SEL-2411P

Pump Automation Controller

Instruction Manual

20241120

SCHWEITZER ENGINEERING LABORATORIES

Part Number: PM2411P-01

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Preface

Safety Information

⚠CAUTION
To ensure proper safety and operation, the equipment ratings, installation instructions, and operating instructions must be checked before commissioning or maintenance of the equipment. The integrity of any protective conductor connection must be checked before carrying out any other actions. It is the responsibility of the user to ensure that the equipment is installed, operated, and used for its intended function in the manner specified in this manual. If misused, any safety protection provided by the equipment may be impaired.

Dangers, Warnings, and Cautions

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

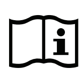
⚠DANGER
Indicates an imminently hazardous situation that, if not avoided, **will** result in death or serious injury.

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

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

Safety Symbols

The following symbols are often marked on SEL products.

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

Safety Marks

The following statements apply to this device.

General Safety Marks

⚠CAUTION There is danger of explosion if the battery is incorrectly replaced. Replace only with Rayovac no. BR2335 or equivalent recommended by manufacturer. See Owner's Manual for safety instructions. The battery used in this device may present a fire or chemical burn hazard if mistreated. Do not recharge, disassemble, heat above 100°C, or incinerate. Dispose of used batteries according to the manufacturer's instructions. Keep battery out of reach of children. For use in Pollution Degree 2 environment.	⚠ATTENTION Une pile remplacée incorrectement pose des risques d'explosion. Remplacez seulement avec un Rayovac no BR2335 ou un produit équivalent recommandé par le fabricant. Voir le guide d'utilisateur pour les instructions de sécurité. La pile utilisée dans cet appareil peut présenter un risque d'incendie ou de brûlure chimique si vous en faites mauvais usage. Ne pas recharger, démonter, chauffer à plus de 100°C ou incinérer. Éliminez les vieilles piles suivant les instructions du fabricant. Gardez la pile hors de la portée des enfants. Pour l'utilisation dans un environnement de Degré de Pollution 2.
Ambient air temperature shall not exceed 40°C (104°F).	La température de l'air ambiant ne doit pas dépasser 40°C (104°F).
Terminal Ratings Wire Material Copper Tightening Torque Mounting Screw: 1.4–1.7 Nm (12–15 in-lb) Terminal Block: 0.9–1.4 Nm (8–12 in-lb) Compression Plug: 0.5–1.0 Nm (4.4–8.8 in-lb) Compression Plug Mounting Screw: 0.18–0.25 Nm (1.6–2.2 in-lb) Serial Ports: 0.6–0.8 Nm (5.0–7.0 in-lb)	Spécifications des bornes Type de filage Cuivre Couple de serrage Vis de montage : 1,4 à 1,7 Nm Bloc de terminaison : 0,9 à 1,4 Nm Bouchon de compression : 0,5 à 1,0 Nm Vis de montage de bouchon de compression : 0,18 à 0,25 Nm Ports Série : 0,6–0,8 Nm (5,0–7,0 livres-pouce)

Hazardous Locations Safety Marks

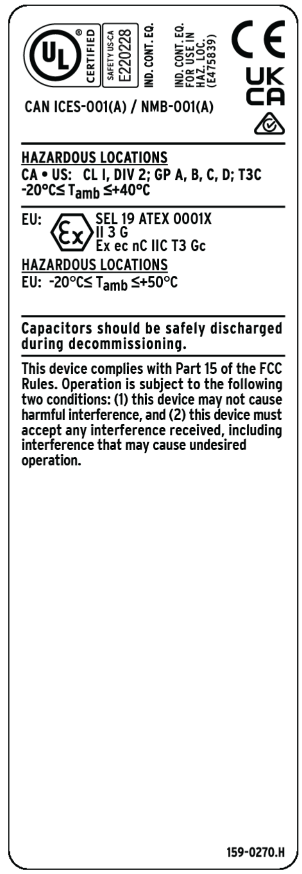
⚠WARNING – EXPLOSION HAZARD Open circuit before removing cover.	⚠AVERTISSEMENT – DANGER D'EXPLOSION Ouvrir le circuit avant de déposer le couvercle.
⚠WARNING – EXPLOSION HAZARD Substitution of components may impair suitability for Class I, Division 2.	⚠AVERTISSEMENT – DANGER D'EXPLOSION La substitution de composants peut détériorer la conformité à Classe I, Division 2.
CA & US Hazardous Locations Operating Temperature Range: $-20°C \leq Ta \leq +40°C$ EU Hazardous Locations Operating Temperature Range: $-20°C \leq Ta \leq +50°C$	Plage de températures de fonctionnement dans les lieux dangereux, Canada et États-Unis : $-20°C \leq Ta \leq +40°C$ Plage de températures de fonctionnement dans les lieux dangereux, Union européenne : $-20°C \leq Ta \leq +50°C$

Hazardous Locations Approval

The SEL-2411P is UL Listed for hazardous locations to U.S. and Canadian standards. In North America, the device is approved for Class I, Division 2, Groups A, B, C, and D, and temperature class T3C in a maximum surrounding air temperature of 40°C. The SEL-2411P shall be installed in an indoor or outdoor (extended) locked enclosure that provides a degree of protection to personnel against access to hazardous parts. In either environment, the device shall be protected from direct sunlight, precipitation, and full wind pressure.

To comply with the requirements of the European ATEX Directive (2014/34/EU), the SEL-2411P shall be installed in an enclosure that provides a minimum ingress protection of IP54 in accordance with IEC 60079-0. The enclosure shall be limited to a surrounding air temperature range of –20°C ≤ Ta ≤ +50°C.

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



Product Compliance Label for Hazardous Locations Approval

Other Safety Marks (Sheet 1 of 2)

⚠DANGER Contact with instrument terminals can cause electrical shock that can result in injury or death.	⚠DANGER Tout contact avec les bornes de l'appareil peut causer un choc électrique pouvant entraîner des blessures ou la mort.
⚠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.
⚠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.

Other Safety Marks (Sheet 2 of 2)

⚠WARNING This device is shipped with default passwords. Default passwords should be changed to private passwords at installation. Failure to change each default password to a private password may allow unauthorized access. SEL shall not be responsible for any damage resulting from unauthorized access.	⚠AVERTISSEMENT Cet appareil est expédié avec des mots de passe par défaut. A l'installation, les mots de passe par défaut devront être changés pour des mots de passe confidentiels. Dans le cas contraire, un accès non-autorisé á l'équipement peut être possible. SEL décline toute responsabilité pour tout dommage résultant de cet accès non-autorisé.
⚠WARNING 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.
⚠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 services.	⚠ATTENTION Les composants de cet équipement sont sensibles aux décharges électrostatiques (DES). Des dommages permanents non-décelables peuvent résulter de l'absence de précautions contre les DES. Raccordez-vous correctement à la terre, ainsi que la surface de travail et l'appareil avant d'en retirer un panneau. Si vous n'êtes pas équipés pour travailler avec ce type de composants, contacter SEL afin de retourner l'appareil pour un service en usine.
⚠CAUTION The device contains devices sensitive to Electrostatic Discharge (ESD). When working on the device with the front panel removed, work surfaces and personnel must be properly grounded or equipment damage may result.	⚠ATTENTION L'appareil contient des pièces sensibles aux décharges électrostatiques (DES). Quand on travaille sur l'appareil avec le panneau avant enlevé, les surfaces de travail et le personnel doivent être mis à la terre convenablement pour éviter les dommages à l'équipement.
⚠CAUTION Use of controls or adjustments, or performance of procedures other than those specified herein, may result in hazardous radiation exposure.	⚠ATTENTION L'utilisation de commandes ou de réglages, ou l'application de tests de fonctionnement différents de ceux décrits ci-après peuvent entraîner l'exposition à des radiations dangereuses.

General Information

Typographic Conventions

There are two ways to communicate with the SEL-2411P:

- 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:

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}	Device front-panel pushbuttons.

Example	Description
ENABLE	Device front- or rear-panel labels.
MAIN > METER	Device front-panel LCD menus and device responses visible on the PC screen. The > character indicates submenus.

Environmental Conditions and Voltage Information

The following table lists important environmental and voltage information.

Condition	Range/Description
Indoor/outdoor use	Indoor
Altitude	Up to 2000 m
Temperature	
IEC Performance Rating (per IEC/EN 60068-Z-1 and 60068-Z-2)	–40 to +85°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

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	Insulation Voltage
Grounding (Earthing) Connection	14 AWG (2.5 mm^2)	14 AWG (2.5 mm^2)	300 V min
Current Connection	16 AWG (1.5 mm^2)	12 AWG (4 mm^2)	300 V min
Potential (Voltage) Connection	18 AWG (0.8 mm^2)	14 AWG (2.5 mm^2)	300 V min
Contact I/O	18 AWG (0.8 mm^2)	14 AWG (2.5 mm^2)	300 V min
Other Connection	18 AWG (0.8 mm^2)	14 AWG (2.5 mm^2)	300 V min

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. Recommended strip length for the wires is 8 mm (0.31 inches). The use of a 8 mm wire ferrule is also recommended.

Instructions for Cleaning and Decontamination

Use care when cleaning the SEL-2411P. 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.

Trademarks

Trademarks appearing in this manual are shown in the following table.

SEL Trademarks	
ACSELERATOR Analytic Assistant®	Compass®
ACSELERATOR Architect®	MIRRORED BITS®
ACSELERATOR QuickSet®	SEL-2407®
ACSELERATOR Report Server®	SELOGIC®

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Technical Assistance

We appreciate your interest in SEL products and services. If you have questions or comments, please contact us at:

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Fax: +1.509.332.7990
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Email: info@selinc.com

Section 1
Introduction and Specifications

Overview

The SEL-2411P Pump Automation Controller provides inputs, logic, outputs, and communications as shown in *Figure 1.1* for many diverse applications. For smaller applications, select the base unit without additional input/output cards (two digital inputs and three contact outputs), or add up to four additional input/output cards to tailor the SEL-2411P to specific applications.

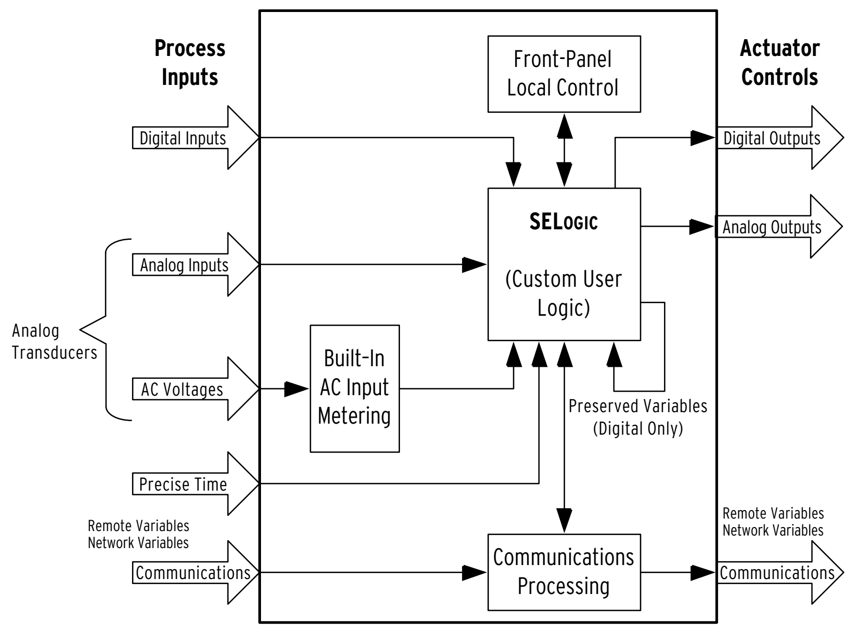


Figure 1.1 Block Diagram

This manual contains information necessary to install, test, operate, and maintain any SEL-2411P. It is not necessary to review the entire manual to perform specific tasks.

Features

Physical

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

Standard
Two isolated dry inputs and three outputs (two Form A and one Form C)
Human-machine-interface (HMI)
One front serial port
One rear serial port (compatible with SEL-2810, SEL-2814, SEL-3010, …)
IRIG-B input
Optional
Analog inputs and outputs
Digital inputs and outputs
Voltages (wye or open-delta)
Currents
EIA-232 or EIA-485 card
One or two (failover) Ethernet ports
Fiber-optic port (compatible with SEL-2600A, SEL-2600D, SEL-2812)

Monitoring

Standard
Record trend data using the Analog Signal Profile feature
Record state changes using the Sequential Event Report (SER) feature:
➤ Trigger on as many as 96 change-of-state conditions
➤ Store as many as 512 nonvolatile change-of-state records
➤ Time-stamp resolution ±1 ms
➤ Change-of-state (time of initial state change, not time of state change after debounce)
Record event data using the Event Report feature
Compatible with SEL-3010 Event Messenger

Automation and Control

Standard
Programmable Boolean operators (such as AND, OR, and NOT)
Programmable math operators (add, subtract, multiply, and divide)
Programmable logic functions (timers, counters, and latches)
Programmable analog comparisons
Programmable rising and falling-edge trigger
Digital output logic to assign logic outputs to digital outputs
Remote control to close digital outputs and reset latched indicators from remote locations

Metering

Standard
Metering
➤ Pump Operation Status
➤ Fundamental
➤ Energy
➤ Maximum and Minimum
➤ Demand
➤ Analog Input
➤ Math Variable
➤ Remote Analog
Analog Signal Profiling

Communications Protocols

Standard	Serial	Ethernet[a]
Modbus	Yes	Yes
Ethernet FTP and Telnet	Yes	Yes
SEL MIRRORED BITS	Yes	
SEL ASCII, Compressed ASCII, Fast Meter, Fast Operate, Fast SER, and Fast Message protocols	Yes	
Optional		
DNP3 Level 2 Outstation	Yes	Yes

[a] With optional Ethernet port.

Models, Options, and Accessories

Models

This manual does not provide complete ordering information. For complete information, see the latest SEL-2411P Model Option Table (MOT) at selinc.com, under SEL Literature, Ordering Information (Model Option Tables).

Options

The SEL-2411P contains six slots for cards. Slot **A** must be used for the power supply and Slot **B** must be used for the main board. Slot C supports the 14 DI card for float-level sensing and pump control for automatic and hand operation. Slot D supports the 4 DI/4 DO card for pump-control outputs and status inputs. Slot E supports the optional pump-voltage monitoring card (3 AVI) or generic 14 DI card. Slot Z supports the optional analog level-sensing cards (8 AI or 4 AI/ 4 AO).

Table 1.1 Slot Allocations for Different Option Cards (Sheet 1 of 2)

Slot	Description
A	Power Supply (Required in Slot **A**)
B	CPU Card plus Two (Failover) Rear Ethernet Ports (Required in Slot **B**)
C	Float-Level-Sensing Card (14 DI)
D	Pump Control and Status Card (4 DI/ 4 DO)

Table 1.1 Slot Allocations for Different Option Cards (Sheet 2 of 2)

Slot	Description
E	None Pump-Voltage-Monitoring Card (3 AVI) Digital Input Card (14 DI) 3PT/3CT Current and Voltage Card Input/Output Card (e.g., 8DI, 8DO, 4DI/4DO, 8AI, …)
Z	None Analog-Input Card (8 AI) Analog-Input/Output Card (8 AI/ 4 AO) Input/Output Card (e.g., 8DI, 8DO, 4DI/4DO,…)

Accessories

For all SEL-2411P mounting accessories, including adapter plates, visit selinc.com/products/accessories/. Contact your Technical Service Center or the SEL factory for additional details and ordering information for all other accessories.

Table 1.2 Optional Accessories

Product	Description
915900050	Vertical Rack-Mount Kit—For single unit 19” rack-mounting plate
915900051	Vertical Rack-Mount Kit—For dual unit 19” rack-mounting plate
915900052	Vertical Rack-Mount Kit—For single unit and a test switch
915900047	Wall-Mount Bracket
915900063	Hinged Wall-Mount Bracket
915900203	Vertical Surface-Mount Kit
915900066	Outdoor Enclosure + FT-1 Cutout, Vertical
915900093	Outdoor Enclosure, No FT-1 Cutout, Vertical
915900170	Dust-Protection Assembly
915900236	SEL-241X Wetting Voltage Jumper Kit, Eight 4-Prong Jumpers
915900241	Wetting Voltage Jumpers Bulk, 100 pack 4-Prong Jumpers
915900222	90 Degree Connector Kit
9260027	SEL-2411P Configurable Labels (Vertical)

Specifications

Compliance

Designed and manufactured under an ISO 9001 certified quality management system.

47 CFR 15B, Class A

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

UL Listed to U.S. and Canadian safety standards (File E220228; NWGQ2, NWGQ8)

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

UL Listed for Hazardous Locations to Canadian and U.S. Standards (File 475839; NRAG, NRAG7)

CE Mark

UKCA Mark

Hazardous Locations

UL Listed for Hazardous Locations to Canadian and U.S. standards

EU

II 3 G
Ex ec nC IIC T3 Gc

EN 60079-0:2018
EN 60079-7:2015/A1:2018
EN 60079:15:2019

Note: Where so marked, ATEX and UL Hazardous Locations Certification tests are applicable to rated supply specifications only and do not apply to the absolute operating ranges, continuous thermal, or short circuit duration specifications.

General

Operating Temperature Range

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

Operating Environment

Pollution Degree:	2
Overvoltage Category:	II
Insulation Class:	1
Relative Humidity:	5–95%, noncondensing
Maximum Altitude:	2000 m

Processing and Memory

32-bit 200 MHz Processor

32 MB DDR RAM

Battery-Backed Real-Time Clock

Dimensions

See *Figure 2.1* and *Figure 2.2*.

Weight

2.0 kg (4.4 lb)

Frequency

System Frequency:	50, 60 Hz

Inputs

AC Current Input Phase

I_{NOM}	**5 A**
Rated Range:	0.1–96.0 A (according to IEC 60255-5, 60664-1)

Note: This is a linearity specification and is not meant to imply continuous operation.

Continuous Thermal Rating:	15 A (according to IEC 60255-6, IEEE C37.90-1989)
1 Second Thermal:	500 A (according to IEC 60255-6)
Rated Frequency:	50/60 ± 5 Hz
Burden (Per Phase):	<0.050 VA
Measurement Category:	II

AC Voltage Input V_{NOM}

Rated Operating Voltage (U_e):	100–250 Vac
Rated Insulation Voltage:	300 Vac
10-Second Thermal:	600 Vac
Rated Frequency:	50/60 ±5 Hz
Burden:	<0.1 W

DC Transducer (Analog) Inputs

Input Impedance:	
Current Mode:	200 Ω
Voltage Mode:	>10 kΩ
Input Range (Maximum):	±20 mA (transducers: 4–20 mA, 0–20 mA, or 0–1 mA typical) ±10 V (transducers: 0–5 V or 0–10 V typical)
Sampling Rate:	At least 5 ms
Step Response:	1 s
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)

Optoisolated Control Inputs

When Used With DC Control Signals:

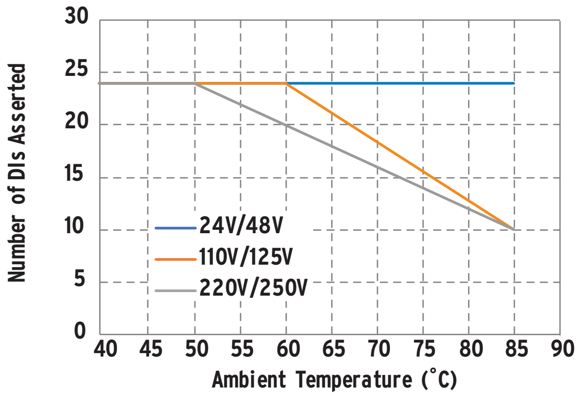
250 V	ON for 200–275 Vdc	OFF below 150 Vdc
220 V	ON for 176–242 Vdc	OFF below 132 Vdc
125 V	ON for 100–135.5 Vdc	OFF below 75 Vdc
110 V	ON for 88–121 Vdc	OFF below 66 Vdc
48 V	ON for 38.4–52.8 Vdc	OFF below 28.8 Vdc
24 V	ON for 15–30 Vdc	OFF for < 5 Vdc

When Used With AC Control Signals:

250 V	ON for 170.6–275 Vac	OFF below 106 Vac
220 V	ON for 150.3–264 Vac	OFF below 93.2 Vac
125 V	ON for 85–150 Vac	OFF below 53 Vac
110 V	ON for 75.1–132 Vac	OFF below 46.6 Vac
48 V	ON for 32.8–60 Vac	OFF below 20.3 Vac
24 V	ON for 14–27 Vac	OFF below 5 Vac

Current Draw at Nominal DC Voltage:	2–4 mA (Except for 240 V, 8 mA)
Rated Insulation Voltage:	300 Vac

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



Time-Code Input (SNTP)

High-Priority Server Accuracy: ±5 ms

Accuracy: ±25 ms

Outputs

General

OUT103 is Form C Trip Output, all other outputs are Form A.

Dielectric Test Voltage: 2000 Vac

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

Mechanical Durability: 10M no load operations

DC Output Ratings

Electromechanical

Rated Operational Voltage: 250 Vdc

Rated Voltage Range: 19.2–275 Vdc

Rated Insulation Voltage: 300 Vdc

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

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

Continuous Carry (UL/CSA Derating with All Outputs Asserted): 5 A @ <60°C; 2.5 A 60 to 70°C

Thermal: 50 A for 1 s

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

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

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

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

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

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

Fast Hybrid (High-Speed High-Current Interrupting)

Make: 30 A

Carry: 6 A continuous carry at 70°C
4 A continuous carry at 85°C

1 s Rating: 50 A

MOV Protection (Maximum Voltage): 250 Vac/330 Vdc

Pickup Time: <50 µs, resistive load

Dropout Time: 8 ms, resistive load

Update Rate: 1/8 cycle

Breaking Capacity (10,000 Operations):

48 Vdc	10.0 A	L/R = 40 ms
125 Vdc	10.0 A	L/R = 40 ms
250 Vdc	10.0 A	L/R = 20 ms

Cyclic Capacity (4 Cycles in 1 Second, Followed by 2 Minutes Idle for Thermal Dissipation):

48 Vdc	10.0 A	L/R = 40 ms
125 Vdc	10.0 A	L/R = 40 ms
250 Vdc	10.0 A	L/R = 20 ms

Note: Per IEC 60255-23:1994, using the simplified method of assessment.
Note: Make rating per IEEE C37.90-1989.

