *x* (*x* = 1 through 8) determines the nature of each channel. For a current channel, insert Jumper *x* in position 12; for a voltage channel, insert Jumper *x* in position 23.

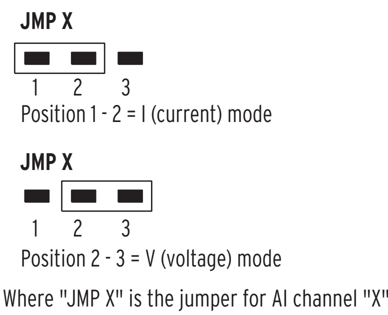

Figure 2.2 Circuit Board of Analog Input Board, Showing Jumper Selection

Password and SELBOOT Jumper Selection

Figure 2.3 shows the major components of the **B**-slot card. Notice the three sets of pins labeled **A**, **B**, and **C**.

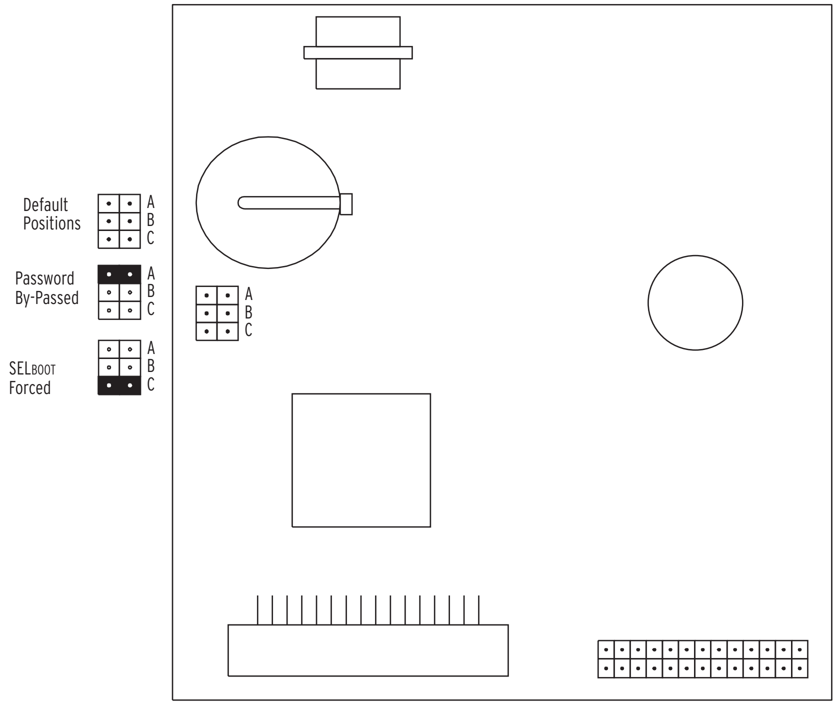

Figure 2.3 Pins for Password Jumper and SELBOOT Jumper

Pins labeled **A** by-pass the password requirement, and pins labeled **C** force the relay to the SEL operating system called SELBOOT (pins labeled **B** are not used). When forced to SELBOOT, you can only communicate with the I/O processor via the front-panel port. *Table 2.1* tabulates the functions of the three sets of pins and jumper default positions.

Table 2.1 Jumper Functions and Default Positions

Pins	Description	Jumper Default Position
A	Password by-pass	Not by-passed (requires password)
B	Not used	Not used
C	Forced SELBOOT	Not by-passed (not forced SELBOOT)

Position the jumper as shown in *Figure 2.3* (position A) to gain access to Level 1 and Level 2 command levels without passwords. Although you gain access to Level 2 without a password, the alarm contact still closes momentarily when accessing Level 2. Should the I/O processor suffer an internal failure, communications with the I/O processor may be compromised. Forcing the I/O processor to SELBOOT provides a means of downloading new firmware.

Rear-Panel Diagram

Figure 2.4 shows the physical layout of the connectors on the rear-panel of a fully configured SEL-2410.

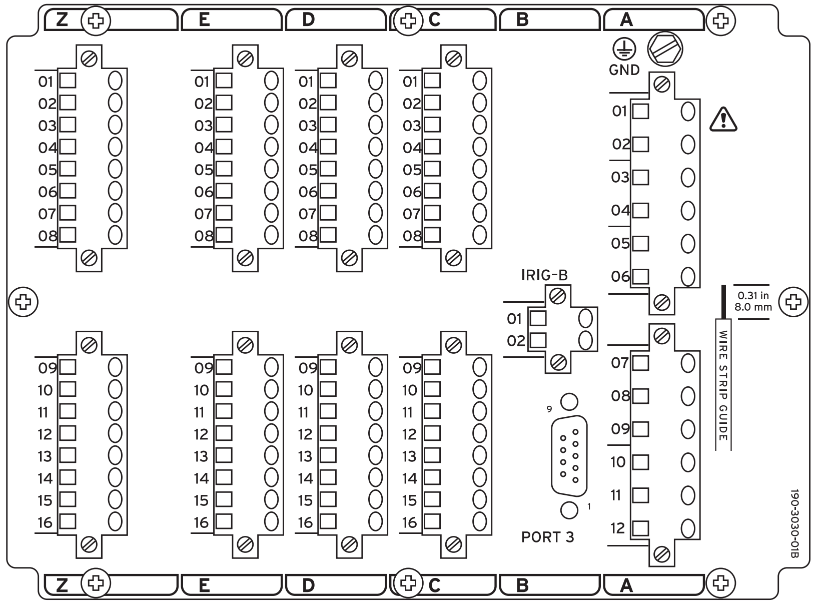

Figure 2.4 Rear-Panel Layout

Top-Panel Diagram

Figure 2.5 and *Figure 2.6* show the input and output designations for the rear-panel connectors of two fully configured SEL-2410 I/O processors. This diagram is located on the top panel of the I/O processor.

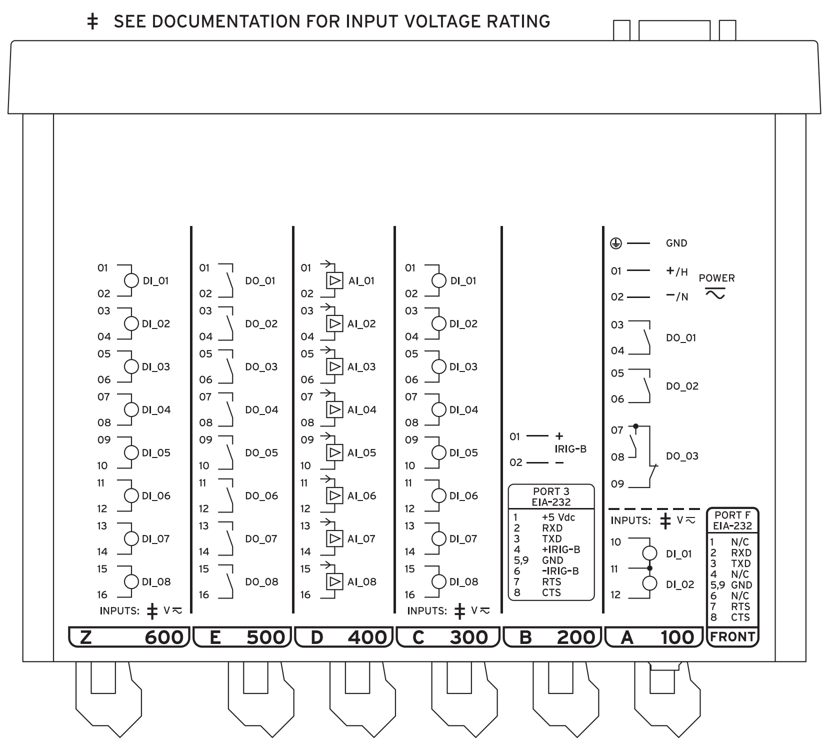

Figure 2.5 Top-Panel Input and Output Designations

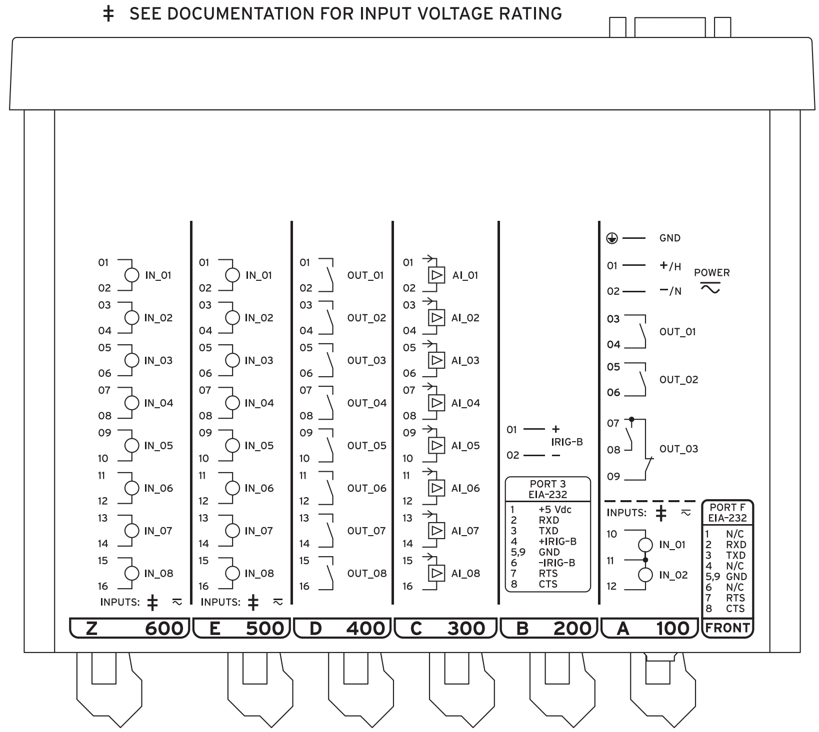

Figure 2.6 Top-Panel Input and Output Designations

Power Connections

The **POWER** terminals on the rear panel (**A01**(**+/H**) and **A02**(**-/N**)) must connect to 110–240 Vac or 110–250 Vdc. (See *Power Supply on page 1.4* for complete power input specifications.) The **POWER** terminals are isolated from chassis ground. Use 16 AWG (1.5 mm^2) size or heavier wire to connect to the **POWER** terminals. Place an external switch, circuit breaker, or overcurrent device in the **POWER** leads for the SEL-2410; this device must interrupt both the hot (**H**) and neutral (**N**) power leads. The maximum current rating for the power disconnect circuit breaker or overcurrent device (fuse) must be 20 A. Be sure to locate this device within 3.0 m (9.8 feet) of the I/O processor. Operational power is internally fused by a power supply fuse (T 3.15 A H250 V 5 x 20 mm). Be sure to use fuses that comply with IEC 60127-2.

I/O Diagram

A more functional representation of the control (I/O) connections is shown in *Figure 2.7*.

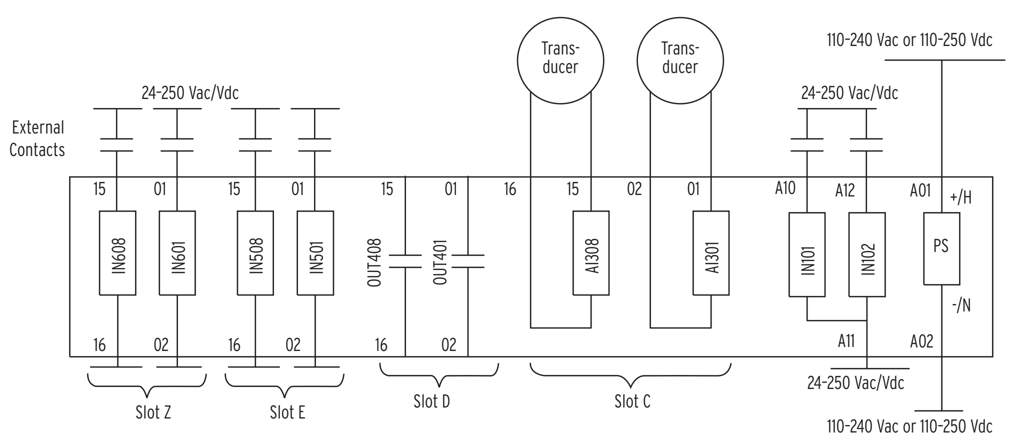

Figure 2.7 Control I/O Connections

- ➤ Optoisolated inputs IN101 and IN102 are standard and located on the card in Slot **A**.
- ➤ All optoisolated inputs are single-rated: 24, 48, 110, 120, 220, or 250 Vac/Vdc.
- ➤ Transducer inputs AI301 through AI308 located on the optional card in Slot **C**.
- ➤ Output contacts OUT401 through OUT408 are located on the optional I/O card in Slot **D**.
- ➤ Optoisolated inputs IN501 through IN508 are located on the optional I/O card in Slot **E**.
- ➤ Optoisolated inputs IN601 through IN608 are located on the optional I/O card in Slot **Z**.

Field Serviceability

The SEL-2410 firmware may be upgraded in the field; refer to *Appendix B: Firmware Upgrade Instructions* for firmware upgrade instructions. You may know when a self-test failure has occurred by configuring an output contact to create a diagnostic alarm. By using the metering functions, you may know if the analog front-end (not monitored by I/O processor self-test) is functional. Refer to *Section 7: Testing and Troubleshooting* for detailed testing and troubleshooting 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 (date and time) 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 10 years at rated load. When the I/O processor is powered from an external source, the battery experiences a low self-discharge rate. Thus, battery life may extend well beyond 10 years. The battery cannot be recharged.

Fuse Replacement

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

Step 1. De-energize the device.

Step 2. Remove the eight rear-panel screws, ground screw, plug-in connectors and the device rear panel.

Step 3. Remove the Slot **A** printed circuit board.

Step 4. Locate the fuse on the board.

Step 5. Remove the fuse from the fuse holder.

Step 6. Ensure fuse holder has not been damaged, bent, or deformed.

Step 7. Be sure to 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 (T315H 250 V).

Step 9. Insert the printed circuit board into Slot **A**.

Step 10. Replace the device rear panel, reinstall all screws and connectors, and energize the unit.

⚠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.

Real-Time Clock Battery Replacement

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

Step 1. De-energize the I/O processor.

Step 2. Remove the eight rear-panel screws, ground screw, plug-in connectors and the I/O processor rear panel.

Step 3. Remove the Slot **B** printed circuit board.

Step 4. Locate the battery clip (holder) on the board.

Step 5. Carefully remove the battery from beneath the clip. Properly dispose of the old battery.

Step 6. Install the new battery with the positive (+) side facing up.

Step 7. Insert the printed circuit board into Slot **B**.

Step 8. Replace the I/O processor rear panel, reinstall all screws and connectors, and energize the unit.

Step 9. Set the I/O processor date and time.

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Section 3
Settings

Overview

For ease of setting the SEL-2410 I/O Processor, I/O processor settings are grouped into six categories. This section describes the settings when using serial communications. I/O processor settings available by serial communications are similar to settings available when setting the I/O processor by front-panel pushbuttons (see *Set/Show Menu on page 5.10*). Setting categories include the following:

Group Settings. Lists settings associated with analog transducers.

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. (p = F or 3) Lists settings that configure the I/O processor front- and rear-panel serial ports.

Front-Panel Settings. Lists settings for the front-panel display and LED control.

Report Settings. Lists settings for the sequential event reports.

Optoisolated Inputs and Remote Control Switches. Discusses Optoisolated Inputs and Remote Control Switches.

In general, settings are not case sensitive, but the I/O processor converts all non-text settings (except engineering unit settings) to capital letters. All settings are saved in nonvolatile memory, and are maintained during firmware upgrades. When saving new settings, the I/O processor is disabled for a maximum of 1 second.

View/Change Settings

The SEL-2410 Settings Sheets at the end of this section list all SEL-2410 settings, the setting definitions, and input ranges. Refer to *Section 4: Communications* for information on how to set up and access the I/O processor serial port with a personal computer and how to use ASCII commands to communicate with the I/O processor.

Use the **SHOW** command to view I/O processor settings, and the **SET** command to change settings. Some setting classes have multiple instances. For example, the I/O processor has two ports, and each port constitutes an instance of the port setting category. *Table 3.1* shows the method of accessing the settings.

Table 3.1 Method of Accessing Settings

	Serial Port Command	Front-Panel HMI SET/SHO Menu
Displayed Settings	All settings in category (**SHO** command)	All settings in category (**SHO** command)
Change Settings	All settings in category (**SET** command)	All settings in category (**SET** command)

The **SHOW** command (available from Access Level 1 and Access Level 2) displays only the enabled settings. To display all settings, including disabled/hidden settings, append an A to the **SHOW** command (e.g., **SHOW A <Enter>**). *Table 3.2* lists the **SHOW** command options.

Table 3.2 SHOW Command Options

Command	Description
SHOW	Show I/O processor group settings
SHOW A	Show all I/O processor settings: enabled, disabled/hidden
SHOW L	Show logic settings
SHOW G	Show global configuration settings
SHOW P *n*	Show serial port settings for Port *n* (*n* = F or 3)
SHOW F	Show front-panel settings
SHOW R	Show Sequential Event Report (SER) settings

Use the **SET <Enter>** command (available from Access Level 2) to view or change settings. *Table 3.3* lists the **SET** command options.

Table 3.3 SET Command Options

ASCII Command	Setting category	Item
SET G	Global Settings	Digital inputs debounce settings
SET	Group Settings	Analog (transducer) Inputs
SET L	Logic Settings	Contact outputs
SET R	Report Settings	Sequential Event Report (SER)
SET F	Front-Panel Settings	Display points, LED assignments
SET P	Port Settings	Baud rate, parity, etc.

When you issue the **SET** command, the I/O processor presents a list of settings one at a time. Enter a new setting or press **<Enter>** to accept the existing setting. *Table 3.4* lists the editing keystrokes available in the SEL-2410.

Table 3.4 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.

The I/O processor checks each entry to ensure that the entry is within the setting range. If it is not in range, the SEL-2410 generates an Out of Range message, and the I/O processor prompts you to again enter the setting. After entering all the settings, the I/O processor displays the new settings and prompts you for approval to save them. Press **Y <Enter>** to save the new settings. The I/O processor is disabled for a maximum of 1 second while it saves the new settings. During this 1 second, the ALARM Device Word bit is set momentarily, and the **ENABLED** LED extinguishes while the I/O processor is disabled.

You may append a setting name to each of the commands to jump to a specific setting (e.g., **SHO P STOP <Enter>** displays the I/O processor port settings starting with setting STOP (stop bit). Without appending the setting name, (**SHO P <Enter>**) the I/O processor starts at the first setting of the port setting category.

Table 3.5 shows the format of the **SET** command.

Table 3.5 SET Command Format

SET n m s TERSE	
Where:	
n	is left blank or is G, L, F, R, or P to identify the class of settings.
m	is left blank or is F, or 3 when *n* = P.
s	is the name of the specific setting you wish to jump to and begin setting. If *s* is not entered, the relay starts at the first setting.
TERSE	instructs the relay to skip the settings display after the last setting. Use this parameter to speed up the **SET** command (you can also type “TE” instead of TERSE). If you wish to review the settings before saving, do not use the **TERSE** option.

Group Settings (SET Command)

Under the Group setting category we set the I/O processor (monitor) and terminal identifiers, and settings pertaining to the analog (transducer) input (AI) cards. The SEL-2410 displays the I/O Processor (Monitor) and Terminal Identifier strings at the top of responses to serial port commands identifying messages from individual I/O processors. Enter up to 16 characters, including capital letters A–Z, numbers 0–9, periods (.), dashes (-), and spaces. *Table 3.6* shows the I/O processor (monitor) and terminal identifiers settings.

Table 3.6 Monitor and Terminal Identifiers

Setting Prompt	Setting Range	Setting Name := Factory Default
Monitor ID	16 Characters	MID := SEL-2410
Terminal ID	16 Characters	TID := MONITOR

Analog Inputs

The I/O processor samples all analog inputs at a fixed value of 4 ms regardless of the frequency of the power system. For the eight analog inputs, set the following parameters for each input:

- Analog type
- High and low input levels
- Engineering units

Because of the flexibility to install any card in any rear-panel slot on the I/O processor, the setting prompt adapts to the *x* and *y* variables shown in *Figure 3.1*. Variable *x* displays the slot position (3 through 6), and variable *y* displays the transducer (analog) input number (1 through 8).

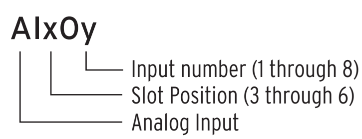


Figure 3.1 Analog Input Card Adaptive Name

Assume we installed an analog card in Slot **3**. On Input 1 of this analog card, we connect a 4–20 mA transducer driven from a device that measures temperature on a transformer tap change mechanism. For this temperature transducer, 4 mA corresponds to –50°C, and 20 mA corresponds to 150°C. You have already installed the correct hardware jumper (see *Section 2: Installation* for more information) for Input 1 to operate as a current input. At power-up, allow approximately five seconds for the SEL-2410 to boot up, perform self-diagnostics, and detect installed cards.

Because the analog card is in Slot **3**, type **SET AI301TYP <Enter>** (**SET** with no setting category assumes the group setting category) to go directly to the setting for Slot **3**, Input 1. The I/O processor displays the following prompt:

```
AI301 Type       (I,V)                         AI301TYP:= I        ?
```

⚠WARNING
Because the SEL-2410 accepts current values ranging from –20.48 to 20.48 mA, be sure to enter the correct range values.

Because this is a 4–20 mA transducer, enter **I <Enter>** (for current driven device) at the prompt. The next two settings define the lower level (AI301L) and the upper level (AI301H) of the transducer. In this example, the low level is 4 mA, and the high level is 20 mA.

The next three settings define the applicable engineering unit (AI301EU), the lower level in engineering units (AI301EL) and the upper level in engineering units (AI301EH). Engineering units refer to actual measured quantities, i.e., temperature, pressure, etc. Use the 16 available characters to assign descriptive names for engineering units. Because we measure temperature in this example, enter "degrees C" (without quotation marks) as engineering units. Enter –50 for the lower level, and 150 for the upper level.

With the levels defined, the next six settings provide two warning settings and one alarm setting for low temperature values, as well as two warning settings and one alarm setting for high temperature values. State the values in engineering units, not the setting range of the transducer. Note the difference between low warnings and alarm functions and high warnings and alarm functions: low warnings and alarm functions assert when the measured value falls below the setting; high warnings and alarm functions assert when the measured values rise above the setting. In this example, we measure the oil temperature of a power transformer, and we want the following three actions to take place at three different temperatures values:

- At 65°C, start the cooling fans
- At 95°C, send an alarm
- At 105°C, trip the transformer

Because we are only interested in cases when the temperature values exceed their respective temperature settings (high warnings and alarm functions), we do not use the low warnings and alarm functions. Therefore, set the lower values (AI301LW1, AI301LW2, AI301LAL) to OFF, and the three higher values as shown in *Figure 3.2*. Set inputs connected to voltage driven transducers in a similar way.

```
=>>SET AI301TYP TERSE <Enter>

Analog Input 301 Settings
AI301 Type       (I,V)                          AI301TYP:= I        ? <Enter>
AI301 Low        (-20.480-20.480 mA)            AI301L  := 4.000    ? <Enter>
AI301 High       (-20.480-20.480 mA)            AI301H  := 20.000   ? <Enter>
AI301 Engr Units (16 Characters)
AI301EU := mA
 ? degrees C <Enter>
AI301 Engr Low   (-99999.000-99999.000)         AI301EL := 4.000    ? -50 <Enter>
AI301 Engr High  (-99999.000-99999.000)         AI301EH := 20.000   ? 150 <Enter>
AI301 Low Warn 1 (Off,-99999.000-99999.000)     AI301LW1:= OFF      ? <Enter>
AI301 Low Warn 2 (Off,-99999.000-99999.000)     AI301LW2:= OFF      ? <Enter>
AI301 Low Alarm  (Off,-99999.000-99999.000)     AI301LAL:= OFF      ? <Enter>
AI301 Hi Warn 1  (Off,-99999.000-99999.000)     AI301HW1:= OFF      ? 65 <Enter>
AI301 Hi Warn 2  (Off,-99999.000-99999.000)     AI301HW2:= OFF      ? 95 <Enter>
AI301 Hi Alarm   (Off,-99999.000-99999.000)     AI301HAL:= OFF      ? 105 <Enter>

Analog Input 302 Settings
AI302 Type       (I,V)                          AI302TYP:= I        ? END <Enter>
Save Changes(Y/N)? Y <Enter>
Settings saved
```

Figure 3.2 Settings to Configure Input 1 as a 4–20 mA Transducer, Measuring Temperatures Between –50°C and 150°C

Analog (DC Transducer) Input Board

Table 3.7 shows the rear-panel terminal number and software reference number correlation for an analog (transducer) card.

Table 3.7 Rear-Panel Terminal Number and Software Reference Number Correlation (Analog Card)

Rear-Panel Terminal Number	Software Reference Number	Description
01, 02	AIx01	AI Input x01
03, 04	AIx02	AI Input x02
05, 06	AIx03	AI Input x03
07, 08	AIx04	AI Input x04
09, 10	AIx05	AI Input x05
11, 12	AIx06	AI Input x06
13, 14	AIx07	AI Input x07
15, 16	AIx08	AI Input x08

x = 3. (For example AI301, AI302, etc. if the card was installed in Slot 3)

Table 3.8 shows a summary of the card allocation options.

Table 3.8 Summary of Card Allocation Options

Rear-Panel Slot	Software Reference	Description
A	1 (e.g. OUT101)	Base unit with fixed card (power supply, two inputs and three contact outputs).
B	N/A	Base unit with fixed card (EIA-232 port).
C	3 (e.g., AI301)	Digital input, contact output or analog input card.
D	4 (e.g., OUT401)	Digital input, contact output.
E	5 (e.g., IN501)	Digital input, contact output.
Z	6 (e.g., IN601)	Digital input, contact output.

Logic Settings (SET L Command)

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

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

SELOGIC Enables

The enable settings for latch bits (ELAT) and SELOGIC® control equations (including timers) ESV control the settings shown in *Table 3.9*. This helps limit the number of settings that need to be made. For example, if you need six timers, only enable six timers.

Table 3.9 SELOGIC Enable Settings

Setting Prompt	Setting Range	Default Setting
SELOGIC LATCHES	N, 1–32	ELAT := N
SV/TIMERS	N, 1–64	ESV := N

Latch Bits

Latch control switches (latch bits are the outputs of these switches) replace traditional latching I/O processors. Traditional latching I/O processors maintain output contact state. The SEL-2410 latch control switches also retain state even when power to the I/O processor is lost. If the latch control switch is set to a programmable output contact and power to the I/O processor is lost, the state of the latch control switch is stored in nonvolatile memory, but the I/O processor de-energizes the output contact. When power to the I/O processor is restored, the programmable output contact will go back to the state of the latch control switch after I/O processor initialization. Traditional latching I/O processor output contact states are changed by pulsing the latching I/O processor inputs (see *Figure 3.3*). Pulse the set input to close (set) the latching I/O processor output contact. Pulse the reset input to open (reset) the latching I/O processor output contact. The external contacts wired to the latching I/O processor inputs are often from remote control equipment (e.g., SCADA, RTU).

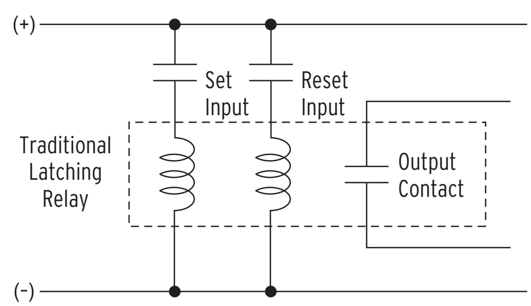


Figure 3.3 Schematic Diagram of a Traditional Latching I/O processor

Thirty-two latch control switches in the SEL-2410 provide latching I/O processor functionality. *Figure 3.4* shows the logic diagram of a latch switch. The output of the latch control switch is a Device Word bit LT*n* (*n* = 01–32), called a latch bit.

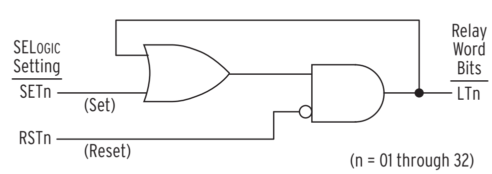


Figure 3.4 Logic Diagram of a Latch Switch

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.

Table 3.10 shows the SET and RESET default settings for Latch 1. The remaining latches have the same settings.

Table 3.10 Latch Bits Equation Settings

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

Latch Bits: Nonvolatile State

Power Loss

The states of the latch bits (LT01–LT32) are retained if power to the I/O processor 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 (I/O processor Word bits LT01 through LT32) are retained, as in the preceding *Power Loss* explanation. If the individual settings change causes a change in SELOGIC control equation settings SET*n* or RST*n* (*n* = 01 through 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 change. 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** I/O processor **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 in providing the necessary time qualification.

SELOGIC Control Equation Variables/Timers

The SEL-2410 has 64 SELOGIC control equation variables/timers. Each SELOGIC control equation variable/timer has a SELOGIC control equation setting input and variable/timer outputs as shown in *Figure 3.5*. Timers SV01T through SV64T in *Figure 3.5* have a setting range of 0.000–16000.000

seconds in 1 ms steps and are processed every 4 ms. These timer setting ranges apply to both pickup and dropout times (SV*n*PU and SV*n*DO, *n* = 01 through 64).

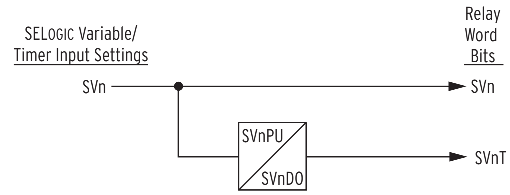


Figure 3.5 SELOGIC Control Equation Variable/Timers SV01/SV01T–SV64T

SELOGIC Control Equation Operators

Use the Boolean operators to combine values with a resulting Boolean value. Edge trigger operators provide a pulse output. Combine the operators and operands to form statements that evaluate complex logic. *Table 3.11* contains a summary of operators available in the SEL-2410.

Operator Precedence

When you combine several operators and operands within a single expression, the SEL-2410 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 I/O processor evaluates the NOT operation of SV04 first and uses the result in subsequent evaluation of the expression. Operator precedence is shown in *Table 3.11*.

Table 3.11 Operator Precedence

Operator	Description
( )	Parenthesis
NOT	Boolean Complement
R_TRIG	Rising Edge Trigger
F_TRIG	Falling Edge Trigger
AND	Boolean AND
OR	Boolean OR

Timers Reset When Power Lost or Settings Changed

If the I/O processor loses power or settings change, the SELOGIC control equation variables/timers reset. Device Word bits SV*n* and SV*n*T (*n* = 01–64) reset to logical 0 after power restoration or a settings change. *Figure 3.6* shows an effective seal-in logic circuit, created by the use of Device Word bit SV07 (SELOGIC control equation variable SV07) in SELOGIC control equation SV07:

SV07 = (SV07 OR OUT101) AND (OUT102 OR OUT401)

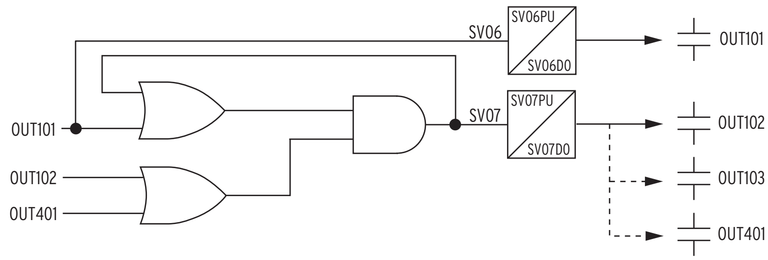


Figure 3.6 Example Use of SELOGIC Variables/Timers

SV/Timers Set

The SEL-2410 includes 64 SELOGIC variables. *Table 3.12* shows the default pick-up, dropout and equation settings for SV01. The remaining SELOGIC variables have the same settings.

Table 3.12 SELOGIC Variable Settings

Setting Prompt	Setting Range	Default Settings
SV TIMER PICKUP	0.000–16000.000	SV01PU := 0.000
SV TIMER DROPOUT	0.000–16000.000	SV01DO := 0.000
SV INPUT EQ	SV	SV01 := NA
• • •	• • •	• • •

Output Contacts

The SEL-2410 provides the ability to use SELOGIC control equations to map protection (warnings and alarms) and general-purpose control elements to the outputs. In addition, you can enable fail-safe output contact operation for I/O processor contacts on an individual basis. If the contact fail-safe is enabled, the I/O processor output is held in its energized position when I/O processor control power is applied.

Fail-Safe/Non Fail-Safe Operation

The SEL-2410 provides fail-safe and non fail-safe operating modes (setting selectable) for all output contacts, including those on the base unit. Notice that all output contacts on the optional cards are normally open or form a contacts. The following occur in fail-safe mode:

- The I/O processor coil is energized continuously if the SEL-2410 is powered and operational.
- When the SEL-2410 generates an output signal, the I/O processor coil is de-energized.

The I/O processor coil is also de-energized if the SEL-2410 power supply voltage is removed or if the SEL-2410 fails (self-test status is FAIL).

Figure 3.7 shows Output OUT301 (assuming a digital output card in Slot **C**), Output OUT302 and the I/O processor power supply. Shown here, the I/O processor is energized and the fail-safe feature is turned off on both output contacts (FS = N). With FS = N, this is a conventional application whereby open output contacts close when the I/O processor energizes the output contact coils.

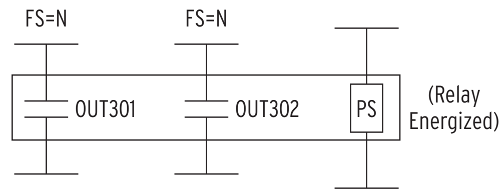


Figure 3.7 Output OUT301 and Output OUT302 in Non Fail-Safe Mode

Figure 3.8 shows the same application, but with Output OUT301 in fail-safe mode (FS = Y). Output OUT302 still operates in the conventional way (FS = N), but Output OUT301 now operates in an inverted way, i.e., the output contact opens when the I/O processor logic operates the output contact.

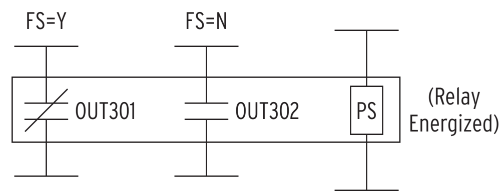


Figure 3.8 Output OUT301 In Fail-Safe Mode, Output OUT302 in Non Fail-Safe Mode

Removing control power from the I/O processor causes those output contacts set to fail-safe mode to fall to the de-energized position. To avoid confusion, all output contact positions on the I/O processor chassis are shown in the de-energized state (FS = N). *Table 3.13* shows the fail-safe and output settings for Output OUT101 and Output OUT102. The remaining latches have the same default settings as Output OUT102.

Table 3.13 Contact Outputs

Setting Prompt	Setting Range	Default settings
OUT101 FAIL-SAFE	Y, N	Y
OUT101	SV	OUT101 := HALARM OR SALARM
OUT102 FAIL-SAFE	Y, N	N
OUT102	SV	0UT102 := 0
• • •	• • •	• • •

Digital Output Card

Table 3.14 shows the rear panel terminal number and software reference number correlation for an output card.

Table 3.14 Rear Panel Terminal Number and Software Reference Number Correlation (Output Card)

Rear Panel Terminal Number	Software Reference Number	Description
01, 02	OUT*x*01	Driven by OUT*x*01 SELOGIC Equation
03, 04	OUT*x*02	Driven by OUT*x*02 SELOGIC Equation
05, 06	OUT*x*03	Driven by OUT*x*03 SELOGIC Equation
07, 08	OUT*x*04	Driven by OUT*x*04 SELOGIC Equation
09, 10	OUT*x*05	Driven by OUT*x*05 SELOGIC Equation
11, 12	OUT*x*06	Driven by OUT*x*06 SELOGIC Equation
13, 14	OUT*x*07	Driven by OUT*x*07 SELOGIC Equation
15, 16	OUT*x*08	Driven by OUT*x*08 SELOGIC Equation

x = 3, 4, 5, or 6. (For example OUT501, OUT502, etc. if the card was installed in Slot 5)

Global Settings (SET G Command)

Use the serial command **SET G <Enter>** to access the Global settings category. In the Global settings category, we set the date format, debounce times for each input of each installed digital input I/O card (DI card), data reset and front-panel disable setting. You can configure the SEL-2410 with up to four DI cards, one in each of the four available slots (Slots C, D, E, and Z).

Because of the flexibility of inserting I/O cards in any of the assigned slots, each connection has two numbers. The first number refers to the physical position (rear-panel terminal number); the second is a software reference number. To determine the software reference number, the I/O processor senses the position of the installed cards and adapts the setting names accordingly. Use the software reference numbers to program the I/O in the I/O processor. *Table 3.15* shows the slot number and prompt correlation for a DI card.

Table 3.15 Slot Number and Setting Correlation

Slot Number	Setting Number	Example
C	3	IN301
D	4	IN401
E	5	IN501
Z	6	IN601

Rear-panel terminal numbers are the same for all three types of I/O cards. State the rear-panel terminal numbers on schematic diagrams to show wiring connections. *Table 3.16* shows the rear panel terminal number and software reference number correlation for a DI card.

Table 3.16 Rear-Panel Terminal Number and Software Reference Number Correlation (DI Card)

Rear-Panel Terminal Number	Software Reference Number
01, 02	INx01
03, 04	INx02
05, 06	INx03
07, 08	INx04
09, 10	INx05
11, 12	INx06
13, 14	INx07
15, 16	INx08

x = 3, 4, 5, or 6. (For example IN401, IN402, etc. if the card was installed in Slot D)

The I/O processor reserves variables and memory for four DI cards, but hides the settings when DI cards are not installed. For example, we install a DI card in Slot D and apply appropriate setting. We then remove the card from Slot D and install the card into Slot E. All settings associated with Slot D are stored, but the variables are hidden. We can now enter new settings for the card in Slot E. If we once again install the card (or another DI card) in Slot D, the previously saved Slot D settings apply and the variables are no longer hidden.

Digital Input Debounce

To comply with different control voltages, the SEL-2410 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 I/O processor logic, as well as to the time stamping in the SER. However, in some cases, it is also important to record the time of first assertion of the input. This information is useful to time-align events from two unsynchronized devices when one device operated on receipt of the output from the other device. To this end, the SEL-2410 provides both the time of first assertion information as well as the delayed time information as separate Device Word bits when set to the dc debounce mode. Following is a description of the two modes.

DC Mode Processing (DC Control Voltage)

Figure 3.9 shows the logic for the dc debounce mode of operation. To select the dc mode of debounce, set IN101D to any number between 0 and 65000 ms. In the figure, Input IN101 becomes IN101R, the raw (unfiltered) digital value after analog to digital conversion. On assertion, IN101R starts Debounce timer 1, producing Device Word bit IN101 after the debounce time delay, and Device Word bit IN101E from the edge detection logic. The debounce timer is a pickup/dropout combination timer, with debounce setting IN101D applying to both pickup (pu) and dropout times (do) timers of both Debounce timer 1 and Debounce timer 2, i.e., you can not set any timer individually. For example, a setting of IN101D = 20 ms delays processing of the input signal by 20 ms (pu), and maintains the output of the timer (do) for 20 ms. Device Word bit IN101 is the output of the debounce timer. If you do not want to debounce a particular input, still use Device Word bit IN101 in logic programming, but set the debounce time delay to 0 (IN101D = 0).

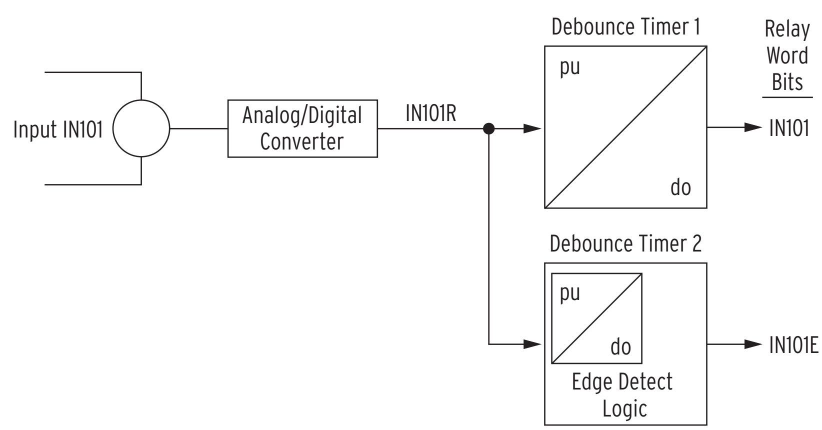


Figure 3.9 DC Mode Processing

Figure 3.10 shows a timing diagram when IN101R changes from the deasserted state to the asserted state. At the first assertion of IN101R the following takes place:

- Device Word bit IN101E asserts
- Debounce timer 2 starts
- All edge changes are ignored

If you want to record the time of first assertion of IN101R, be sure to enter Device Word bit IN101E in the SER (see *Report Settings (SET R Command) on page 3.29*). During the time when Debounce timer 2 runs, the I/O processor ignores all edge changes. At the end of this timing period, the I/O processor evaluates the status of Device Word bit IN101R (either logical 0, or logical 1), and sets Device Word bit IN101E to this value. In *Figure 3.10*, Device Word bit IN101R has a status of logical 1, and Device Word bit IN101E remains at logical 1.

Device Word bit IN101 asserts only if Device Word bit IN101R stays asserted for the complete duration of Debounce timer 1. If Device Word bit IN101R 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.

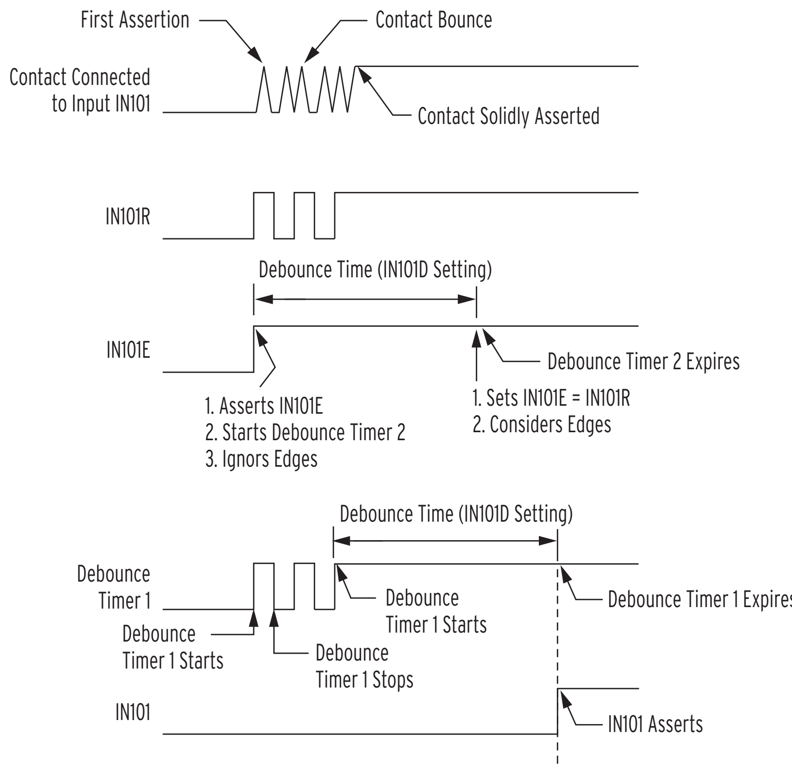


Figure 3.10 Timing Diagram When IN101R Changes From the Deasserted State to the Asserted State

When changing from the asserted state to the deasserted state, the inverse operation applies, as shown in *Figure 3.11*.

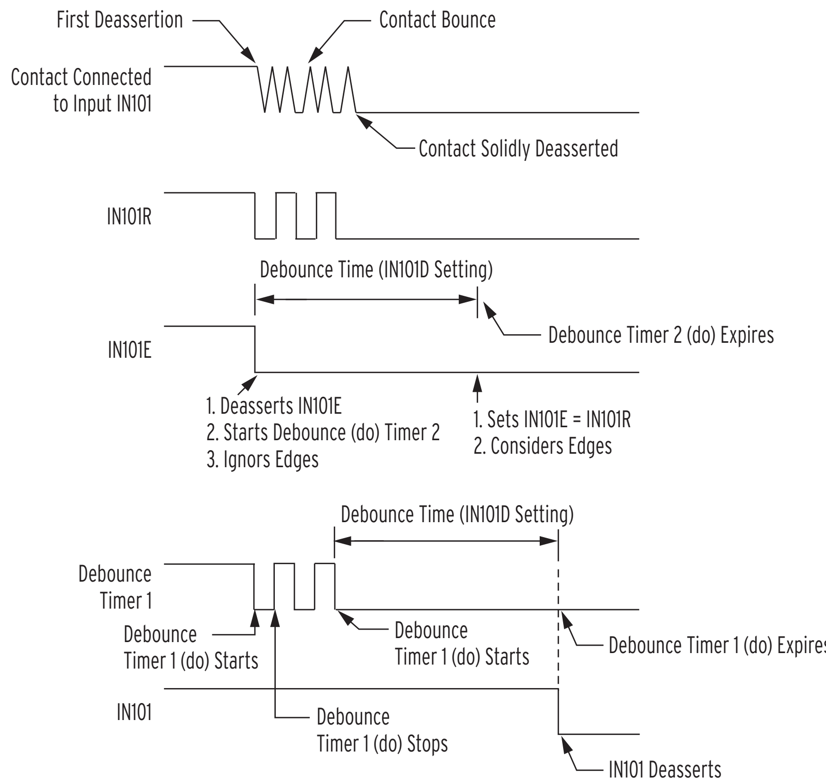


Figure 3.11 Timing Diagram When Input IN101 Changes From the Asserted State to the Deasserted State

AC Mode Processing (AC Control Voltage)

Figure 3.12 shows a raw (unfiltered) sampled input from Input IN101 applied to a pickup/dropout timer. Different from the dc mode, only the delayed time information is available in the ac mode. There are also no time settings for the debounce timer in the ac mode: the pickup time delay is fixed at 2ms, and the dropout time is fixed at 16ms. Device Word bit IN101 is the output of the debounce timer. To select the ac mode of debounce, set IN101D = AC.

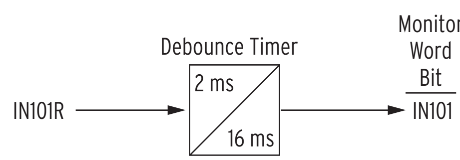


Figure 3.12 AC Mode Processing

Figure 3.13 shows a timing diagram for the ac mode of operation. On the rising edge of Device Word bit IN101R, the pick-up timer starts timing (points marked 1 in *Figure 3.13*). If IN101R deasserts (points marked 2 in *Figure 3.13*) before expiry of the pick-up time setting, Device Word bit IN101 does not assert, and remains at logical 0. If, however, IN101R remains asserted for a period longer than the pick-up timer setting, then Device Word bit IN101 asserts to a logical 1.

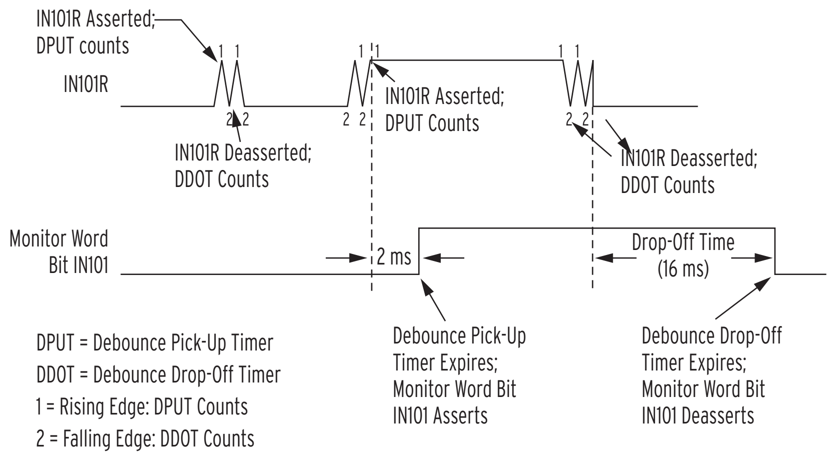


Figure 3.13 Timing Diagram for Debounce Timer Operation When Operating in AC Mode

Deassertion follows the same logic. On the falling edge of IN101R, the drop-off timer starts timing. If IN101R remains deasserted for a period longer than the drop-off timer setting, then Device Word bit IN101 deasserts to a logical 0.

Data Reset

Table 3.17 Target Reset Setting

Setting Prompt	Setting Range	Setting Name := Factory Default
TARGET RESET EQ	SV	RSTTRGT := 0

The RSTTRGT setting resets the trip output and front-panel TRIP LED, provided all LED initiate conditions were cleared.

Access Control

Table 3.18 Setting Change Disable Setting

Setting Prompt	Setting Range	Setting Name := Factory Default
DISABLE SETTINGS	SV	DSABLSET := 0

NOTE: DSABLSET does not disable the setting changes from the serial ports.

The DSABLSET setting defines conditions for disabling all setting changes from front-panel interface. You can view the settings but cannot change them when the Device Word bit DSABLSET is asserted. You should assign a contact input (e.g., DSABLSET := IN402) if you want disabling of a setting change from the front-panel interface.

Port Settings (SET P Command)

The SEL-2410 provides settings that allow you to configure the parameters for the communications ports. See *Section 4: Communications* for the detailed description. The front-panel serial **PORT F** and the rear **PORT 3** (main board) consist of EIA-232. *Table 3.19* shows the serial port settings ranges and default settings for **PORT F** and **PORT 3**.

Table 3.19 Serial Port Settings Setting Ranges and Default Settings

Setting Prompt	Setting Range	Factory default setting
SPEED	300 to 38400 bps	9600
DATA BITS	7,8 bits	8
PARITY	O,E,N	N
STOP BITS	1,2 bits	1
PORT TIME-OUT	0–30 min	5
SEND AUTO MESSAGE	Y,N	N
HDWR HANDSHAKING	Y,N	N
FAST OP MESSAGES[a]	Y,N	N

[a] Fast Operate message available on the rear port only.

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 minutes of inactivity on a serial port at Access Level 2, the port automatically returns to Access Level 1. This security feature helps prevent unauthorized access to the I/O processor settings if the I/O processor is accidentally left in Access Level 2. If you do not want the port to time out, set Port Timeout equal to 0 minutes. **Port F** and **Port 3** support only the SEL protocol.

Set the AUTO := Y to allow automatic messages at a serial port. The I/O processor 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.

Front-Panel Set (SET F Command)

General Settings

Table 3.20 shows the time-out and contrast settings. Use the front-panel LCD time-out setting (FP_TO) as a security measure. If the display is within an Access Level 2 function when a time-out occurs, such as the I/O processor setting entry, the function is automatically terminated (without saving changes) after inactivity for this length of time. After terminating the function, the front-panel display returns to the default display. If you prefer to disable the front-panel time-out function during I/O processor testing, set the LCD time-out equal to OFF. Use the front-panel LCD contrast setting (FP_CONT) to adjust the contrast of the liquid crystal display.

Table 3.20 General LCD Display Settings

Setting Prompt	Setting Range	Setting Name := Factory Default
LCD TIMEOUT	Off, 1–30 min	FP_TO := 15
LCD CONTRAST	1–8	FP_CONT := 5

Enable Settings

Local bits provide control from the front panel (local bits), and display points display selected information on the LCD display. However, you need to first enable the appropriate number of local bits and display points necessary for your application. When your SEL-2410 arrives, two display points are already enabled, but no local bits are enabled. If more display points are necessary for your application, use the EDP setting to enable up to 32 display points. Use the ELB setting to enable up to 32 local bits. *Table 3.21* shows the display point and local bit default settings.

Table 3.21 Display Point and Local Bit Default Settings

Name	Prompt	Range	Default
EDP	Enable Display Points (N,1–32)	N, 1–32	2
ELB	Enable Local Bits (N,1–32)	N, 1–32	N

Display Points

Use display points to view either the state of internal I/O processor elements (Boolean information) or analog information on the LCD display. Although the LCD screen displays a maximum of 16 characters at a time, you can enter up to 60 valid characters. Valid characters are 0–9, A–Z,-,/,",{,}, space. For text exceeding 16 characters, the LCD displays the first 16 characters, then scrolls through the remaining text not initially displayed on the screen.

Boolean Display Point Entry Composition

Boolean information is the status of Device Word bits (see *Appendix D: I/O Processor Word Bits*). In general, the legal syntax for Boolean display points consist of the following four fields or strings, separated by commas:

Device Word Bit Name, “Alias”, “Set String”, “Clear String”

Where:

Name = Device Word bit name (IN101 for example). All binary quantities occupy one line on the front-panel display. (All analog quantities occupy two lines).

Alias = A more descriptive name for the Device Word bit (such as TRANSFORMER 3), or the analog quantity (such as TEMPERATURE).

Set string = State what should be displayed on the LCD when the Device Word bit is asserted (CLOSED, for example)

Clear string = State what should be displayed on the LCD when the Device Word bit is deasserted (OPEN, for example)

Any or all of Alias, Set String, or Clear String can be empty. Although the I/O processor accepts an empty setting Name as valid, a display point with an empty Name setting is always hidden (see below). Commas are significant in identifying and separating the four strings. Use quotation marks only if the text you enter for Alias, Set String, or Clear String contains commas or spaces. For example, DP01 = Name,Text is valid, but Name,Alias 3 is not valid (contains a comma). Correct the Alias name by using the quotation marks: Name,"Text 3". You can customize the data display format by entering data in selected strings only. Following is a description of the various display appearances resulting from entering data in selected strings.

Hidden (No Display)

A display point is hidden when settings are entered (DP*n* = XX, where *n* = 01 through 32 and XX = any valid setting), but nothing shows on the front-panel display. *Table 3.22* shows examples of settings that always, never or conditionally hide a display point.

Following are examples of selected display point settings, showing the resulting front-panel displays. For example, at a certain station we want to display the status of both HV and LV circuit breakers of Transformer 1. When the HV circuit breaker is open, we want the LCD display to show: TRFR 1 HV BRKR: OPEN, and when the HV circuit breaker is closed, we want the display to show: TRFR 1 HV BRKR: CLOSED. We also want similar displays for the LV breaker. After connecting a form a (normally open) auxiliary contact from the HV circuit breaker to Input IN101 and a similar contact from the LV circuit breaker to Input IN102 of the SEL-2410, we are ready to program the display points, using the following information for the HV breaker (LV breaker similar):

- Device Word bit—IN101
- Alias—TRFR 1 HV BRKR:
- Set string—CLOSED (the form a (normally open) contact asserts or sets Device Word bit IN101 when the circuit breaker is closed)
- Clear string—OPEN (the form a (normally open) contact deasserts or clears Device Word bit IN101 when the circuit breaker is open)

Table 3.22 Settings That Always, Never or Conditionally Hide a Display Point

I/O Processor Setting	Name	Alias	Set string	Clear string	Comment
DP01 := IN101,TRFR1,CLOSED,OPEN	IN101	TRFR1	CLOSED	OPEN	Never hidden
DP01 := IN101,TRFR1	IN101	TRFR1	—	—	Never hidden
DP01 := NA	—	—	—	—	Always hidden
DP01 := IN101,,,	IN101	—	—	—	Always hidden
DP01 := IN101,TRFR1,,	IN101	TRFR1	—	—	Always hidden
DP01 := IN101,TRFR1,CLOSED,	IN101	TRFR1	CLOSED	—	Hidden when IN101 is deasserted
DP01 := IN101,"TRFR 1",,OPEN	IN101	TRFR 1	—	OPEN	Hidden when IN101 is asserted

Name, Alias, Set String, and Clear String

When all four strings have entries, the I/O processor reports all states. *Table 3.23* shows the entries for the four strings.

Table 3.23 Entries for the Four Strings

Name	Alias	Set string	Clear string
IN101	TRFR 1 HV BRKR	OPEN	CLOSED

Figure 3.14 shows the settings for the example, using the **SET F** command. Use the > character to move to the next settings category.

```
=>>SET F TERSE <Enter>

Front Panel Set

General Settings
Enable Display Points (N,1-32)                  EDP     := 2        ? > <Enter>

Target LED Set
LED 1 LATCH      (Y,N)                          T01LEDL := Y        ? > <Enter>

Display Point Settings (maximum 60 characters):
(Boolean): Monitor Word Bit Name, "Alias", "Set String", "Clear String"
(Analog) : Analog Quantity Name, "User Text and Formatting"

DP01    := 1,"FACTORY DEFAULT"
 ? IN101,"TRFR 1 HV BRKR:",CLOSED,OPEN <Enter>

DP02    := 1,"   SETTINGS"
 ? IN102,"TRFR 1 LV BRKR:",CLOSED,OPEN <Enter>
Save Changes(Y/N)? Y <Enter>
Settings saved
=>>
```

Figure 3.14 Display Point Settings

Figure 3.15 shows the display when both HV and LV breakers are open (both IN101 and IN102 deasserted). *Figure 3.16* shows the display when the HV breaker is closed, and the LV breaker is open (IN101 asserted, but IN102 still deasserted).

Figure 3.15 Front-Panel Display—Both HV and LV Breakers Open

Figure 3.16 Front-Panel Display—HV Breaker Closed, LV Breaker Open

Name String, Alias String and Either Set String or Clear String Only

The following discusses omission of the clear string; omission of the set string gives similar results. Omitting the Clear string causes the I/O processor to only show display points in the set state, using the **SET F** command as follows:

```
DP01    := 1,"FACTORY DEFAULT"
 ? IN101,"TRFR 1 HV BRKR:",CLOSED <Enter>
```

When the Device Word bit IN101 deasserts, the I/O processor removes the complete line with the omitted Clear string (TRFR 1 HV Breaker line). When both breakers are closed, the I/O processor has the Set state information for both HV and LV breakers, and the I/O processor displays the information as shown in *Figure 3.17*. When the HV breaker opens (LV breaker is still closed), the I/O processor removes the line containing the HV breaker information because the Clear string information was omitted. Because the line containing the HV breaker information is removed, the I/O processor now displays the LV breaker information on the top line, as shown in *Figure 3.18*.

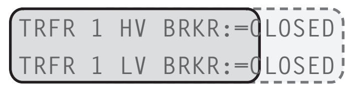


Figure 3.17 Front-Panel Display—Both HV and LV Breakers Closed

Figure 3.18 Front-Panel Display—HV Breaker Open, LV Breaker Closed

If you want the I/O processor to display a blank state when IN101 deasserts instead of removing the line altogether, use the curly brackets { } for the clear string, as follows:

```
DP01    := 1,"FACTORY DEFAULT"
 ? IN101,"TRFR 1 HV BRKR:",CLOSED,{} <Enter>
```

When Input IN101 now deasserts, the I/O processor still displays the line with the HV breaker information, but the state is left blank, as shown in *Figure 3.20*.

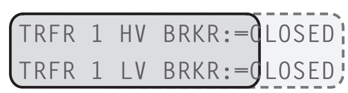


Figure 3.19 Front-Panel Display—Both HV and LV Breakers Closed

Figure 3.20 Front-Panel Display—HV Breaker Open, LV Breaker Closed

Name Only

Table 3.24 shows an entry in the Name string only (leaving the Alias string, Set string, and Clear string void), using the **SET F** command as follows:

```
DP01    := 1,"FACTORY DEFAULT"
 ? IN101 <Enter>
```

Table 3.24 Binary Entry in the Name String Only

Name	Alias	Set String	Clear String
IN101	—	—	—

Figure 3.21 shows the front-panel display for the entry in *Table 3.24*. Input IN101 is deasserted in this display (IN101=0), but changes to IN101=1 when Input IN101 asserts.

```
IN101=0
```

Figure 3.21 Front-Panel Display For a Binary Entry In the Name String Only

Analog Display Point Entry Composition

In general, the legal syntax for analog display points consist of the following two fields or strings: Name, "User Text and Formatting."

Where:

Name	=	Analog quantity name. (AI301 for example). All analog quantities occupy two lines on the front-panel display (all binary quantities occupy one line on the display).
User text and numerical formatting	=	Display the user text, replacing the numerical formatting {width.dec,scale} with the value of Name, scaled by 'scale', formatted with total width 'width' and 'dec' decimal places. Name can be either an analog quantity or a Device Word bit. The width value includes the decimal point and sign character, if applicable. The 'scale' value is optional; if omitted, the scale factor is 1. If the numeric value is smaller than the string size requested, the string is padded with spaces to the left of the number. If the numeric value does not fit within the string width given, the string grows (to the left of the decimal point) to accommodate the number.

Unlike binary quantities, the I/O processor displays analog quantities on both display lines. *Table 3.25* shows an entry in the Name string only (leaving the User Text and Formatting string void) with the following syntax:

Table 3.25 Analog Entry in the Name String Only

Name	Alias	Set String	Clear String
AI301	—	—	—

Figure 3.22 shows the front-panel display for the entry in *Table 3.25*, using the **SET F** command as follows:

```
DP01    := 1,"FACTORY DEFAULT"
 ? AI301 <Enter>
```

```
AI301
             0.025 mA
```

Figure 3.22 Front-Panel Display for an Analog Entry in the Name String Only

Name and Alias

For a more descriptive name of the Device Word bit, enter the Device Word bit in the Name string, and an alias name in User Text and Formatting string. *Table 3.26* shows a Boolean entry in the Name and Alias strings (DP01) and an entry in the Name and User Text and Formatting strings (DP02), using the **SET F** command as follows:

```
DP01     := 1,"FACTORY DEFAULT"
  ? IN101,"INPUT IN101:" <Enter>
DP02     := 2,"SETTINGS"
  ? AI301,TEMPERATURE: <Enter>
```

Table 3.26 Entry in the Name String and the Alias Strings

Name	Alias	Set String	Clear String
IN101	INPUT IN101	—	—
AI301	TEMPERATURE	—	—

Figure 3.23 shows the front-panel display for the entry in *Table 3.26*. Input IN101 is deasserted in this display (0), and the display changes to INPUT IN101=1 when Input IN101 asserts.

Figure 3.23 Front-Panel Display for an Entry in (a) Boolean Name and Alias Strings and (b) Analog Name and User Text and Formatting Strings

If the engineering units are set, then the front-panel display shows the engineering units. For example, in the Group setting example, we set AI301EU to degrees C. With this setting, the front-panel display looks as shown in *Figure 3.24*.