AC Output Ratings

Electromechanical

Maximum Operational Voltage (U_e) Rating: 240 Vac

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

Utilization Category: AC-15 (control of electromagnetic loads >72 VA)

Contact Rating Designation: B300 (B = 5 A, 300 = rated insulation voltage)

Voltage Protection Across Open Contacts: 270 Vac, 40 J

Rated Operational Current (I_e): 3 A @ 120 Vac
1.5 A @ 240 Vac

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

Rated Frequency: 50/60 ±5 Hz

Pickup/Dropout Time: ≤8 ms (coil energization to contact closure)

Electrical Durability Make VA Rating: 3600 VA, cosϕ = 0.3

Electrical Durability Break VA Rating: 360 VA, cosϕ = 0.3

Fast Hybrid (High-Speed High-Current Interrupting)

Make: 30 A

Carry: 6 A continuous carry at 70°C
4 A continuous carry at 85°C

1 s Rating: 50 A

MOV Protection (Maximum Voltage): 250 Vac/330 Vdc

Pickup Time: <50 µs, resistive load

Dropout Time: 8 ms, resistive load

Update Rate: 1/8 cycle

Breaking Capacity (10,000 Operations):

48 Vac	10.0 A	L/R = 40 ms
125 Vac	10.0 A	L/R = 40 ms
250 Vac	10.0 A	L/R = 20 ms

Cyclic Capacity (4 Cycles in 1 Second, Followed by 2 Minutes Idle for Thermal Dissipation):

48 Vac	10.0 A	L/R = 40 ms
125 Vac	10.0 A	L/R = 40 ms
250 Vac	10.0 A	L/R = 20 ms

Note: Per IEC 60255-23:1994, using the simplified method of assessment.
Note: Make rating per IEEE C37.90-1989.

Analog Outputs

Current Ranges (Max):	±20 mA
Voltage Ranges (Max):	±10 V
Output Impedance For Current Outputs:	≥100 kΩ
Output Impedance For Voltage Outputs:	≤20 Ω
Maximum Load:	0–750 Ω current mode >2 kΩ voltage mode
Accuracy:	±0.55% of full-scale at 25°C
Step Response:	100 ms

Communications

Communications Ports

Standard EIA-232 (2 Ports)

Location (fixed):	Front Panel Rear Panel
Data Speed:	300–38400 bps

Ethernet Port

Dual 10/100BASE-T copper (RJ45 connector)

Communications Protocols

Modbus RTU slave or Modbus TCP
DNP3 Level 2 Outstation (LAN/WAN and Serial)
Ethernet FTP
Telnet
SEL MIRRORED BITS (MBA, MBB, MB8A, MB8B, MBTB)
Ymodem file transfer on the front and rear port
Xmodem file transfer on the front port
SEL ASCII and Compressed ASCII
SEL Fast Meter
SEL Fast Operate
SEL Fast SER
SEL Fast Message unsolicited write
SEL Fast Message read request

Maximum Concurrent Connections

Modbus Slave:	2[a]
DNP3 Level 2 Outstation:	5[a]
Ethernet FTP:	2
Telnet:	3

[a] Maximum in any combination of serial and/or LAN/WAN links.

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

Fuse Rating

High-Voltage Model:	3.15 A, high breaking capacity, time lag T, 250 V (5x20 mm, T3.15AH 250 V)
Low-Voltage Model:	3.15 A, high breaking capacity, time lag T, 250 V (5x20 mm, T3.15AH 250 V)

AC Metering Accuracies

Current

Phase Current:	±0.5% typical, 25°C, 60 Hz, nominal current
Neutral Current:	±0.5% typical, 25°C, 60 Hz, nominal current
Negative Sequence (3I2):	±0.5% typical, 25°C, 60 Hz, nominal current (calculated)
Residual Ground Current:	±0.5% typical, 25°C, 60 Hz, nominal current (calculated)

Voltage

Line-to-Neutral Voltage:	±0.08% typical, 25°C, 60 Hz, nominal voltage
Line-to-Line Voltage:	±0.08% typical, 25°C, 60 Hz, nominal voltage
Negative Sequence (3V2):	± 0.5% typical, 25°C, 60 Hz, nominal voltage (calculated)

Frequency

±0.05 Hz (V1 > 60 V) with voltage tracking from 44.00–66.00 Hz
±0.10 Hz (I1 > 0.8 • I_{NOM}) with current tracking from 44.00–66.00 Hz

Power

Three-Phase Real Power (kW):	±1% typical, 25°C, 60 Hz, nominal voltage and current with 0.70 ≤ PF ≤ 1.00; ±5% of reading, worst case
Three-Phase Reactive Power (kVAR):	±1% typical, 25°C, 60 Hz, nominal voltage and current with 0.00 ≤ PF ≤ 0.30; ±5% of reading, worst case
Three-Phase Apparent Power (kVA):	±1% typical, 25°C, 60 Hz, nominal voltage and current; ±2% of reading, worst case

Power Factor

Three-Phase (Wye Connected):	±1% typical, 25°C, 60 Hz, nominal voltage and current for 0.97 ≤ PF ≤ 1.00; ±2% of reading, worst case

Fast Analog Alarm Pickup

Voltage:	±5% of setting ±0.5 V

Sampling and Processing Specifications

Without Voltage Card or Current Card

Analog Inputs

Sampling Rate:	Every 4 ms

Digital Inputs

Sampling Rate:	2 kHz

Contact Outputs

Refresh Rate:	2 kHz
Logic Update:	Every 4 ms

Analog Outputs

Refresh Rate:	Every 4 ms
New Value:	Every 100 ms

Timer Accuracy

± 0.5% of settings and ± 1/4 cycle

With Either Voltage Card, Current Card, or Both Voltage and Current Cards

Analog Inputs

Sampling Rate:	4 times/cycle

Digital Inputs

Sampling Rate:	32 times/cycle

Contact Outputs

Refresh Rate:	32 times/cycle
Logic Update:	4 times/cycle

Analog Outputs

Refresh Rate:	4 times/cycle
New Value:	Every 100 ms

Timer Accuracy

± 0.5% of settings and ± 1/4 cycle

Processing Specifications

AC Voltage and Current Inputs:	16 samples per power system cycle
Frequency Tracking Range:	44–66 Hz
Digital Filtering:	Cycle cosine after low-pass analog filtering. Net filtering (analog plus digital) rejects dc and all harmonics greater than the fundamental.
Control Processing:	Four times per power system cycle or 4 ms if no current or voltage card (except for math variables and analog signals used in logic, which are processed every 100 ms)

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 + A1:1993 + A2:1994 –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 + A1:1985 25–55°C, 6 cycles, 95% relative humidity
Dry Heat:	IEC 60068-2-2:1974 + A1:1993 + A2:1994 85°C, 16 hours

Dielectric Strength and Impulse Tests

Dielectric (HIPOT):	IEC 60255-5:2000 IEEE C37.90-1989 2.0 kVac on ac current and voltage inputs, analog inputs, contact I/O 2.83 kVdc on power supply and analog outputs
Impulse:	IEC 60255-5:2000 0.5 J, 4.7 kV on power supply, contact I/O, voltage and current inputs 0.5 J, 530 V on analog inputs and analog outputs

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 61000-4-4:1995 + A1:2001 4 kV @ 2.5 kHz 2 kV @ 5.0 kHz for comm. ports
Surge Immunity:	IEC 61000-4-5:2001 2 kV line-to-line 4 kV line-to-earth
Surge Withstand Capability Immunity:	IEC 60255-22-1:2005 2.5 kV common-mode 2.5 kV differential-mode 1 kV common-mode on comm. ports IEEE C37.90.1-2002 2.5 kV oscillatory, 4 kV fast transient
Conducted RF Immunity:	IEC 61000-4-6:2004, 10 Vrms
Magnetic Field Immunity:	IEC 61000-4-8:2001 1000 A/m for 3 seconds 100 A/m for 1 minute

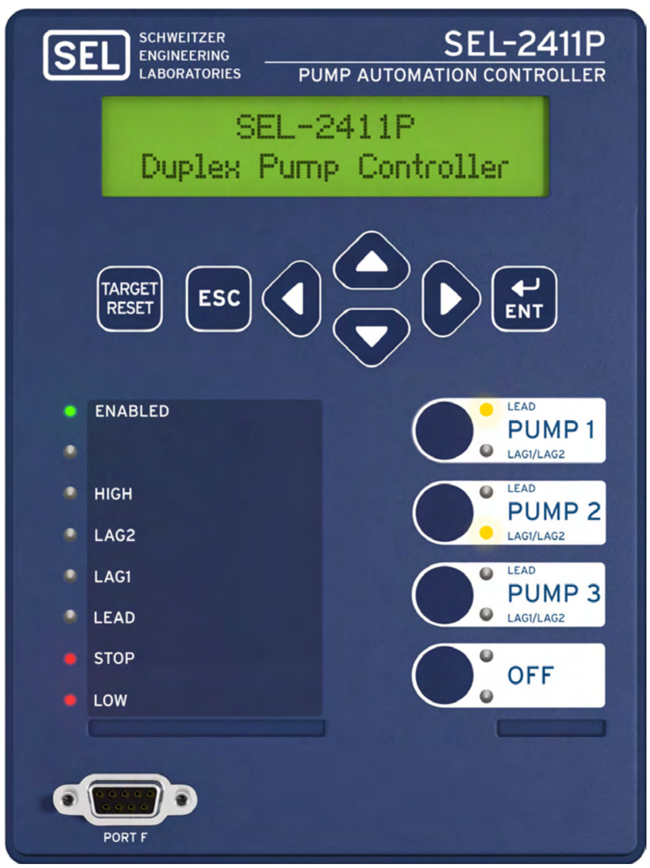
EMC Emissions

Radiated and Conducted Emissions:	EN 55011:1998 + A1:1999 + A2:2002, Class A Canada ICES-001 (A) / NMB-001 (A)

Section 2
Installation

Overview

The first steps in applying the SEL-2411P Pump Automation Controller are installing and connecting the device. This section describes common installation features and requirements and I/O options. To install and connect the device safely and effectively, you must be familiar with device configuration features and options. You should carefully plan the placement, cable connections, and communication. This section contains drawings of typical ac and dc connections to the SEL-2411P. Use these drawings as a starting point for planning your particular application.



Device Placement

Proper placement of the SEL-2411P helps make certain that you receive years of trouble-free service. Use the following guidelines for proper physical installation of the SEL-2411P.

Physical Location

You can mount the SEL-2411P in a sheltered indoor environment (a building or an enclosed cabinet) that does not exceed the temperature and humidity ratings for the device. The device is EN 61010-1 rated at Installation/Overvoltage Category II and Pollution Degree 2. This rating allows mounting of the device indoors or in an outdoor enclosure where the device is protected against exposure to direct sunlight, precipitation, and full wind pressure, but neither temperature nor humidity are controlled. You can place the device in extreme temperature and humidity locations (see *Specifications on page 1.5*). For EN 61010 certification, the SEL-2411P rating is 2000 m (6560 feet) above mean sea level.

The SEL-2411P is UL Listed for hazardous locations to U.S. and Canadian standards. In North America, the device is approved for Class I, Division 2, Groups A, B, C, and D, and temperature class T3C in a maximum surrounding air temperature of 40°C. The SEL-2411P shall be installed in an indoor or outdoor (extended) locked enclosure that provides a degree of protection to personnel against access to hazardous parts. In either environment, the device shall be protected from direct sunlight, precipitation, and full wind pressure.

To comply with the requirements of the European ATEX Directive (2014/34/EU), the SEL-2411P shall be installed in an enclosure that provides a minimum ingress protection of IP54 in accordance with IEC 60079-0. The enclosure shall be limited to a surrounding air temperature range of –20°C ≤ Ta ≤ +50°C.

Device Mounting

To flush mount the SEL-2411P in a panel, cut a rectangular hole with the dimensions shown in *Figure 2.1*.

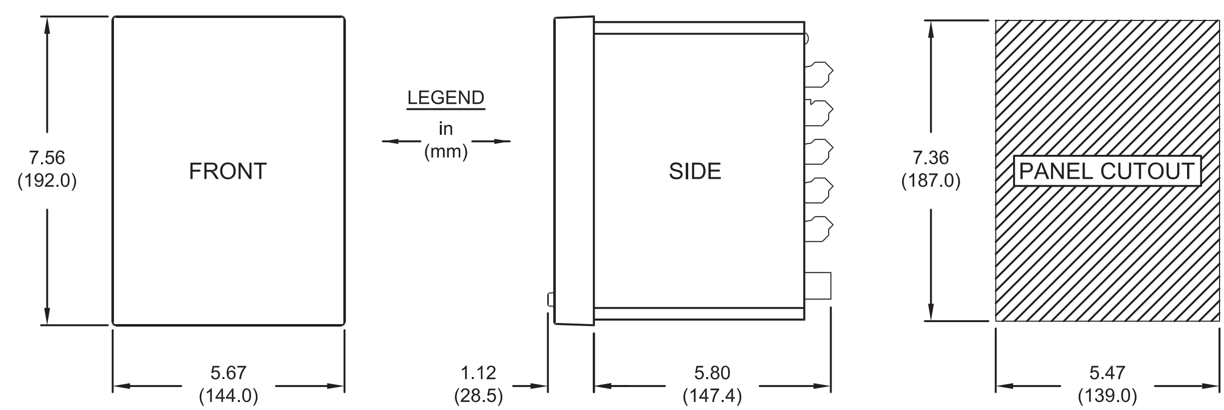


Figure 2.1 Pump Automation Controller Vertical Panel-Mount Dimensions

To surface mount the SEL-2411P, you can purchase the surface-mount bracket accessory kit (part number 915900116). The mounting dimensions for the surface mount kit are shown in *Figure 2.2*.

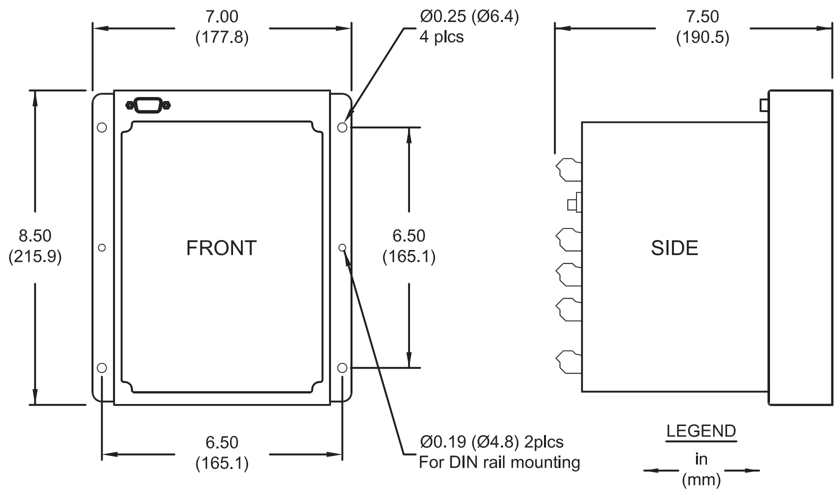


Figure 2.2 Pump Automation Controller Surface-Mount Dimensions

Card Configuration

The SEL-2411P has six rear-panel slots, labeled as Slots **A**, **B**, **C**, **D**, **E**, and **Z**. *Table 2.1* shows the slot allocations for the option cards.

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

Table 2.1 Slot Allocations for Different Option Cards

Rear-Panel Slot	Software Reference	Description
A	1 (e.g., AUX_OUT)	Power Supply (Required in Slot **A**)
B	N/A	CPU Card plus Two (Failover) Rear Ethernet Ports (Required in Slot **B**)
C	3 (e.g., LEAD_IN)	Float-Level-Sensing Card (14 DI)
D	4 (e.g., PUMP1)	Pump Control and Status Card (4 DI/ 4DO)
E	5 (e.g., VAB)	None Pump-Voltage-Monitoring Card (3 AVI) Digital Input Card (14 DI) 3PT/3CT Current and Voltage Card Input/Output Card (e.g., 8DI, 8DO, 4DI/4DO, 8AI, …)
Z	6 (e.g., AIx01)	None Analog-Input Card (8 AI) Analog-Input/Output Card (8 AI/ 4 AO) Input/Output Card (e.g., 8DI, 8DO, 4DI/4DO,…)

CPU Card Communications Ports

Required in Slot **B**, this card provides two serial ports and two Ethernet ports. *Table 7.5* shows the protocols supported by each port.

Table 2.2 Communications Ports

Port	Location	Description
1	Rear Panel	Two (Failover) Rear Ethernet Ports
3	Rear Panel	Nonisolated EIA-232 serial port

Current/Voltage Card (3 ACI/3 AVI)

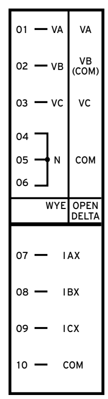
⚠CAUTION
If CT inputs are connected to external CTs, ensure that the external CTs are shorted prior to removing CT connections.

NOTE: The device tracks the frequency if 3V1 is greater than 0.75 V.

NOTE: The 8V LEA inputs can be configured to read DC analog inputs (VSCALE = CUSTOM).

Supported in Slot **E** only, order this card when you have three-phase CTs and either single or three-phase (wye or delta) PTs needed in a single slot. Secondary phase current ratings are 5 A rated. Voltage ratings on the PTs support three regular (300 Vac) inputs or three (8 Vac) low energy analog (LEA) inputs. With a current and voltage combination card installed, the SEL-2411P tracks the frequency (using positive-sequence current) and samples at 4 times a cycle—see *Sampling and Processing Specifications on page 1.7* for more information.

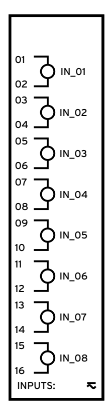
Table 2.3 Current/Voltage Card (3 ACI/3 AVI) Terminal Designation

Terminals	Label	Description
		VA, Phase A voltage input VB, Phase B voltage input VC, Phase C voltage input N, Common connection for VA, VB, VC N, Common connection for VA, VB, VC N, Common connection for VA, VB, VC IA, Phase A current input IB, Phase B current input IC, Phase C current input N, current neutral return

Digital Input Card (8 DI)

Supported in expansion slots **E** and **Z**, this card has eight digital inputs. *Table 2.4* shows the terminal allocation.

Table 2.4 Eight Digital Input Card (8 DI) Terminal Allocation

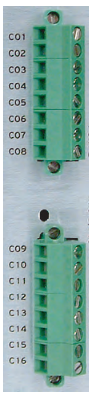
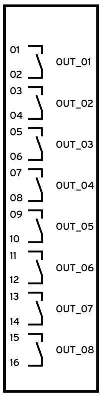
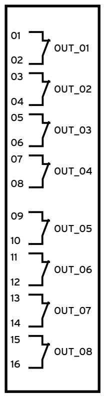
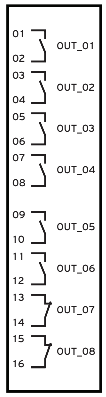
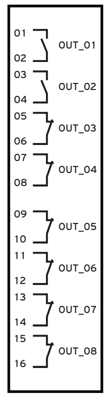
Terminals	Label	Description
		IN01, drives IN*x*01 element IN02, drives IN*x*02 element IN03, drives IN*x*03 element IN04, drives IN*x*04 element IN05, drives IN*x*05 element IN06, drives IN*x*06 element IN07, drives IN*x*07 element IN08, drives IN*x*08 element

Digital Output Card (8 DO)

NOTE: You can run three 8 DO boards at 85 V in accordance with UL 61010-1.

Supported in expansion slots **E** and **Z**, this card has eight contact outputs. *Table 2.5* shows the terminal allocation. When ordering, select eight normally open (Form A) contact outputs, eight normally closed (Form B) contact outputs, six normally open (Form A) and two normally closed (Form B) contact outputs, or six normally closed (Form B) and two normally open (Form A).

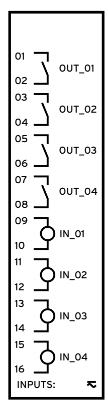
Table 2.5 Digital Output Card (8 DO) Terminal Allocation

Terminals	Form A	Form B	6 Form A/ 2 Form B	2 Form A/ 6 Form B	Description
					OUT01, driven by OUT*x*01 SELOGIC equation OUT02, driven by OUT*x*02 SELOGIC equation OUT03, driven by OUT*x*03 SELOGIC equation OUT04, driven by OUT*x*04 SELOGIC equation OUT05, driven by OUT*x*05 SELOGIC equation OUT06, driven by OUT*x*06 SELOGIC equation OUT07, driven by OUT*x*07 SELOGIC equation OUT08, driven by OUT*x*08 SELOGIC equation

Digital Input/Output Card (4 DI/3 DO)

Supported in any expansion slots **E** and **Z**, this card has four digital inputs and three outputs. The three outputs are one Form B output and two Form C outputs. *Table 2.6* shows the terminal allocation.

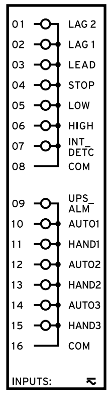
Table 2.6 Four Digital Input/Three Digital Output Card (4 DI/3 DO) Terminal Allocation

Terminals	Label	Description
		OUT01, driven by OUT*x*01 SELOGIC equation OUT02, driven by OUT*x*02 SELOGIC equation OUT03, driven by OUT*x*03 SELOGIC equation IN01, drives IN*x*01 element IN02, drives IN*x*02 element IN03, drives IN*x*03 element IN04, drives IN*x*04 element

Float-Level-Sensing Card (14 DI)

Supported in expansion Slot **C**, this card has 14 digital inputs (DI). It uses 6 inputs to provide level sensing for float switches, 1 input for detecting cabinet intrusion, and 1 input for detecting power-supply failures. It also uses 6 inputs to detect pump control for automatic or hand operation. *Table 2.7* illustrates the terminal allocation.