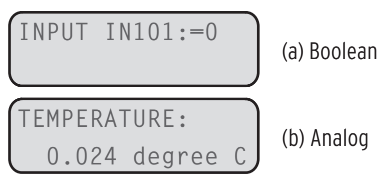


Figure 3.24 Front-Panel Display for an Entry in (a) Boolean Name and Alias Strings and (b) Analog Name and User Text and Formatting Strings, and Engineering Units

For fixed text such as the default settings (DEFAULT SETTINGS), enter a 1 in the Name string, then enter the fixed text (DEFAULT SETTINGS) as the alias text. To display the word DEFAULT and SETTINGS on two different lines, use a display point for each word, i.e. DP01 = 1,"FACTORY DEFAULT" and DP02 = 1," SETTINGS".

Table 3.27 shows other options and front-panel displays for the User Text and Formatting settings.

Table 3.27 Example Settings and Displays

Example Display Point Setting Value	Example Display
AI301,"TEMP {4}deg C	"TEMP 1234 deg C
AI301,"TEMP = {4.1}	"TEMP =xx.x
AI301,"TEMP = {5}	"TEMP = 1230
AI301,"TEMP={4.2,0.001} C	"TEMP=1.23 C
AI301,"TEMP HV HS1={4,1000}	"TEMP HV HS1=1234
1,{}	Empty line

Following is an example of an application of analog settings. Assume we also want to know the hot spot temperature, oil temperature, and winding temperature of the transformer at a certain installation. To measure these temperatures, we have installed an analog card in I/O processor Slot **C**, and connected 4-20 mA transducers inputs to analog inputs AI301 (hot spot temperature), AI302 (oil temperature) and AI303 (winding temperature).

Because we already programmed the two default enabled display points, first enable three more display points for the analog measurements (EDP = 5). *Figure 3.25* shows the settings to add the three transducer measurements. (Use the > character to move to the next settings category).

```
=>>SET F TERSE <Enter>

Front Panel Set
General Settings
Enable Display Points (N,1-32)                  EDP     := 2         ? 5
Enable Local Bits (N,1-16)                      ELB     := N         ? > <Enter>

Target LED Set
LED 1 LATCH      (Y,N)                          T01LEDL := Y         ? > <Enter>

Display Point Settings (maximum 60 characters):
(Boolean): Monitor Word Bit Name, "Alias", "Set String", "Clear String"
(Analog) : Analog Quantity Name, "User Text and Formatting"

DP01    := IN101,"TRFR 1 HV BRKR:","CLOSED","OPEN"
 ? <Enter>

DP02    := IN102,"TRFR 1 LV BRKR:","CLOSED","OPEN"
 ? <Enter>

DP03    :=
 ? AI301,"HOT SPOT TEMP" <Enter>

DP04    :=
 ? AI302,"OIL TEMPERATURE" <Enter>

DP05    :=
 ? AI303,"WINDING TEMP" <Enter>
Save Changes(Y/N)? Y <Enter>
Settings saved
=>>
```

Figure 3.25 Adding Temperature Measurement Display Points

Rotating Display

With more than two display points enabled, the I/O processor scrolls through all enabled display points, thereby forming a rotating display, as shown in *Figure 3.26*.

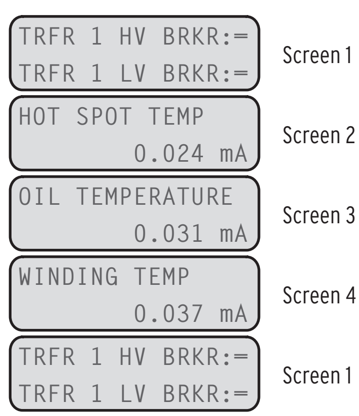


Figure 3.26 Rotating Display

To change the temperature units to more descriptive engineering units, enter the desired units with the AI301EU setting (see *Group Settings (SET Command) on page 3.4* for an example).

Local Bits

Local bits are variables (LB*nn*, where *nn* means LB01 through LB32) that are controlled from front-panel pushbuttons. Use local bits to replace traditional panel switches. Each local bit requires three of the following four settings, using a maximum of 14 valid characters for the NLB*nn* setting, and a maximum seven valid characters (0–9, A–Z, -,/,., space) for the remainder:

NLB*nn*: Name the switch (normally the function that the switch performs, such as SUPERV SW) that will appear on the LCD display.

CLB*nn*: Clear local bit. Enter the text that describes the intended operation of the switch (this text appears on the display) when LB*nn* deasserts (OPEN, for example).

*SLB*nn*: Set local bit. Enter the text that describes the intended operation of the switch (this text appears on the display) when LB*nn* asserts (CLOSE, for example).

*PLB*nn*: Pulse local bit. When selecting the pulse operation, LB*nn* asserts for only one processing interval before deasserting again. Enter the text that describes the intended operation when LB*nn* asserts (START for example).

*Omit either SLB*nn* or PLB*nn* (never CLB*nn*) by setting the omitted setting to NA.

For the transformer in our example, configure two local bits: one to replace a supervisory switch, and the other to start a fan motor. Local bit 1 replaces a supervisory switch (SUPERV SW) and we use the clear/set combination. Local bit 2 starts a fan motor (START) that only needs a short pulse to seal itself in, and we use the clear/pulse combination. *Figure 3.27* shows the settings to program the two local bits.

```
=>>SET F TERSE <Enter>

Front Panel Set

General Settings
Enable Display Points (N,1-32)                   EDP     := 5         ?  <Enter>
Enable Local Bits (N,1-16)                       ELB     := N         ? 2 <Enter>
LCD TIMEOUT      (Off, 1-30; min)                FP_TO   := 15        ? > <Enter>

Target LED Set
LED 1 LATCH      (Y,N)                           T01LEDL := Y         ? > <Enter>

Display Point Settings (maximum 60 characters):
(Boolean): Monitor Word Bit Name, "Alias", "Set String", "Clear String"
(Analog) : Analog Quantity Name, "User Text and Formatting"

DP01     := IN101,"TRFR 1 HV BRKR:","CLOSED","OPEN"
 ? > <Enter>

Local Control Bit Labels:
Local Bit LB_ Name (14 char; enter NA to null)
NLB01    :=
 ? SUPERV SW <Enter>
Clear Local Bit LB_ Label (7 char; enter NA to null)
CLB01    :=
 ? OPEN <Enter>
Set Local Bit LB_ Label (7 char; enter NA to null)
SLB01    :=
 ? CLOSE <Enter>
Pulse Local Bit LB_ Label (7 char; enter NA to null)
PLB01    :=
 ? NA <Enter>
Local Bit LB_ Name (14 char; enter NA to null)
NLB02    :=
 ? FAN START <Enter>
Clear Local Bit LB_ Label (7 char; enter NA to null)
CLB02    :=
 ? OFF <Enter>
Set Local Bit LB_ Label (7 char; enter NA to null)
SLB02    :=
 ? NA <Enter>
Pulse Local Bit LB_ Label (7 char; enter NA to null)
PLB02    :=
 ? START <Enter>
Save Changes(Y/N)? Y <Enter>
Settings saved
=>>
```

Figure 3.27 Adding Two Local Bits

Target LED Set

Settings T0*n*_LEDL (*n* = 1 through 6) and T0*n*_LED (*n* = 1 through 6) control the six front-panel LEDs. With T0*n*_LEDL set to Y, the LEDs latch after assertion. To reset these latched LEDs, the corresponding LED equation must be deasserted (logical 0) and one of the following takes place:

1. Pressing Target Reset on the front panel.
2. Issuing the Serial port command: **TAR R**.
3. The assertion of the SELOGIC equation RSTTRGT.
4. With T0*n*_LEDL settings set to *n*, the LEDs do not latch and directly follow the state of the associated SELOGIC control equation (SV) setting.

Enter any of the Device Word bits (or combinations of Device Word bits) as conditions in the T0*n*_LED SELOGIC control equation (SV) settings. When these Device Word bits assert, the corresponding LED also asserts. *Table 3.28* shows the setting prompts, setting ranges and default settings for the target settings.

Table 3.28 Setting Prompts, Setting Ranges, and Default Settings

Settings Prompt	Setting Range	Default Settings
LED 1 LATCH T01LEDL:=	(Y, N)	Y
LED1 EQUATION T01_LED := [PRESENT SETTING] ?	(SV)	0
• • •	• • •	• • •
LED 6 LATCH T01LEDL	(Y, N)	Y
LED6 EQUATION T06_LED := [PRESENT SETTING] ?	(SV)	0

Report Settings (SET R Command)

The report settings use Device Word bits for the SER trigger (See *Appendix D: I/O Processor Word Bits* for more information).

Automatic Deletion and Reinsertion

The SER includes an automatic deletion and reinsertion function to prevent overfilling of the SER buffer with chattering information. Each processing interval the I/O processor checks the Device Word bits in the four SER reports for any changes of state. When detecting of a change of state, the I/O processor adds a record to the SER report containing the Device Word bit(s), new state, time stamp, and checksum.

When detecting oscillating SER items, the I/O processor automatically deletes these oscillating items from SER recording. *Table 3.29* shows the auto-removal settings.

Table 3.29 Auto-Removal Settings

Setting Prompt	Setting Range	Factory Default
Auto-Removal EN	(Y, N)	ESERDEL := N
Number of Counts	2–20	SRDLCNT := 5
Removal Time	0.1–90.0 s	SRDLTIM := 1.0

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

Step 1. Set Report setting ESERDEL (Enable SER Delete) to Y to enable this function.

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 I/O processor 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 I/O processor automatically removes these Device Word bits from SER recording. Once deleted from recording, the item(s) will be ignored for the next 9 intervals. At the 9^{th} interval, the chatter criteria will again be checked and, if the point does not exceed the criteria, it will be automatically reinserted into recording at the starting of the 10^{th} interval. The user can enable or disable the auto-deletion function via the SER settings. Any auto-deletion notice entry will be lost during changes of settings.

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 allows entry of as many as 24 Device Word bits separated by spaces or commas; the SER report accepts a total of 96 Device Word bits. *Table 3.30* shows the setting prompt, and default settings for the four SER trigger equations.

Table 3.30 SER Trigger Settings

Settings Prompt	Default Settings
SER1	IN101
SER2	IN102
SER3	NA
SER4	NA

Optoisolated Inputs and Remote Control Switches

This subsection explains the settings and operation of the logic input of the SEL-2410, including the following:

- Optoisolated Inputs
- Remote Control Switches

Introduction

Table 3.31 describes all of the logic input of the SEL-2410.

Table 3.31 SEL-2410 Input

Description	Device Word Bits
Optoisolated inputs	IN101–IN102
Optoisolated inputs (optional)	IN*x*01–IN*x*08
Remote control switches	RB01–RB32

Where x = 3, 4, 5, or 6

Optoisolated Inputs

Figure 3.28 shows two optoisolated inputs (Input IN101 and Input IN102) and the corresponding Device Word bits (IN101 and IN102) that follow the state of the two inputs. In the figure, Input IN101 is de-energized and Input IN102 is energized; the corresponding Device Word bits IN101 is deasserted (logical 0) and IN102 is asserted (logical 1). To assert an optoisolated input, apply rated control voltage to the appropriate terminal pair. Rated control voltage can be either ac or dc. All Device Word bits are updated every 4 ms.

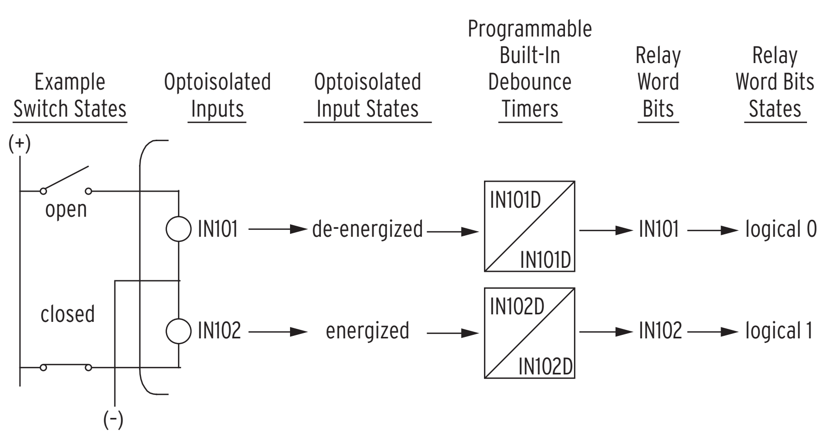


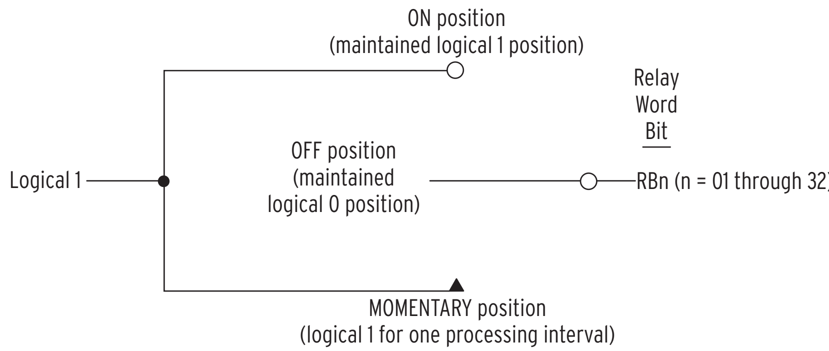
Figure 3.28 Example Operation of Optoisolated Inputs IN101–102

Input Functions

There are no optoisolated input settings such as IN101 := OUT101 or IN102 := OUT301. Optoisolated inputs IN101 and IN102 control Device Word bits IN101 and IN102 that are used in SELOGIC control equations.

Remote Control Switches

Remote control switches are operated via the serial communications port only, using the **Control** command, or Fast Operate message. The outputs of the remote control switches in *Figure 3.29* are Device Word bits RB*n* (*n* = 1 to 32), called remote bits. Use these remote bits in SELOGIC control equations.



The switch representation in this figure is derived from the standard:

Graphic Symbols for Electrical and Electronics Diagrams
IEEE Standard 315-1975, CSA Z99-1975, ANSI Y32.2-1975
4.11 Combination Locking and Nonlocking Switch, Item 4.11.1

Figure 3.29 Remote Control Switches Drive Remote Bits RB1–RB8

Any given remote control switch can be put in one of the following three positions:

ON (logical 1)

OFF (logical 0)

MOMENTARY (logical 1 for one processing interval-4 ms)

Remote Bit States When Power Lost

The states of the remote bits (Device Word bits RB01–RB32) are not retained if I/O processor power is cycled. The remote control switches always come back in the OFF position (corresponding remote bit is deasserted to logical 0) when power is restored to the I/O processor.

Remote Bit States When Settings Changed

The state of each remote bit (Device Word bits RB01–RB32) is retained if I/O processor settings are changed. If a remote control switch is in the ON position (corresponding remote bit is asserted to logical 1) before a setting change, it comes back in the ON position (corresponding remote bit is still asserted to logical 1) after the change. If a remote control switch is in the OFF position (corresponding remote bit is deasserted to logical 0) before a settings change, it comes back in the OFF position (corresponding remote bit is still deasserted to logical 0) after the change.

Remote Control Switch MOMENTARY Position

This subsection describes how to operate remote bit RB03 as a momentary switch. You can make RB01–RB32 operate in the same way. The **CON 3** command and **PRB 3** subcommand place Remote Control Switch 3 into the MOMENTARY position for one processing interval, regardless of the initial state of the switch. Remote Control Switch 3 is then placed in the OFF position.

If RB03 is initially at logical 0, pulsing it with the **CON 3** command and **PRB 3** subcommand will change RB03 to logical 1 for one processing interval and then return it to logical 0. In this situation, the R_TRIG RB03 (rising edge operator) will also assert for one processing interval, followed by the F_TRIG RB03 (falling edge operator) one processing interval later. If RB03 is initially at logical 1 instead, pulsing it with the **CON 3** command and **PRB 3** subcommand will change RB03 to a logical 0. In this situation, the R_TRIG RB03 (rising edge operator) will not assert, but the F_TRIG RB03 (falling edge operator) will assert for one processing interval.

SEL-2410 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.

Group Settings (SET Command)

Monitor Settings

Monitor ID (16 Characters)	**MID**	:=	________
Terminal ID (16 Characters)	**TID**	:=	________

For the following settings, x is the card position, and is one of 3, 4, 5, or 6

Analog Input x01 Settings

AIx01 Type (I,V)	**AIx01TYP**	:=	________

If AIx01TYP = I

AIx01 Low (–20.480 to +20.480; mA)	**AIx01L**	:=	________
AIx01 High (–20.480 to +20.480; mA)	**AIx01H**	:=	________

If AIx01TYP = V

AIx01 Low (–10.240 to +10.240 V)	**AIx01L**	:=	________
AIx01 High (–10.240 to +10.240 V)	**AIx01H**	:=	________

NOTE: Set Warn and Alarm settings to a value between Engr Low and Engr High settings.

AIx01 Engr Units (16 Characters)	**AIx01EU**	:=	________
AIx01 Engr Low (–99999.000 to +99999.000)	**AIx01EL**	:=	________
AIx01 Engr High (–99999.000 to +99999.000)	**AIx01EH**	:=	________
AIx01 Low Warn 1 (Off,–99999.000 to +99999.000)	**AIx01LW1**	:=	________
AIx01 Low Warn 2 (Off,–99999.000 to +99999.000)	**AIx01LW2**	:=	________
AIx01 Low Alarm (Off,–99999.000 to +99999.000)	**AIx01LAL**	:=	________
AIx01 Hi Warn 1 (Off,–99999.000 to +99999.000)	**AIx01HW1**	:=	________
AIx01 Hi Warn 2 (Off,–99999.000 to +99999.000)	**AIx01HW2**	:=	________
AIx01 Hi Alarm (Off,–99999.000 to +99999.000)	**AIx01HAL**	:=	________

Analog Input x02 Settings

AIx02 Type (I,V)	**AIx02TYP**	:=	________

If AIx02TYP = I

AIx02 Low (–20.480 to +20.480; mA)	**AIx02L**	:=	________
AIx02 High (–20.480 to +20.480; mA)	**AIx02H**	:=	________

If AIx02TYP = V

AIx02 Low (–10.240 to +10.240 V)	**AIx02L**	:=	________
AIx02 High (–10.240 to +10.240 V)	**AIx02H**	:=	________

NOTE: Set Warn and Alarm settings to a value between Engr Low and Engr High settings.

AIx02 Engr Units (16 Characters)	**AIx02EU**	:=	________
AIx02 Engr Low (–99999.000 to +99999.000)	**AIx02EL**	:=	________
AIx02 Engr High (–99999.000 to +99999.000)	**AIx02EH**	:=	________
AIx02 Low Warn 1 (Off,–99999.000 to +99999.000)	**AIx02LW1**	:=	________
AIx02 Low Warn 2 (Off,–99999.000 to +99999.000)	**AIx02LW2**	:=	________
AIx02 Low Alarm (Off,–99999.000 to +99999.000)	**AIx02LAL**	:=	________
AIx02 Hi Warn 1 (Off,–99999.000 to +99999.000)	**AIx02HW1**	:=	________
AIx02 Hi Warn 2 (Off,–99999.000 to +99999.000)	**AIx02HW2**	:=	________
AIx02 Hi Alarm (Off,–99999.000 to +99999.000)	**AIx02HAL**	:=	________

Analog Input x03 Settings

AIx03 Type (I,V)	**AIx03TYP**	:=	________

If AIx03TYP = I

AIx03 Low (–20.480 to +20.480; mA)	**AIx03L**	:=	________
AIx03 High (–20.480 to +20.480; mA)	**AIx03H**	:=	________

If AIx03TYP = V

AIx03 Low (–10.240 to +10.240 V)	**AIx03L**	:=	________
AIx03 High (–10.240 to +10.240 V)	**AIx03H**	:=	________

NOTE: Set Warn and Alarm settings to a value between Engr Low and Engr High settings.

AIx03 Engr Units (16 Characters)	**AIx03EU**	:= ___________
AIx03 Engr Low (–99999.000 to +99999.000)	**AIx03EL**	:= ___________
AIx03 Engr High (–99999.000 to +99999.000)	**AIx03EH**	:= ___________
AIx03 Low Warn 1 (Off,–99999.000 to +99999.000)	**AIx03LW1**	:= ___________
AIx03 Low Warn 2 (Off,–99999.000 to +99999.000)	**AIx03LW2**	:= ___________
AIx03 Low Alarm (Off,–99999.000 to +99999.000)	**AIx03LAL**	:= ___________
AIx03 Hi Warn 1 (Off,–99999.000 to +99999.000)	**AIx03HW1**	:= ___________
AIx03 Hi Warn 2 (Off,–99999.000 to +99999.000)	**AIx03HW2**	:= ___________
AIx03 Hi Alarm (Off,–99999.000 to +99999.000)	**AIx03HAL**	:= ___________

Analog Input x04 Settings

AIx04 Type (I,V)	**AIx04TYP**	:= ___________

If AIx04TYP = I

AIx04 Low (–20.480 to +20.480; mA)	**AIx04L**	:= ___________
AIx04 High (–20.480 to +20.480; mA)	**AIx04H**	:= ___________

If AIx04TYP = V

AIx04 Low (–10.240 to +10.240 V)	**AIx04L**	:= ___________
AIx04 High (–10.240 to +10.240 V)	**AIx04H**	:= ___________

NOTE: Set Warn and Alarm settings to a value between Engr Low and Engr High settings.

AIx04 Engr Units (16 Characters)	**AIx04EU**	:= ___________
AIx04 Engr Low (–99999.000 to +99999.000)	**AIx04EL**	:= ___________
AIx04 Engr High (–99999.000 to +99999.000)	**AIx04EH**	:= ___________
AIx04 Low Warn 1 (Off,–99999.000 to +99999.000)	**AIx04LW1**	:= ___________
AIx04 Low Warn 2 (Off,–99999.000 to +99999.000)	**AIx04LW2**	:= ___________
AIx04 Low Alarm (Off,–99999.000 to +99999.000)	**AIx04LAL**	:= ___________
AIx04 Hi Warn 1 (Off,–99999.000 to +99999.000)	**AIx04HW1**	:= ___________
AIx04 Hi Warn 2 (Off,–99999.000 to +99999.000)	**AIx04HW2**	:= ___________
AIx04 Hi Alarm (Off,–99999.000 to +99999.000)	**AIx04HAL**	:= ___________

Analog Input x05 Settings

AIx05 Type (I,V)	**AIx05TYP**	:= ________

If AIx05TYP = I

AIx05 Low (–20.480 to +20.480; mA)	**AIx05L**	:= ________
AIx05 High (–20.480 to +20.480; mA)	**AIx05H**	:= ________

If AIx05TYP = V

AIx05 Low (–10.240 to +10.240 V)	**AIx05L**	:= ________
AIx05 High (–10.240 to +10.240 V)	**AIx05H**	:= ________

NOTE: Set Warn and Alarm settings to a value between Engr Low and Engr High settings.

AIx05 Engr Units (16 Characters)	**AIx05EU**	:= ________
AIx05 Engr Low (–99999.000 to +99999.000)	**AIx05EL**	:= ________
AIx05 Engr High (–99999.000 to +99999.000)	**AIx05EH**	:= ________
AIx05 Low Warn 1 (Off,–99999.000 to +99999.000)	**AIx05LW1**	:= ________
AIx05 Low Warn 2 (Off,–99999.000 to +99999.000)	**AIx05LW2**	:= ________
AIx05 Low Alarm (Off,–99999.000 to +99999.000)	**AIx05LAL**	:= ________
AIx05 Hi Warn 1 (Off,–99999.000 to +99999.000)	**AIx05HW1**	:= ________
AIx05 Hi Warn 2 (Off,–99999.000 to +99999.000)	**AIx05HW2**	:= ________
AIx05 Hi Alarm (Off,–99999.000 to +99999.000)	**AIx05HAL**	:= ________

Analog Input x06 Settings

AIx06 Type (I,V)	**AIx06TYP**	:= ________

If AIx06TYP = I

AIx06 Low (–20.480 to +20.480; mA)	**AIx06L**	:= ________
AIx06 High (–20.480 to +20.480; mA)	**AIx06H**	:= ________

If AIx06TYP = V

AIx06 Low (–10.240 to +10.240 V)	**AIx06L**	:= ________
AIx06 High (–10.240 to +10.240 V)	**AIx06H**	:= ________

NOTE: Set Warn and Alarm settings to a value between Engr Low and Engr High settings.

AIx06 Engr Units (16 Characters)	**AIx06EU**	:= ____________
AIx06 Engr Low (–99999.000 to +99999.000)	**AIx06EL**	:= ____________
AIx06 Engr High (–99999.000 to +99999.000)	**AIx06EH**	:= ____________
AIx06 Low Warn 1 (Off,–99999.000 to +99999.000)	**AIx06LW1**	:= ____________
AIx06 Low Warn 2 (Off,–99999.000 to +99999.000)	**AIx06LW2**	:= ____________
AIx06 Low Alarm (Off,–99999.000 to +99999.000)	**AIx06LAL**	:= ____________
AIx06 Hi Warn 1 (Off,–99999.000 to +99999.000)	**AIx06HW1**	:= ____________
AIx06 Hi Warn 2 (Off,–99999.000 to +99999.000)	**AIx06HW2**	:= ____________
AIx06 Hi Alarm (Off,–99999.000 to +99999.000)	**AIx06HAL**	:= ____________

Analog Input x07 Settings

AIx07 Type (I,V)	**AIx07TYP**	:= ____________

If AIx07TYP = I

AIx07 Low (–20.480 to +20.480; mA)	**AIx07L**	:= ____________
AIx07 High (–20.480 to +20.480; mA)	**AIx07H**	:= ____________

If AIx07TYP = V

AIx07 Low (–10.240 to +10.240 V)	**AIx07L**	:= ____________
AIx07 High (–10.240 to +10.240 V)	**AIx07H**	:= ____________

NOTE: Set Warn and Alarm settings to a value between Engr Low and Engr High settings.

AIx07 Engr Units (16 Characters)	**AIx07EU**	:= ____________
AIx07 Engr Low (–99999.000 to +99999.000)	**AIx07EL**	:= ____________
AIx07 Engr High (–99999.000 to +99999.000)	**AIx07EH**	:= ____________
AIx07 Low Warn 1 (Off,–99999.000 to +99999.000)	**AIx07LW1**	:= ____________
AIx07 Low Warn 2 (Off,–99999.000 to +99999.000)	**AIx07LW2**	:= ____________
AIx07 Low Alarm (Off,–99999.000 to +99999.000)	**AIx07LAL**	:= ____________
AIx07 Hi Warn 1 (Off,–99999.000 to +99999.000)	**AIx07HW1**	:= ____________
AIx07 Hi Warn 2 (Off,–99999.000 to +99999.000)	**AIx07HW2**	:= ____________
AIx07 Hi Alarm (Off,–99999.000 to +99999.000)	**AIx07HAL**	:= ____________

Analog Input x08 Settings

AIx08 Type (I,V)	**AIx08TYP**	:= ________________
If AIx08TYP = I		
AIx08 Low (–20.480 to +20.480; mA)	**AIx08L**	:= ________________
AIx08 High (–20.480 to +20.480; mA)	**AIx08H**	:= ________________
If AIx08TYP = V		
AIx08 Low (–10.240 to +10.240 V)	**AIx08L**	:= ________________
AIx08 High (–10.240 to +10.240 V)	**AIx08H**	:= ________________

NOTE: Set Warn and Alarm settings to a value between Engr Low and Engr High settings.

AIx08 Engr Units (16 Characters)	**AIx08EU**	:= ________________
AIx08 Engr Low (–99999.000 to +99999.000)	**AIx08EL**	:= ________________
AIx07 Engr High (–99999.000 to +99999.000)	**AIx07EH**	:= ________________
AIx08 Low Warn 1 (Off,–99999.000 to +99999.000)	**AIx08LW1**	:= ________________
AIx08 Low Warn 2 (Off,–99999.000 to +99999.000)	**AIx08LW2**	:= ________________
AIx08 Low Alarm (Off,–99999.000 to +99999.000)	**AIx08LAL**	:= ________________
AIx08 Hi Warn 1 (Off,–99999.000 to +99999.000)	**AIx08HW1**	:= ________________
AIx08 Hi Warn 2 (Off,–99999.000 to +99999.000)	**AIx08HW2**	:= ________________
AIx08 Hi Alarm (Off,–99999.000 to +99999.000)	**AIx08HAL**	:= ________________
AIx08 Engr High (–99999.000 to +99999.000)	**AIx08EH**	:= ________________

Logic Settings (SET L Command)

SELOGIC Enables

SELOGIC LATCHES (N, 1–32)	**ELAT**	:=	________
SV/TIMERS (N, 1–64)	**ESV**	:=	________

Latch Bits Eqns

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	:=	____________

SV/Timers Set

SV TIMER PICKUP (0.000–16000.000; sec)	**SV01PU**	:=	____________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV01DO**	:=	____________
SV INPUT EQ (SV)	**SV01**	:=	____________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV02PU**	:=	____________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV02DO**	:=	____________
SV INPUT EQ (SV)	**SV02**	:=	____________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV03PU**	:=	____________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV03DO**	:=	____________
SV INPUT EQ (SV)	**SV03**	:=	____________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV04PU**	:=	____________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV04DO**	:=	____________
SV INPUT EQ (SV)	**SV04**	:=	____________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV05PU**	:=	____________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV05DO**	:=	____________
SV INPUT EQ (SV)	**SV05**	:=	____________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV06PU**	:=	____________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV06DO**	:=	____________
SV INPUT EQ (SV)	**SV06**	:=	____________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV07PU**	:=	____________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV07DO**	:=	____________
SV INPUT EQ (SV)	**SV07**	:=	____________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV08PU**	:=	____________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV08DO**	:=	____________
SV INPUT EQ (SV)	**SV08**	:=	____________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV09PU**	:=	____________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV09DO**	:=	____________
SV INPUT EQ (SV)	**SV09**	:=	____________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV10PU**	:=	____________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV10DO**	:=	____________
SV INPUT EQ (SV)	**SV10**	:=	____________

SV TIMER PICKUP (0.000–16000.000; sec)	**SV11PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV11DO**	:=	______
SV INPUT EQ (SV)	**SV11**	:=	______
SV TIMER PICKUP (0.000–16000.000; sec)	**SV12PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV12DO**	:=	______
SV INPUT EQ (SV)	**SV12**	:=	______
SV TIMER PICKUP (0.000–16000.000; sec)	**SV13PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV13DO**	:=	______
SV INPUT EQ (SV)	**SV13**	:=	______
SV TIMER PICKUP (0.000–16000.000; sec)	**SV14PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV14DO**	:=	______
SV INPUT EQ (SV)	**SV14**	:=	______
SV TIMER PICKUP (0.000–16000.000; sec)	**SV15PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV15DO**	:=	______
SV INPUT EQ (SV)	**SV15**	:=	______
SV TIMER PICKUP (0.000–16000.000; sec)	**SV16PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV16DO**	:=	______
SV INPUT EQ (SV)	**SV16**	:=	______
SV TIMER PICKUP (0.000–16000.000; sec)	**SV17PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV17DO**	:=	______
SV INPUT EQ (SV)	**SV17**	:=	______
SV TIMER PICKUP (0.000–16000.000; sec)	**SV18PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV18DO**	:=	______
SV INPUT EQ (SV)	**SV18**	:=	______
SV TIMER PICKUP (0.000–16000.000; sec)	**SV19PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV19DO**	:=	______
SV INPUT EQ (SV)	**SV19**	:=	______
SV TIMER PICKUP (0.000–16000.000; sec)	**SV20PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV20DO**	:=	______
SV INPUT EQ (SV)	**SV20**	:=	______

SV TIMER PICKUP (0.000–16000.000; sec)	**SV21PU**	:=	___
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV21DO**	:=	___
SV INPUT EQ (SV)	**SV21**	:=	___
SV TIMER PICKUP (0.000–16000.000; sec)	**SV22PU**	:=	___
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV22DO**	:=	___
SV INPUT EQ (SV)	**SV22**	:=	___
SV TIMER PICKUP (0.000–16000.000; sec)	**SV23PU**	:=	___
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV23DO**	:=	___
SV INPUT EQ (SV)	**SV23**	:=	___
SV TIMER PICKUP (0.000–16000.000; sec)	**SV24PU**	:=	___
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV24DO**	:=	___
SV INPUT EQ (SV)	**SV24**	:=	___
SV TIMER PICKUP (0.000–16000.000; sec)	**SV25PU**	:=	___
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV25DO**	:=	___
SV INPUT EQ (SV)	**SV25**	:=	___
SV TIMER PICKUP (0.000–16000.000; sec)	**SV26PU**	:=	___
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV26DO**	:=	___
SV INPUT EQ (SV)	**SV26**	:=	___
SV TIMER PICKUP (0.000–16000.000; sec)	**SV27PU**	:=	___
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV27DO**	:=	___
SV INPUT EQ (SV)	**SV27**	:=	___
SV TIMER PICKUP (0.000–16000.000; sec)	**SV28PU**	:=	___
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV28DO**	:=	___
SV INPUT EQ (SV)	**SV28**	:=	___
SV TIMER PICKUP (0.000–16000.000; sec)	**SV29PU**	:=	___
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV29DO**	:=	___
SV INPUT EQ (SV)	**SV29**	:=	___
SV TIMER PICKUP (0.000–16000.000; sec)	**SV30PU**	:=	___
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV30DO**	:=	___
SV INPUT EQ (SV)	**SV30**	:=	___

SV TIMER PICKUP (0.000–16000.000; sec)	**SV31PU**	:=	________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV31DO**	:=	________
SV INPUT EQ (SV)	**SV31**	:=	________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV32PU**	:=	________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV32DO**	:=	________
SV INPUT EQ (SV)	**SV32**	:=	________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV33PU**	:=	________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV33DO**	:=	________
SV INPUT EQ (SV)	**SV33**	:=	________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV34PU**	:=	________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV34DO**	:=	________
SV INPUT EQ (SV)	**SV34**	:=	________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV35PU**	:=	________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV35DO**	:=	________
SV INPUT EQ (SV)	**SV35**	:=	________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV36PU**	:=	________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV36DO**	:=	________
SV INPUT EQ (SV)	**SV36**	:=	________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV37PU**	:=	________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV37DO**	:=	________
SV INPUT EQ (SV)	**SV37**	:=	________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV38PU**	:=	________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV38DO**	:=	________
SV INPUT EQ (SV)	**SV38**	:=	________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV39PU**	:=	________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV39DO**	:=	________
SV INPUT EQ (SV)	**SV39**	:=	________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV40PU**	:=	________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV40DO**	:=	________
SV INPUT EQ (SV)	**SV40**	:=	________

SV TIMER PICKUP (0.000–16000.000; sec)	**SV41PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV41DO**	:=	______
SV INPUT EQ (SV)	**SV41**	:=	______
SV TIMER PICKUP (0.000–16000.000; sec)	**SV42PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV42DO**	:=	______
SV INPUT EQ (SV)	**SV42**	:=	______
SV TIMER PICKUP (0.000–16000.000; sec)	**SV43PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV43DO**	:=	______
SV INPUT EQ (SV)	**SV43**	:=	______
SV TIMER PICKUP (0.000–16000.000; sec)	**SV44PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV44DO**	:=	______
SV INPUT EQ (SV)	**SV44**	:=	______
SV TIMER PICKUP (0.000–16000.000; sec)	**SV45PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV45DO**	:=	______
SV INPUT EQ (SV)	**SV45**	:=	______
SV TIMER PICKUP (0.000–16000.000; sec)	**SV46PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV46DO**	:=	______
SV INPUT EQ (SV)	**SV46**	:=	______
SV TIMER PICKUP (0.000–16000.000; sec)	**SV47PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV47DO**	:=	______
SV INPUT EQ (SV)	**SV47**	:=	______
SV TIMER PICKUP (0.000–16000.000; sec)	**SV48PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV48DO**	:=	______
SV INPUT EQ (SV)	**SV48**	:=	______
SV TIMER PICKUP (0.000–16000.000; sec)	**SV49PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV49DO**	:=	______
SV INPUT EQ (SV)	**SV49**	:=	______
SV TIMER PICKUP (0.000–16000.000; sec)	**SV50PU**	:=	______
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV50DO**	:=	______
SV INPUT EQ (SV)	**SV50**	:=	______

SV TIMER PICKUP (0.000–16000.000; sec)	**SV51PU**	:=	
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV51DO**	:=	
SV INPUT EQ (SV)	**SV51**	:=	
SV TIMER PICKUP (0.000–16000.000; sec)	**SV52PU**	:=	
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV52DO**	:=	
SV INPUT EQ (SV)	**SV52**	:=	
SV TIMER PICKUP (0.000–16000.000; sec)	**SV52PU**	:=	
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV53DO**	:=	
SV INPUT EQ (SV)	**SV53**	:=	
SV TIMER PICKUP (0.000–16000.000; sec)	**SV54PU**	:=	
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV54DO**	:=	
SV INPUT EQ (SV)	**SV54**	:=	
SV TIMER PICKUP (0.000–16000.000; sec)	**SV55PU**	:=	
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV55DO**	:=	
SV INPUT EQ (SV)	**SV55**	:=	
SV TIMER PICKUP (0.000–16000.000; sec)	**SV56PU**	:=	
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV56DO**	:=	
SV INPUT EQ (SV)	**SV56**	:=	
SV TIMER PICKUP (0.000–16000.000; sec)	**SV57PU**	:=	
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV57DO**	:=	
SV INPUT EQ (SV)	**SV57**	:=	
SV TIMER PICKUP (0.000–16000.000; sec)	**SV58PU**	:=	
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV58DO**	:=	
SV INPUT EQ (SV)	**SV58**	:=	
SV TIMER PICKUP (0.000–16000.000; sec)	**SV59PU**	:=	
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV59DO**	:=	
SV INPUT EQ (SV)	**SV59**	:=	
SV TIMER PICKUP (0.000–16000.000; sec)	**SV60PU**	:=	
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV60DO**	:=	
SV INPUT EQ (SV)	**SV60**	:=	

SV TIMER PICKUP (0.000–16000.000; sec)	**SV61PU**	:=	________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV61DO**	:=	________
SV INPUT EQ (SV)	**SV61**	:=	________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV62PU**	:=	________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV62DO**	:=	________
SV INPUT EQ (SV)	**SV62**	:=	________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV63PU**	:=	________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV63DO**	:=	________
SV INPUT EQ (SV)	**SV63**	:=	________
SV TIMER PICKUP (0.000–16000.000; sec)	**SV64PU**	:=	________
SV TIMER DROPOUT (0.000–16000.000; sec)	**SV64DO**	:=	________
SV INPUT EQ (SV)	**SV64**	:=	________

Output Contacts (Base Unit)

OUT101 FAIL-SAFE (Y,N) **OUT101FS** := ________

OUT101 := ________

OUT102 FAIL-SAFE (Y,N) **OUT102FS** := ________

OUT102 := ________

OUT103 FAIL-SAFE (Y,N) **OUT103FS** := ________

OUT103 := ________

Output Contacts (DO Units)

For a card in Slot 3

OUT301 FAIL-SAFE (Y,N) **OUT301FS** := ________

OUT301 := ________

OUT302 FAIL-SAFE (Y,N) **OUT302FS** := ________

OUT302 := ________

OUT303 FAIL-SAFE (Y,N) **OUT303FS** := ________

OUT303 := ________

OUT304 FAIL-SAFE (Y,N) **OUT304FS** := ________

OUT304 := ________

OUT305 FAIL-SAFE (Y,N) **OUT305FS** := ________

OUT305 := ________

OUT306 FAIL-SAFE (Y,N) **OUT306FS** := ______________________
OUT306 := ____
OUT307 FAIL-SAFE (Y,N) **OUT307FS** := ______________________
OUT307 := ____
OUT308 FAIL-SAFE (Y,N) **OUT308FS** := ______________________
OUT308 := ____

For a card in Slot 4

OUT401 FAIL-SAFE (Y,N) **OUT401FS** := ______________________
OUT401 := ____
OUT402 FAIL-SAFE (Y,N) **OUT402FS** := ______________________
OUT402 := ____
OUT403 FAIL-SAFE (Y,N) **OUT403FS** := ______________________
OUT403 := ____
OUT404 FAIL-SAFE (Y,N) **OUT404FS** := ______________________
OUT404 := ____
OUT405 FAIL-SAFE (Y,N) **OUT405FS** := ______________________
OUT405 := ____
OUT406 FAIL-SAFE (Y,N) **OUT406FS** := ______________________
OUT406 := ____
OUT407 FAIL-SAFE (Y,N) **OUT407FS** := ______________________
OUT407 := ____
OUT408 FAIL-SAFE (Y,N) **OUT408FS** := ______________________
OUT408 := ____

For a card in Slot 5

OUT501 FAIL-SAFE (Y,N) **OUT501FS** := ______________________
OUT501 := ____
OUT502 FAIL-SAFE (Y,N) **OUT502FS** := ______________________
OUT502 := ____
OUT503 FAIL-SAFE (Y,N) **OUT503FS** := ______________________
OUT503 := ____
OUT504 FAIL-SAFE (Y,N) **OUT504FS** := ______________________
OUT504 := ____
OUT505 FAIL-SAFE (Y,N) **OUT505FS** := ______________________
OUT505 := ____

OUT506 FAIL-SAFE (Y,N) **OUT506FS** := ____________

OUT506 := ____________

OUT507 FAIL-SAFE (Y,N) **OUT507FS** := ____________

OUT507 := ____________

OUT508 FAIL-SAFE (Y,N) **OUT508FS** := ____________

OUT508 := ____________

For a card in Slot 6

OUT601 FAIL-SAFE (Y,N) **OUT601FS** := ____________

OUT601 := ____________

OUT602 FAIL-SAFE (Y,N) **OUT602FS** := ____________

OUT602 := ____________

OUT603 FAIL-SAFE (Y,N) **OUT603FS** := ____________

OUT603 := ____________

OUT604 FAIL-SAFE (Y,N) **OUT604FS** := ____________

OUT604 := ____________

OUT605 FAIL-SAFE (Y,N) **OUT605FS** := ____________

OUT605 := ____________

OUT606 FAIL-SAFE (Y,N) **OUT606FS** := ____________

OUT606 := ____________

OUT607 FAIL-SAFE (Y,N) **OUT607FS** := ____________

OUT607 := ____________

OUT608 FAIL-SAFE (Y,N) **OUT608FS** := ____________

OUT608 := ____________

Global Settings (SET G Command)

General Settings

DATE FORMAT (MDY,YMD,DMY)	**DATE_F**	:=	____________

Input Debounce Settings

Base Unit

IN101 Debounce (AC, 0–65000; msec)	**IN101D**	:=	____________
IN102 Debounce (AC, 0–65000; msec)	**IN102D**	:=	____________

For a card in Slot 3

IN301 Debounce (AC, 0–65000; msec)	**IN301D**	:=	____________
IN302 Debounce (AC, 0–65000; msec)	**IN302D**	:=	____________
IN303 Debounce (AC, 0–65000; msec)	**IN303D**	:=	____________
IN304 Debounce (AC, 0–65000; msec)	**IN304D**	:=	____________
IN305 Debounce (AC, 0–65000; msec)	**IN305D**	:=	____________
IN306 Debounce (AC, 0–65000; msec)	**IN306D**	:=	____________
IN307 Debounce (AC, 0–65000; msec)	**IN307D**	:=	____________
IN308 Debounce (AC, 0–65000; msec)	**IN308D**	:=	____________

For a card in Slot 4

IN401 Debounce (AC, 0–65000; msec)	**IN401D**	:=	____________
IN402 Debounce (AC, 0–65000; msec)	**IN402D**	:=	____________
IN403 Debounce (AC, 0–65000; msec)	**IN403D**	:=	____________
IN404 Debounce (AC, 0–65000; msec)	**IN404D**	:=	____________
IN405 Debounce (AC, 0–65000; msec)	**IN405D**	:=	____________
IN406 Debounce (AC, 0–65000; msec)	**IN406D**	:=	____________
IN407 Debounce (AC, 0–65000; msec)	**IN407D**	:=	____________
IN408 Debounce (AC, 0–65000; msec)	**IN408D**	:=	____________

For a card in Slot 5

IN501 Debounce (AC, 0–65000; msec)	**IN501D**	:=	____________
IN502 Debounce (AC, 0–65000; msec)	**IN502D**	:=	____________
IN503 Debounce (AC, 0–65000; msec)	**IN503D**	:=	____________
IN504 Debounce (AC, 0–65000; msec)	**IN504D**	:=	____________

IN505 Debounce (AC, 0–65000; msec)	**IN505D**	:= ______________
IN506 Debounce (AC, 0–65000; msec)	**IN506D**	:= ______________
IN507 Debounce (AC, 0–65000; msec)	**IN507D**	:= ______________
IN508 Debounce (AC, 0–65000; msec)	**IN508D**	:= ______________

For a card in Slot 6

IN601 Debounce (AC, 0–65000; msec)	**IN601D**	:= ______________
IN602 Debounce (AC, 0–65000; msec)	**IN602D**	:= ______________
IN603 Debounce (AC, 0–65000; msec)	**IN603D**	:= ______________
IN604 Debounce (AC, 0–65000; msec)	**IN604D**	:= ______________
IN605 Debounce (AC, 0–65000; msec)	**IN605D**	:= ______________
IN606 Debounce (AC, 0–65000; msec)	**IN606D**	:= ______________
IN607 Debounce (AC, 0–65000; msec)	**IN607D**	:= ______________
IN608 Debounce (AC, 0–65000; msec)	**IN608D**	:= ______________

Data Reset

TARGET RESET EQ (SV)	**RSTTRGT**	:= ______________

Access Control

DISABLE SETTINGS (SV)	**DSABLSET**	:= ______________

Port Settings (SET P Command)

Port F

SPEED (300 to 38400 bps)	**SPEED**	:=	________
DATA BITS (7,8 bits)	**BITS**	:=	________
PARITY (O,E,N)	**PARITY**	:=	________
STOP BITS (1,2 bits)	**STOP**	:=	________
PORT TIME-OUT (0–30 min)	**T_OUT**	:=	________
SEND AUTOMESSAGE (Y,N)	**AUTO**	:=	________
HDWR HANDSHAKING (Y,N)	**RTSCTS**	:=	________

Port 3

SPEED (300–38400 bps)	**SPEED**	:=	________
DATA BITS (7,8 bits)	**BITS**	:=	________
PARITY (O,E,N)	**PARITY**	:=	________
STOP BITS (1,2 bits)	**STOP**	:=	________
PORT TIME-OUT (0–30 min)	**T_OUT**	:=	________
SEND AUTOMESSAGE (Y,N)	**AUTO**	:=	________
HDWR HANDSHAKING (Y,N)	**RTSCTS**	:=	________
FAST OP MESSAGES (Y,N)	**FASTOP**	:=	________

Front-Panel Settings (SET F Command)

General Settings

Enable Display Points (N,1–32)	**EDP**	:=	________
Enable Local Bits (N,1–32)	**ELB**	:=	________
LCD TIMEOUT (Off,1–30; min)	**FP_TO**	:=	________
LCD CONTRAST(1–8)	**FP_CONT**	:=	________

Target LED Settings

LED 1 LATCH (Y,N)	**T01LEDL**	:=	________
LED1 EQUATION (SV)	**T01_LED**	:=	________
LED 2 LATCH (Y,N)	**T021LEDL**	:=	________
LED2 EQUATION (SV)	**T02_LED**	:=	________
LED 3 LATCH (Y,N)	**T03LEDL**	:=	________
LED3 EQUATION (SV)	**T03_LED**	:=	________
LED 4 LATCH (Y,N)	**T041LEDL**	:=	________
LED4 EQUATION (SV)	**T04_LED**	:=	________
LED 5 LATCH (Y,N)	**T05LEDL**	:=	________
LED5 EQUATION (SV)	**T05_LED**	:=	________
LED 6 LATCH (Y,N)	**T06LEDL**	:=	________
LED6 EQUATION (SV)	**T06_LED**	:=	________

Display Point Settings

Display Point Settings (maximum 60 characters):
(Boolean): Monitor Word Bit Name, “Alias”, “Set String”, “Clear String”
(Analog) : Analog Quantity Name, “User Text and Formatting”

DP01	:=	________
DP02	:=	________
DP03	:=	________
DP04	:=	________
DP05	:=	________
DP06	:=	________
DP07	:=	________
DP08	:=	________
DP09	:=	________
DP10	:=	________

DP11	:=	______________________
DP12	:=	______________________
DP13	:=	______________________
DP14	:=	______________________
DP15	:=	______________________
DP16	:=	______________________
DP17	:=	______________________
DP18	:=	______________________
DP19	:=	______________________
DP20	:=	______________________
DP21	:=	______________________
DP22	:=	______________________
DP23	:=	______________________
DP24	:=	______________________
DP25	:=	______________________
DP26	:=	______________________
DP27	:=	______________________
DP28	:=	______________________
DP29	:=	______________________
DP30	:=	______________________
DP31	:=	______________________
DP32	:=	______________________

Local Control Bit Settings

Local Bit LB_Name (14 char; enter NA to null)	**NLB01**	=	__________
Clear Local Bit LB_Label (7 char; enter NA to null)	**CLB01**	=	__________
Set Local Bit LB_Label (7 char; enter NA to null)	**SLB01**	=	__________
Pulse Local Bit LB_Label (7 char; enter NA to null)	**PLB01**	=	__________
Local Bit LB_Name (14 char; enter NA to null)	**NLB02**	=	__________
Clear Local Bit LB_Label (7 char; enter NA to null)	**CLB02**	=	__________
Set Local Bit LB_Label (7 char; enter NA to null)	**SLB02**	=	__________
Pulse Local Bit LB_Label (7 char; enter NA to null)	**PLB02**	=	__________
Local Bit LB_Name (14 char; enter NA to null)	**NLB03**	=	__________
Clear Local Bit LB_Label (7 char; enter NA to null)	**CLB03**	=	__________
Set Local Bit LB_Label (7 char; enter NA to null)	**SLB03**	=	__________
Pulse Local Bit LB_Label (7 char; enter NA to null)	**PLB03**	=	__________

Local Bit LB_Name (14 char; enter NA to null)	**NLB04**	=	______________
Clear Local Bit LB_Label (7 char; enter NA to null)	**CLB04**	=	______________
Set Local Bit LB_Label (7 char; enter NA to null)	**SLB04**	=	______________
Pulse Local Bit LB_Label (7 char; enter NA to null)	**PLB04**	=	______________
Local Bit LB_Name (14 char; enter NA to null)	**NLB05**	=	______________
Clear Local Bit LB_Label (7 char; enter NA to null)	**CLB05**	=	______________
Set Local Bit LB_Label (7 char; enter NA to null)	**SLB05**	=	______________
Pulse Local Bit LB_Label (7 char; enter NA to null)	**PLB05**	=	______________
Local Bit LB_Name (14 char; enter NA to null)	**NLB06**	=	______________
Clear Local Bit LB_Label (7 char; enter NA to null)	**CLB06**	=	______________
Set Local Bit LB_Label (7 char; enter NA to null)	**SLB06**	=	______________
Pulse Local Bit LB_Label (7 char; enter NA to null)	**PLB06**	=	______________
Local Bit LB_Name (14 char; enter NA to null)	**NLB07**	=	______________
Clear Local Bit LB_Label (7 char; enter NA to null)	**CLB07**	=	______________
Set Local Bit LB_Label (7 char; enter NA to null)	**SLB07**	=	______________
Pulse Local Bit LB_Label (7 char; enter NA to null)	**PLB07**	=	______________
Local Bit LB_Name (14 char; enter NA to null)	**NLB08**	=	______________
Clear Local Bit LB_Label (7 char; enter NA to null)	**CLB08**	=	______________
Set Local Bit LB_Label (7 char; enter NA to null)	**SLB08**	=	______________
Pulse Local Bit LB_Label (7 char; enter NA to null)	**PLB08**	=	______________
Local Bit LB_Name (14 char; enter NA to null)	**NLB09**	=	______________
Clear Local Bit LB_Label (7 char; enter NA to null)	**CLB09**	=	______________
Set Local Bit LB_Label (7 char; enter NA to null)	**SLB09**	=	______________
Pulse Local Bit LB_Label (7 char; enter NA to null)	**PLB09**	=	______________
Local Bit LB_Name (14 char; enter NA to null)	**NLB10**	=	______________
Clear Local Bit LB_Label (7 char; enter NA to null)	**CLB10**	=	______________
Set Local Bit LB_Label (7 char; enter NA to null)	**SLB10**	=	______________
Pulse Local Bit LB_Label (7 char; enter NA to null)	**PLB10**	=	______________
Local Bit LB_Name (14 char; enter NA to null)	**NLB11**	=	______________
Clear Local Bit LB_Label (7 char; enter NA to null)	**CLB11**	=	______________
Set Local Bit LB_Label (7 char; enter NA to null)	**SLB11**	=	______________
Pulse Local Bit LB_Label (7 char; enter NA to null)	**PLB11**	=	______________

Local Bit LB_Name (14 char; enter NA to null)	**NLB12**	=	__________
Clear Local Bit LB_Label (7 char; enter NA to null)	**CLB12**	=	__________
Set Local Bit LB_Label (7 char; enter NA to null)	**SLB12**	=	__________
Pulse Local Bit LB_Label (7 char; enter NA to null)	**PLB12**	=	__________
Local Bit LB_Name (14 char; enter NA to null)	**NLB13**	=	__________
Clear Local Bit LB_Label (7 char; enter NA to null)	**CLB13**	=	__________
Set Local Bit LB_Label (7 char; enter NA to null)	**SLB13**	=	__________
Pulse Local Bit LB_Label (7 char; enter NA to null)	**PLB13**	=	__________
Local Bit LB_Name (14 char; enter NA to null)	**NLB14**	=	__________
Clear Local Bit LB_Label (7 char; enter NA to null)	**CLB14**	=	__________
Set Local Bit LB_Label (7 char; enter NA to null)	**SLB14**	=	__________
Pulse Local Bit LB_Label (7 char; enter NA to null)	**PLB14**	=	__________
Local Bit LB_Name (14 char; enter NA to null)	**NLB15**	=	__________
Clear Local Bit LB_Label (7 char; enter NA to null)	**CLB15**	=	__________
Set Local Bit LB_Label (7 char; enter NA to null)	**SLB15**	=	__________
Pulse Local Bit LB_Label (7 char; enter NA to null)	**PLB15**	=	__________
Local Bit LB_Name (14 char; enter NA to null)	**NLB16**	=	__________
Clear Local Bit LB_Label (7 char; enter NA to null)	**CLB16**	=	__________
Set Local Bit LB_Label (7 char; enter NA to null)	**SLB16**	=	__________
Pulse Local Bit LB_Label (7 char; enter NA to null)	**PLB16**	=	__________
Local Bit LB_Name (14 char; enter NA to null)	**NLB17**	=	__________
Clear Local Bit LB_Label (7 char; enter NA to null)	**CLB17**	=	__________
Set Local Bit LB_Label (7 char; enter NA to null)	**SLB17**	=	__________
Pulse Local Bit LB_Label (7 char; enter NA to null)	**PLB17**	=	__________
Local Bit LB_Name (14 char; enter NA to null)	**NLB18**	=	__________
Clear Local Bit LB_Label (7 char; enter NA to null)	**CLB18**	=	__________
Set Local Bit LB_Label (7 char; enter NA to null)	**SLB18**	=	__________
Pulse Local Bit LB_Label (7 char; enter NA to null)	**PLB18**	=	__________
Local Bit LB_ Name (14 char; enter NA to null)	**NLB19**	=	__________
Clear Local Bit LB_Label(7 char; enter NA to null)	**CLB19**	=	__________
Set Local Bit LB_Label(7 char; enter NA to null)	**SLB19**	=	__________
Pulse Local Bit LB_Label(7 char; enter NA to null)	**PLB19**	=	__________

Local Bit LB_ Name (14 char; enter NA to null)	**NLB20**	=	________________
Clear Local Bit LB_Label(7 char; enter NA to null)	**CLB20**	=	________________
Set Local Bit LB_Label(7 char; enter NA to null)	**SLB20**	=	________________
Pulse Local Bit LB_Label(7 char; enter NA to null)	**PLB20**	=	________________
Local Bit LB_ Name (14 char; enter NA to null)	**NLB21**	=	________________
Clear Local Bit LB_Label(7 char; enter NA to null)	**CLB21**	=	________________
Set Local Bit LB_Label(7 char; enter NA to null)	**SLB21**	=	________________
Pulse Local Bit LB_Label(7 char; enter NA to null)	**PLB21**	=	________________
Local Bit LB_ Name (14 char; enter NA to null)	**NLB22**	=	________________
Clear Local Bit LB_Label(7 char; enter NA to null)	**CLB22**	=	________________
Set Local Bit LB_Label(7 char; enter NA to null)	**SLB22**	=	________________
Pulse Local Bit LB_Label(7 char; enter NA to null)	**PLB22**	=	________________
Local Bit LB_ Name (14 char; enter NA to null)	**NLB23**	=	________________
Clear Local Bit LB_Label(7 char; enter NA to null)	**CLB23**	=	________________
Set Local Bit LB_Label(7 char; enter NA to null)	**SLB23**	=	________________
Pulse Local Bit LB_Label(7 char; enter NA to null)	**PLB23**	=	________________
Local Bit LB_ Name (14 char; enter NA to null)	**NLB24**	=	________________
Clear Local Bit LB_Label(7 char; enter NA to null)	**CLB24**	=	________________
Set Local Bit LB_Label(7 char; enter NA to null)	**SLB24**	=	________________
Pulse Local Bit LB_Label(7 char; enter NA to null)	**PLB24**	=	________________
Local Bit LB_ Name (14 char; enter NA to null)	**NLB25**	=	________________
Clear Local Bit LB_Label(7 char; enter NA to null)	**CLB25**	=	________________
Set Local Bit LB_Label(7 char; enter NA to null)	**SLB25**	=	________________
Pulse Local Bit LB_Label(7 char; enter NA to null)	**PLB25**	=	________________
Local Bit LB_ Name (14 char; enter NA to null)	**NLB26**	=	________________
Clear Local Bit LB_Label(7 char; enter NA to null)	**CLB26**	=	________________
Set Local Bit LB_Label(7 char; enter NA to null)	**SLB26**	=	________________
Pulse Local Bit LB_Label(7 char; enter NA to null)	**PLB26**	=	________________
Local Bit LB_ Name (14 char; enter NA to null)	**NLB27**	=	________________
Clear Local Bit LB_Label(7 char; enter NA to null)	**CLB27**	=	________________
Set Local Bit LB_Label(7 char; enter NA to null)	**SLB27**	=	________________
Pulse Local Bit LB_Label(7 char; enter NA to null)	**PLB27**	=	________________

Local Bit LB_ Name (14 char; enter NA to null)	**NLB28**	=	____________
Clear Local Bit LB_Label(7 char; enter NA to null)	**CLB28**	=	____________
Set Local Bit LB_Label(7 char; enter NA to null)	**SLB28**	=	____________
Pulse Local Bit LB_Label(7 char; enter NA to null)	**PLB28**	=	____________
Local Bit LB_ Name (14 char; enter NA to null)	**NLB29**	=	____________
Clear Local Bit LB_Label(7 char; enter NA to null)	**CLB29**	=	____________
Set Local Bit LB_Label(7 char; enter NA to null)	**SLB29**	=	____________
Pulse Local Bit LB_Label(7 char; enter NA to null)	**PLB29**	=	____________
Local Bit LB_ Name (14 char; enter NA to null)	**NLB30**	=	____________
Clear Local Bit LB_Label(7 char; enter NA to null)	**CLB30**	=	____________
Set Local Bit LB_Label(7 char; enter NA to null)	**SLB30**	=	____________
Pulse Local Bit LB_Label(7 char; enter NA to null)	**PLB30**	=	____________
Local Bit LB_ Name (14 char; enter NA to null)	**NLB31**	=	____________
Clear Local Bit LB_Label(7 char; enter NA to null)	**CLB31**	=	____________
Set Local Bit LB_Label(7 char; enter NA to null)	**SLB31**	=	____________
Pulse Local Bit LB_Label(7 char; enter NA to null)	**PLB31**	=	____________
Local Bit LB_ Name (14 char; enter NA to null)	**NLB32**	=	____________
Clear Local Bit LB_Label(7 char; enter NA to null)	**CLB32**	=	____________
Set Local Bit LB_Label(7 char; enter NA to null)	**SLB32**	=	____________
Pulse Local Bit LB_Label(7 char; enter NA to null)	**PLB32**	=	____________

Report Settings (SET R Command)

SER Chatter Criteria

Auto-Removal EN (Y,N)	**ESERDEL**	:= ________
Number of Counts (2–20)	**SRDLCNT**	:= ________
Removal Time (0.1–90.0; Seconds)	**SRDLTIM**	:= ________

SER Trigger Lists

Up to 24 Relay-Word elements separated by spaces or commas.

Use NA to disable setting.

SER1 := ________________

SER2 := ________________

SER3 := ________________

SER4 := ________________

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Section 4
Communications

Overview

In order to communicate with the SEL-2410 I/O Processor, you require a communications interface and suitable protocol. A communications interface is the physical connection on a device. Serial ports that conform to the EIA-232 standard (often called RS-232) use DB-9 or DB-25 connectors as the physical interface. Once you have established a physical connection, you must use a communications protocol to interact with the relay. A communications protocol is a language used to perform relay operations and collect data. This section describes communications interfaces and protocols available with the relay, including communication interface connections.

Communications Interfaces

Serial Ports

Use the EIA-232 protocol to communicate with the front-panel serial port as well as the rear serial port. To connect a PC serial port to the relay front-panel serial port and enter relay commands, you need the following:

- A personal computer equipped with one available EIA-232 serial port.
- A communications cable to connect the computer serial port to the relay serial ports.
- Terminal emulation software (EIA-232 protocol) to control the computer serial port.
- An SEL-2410 I/O Processor.

You can also communicate with the SEL-2410 by means of a separate communication device (such as the SEL-2032, SEL-2030, or SEL-2020). Use these devices to either improve the robustness of the communication system or for integration purposes. A number of terminal emulation programs are available for personal computers that can communicate with the relay.

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 3: Settings*) or the front panel. *Section 5: Front-Panel Operations* provides details on making settings with the front panel.

IRIG-B

Use either one of two physical interfaces for the demodulated IRIG-B time-code input. One physical interface is via terminals B01 and B02, 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 Cable C273A (see the cable diagrams that follow in this section or Cable SELECTOR Software (SEL-5801).

+5 Vdc Power Supply

Port power provides as much as 0.5 A total from all of the +5 Vdc pins. Some SEL communications devices require the +5 Vdc power supply.

Connect Your PC to the I/O Processor

The front port of the SEL-2410 is a standard female 9-pin connector with pin numbering shown in *Figure 4.1*. You can connect to a standard 9-pin computer port with SEL Cable C234A, as shown in *SEL-2410 Cable Connections to Communications Devices on page 4.4*. SEL Cable C234A and other cables are available from SEL. Use the Cable SELECTOR Software (SEL-5801) to select an appropriate cable for another application. This software is available for free download from the SEL website at www.selinc.com.