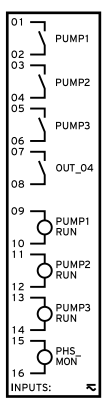
Table 2.7 Float-Level-Sensing Card With Input Expansion (14 DI) Terminal Allocation

Label	Description
	LAG2, float-switch input that drives the IN301 element and LAG2_IN
	LAG1, float-switch input that drives the IN302 element and LAG1_IN
	LEAD, float-switch input that drives the IN303 element and LEAD_IN
	STOP, float-switch input that drives the IN304 element and STOP_IN
	LOW, float-switch input that drives the IN305 element and LOW_IN
	HIGH, float-switch input that drives the IN306 element and HIGH_IN
	INT_DETC, intrusion-detection input that drives the IN307 element and INT_DETC
	UPS_ALM, power supply alarm input that drives the IN308 element and UPS_ALM
	AUTO1, drives the IN309 element and HOA1AUTO
	HAND1, drives the IN310 element and HOA1HAND
	AUTO2, drives the IN311 element and HOA2AUTO
	HAND2, drives the IN312 element and HOA2HAND
	AUTO3, drives the IN313 element and HOA3AUTO
	HAND3, drives the IN314 element and HOA3HAND
	COM

Pump Control and Status Card (4 DI/ 4 DO)

Supported in Slot D, this card with alarm outputs has four digital inputs and four fast high-current digital outputs (DO). It uses three of the digital inputs to provide pump-running status to the pump automation controller and three fast high-current outputs to start and stop pump motors. *Table 2.8* shows the terminal allocation.

Table 2.8 Pump Control and Status Card (4 DI/4 DO) Terminal Allocation

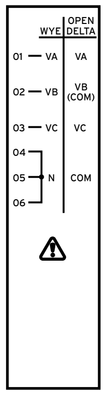
Label	Description
	PUMP1, Pump 1 control output driven by OUT401 SELOGIC control equation
	PUMP2, Pump 2 control output driven by OUT402 SELOGIC control equation
	PUMP3, Pump 3 control output driven by OUT403 SELOGIC control equation
	OUT_404, driven by OUT404 SELOGIC control equation
	PUMP1RUN, Pump 1 run status that drives the IN401 element and PUMP1RUN
	PUMP2RUN, Pump 2 run status that drives the IN402 element and PUMP2RUN
	PUMP3RUN, Pump 3 run status that drives the IN403 element and PUMP3RUN
	PHS_MON, external voltage monitor input that drives the IN404 element and PHS_MON

Pump-Voltage-Monitoring Card (3 AVI)

Supported in Slot E only, order this card when you have either four-wire wye-connected PTs or open-delta connected PTs. With this card installed, the SEL-2411P monitors pump voltage to detect voltage loss, phase reversal, and more (see *Pump Voltage Monitoring on page 5.13*). Additionally, the SEL-2411P tracks the frequency (using positive-sequence voltage) and samples at 4 times a cycle—see *Sampling and Processing Specifications on page 1.7* for more information.

NOTE: The device tracks the frequency if 3V1 is greater than 0.75 V.

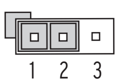
Table 2.9 Pump-Voltage-Monitoring Card (3 AVI) Terminal Allocation

Label	Description
	VA, A-phase voltage input VB, B-phase voltage input VC, C-phase voltage input N, common connection for VA, VB, VC

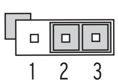
Analog-Input Card (8 AI)

NOTE: Jumper x (x = 1 through 8) determines the nature of each channel.

For current (default), install jumper on JMPX position 1-2.

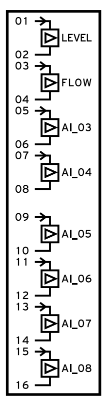


For voltage, install jumper on JMPX position 2-3.



Supported in expansion slots **E** and **Z**, this card has eight analog inputs (AI). *Table 2.10* shows the terminal allocation. Please refer to *Specifications* for the DC Analog inputs ranges.

Table 2.10 Analog-Input Card (8 AI) Terminal Allocation

Label	Description
	AIx01, fluid level transducer input that drives LEVEL_IN AIx02, flow transducer input that drives FLOW_IN AIx03, transducer input number 03 AIx04, transducer input number 04 AIx05, transducer input number 05 AIx06, transducer input number 06 AIx07, transducer input number 07 AIx08, transducer input number 08

Analog-Input/Output Card (4 AI/4 AO)

Supported in expansion Slot **E** and **Z**, this card has four analog inputs and four analog outputs (AO). *Table 2.11* shows the terminal allocation.

NOTE: Jumper x (x = 1 through 4) determines the nature of each analog output channel. Jumper x (x = 5 through 8) determines the nature of each analog input channel.

For current output (default), install jumpers between pins 1–2, 5–6, and 9–10.
For voltage output, install jumpers between pins 3–4 and 7–8.
For current input, connect the middle pin with the one labeled I.
For voltage input, connect the middle pin with the one labeled V.

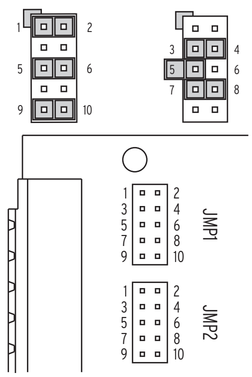
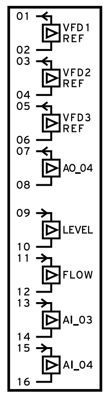


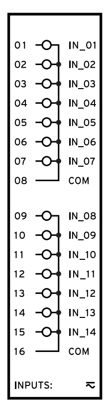
Table 2.11 Four Analog Input/Four Analog Output Card (4 AI/4 AO) Terminal Allocation

Label	Description
	VFD1 REF, Variable Frequency-Drive Output 01 (AOx01)
	VFD2 REF, Variable Frequency-Drive Output 02 (AOx02)
	VFD3 REF, Variable Frequency-Drive Output 03 (AOx03)
	AOx04, analog output number 04
	AIx01, fluid level transducer input that drives LEVEL_IN
	AIx02, flow transducer input that drives FLOW_IN
	AIx03, transducer input number 03
	AIx04, transducer input number 04

Digital Input Card (14 DI)

Supported in expansion Slot **E** only, this card has 14 digital inputs. *Table 2.12* shows the terminal allocation.

Table 2.12 Eight Digital Input Card (8 DI) Terminal Allocation

Label	Description
	IN01, drives IN501 element
	IN02, drives IN502 element
	IN03, drives IN503 element
	IN04, drives IN504 element
	IN05, drives IN505 element
	IN06, drives IN506 element
	IN07, drives IN507 element
	IN08, drives IN508 element
	IN09, drives IN509 element
	IN10, drives IN510 element
	IN11, drives IN511 element
	IN12, drives IN512 element
	IN13, drives IN513 element
	IN14, drives IN514 element

Changing Cards

Changing cards in the optional card slots (Slot **E** or Slot **Z**), requires no card programming; the device detects the new hardware and updates the software accordingly (you still have to program the I/O using the **SET** command). Fully updating the MOT requires the use of the **PART** command.

Following a change in configuration, the device is always disabled until you accept the new device configuration. You can accept the new device configuration in two ways, depending on the AUTO setting (Port settings). In the following steps, *Step 6* describes accepting the new configuration with the AUTO setting = Y, and *Step 7* and *Step 8* describe accepting the new configuration with the AUTO setting = N. To interchange cards, 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 rear panel.

Step 3. Remove the card from the device.

Step 4. Insert the new card into the slot.

Step 5. Replace the rear panel, reinstall all screws and connectors, and energize the unit.

Step 6. For an AUTO = Y (Port settings), the device displays the following:

```
=>STA <Enter>

SEL-2411P                                Date: 1/29/2002 Time: 17:18:55
DEVICE

Serial Num = 2007036022      FID = SEL-2411P-R300-V0-Z001007-D20160930
CID = 211A                   PART NUM = 241101A329X73851140

SELF TESTS (W=Warn)
  FPGA   GPSB   HMI   RAM   ROM   CR_RAM   NON_VOL  CLOCK   INTRTD   CID_FILE   +3.3V
  OK     OK     OK    OK    OK    OK       OK       OK      OK       OK         3.28

  +5.0V   +2.5V   +3.75V  -1.25V  -5.0V  BATT
  4.99    2.48    3.77    -1.27   -4.97  3.37

Option Cards
  CARD_C    CARD_D    CARD_E    CARD_Z
  OK        OK        OK        OK

Offsets
   IA      IB      IC      IN      VA      VB      VC      IAX      IBX      ICX
  OK      OK      OK      OK      OK      OK      OK      OK       OK       OK

Device Disabled
Confirm Hardware Config
Accept & Reboot (Y,N)?
```

Step 7. Type **Y <Enter>** to accept the new configuration. The device reboots (approximately five seconds) and is ready for service.

For an AUTO = N (Port settings) the device communications software returns to the Level 0 prompt. The only indication that the device is disabled is on the front panel, where the **ENABLED** LED is not illuminated and the device displays the following message on the front panel (X indicates the specific slot):

```
STATUS FAIL
Card X Failure
```

Step 8. Go to Level 1 and type **STA <Enter>**, followed by **Y <Enter>** at the prompt (see *Step 6*) to accept the new configuration. The device reboots (approximately five seconds) and is ready for service.

After reconfiguration, the device updates the part number, except for the digits shown in *Figure 2.3*. The digits indicated in *Figure 2.3* remain unchanged, i.e., these digits retain the same character as before the reconfiguration.

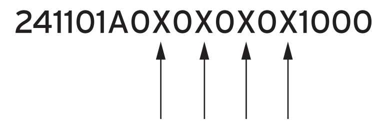


Figure 2.3 Digits That Remain Unchanged After Device Reconfiguration

Use the Level 2 **PAR <Enter>** (see *Section 7: Communications* for more information) command to update the unchanged digits of the part number.

Password and SELBOOT Jumper Selection

Figure 2.4 shows the major components of the B-slot card in the base unit. Notice the three sets of pins labeled A, B, and C. Jumper location will vary depending on your main processor board. Shown below are the two most common locations.

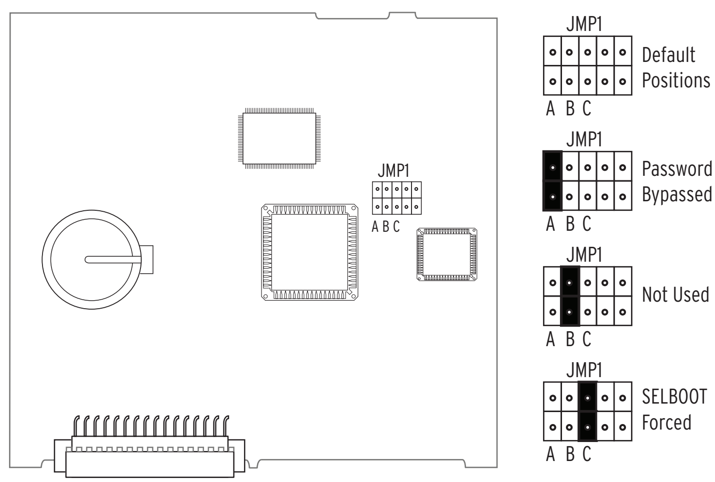


Figure 2.4 Pins for Password Jumper and SELBOOT Jumper

Pins labeled A bypass the password requirement, and pins labeled C force the device to the SEL operating system called SELBOOT (pins labeled B are not used). In the unlikely event that the SEL-2411P suffers an internal failure, communications with the device may be compromised. Forcing the device to SELBOOT provides a means of downloading new firmware. To force the device to SELBOOT, position the jumper in position C, as shown in *Figure 2.4* (SELBOOT forced). When forced to SELBOOT, you can only communicate with the device via the front-panel port.

To gain access to Level 1 and Level 2 command levels without passwords, position the jumper in position A, as shown in *Figure 2.4* (Password bypassed). Although you gain access to Level 2 without a password, the alarm contact still closes momentarily when accessing Level 2. *Table 2.13* tabulates the functions of the three sets of pins and jumper default positions.

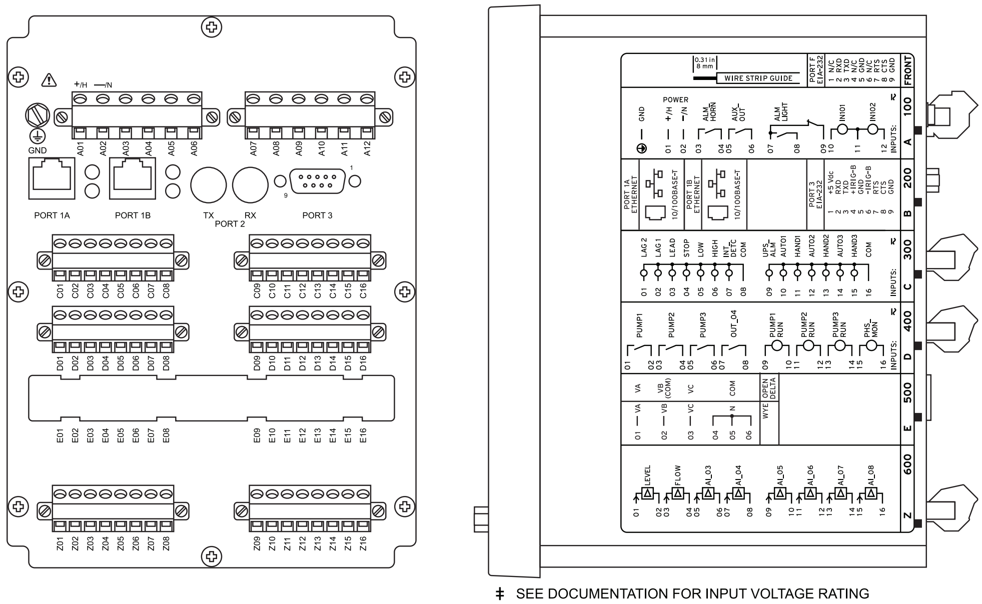
Table 2.13 Jumper Functions and Default Positions

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

Rear-Panel Connections

Rear-Panel and Side-Panel Diagrams

The physical layout of the connectors on the rear-panel and side-panel diagrams of the SEL-2411P are shown in *Figure 2.5*.



(A) Rear-Panel Layout (B) Side-Panel Input and Output Designations

Figure 2.5 Rear- and Side-Panel Diagrams

Power Connections

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

The **POWER** terminals on the rear panel (**A01(+/H)** and **A02(—/N)**) must connect to 110–240 Vac, 110–250 Vdc, or 24–48 Vdc (orange connector) (see *Power Supply on page 1.7* for complete power input specifications.) The **POWER** terminals are isolated from chassis ground. Use 16–14 AWG (1.5–2.5 mm²) wire of sufficient current capacity and insulation voltage rating to connect to the **POWER** terminals.

Grounding (Earthing) Connections

Connect the ground terminal labeled **GND** on the rear of the panel to a rack frame or switchgear ground for proper safety and performance. Use less than 2 m (6.6 feet) of 14 AWG (2.5 mm²) wire of sufficient current capacity and insulation voltage rating for the ground connection.

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

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

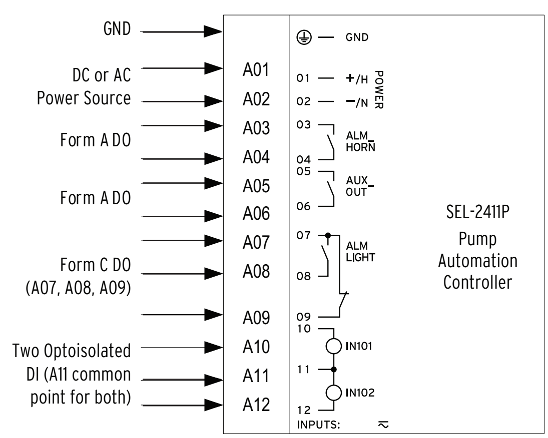


Figure 2.6 Power Connections

Communications Ports

Serial Ports

Because all ports (**F** and **3**) are independent, you can communicate to any combination simultaneously. Port **3** includes the IRIG-B time-code signal input (see below).

IRIG-B Time-Code Input

The SEL-2411P accepts a demodulated IRIG-B time signal to synchronize the internal clock with an external source on serial Port **3**.

Ethernet Port

The SEL-2411P comes with two 10/100BASE-T Ethernet ports. Connect to Port **1A** or **1B** of the device using a standard RJ45 connector.

Cables

Table 2.14 Communications Cables for Connecting the SEL-2411P to Other Devices

EIA-232 Serial Ports	Connect to Device	SEL Cable No.
All EIA-232 ports	Laptop PC, 9-pin Male (DTE)	SEL-C287
EIA-232 Port 3	SEL Communications Processors and SEL-2100 without IRIG-B	SEL-C272A
EIA-232 Port 3	SEL RTAC or Communications Processor with IRIG-B	SEL-C273A

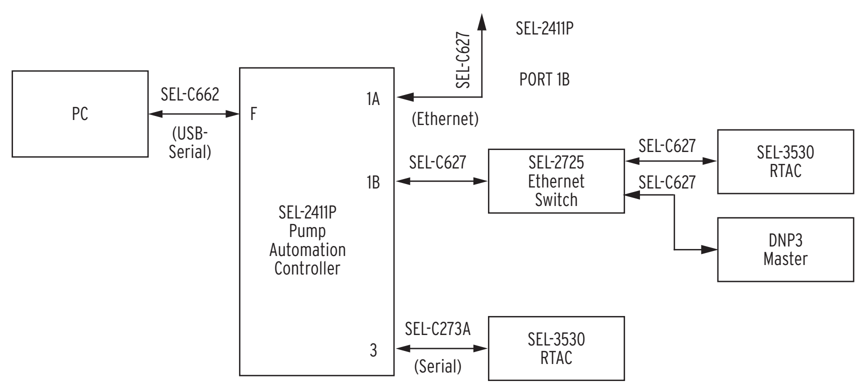


Figure 2.7 Communications Ports

Digital Inputs

The SEL-2411P optoisolated inputs (e.g., IN102, IN404) are not polarity-dependent. With nominal control voltage applied, each optoisolated input draws between 2–6 mA of current. Refer to *Section 1: Introduction and Specifications* for optoisolated input ratings. Inputs can be configured to respond to ac or dc control signals via global settings IN101D–IN102D and IN401D–IN404D.

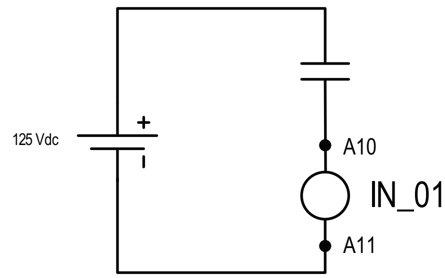


Figure 2.8 Digital Inputs

Digital Outputs

The base unit has standard output contacts only (two Form A and one Form C). Refer to *Section 1: Introduction and Specifications* for output contact ratings. Standard output contacts are not polarity-dependent.

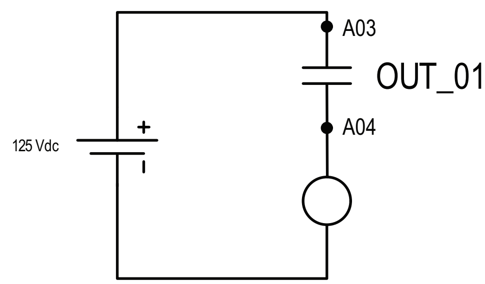


Figure 2.9 Digital Outputs

Analog Inputs and Outputs

Be sure to connect wiring to the analog inputs and analog outputs with the correct polarity. *Figure 2.10* shows the device symbol representing an analog input. Connect the positive conductor to Terminal 01 (arrow represents conventional current flow). Conventional current flow also applies to the analog outputs. You will not damage the device if you connect the negative conductor to Terminal 01, but connecting the negative conductor to Terminal 01 inverts the polarity of the input.

Figure 2.10 Analog Input and Analog Output

Current Connections

The default Measurement Category for SEL Products is Measurement Category II (CAT II). For rated maximum voltage and rated maximum current see *Section 1: Introduction and Specifications*. You can install the current option card in Slot **E** only. Because the three current channels are independent of each other, be sure to apply a ground to each CT or each group of CTs. *Figure 2.11* shows a three-phase motor with the three-phase CTs from the motor connected to the phase CTs of the device,

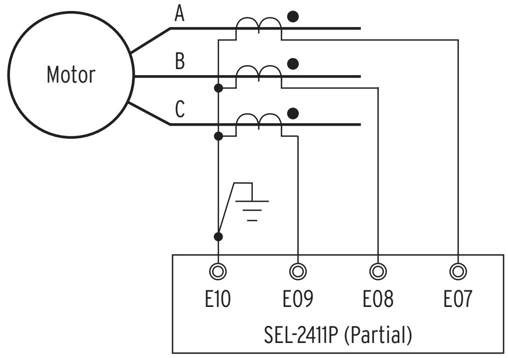


Figure 2.11 Current Connections Through CTs

Voltage Connections

You can install the voltage option card in Slot E only. Connect voltages from any one of the following three sources to the SEL-2411P (see *Figure 2.12* through *Figure 2.15*):

- ➤ Direct connection
- ➤ Wye-wye connected VT
- ➤ Open-delta connected VT
- ➤ High-leg-delta connected VT

Select appropriate fuse ratings according to the VT VA rating. For the direct connection (*Figure 2.12*), SEL recommends a fuse rating of 100 mA (see *Section 1: Introduction and Specifications* for the voltage information of the device).

NOTE: Current-limiting fuses in direct connected voltage applications are recommended to limit short-circuit arc incident energy.