For best performance, keep the length of the SEL Cable C234A shorter than 15 meters (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 4.1 shows the front-panel EIA-232 serial port (PORT F) DB-9 connector pinout for the SEL-2410.

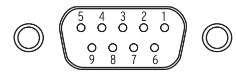


Figure 4.1 EIA-232 DB-9 Connector Pin Numbers

Table 4.1 shows the pin functions for the EIA-232 serial ports.

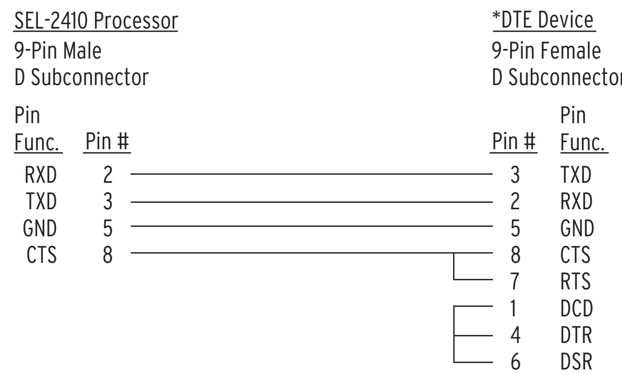
Table 4.1 EIA Serial Port Pin Functions

Pin	Port 3 EIA-232	Port F EIA-232
1	+5 Vdc	N/C
2	RXD	RXD
3	TXD	TXD
4	IRIG+	N/C
5	GND	GND
6	IRIG-	N/C
7	RTS	RTS
8	CTS	CTS
9	GND	GND

The following cable diagrams show several types of EIA-232 serial communications cables that connect the SEL-2410 to other devices. These and other cables are available from SEL. Contact the factory for more information.

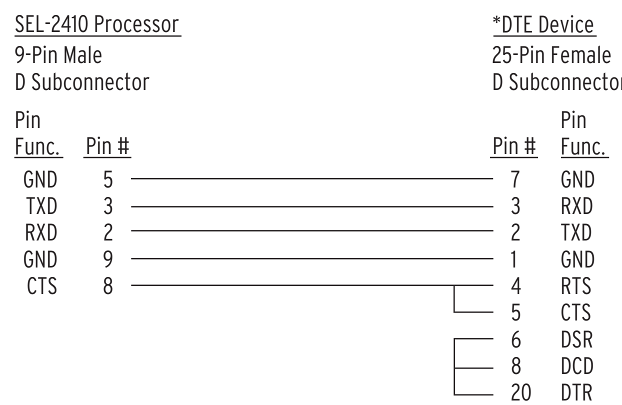
SEL-2410 Cable Connections to Communications Devices

SEL Cable C234A



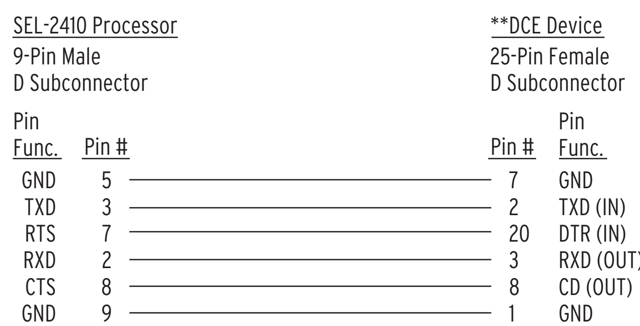
*DTE = Data Terminal Equipment (Computer, Terminal, etc.)

SEL Cable C227A



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

SEL Cable C222



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

SEL Cable C272A

SEL Communications Processor 9-Pin Male D Subconnector Pin Func.	Pin #	Pin #	SEL-2410 Processor 9-Pin Male D Subconnector Pin Func.
RXD	2	3	TXD
TXD	3	2	RXD
GND	5	5	GND
RTS	7	8	CTS
CTS	8	7	RTS

Cable SEL-C273A

SEL Communications Processor 9-Pin Male D Subconnector Pin Func.	Pin #	Pin #	SEL-2410 Processor 9-Pin Male D Subconnector 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

Communications Protocols

Hardware Flow Control

All EIA-232 serial ports support RTS/CTS hardware handshaking (hardware flow control). To enable hardware handshaking, use the **SET P** command or front-panel Set Port submenu 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

The SEL-2410 supports the protocols and command sets shown in *Table 4.2*.

Table 4.2 Command Sets

Command Set	Description
SEL ASCII	Commands and responses
SEL Compressed ASCII	Commands and comma-delimited response
Fast Meter	Binary meter and digital element commands and response
Fast operate	Binary operation command
Fast SER	Use this protocol to receive binary SER unsolicited responses

SEL Communications Protocols

SEL ASCII

This protocol is described in *SEL ASCII Protocol Details*

SEL Compressed ASCII

This protocol provides compressed versions of some of the ASCII commands. The compressed commands are described in *SEL ASCII Protocol Details* and the protocol is described 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 *SEL ASCII Protocol Details* and the protocol is described 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 supports binary Sequential Events Recorder unsolicited responses. The protocol is described in *Appendix C: SEL Communications Processors*.

SEL ASCII Protocol Details

Message Format

SEL ASCII protocol is designed for manual and automatic communication. All commands the relay receives must be of the following form:

```
<command><CR>    or    <command><CRLF>
```

A command transmitted to the relay consists of the command followed by either a CR (carriage return) or a CRLF (carriage return and line feed). You can truncate commands to the first three characters. For example, **METER <Enter>** becomes **MET <Enter>**. Use upper- and lowercase characters without distinction, except in passwords.

The I/O processor transmits all messages in the following format:

```
<STX><MESSAGE LINE 1><CRLF>
<MESSAGE LINE 2><CRLF>
                .
                .
                .
<LAST MESSAGE LINE><CRLF>< ETX>
```

Each message begins with the start-of-transmission character (ASCII 02) and ends with the end-of-transmission character (ASCII 03). Each line of the message ends with a carriage return and line feed.

Software Flow Control

The relay implements XON/XOFF flow control. You can use the XON/XOFF protocol to control the relay during data transmission. When the relay receives XOFF during transmission, it pauses until it receives an XON character. If there is no message in progress when the relay receives XOFF, it blocks transmission of any message presented to the relay input buffer. Messages will be accepted after the relay receives XON. The relay transmits XON (ASCII hex 11) and asserts the RTS output (if hardware handshaking is enabled) when the relay input buffer drops below 25 percent full. The relay transmits XOFF (ASCII hex 13) when the buffer is more than 75 percent full. If hardware handshaking is enabled, the relay deasserts the RTS output when the buffer is approximately 95 percent full. Automatic transmission sources should monitor for the XOFF character to avoid overwriting the buffer. Transmission should terminate at the end of the message in progress when XOFF is received and can resume when the relay sends XON. The CAN character (ASCII hex 18) aborts a pending transmission. This is useful for terminating an unwanted transmission. You can send control characters from most keyboards with the following keystrokes:

XOFF: **<Ctrl+S>** (hold down the **<Ctrl>** key and press **S**)
XON: **<Ctrl+Q>** (hold down the **<Ctrl>** key and press **Q**)
CAN: **<Ctrl+X>** (hold down the **<Ctrl>** key and press **X**)

Automatic Messages

When the serial port AUTO setting is Y, the relay sends automatic messages to indicate specific conditions. *Table 4.3* describes the automatic messages.

Table 4.3 Serial Port Automatic Messages

Condition	Description
Power Up	The I/O processor sends a message containing the present date and time, I/O processor and terminal identifiers, and the Access Level 0 prompt when the I/O processor is turned on.
Self-Test Warning or Failure	The SEL-2410 sends a status report each time a self-test warning or failure condition is detected.

ASCII Commands

Overview

This section lists ASCII 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 are determined based on the application. Command options appear with brief explanations about the command 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 ASCII command to the first three characters; for example, **ACCESS** becomes **ACC**. Always send a carriage return **<CR>** character or a carriage return character followed by a line feed character **<CR><LF>** to command the control to process the ASCII command. Usually, most terminals and terminal programs interpret the Enter key as a **<CR>**. For example, to send the **ACCESS** command, type **ACC <Enter>**. Tables in this section show the 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.

- Access Commands (**ACCESS** and **2ACCESS**)
- Passwords
- **BNAMES** Command
- **CASCII** Command
- **CONTROL** Command (Control Remote Bit)
- **CSTATUS** Command (Compressed Status)
- **DATE** Command (View/Change Date)
- **DNAMES** Command
- **FILE** Command
- **IDENTIFICATION** Command
- **IRIG** Command
- **L_D** Command (Load Firmware)
- **METER** Command
- **PASSWORD** Command (View/Change Passwords)
- **QUIT** Command
- **SER** Command (Sequential Events Recorder Report)
- **SET** Command (Change Settings)
- **SHOW** Command (Show/View Settings)
- **SNS** Command
- **STATUS** Command (I/O Processor self-test status)
- **TARGET** Command (Display Device Word Bit Status)
- **TIME** Command (View/Change Time)

Access Levels

Commands can be issued to the SEL-2410 via the serial port to view metering values, change processor settings, etc. The available serial port commands are listed in the *SEL-2410 Command Summary* at the end of this manual. These commands can be accessed only from the corresponding access level, as shown in the *SEL-2410 Command Summary*. The serial port commands at the different access levels offer varying levels of control:

- The Access Level 0 commands provide the first layer of security. In addition, Access Level 0 supports several commands required by SEL communications processors.
- The Access Level 1 commands are primarily for reviewing information only (settings, metering, etc.), not changing it.
- The Access Level 2 commands are primarily for changing processor settings.

Access Level 0

Once serial port communication is established with the SEL-2410, the processor 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-2410 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-2410 to Access Level 1. See *Access Commands (ACCESS and 2ACCESS) on page 4.11* for more detail.

Access Level 1

When the SEL-2410 is in Access Level 1, the processor sends the following prompt:

```
=>
```

See the *SEL-2410 Command Summary* at the end of this manual for the commands available from Access Level 1. The processor can go to Access Level 2 from this level. The **2AC** command places the processor in Access Level 2. See *Access Commands (ACCESS and 2ACCESS) on page 4.11* for more detail. Enter the **2AC** command at the Access Level 1 prompt:

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

Access Level 2

When the processor is in Access Level 2, the SEL-2410 sends the prompt:

```
=>>
```

See the *SEL-2410 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-2410 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.

Header

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

```
SEL-2410                                  Date: 04/30/2004    Time: 11:14:10.736
MONITOR                                   Time Source: internal
```

Table 4.4 lists header item definitions:

Table 4.4 Command Response Header

Item	Definition
(MID Setting):	This is the MID (Monitor Identifier) setting. The processor is shipped with the default settings MID = SEL-2410.
(TID Setting):	This is the TID (Terminal Identifier) setting. The processor is shipped with the default settings TID = MONITOR.
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.
Time source:	This is internal if no time-code input is attached and external if an input is attached.

Access Commands (ACCESS and 2ACCESS)

The **ACC** and **2AC** commands provide entry to the multiple access levels, as shown in *Table 4.5*. Different commands are available at the different access levels, as shown in the *SEL-2410 Command Summary* at the end of this manual. Commands **ACC** and **2AC** are explained together because they operate similarly.

Table 4.5 Access Commands

Command	Description	Access Level
ACC	Moves from Access Level 0 to Access Level 1	0
2AC	Moves from Access Level 1 to Access Level 2	1

Password Requirements

Passwords are required if they are not disabled. See *PASSWORD Command (View/Change Passwords) on page 4.17* 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 not disabled, the processor prompts you for the Access Level 1 password:

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

The processor is shipped with the default Access Level 1 password shown in *PASSWORD Command (View/Change Passwords) on page 4.17*. At the prompt, enter the default password and press the **<Enter>** key. The processor responds with the following:

```
[RID Setting]                              Date: mm/dd/yyyy  Time: hh:mm:ss.sss
[TID Setting]                              Time Source: external

Level 1
=>
```

The => prompt indicates the processor is now in Access Level 1. If the entered password is incorrect, the processor prompts you for the password again (Password: ?). The processor prompts for the password as many as three times. If the requested password is incorrectly entered three times, the processor pulses the SALARM Device Word bit for one second and remains at Access Level 0 (= prompt):

```
=>acc <Enter>

SEL-2410                          Date: 06/24/2004    Time: 02:42:21.515
MONITOR                           Time Source: internal


Level 1
=>acc <Enter>
Password: ? &&&&&&@@@@@@
Invalid Password
Password: ? &&&&&&@@@@@@
Invalid Password
Password: ? &&&&&&&@@@@@
Invalid Password
Access Denied

WARNING: ACCESS BY UNAUTHORIZED PERSONS STRICTLY PROHIBITED
Access Temporarily Denied
```

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 processor responds with the following:

```
[RID Setting]                                  Date: mm/dd/yyyy  Time: hh:mm:ss.sss
[TID Setting]                                  Time Source: external

Level 1
=>
```

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

BNAMES Command

The **BNA** command produces ASCII names of all relay status bits reported in the Fast Meter Data Block (A5D1) message in Compressed ASCII format.

Table 4.6 BNAMES Command

Command	Description	Access Level
BNA	Display ASCII names of all relay status bits.	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 4.7 CAL Command

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

CASCII Command

The **CAS** command produces the Compressed ASCII configuration message. This configuration instructs an external computer on the method for extracting data from other Compressed ASCII commands.

Table 4.8 CASCII Command

Command	Description	Access Level
CAS	Return the Compressed ASCII configuration message.	0

Upon receiving the **CAS** command, the processor responds with the configurations of the Compressed ASCII status commands **CST**.

CONTROL Command (Control Remote Bit)

The **CON** command is a two-step command for controlling remote bits, which are Device Word bits RB01–RB32.

Table 4.9 CONTROL Command

Command	Description	Access Level
CON *n*[a]	First step of a two-command sequence. The SEL-2410 will prompt for the second step (subcommand), shown below.	2

[a] Parameter n is a number from 1 to 32 representing RB01–RB32.

Table 4.10 CONTROL Subcommands

Subcommand	Description
SRB *n*	Set Remote Bit *n* (ON position)
CRB *n*	Clear Remote Bit *n* (OFF position)
PRB *n*	Pulse Remote Bit *n* for 4 ms (MOMENTARY position)

Use the **CON** command to exercise remote bits.

```
>>CON 5 <Enter>
CONTROL RB5: PRB 5 <Enter>
=>>
```

You must enter the same remote bit number in both command steps. If the bit numbers do not match, the recloser control responds with the following:

```
Invalid Command
```

CSTATUS Command (Compressed Status)

The **CST** command generates a processor status report in Compressed ASCII format.

Table 4.11 CSTATUS Command (Compressed Status)

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

DATE Command (View/Change Date)

Use the **DATE** command to view and set the processor date.

Table 4.12 Date Command

Command	Description	Access Level
DATE	Display the internal clock date.	1
DATE ***date***	Set the internal clock date (DATE_F set to MDY, YMD, or DMY).	1

The processor can overwrite the date entered by using other time sources such as IRIG. Enter the **DATE** command with a date to set the internal clock date. Separate the month, day, and year parameters with spaces, commas, slashes, colons, and semicolons. Set the year in 4-digit form (for dates 2000-2099). Global setting DATE_F sets the date format.

DNAMES Command

The **DNA** command produces the ASCII names of all Device Word bits reported in a Fast Meter message in Compressed ASCII format.

Table 4.13 DNAMES Command

Command	Description	Access Level
DNA	Display ASCII names of all Device Word bits digital I/O.	0

FILE Command

The **FIL** command provides a safe and efficient means of transferring files between intelligent electronic devices (IEDs) and external support software (ESS). Use the **FIL** commands for sending settings to the SEL-2410 and receiving settings from the processor.

Table 4.14 FILE Command

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

IDENTIFICATION Command

Use the **ID** command to extract device identification codes.

Table 4.15 IDENTIFICATION Command

Command	Description	Access Level
ID	Return a list of device identification codes.	0

IRIG Command

IRI directs the relay to read the demodulated IRIG-B time code at the serial port or IRIG-B input.

Table 4.16 IRI Command

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

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

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

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

```
SEL-2410                          Date: 04/30/2004    Time: 11:14:10.736
MONITOR                           Time Source: external
=>
```

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

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

If an IRIG-B signal is present, the processor synchronizes its internal clock with IRIG-B. It is not necessary to issue the **IRI** command to synchronize the relay clock with IRIG-B. Use the **IRI** command to determine if the relay is properly reading the IRIG-B signal.

L_D Command (Load Firmware)

Use the **L_D** command to load firmware. 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 4.17 L_D Command (Load Firmware)

Command	Description	Access Level
L_D	Download firmware to the control.	2

Only download firmware to the front port.

METER Command

The **MET AI** command displays the AI Slow Value of up to eight analog channels (see *Analog Inputs on page 3.4* for more information). *Figure 4.2* shows the processor response to the **MET AI** command. Under the heading Analog Input Card *N*, the report displays the card location (*N* = 3 in this example), followed by a line for each analog input the card supports. Information in the three columns is: the analog input number, the AI Low Value in engineering units, and the name of the units.

```
=>MET <Enter>
[RID Setting]                              Date: mm/dd/yyyy   Time: hh:mm:ss.sss
[TID Setting]                              Time Source: internal

Analog Input Card 3
AI301      -20749    nanoAmps
AI302      9381.6    uMeters
AI303      0.0006    Mwatts
AI304     -55.471    volts
AI305      130.26    mA
AI306       98.14    mA
AI307     -275.29    mA
AI308        0.07    mA
```

Figure 4.2 METER Command

Because values for different analog inputs vary in length, the processor adapts the display format for each analog input by using the input maximum or minimum setting (whichever has the larger magnitude) in engineering units. The display format uses up to five digits to show the scaled maximum magnitude of the input without using exponential notation (e.g., –0.0732, 961.82, or 21936).

PASSWORD Command (View/Change Passwords)

Use the **PAS** command to inspect or change existing passwords.

Table 4.18 PASSWORD Command

Command	Description	Access Level
PAS	Display the passwords for each access level (except Access Level 0, which has no password).	2
PAS *level new-password*	Set a password *new-password* for Access Level *level*.	2
PAS *level*	Display the password for the Access Level *level*.	2

Table 4.19 PAS Command Format

Parameter	Description
level	Parameter ***level*** represents the relay Access Levels 1 or 2.
new-password	New password.

The factory default passwords are as shown in *Table 4.20*.

Table 4.20 Factory Default Passwords

Access Level	Factory Default Password
1	OTTER
2	TAIL
C	CLARKE

To change the password for Access Level 1 to Ot3579, enter the following command:

```
=>>PAS 1 Ot3579 <Enter>
Set
=>>
```

Similarly, use **PAS 2** to change Level 2 passwords.

Table 4.21 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	! " # $ % & ' ( ) * + , - . / : ; < = > ? @ [\ ] ^ _ ` { | } ~

Passwords can contain as many as twelve characters. Upper- and lowercase letters are treated as different characters. Strong passwords consist of at least eight characters, with at least one special character or digit and mixed case sensitivity, but 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, and strong passwords are shown below:

#0t3579!

$A24.68&

(Ih2dcs)

*4u-Iwg+

After entering new passwords, type **PAS <Enter>** to confirm that you entered the passwords correctly. Make sure that the passwords are what you intended, and record the new passwords.

If you want to disable password protection for a specific access level, set the password to DISABLE. For example, **PAS 1 DISABLE <Enter>** disables password protection for Level 1.

QUIT Command

Use the **QUIT** command to revert to Access Level 0.

Table 4.22 QUIT Command

Command	Description	Access Level
QUI	Go to Access Level 0.	0

Access Level 0 is the lowest access level; the SEL-2410 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.

Table 4.23 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 512 rows). Row 1 is the most recently triggered row and row 512 is the oldest.	
SER ***row1*** **SER** ***row1 row2*** **SER** ***date1*** **SER** ***date1 date2***	Use the **SER** command with parameters (*row* or *date*) to display a chronological or reverse chronological subset of the SER rows, see *Table 4.24* below.	1
SER C	Use this command to clear/reset the SER records.	1
SER R	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.	

Table 4.24 SER Command Format

Parameter	Description
row1	Append **row1** to return a chronological progression of the first **row1** rows. For example, use **SER 5** to return the first five rows.
row1 row2	Append **row1** and **row2** to return all rows between **row1** and **row2**, beginning with row1 and ending with **row2**. 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. For example, use **SER 1 10** to return the first ten rows in numeric order or **SER 10 1** to return these same items in reverse numeric order.
date1	Append **date1** to return all rows with this date. For example, use **SER 1/1/2003** to return all records for January 1, 2003.
date1 date2	Append **date1** and **date2** to return all rows beginning with **date1** and ending with **date2**. 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. For example, use **SER 1/5/2003 1/7/2003** to return all records for January 5, 6, and 7, 2003.

If the requested SER report rows do not exist, the relay responds with the following:

```
No SER Data
```

SET Command (Change Settings)

The **SET** command is for viewing or changing the relay settings as shown in *Table 4.25*.

Table 4.25 SET Command (Change Settings)

Command	Description	Access Level
SET *s* TERSE	Set the Group settings, beginning at the first setting.	2
SET L *s* TERSE	Set general logic settings.	2
SET G *s* TERSE	Set global settings.	2
SET P *n s* TERSE	Set serial port settings, *n* specifies the either Port F or Port 3; *n* defaults to the active port if not listed.	2
SET R *s* TERSE	Set SER report settings.	2
SET F *s* TERSE	Set front-panel settings.	2

Table 4.26 SET Command Format

Parameter	Description
s	Append ***s***, the name of the specific setting you want to view and jump to this setting. If ***s*** is not entered, the relay starts at the first setting.
TERSE	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.

When you issue the **SET** command, the processor presents a list of settings one at a time. Enter a new setting or press **<Enter>** to accept the existing setting. Editing keystrokes are shown in *Table 4.27*.

Table 4.27 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.

The processor checks each setting to ensure that it is within the allowed range. If the setting is not within the allowed range, the processor generates an Out of Range message and prompts you for the setting again. When all the settings are entered, the processor displays the new settings and prompts you for approval to enable them. Answer **Y <Enter>** to enable the new settings. The processor is disabled for as long as five seconds while it saves the new settings. The SALARM Device Word bit is set momentarily, and the ENABLED LED extinguishes while the processor is disabled.

SHOW Command (Show/View Settings)

When showing settings, the processor displays the settings label and the present value from nonvolatile memory for each setting class.

Table 4.28 SHOW Command (Show/View Settings)

Command	Description	Access Level
SHO *s*	Show Group settings.	1
SHO L *s*	Show general logic settings.	1
SHO G *s*	Show global settings.	1
SHO P *n s*	Show serial port settings. *n* specifies the port (3, 4, or F); *n* defaults to the active port if not listed.	1
SHO R *s*	Show report settings such as Sequential Events Recorder (SER) and Event Report (ER) settings.	1
SHO F *s*	Show front-panel settings.	1

Table 4.29 SHOW Command Format

Parameter	Description
s	Append ***s***, the name of the specific setting you want to view and jumps to this setting. If ***s*** is not entered, the relay starts at the first setting.

SNS Command

The **SNS** command displays the SER settings in Compressed ASCII format.

Table 4.30 SNS Command

Command	Description	Access Level
SNS	The **SNS** command displays the SER settings in Compressed ASCII format.	0

The setting name values are gathered in groups of eight names to be displayed on each line of the report, as shown in *Figure 4.3*. The last line of the report may have fewer than eight names. Each line is formatted as a comma-separated list of quoted setting names, 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 setting name values, (i.e., all SER settings are NA), no lines are generated for the report.

```
SNS <Enter>
"IN101","IN102","IN301","IN302","IN303","IN304","IN305","IN306","0CE4"
"IN307","IN308","IN401","IN402","IN403","IN404","IN405","IN406","0CFA"
"IN407","IN408","IN501","IN502","IN503","IN504","IN505","IN506","0D02"
"IN507","IN508","IN601","IN602","IN603","IN604","IN605","IN606","0D0A"
"IN607","IN608","0349"

=>>
```

Figure 4.3 SER Settings, Using the SNS Command

STATUS Command (Processor Self-Test Status)

The **STA** command displays the status report.

Table 4.31 STATUS Command (Relay Self-test Status)

Command	Description	Access Level
STA *n*	Display the I/O processor self-test information *n* times (*n* = 1–32767). Defaults to 1 if *n* is not specified.	1
STA S	Display the memory and execution utilization for the SELOGIC® control equations.	1
STA C or **R**	Reboot the I/O processor and clear self-test warning and failure status results.	2

Refer to *Section 7: Testing and Troubleshooting* for self-test thresholds and corrective actions, as well as hardware configuration conflict resolution. *Figure 4.4* shows the processor response to the **STA** command.

```
=>>STA <Enter>

SEL-2410                          Date: 05/06/2004    Time: 11:18:19.164
MONITOR                           Time Source: External
FID=SEL-2410-R100-V0-Z001001-D20040423       CID=DFC1

Part Number 241001A5X0X0X0XXXX

SELF TESTS

W=Warn    F=Fail

PS_Vdc    FPGA      GPSB      HMI
OK        OK        OK        OK

RAM       ROM       CR_RAM    Non_Vol   Clk_Bat   Clock
OK        OK        OK        OK        OK        OK

CARD_C    CARD_D    CARD_E    CARD_Z
OK        OK        OK        OK

Monitor Enabled

=>>
```

Figure 4.4 Processor Response to the STATUS Command

Table 4.32 shows the status report definitions and message formats for each test.

Table 4.32 STA Command Definitions (Sheet 1 of 2)

Command	Description	Message Format
FID	Firmware identifier string	(FID string)
CID	Firmware checksum identifier	OK/FAIL
PS_Vdc	Power supply status	OK/FAIL
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 4.32 STA Command Definitions (Sheet 2 of 2)

Command	Description	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
Clk_Bat	Clock battery integrity	OK/FAIL
Clock	Clock functionality	OK/FAIL
CARD_C	Integrity of Card in Slot C	OK/FAIL
CARD_D	Integrity of Card in Slot D	OK/FAIL
CARD_E	Integrity of Card in Slot E	OK/FAIL
CARD_Z	Integrity of Card in Slot F	OK/FAIL

TARGET Command (Display Device Word Bit Status)

The **TAR** command displays the status of front-panel target LEDs or Device Word bit, whether these LEDs or Device Word bits are asserted or deasserted.

Table 4.33 TARGET Command (Display Device Word Bit Status)

Command	Description	Access Level
TAR R	Clears front-panel tripping targets. Unlatches the trip logic for testing purposes (see *Figure 5.1*). Shows Device Word Row 0.	1

Table 4.34 TARGET Command Format

Parameter	Description
name	Display the Device Word row with Device Word bit Name.
n k	Show Device Word row number ***n*** (0–65) and repeat ***k*** times (1–32767).

The elements are represented as Device Word bits and are listed in rows of eight, called Device Word rows. The first four rows, representing the front-panel operation and target LEDs, correspond to *Table 4.35*. All Device Word rows are described in *Table D.1* and *Table D.2*. Device Word bits are used in SELOGIC control equations. See *Appendix D: I/O Processor Word Bits*. The **TAR** command does not remap the front-panel target LEDs, as is done in some previous SEL processors.

Table 4.35 Front-Panel LEDs and the TAR 0 Command

LEDs	7	6	5	4	3	2	1	0
TAR 0	ENABLED	*	T01_LED	T02_LED	T03_LED	T04_LED	T05_LED	T06_LED

TIME Command (View/Change Time)

The **TIM** command returns information about the SEL-2410 internal clock, as shown in *Table 4.36*. 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 4.36 TIME Command (View/Change Time)

Command	Description	Access Level
TIM	Display the present internal clock time.	1
TIM *hh:mm*	Set the internal clock to *hh:mm*.	1
TIM *hh:mm:ss*	Set the internal clock to *hh:mm:ss*.	1

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 processor updates and saves the time in the nonvolatile clock, and displays the time you just entered. If you enter an invalid time, the SEL-2410 responds, Invalid Time.

Section 5
Front-Panel Operations

Overview

The SEL-2410 I/O Processor front panel makes data collection and control quick and efficient. Use the front panel to analyze operating information, view and change relay settings, and perform control functions. The SEL-2410 features a straightforward menu-driven control structure presented on the front-panel liquid crystal display (LCD). Front-panel targets and other LED indicators give a quick look at SEL-2410 operation status. The features that help you operate the relay from the front panel include the following:

- Reading dc analog (transducer) metering
- Inspecting targets
- Accessing settings
- Controlling relay operations
- Viewing relay diagnostics

Front-Panel Layout

Figure 5.1 shows and identifies the following regions:

➤ EIA-232 Serial Port. See Section 4: Communications for details on the serial port.

➤ Human-Machine Interface (HMI)

➤ Operation and target LEDs

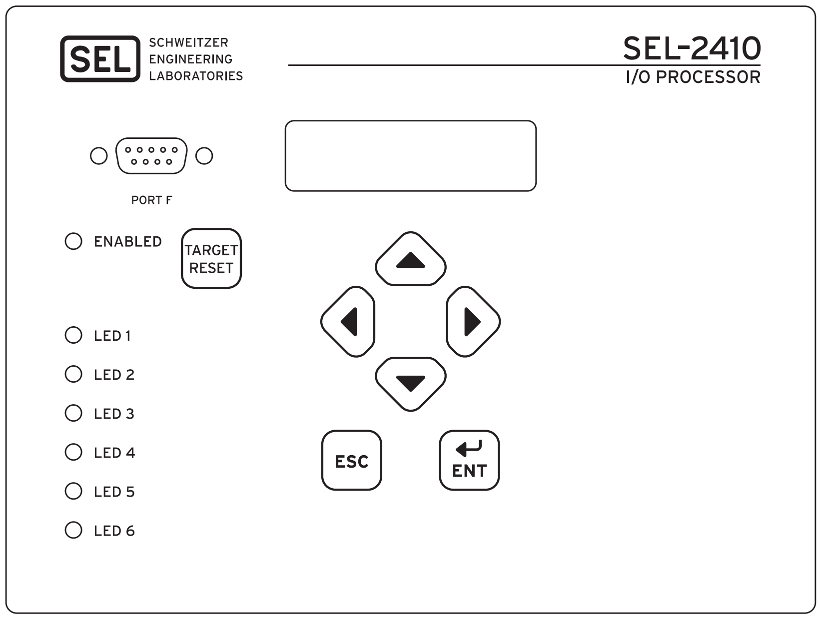


Figure 5.1 Front-Panel Overview

This versatile front panel supports the following features so you can customize it for your needs:

➤ Display on the HMI

➤ Programmable target LEDs

➤ Slide-in configurable front-panel labels to change the identification of operation and target LEDs.
(The source for label template files is the SEL-2410 Product Literature CD. In addition, you can find these files on the SEL Industrial website at www.selindustrial.com.)

Human-Machine Interface

Default Display

The front-panel display of the SEL-2410 is a 2 line, 16 column (16 x 2) Liquid Crystal Display (LCD) display. *Figure 5.2* shows the LCD default display at first power-up. By using display points, you can create a rotating display on the LCD of certain relay information such as measured transducer values. (See *Rotating Display on page 3.25* for more information).

Figure 5.2 LCD Default Display

Contrast

You can adjust the LCD screen contrast to suit your viewing angle and lighting conditions. To change screen contrast, press and hold the **ESC** pushbutton for two seconds. The SEL-2410 displays a contrast adjustment box. Pressing the **RIGHT ARROW** pushbutton increases the contrast. Pressing the **LEFT ARROW** pushbutton decreases the screen contrast. When you are finished adjusting the screen contrast, press the **ENT** pushbutton; this process is a shortcut for changing the LCD contrast setting FP_CONT in the front-panel settings.

Front-Panel Automatic Messages

The relay displays automatic messages (type of latest failure) when detecting any failure (see *Section 7: Testing and Troubleshooting*).

Front-Panel Security

Front-Panel Access Levels

The SEL-2410 front panel typically operates at Access Level 1 and provides viewing of relay measurements and settings. Some activities, such as editing settings and controlling output contacts, are restricted to those operators who know the Access Level 2 passwords. Use caution when including the SALARM Device Word bit in the control logic. In the figures that follow, restricted activities are indicated by the padlock symbol shown in *Figure 5.3*.

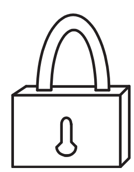


Figure 5.3 Access Level Security Padlock Symbol

Before you can perform a front-panel menu activity that is marked with the padlock symbol, you must enter the correct Access Level 2 passwords. After you have correctly entered the password, you can perform other Access Level 2 activities without reentering the password.

Front-Panel Text Symbols Matrix

Figure 5.4 shows the display structure for modifying existing values, consisting of a Setting Name (MID) and an Editable Value (SEL-2410, for example).

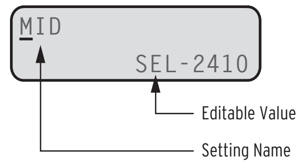


Figure 5.4 Front-Panel Display Structure

Replace existing values of the Editable Value with any symbol from a set of approved symbols called the symbol matrix. *Figure 5.5* shows the symbol matrix for text inputs, and four editorial functions (Space, Delete (Del), Clear (Clr), and Accept).

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

Figure 5.5 Symbol Matrix For a Text Input

The `Space` function inserts a space, and the `Del` function deletes the character pointed to by the block cursor. If the block cursor is beyond the end of the current value in the input field, the last character of the item is deleted and the block cursor is moved left one character. If the input field is empty, the `Del` function has no effect. The `Clr` function deletes all characters in the setting value, and the `Accept` function accepts the new value of the setting and exits the page. Inputting text has two modes of operation, as shown in *Table 5.1*.

Table 5.1 Two Modes of Text Input Operations

Mode of Operation	Description
Cursor movement	Cursor movement mode allows the cursor to be moved in the input field.
Symbol selection	Symbol selection mode allows the symbol under the cursor to be inserted into the input field.

In cursor movement mode, the left and right arrows move the cursor in the input field. If the cursor is at the first position in the field and a left event occurs, the event is ignored. If the cursor is at the end of the current setting value, but not at the end of the field, and the right event occurs, a space is inserted at the end of the setting value. If the cursor is at the end of the field and the right arrow is pushed, the event is ignored. Pushing the Escape (**Esc**) pushbutton discards the current value and returns to the previous. Pushing the Enter **ENT** pushbutton accepts the new value and exits the page. Pressing the **UP ARROW** or **DOWN ARROW** pushbuttons switches the mode to symbol modification.

Figure 5.6 Display to Change the Default MID Setting

In symbol modification mode, a solid black rectangle cursor (block cursor) is placed at the cursor position in the settings value (SEL-2410), and the underline cursor is placed in the symbol matrix (Space), as shown in *Figure 5.7*. This rectangle blinks at a frequency of 1 Hz. As an example, change the default MID setting from SEL-2410 to MILAN by navigating as followings: **Esc**, Set/Show **ENT**, Monitor **ENT**, Monitor Settings **ENT** and MID **ENT** to end up with the display as shown in *Figure 5.6*.

Figure 5.7 Display When in Symbol Modification Mode

Press the down arrow four times (or the up arrow 14 times) to move the underline cursor in the symbol matrix to the row containing uppercase M, as shown in *Figure 5.8*. The cursor wraps at the edges of the matrix: left to right, right to left, top to bottom, and bottom to top. Use the right arrow to position the cursor under the letter M.

Figure 5.8 Navigate to the Row in the Symbol Matrix Containing Letter M

Press the **ENT** pushbutton to insert the letter M into the setting value at the position indicated by the block cursor. This moves the block cursor and the symbol it pointed to one symbol to the right, as shown in *Figure 5.9*.

Figure 5.9 Insert Letter M Into the Setting Value

Any symbols that exceed the width of the field are discarded, as shown in *Figure 5.10*. The back event returns the mode to cursor movement. Continue to enter the remainder of the text.

Figure 5.10 Completed Entry of New Text, With the Old Text Still Visible

Press the up arrow three times, and the right arrow once to position the cursor under the delete (Del) function. Press the Enter (**ENT**) pushbutton eight times to delete the remainder of the previous test, see *Figure 5.11*. Press the **DOWN ARROW** pushbutton once and the Enter **ENT** pushbutton once to accept the new setting, resulting in the display shown in *Figure 5.12*.

Figure 5.11 Completed Entry of New Text

```
MID
                MILAN
```

Figure 5.12 Acceptance of New Text

Accepting the new settings does not save the setting at the same time. Press the **Esc** pushbutton twice to see the display shown in *Figure 5.13*. Press the **ENT** pushbutton to save the new settings.

```
Save Changes?
Yes No
```

Figure 5.13 Save the New text Settings

Access Level 2 Password Entry

When you try to perform an Access Level 2 activity, the relay determines whether you have entered the correct Access Level 2 password. If you have not entered the correct password, the relay displays the screen shown in *Figure 5.14*, prompting you to enter the password.

```
Password=
Del Clr Accept
```

Figure 5.14 Password Prompt Display

In general, the I/O processor determines the password validity in the following way:

1. The user enters a password.
2. The I/O processor compares this password with all (non-disabled) passwords in the relay. The comparison starts with the highest level password, and works toward the lowest level password.
3. If a password match exists, then the access level is set to the level where the password matches.
4. If no match exists, the I/O processor displays 'Invalid Password'. If the user acknowledges this message (by pressing the **ENT** pushbutton), the I/O processor again prompts for a password, and a third time if no match exists after the second attempt and the user acknowledged the displayed message. Upon three failures, the I/O processor displays the following message: 'Invalid Password Access denied. WARNING: ACCESS BY UNAUTHORIZED PERSONS STRICTLY PROHIBITED'. When the user acknowledges this message, the I/O processor returns to the default display, and the user starts from the beginning.
5. If the new access level still does not give the user access to the entry, then the I/O processor displays the following message (after the user acknowledged the displayed message): 'Insufficient Access Level, Level sac Required', where sac is the access level required.

Note that the HMI always starts at (and returns to after idle time-out) access Level 1 (ACC).

Front-Panel Time-Out

To help prevent unauthorized access to password-protected functions, the SEL-2410 provides a front-panel time-out, setting FP_TO. A timer is reset every time a front-panel pushbutton is pressed. Once the time-out period has expired, the access level is reset to Access Level 1. Manually reset the access level by selecting Reset Access Lvl from the MAIN menu.

Front-Panel Menus and Screens

Navigating the Menus

The SEL-2410 front panel gives you access to most of the information that the relay measures and stores. You can also use front-panel controls to view or modify relay settings. All of the front-panel functions are accessible through use of the six-button keypad and LCD display, as shown in *Figure 5.15*.

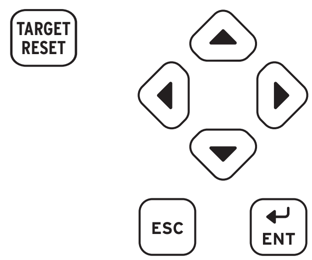


Figure 5.15 Front-Panel Pushbuttons

Use the keypad pushbuttons to maneuver within the front-panel menu structure, and the **Reset** pushbutton to reset or clear the LEDs (except the **ENABLE** LED). *Table 5.2* describes the function of each front-panel pushbutton.

Table 5.2 Front-Panel Pushbutton Functions (Sheet 1 of 2)

Pushbutton		Function
	UP ARROW}	Move up within a menu or data list. While editing a setting value, increase the value of the underlined digit.
	DOWN ARROW	Move down within a menu or data list. While editing a setting value, decrease the value of the underlined digit.
	LEFT ARROW	Move the cursor to the left.
	RIGHT ARROW	Move the cursor to the right.
	ESC	Escape from the current menu or display. Move from the default display to the **MAIN** display. Hold for 2 seconds to display contrast adjustment screen.

Table 5.2 Front-Panel Pushbutton Functions (Sheet 2 of 2)

Pushbutton	Function
ENT	Move from the default display to the **MAIN** display. Select the menu item at the cursor. Select the displayed setting to edit that setting.
TARGET RESET	All LEDs illuminate as long as the button is pushed. Resets latched LEDs if the conditions driving the LEDs (as stated in the SELOGIC® control equations) are deasserted. Device Word bit TRGTR asserts as long as the button is pushed.

The SEL-2410 automatically scrolls information that requires more space than provided by a 16-character LCD line. Use the **LEFT ARROW** and **RIGHT ARROW** pushbuttons to suspend automatic scrolling and enable manual scrolling of this information.

SEL-2410 Menu Structure

Figure 5.16 through *Figure 5.30* describe major items of the menu hierarchy. Menus and displays are available for most SEL-2410 functions. From the **MAIN** menu, you can navigate to one of the following specific menus:

- Meter
- Targets
- Control
- Set/Show
- Status
- Reset Access Lv1

Meter Menu

Select the **Meter** menu item on the **MAIN** menu to access the analog metering data. Metered values are the 6-cycle average of the transducer values. See *METER Command on page 4.17* for formatting information.

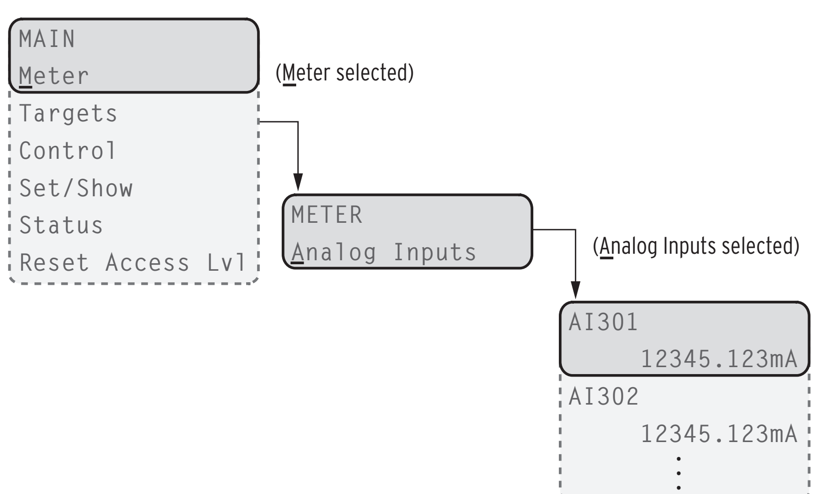


Figure 5.16 Main Menu and Meter Submenu

Targets Menu

Figure 5.17 shows the Targets menu item on the MAIN menu and the submenus to access the target rows (Device Word bits).

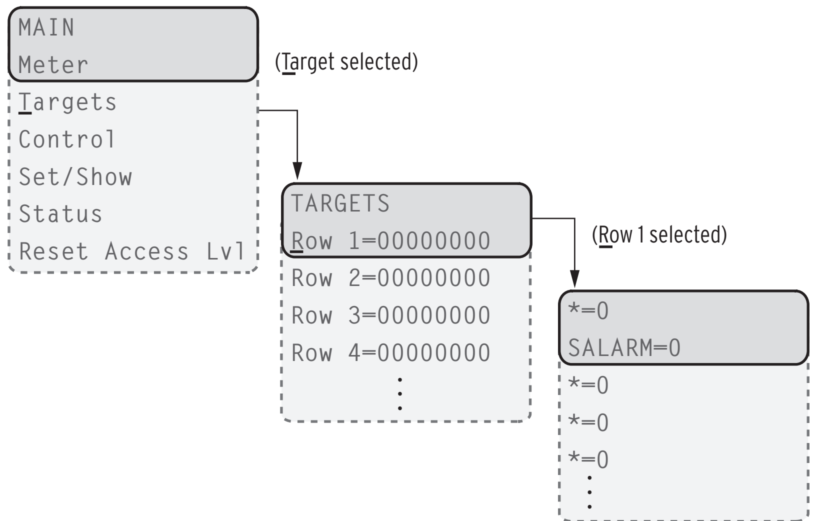


Figure 5.17 Main Menu and Target Submenu

Use the features shown in *Table 5.3* to monitor the relay during operation and testing. In this example, Remote bits RB17 and RB18 are displayed.

Table 5.3 Monitoring of Remote Bit RB17 and Remote Bit RB18

Navigate to the target row that contains the Device Word bit you want to access. Monitor two consecutive rows that contain 16 Device Word bits with this display.	Row 4=00000000 Row 5=00000000
Display the Device Word bit names and status of two consecutive bits by pressing **ENT** while the cursor is at the row you want to access. Use the **UP ARROW** or **DOWN ARROW** to navigate to any of the Device Word bits in the selected row.	RB17=0 RB18=0

Control Menu

The SEL-2410 provides a means to assert selected output contact through the **MAIN < Control** menu as shown in *Figure 5.18*. For control from the front panel, the relay uses variables known as local bits. Local bits take the place of traditional panel switches, and perform open, close or pulse operations. With the settings as per the example in *Section 3* (see *Front-Panel Set (SET F Command) on page 3.19* for more information), Local bit 1 replaces a supervisory switch. *Figure 5.18* shows the screens in closing the supervisory switch. In this operation, Local bit LB01 is deasserted (SUPER SW = OPEN), and changes to asserted (SUPER SW = CLOSE) as shown in the final screen of *Figure 5.18*.

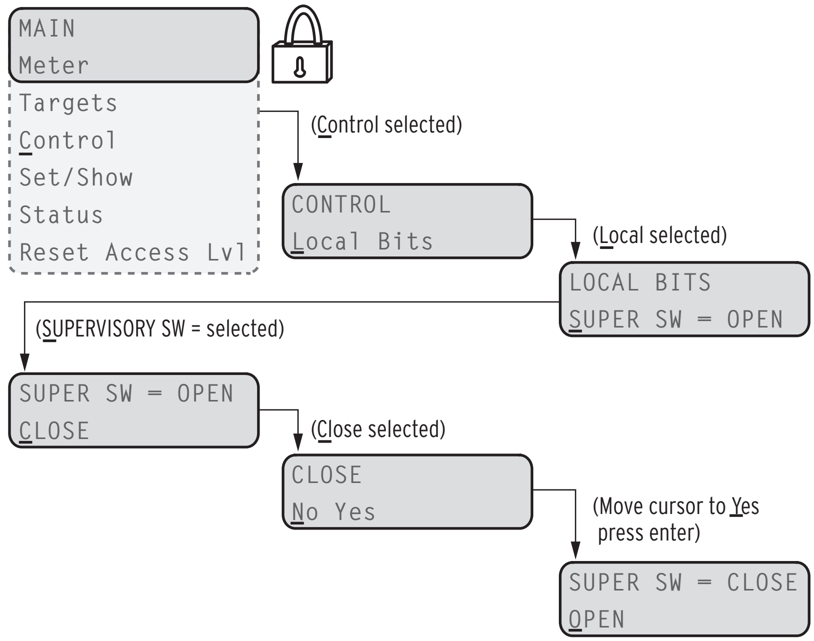


Figure 5.18 Main Menu and Control Submenu

Set/Show Menu

Figure 5.19 shows the SET/SHO menu of the SEL-2410.

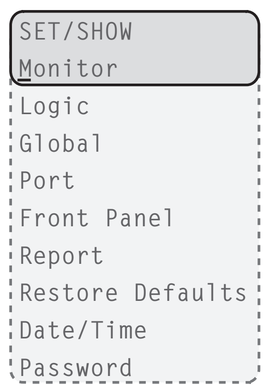


Figure 5.19 SET/SHO Submenu

Each settings class includes headings that create subgroups of associated settings. Select the heading that contains the setting of interest, then navigate to the setting of interest. View or edit the setting by pressing **ENT**. For text settings, use the four navigation pushbuttons to scroll through available alphanumeric and special character settings matrix. For numeric settings, use the **LEFT ARROW** and **RIGHT ARROW** pushbuttons to select the digit to change and the **UP ARROW** and **DOWN ARROW** pushbuttons to change the value. Press **ENT** to enter the new setting. Setting changes can also be made using the ASCII SET commands via a communications port.

View/Change Settings Using the Front Panel

You can use the pushbuttons on the front panel to view/change settings. Enter the front-panel menu by pushing the **ESC** pushbutton. After pressing **ESC**, the LCD display the following message:

```
MAIN
Meter
```

Scroll down the menu by using the **DOWN ARROW** pushbutton until the display shows the following message:

```
Control
Set/Show
```

The cursor (underline) should be on the **SET/SHOW** command. Enter the **SET/SHOW** command by pushing the **ENT** pushbutton. After pressing **ENT**, the LCD displays the following message:

```
SET/SHOW
Monitor
```

Enter the underlined Monitor message with the **ENT** pushbutton, and the relay will present you with the Monitor settings as listed in the SEL-2410 settings sheets. Use the **UP ARROW** and **DOWN ARROW** and the **LEFT ARROW** and **RIGHT ARROW** pushbuttons to scroll through the relay setting categories and view/ change them according to your needs by selecting and editing them. After viewing/ changing the RELAY settings, press the **ESC** pushbutton until the following message appears:

```
Save Changes?
Yes   No
```

Select and enter the appropriate command by pushing the **ENT** pushbutton. Select Yes to save the settings changes and No to discard the changes. *Figure 5.20* shows the Monitor submenu with an analog card installed in Slot **3**.

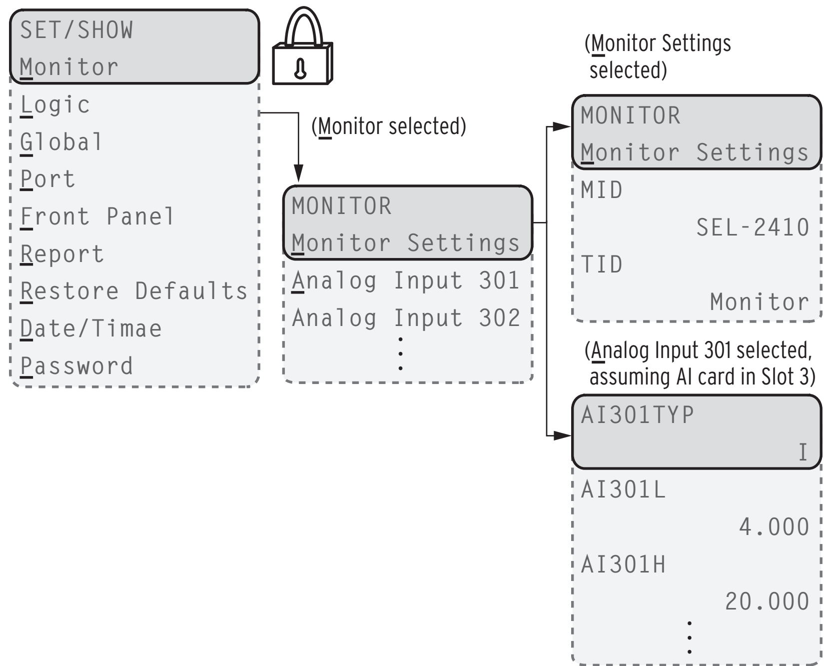


Figure 5.20 Monitor Submenu

Figure 5.21 shows the Logic submenu. Logic settings refer to items such as latch bits, SELOGIC variables, timers and output contact settings.

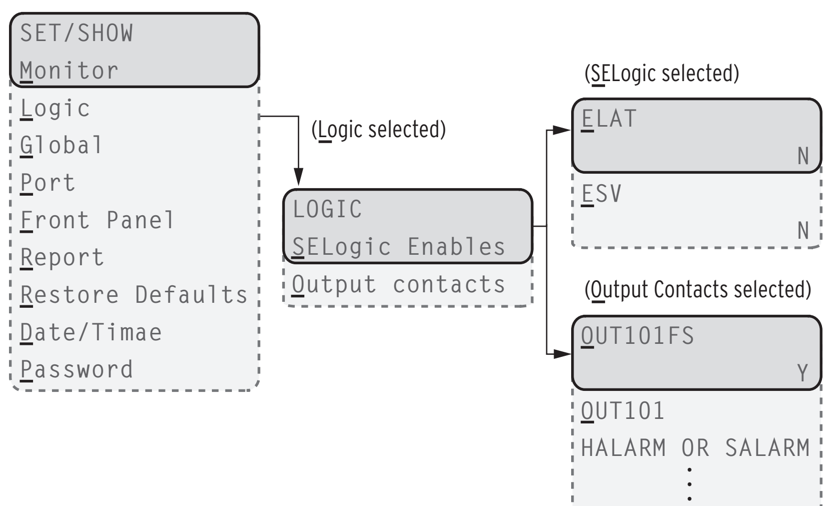


Figure 5.21 Logic Submenu

Figure 5.22 shows the Global submenu. Settings available here are date format settings, digital input (DI) debounce settings, data reset and access control settings.

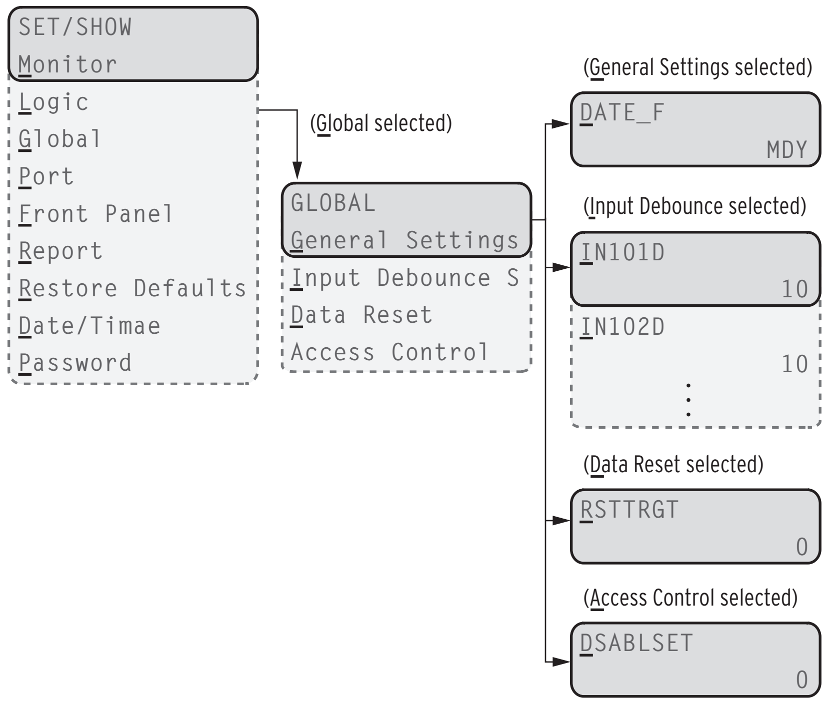


Figure 5.22 Global Submenu

Figure 5.23 shows the Port submenu. Settings available here are communication speed, databits, parity, stopbits, port time-out, automatic message, hardware handshake and fast operate settings.

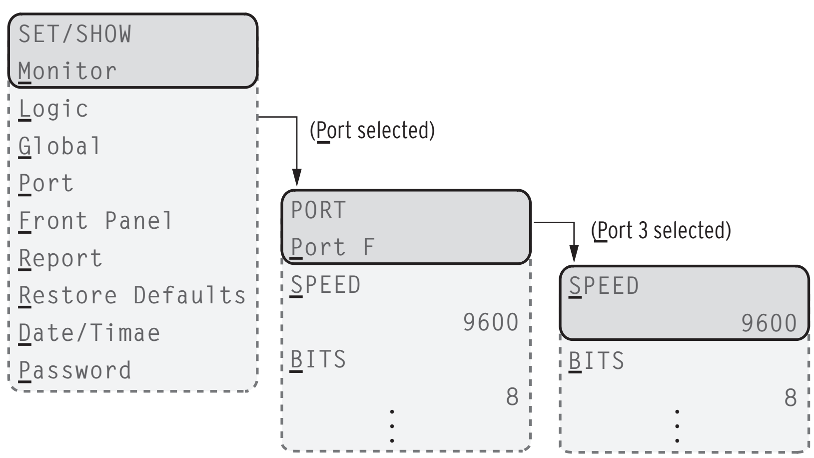


Figure 5.23 Port Submenu

Figure 5.24 shows the Front-Panel submenu. Settings available here are LCD time-out and contrast, time and date, displays and the configuration of the six LEDs (see *Operation and Target LEDs on page 5.17*).

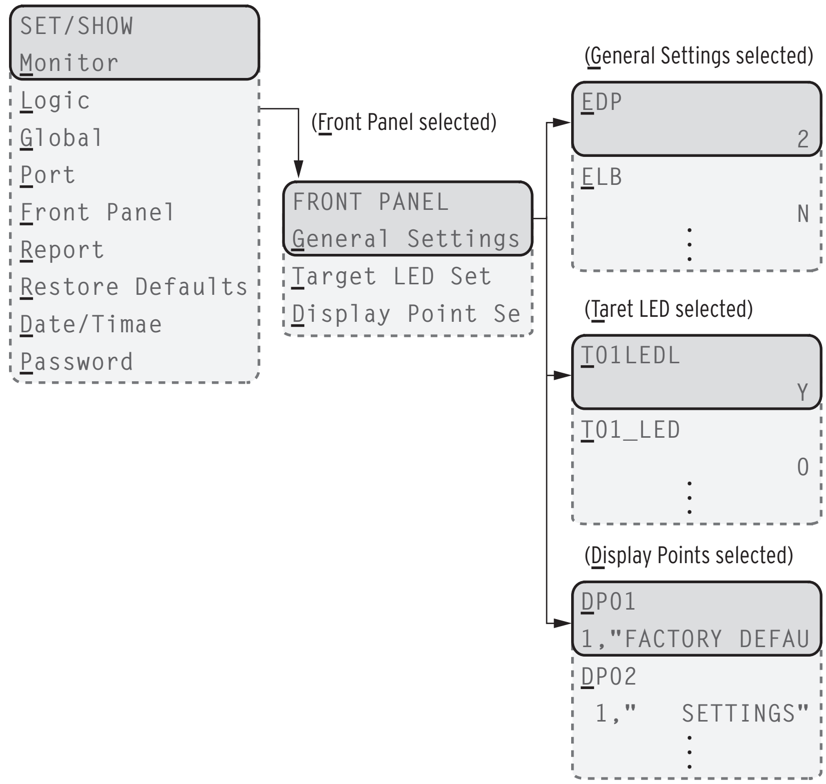


Figure 5.24 Front-Panel Submenu

Figure 5.25 shows the Report submenu. Settings available here are the chatter criteria and the automatic deletion of chattering inputs from the SER, and the items for each of the four SERs.

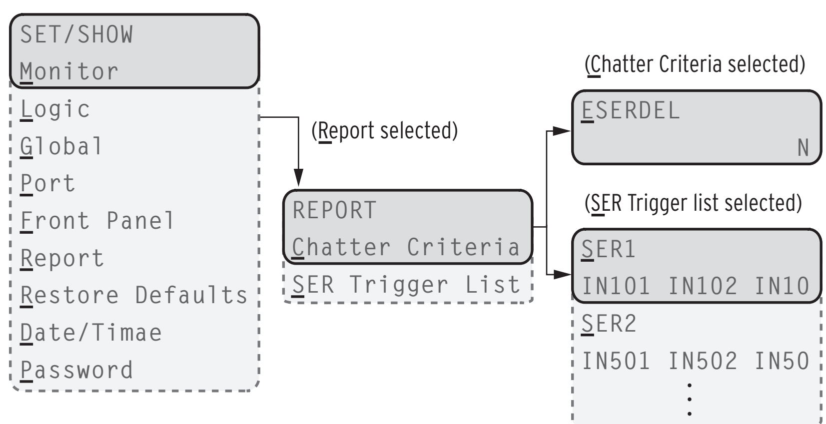


Figure 5.25 Report Submenu

You can only restore the relay default settings in the unlikely event when the SEL-2410 has suffered an internal failure. In this event, the relay displays a failure message, indicating the type of failure. Be sure to record this message before you navigate to restore default settings sub-menu. Attempting to restore the default settings without a failure is not allowed, as shown in *Figure 5.26*.

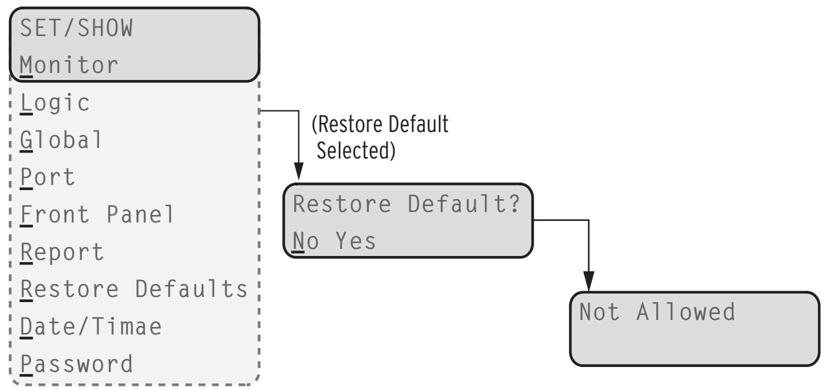


Figure 5.26 Result From Attempting To Restore Default Settings Without a Relay Failure

Set the time and date settings as shown in *Figure 5.27*.

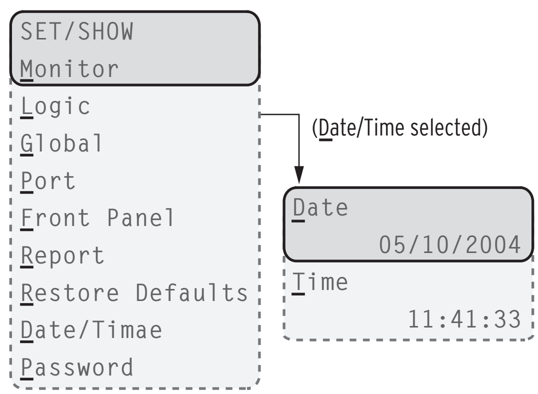


Figure 5.27 Date and Time Settings

Change existing passwords with the password setting, as shown in *Figure 5.28*.

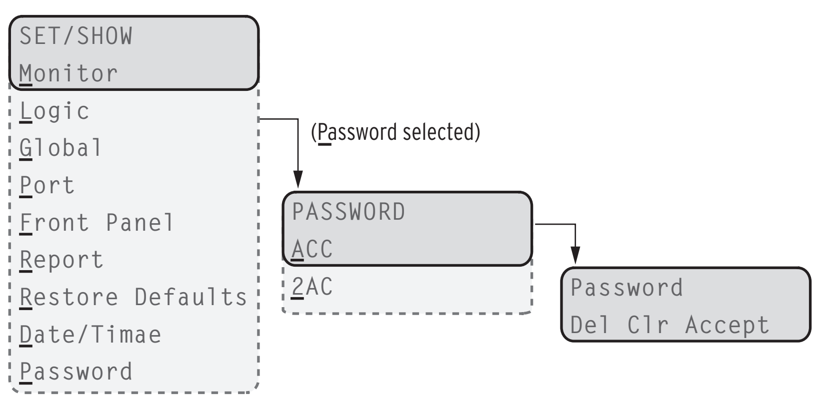


Figure 5.28 Password Setting

Status Menu

The Status menu item of the MAIN menu allows you to access the Relay Status data and Reboot Relay, as shown in *Figure 5.29*. See *STATUS Command (Processor Self-Test Status) on page 4.22* for the **STATUS** command description.