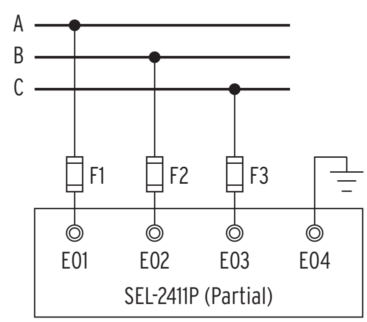


Figure 2.12 Direct Voltage Connection

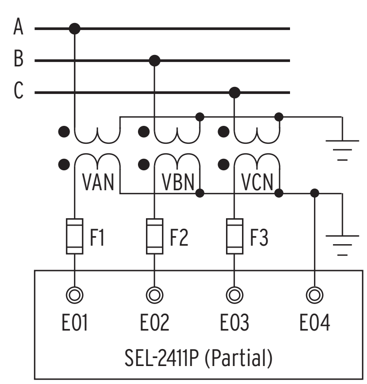


Figure 2.13 Wye-Wye VT Connection

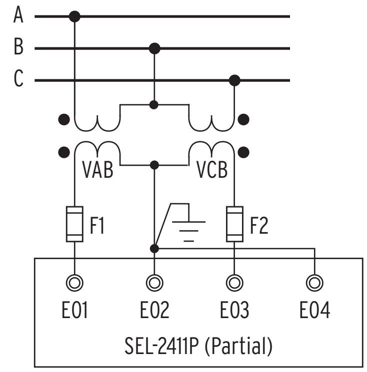


Figure 2.14 Open-Delta VT Connection

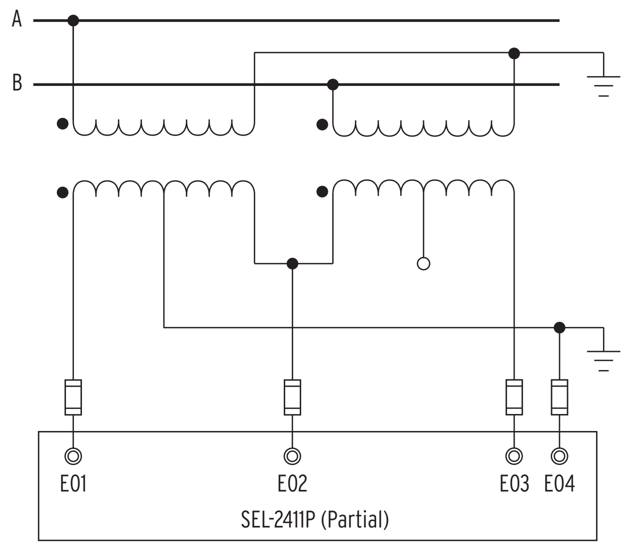


Figure 2.15 High-Leg-Delta VT Connection

Because the SEL-2411P uses the A-phase voltage as reference when displaying metered values (see **MET** command), connecting voltages other than the voltages shown in *Figure 2.12* through *Figure 2.15* to the device can result in incorrect angle values.

Field Serviceability

The SEL-2411P firmware may be upgraded in the field; refer to *Appendix B: Firmware Upgrade Instructions*. Configure an output contact to create a diagnostic alarm for a self-test failure as explained in *Section 4: Logic Functions*. Use the metering functions to determine if the analog front-end (not monitored by self-testing) is functional. Refer to *Section 10: Testing and Troubleshooting* for detailed testing and troubleshooting information.

The only field replaceable components 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, Rayovac BR2335 or equivalent. At room temperature (25°C), the battery will operate nominally for 10 years at rated load. When the device is powered from an external source, the battery experiences a low self-discharge rate. Thus, battery life may extend well beyond 10 years. The battery cannot be recharged.

Fuse Replacement

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

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

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 that the 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.

Real-Time Clock Battery Replacement

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

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

Step 1. De-energize the device.

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

Step 9. Set the device date and time.

Section 3
Getting Started

Overview

Section 2: Installation describes how to configure and connect the hardware of the device; which might be necessary before getting started operating the device. This section presents the fundamental knowledge you need to operate the SEL-2411P, organized by task. These tasks help you become familiar with the device and include the following:

- ➤ Connecting the device
- ➤ Matching device connection parameters
- ➤ Checking device status
- ➤ Editing device settings

Connecting the Device

Connect the power, ground, and communications as shown in *Figure 3.1*. For more details, see *Power Connections on page 2.11* and *Grounding (Earthing) Connections on page 2.11*. Once connected to power, the device does an internal self-check and the **ENABLED** LED illuminates.

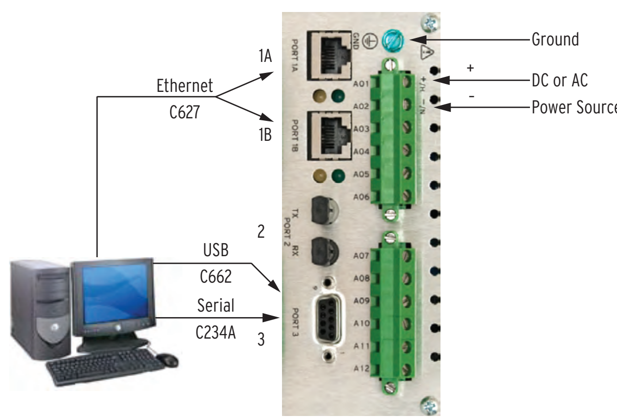


Figure 3.1 Power, Ground, and Communications Connections

QuickSet

Overview

ACSELERATOR QuickSet SEL-5030 Software is a powerful setting, event analysis, and measurement tool that aids in setting, applying, and using the SEL-2411P. *Table 3.1* shows the suite of QuickSet applications provided for the SEL-2411P.

Table 3.1 QuickSet SEL-5030 Software

Terminal	Provides a direct connection to the SEL device. Use this communication method to interface directly with the device.
Rules-Based Settings Editor	Provides online or offline device settings that include interdependency checks. Use this feature to create and manage settings for multiple devices in a database.
Event analysis	Provides oscillography and other event analysis tools.
HMI	Provides metering and control features.
Settings Database Management	QuickSet uses a database to manage the settings of multiple devices.
Help	Provides general QuickSet and device-specific QuickSet context help.

Other PC software applications that support the SEL-2411P are listed in *Table 3.2*.

Table 3.2 SEL Software Solutions

Part Number	Product Name	Description
SEL-5032	ACSELERATOR Architect SEL-5032 Software	Configures IEC 61850 communications
SEL-5040	ACSELERATOR Report Server SEL-5040 Software	This application automatically collects event reports.
SEL-5601	ACSELERATOR Analytic Assistant SEL-5601 Software	Converts SEL Compressed ASCII event report files to oscillography.

Installation

Install QuickSet on your personal computer. Once QuickSet is installed, launch the application and a launch pad similar to *Figure 3.4* will appear.

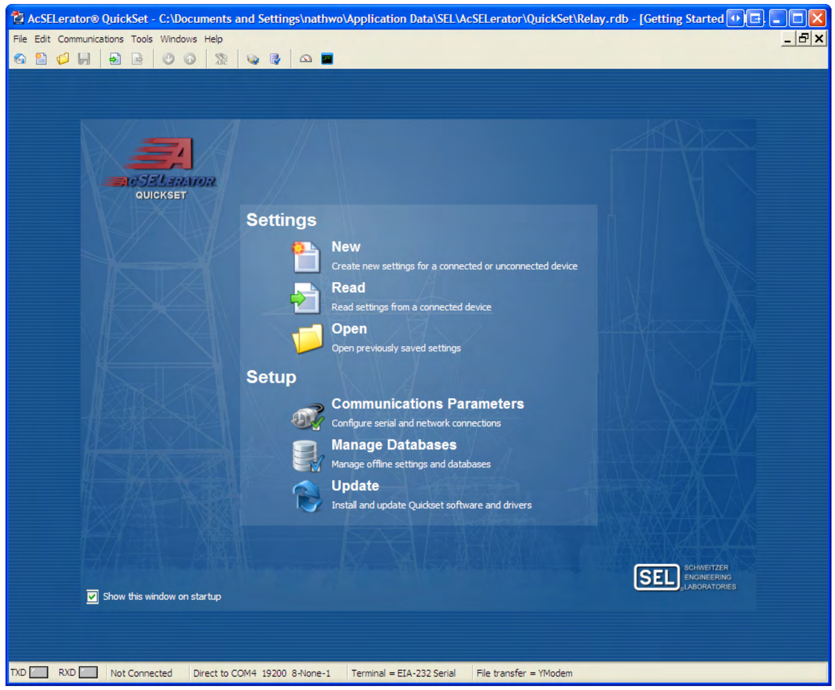


Figure 3.2 QuickSet Launch Pad

Connections Parameters

The **Connection Parameters** launch pad selection is a shortcut to the **Communications > Parameters** selection on the menu bar. Configure the QuickSet communications parameters and passwords to match those in the SEL-2411P. The SEL-2411P default passwords are shown in *Table 3.3*.

Check the SEL-2411P Port 2 parameters by selecting **SET/SHOW > Port > 2 > Communications Settings** on the SEL-2411P front panel and then using the UP and DOWN pushbuttons to view all of the parameters.

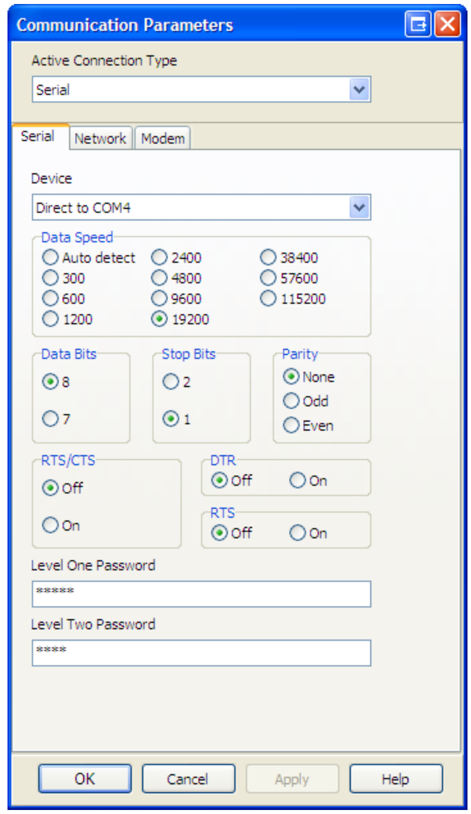


Figure 3.3 Communications Parameters

Table 3.3 Factory Default Passwords

Access Level	Password
0	N/A
1	OTTER
2	TAIL
C	CLARKE

Checking Device Status

View a device status report similar to that shown in *Figure 3.4* by selecting **Tools > HMI > HMI** from the main menu and then selecting **Device Status** from the tree. The beginning of the status report printout contains the device firmware identification string (FID) and checksum string (CID). These strings uniquely identify the device and the version of the operating firmware. The last line in the report states whether the device status is enabled or disabled, which depends on whether any particular status field is failed. *Table 7.47* provides the definition of each status field.

NOTE: With terminal emulation, use the **STA** command to access the device status.

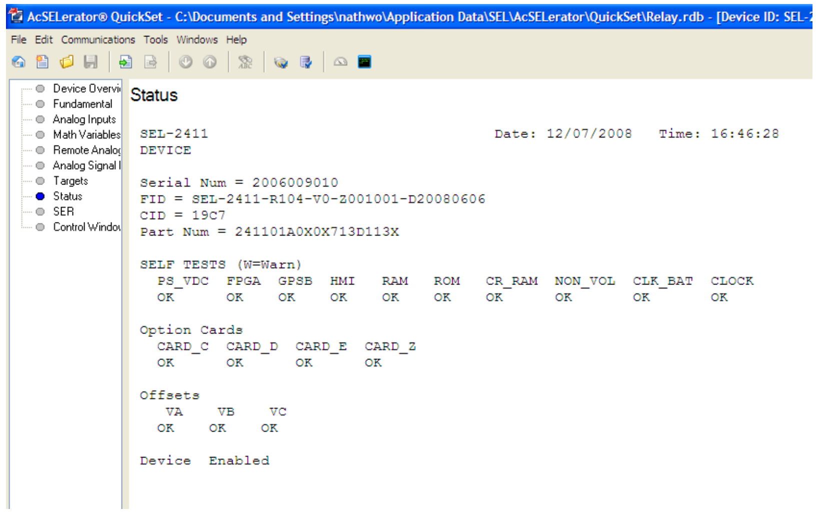


Figure 3.4 Communications Menu

Viewing Device Information

The device overview screen provides an overview of the device. All metering functions are shown whether or not the current and voltage cards are installed. When no current or voltage cards are installed, metering values show `xxxx.xx` instead of current or voltage values.

The Contact I/O portion of the window displays the status of the two inputs and three outputs of the main board. You cannot change these assignments.

You can assign any Device Word bit to the 16 user-defined Target LEDs. To change the present assignment, double-click on the text above the square you want to change. After double-clicking on the text, a box with available Device Word bits appears in the bottom left corner of the screen. Select the appropriate Device Word bit, and click the **Update** button to assign the Device Word bit to the LED. To change the color of the LED, click in the square and make your selection from the color palette.

The front-panel LEDs display the status of the 11 front-panel LEDs. Use the front-panel settings to change the front-panel LED assignment.

Screens between the **Overview** and **Control** screens display the corresponding values.

Click on **Target** to view the status of all the Device Word bits.

With the control screen, you can clear the event history, SER, MIRRORED BITS report, analog profile, and trigger events. You can also reset the targets, synchronize with IRIG, and set the time and date. To control the Remote Bits, click on the appropriate square, then select the operation.

Update

Select **Update** from the launch pad to update the QuickSet application, add support for new products (drivers), or update the support for existing products (drivers). This selection will launch SEL Compass, the SEL software and literature management application.

Manage Databases

Select **File > Database Manager** on the main menu bar to open the database manager or **Manage Databases** from the launch pad. With the manager you can create, copy, and manage databases and manage records within existing databases. The manager gives you access to the **New Database** button and the **Copy/ Move Settings Between Databases** tab.

Edit (New, Open, Read) Settings

Begin the settings process by selecting **New**, **Open**, or **Read** from the launch pad shown in *Figure 3.2*, QuickSet launch pad, or by selecting **File** > **New**, **File** > **Open**, or **File** > **Read** from the menu bar, as shown in *Figure 3.5*.

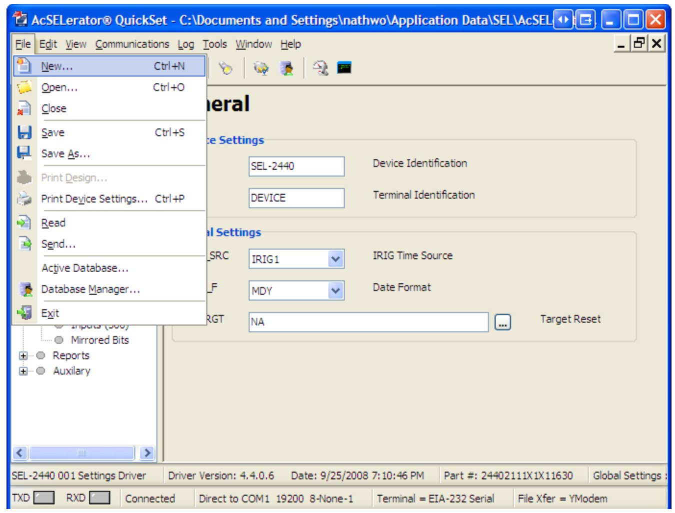


Figure 3.5 Creating a New Settings File

File > New

Selecting the **New** menu item creates new settings files. QuickSet makes the new settings files from the driver that you specify in the **Settings Editor Selection** dialog box. QuickSet uses the Z-number in the FID string to create a particular version of settings. To get started making SEL-2411P settings with the Device Editor in the Editor Mode, select **Settings > New** from the main menu bar, and SEL-2411P and **002** from the **Settings Editor Selection** window as shown in *Figure 3.6*.

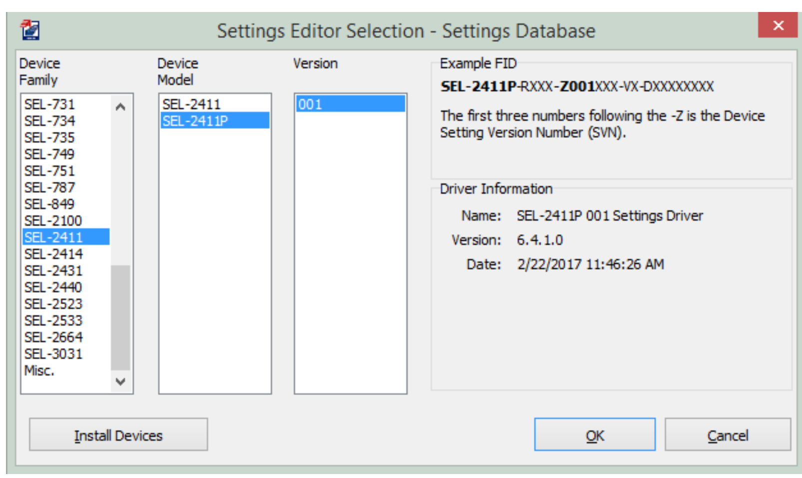


Figure 3.6 Selection of Drivers

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

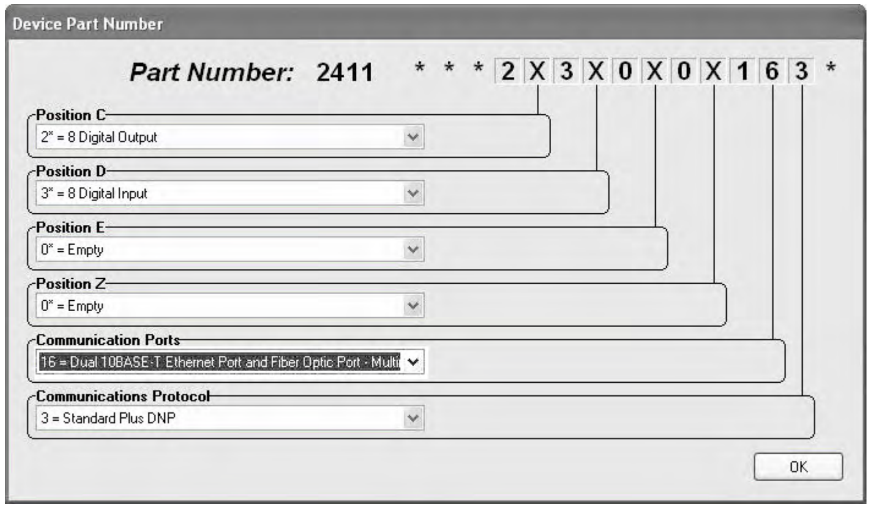


Figure 3.7 Update Part Number

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

NOTE: Compare the QuickSet Settings Driver number and the first portion of the Z-number in the FID string.

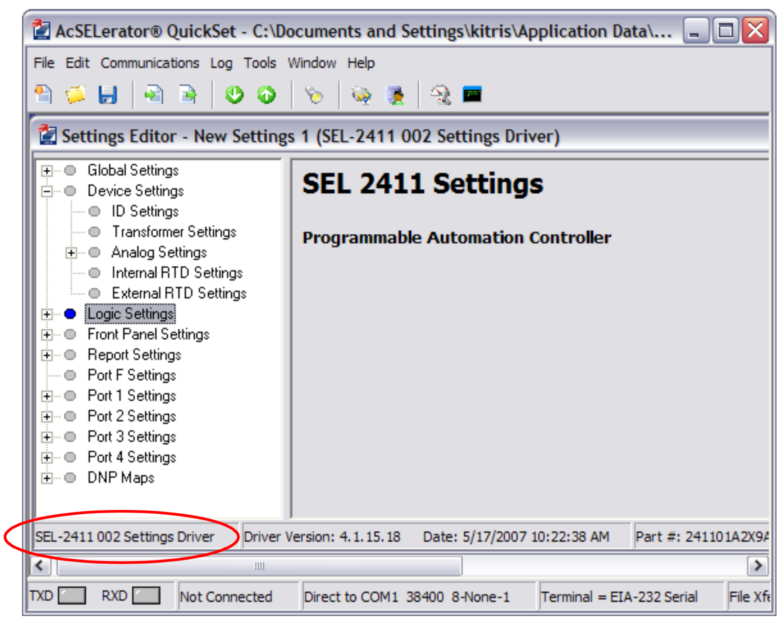


Figure 3.8 New Setting Screen

File > Open

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

File > Read

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

Help

Various forms of QuickSet help are available, as shown in *Table 3.4*. Press **<F1>** to open a context-sensitive help file with the appropriate topic as the default.

Table 3.4 Help

Help	Description
General QuickSet	Select **Help** from the main menu bar
Device Editor	Select **SEL-5030 Editor Help** from the **Device Editor** menu bar
SEL-2411P Settings	Select **Settings Help** from the **Device Editor** menu bar
Database manager	Select **Help** from the bottom of the **Database Manager** window

QuickSet Graphical Logic Editor

Use the QuickSet Graphical Logic Editor to create SELOGIC settings easily by creating a logic diagram with standard logic gates.

QuickSet Design Templates

QuickSet allows you to create personalized templates for relay applications. Use the Design Templates within QuickSet to implement such various schemes as transformer protection or fan control. These Design Templates hide settings you do not want to change (e.g., SELOGIC control equations), while making visible the minimum necessary settings (e.g., timer and pickup settings) to implement the scheme. All settings can use aliases and allow mathematical manipulation for simple end-user interfacing. Create QuickSet Design Templates that include the most commonly used relay features and settings for your application.

QuickSet Design Templates are stored locally on the SEL-2411P. This ensures that users connecting with different computers will retrieve the correct template.

Section 4

Logic Functions

Overview

The SEL-2411P Pump Automation Controller provides digital and analog logic capabilities that operate on physical inputs and outputs and virtual inputs and outputs, as shown in *Figure 4.1* and *Figure 4.2*.