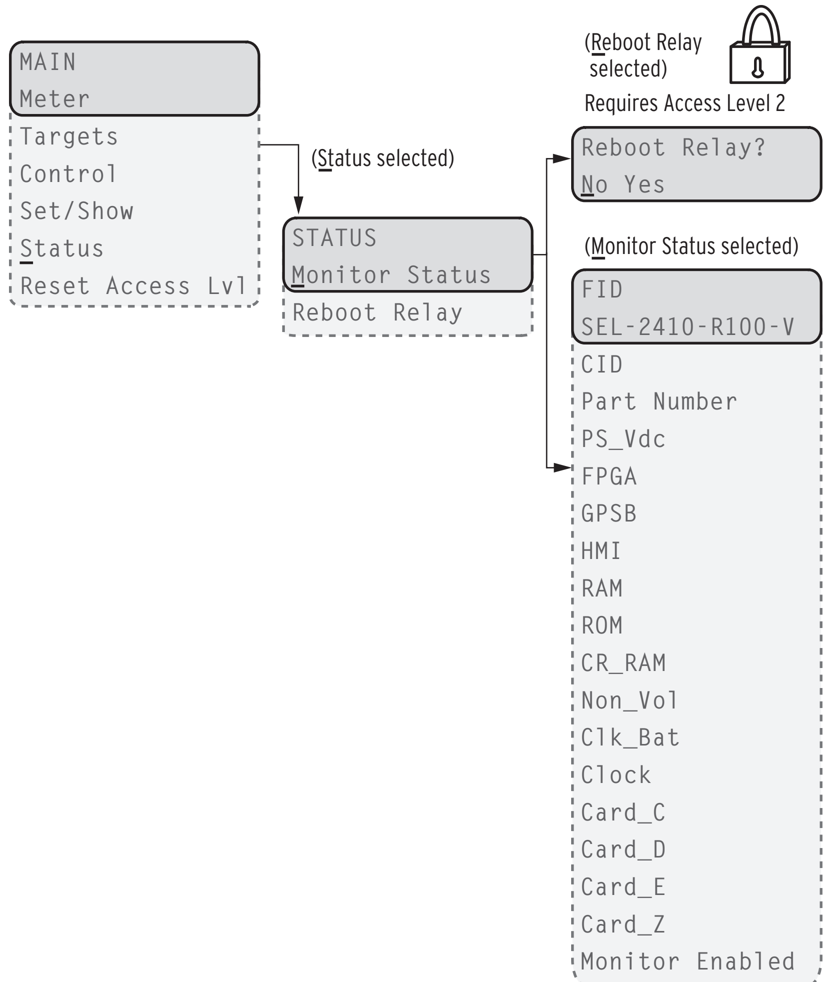


Figure 5.29 Status Submenu

Reset Access Lvl Menu

Select the Reset Access Lvl menu item on the MAIN menu to reset the front-panel access to level 1. The reset is confirmed by the display message Access Lvl Reset. As shown in *Figure 5.30*.

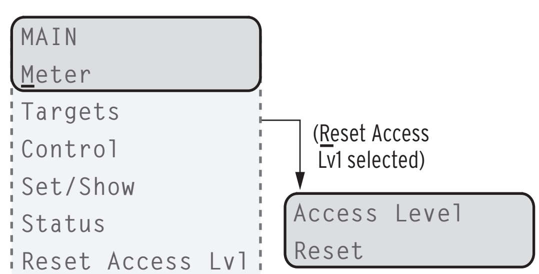


Figure 5.30 Reset Front-Panel Access To Level 1

Operation and Target LEDs

Programmable LEDs

The SEL-2410 provides quick confirmation of relay conditions via operation and target LEDs. *Figure 5.31* shows this region with factory default text on the front-panel configurable labels.

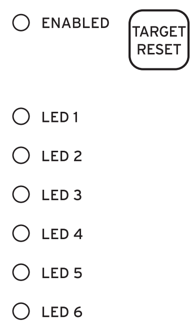


Figure 5.31 Factory Default Front-Panel LEDs

You can reprogram front-panel LEDs **LED 01** through **LED 06** using settings T0*n*_LED (*n* = 1 through 6). T0n_LED settings are SELOGIC control equations that, when asserted, illuminate the corresponding LED. By setting the T0*n*LEDL setting to Y, you can latch the target LEDs after assertion. In the default settings, this setting is set to *N* to disable the latch. After setting the target LEDs, push the **TARGET RESET** pushbutton to reset the target LEDs (you can also issue the **TAR R** command or assert Device Word bit TRGTR to reset the target LEDs).

The SEL-2410 features slide-in labels for custom LED designations that match custom LED logic. Use the slide-in labels to mark the LEDs with these custom names. Included on the SEL-2410 Product Literature CD are Customer Label Templates to print labels for the slide-in label carrier. An illuminated **ENABLED** LED indicates that the supply voltage is present, the device is healthy, and processing is enabled. When the **ENABLED** LED is not illuminated, one of the following could be the cause:

- Supply voltage absent
- Firmware upload or download
- Self-test failure

When the **ENABLED** LED is not illuminated, the relay displays a message on the LCD describing why the LED is not illuminated.

TARGET RESET Pushbutton

TARGET RESET

Use the **TARGET RESET** pushbutton to reset latched target LEDs. When a new event occurs and the previously latched trip targets have not been reset, the relay clears the latched targets and displays the new targets. Pressing and holding the **TARGET RESET** pushbutton illuminates all the LEDs. Upon release of the **TARGET RESET** pushbutton, two possible situations can exist: the conditions that caused the LED to illuminate have cleared, or the conditions remain present at the relay inputs. If the conditions have cleared, the latched target LEDs turn off. If the conditions remain, the relay re-illuminates the corresponding target LEDs.

Lamp Test

The TARGET RESET pushbutton also provides a front-panel lamp test. Pressing and holding TARGET RESET pushbutton illuminates all the front-panel LEDs, and these LEDs remain illuminated for as long as TARGET RESET is pressed. The target LEDs return to a normal operational state after release of the TARGET RESET pushbutton.

Other Target Reset Options

Use the ASCII command **TAR R** to reset the target LEDs; see *TARGET Command (Display Device Word Bit Status) on page 4.23* for more information. Programming specific conditions in the SELOGIC control equation RSTTRGT is another method for resetting target LEDs. Access RSTTRGT in the Global settings (Data Reset Control).

Section 6
Analyzing Events

Overview

The SEL-2410 SER (Sequential Events Recorder) report gives you detailed information on processor states and processor element operation. The SER captures and time tags state changes of Device Word bits and processor conditions. These conditions include power up, processor enable and disable, settings changes, memory overflow, and SER automatic removal and reinsertion.

The SER records up to 512 state changes of up to 96 Device Word bits listed in the SER trigger equations. SER data are stored in nonvolatile memory, ensuring that a loss of power to the SEL-2410 will not result in lost data.

SER Contact Input Sampling And Time Tag Accuracy

To achieve predictable and deterministic time stamping that is independent of power system frequency, the SEL-2410 references an internal generated frequency of 62.5 Hz. This reference frequency is not settable; it is fixed at 62.5 Hz regardless of the power system frequency. Therefore, using this internally fixed frequency of 62.5 Hz, the SEL-2410 provides the same time stamping whether you install the I/O processor on a power system operating on 50 Hz or 60 Hz. The SEL-2410 processes the SER data at a rate of 1/32 of the reference frequency, with a recording resolution of 1/10 of a millisecond. To express the sampling rate in milliseconds, do the following calculation:

$$\text{SampleRate} = \frac{\text{Time}}{\text{Frequency} \bullet \text{SampleRate}}\ \text{ms}$$

$$\text{SampleRate} = \frac{1000}{62.5 \bullet 32}\ \text{ms} \qquad \textbf{Equation 6.1}$$

$$\text{SampleRate} = 0.5\ \text{ms (or 500 microseconds)}$$

Allowing another 0.5 ms for processing latency in the I/O processor gives an SEL-2410 SER to the millisecond.

SER Report

Figure 6.1 shows the following data contained in the SER report:

- Standard report header
- I/O processor (monitor) and terminal identification
- Date and time of report
- SER number
- SER date and time
- Monitor element or condition
- Element state (including auto-removal and auto-insertion)

```
SEL-2410                                 Date: 05/12/2004    Time:  08:12:52.713
MONITOR                                  Time Source: internal

FID-SEL-2410-R101-V0-Z001001-D20040505        CID=E242

#      DATE         TIME           ELEMENT              STATE

20     05/12/2004   04:32:10.138   Monitor newly powered up
19     05/12/2004   08:12:29.854   Monitor settings changed
18     05/12/2004   08:12:29.854   IN101                Auto-Removed
17     05/12/2004   08:15:09.432   IN101                Auto-Reinstated
            .
            .
            .
 1     05/12/2004   08:12:41.490   RB01                 Asserted
```

SER Number | Relay Element or Condition | Element State

Figure 6.1 Sample SER Report

Each entry in the SER 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 (RB01 in *Figure 6.1*). 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 4.19* 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 (SER1 through SER4) trigger equations. Each of the four programmable trigger equations allows entry of as many as 24 processor elements separated by spaces or commas; the SER report accepts a total of 96 Device Word bits.

The SEL-2410 always creates an SER record for power-up, processor enable and processor disable, any settings change, and memory overflow. *Figure 6.2* shows the SER entry following a settings change.

```
Monitor settings changed
```

Figure 6.2 SER Entry After a Settings Change

Retrieving and Clearing SER Reports

See *SER Command (Sequential Events Recorder Report) on page 4.19* for details on the **SER** command.

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Section 7
Testing and Troubleshooting

Overview

I/O processor testing is typically divided into two categories:

- Tests performed at the time the I/O processor is installed or commissioned.
- Tests performed periodically once the I/O processor is in service.

This section provides information on testing at the time of installation. Because the SEL-2410 is equipped with extensive self-tests, traditional periodic test procedures may be eliminated or greatly reduced. Should a problem arise during either commissioning or periodic tests, the section on *Troubleshooting* provides a guide to isolating and correcting the problem.

Testing Tools

Test Features Provided by the I/O Processor

The following features assist you during I/O processor testing.

METER Command

The **METER** command shows the transducer (analog) values measured by the I/O processor. Compare these quantities against other devices of known accuracy. The **METER** command is available at the serial ports and front-panel display.

SER Command

The I/O processor provides a Sequential Events Recorder (SER) event report that time-tags changes in I/O processor element and input/output contact states. The SER provides a convenient means to verify the pickup/dropout of any element in the I/O processor. The **SER** command is available at the serial ports.

TARGET Command

Use the **TARGET** command to view the state of I/O processor control inputs, I/O processor outputs, and I/O processor elements individually during a test. The **TARGET** command is available at the serial ports and the front panel.

Troubleshooting

Refer to *Table 7.1* for troubleshooting instructions for particular situations.

Table 7.1 Troubleshooting

Problem	Possible Cause	Solution
The I/O processor ENABLED front-panel LED is dark.	Input power is not present or a fuse is blown. Self-test failure.	Verify that input power is present. View the self-test failure message on the front-panel display.
The I/O processor front-panel display does not show characters.	The I/O processor front panel has timed out. The I/O processor is de-energized.	Press the ESC pushbutton to activate the display. Verify input power and fuse continuity.
The I/O processor does not accurately measure transducer values.	Wiring error. Incorrect AI settings (Group settings).	Verify input wiring. Verify AI settings.
The I/O processor does not respond to commands from a device connected to the serial port.	Cable is not connected. Cable is the incorrect type. The I/O processor of communicating device has communications mismatch(es). The I/O processor serial port has received an XOFF, halting communications.	Verify the cable connections. Verify the cable pinout. Verify device communications parameters. Type **<Ctrl>Q** to send the I/O processor XON and restart communications.

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Appendix A
Firmware and Manual Versions

Firmware

Determining the Firmware Version in Your I/O Processor

To find the firmware version number in your SEL-2410 I/O Processor, use the **STA** command (see *STATUS Command (Processor Self-Test Status) on page 4.22* for more information on the **STA** command). The firmware revision number is after the R, and the release date is after the D. For example, the following is firmware revision number 100, release date July 12, 2004.

FID=SEL-2410-R100-V0-Z001001-D20040712

Table A.1 lists the firmware versions, a description of modifications, and the instruction manual date code that corresponds to firmware versions. The most recent firmware version is listed first.

Table A.1 Firmware Revision History

Firmware Identification (FID) Number	Description of Changes	Manual Date Code
SEL-2410-R101-V0-Z001001-D20060706	➤ Manual update only (see *Table A.2*).	20120907
SEL-2410-R101-V0-Z001001-D20060706	➤ Manual update only (see *Table A.2*).	20120203
SEL-2410-R101-V0-Z001001-D20060706	➤ Manual update only (see *Table A.2*).	20080325
SEL-2410-R101-V0-Z001001-D20060706	➤ Manual update only (see *Table A.2*).	20061017
SEL-2410-R101-V0-Z001001-D20060706	➤ Fixed possible communications lockup when XOFF command is sent to the serial port. ➤ Added low voltage 24/48 Vdc power supply option.	20060706
SEL-2410-R100-V0-Z001001-D20040702	➤ Original firmware release.	20040702

Instruction Manual

The date code at the bottom of each page of this manual reflects the creation or revision date.

Table A.2 lists the instruction manual release dates and a description of modifications. The most recent instruction manual revisions are listed at the top.

Table A.2 Instruction Manual Revision History

Revision Date	Summary of Revisions
20120907	Preface ➤ Updated product label example in *Product Labels*. Section 1 ➤ Updated *Specifications*.
20120203	Section 4 ➤ Added **CAL** command description and password.
20080325	Preface ➤ Added Hazardous Locations Approvals. ➤ Updated S*afety and General Information*. Section 1 ➤ Updated Operating Temperature Range in *Specifications*. ➤ Added Hazardous Locations Approvals under Certifications in *Specifications*. Section 2 ➤ Updated Physical Location information.
20061017	Section 1 ➤ Updated accuracy information in *Specifications*. Section 3 ➤ Updated *Figure 3.11: Timing Diagram When Input IN101 Changes From the Asserted State to the Deasserted State*.
20060706	Section 1 ➤ Updated power supply information in *Specifications*. Section 2 ➤ Updated steps in Fuse Replacement. Appendix A ➤ Updated for firmware revision R101.
20040702	Initial Release.

Appendix B
Firmware Upgrade Instructions

Overview

SEL occasionally offers firmware upgrades to improve the performance of your device. Because the SEL-2410 I/O Processor stores firmware in flash memory, changing physical components is not necessary. Upgrade the device firmware by downloading a file from a personal computer 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 protocol
- ➤ Serial communications cable (SEL Cable C234A or equivalent, or a null-modem cable)
- ➤ Disk containing the firmware upgrade (e.g., r1012410.s19) file

Upgrade Instructions

The instructions below assume you have a working knowledge of your personal computer terminal emulation software. In particular, you must be able to modify your serial communications parameters (baud rate, data bits, parity, etc.), select transfer protocol (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, using the following steps:

a. Issue the following commands at the ASCII prompt:

SHO, **SHO L**, **SHO G**, **SHO P**, **SHO F**, **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 relay 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 device and PC data rates.

Step 5. Change the baud rate, if desired.

a. Type **BAU 38400 <Enter>**.

This will change the baud rate of the communications port to 38400.

b. Change the baud rate of the PC to 38400 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.

a. Select the send file option in your communications software.

b. Use the XMODEM protocol and send the file that contains the new firmware (e.g., r1012410.s19).

The file transfer takes less than 15 minutes at 38400 baud. 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 relay to receive firmware(Y/N) ? Y <Enter>
Are you sure (Y,N) ? Y <Enter>
Relay Disabled
!>BAU 38400 <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 illuminates 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 or the front-panel displays STATUS FAIL, EEPROM FAILURE, or Non_Vol Failure, use the following procedure to restore the factory default settings:

a. Set the communications software settings to 9600 baud, 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.

d. The device will then reboot with the factory default settings.

e. Enter Access Level 2.

f. Restore device settings back to the settings saved in *Step 3*.

Step 11. Change the baud rate of the PC 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.

Step 13. Apply analog current or voltage signals to the device.

Step 14. Issue the **METER** command; verify that the signals are correct.

The device is now ready for your commissioning procedure.

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Appendix C
SEL Communications Processors

SEL Communications Protocols

The SEL-2410 I/O Processor supports 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 human 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.
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 ASCII Commands

We originally designed SEL ASCII commands for communication between the relay and a human operator via a keyboard and monitor or a printing terminal. A computer with a serial port can also use the SEL ASCII protocol to communicate with the relay, collect data, and issue commands.

SEL Compressed ASCII Commands

The relay 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 relay can execute software to parse and interpret comma-delimited messages without expending the customization and maintenance labor needed to interpret nondelimited messages. The relay 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 to 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 because the compressed reports reduce blanks, tabs, and other white space between data fields to a single comma.

Table C.2 lists the Compressed ASCII commands and contents of the command responses.

Table C.2 Compressed ASCII Commands

Command	Response	Access Level
BNAME	ASCII names of Fast Meter status bits	0
CASCII	Configuration data of all Compressed ASCII commands available at access levels > 0	0
CSTATUS	Relay status	1
DNAME	ASCII names of digital I/O reported in Fast Meter	0
ID	Relay identification	0
SNS	ASCII names for SER data reported in Fast Meter	0

Interleaved ASCII and Binary Messages

SEL relays have two separate data streams that share the same physical serial port. Human data communications with the relay consist of ASCII character commands and reports that you view through use of 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 communication (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 using these interleaved data streams is when the SEL-2410 communicates with an SEL communications processor. These 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 to populate a local database and to perform SCADA operations. At the same time, you can use the binary data stream to connect transparently to the SEL-2410 and 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 remote bit control. The relay can also send unsolicited Fast SER messages automatically. If the relay is connected to an SEL communications processor, these messages provide the mechanism that the communications processor uses for SCADA or DCS functions that occur simultaneously with ASCII interaction.

SEL Communications Processor

SEL offers SEL communications processors, powerful tools 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*.

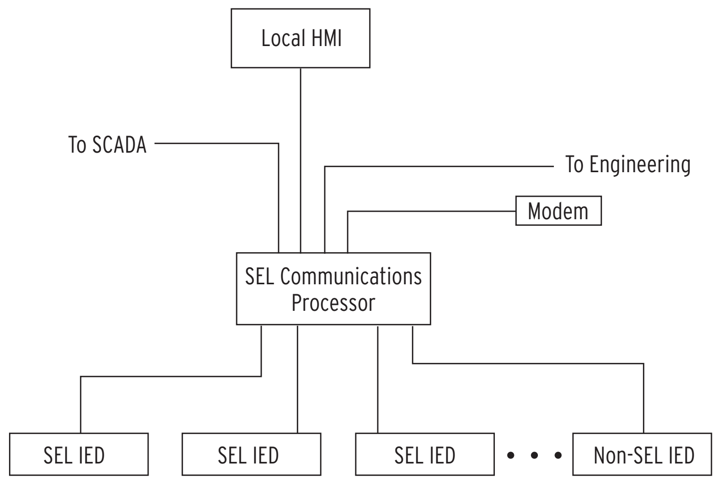

Figure C.1 SEL Communications Processor Star Integration Network

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 plus 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 that serves as the central point of access to substation data and substation IEDs.

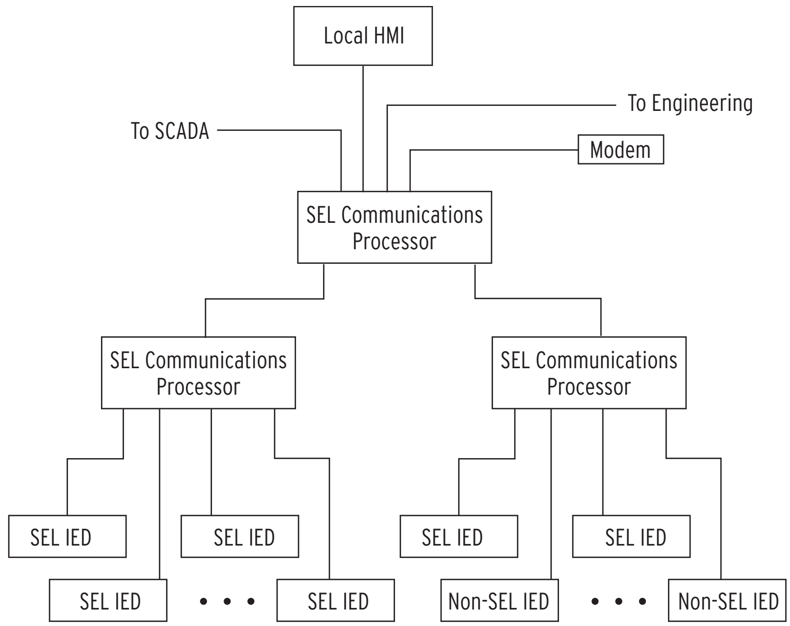

Figure C.2 Multitiered SEL Communications Processor Architecture

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 Slave	DNP3 masters
Modbus® RTU Protocol	Modbus masters
SEL ASCII/Fast Message Slave	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[a]	Modbus Plus peers with global data and Modbus Plus masters
FTP (File Transfer Protocol)[b]	FTP clients
Telnet[b]	Telnet servers and clients
UCA2 GOMSFE[b]	UCA2 protocol masters
UCA2 GOOSE[b]	UCA2 protocol and peers

[a] Requires SEL-2711 Modbus Plus protocol card.
[b] Requires SEL-2701 Ethernet Processor.

SEL Communications Processor and Relay Architecture

You can apply SEL communications processors and SEL relays 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

The simplest architecture using both the SEL-2410 and an SEL communications processors is shown in *Figure C.1*. In this architecture, the SEL communications processor collects data from the SEL-2410 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); communication 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 relays 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.

SEL communications processors equipped with an SEL-2701 Ethernet Processor can provide a UCA2 interface to SEL-2410 relays and other serial IEDs. The SEL-2410 data appear in models in a virtual device domain. The combination of the SEL-2701 with an SEL communications processor offers a significant cost savings because you can use existing IEDs or purchase less expensive IEDs. For full details on applying the SEL-2701 with an SEL communications processor, see the SEL-*2701 Ethernet Processor Instruction Manual*.

The engineering connection can use either an Ethernet network connection through the SEL-2701 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 relays 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 SEL-2701 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

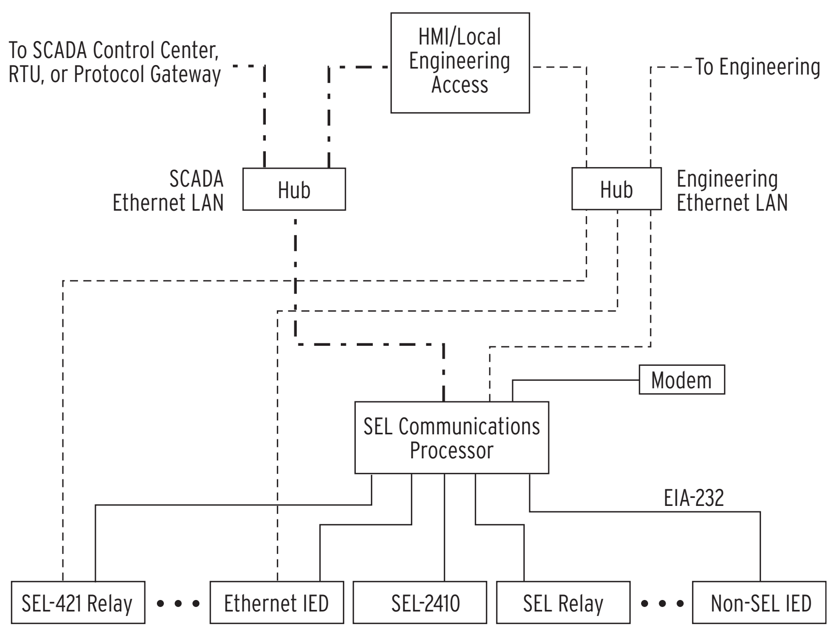

Figure C.3 Enhancing Multidrop Networks With SEL Communications Processors

SEL Communications Processor Example

This example demonstrates the data and control points available in the SEL communications processor when you connect an SEL-2410. The physical configuration used in this example is shown in *Figure C.4*.

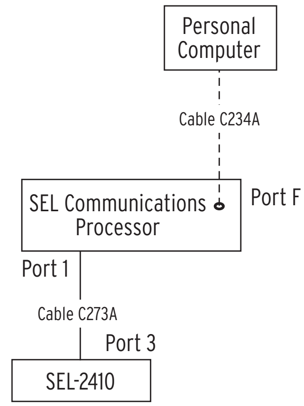

Figure C.4 Example SEL Relay and SEL Communications Processor Configuration

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	*Relay 1*	Name of connected relay[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-2410, using the list in *Table C.5*.

Table C.5 SEL Communications Processor Data Collection Automessages

Message	Data Collected
20METER	Analog input metering data
20TARGET	Selected Device Word bit elements
20STATUS	Status Command (ASCII)

Table C.6 shows the automessage (Set A) settings for the SEL communications processor.

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	N	Automatic sequential event recorder data collection disabled
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 Device 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-2410. 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	Relay 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

Relay Metering 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). 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

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
MIN	2008h	char
SECONDS	2009h	char
MSEC	200Ah	int
AI601	200Bh	float
AI602	200Dh	float
AI603	200Fh	float
AI604	2011h	float
AI605	2013h	float
AI606	2015h	float
AI607	2017h	float
AI608	2019h	float

Device Word Bits Information

Table C.9 lists the Device Word bit data available in the SEL communications processor TARGET region.

Table C.9 Communications Processor TARGET Region

Address	Device Word Bits (in Bits 7-0)							
	7	6	5	4	3	2	1	0
2805h	ENABLED	*	T01_LED	T01_LED	T01_LED	T01_LED	T01_LED	T01_LED
2806h	See *Table D.1*, Row 1							
2807h	See *Table D.1*, Row 2							
2808h	See *Table D.1*, Row 3							
2809h	See *Table D.1*, Row 4							
280Ah	See *Table D.1*, Row 5							
• • •	• • •							
285dH	See *Table D.1*, Row 88							

Control Points

The SEL communications processor can automatically pass control messages, called Fast Operate messages, to the SEL-2410. You must enable Fast Operate messages by using the FASTOP setting in the SEL-2410 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 relay for changes in remote bits RB1–RB16 on the corresponding SEL communications processor port. In this example, if you set RB1 on Port 1 in the SEL communications processor, it automatically sets RB1 in the SEL-2410.

There are no breaker bits in the SEL-2410.

Appendix D
I/O Processor Word Bits

Overview

I/O Processor Word bits (called hereafter Device Word bits) are the Boolean status (0 or 1) of the processor elements. Each Device Word bit has a label name and can be in either of the following states:

- 1 (logical 1)
- 0 (logical 0)

Logical 1 represents an element being picked up or asserted.
Logical 0 represents an element being dropped out or deasserted.

Table D.1 shows a list of available Device Word bits in the SEL-2410. Each row in *Table D.1* contains eight Device Word bits, and corresponds to the row numbers used in the **TAR** command. *Table D.2* describes each Device Word bit.

Use any Device Word bit (except Row 0) in SELOGIC® control equations and the Sequential Events Recorder (SER) trigger list settings.