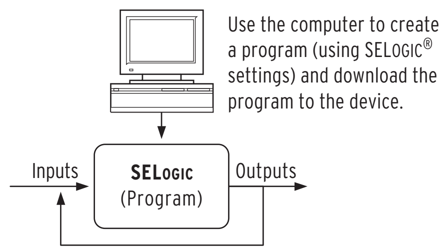


Figure 4.1 Program Model Overview

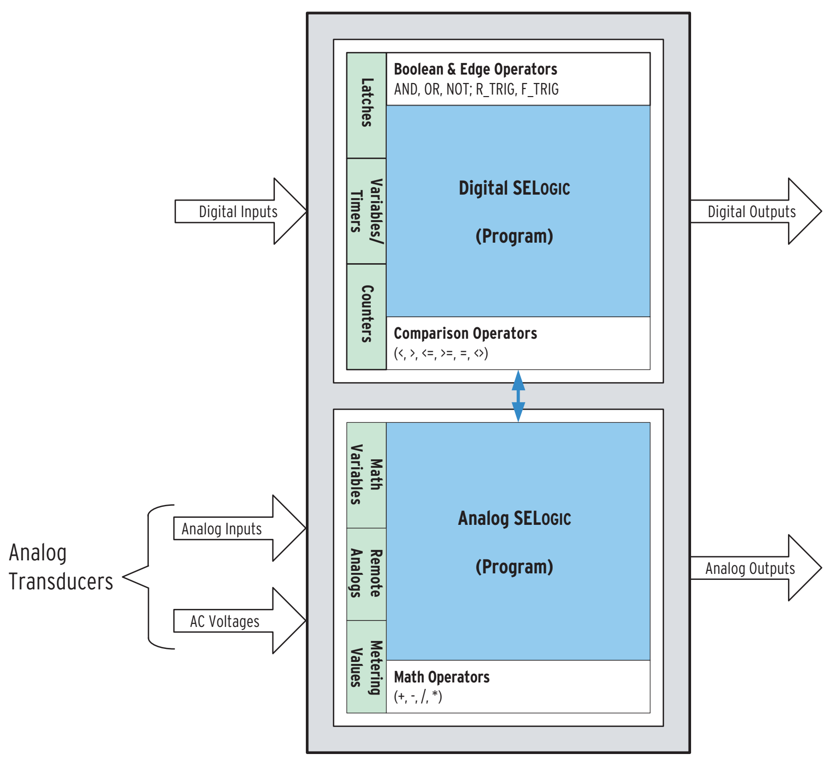


Figure 4.2 Detailed Program Model

The process of reading the physical inputs, evaluating the logic settings using all of the inputs and outputs, and operating the physical outputs is shown in *Figure 4.3*.

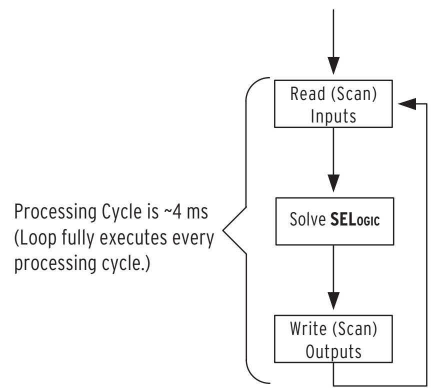


Figure 4.3 Operation Sequence

For ease of setting (programming) the device, the settings are grouped into seven categories, as described in *Table 4.1*. Many of these categories provide application-specific SELOGIC equations that are explained in *Section 6: Settings*. However, most of the SELOGIC equations and other general-purpose capabilities are provided by the Logic (SET L) category.

Table 4.1 Setting Categories

Category	Description
Global	Settings for date format and input debounce timers.
Device	Settings associated with analog transducers, voltage transformer(s), and the pump-alternation function block.
Logic	Settings associated with latches, timers, counters, and output contacts.
Port	Settings that configure the device front- and rear-panel serial ports (*p* = F or 3 on the base unit, *p* = 4 on optional communications card).
Front-Panel	Settings for the front-panel display and LED control.
Report	Settings for the sequential event reports.
DNP	Settings for DNP communications

Logical Operators

Logical operators can be used in any SELOGIC equation; they are shown in *Table 4.2*. Use the comparison operators with Analog Quantities (e.g., IA, IB, IC); including Math Variables (MV01–MV64). R_TRIG and F_TRIG only function with individual Device Word bits. See *SELOGIC Control Equation Operators* for more details.

Table 4.2 Logical Operators (Sheet 1 of 2)

Operation	Operator
Boolean	
Boolean AND	AND
Boolean OR	OR
Complement	NOT
Edge Detection	
Rising-edge trigger/detect	R_TRIG
Falling-edge trigger/detect	F_TRIG

Table 4.2 Logical Operators (Sheet 2 of 2)

Operation	Operator
Comparison	
Greater Than	>
Greater Than or Equal	>=
Equality	=
Less Than or Equal	<=
Less Than	<
Inequality	<>

Mathematical Operators

Mathematical operators can only be used in SELOGIC Math Variables; the operators are shown in *Table 4.3*. Use the mathematical operators with Analog Quantities (e.g., IA, IB, IC); including Math Variables (MV01–MV64). See *SELOGIC Control Equation Operators* for more details.

Table 4.3 Mathematical Operators (Use in Math Variables)

Operation	Operator
Negation	–
Multiply	*
Divide	/
Add	+
Subtract	-

Function Blocks

Function block outputs can be used in any SELOGIC equation; the function blocks and their outputs are shown in *Table 4.4*. Likewise, logical operators can be used in any of the SELOGIC equations that drive the function blocks. Each function block is described in more detail in *General Logic Functions*.

Table 4.4 Function Blocks

Function	Output
Latches	LT01–LT32
Variables	SV01–SV64
Timers	SV01T–SV64T
Counters	SC01–SC32

General Logic Functions

SELOGIC Enables

Enable settings are provided for latch bits (ELAT), SELOGIC control equations (variables/timers) (ESV), counters (ESC), and Math Variables (EMV). This helps limit the number of settings that you need to make. For example, if you need six timers, only enable six timers.

Latches

SELOGIC latches replace traditional latching devices (see *Figure 4.4*). The SEL-2411P latches retain state even when power to the device is lost. If the latch is set to a programmable output contact and power to the device is lost, the state of the latch is stored in nonvolatile memory, but the device de-energizes the output contact. When power to the device is restored, the programmable output contact will go back to the state of the latch after device initialization. Pulse the set input to close (set) the latch or pulse the reset input to open (reset) the latch. The external contacts wired to the latching device inputs are often from remote control equipment (e.g., SCADA, RTU).

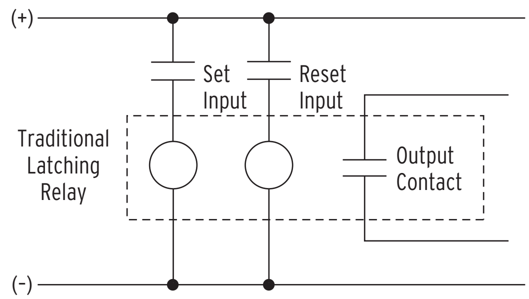


Figure 4.4 Schematic Diagram of a Traditional Latching Device

Thirty-two latches are provided by the SEL-2411P. *Figure 4.5* shows the logic diagram of a latch switch. The output of the latch is a Device Word bit (LT01 through LT32) called a latch bit.

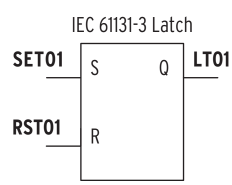


Figure 4.5 Logic Diagram of a Latch Switch

Settings Change

If individual settings are changed, the latch states are retained. If an individual setting change causes a change in a set or reset SELOGIC control equation setting, the retained states of the latch bits can be changed, subject to the newly enabled settings SET*n* or RST*n*.

Latch Settings

Latch states are stored in battery-backed RTC SRAM. An operational battery in the Real Time Clock is necessary to ensure that Latch settings are not compromised.

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.

Variables/Timers

Each SELOGIC control equation variable/timer has a SELOGIC control equation setting input and variable/timer outputs as shown in *Figure 4.6*. Timers SV01T through SV32T in *Figure 4.6* have a setting range of 0.000–16000.00 seconds. This timer setting range applies to both pickup and dropout times (Sv*n*PU and SV*n*DO; *n* = 1 through 64). You can enter up to 15 elements per SELOGIC equation.

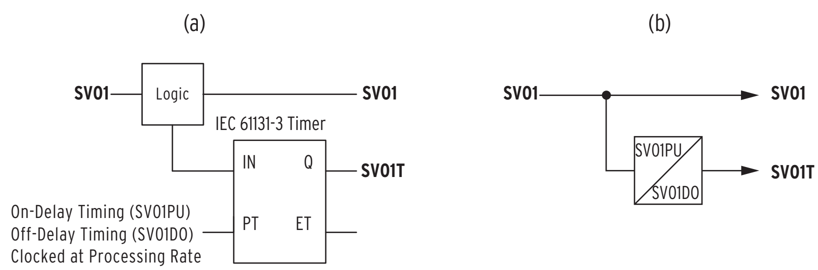


Figure 4.6 SELOGIC Control Equation Variable/Timers SV01/SV01T–SV32T

If the device loses power or settings change, the SELOGIC control equation variables/timers reset. Device Word bits SV*n* and SV*n*T (*n* = 01–32) reset to logical 0 after power restoration or a settings change.

Run-Time Configurable Timers

Run-time configurable timers function just like standard SELOGIC timers except the PU and DO settings are set dynamically by using specific analog quantities. Run-time configurable timers are only available in the SEL-2411P and replace the standard SELOGIC timers in the SEL-2411P. There are 64 run-time configurable timers in the SEL-2411P.

Table 4.5 Run-Time Configurable Timer Settings

Setting	Description
SV*n*	SELOGIC Variables 1–64
SV*n*PU	SELOGIC pickup threshold. A constant value or the analog quantities: MV*xx*, ACV*xx*, or RA*xxx*
SV*n*DO	SELOGIC dropout threshold. A constant value or the analog quantities: MV*xx*, ACV*xx*, or RA*xxx*

SV*n*PU and SV*n*DO are clamped between 0.000 and 86400.000 (86400.000 is a PU or DO of 24 hours). If a variable assigned to SV*n*PU or SV*n*DO exceeds these limits, they will be clamped to these values.

Analog Control Variables

Analog control variables (ACVs) provide a means of easily adjusting and defining limits and thresholds used in SELOGIC control equations. Thirty-two ACVs are available for use with SELOGIC expressions and for display. ACVs are nonvolatile analog registers that you can modify through the front panel, SEL ASCII Terminal, DNP, or Modbus. ACVs are useful for quick and easy adjustment of control limits and threshold settings.

Table 4.6 ACV Settings

EACV	Number of ACVs to enable
EACV	Number of ACVs to enable
ACV*nn*A	ACV alias
ACV*nn*P	Prompt displayed in the ACV data entry screen
ACV*nn*MIN	ACV minimum value
ACV*nn*MAX	ACV maximum value
ACV*nn*RV	ACV reset value
ACV*nn*U	ACV display units
ACV*nn*RST	ACV SELOGIC reset equation

Use the Analog Control Value Alias (ACVA) setting to customize a label under the **SET/SHOW** menu on the front panel. For example, assume that you are using ACV registers to change the length of time a pump will run. You can set the ACVA setting to PUMP RUNTIME.

Use the ACVA*nn* settings to customize labels for each ACV register. Following the example above, you might choose to set ACV01A to PUMP RUNTIME and ACV01U to HOURS. By default, the aliases are set to the Analog Quantity name of the ACV register, ACV*nn*.

Use the ACV*nn*MAX and ACV*nn*MIN settings to limit the range of values that ACV registers accept. The SEL-2411P returns an out-of-range error if an attempt is made to set an ACV outside of this range.

You can change the value of an ACV using the methods listed below:

- Use the **CON** command: **CON ACV ACV*nn value***
- Use the **Control** menu on the front panel
- Send a DNP3 Analog Output Write (Object 41)
- Send a Modbus Holding Register Write (function code 06h and 10h)

Analog Values input from the front panel or communication protocols will be rejected if outside the range defined by ACV*nn*MIN and ACV*nn*MAX

ACV*nn* will accept the newest value entered from either the front panel, a terminal, or a communication protocol.

NOTE: The SEL-2411P applies new ACVs to all interfaces when writing to the ACV from any interface.

ACV*nn*RV is the value to which ACV*nn* is set if the value in ACV*nn* is invalid (e.g., ACV*nn* is outside new MIN/MAX values configured during a settings change, or there is no value currently in ACV*nn*).

ACV*nn*RST evaluating to TRUE will force the ACV to remain at ACV*nn*RV until ACV*nn*RST evaluates to FALSE.

Counters

SELOGIC counters are up- or down-counting elements, updated every processing interval. Each counter element consists of one count setting, four control inputs, two digital outputs, and one analog output. *Figure 4.7* shows Counter 01, the first of 32 counters available in the device.

SELOGIC counters can be saved in nonvolatile storage to restore the value after a power cycle. SC*nn*NV enables nonvolatile storage of each counter. When enabled, the unit will store the present value of the counter every 2–5 seconds and automatically restore the value after reboot. In a controlled power cycle, the present value will be stored before the reboot even if it occurs before the automatic save interval.

NOTE: These counter elements conform to the standard counter function block #3 in IEC 61131–3 First Edition 1993–03 International Standard for Programmable Controllers—Part 3: Programming Languages.

NOTE: If setting SCnnCD is set to NA, the entire counter nn is disabled.

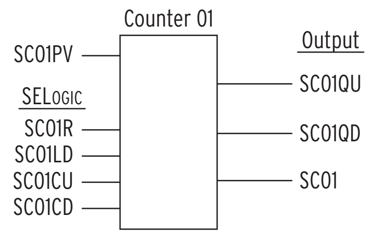


Figure 4.7 Counter 01

Table 4.7 describes the counter operation. Control input precedence is first followed by SC*nn*R, SC*nn*LD, SC*nn*CU, and SC*nn*CD.

Table 4.7 Counter Input/Output Description

Name	Type	Description
SC*nn*LD	Active high input	Load counter with the preset value to assert the output (SC*n*QU) (SELOGIC setting). When SC*nn*LD is asserted, SC*nn*CU and SC*nn*CD are ignored.
SC*nn*PV	Input value	This preset value is loaded when SC*n*LD pulsed. This preset value is the number of counts before the output (SC*n*QU) asserts (SELOGIC setting). The counter will not increment higher than this value.
SC*nn*CU	Rising edge input	Count-up increments the counter (SELOGIC setting). When SC*nn*CU has a rising edge, a rising edge on SC*nn*CD is ignored (unless SC*nn* is already at the maximum value SC*nn*PV), in which case SC*nn*CU is ignored and SC*nn*CD is processed. Set SC*nn*CU to 0 if it is unused.
SC*nn*CD	Rising edge input	Count-down decrements the counter (SELOGIC setting). Setting this to NA disables the counter. Set SC*nn*CD to 0 if it is unused.
SC*nn*R	Active high input	Reset counter to zero (SELOGIC setting). When SC*nn*R is asserted, SC*nn*LD, SC*nn*CU, and SC*nn*CD are ignored.
SC*nn*QU	Active high output	This count-up output asserts when the preset value (maximum count) is reached (SC*n* = SC*n*PV, *n* = 01 to 32).
SC*nn*QD	Active high output	This count-down output asserts when the counter reaches zero (SC*n* = 0, *n* = 01 to 32).
SC*nn*	Output value	This counter output is an analog value that may be used with analog comparison operators in a SELOGIC control equation and viewed using the **COU** command.

When a counter is disabled by its setting, the present count value is forced to 0 (SC*nn* := 0), causing Device Word bit SC*nn*QD to assert and Device Word bit SC*nn*QU to deassert.

Math Variables

The executed result of a math SELOGIC control equation is stored in a math variable. The storage format of the math variable is a 32-bit fixed point signed integer; 24 bits represent the integer portion, 7 bits represent the fractional portion, and 1 bit represents the sign. The smallest and largest values that a math variable can represent are –16777215.99 and +16777215.99, respectively. If the executed result exceeds these limits, it will be clipped at the limit value. For example, when the MV01:= executed result is –16777219.00, MV01 will be –16777215.99. Similarly, when the MV02 := executed result is +16777238.00, MV02 will be +16777215.99.

Since there are only seven bits available for the fractional portion, the result of multiplication and division with decimals will have lower accuracy than one would expect with a floating-point processor. As illustrated by the results in *Table 4.8*, the results vary from 20 percent at the smallest end of the fractional values to 0.2 percent at the largest. Using scaling factors where possible is recommended to avoid the error introduced by the fixed point processor when multiplying and dividing fractional numbers.

Table 4.8 Math Variable Fractional Multiplication Results

MV01 := 0.01*10	Result = 0.08	Error = 20%
MV01 := 0.05*10	Result = 0.47	Error = 6%
MV01 := 0.1*10	Result = 1.02	Error = 2.0%
MV01 := 0.5*10	Result = 5.00	Error = 0%
MV01 := 0.99*10	Result = 9.92	Error = 0.2%

SELOGIC math variables can be saved in nonvolatile storage to restore the value after a power cycle. MV*nn*NV enables nonvolatile storage of each math variable. When enabled, the unit will store the present value of the math variable every 2–5 seconds and automatically restore the value after reboot. In a controlled power cycle, the present value will be stored before the reboot even if it occurs before the automatic save interval.

Table 4.9 shows example settings using nonvolatile math storage to maintain the maximum value of a temperature input.

Table 4.9 Nonvolatile Max Temperature Example

SV01 := INTEMP01 > MV01
MV01NV :=Y
MV01 := (SV01*INTEMP01)+MV01*(NOT SV01)

Device Word bits provided for math are shown in *Table 4.10*.

Table 4.10 Math Device Word Bits

Device Word Bit	Description
MATHSTRT	Pulses for one processing interval pulse when math starts.
MATHTSK	Asserts while math is running.
MATHERR	Asserts when a math error occurs.

Output Contacts

The SEL-2411P provides the ability to use SELOGIC control equations to map logic outputs to the physical outputs. If you do not want to configure an output contact enter 0 as the setting, which is the default setting.

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. SELOGIC control equations are either Boolean type or math type. Because the equals sign (=) is already used as an equality comparison, both Boolean type and math type of SELOGIC control equation settings begin with an “assignment” operator (:=) instead of with an equals sign.

Boolean SELOGIC control equation settings use logic similar to Boolean algebra logic, combining Device Word bits together with one or more of the Boolean operators listed in *Table 4.11*. Math SELOGIC control equation settings operate on numerical values, using one or more of the Mathematical operators listed in *Table 4.11*. These numerical values can be mathematical variables or actual real numbers.

Operator Precedence

When you combine several operators and operands within a single expression, the SEL-2411P evaluates the operators from left to right, starting with the highest precedence operators and working down to the lowest precedence.

Table 4.11 SELOGIC Control Equation Operators (Listed in Operator Precedence)

Operator	Function	Function Type (Boolean and/or Mathematical)
( )	Parentheses	Boolean and Mathematical (highest precedence)
–	Negation	Mathematical
NOT	NOT	Boolean
R_TRIG	Rising-edge trigger/detect	Boolean
F_TRIG	Falling-edge trigger/detect	Boolean
*	Multiply	Mathematical
/	Divide	Mathematical
+	Add	Mathematical
-	Subtract	Mathematical
<, >, <=, >=	Comparison	Boolean
=	Equality	Boolean
<>	Inequality	Boolean
AND	AND	Boolean
OR	OR	Boolean (lowest precedence)

Parentheses Operator ( )

You can use more than one set of parentheses in a SELOGIC control equation setting. Use as many as14 sets of parentheses in a single SELOGIC control equation setting. The parentheses can be "nested" (parentheses within parentheses).

Boolean Rising Edge Operator (R_TRIG)

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

Boolean Falling-Edge Operator (F_TRIG)

Apply the falling-edge operator, F_TRIG, to individual Device Word bits only; you cannot apply F_TRIG to groups of elements within parentheses. When the Device Word bit deasserts, F_TRIG interprets this logical 1 to logical 0 transition as a "falling edge" and asserts to logical 1 for one processing interval, as shown in *Figure 4.8*.

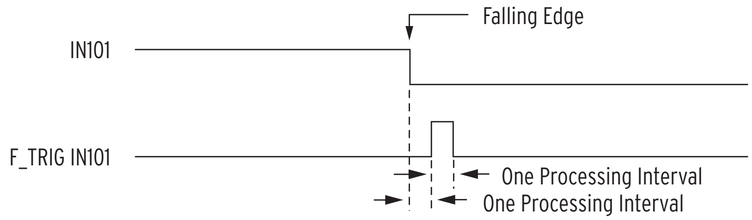


Figure 4.8 Result of Falling-Edge Operator on a Deasserting Input

Math Arithmetic Operators (*, /, +, and –)

Device Word bits (which are effectively Boolean resultants, equal to logical 1 or logical 0) may be used in mathematical operations, they are treated as numerical values 0 and 1.

Boolean Comparison Operators (<, >, <=, and >=)

Comparisons are mathematical operations that compare two numerical values, with the result being a logical 0 or logical 1. Thus, what starts out as a mathematical comparison ends up as a Boolean resultant.

Boolean Equality (=) and Inequality (<>) Operators

Equality and inequality operators operate similar to the comparison operators.

Other

Table 4.12 shows other operators and values that you can use in writing SELOGIC control equations.

Table 4.12 Other SELOGIC Control Equation Operators/Values

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

Fast Analog Logic

Use Fast Analog Alarms to detect overvoltage, undervoltage, and overcurrent conditions on the inputs of the 3 AVI, 3 AVI/3 ACI, and 4 ACI SELECT I/O cards. Two warning levels and an alarm level are available for each ACI and AVI input channel that are processed every 1/4 cycle. The analog math delay of 100 ms does not apply to these alarms. Every processing interval, the instantaneous value is compared to the warning level and alarm set points and asserts any of those alarms if applicable. Each warning level and alarm is available for use in logic for tripping or logging purposes. Each channel has threshold settings for each level and can be turned off if desired. The threshold settings are entered in secondary current/voltage values. *Figure 4.9* illustrates the behavior of the Fast Analog Logic blocks.