Table D.1 SEL-2410 Device Word Bits (Sheet 1 of 3)

Bit/ Row	Device Word Bits							
	7	6	5	4	3	2	1	0
TAR 0	ENABLED	*	T01_LED	T02_LED	T03_LED	T04_LED	T05_LED	T06_LED
1	*	SALARM	*	*	*	*	IRIGOK	HALARM
2	RB01	RB02	RB03	RB04	RB05	RB06	RB07	RB08
3	RB09	RB10	RB11	RB12	RB13	RB14	RB15	RB16
4	RB17	RB18	RB19	RB20	RB21	RB22	RB23	RB24
5	RB25	RB26	RB27	RB28	RB29	RB30	RB31	RB32
6	LB01	LB02	LB03	LB04	LB05	LB06	LB07	LB08
7	LB09	LB10	LB11	LB12	LB13	LB14	LB15	LB16
8	LB17	LB18	LB19	LB20	LB21	LB22	LB23	LB24
9	LB25	LB26	LB27	LB28	LB29	LB30	LB31	LB32
10	SV01	SV02	SV03	SV04	SV05	SV06	SV07	SV08
11	SV01T	SV02T	SV03T	SV04T	SV05T	SV06T	SV07T	SV08T
12	SV09	SV10	SV11	SV12	SV13	SV14	SV15	SV16
13	SV09T	SV10T	SV11T	SV12T	SV13T	SV14T	SV15T	SV16T
14	SV17	SV18	SV19	SV20	SV21	SV22	SV23	SV24
15	SV17T	SV18T	SV19T	SV20T	SV21T	SV22T	SV23T	SV24T
16	SV25	SV26	SV27	SV28	SV29	SV30	SV31	SV32

Table D.1 SEL-2410 Device Word Bits (Sheet 2 of 3)

Bit/ Row	Device Word Bits							
	7	6	5	4	3	2	1	0
17	SV25T	SV26T	SV27T	SV28T	SV29T	SV30T	SV31T	SV32T
18	SV33	SV34	SV35	SV36	SV37	SV38	SV39	SV40
19	SV33T	SV34T	SV35T	SV36T	SV37T	SV38T	SV39T	SV40T
20	SV41	SV42	SV43	SV44	SV45	SV46	SV47	SV48
21	SV41T	SV42T	SV43T	SV44T	SV45T	SV46T	SV47T	SV48T
22	SV49	SV50	SV51	SV52	SV53	SV54	SV55	SV56
23	SV49T	SV50T	SV51T	SV52T	SV53T	SV54T	SV55T	SV56T
24	SV57	SV58	SV59	SV60	SV61	SV62	SV63	SV64
25	SV57T	SV58T	SV59T	SV60T	SV61T	SV62T	SV63T	SV64T
26	SET01	SET02	SET03	SET04	SET05	SET06	SET07	SET08
27	RST01	RST02	RST03	RST04	RST05	RST06	RST07	RST08
28	SET09	SET10	SET11	SET12	SET13	SET14	SET15	SET16
29	RST09	RST10	RST11	RST12	RST13	RST14	RST15	RST16
30	SET17	SET18	SET19	SET20	SET21	SET22	SET23	SET24
31	RST17	RST18	RST19	RST20	RST21	RST22	RST23	RST24
32	SET25	SET26	SET27	SET28	SET29	SET30	SET31	SET32
33	RST25	RST26	RST27	RST28	RST29	RST30	RST31	RST32
34	LT01	LT02	LT03	LT04	LT05	LT06	LT07	LT08
35	LT09	LT10	LT11	LT12	LT13	LT14	LT15	LT16
36	LT17	LT18	LT19	LT20	LT21	LT22	LT23	LT24
37	LT25	LT26	LT27	LT28	LT29	LT30	LT31	LT32
38	*	DSABLSET	RSTTRGT	[ER]	TRGTR	*	[FREQ]	*
39	*	*	*	*	*	*	*	*
40	IN101	IN102	*	*	*	*	*	*
41	IN301	IN302	IN303	IN304	IN305	IN306	IN307	IN308
42	IN401	IN402	IN403	IN404	IN405	IN406	IN407	IN408
43	IN501	IN502	IN503	IN504	IN505	IN506	IN507	IN508
44	IN601	IN602	IN603	IN604	IN605	IN606	IN607	IN608
45	OUT101	OUT102	OUT103	*	*	*	*	*
46	OUT301	OUT302	OUT303	OUT304	OUT305	OUT306	OUT307	OUT308
47	OUT401	OUT402	OUT403	OUT404	OUT405	OUT406	OUT407	OUT408
48	OUT501	OUT502	OUT503	OUT504	OUT505	OUT506	OUT507	OUT508
49	OUT601	OUT602	OUT603	OUT604	OUT605	OUT606	OUT607	OUT608
50	AILW1	AILW2	AILAL	*	AIHW1	AIHW2	AIHAL	*
51	AI301LW1	AI301LW2	AI301LAL	*	AI301HW1	AI301HW2	AI301HAL	*
52	AI302LW1	AI302LW2	AI302LAL	*	AI302HW1	AI302HW2	AI302HAL	*
53	AI303LW1	AI303LW2	AI303LAL	*	AI303HW1	AI303HW2	AI303HAL	*
54	AI304LW1	AI304LW2	AI304LAL	*	AI304HW1	AI304HW2	AI304HAL	*
55	AI305LW1	AI305LW2	AI305LAL	*	AI305HW1	AI305HW2	AI305HAL	*
56	AI306LW1	AI306LW2	AI306LAL	*	AI306HW1	AI306HW2	AI306HAL	*
57	AI307LW1	AI307LW2	AI307LAL	*	AI307HW1	AI307HW2	AI307HAL	*

Table D.1 SEL-2410 Device Word Bits (Sheet 3 of 3)

Bit/ Row	Device Word Bits							
	7	6	5	4	3	2	1	0
58	AI308LW1	AI308LW2	AI308LAL	*	AI308HW1	AI308HW2	AI308HAL	*
59	AI401LW1	AI401LW2	AI401LAL	*	AI401HW1	AI401HW2	AI401HAL	*
60	AI402LW1	AI402LW2	AI402LAL	*	AI402HW1	AI402HW2	AI402HAL	*
61	AI403LW1	AI403LW2	AI403LAL	*	AI403HW1	AI403HW2	AI403HAL	*
62	AI404LW1	AI404LW2	AI404LAL	*	AI404HW1	AI404HW2	AI404HAL	*
63	AI405LW1	AI405LW2	AI405LAL	*	AI405HW1	AI405HW2	AI405HAL	*
64	AI406LW1	AI406LW2	AI406LAL	*	AI406HW1	AI406HW2	AI406HAL	*
65	AI407LW1	AI407LW2	AI407LAL	*	AI407HW1	AI407HW2	AI407HAL	*
66	AI408LW1	AI408LW2	AI408LAL	*	AI408HW1	AI408HW2	AI408HAL	*
67	AI501LW1	AI501LW2	AI501LAL	*	AI501HW1	AI501HW2	AI501HAL	*
68	AI502LW1	AI502LW2	AI502LAL	*	AI502HW1	AI502HW2	AI502HAL	*
69	AI503LW1	AI503LW2	AI503LAL	*	AI503HW1	AI503HW2	AI503HAL	*
70	AI504LW1	AI504LW2	AI504LAL	*	AI504HW1	AI504HW2	AI504HAL	*
71	AI505LW1	AI505LW2	AI505LAL	*	AI505HW1	AI505HW2	AI505HAL	*
72	AI506LW1	AI506LW2	AI506LAL	*	AI506HW1	AI506HW2	AI506HAL	*
73	AI507LW1	AI507LW2	AI507LAL	*	AI507HW1	AI507HW2	AI507HAL	*
74	AI508LW1	AI508LW2	AI508LAL	*	AI508HW1	AI508HW2	AI508HAL	*
75	AI601LW1	AI601LW2	AI601LAL	*	AI601HW1	AI601HW2	AI601HAL	*
76	AI602LW1	AI602LW2	AI602LAL	*	AI602HW1	AI602HW2	AI602HAL	*
77	AI603LW1	AI603LW2	AI603LAL	*	AI603HW1	AI603HW2	AI603HAL	*
78	AI604LW1	AI604LW2	AI604LAL	*	AI604HW1	AI604HW2	AI604HAL	*
79	AI605LW1	AI605LW2	AI605LAL	*	AI605HW1	AI605HW2	AI605HAL	*
80	AI606LW1	AI606LW2	AI606LAL	*	AI606HW1	AI606HW2	AI606HAL	*
81	AI607LW1	AI607LW2	AI607LAL	*	AI607HW1	AI607HW2	AI607HAL	*
82	AI608LW1	AI608LW2	AI608LAL	*	AI608HW1	AI608HW2	AI608HAL	*
83	*	*	*	*	*	*	*	*
84	IN101E	IN102E	*	*	*	*	*	*
85	IN301E	IN302E	IN303E	IN304E	IN305E	IN306E	IN307E	IN308E
86	IN401E	IN402E	IN403E	IN404E	IN405E	IN406E	IN407E	IN408E
87	IN501E	IN502E	IN503E	IN504E	IN505E	IN506E	IN507E	IN508E
88	IN601E	IN602E	IN603E	IN604E	IN605E	IN606E	IN607E	IN608E

Definitions

Table D.2 Device Word Bit Definitions (Sheet 1 of 12)

Row	Bit	Definition
0	ENABLED	Relay Enabled
	*	
	T01_LED	SELOGIC equation: drives LED 3
	T02_LED	SELOGIC equation: drives LED 4
	T03_LED	SELOGIC equation: drives LED 5
	T04_LED	SELOGIC equation: drives LED 6
	T05_LED	SELOGIC equation: drives LED 7
	T06_LED	SELOGIC equation: drives LED 8
1	*	Reserved
	SALARM	Software Alarms: invalid password, changing access levels, settings changes
	*	Reserved
	*	
	*	Reserved
	*	Reserved
	IRIGOK	IRIG-B Time Synchronism Input Data is valid.
	HALARM	Diagnostics Failure.
2	RB01	Remote Bits RB01 through RB08
	RB02	
	RB03	
	RB04	
	RB05	
	RB06	
	RB07	
	RB08	
3	RB09	Remote Bits RB09 through RB16
	RB10	
	RB11	
	RB12	
	RB13	
	RB14	
	RB15	
	RB16	
4	RB17	Remote Bits RB17 through RB24
	RB18	
	RB19	
	RB20	
	RB21	
	RB22	

Table D.2 Device Word Bit Definitions (Sheet 2 of 12)

Row	Bit	Definition
	RB23	
	RB24	
5	RB25	Remote Bits RB25 through RB32
	RB26	
	RB27	
	RB28	
	RB29	
	RB30	
	RB31	
	RB32	
6	LB01	Local Bits LB01 through LB08
	LB02	
	LB03	
	LB04	
	LB05	
	LB06	
	LB07	
	LB08	
7	LB09	Local Bits LB09 through LB16
	LB10	
	LB11	
	LB12	
	LB13	
	LB14	
	LB15	
	LB16	
8	LB17	Local Bits LB17 through LB24
	LB18	
	LB19	
	LB20	
	LB21	
	LB22	
	LB23	
	LB24	
9	LB25	Local Bits LB25 through LB32
	LB26	
	LB27	
	LB28	
	LB29	

Table D.2 Device Word Bit Definitions (Sheet 3 of 12)

Row	Bit	Definition
	LB30 LB31 LB32	
10	SV01 SV02 SV03 SV04 SV05 SV06 SV07 SV08	SELOGIC control equation variables SV01 through SV08.
11	SV01T SV02T SV03T SV04T SV05T SV06T SV07T SV08T	SELOGIC control equation variables SV01T through SV08T with settable pickup and dropout time delay.
12	SV09 SV10 SV11 SV12 SV13 SV14 SV15 SV16	SELOGIC control equation variables SV09 through SV16.
13	SV09T SV10T SV11T SV12T SV13T SV14T SV15T SV16T	SELOGIC control equation variables SV09T through SV16T with settable pickup and dropout time delay.
14	SV17 SV18 SV19 SV20 SV21 SV22	SELOGIC control equation variables SV17 through SV24

Table D.2 Device Word Bit Definitions (Sheet 4 of 12)

Row	Bit	Definition
	SV23 SV24	
15	SV17T SV18T SV19T SV20T SV21T SV22T SV23T SV24T	SELOGIC control equation variables SV17T through SV24T with settable pickup and dropout time delay.
16	SV25 SV26 SV27 SV28 SV29 SV30 SV31 SV32	SELOGIC control equation variables SV25 through SV32.
17	SV25T SV26T SV27T SV28T SV29T SV30T SV31T SV32T	SELOGIC control equation variables SV25T through SV32T with settable pickup and dropout time delay.
18	SV33 SV34 SV35 SV36 SV37 SV38 SV39 SV40	SELOGIC control equation variables SV33 through SV40.
19	SV33T SV34T SV35T SV36T SV37T SV38T	SELOGIC control equation variables SV33T through SV40T with settable pickup and dropout time delay.

Table D.2 Device Word Bit Definitions (Sheet 5 of 12)

Row	Bit	Definition
ENABLED	*	T01_LED
	SV40T	
20	SV41	SELOGIC control equation variables SV41 through SV48.
	SV42	
	SV43	
	SV44	
	SV45	
	SV46	
	SV47	
	SV48	
21	SV41T	SELOGIC control equation variables SV48T through SV48T with settable pickup and dropout time delay.
	SV42T	
	SV43T	
	SV44T	
	SV45T	
	SV46T	
	SV47T	
	SV48T	
22	SV49	SELOGIC control equation variables SV49 through SV56.
	SV50	
	SV51	
	SV52	
	SV53	
	SV54	
	SV55	
	SV56	
23	SV49T	SELOGIC control equation variables SV49T through SV56T with settable pickup and dropout time delay.
	SV50T	
	SV51T	
	SV52T	
	SV53T	
	SV54T	
	SV55T	
	SV56T	
24	SV57	SELOGIC control equation variables SV57 through SV64.
	SV58	
	SV59	
	SV60	
	SV61	
	SV62	

Table D.2 Device Word Bit Definitions (Sheet 6 of 12)

Row	Bit	Definition
	SV63	
	SV64	
25	SV57T	SELOGIC control equation variables SV57T through SV64T with settable pickup and dropout time delay.
	SV58T	
	SV59T	
	SV60T	
	SV61T	
	SV62T	
	SV63T	
	SV64T	
26	SET01	SELOGIC SET Latch bit variables 1–8
	SET02	
	SET03	
	SET04	
	SET05	
	SET06	
	SET07	
	SET08	
27	RST01	SELOGIC RST Latch bit variables 1–8
	RST02	
	RST03	
	RST04	
	RST05	
	RST06	
	RST07	
	RST08	
28	SET09	SELOGIC SET Latch bit variables 9–16
	SET10	
	SET11	
	SET12	
	SET13	
	SET14	
	SET15	
	SET16	
29	RST09	SELOGIC RST Latch bit variables 9–16
	RST10	
	RST11	
	RST12	
	RST13	
	RST14	

Table D.2 Device Word Bit Definitions (Sheet 7 of 12)

Row	Bit	Definition
	RST15	
	RST16	
30	SET17	SELOGIC SET Latch bit variables 17–24
	SET18	
	SET19	
	SET20	
	SET21	
	SET22	
	SET23	
	SET24	
31	RST17	SELOGIC RST Latch bit variables 17–24
	RST18	
	RST19	
	RST20	
	RST21	
	RST22	
	RST23	
	RST24	
32	SET25	SELOGIC SET Latch bit variables 25–32
	SET26	
	SET27	
	SET28	
	SET29	
	SET30	
	SET31	
	SET32	
33	RST25	SELOGIC RST Latch bit variables 25–32
	RST26	
	RST27	
	RST28	
	RST29	
	RST30	
	RST31	
	RST32	
34	LT01	Latch bits 1–8
	LT02	
	LT03	
	LT04	
	LT05	
	LT06	

Table D.2 Device Word Bit Definitions (Sheet 8 of 12)

Row	Bit	Definition
	LT07	
	LT08	
35	LT09	Latch bit variables 9–16
	LT10	
	LT11	
	LT12	
	LT13	
	LT14	
	LT15	
	LT16	
36	LT17	Latch bits 17–24
	LT18	
	LT19	
	LT20	
	LT21	
	LT22	
	LT23	
	LT24	
37	LT25	Latch bit variables 25–32
	LT26	
	LT27	
	LT28	
	LT29	
	LT30	
	LT31	
	LT32	
38	*	Reserved
	DSABLSET	SELOGIC equation: Do not allow settings changes when asserted.
	RSTTRGT	SELOGIC equation: Reset targets when asserted. (Remote target reset via rising-edge of this RW)
	*	
	TRGTR	Target Reset. Asserts for one quarter-cycle when you execute a front-panel, or serial port target reset command.
	*	
	*	
	*	
39	*	
	*	
	*	
	*	
	*	
	*	

Table D.2 Device Word Bit Definitions (Sheet 9 of 12)

Row	Bit	Definition
	*	
	*	
40	IN101	Contact Inputs (Slot 1: power supply card)
	IN102	
	*	
	*	
	*	
	*	
	*	
	*	
41	IN301	Contact Inputs (Slot 3)
	IN302	
	IN303	
	IN304	
	IN305	
	IN306	
	IN307	
	IN308	
42	IN401	Contact Inputs (Slot 4)
	IN402	
	IN403	
	IN404	
	IN405	
	IN406	
	IN407	
	IN408	
43	IN501	Contact Inputs (Slot 5)
	IN502	
	IN503	
	IN504	
	IN505	
	IN506	
	IN507	
	IN508	
44	IN601	Contact Inputs (Slot 6)
	IN602	
	IN603	
	IN604	
	IN605	
	IN606	

Table D.2 Device Word Bit Definitions (Sheet 10 of 12)

Row	Bit	Definition
	IN607	
	IN608	
45	OUT101	Contact Outputs (Slot 1: power supply card)
	OUT102	
	OUT103	
	*	
	*	
	*	
	*	
	*	
46	OUT301	Contact Outputs (Slot 3)
	OUT302	
	OUT303	
	OUT304	
	OUT305	
	OUT306	
	OUT307	
	OUT308	
47	OUT401	Contact Outputs (Slot 4)
	OUT402	
	OUT403	
	OUT404	
	OUT405	
	OUT406	
	OUT407	
	OUT408	
48	OUT501	Contact Outputs (Slot 5)
	OUT502	
	OUT503	
	OUT504	
	OUT505	
	OUT506	
	OUT507	
	OUT508	
49	OUT601	Contact Outputs (Slot 6)
	OUT602	
	OUT603	
	OUT604	
	OUT605	
	OUT606	

Table D.2 Device Word Bit Definitions (Sheet 11 of 12)

Row	Bit	Definition
	OUT607	
	OUT608	
50	AILW1	Analog Inputs Low Warning, Level 1. If any AxxxLW1 = 1, then ALW1 = 1.
	AILW2	Analog Inputs Low Warning, Level 2. If any AxxxLW2 = 1, then ALW2 = 1.
	AILAL	Analog Inputs Low Alarm Limit. If any AxxxLAL = 1, then ALAL = 1.
	*	
	AIHW1	Analog Inputs High Warning, Level 1. If any AxxxHW1 = 1, then AHW1 = 1.
	AIHW2	Analog Inputs High Warning, Level 2. If any AxxxHW2 = 1, then AHW2 = 1.
	AIHAL	Analog Inputs High Alarm Limit. If any AxxxHAL = 1, then AHAL = 1.
	*	
51–82	AIxxxLW1	Analog inputs 301–608 Warnings / Alarms (where xxx = 301–608) Low Warning, Level 1
	AIxxxLW2	Low Warning, Level 2
	AIxxxLAL	Low Alarm Limit
	*	
	AIxxxHW1	High Warning, Level 1
	AIxxxHW2	High Warning, Level 2
	AIxxxHAL	High Alarm Limit
	*	
83	Not used	
	Not used	
	Not used	
	Not used	
	Not used	
	Not used	
	Not used	
	Not used	
84	IN101E	
	IN102E	
	*	
	*	
	*	
	*	
	*	
	*	
85	IN301E	
	IN302E	
	IN303E	
	IN304E	
	IN305E	
	IN306E	

Table D.2 Device Word Bit Definitions (Sheet 12 of 12)

Row	Bit	Definition
	IN307E	
	IN308E	
86	IN401E	
	IN402E	
	IN403E	
	IN404E	
	IN405E	
	IN406E	
	IN407E	
	IN408E	
87	IN501E	
	IN502E	
	IN503E	
	IN504E	
	IN505E	
	IN506E	
	IN507E	
	IN508E	
88	IN601E	
	IN602E	
	IN603E	
	IN604E	
	IN605E	
	IN606E	
	IN607E	
	IN608E	

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Glossary

ASCII Abbreviation for American Standard Code for Information Interchange. Defines a standard way to communicate text characters between two electronic devices. The SEL-2410 I/O Processor uses ASCII text characters to communicate using the I/O processor 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-2410 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.

Breaker Auxiliary Contact A spare electrical contact associated with a circuit breaker that opens or closes to indicate the breaker position. A form-a breaker auxiliary contact (ANSI Standard Device Number 52A) closes when the breaker is closed, opens when the breaker is open. A form-b breaker auxiliary contact (ANSI Standard Device Number 52B) opens when the breaker is closed and closes when the breaker is open.

Checksum A numeric identifier of the firmware in the relay. Calculated by the result of a mathematic 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 I/O processor Random Access Memory (RAM) where the I/O processor stores mission critical data.

CRC-16 Abbreviation for Cyclical Redundancy Check-16. A mathematical algorithm applied to a block of digital information to produce a unique, identifying number. Used to ensure that the information was received without data corruption.

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-2410 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.

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

Fail-Safe Refers to an output contact that is energized during normal I/O processor operation and de-energized when I/O processor power is removed or if the I/O processor fails.

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 I/O processor firmware identification string. Lists the I/O processor model, firmware version and date code, and other information that uniquely identifies the firmware installed in a particular I/O processor.

Firmware The nonvolatile program stored in the I/O processor that defines I/O processor operation.

Flash A type of nonvolatile I/O processor memory used for storing large blocks of nonvolatile data, such as load profile records.

Device Word The collection of I/O processor element and logic results. Each element or result is represented by a unique identifier, known as an Device Word bit.

Device Word Bit A single I/O processor element or logic result that the relay updates once each processing interval. An 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 relay tripping, event triggering, and output contacts, as well as other functions.

LCD Abbreviation for Liquid Crystal Display. Used as the I/O processor front-panel alphanumeric display.

LED Abbreviation for Light-Emitting Diode. Used as indicator lamps on the I/O processor front panel.

NEMA Abbreviation for National Electrical Manufacturers Association.

Nominal Frequency Normal electrical system frequency, usually 50 or 60 Hz.

Nonfail-Safe Refers to an output contact that is not energized during normal I/O processor operation. When referred to a trip or stop output contact, the protected motor remains in operation unprotected when relay power is removed or if the I/O processor fails.

Nonvolatile Memory I/O processor memory that is able to correctly maintain data it is storing even when the I/O processor 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 I/O processor stores intermediate calculation results, Device Word bits, and other data that are updated every processing interval.

Remote Bit An Device Word bit for which state is controlled by serial port commands, including the **CONTROL** command, binary Fast Operate command, or Modbus® command.

ROM Abbreviation for Read-Only Memory. Nonvolatile memory where the I/O processor 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-2410 is equipped with self-tests that validate the I/O processor power supply, microprocessor, memory, and other critical systems.

SELOGIC Control Equation An I/O processor setting that allows you to control an I/O processor function (such as an output contact) by using a logical combination of I/O processor element outputs and fixed logic outputs. Logical AND, OR, INVERT, rising edge [/], and falling edge [\] operators, plus a single level of parentheses are available to use in each control equation setting.

Sequential Events Recorder An I/O processor 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 an I/O processor operation.

SER Abbreviation for Sequential Events Recorder or the I/O processor serial port command to request a report of the latest 512 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.

Transducer Device that converts the input to the device to an analog output quantity of either current (±1, 2.5, 5, 10 and 20 mA, or 4–20 ma), or voltage (±1, 2.5, 5, or 10 V).

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

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Index

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

SEL-2410 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 with lowercase letters.

ASCII Commands

Serial Port Command	Minimum Access Level	Command Description	Page Number
2AC	1	Go to Access Level 2.	*Page 4.11*
ACC	0	Go to Access Level 1.	*Page 4.11*
BNA	0	Display ASCII names of all the Device Word bits returned in the Fast Meter Data Block.	*Page 4.13*
CAL	2	Go to Access Level C.	*Page 4.13*
CAS	0	Return the Compressed ASCII configuration message.	*Page 4.13*
CON *n*	2	Set, clear, or pulse an internal remote bit (*n* is the remote bit number from 1–32).	*Page 4.14*
CST	1	Display compressed status report.	*Page 4.14*
DAT	1	View the date.	*Page 4.15*
DAT *dd/mm/yyyy*	1	Enter date in DMY format if DATE_F setting is DMY.	*Page 4.15*
DAT *mm/dd/yyyy*	1	Enter date in MDY format if DATE_F setting is MDY.	*Page 4.15*
DAT *yyyy/mm/dd*	1	Enter date in YMD format if DATE_F setting is YMD.	*Page 4.15*
DNA	0	Display ASCII names of Device Word bits reported in Fast Meter.	*Page 4.15*
FIL DIR	1	Return a list of files.	*Page 4.15*
FIL READ *filename*	1	Transfer settings file *filename* from the relay to the PC.	*Page 4.15*
FIL SHOW *filename*	1	Filename 1 displays contents of the file *filename*.	*Page 4.15*
FIL WRITE *filename*	2	Transfer settings file *filename* from the PC to the relay.	*Page 4.15*
ID	0	Relay identification code.	*Page 4.16*
IRIG	1	Force synchronization of internal control clock to IRIG-B time-code input.	*Page 4.16*
L_D	2	Load new firmware.	*Page 4.17*
MET	1	Display instantaneous metering data.	*Page 4.17*
PAS	2	Show existing Access Level 1 and Level 2 passwords.	*Page 4.17*
PAS 1 *xxxxxxxxxxxx*	2	Change Access Level 1 password to *xxxxxxxxxxxx*.	*Page 4.17*
PAS 2 *xxxxxxxxxxxx*	2	Change Access Level 2 password to *xxxxxxxxxxxx*.	*Page 4.17*
QUI	0	Go to Access Level 0.	*Page 4.19*

Serial Port Command	Minimum Access Level	Command Description	Page Number
SER	1	Display all Sequential Events Recorder (SER) data.	Page 4.19
SER *date1*	1	Display all SER records made on *date1*.	Page 4.19
SER *date1 date2*	1	Display all SER records made from dates *d2* to *d1*, inclusive, starting with *d2*.	Page 4.19
SER *row1*	1	Display the *n* most recent SER records starting with record *n*.	Page 4.19
SER *row1 row2*	1	Display SER records *n2* to *n1*, starting with *n2*.	Page 4.19
SER C or R	1	Clear/Reset SER data.	Page 4.19
SER D	1	List elements that are currently unchattered.	Page 4.19
SET	2	Enter/change relay settings.	Page 4.20
SET F	2	Enter/change front-panel settings.	Page 4.20
SET G	2	Enter/change global settings.	Page 4.20
SET L	2	Enter/change SELOGIC variable and timer settings.	Page 4.20
SET P *n*	2	Enter/change serial Port *n* settings (*n* = 3, or F; if not specified, the default is the active port).	Page 4.20
SET R	2	Enter/change report (event and SER) settings.	Page 4.20
SET *s*	2	For all **SET** commands, jump ahead to a specific setting by entering the setting name, e.g., **AI301TYP**.	Page 4.20
SET …TERSE	2	For all **SET** commands, **TERSE** disables the automatic **SHO** command after settings entry.	Page 4.20
SHO	1	Show group settings.	Page 4.21
SHO F	1	Show front-panel settings.	Page 4.21
SHO G	1	Show global settings.	Page 4.21
SHO L	1	Show general logic settings.	Page 4.21
SHO P *n*	1	Show serial port settings, where *n* specifies the port (3, 4, or F); *n* defaults to the active port if not listed.	Page 4.21
SHO R	1	Show report (event and SER) settings.	Page 4.21
SNS	0	Display SER settings in Compressed ASCII format.	Page 4.21
STA	1	Display relay self-test status.	Page 4.22
STA R or C	2	Clear self-test status and restart relay.	Page 4.22
STA S	1	Display SELOGIC usage status report.	Page 4.22
TAR	1	Display Device Word Row 0 (front-panel target LEDs).	Page 4.23
TAR *n k*	1	Display Device Word Row *n* (*n* = 0 to 65). Repeat *k* times (1–32767).	Page 4.23
TAR *name k*	1	Display Device Word Row containing Device Word *name*. Repeat *k* times.	Page 4.23
TAR R	1	Reset front-panel trip/target LEDs.	Page 4.23
TIM	1	View time.	Page 4.24
TIM *hh:mm:ss*	1	Set time by entering **TIM** followed by hours, minutes, and seconds, as shown (24-hour clock).	Page 4.24

Key Stroke Commands

Key Stroke	Description	SET Command Key Stroke	Description
<Ctrl+Q>	Sends **XON** command to restart communications port output previously halted by XOFF.	**<Enter>**	Retains setting and moves on to next setting.
<Ctrl+S>	Sends **XOFF** command to pause communications port output.	**^ <Enter>**	Returns to previous setting.
<Ctrl+X>	Sends **CANCEL** command to abort current command and return to current access level prompt.	**< <Enter>**	Returns to previous setting section.
		> <Enter>	Skips to next setting section.
		END <Enter>	Exits setting editing session, then prompts user to save settings.
		<Ctrl+X>	Aborts setting editing session without saving changes.

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SEL-2410 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 with lowercase letters.

ASCII Commands

Serial Port Command	Minimum Access Level	Command Description	Page Number
2AC	1	Go to Access Level 2.	*Page 4.11*
ACC	0	Go to Access Level 1.	*Page 4.11*
BNA	0	Display ASCII names of all the Device Word bits returned in the Fast Meter Data Block.	*Page 4.13*
CAL	2	Go to Access Level C.	*Page 4.13*
CAS	0	Return the Compressed ASCII configuration message.	*Page 4.13*
CON *n*	2	Set, clear, or pulse an internal remote bit (*n* is the remote bit number from 1–32).	*Page 4.14*
CST	1	Display compressed status report.	*Page 4.14*
DAT	1	View the date.	*Page 4.15*
DAT *dd/mm/yyyy*	1	Enter date in DMY format if DATE_F setting is DMY.	*Page 4.15*
DAT *mm/dd/yyyy*	1	Enter date in MDY format if DATE_F setting is MDY.	*Page 4.15*
DAT *yyyy/mm/dd*	1	Enter date in YMD format if DATE_F setting is YMD.	*Page 4.15*
DNA	0	Display ASCII names of Device Word bits reported in Fast Meter.	*Page 4.15*
FIL DIR	1	Return a list of files.	*Page 4.15*
FIL READ *filename*	1	Transfer settings file *filename* from the relay to the PC.	*Page 4.15*
FIL SHOW *filename*	1	Filename 1 displays contents of the file *filename*.	*Page 4.15*
FIL WRITE *filename*	2	Transfer settings file *filename* from the PC to the relay.	*Page 4.15*
ID	0	Relay identification code.	*Page 4.16*
IRIG	1	Force synchronization of internal control clock to IRIG-B time-code input.	*Page 4.16*
L_D	2	Load new firmware.	*Page 4.17*
MET	1	Display instantaneous metering data.	*Page 4.17*
PAS	2	Show existing Access Level 1 and Level 2 passwords.	*Page 4.17*
PAS 1 *xxxxxxxxxxxx*	2	Change Access Level 1 password to *xxxxxxxxxxxx*.	*Page 4.17*
PAS 2 *xxxxxxxxxxxx*	2	Change Access Level 2 password to *xxxxxxxxxxxx*.	*Page 4.17*
QUI	0	Go to Access Level 0.	*Page 4.19*

Serial Port Command	Minimum Access Level	Command Description	Page Number
SER	1	Display all Sequential Events Recorder (SER) data.	Page 4.19
SER *date1*	1	Display all SER records made on *date1*.	Page 4.19
SER *date1 date2*	1	Display all SER records made from dates *d2* to *d1*, inclusive, starting with *d2*.	Page 4.19
SER *row1*	1	Display the *n* most recent SER records starting with record *n*.	Page 4.19
SER *row1 row2*	1	Display SER records *n2* to *n1*, starting with *n2*.	Page 4.19
SER C or R	1	Clear/Reset SER data.	Page 4.19
SER D	1	List elements that are currently unchattered.	Page 4.19
SET	2	Enter/change relay settings.	Page 4.20
SET F	2	Enter/change front-panel settings.	Page 4.20
SET G	2	Enter/change global settings.	Page 4.20
SET L	2	Enter/change SELOGIC variable and timer settings.	Page 4.20
SET P *n*	2	Enter/change serial Port *n* settings (*n* = 3, or F; if not specified, the default is the active port).	Page 4.20
SET R	2	Enter/change report (event and SER) settings.	Page 4.20
SET *s*	2	For all **SET** commands, jump ahead to a specific setting by entering the setting name, e.g., **AI301TYP**.	Page 4.20
SET …TERSE	2	For all **SET** commands, **TERSE** disables the automatic **SHO** command after settings entry.	Page 4.20
SHO	1	Show group settings.	Page 4.21
SHO F	1	Show front-panel settings.	Page 4.21
SHO G	1	Show global settings.	Page 4.21
SHO L	1	Show general logic settings.	Page 4.21
SHO P *n*	1	Show serial port settings, where *n* specifies the port (3, 4, or F); *n* defaults to the active port if not listed.	Page 4.21
SHO R	1	Show report (event and SER) settings.	Page 4.21
SNS	0	Display SER settings in Compressed ASCII format.	Page 4.21
STA	1	Display relay self-test status.	Page 4.22
STA R or C	2	Clear self-test status and restart relay.	Page 4.22
STA S	1	Display SELOGIC usage status report.	Page 4.22
TAR	1	Display Device Word Row 0 (front-panel target LEDs).	Page 4.23
TAR *n k*	1	Display Device Word Row *n* (*n* = 0 to 65). Repeat *k* times (1–32767).	Page 4.23
TAR *name k*	1	Display Device Word Row containing Device Word *name*. Repeat *k* times.	Page 4.23
TAR R	1	Reset front-panel trip/target LEDs.	Page 4.23
TIM	1	View time.	Page 4.24
TIM *hh:mm:ss*	1	Set time by entering **TIM** followed by hours, minutes, and seconds, as shown (24-hour clock).	Page 4.24

Key Stroke Commands

Key Stroke	Description	SET Command Key Stroke	Description
<Ctrl+Q>	Sends **XON** command to restart communications port output previously halted by XOFF.	**<Enter>**	Retains setting and moves on to next setting.
<Ctrl+S>	Sends **XOFF** command to pause communications port output.	**^ <Enter>**	Returns to previous setting.
<Ctrl+X>	Sends **CANCEL** command to abort current command and return to current access level prompt.	**< <Enter>**	Returns to previous setting section.
		> <Enter>	Skips to next setting section.
		END <Enter>	Exits setting editing session, then prompts user to save settings.
		<Ctrl+X>	Aborts setting editing session without saving changes.

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