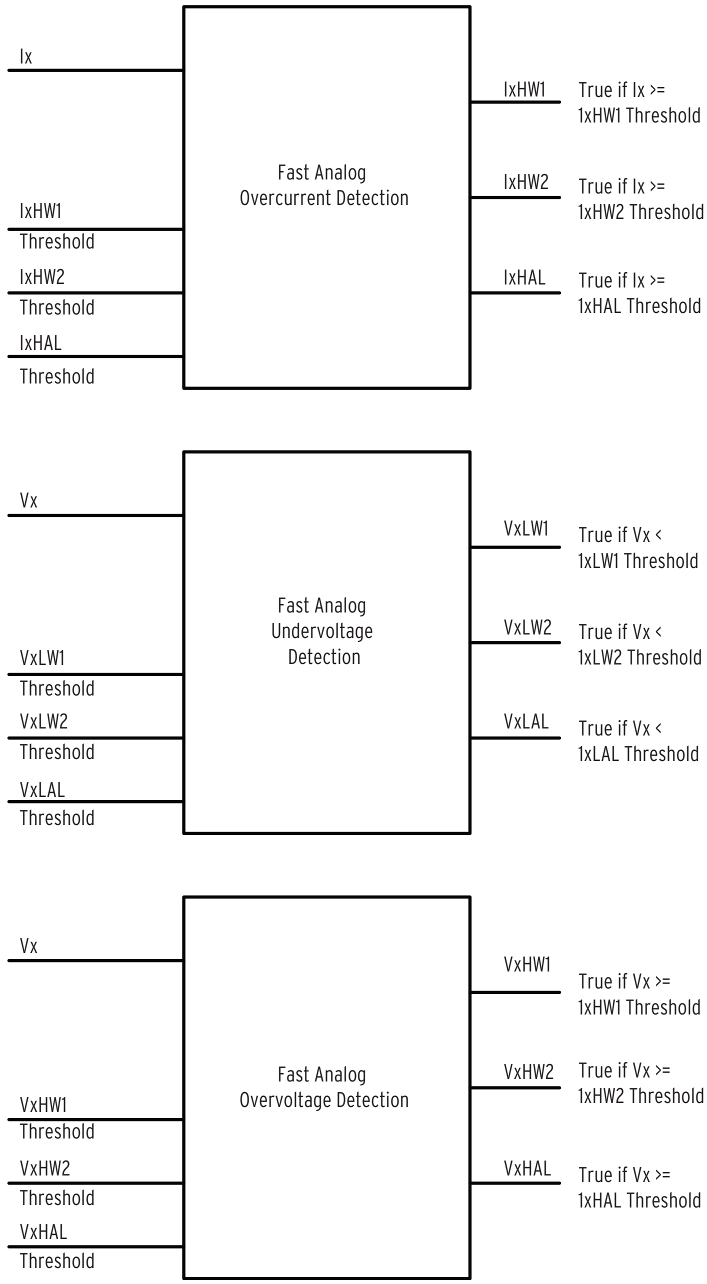


Figure 4.9 Fast Analog Logic

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Section 5
Metering and Monitoring

Overview

The SEL-2411P Pump Automation Controller includes metering functions to display the present values of current (if included), voltage (if included), and analog inputs (if included). The device provides the following methods to read the present meter values:

- ➤ Front-panel rotating display
- ➤ Front-panel menu
- ➤ SEL ASCII and CASCII text commands
- ➤ ACSELERATOR QuickSet SEL-5030 Software
- ➤ SEL Fast Message Read
- ➤ Modbus RTU via either EIA-485 port or EIA-232 port
- ➤ Modbus TCP via Ethernet port
- ➤ DNP3 Level 2 Outstation via EIA-232 port
- ➤ DNP3 Level 2 Outstation LAN/WAN via Ethernet port

Pump Operation Status

The SEL-2411P records pump operation status for EPUMPS pumps and NUMSTG stages. It uses inputs and outputs from the *Appendix J: Pump Alternation Function Block* to provide instantaneous and historical pump operation data. All values update once per second. Additionally, the SEL-2411P stores the status values in nonvolatile memory every 30 seconds. *Table 5.1* includes all values that the SEL-2411P provides for pump operation status. The *x* value represents Pumps 1–4 and *y* represents Stages 1–4.

Table 5.1 Pump Operation Status Values (Sheet 1 of 2)

Operation Status	Description	Units
P*x*RT2H	Pump run time that has accumulated over the previous 2 hours	Minutes
P*x*RT1D	Pump run time that has accumulated over the previous 24 hours	Minutes
P*x*RT2D	Pump run time that has accumulated over the previous 48 hours	Minutes
P*x*RTTOT	Total pump run time that has accumulated over the lifetime of the pump	Hours

Table 5.1 Pump Operation Status Values (Sheet 2 of 2)

Operation Status	Description	Units
P*x*STC2H	Pump start counts that have accumulated over the previous 2 hours	Starts
P*x*STC1D	Pump start counts that have accumulated over the previous 24 hours	Starts
P*x*STC2D	Pump start counts that have accumulated over the previous 48 hours	Starts
P*x*STCTOT	Total pump start counts that have accumulated over the lifetime of the pump	Starts
P*x*LASTST	Time since last start for Pump *x*	Minutes
STG*y*CRTM	Stage *y* run time	Seconds
Pump Status	Current pump status for Pump *x* (see *Table 5.2*)	–
Starting Stage Call	Current stage assignment for Pump *x* (see *Table 5.7*)	–
Last Reset Date	Most recent pump status reset date (MM = month of year, DD = day of month, YYYY = year)	MM/DD/YYYY
Last Reset Time	Most recent pump status reset time (hh = hour, mm = minutes, ss = seconds)	hh:mm:ss
Stage Status	Current stage status for Stage *y* (see *Table 5.2*)	–
LEVEL_IN	Analog level sensor measurement value	–
FLOW_IN	Analog flow sensor measurement value	–

NOTE: Any changes to the SEL-2411P time and date directly affect PxLASTST. Additionally, if the system time changes to a time and date that precedes the most recent pump start time, PxLASTST results in negative minutes.

The SEL-2411P provides two-hour, one-day, two-day, and total run times and start counts for Pump *x*. Pump run times accumulate while PUMP*x*RUN evaluates to TRUE and stop accumulating as soon as PUMP*x*RUN evaluates to FALSE. Similarly, pump start counts increment by one every time PUMP*x*RUN evaluates to TRUE for a duration of 1 second or longer.

The SEL-2411P supports as many as 2880 start-count and run-time occurrences from all pumps within the two-hour, one-day, and two-day time windows. For example, the two-day, start-count, and run-time quantities can accurately track a single pump that starts every minute within a two-day time window or four pumps that start every four minutes within a two-day time window.

P*x*LASTST tracks the time, in hours, that has transpired since Pump *x* last started. When PUMP*x*RUN evaluates to a rising edge, P*x*LASTST resets to 0 and begins accumulating time until the next pump start occurs.

STG*y*CRTM stage cycle run time tracks the time that has transpired while stage *y* is active. When STG*y*CALL evaluates to a rising edge, STG*y*CRTM begins timing the time duration, in seconds, that Stage *y* is active. STG*y*CRTM stops accumulating time and resets to 0 when STG*y*CALL evaluates to a falling edge.

View Operation Status

Access the operation status values from *Table 5.1* at Access Level 1 or higher. Use the serial command **MET** to view all pump operation status values in a terminal window. Follow the paths in *Figure 5.1* to view the status values on the SEL-2411P front panel. Select **Pump *x*** under DISPLAY PUMPS to view pump status, starting stage call, run times, start counts, and reset date and time for Pump *x*. Select **Stage *y*** under DISPLAY STAGES to view status and cycle run

NOTE: If EPUMPS = N, the SEL-2411P will responds to a **MET** command with `No Pumps Enabled`.

time for Stage *y*. Select **Display Pump Analogs** under DISPLAY to view the analog level and flow input measurements. See *Table 5.1–Table 5.7* for more details regarding pump status, starting stage call, and stage status.

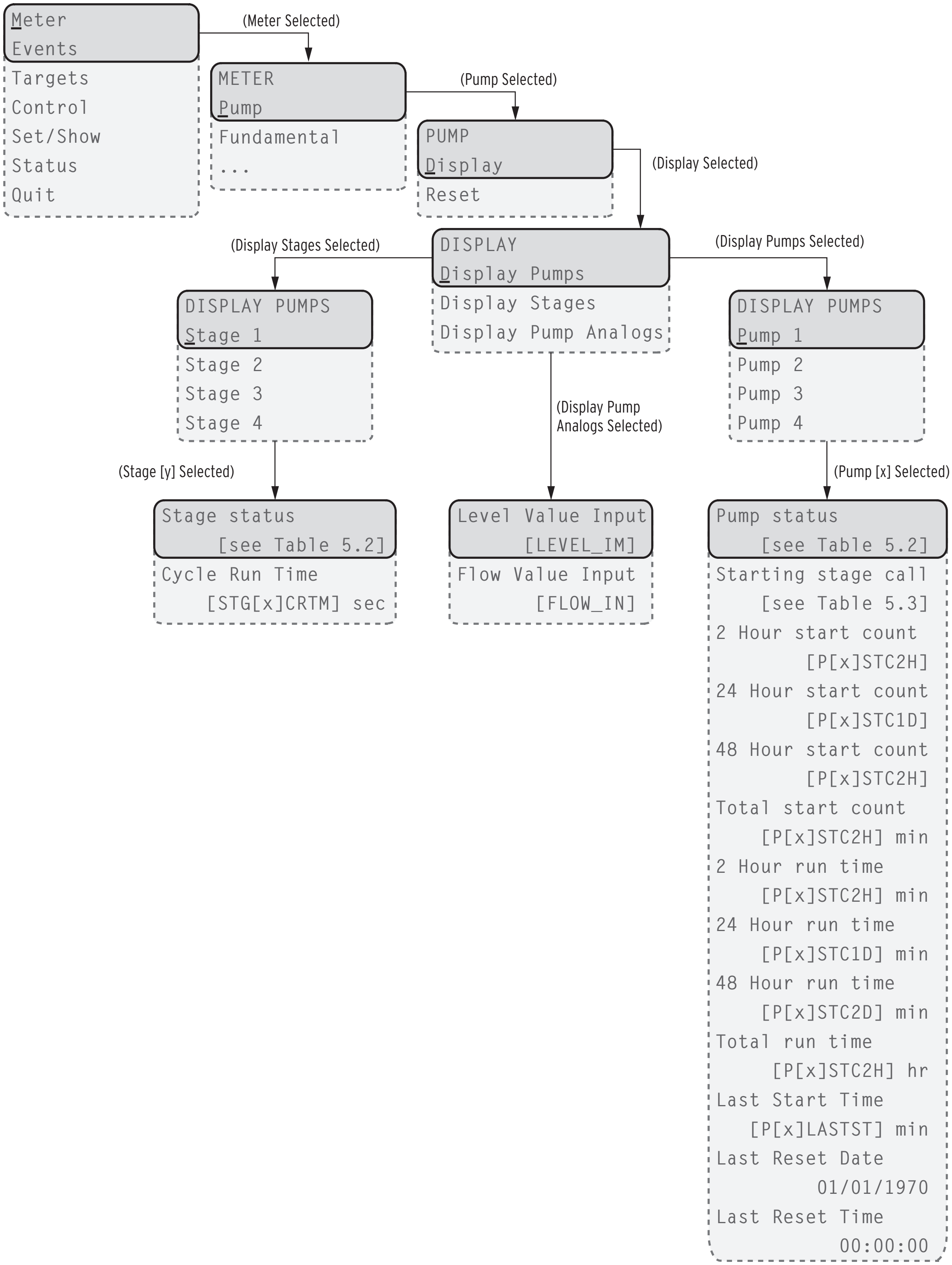


Figure 5.1 View Pump Control Status and Statistics via the Front Panel

Table 5.2 provides the different pump and stage status values. Each pump or stage status includes a display priority, where 0 is the lowest and 7 is the highest. The SEL-2411P displays the status that complies with the corresponding status requirement and has the highest display priority value.

Table 5.2 Pump and Stage Status Display

Pump Status Display	Status Requirement	Display Priority
`Disabled`	PUMP*x*EN = FALSE	0
`Ready`	PUMP*x*EN = TRUE	1
`Called`	PUMP*x* = TRUE	2
`Running`	PUMP*x*RUN = TRUE	3
`Long Runtime`	P*x*LONGRT = TRUE	4
`Min Runtime`	P*x*MINRT = TRUE	5
`Stop Fault`	PUMP*x*STP = TRUE	6
`Start Fault`	PUMP*x*FLT = TRUE	7
Stage Status Display	**Status Requirement**	**Display Priority**
`Ready`	STAGE*x* = FALSE	0
`Called`	STAGE*x* = TRUE	1
`Alarm`	STGXALM = TRUE	2

Table 5.3 provides the different starting stage calls for Pump *x*. The SEL-2411P displays the starting stage call of the pump when the corresponding stage assignment status is TRUE.

Table 5.3 Pump Starting Stage Call for Pump x

Starting Stage Call	Status Requirement
`LEAD`	P*x*LEAD = TRUE
`LAG1`	P*x*LAG1 = TRUE
`LAG2`	P*x*LAG2 = TRUE
`LAG3`	P*x*LAG3 = TRUE

Preload Pump Operation Status

When first commissioning the SEL-2411P, some pumps may already have operating history. Preload pump operation status for total run times and total start counts by using the **MET PUMP PRELOAD *x*** serial command. This command requires Level 2 access. Additionally, the SEL-2411P rejects any preload commands for Pump *x* if EPUMPS is OFF (i.e., no pumps are enabled). Enter the total run time in hours for Pump *x* within the range 0.00–999999.99 to provide an initial value for P*x*RTTOT. Similarly, enter the total start counts for Pump *x* within the range 0–1000000 to provide an initial value for P*x*STCTOT. Save the new pump status data by answering **Y** when the prompt says `Preload Pump x Statistics (Y,N)`. Repeat these steps for each pump as necessary.

Reset Pump Status Values

Use the following methods to reset pump run times and start count status data in *Table 5.1* to 0. All serial commands and front-panel operations for resetting pump data require Level 2 access. Additionally, the SEL-2411P rejects any reset commands for Pump *x* if EPUMPS is OFF.

Reset the two-hour run time and start count values for Pump *x* by using the RST-P*x*DAT SELOGIC control equation. When RSTP*x*DAT evaluates to a rising edge, the SEL-2411P resets the two-hour pump statistics.

Issue the serial command **MET PUMP RESET SHORT *x*** to force the SEL-2411P to reset the two-hour, one-day, and two-day run-time and start-count data for Pump *x*. After you issue the command, the SEL-2411P responds with the prompt `Reset Pump x Short Term Statistics (Y,N)?`. Answer with **Y** to initiate the short-term data reset. Answer with **N** to cancel.

In addition to the serial command, follow the path in *Figure 5.2* to reset the short-term data by using the front panel.

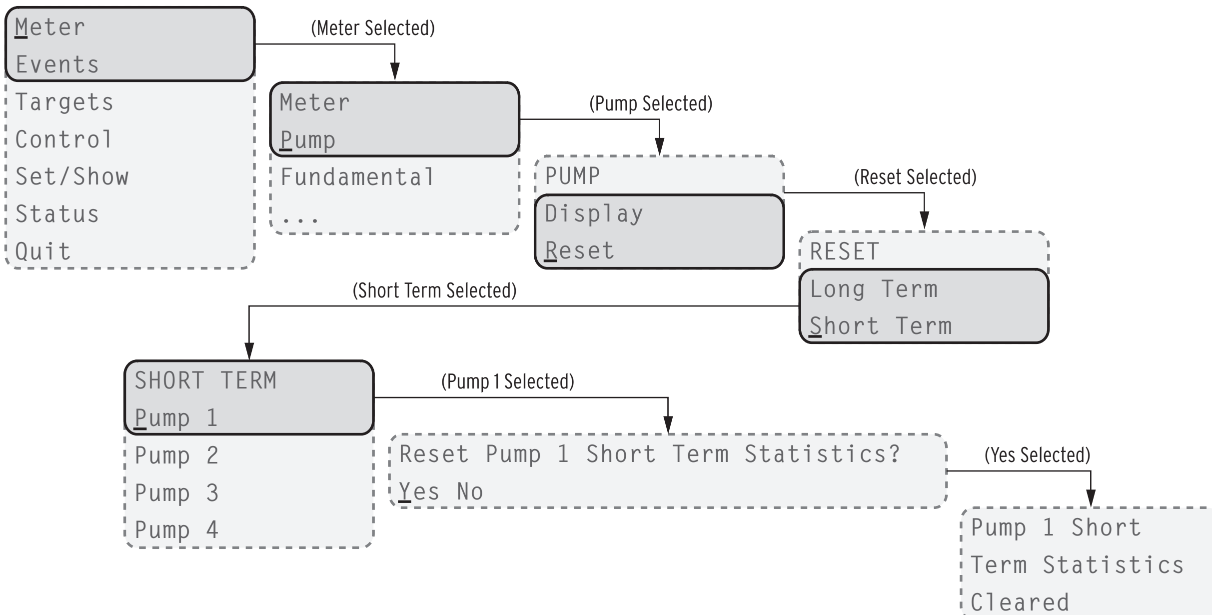


Figure 5.2 Reset Short-Term Statistics via Front Panel

Issue the serial command **MET PUMP RESET LONG *x*** to force the SEL-2411P to reset all of the run-time and start-count data for Pump *x*. The SEL-2411P updates the Last Reset Date and Last Reset Time in *Table 5.1* to record the time and date of the pump status reset. After you issue the command, the SEL-2411P responds with the prompt `Reset Pump x Long Term Statistics (Y,N)?`. Answer with **Y** to initiate the long-term data reset. Answer with **N** to cancel.

Reset the long-term operation data through use of the front panel by following the path in *Figure 5.2* and selecting **Long Term** under RESET.

Metering

The SEL-2411P meter data fall into the following categories:

- ➤ Fundamental metering
- ➤ Energy metering
- ➤ Maximum and minimum metering
- ➤ Demand Metering
- ➤ Analog Input metering
- ➤ Math Variable metering
- ➤ Remote Analog metering
- ➤ Analog Signal Profiling

NOTE: The SEL-2411P performs all power calculations with the understanding that the voltages connected to the device are from a balanced, three-phase supply. Device calculations for single-phase voltages or other unbalanced supply voltages are meaningless.

Because of the flexibility of the SEL-2411P, you can configure your device in any combination of analog input, current, and/or voltage cards. As a result of this flexible configuration, displayed metering is a function of the particular device configuration. For example, to display power, you need to install the 3 ACI/3 AVI combination card.

Fundamental Metering

Table 5.4 details each of the eight cycle-averaged meter data types in the SEL-2411P. *Section 8: Front-Panel Operations* and *Section 7: Communications* describe how to access the various types of meter data by using the device front-panel and communications ports.

Table 5.4 Fundamental Meter Values

Values		Units	Description
Currents (3 ACI / 3 AVI)			
IAX, IBX, ICX		A, deg	Line
IGX		A, deg	Residual Ground
3I2X		A	Negative-Sequence
Voltages (3 AVI or 3 ACI / 3 AVI)			
VA, VB, VC or VAB, VBC, VCA		V, deg	Line or Line-to-Line
VG		V, deg	Residual Ground
3V2		V	Negative-Sequence
Power			
P		kW	Real Power
Q		kVAR	Reactive Power
S		kVA	Apparent Power
PF		-	Power Factor
Other			
HZ	HZ	Hz	System Frequency

All angles are displayed between –180 and +180 degrees. The angles are referenced to VAB (for delta-connected PTs) or VAN (for wye-connected PTs) or IA (when only a current card is present). If the AVI card is not installed, or if VAB < 13 V (for delta-connected PTs) or VAN < 13 V (for wye-connected PTs), the angles are referenced to IA current.

Power Measurement Conventions

The SEL-2411P uses the IEEE convention for power measurement assuming motor action, as shown in *Figure 5.3* and *Figure 5.4*.

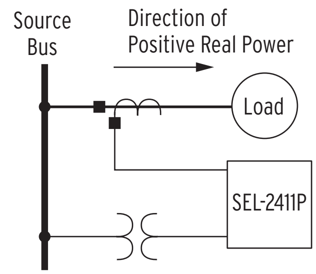


Figure 5.3 Primary Plant Connections

Figure 5.4 shows the grouping of voltage/current relationships into four quadrants (I through IV) as a function of the power factor and the direction of current flow (i) relative to the applied voltage (v).

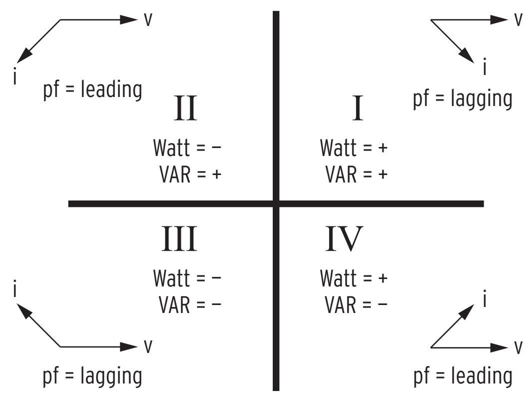


Figure 5.4 Complex Power Measurement Conventions—Motor Action

In the SEL-2411P, reported positive real power is always into the load. See *Section 7: Communications* for examples of the device response to power measurement in the four quadrants.

The device uses a nominal system frequency of 50 or 60 Hz to control the sampling (data acquisition) of current and voltage waveforms for use in calculating magnitudes and angles. If the system frequency deviates from the nominal frequency then the metering accuracy might degrade. When the device is connected to a three-phase system then it is able to track the frequency and maintain accuracy.

Energy Metering

The device provides energy metering when current and voltage inputs are included. Use this form of metering to quantify real, reactive, and apparent energy supplied to the load. Below are the energy meter values.

Table 5.5 Energy Meter Values

Values	Units	Description
MWh3P	MWh	Real 3-Phase Energy (from source to load)
MVARh3P_IN	MVAR	Reactive 3-Phase Energy (from load to source)
MVARh3P_OUT	MVAR	Reactive 3-Phase Energy (from source to load)
MVAh3P	MVA	Apparent 3-Phase Energy

To reset energy meter values, issue the **MET RE** command.

Maximum and Minimum Metering

Maximum and minimum metering allows you to determine maximum and minimum operating quantities such as currents, voltages, power, and frequency. *Table 5.6* lists the max/min metering quantities.

Table 5.6 Maximum/Minimum Meter Values

Values		Units	Description
Currents (3 ACI / 3 AVI)			
IAX, IBX, ICX		A	Line
IGX		A	Residual Ground
3I2X		A	Negative-Sequence
Voltages (3 AVI or 3 ACI / 3 AVI)			
VA, VB, VC or VAB, VBC, VCA		V	Line or Line-to-Line
VG		V	Residual Ground
3V2		V	Negative-Sequence
Power			
P		kW	Real Power
Q		kVAR	Reactive Power
S		kVA	Apparent Power
Other			
FREQ		Hz	System Frequency

All maximum and minimum metering values will have the date and time that they occurred. The analog quantities from *Table 5.6* are checked approximately every 0.5 seconds and, if a new maximum or minimum value occurs, this value is saved along with the date and time that the maximum or minimum value occurred. Maximum and minimum values are only checked if the following minimum thresholds are met:

- Current values IA, IB, IC, and IN: 3% of the nominal CT rating.
- Voltage values (phase and phase-to-phase): 7.5 V and 13 V, respectively.
- Power values (real, reactive, and apparent): All three currents (IA, IB, IC) and all three voltages (VA, VB, VC or VAB, VBC, VCA) must be above their thresholds.

To reset maximum/minimum meter values, issue the **MET RM** command. The date and time of the reset are preserved and shown in the max/min meter report.

All maximum and minimum metering values are stored to nonvolatile memory four times per day and within one minute of the maximum and minimum metering values being reset.

Demand Metering

The SEL-2411P provides demand and peak demand metering based on either thermal or rolling demand calculations. The following values are supported if the appropriate cards are installed:

Table 5.7 Demand Meter Values

Values		Units	Description
Currents (3 ACI / 3 AVI)			
IAX, IBX, ICX		A	Line
IGX		A	Residual Ground
3I2X		A	Negative-Sequence

The demand metering settings (in *Table 5.8*) are available via the **SET** command. Also refer to *METER Command (Metering Data) on page 7.17*.

Depending on enable setting EDEM, these demand and peak demand values are thermal demand or rolling demand values. The differences between thermal and rolling demand metering are explained in the following subsection.

Comparison of Thermal and Rolling Demand Meters

The example in *Figure 5.5* shows the response of thermal and rolling demand meters to a step-current input. The current input is at a magnitude of zero and then suddenly goes to an instantaneous level of 1.0 per unit (a "step").

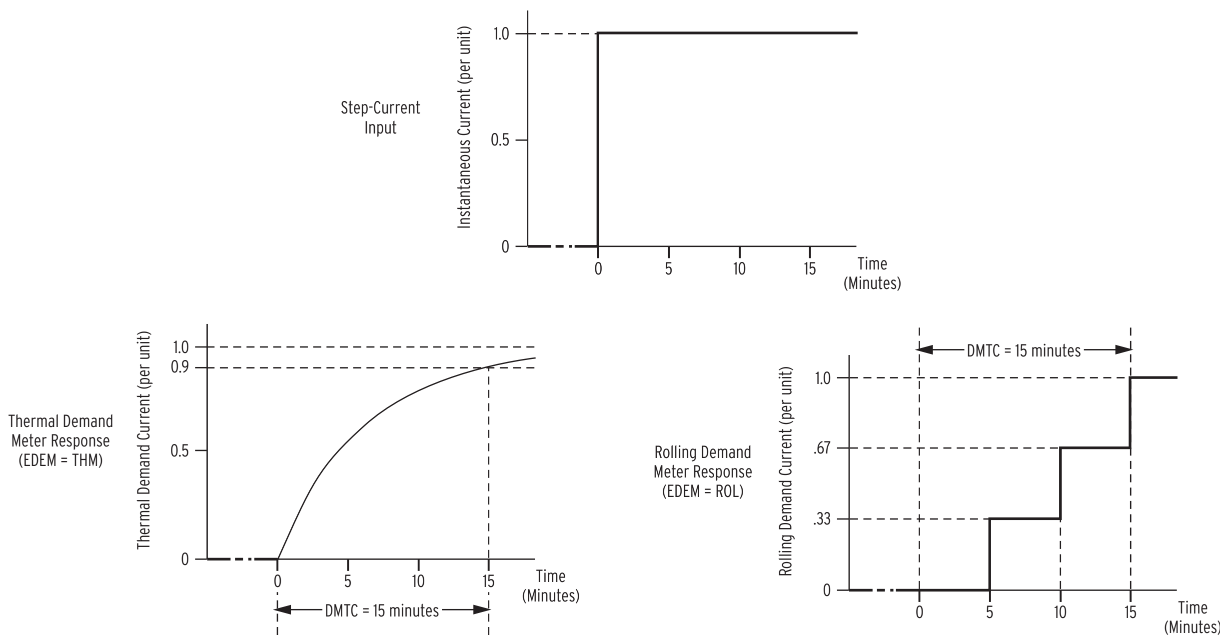


Figure 5.5 Response of Thermal and Rolling Demand Meters to a Step Input (Setting DMTC = 15 Minutes)

Thermal Demand Meter Response (EDEM := THM)

The response of the thermal demand meter in *Figure 5.5* (middle) to the step-current input (top) is analogous to the series RC circuit in *Figure 5.6*.

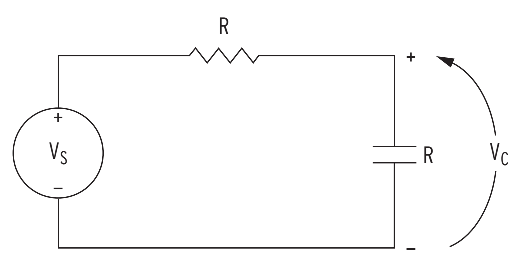


Figure 5.6 Voltage V_S Applied to Series RC Circuit

In the analogy:

Voltage V_S in *Figure 5.6* corresponds to the step-current input in *Figure 5.5* (top).

Voltage V_C across the capacitor in *Figure 5.6* corresponds to the response of the thermal demand meter in *Figure 5.5* (middle).

If voltage V_S in *Figure 5.6* has been at zero (V_S = 0.0 per unit) for some time, voltage V_C across the capacitor in *Figure 5.6* is also at zero (V_C = 0.0 per unit). If voltage V_S is suddenly stepped up to some constant value (V_S = 1.0 per unit), voltage V_C across the capacitor starts to rise towards the 1.0 per unit value. This voltage rise across the capacitor is analogous to the response of the thermal demand meter in *Figure 5.5* (middle) to the step-current input (top).

NOTE: The examples in this section discuss demand current, but MVA, MW, and MVAR demand values are also available, as stated at the beginning of this subsection.

In general, because voltage V_C across the capacitor in *Figure 5.6* cannot change instantaneously, the thermal demand meter response is not immediate either for the increasing or decreasing applied instantaneous current. The thermal demand meter response time is based on the demand meter time constant setting DMTC (see *Table 5.8*). Note in *Figure 5.5*, the thermal demand meter response (middle) is at 90 percent (0.9 per unit) of full applied value (1.0 per unit) after a time period equal to setting DMTC := 15 minutes, referenced to when the step-current input is first applied.

The SEL-2411P updates thermal demand values approximately every two seconds.

Rolling Demand Meter Response (EDEM := ROL)

The response of the rolling demand meter in *Figure 5.5* (bottom) to the step-current input (top) is calculated with a sliding time-window arithmetic average calculation. The width of the sliding time window is equal to the demand meter time constant setting DMTC (see *Table 5.8*). Note in *Figure 5.5*, the rolling demand meter response (bottom) is at 100 percent (1.0 per unit) of full applied value (1.0 per unit) after a time period equal to setting DMTC := 15 minutes, referenced to when the step-current input is first applied.

The rolling demand meter integrates the applied signal, such as step current, input in 5-minute intervals. The integration is performed approximately every 2 seconds. The average value for an integrated 5-minute interval is derived and stored as a 5-minute total. The rolling demand meter then averages a number of the 5-minute totals to produce the rolling demand meter response. In the *Figure 5.5* example, the rolling demand meter averages the three latest 5-minute totals because setting DMTC = 15 (15/5 = 3). The rolling demand meter response is updated every 5 minutes after a new 5-minute total is calculated.

Demand Meter Settings

Table 5.8 Demand Meter Settings and Settings Range

Setting	Definition	Range
EDEM	Demand meter type	THM = thermal ROL = rolling
DMTC	Demand meter time constant	5, 10, 15, 30, or 60 minutes

View or Reset Demand Metering Information

See *METER Command (Metering Data) on page 7.17*, *MET Demand/Peak Demand Metering on page 7.18*. The **MET D** command displays demand and peak demand metering.

The **MET RD** command resets the demand metering values. The **MET RP** command resets the peak demand metering values.

After demand values are reset, if setting EDEM := ROL, there may be a delay of as many as two times the DMTC setting before the demand values are updated.

Demand Metering Updating and Storage

The SEL-2411P updates demand values approximately every two seconds.

The SEL-2411P stores peak demand values to nonvolatile storage once per day and overwrites the previous stored value if it is exceeded. Should the SEL-2411P lose power, it will restore the peak demand values saved by the device at 23:50 hours on the previous day.

Analog Input Metering

The SEL-2411P can monitor analog (transducer) quantities that it is measuring if equipped with optional analog inputs. Analog input metering shows transducer values from standard voltage and current transducers. These values can then be used for automation and control applications within an industrial plant or application.

Through the global settings, you can set each type of analog input to the type of transducer that drives that analog input. You also set the range of the transducer output. Analog inputs can accept both current and voltage transducer outputs. Ranges for the current transducers are ±20 mA and ranges for the voltage transducers are ±10 V. You also set the corresponding output of the analog inputs in engineering units. See *Section 4: Logic Functions* for an explanation of how to set up analog inputs for reading transducers. *Figure 5.7* shows an example of analog input metering.

```
=>MET AI <Enter>

SEL-2411P                                  Date: 11/28/2005   Time: 16:22:22
DEVICE                                    Time Source: Internal

Input Card 4
AI501 (psi)         99.97
AI502 (mA)           2.013
AI503 (Volts)       -0.0027
AI504 (ft-lbs)     993
AI505 (HP)        1423
AI506 (mA)           9.013
AI507 (mA)          -3.014
AI508 (mA)          -0.013

=>
```

Figure 5.7 Device Response to the METER AI Command

Math Variable Metering

Use math variable metering to verify the values of the math variables. The SEL-2411P includes 64 math variables. When you receive your SEL-2411P, no math variables are enabled if you chose the no template option. To use math variables, enable the number of math variables (between 1 and 64) you require, using the EMV setting in the Logic setting category. *Figure 5.8* shows the device response to the **METER MV M(ath) V(ariable)** command with eight of the 64 math variables enabled.

```
=>>MET MV <Enter>

SEL-2411P                                    Date: 02/15/2005   Time: 14:15:43
DEVICE                                      Time Source: Internal

MV01       1.00
MV02  -32767.00
MV03      -1.00
MV04       0.00
MV05    1000.59
MV06   -1000.61
MV07    2411.01
MV08    2410.99

=>>
```

Figure 5.8 Device Response to the MET MV Command

When Global Setting DELTA_Y = DELTA, you still may use the phase-to-neutral voltage quantities (VA, VB, VC) in math variable equations, but the SEL-2411P zeros these values out.

Remote Analog Metering

Use remote analog metering to verify the values received from an external device. The SEL-2411P includes 128 remote analog variables. In *Appendix C: SEL Communications Processors*, we show how to enter remote analog settings in an SEL Communications Processor and the SEL-2411P. *Figure 5.9* shows the device response to the **METER RA** command for the settings in *Appendix C: SEL Communications Processors*.

NOTE: The setting ERAFAST enables updating RA001–RA032 at the SELOGIC processing interval instead of the standard 100 ms analog processing interval.

```
=>>MET RA <Enter>

SEL-2411P                                    Date: 02/15/2005   Time: 13:42:23
DEVICE                                      Time Source: External

RA01      1.00
RA02 -32767.00
RA03     -1.00
RA04      0.00
RA05   1000.59
RA06  -1000.61
RA07   2411.01
RA08   2410.99
RA09  98303.00
RA10 -98303.00
RA11 -38400.00
RA12 -65536.00
RA13      0.00
RA14      0.00
RA15      0.00
 •          •
 •          •
 •          •
RA126     0.00
RA127     0.00
RA128     0.00

=>>
```

Figure 5.9 Device Response to the MET RA Command

Analog Signal Profiling

IMPORTANT NOTE: All stored signal data are lost when changing either SPLIST1 or SPLIST2 settings.

Use the analog signal profiling function to record and track values of up to 32 analog channels. This function provides human-readable data in ASCII format (**PRO** command) and machine readable data in CASCII format (**CPR** command) that is compatible to import directly into applications like spreadsheets. Specify the analog quantities for profiling with the SPLIST1 and SPLIST2 report settings (see *Section 6: Settings* for more information).

Signal Profile Settings

IMPORTANT NOTE: All stored signal data are lost when changing either SPLIST1 or SPLIST2.

Enter as many as 16 analog quantities, separated by spaces or commas, into either SPLIST1 or SPLIST2 settings, for a total of 32 analog quantities. Choose from the analog quantities in *Appendix H: Analog Quantities*. *Table 5.9* shows the settings for the Signal Profile List.

Table 5.9 Signal Profile List Settings

Settings Prompt	Description	Setting Range	Default Settings
SPLIST1	Signal Profile List	As many as 16 analog quantities	NA
SPLIST2	Signal Profile List	As many as 16 analog quantities	NA
SPAR	Signal Profile Acquisition Rate	5, 10, 15, 30, 60 min	5
SPEN[a]	Signal Profile Enable	SV	1

[a] Enter as many as 14 nested parentheses and as many as 15 elements.

At the data acquisition rate of 5 minutes, the SEL-2411P stores at least 10 days of all analog signals selected for profiling in nonvolatile memory. The report includes the time of acquisitions and the magnitude of each selected analog quantity. By defining conditions in the signal profiling enable SELOGIC variable setting (SPEN), you can record analog values only at particular periods or conditions of interest. Depending on the card configuration of the device, you can choose any analog quantity shown in *Appendix H: Analog Quantities*.

Because the data are optimally formatted for machine-to-machine compatibility, use software such as Microsoft Excel to display the profile data. *Figure 5.10* shows the data and graphed data after importing the data (comma-delimited) into an Excel spreadsheet. Use the **PRO C**(lear) command to clear all profile data.

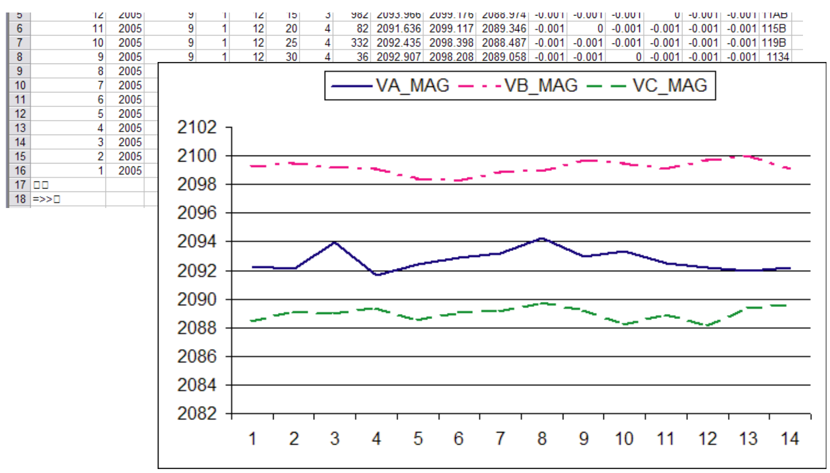


Figure 5.10 Profile Data in an Excel Spreadsheet and Graph

Pump Voltage Monitoring

The SEL-2411P provides pump voltage monitoring logic (PVML) to detect undesired pump voltage conditions, including voltage loss and phase reversal. PVML also detects the type of voltage wiring configuration that the SEL-2411P measures. For internal voltage monitoring (VMON_SRC = INTERNAL or BOTH), PVML requires line-to-line voltage, negative-sequence voltage, and zero-sequence voltage to provide the necessary measurements to detect voltage loss, phase reversal, and wiring configuration, respectively. For external voltage monitoring (VMON_SRC = EXTERNAL or BOTH), PVML uses PHS_MON to detect undesired voltage conditions by using an external device. See *VMON_SRC on page 6.28* for more details regarding VMON_SRC.

Voltage-Loss Detection Logic (SV05)

Figure 5.11 illustrates the logic for detecting a voltage-loss condition. This logic indicates a voltage loss by asserting SV05 if the line-to-line voltage magnitude, VAB_MAG, becomes less than VLL_THRS. Additionally, SV05 asserts if VBC_MAG or VCA_MAG deviates beyond a given percentage (MV01) of VAB_MAG. SV05T includes one-second pickup and dropout times.

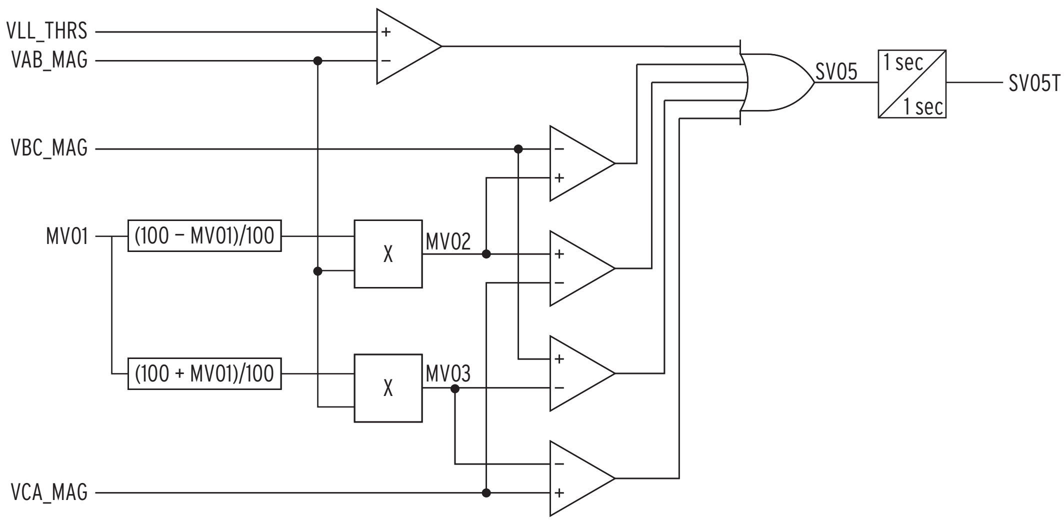


Figure 5.11 Voltage-Loss Detection Logic

Table 5.10 includes the station setting assignments that the PVML uses to implement the voltage-loss detection logic in *Figure 5.11*. PVML only uses this logic when VMON_SRC = INTERNAL or BOTH.

NOTE: By default, the voltage-loss-detection logic assumes the nominal line-to-line voltage is 240 V and uses a voltage-loss threshold (VLL_THRS) of 200 V. Adjust VLL_THRS as necessary to correctly detect voltage losses for different nominal voltages.

Table 5.10 Station Setting Assignments

Name	Value
VLL_THRS	200
MV01	10
MV02	VAB_MAG*(100-MV01)/100
MV03	VAB_MAG*(100+MV01)/100
SV05	VBC_MAG < MV02 OR VBC_MAG > MV03 OR VCA_MAG < MV02 OR VCA_MAG > MV03 OR VAB_MAG < VLL_THRS
SV05PU	1
SV05DO	1

Phase-Reversal Detection Logic (SV06)

Figure 5.12 illustrates the logic for detecting a phase-reversal condition. The logic compares the negative-sequence voltage to the A-phase, line-to-neutral voltage to determine the presence of backward rotating voltage phases. This logic will detect a phase-reversal condition only if no voltage loss has occurred (i.e., SV05 has not asserted). SV06T includes 0.5-second pickup and dropout times.

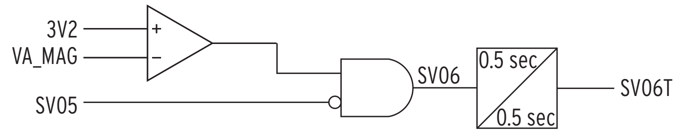


Figure 5.12 Phase-Reversal Detection Logic

Table 5.11 includes the station setting assignments that PVML uses to implement the phase-reversal detection logic in *Figure 5.12*. PVML only uses this logic when VMON_SRC = INTERNAL or BOTH.

Table 5.11 Phase-Reversal Detection Logic Assignments

Name	Value
SV06	NOT SV05 AND 3V2 > VA_MAG
SV06PU	0.5
SV06DO	0.5

Voltage Monitor Alarm (PHS_ALM)

PHS_ALM is the primary voltage monitoring alarm that asserts when the PVML detects any undesired voltage conditions. *Figure 5.13* illustrates the logic for the voltage monitor alarm. Depending on the VMON_SRC setting, PHS_ALM asserts when either PHS_MON, SV05T, or SV06T asserts.

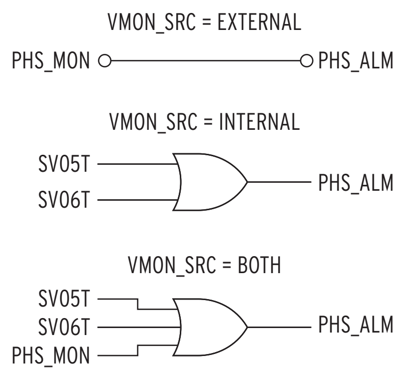


Figure 5.13 Voltage Monitor Alarm

Table 5.12 includes the station setting assignments for PHS_ALM for each VMON_SRC setting.

Table 5.12 PHS_ALM Logic Assignments

VMON_SRC	PHS_ALM Value
EXTERNAL	PHS_MON
INTERNAL	SV05T or SV06T
BOTH	SV05T or SV06T or PHS_MON

Wiring-Configuration Detection Logic (SV07 and SV08)

Wiring-configuration detection logic indicates the presence of either a high-leg delta or wye voltage connection (see *Figure 5.14*) to the SEL-2411P. The logic requires all phase-to-neutral voltage measurements to appropriately measure zero-sequence voltage. Consequently, it does not work for open-delta voltage connections and requires that DELTA_Y = WYE before it can measure zero-sequence voltage. See *Current Connections on page 2.13* for more details regarding voltage connections.

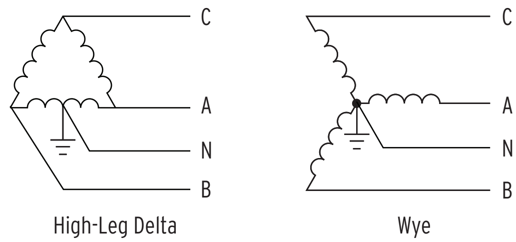


Figure 5.14 Wiring Configurations for High-Leg Delta and Wye

Figure 5.15 illustrates the logic that PVML uses for voltage wiring configuration detection. When the zero-sequence voltage magnitude (VG_MAG) becomes greater than or equal to one half of the A-phase voltage magnitude (VA_MAG), SV07 asserts, indicating the presence of a high-leg delta wiring configuration. Conversely, when the zero-sequence voltage magnitude (VG_MAG) becomes less than one half of the A-phase voltage magnitude (VA_MAG), SV08 asserts. indicating the presence of a wye voltage configuration. This logic asserts SV07 or SV08 only if no voltage loss has occurred (i.e., SV05 has not asserted). SV07T and SV08T include 0.5-second pickup and dropout times.

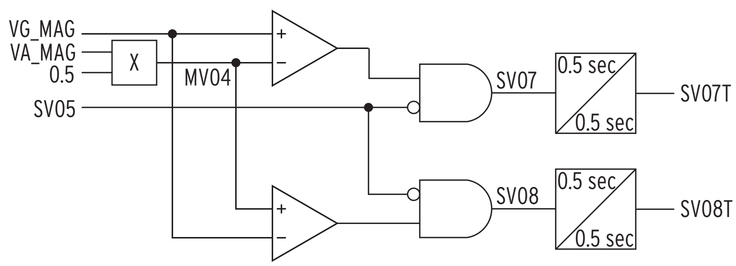


Figure 5.15 Wiring Configuration Detection Logic

Table 5.13 includes the station settings logic assignments for the voltage wiring configuration detection logic assignments, SV07 and SV08.

Table 5.13 Wiring Configuration Detection Logic Assignments

Name	Value
SV07	NOT SV05 AND VG_MAG >= MV04
SV07PU	0.5
SV07DO	0.5
SV08	NOT SV05 AND VG_MAG < MV04
SV08PU	0.5
SV08DO	0.5
MV04	VA_MAG*0.5

Section 6
Settings

Overview

The SEL-2411P Pump Automation Controller stores settings you enter in nonvolatile memory. Settings are divided into seven setting classes (Device, Logic, Global, Port, Front-Panel, Report, and DNP settings). In this section, we discuss the following setting classes (see *Section 4: Logic Functions* settings for Logic settings, and *Appendix D: DNP3 Communications* for DNP settings):

1. Device
2. Global
3. Port *p* (where *p* = F, 1 (Ethernet), 2, 3, or 4)
4. Front-Panel Set
5. Report
6. Station

Some setting classes have multiple instances. In the above list, there are four port setting instances, one for each port. *Table 6.1* shows the three different ways in which you can view or set the device settings.

Table 6.1 Methods of Accessing Settings

	Serial Port Commands[a]	Front-Panel HMI Set/Show Menu[b]	ACSELERATOR QuickSet SEL-5030 (PC software)[c]
Display Settings	All settings (**SHO** command)	All settings	All settings
Change Settings	All settings (**SET** command)	All settings	All settings

[a] Refer to Section 7: Communications for detailed information on setup and use of the serial communications port.

[b] Refer to Section 8: Front-Panel Operations for detailed information on the front-panel layout, menus and screens, and operator control pushbuttons.

[c] Refer to Section 3: Getting Started for detailed information.

Setting entry error messages, together with corrective actions, are also presented in this section to assist correct settings entry. The SEL-2411P settings sheets at the end of this section list all SEL-2411P settings.

View/Change Settings Using the Front Panel

You can use the pushbuttons on the front panel to view/change settings. *Section 8: Front-Panel Operations* presents the operating details of the front panel. Enter the front-panel menu by pushing the **ESC** pushbutton. It will display the following message:

```
MAIN
Device
```

Scroll down the menu by using the **Down Arrow** pushbutton until the display shows the following message:

```
MAIN
Set/Show
```

The cursor (underline) should be on the **SET/SHOW** command. Enter the **SET/SHOW** command by pushing the **Enter** pushbutton. The display shows the following message:

```
SET/SHOW
Device
```

Select the underlined `Device` message with the **Enter** pushbutton, and the device will present you with the Device settings as listed in the SEL-2411P settings sheets. Use the **Up Arrow**, **Down Arrow**, **Left Arrow**, and **Right Arrow** pushbuttons to scroll through the Device settings and view/change them according to your needs by selecting and editing them. After viewing/changing the Device settings, press the **ESC** pushbutton until the following message appears:

```
Save Changes?
Yes No
```

Select and enter the appropriate command by pushing the **Enter** pushbutton. Select **Yes** to save the settings changes and **No** to discard the changes.

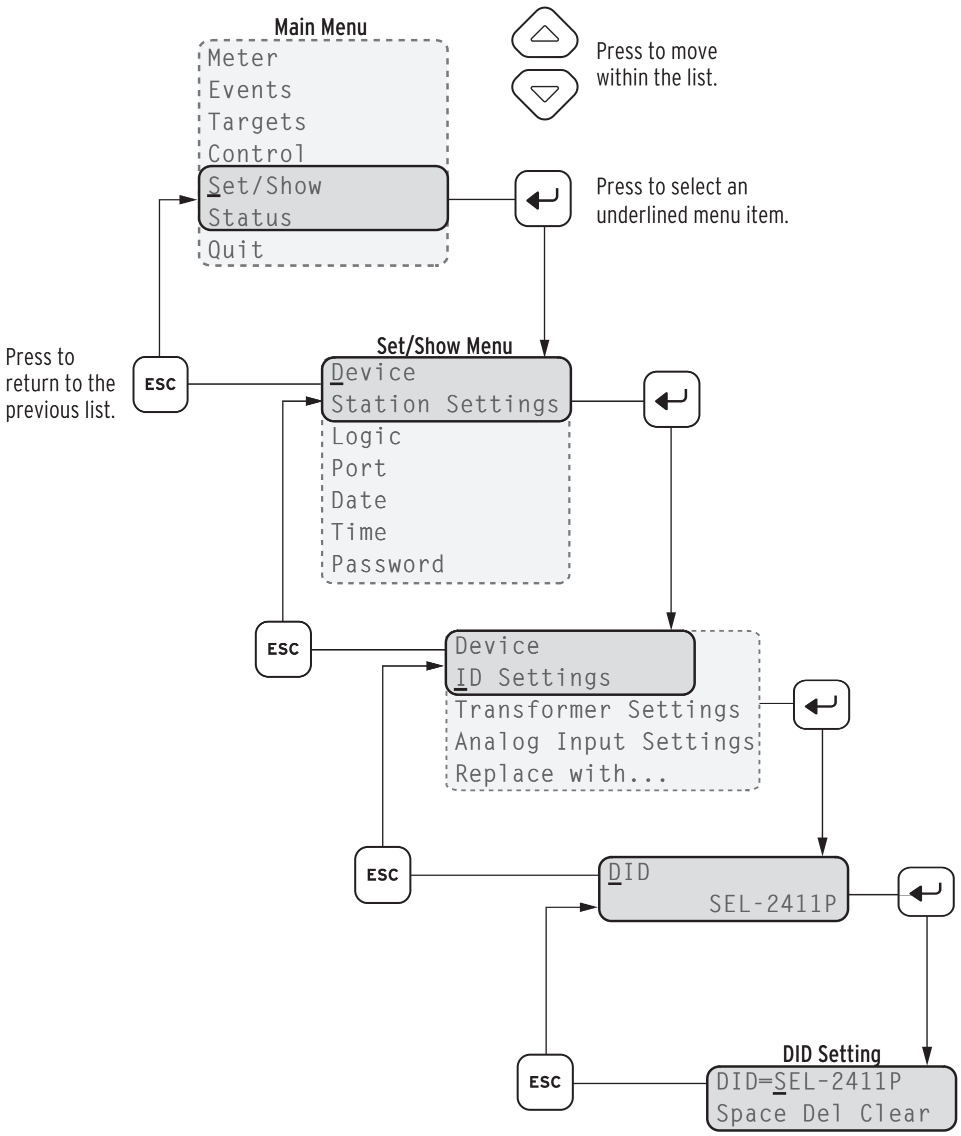


Figure 6.1 Front-Panel Setting Entry Example

View/Change Settings Over Communications Port

Refer to *Section 7: Communications* for information on how to set up and access the device serial or Ethernet port with a personal computer and how to use ASCII commands to communicate with the device.

View Settings

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

Table 6.2 SHO Command

Command	Description	Access Level
SHO *k*	Show device settings	1
SHO A	Show all device settings: enabled, disabled/hidden	1
SHO F *k*	Show front-panel settings	1
SHO L *k*	Show logic settings	1
SHO G *k*	Show Global settings	1
SHO P *n k*	Show serial port settings, *n* specifies either Port F or Ports 1 through 4; defaults to the active port if not listed	1
SHO R *k*	Show report settings such as Sequential Events Recorder (SER) and Event Report (ER) settings	1
SHO S	Show station settings	1
SHO DNP *k*	Show DNP3 settings	1

Replace ***k*** with the specific setting name you want to view in the **SHOW** command to immediately jump to the setting. If ***k*** (the setting name) is not included, the device presents settings beginning with the first one in the group. The **SHOW** command 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 Settings

The **SET** command (available from Access Level 2) allows you to view or change settings. *Table 6.3* lists the **SET** command options. The alarm contact closes for one second when saving new settings.

Table 6.3 SET Command

Command	Description	Access Level
SET *k* TERSE	Set Device settings	2
SET F *k* TERSE	Set front-panel settings	2
SET L *k* TERSE	Set Logic settings	2
SET G *k* TERSE	Set Global settings	2
SET P *n k* TERSE	Set serial port settings, depending on the device configuration, *n* specifies either Port F or Ports 1 through 4; defaults to the active port if not listed	2
SET R *k* TERSE	Set SER report settings	2
SET S TERSE	Set station settings	2
SET DNP *k* TERSE	Set DNP3 settings	2

Replace ***k*** with the specific setting name you want to change in the **SET** command to immediately jump to the setting. If ***k*** (the setting name) is not included, the device presents settings beginning with the first one in the group. Enter a new setting or press **<Enter>** to accept the existing setting. *Table 6.4* lists the editing keystrokes.

Table 6.4 SET Command Editing Keystrokes

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

As you enter Device settings, the device checks the setting entered against the range for the setting as published on the device settings sheets. If any setting entered falls outside the corresponding range for that setting, the device immediately responds `Out of Range` and prompts you to reenter the setting. In addition to the immediate range check, several of the settings have interdependency checks with other settings. The device checks setting interdependencies after you answer **Y** to the `Save Settings?` prompt, but before the settings are stored. If any of these checks fail, the device issues an error message, and returns you to the settings list for a correction.

Device Settings (SET Command)

Under the Device setting category, we set the device and terminal identifiers, settings pertaining to the analog (transducer) input (AI) cards, analog output (AO) cards, and transformers. The SEL-2411P displays the Device and Terminal Identifier strings at the top of responses to serial port commands identifying messages from individual devices. Enter as many as 16 characters, including capital letters A–Z, numbers 0–9, periods (.), dashes (-), and spaces. *Table 6.5* shows the device and terminal identifiers settings.

Table 6.5 Device and Terminal Identifiers

Setting Prompt	Setting Range	Setting Name := Factory Default
Device ID	16 Characters	DID := SEL-2411P
Terminal ID	16 Characters	TID := DEVICE

Transformer Settings

For devices with a current card, a voltage card, or both current and voltage cards installed, the device prompts for the settings as shown in *Table 6.6*.

Table 6.6 Current and Voltage Transformer Settings (Sheet 1 of 2)

Setting Prompt	Setting Range	Setting Name := Factory Default
Current Transformer Ratio	1–5000	CTR := 250
Neutral Current Transformer Ratio	1–5000	CTRN := 250

Table 6.6 Current and Voltage Transformer Settings (Sheet 2 of 2)

Setting Prompt	Setting Range	Setting Name := Factory Default
Additional Current Transformer Ratio	1–5000	CTRX := 250
Potential Transformer Ratio	1.00–10000.00	PTR := 35.00

Potential Transformer (PT) Ratios

Device setting PTR is the potential transformer ratio from the primary system to the SEL-2411P VT-terminal voltage inputs. See voltage input details in *Figure 2.12*.

For example, on a 12.47 kV phase-to-phase primary system with wye-connected 7200:120 V PTs, the correct PTR setting is 7200 / 120 = 60.00.

Setting PTR Adjustments for Low-Energy Analog (LEA) Inputs

The SEL-2411P can be ordered with 3 AC voltage inputs, with a maximum input voltage of 300 V using the 3 ACI/3 AVI card. The SEL-2411P can also be ordered with three 8 Vac low-energy analog (LEA) inputs, suitable for high-impedance sensors such as capacitive screen voltage dividers and resistive voltage dividers. The LEA input option is only available on the terminals of the 3 ACI/3 AVI combination card.

The SEL-2411P does not internally scale the LEA inputs any differently than the 300 V inputs. An 8 V (LEA) input with 4 Vac applied will appear as 3.843 / 7.686 = 50% of full-scale, or 150 Vac on a 300 V base. Any VT-terminal voltage-related settings have the same setting range, regardless of whether the VT-terminal voltage inputs are standard 300 V inputs or LEA (8 V) inputs. When the VT-terminal voltage inputs are LEA (8 V) inputs, the SEL-2411P still thinks it is looking at a 300 V input, even though the LEA inputs have a 7.686 V range.

One step in making the VT-terminal voltage-related settings work when the VT-terminal voltage inputs are LEA (8 V) inputs is to set the VT-terminal PT ratio setting (PTR), as follows:

$$\text{setting PTR} = (\text{PTR}_{\text{LEA}}) \bullet \left(\frac{7.686}{300}\right) \qquad \textbf{Equation 6.1}$$

where PTR_{LEA} is the effective nominal PT ratio of the voltage divider connected between the primary system and the LEA inputs (e.g., PTR_{LEA} = 10000). PTR_{LEA} is also referred to as the marked ratio. Again, the SEL-2411P thinks it is looking at a 300 V range signal, when the LEA inputs actually have only a 7.686 V range. Thus, PTR_{LEA} is corrected by a 7.686 / 300 factor (7.686 V / 300 V = 7.686 / 300) in *Equation 6.1*.

EXAMPLE 6.1 Setting PTR for LEA Inputs

A voltage divider (10000 ratio) is connected between a 12.47 kV system (7.2 kV line-to-neutral) and the LEA inputs (similar to Example 6.5).

PTR_{LEA} = 10000 = marked ratio

Using Equation 6.1:

$$\text{setting PTR} = (\text{PTR}_{\text{LEA}}) \bullet \left(\frac{7.686}{300}\right)$$

$$= 10000 \bullet \left(\frac{7.686}{300}\right) = 256.20 \qquad \textbf{Equation 6.2}$$

$$\frac{7200\ \text{V}}{10000} = 0.72\ \text{V}$$ (actual voltage divider output to the LEA inputs; 8 V base)

$$\frac{0.72\ \text{V}}{7.686\ \text{V}} = 0.0937\ \text{per unit output}$$ (9.4% of full scale)

$$0.0937 \bullet 300\ \text{V} = 28.10\ \text{V}$$ (the device thinks it is looking at 28.10 V on a 300 V base, not 0.72 V on a 7.686 V base)

$$\frac{7200\ \text{V}}{28.10\ \text{V}} = 256.20$$ (same as setting PTR in Equation 6.2)

The PTR setting in *Equation 6.1* is used to take these 300 V base secondary voltage values (that the SEL-2411P thinks it sees) and ratio them up to primary values for metering and event reports.

Voltage-Related Settings and Low Energy Analog (LEA) Inputs

Read the setting PTRY/LEA discussion in the preceding *Potential Transformer (PT) Ratios on page 6.6* subsection.

When the VT-terminal voltage inputs are LEA (8 V) inputs, any voltage-related setting tied to the VT-terminal voltage inputs is adjusted by a factor of 300/7.686.

EXAMPLE 6.2 Voltage Setting Conversion to 300 V Base

This example uses much of the same information in Example 6.1. A voltage divider (10000 ratio) is connected between a 12.47 kV system (7.2 kV line-to-neutral) and the LEA inputs.

$$\frac{7200\ \text{V}}{10000} = 0.72\ \text{V}$$ (actual voltage divider output to the LEA inputs; 8 V base)

$$0.72\ \text{V} \bullet \frac{300}{7.686} = 28.103\ \text{V}$$ (the device thinks it is looking at 28 V on a 300 V base, not 0.72 V on an 8 V base)

28 V is the nominal adjusted secondary voltage—adjusted by the 300/8 factor from an 8 V base to a 300 V base. For this same example, if a 0.8 V output of the LEA (8 V base) is deemed an overvoltage condition, then a pickup setting could be set at:

$$0.8\ \text{V} \bullet \frac{300}{7.686} = 31.23\ \text{V} \qquad (300\ \text{V base})$$

Voltage-Related Settings Possibly Limited by RCF Settings

Read the preceding *Voltage Ratio Correction Factors for VT-Terminal Voltage Inputs on page 6.22*.

If most of the voltage range for VT-terminal voltage inputs (ordered as LEA [8 V] inputs) is used in a particular installation (i.e., the nominal applied secondary voltage is close to or equal to 8 V), then a ratio correction factor (RCF) set below unity (RCF < 1.000) can effectively limit the upper setting range of a voltage-related setting.

This subsection, together with *Example 6.2*, discusses making voltage-related settings for LEA (8 V) inputs by applying an adjustment factor of 300/7.686. This adjustment factor puts the setting on a 300 V base. Thus, a 7.686 V signal on an LEA (8 V) input translates to a 300 V signal on a 300 V base. 300 V is the upper setting range for the phase-to-neutral voltage-related settings.

For example, if the RCF for voltage input V2Y is set:

$$\text{global setting VARCF} = 0.900 \qquad (< 1.000\text{; set below unity})$$

and 7.686 V is applied to voltage input VAR, then this applied voltage is normalized to:

$$7.686 \text{ V} \bullet 0.900 = 6.9174 \text{ V} \ \ (\text{normalized voltage from voltage input VAR})$$

8 V is the upper limit for voltage that can be applied to the VT-terminal voltage inputs. Assuming the above 0.900 RCF is the lowest RCF for the VT-terminal voltage inputs and that the normalized voltages for all the voltage inputs should be 6.9174, then the maximum applied voltages for the other two channels (RCF's > 0.900) must be less than 8 V:

$$\frac{6.9174 \text{ V}}{\text{RCF}} < 7.686 \qquad (\text{RCF} > 0.900)$$

The 6.9174 V normalized voltage in this example translates to 270 V on a 300 V base:

$$6.9174 \text{ V} \bullet \frac{300}{7.686} = 270 \text{ V} \qquad (300 \text{ V base})$$

270 V is thus the effective upper setting range for the phase-to-neutral voltage-related settings in this example. A phase-to-neutral voltage-related setting can be set higher (e.g., 290 V), but for voltage input VAR such a setting would be indistinguishable from a 270 V setting, in this example. The VT-terminal voltage inputs (ordered as LEA [8 V] inputs) cannot distinguish voltages above 8 V.

$$7.686 \text{ V} \bullet 0.900 \bullet \frac{300}{7.686} = 270 \text{ V} \qquad (300 \text{ V base})$$

Preceding *Example 6.2* is **not** an example of this possible effective limiting of the upper setting range of voltage-related settings. In *Example 6.2*, the nominal applied secondary voltage to the VT-terminal voltage inputs is 6.9174 V, no where near the 7.686 V upper limit for VT-terminal voltage inputs (ordered as LEA [8 V] inputs).

Analog Inputs

For an SEL-2411P configuration without the pump-voltage-monitoring card, the device samples all analog inputs at a fixed value of 4 ms regardless of the frequency of the power system. See *Sampling and Processing Specifications on page 1.7* for more information. 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 different cards in the rear-panel slot on the device, the setting prompt adapts to the *x* and *y* variables shown in *Figure 6.2*. Variable *y* displays the transducer (analog) input number (1 through 8).

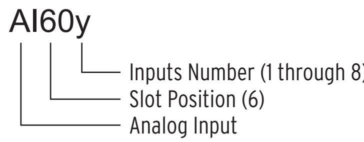


Figure 6.2 Analog Input Names

Analog-Input Field Calibration Process

In the analog-input circuit, the dominant error is signal offset. To minimize the signal offset, we adjust each of the device analog-input channels by a compensation factor. These compensation factors correct the signal offset errors to within ±1 µA or ±1 mV.

Signal offset compensation factor calculation procedure is as follows.

1. Turn the SEL-2411P on and allow it to warm up for a few minutes.
2. Set the analog inputs for each analog channel to the desired range (e.g., ±1 mA), using the AI*xxx*TYP, AI*xxx*L, and AI*xxx*H settings.
3. Set AI*xxx*EL equal to AI*xxx*L and AI*xxx*EH equal to AI*xxx*H.
4. Using a calibrated source, drive the signal line from the transducer end to the low value (e.g., 4 mA).
5. Issue the command **MET AI 10** to obtain ten measurements for each channel.
6. Record these ten measurements, then calculate the average of the ten measurements by adding the ten values algebraically, and dividing the sum by ten. This is the experimental low value (e.g., 3.9 mA).
7. Enter this value in AI*xxx*L.
8. Drive the line to the high value (e.g., 20 mA).
9. Issue the command **MET AI 10** to obtain ten measurements for each channel.
10. Record these ten measurements, then calculate the average of the ten measurements by adding the ten values algebraically, and dividing the sum by ten. This is the experimental high value (e.g., 20.012 mA).
11. Set AI*xxx*EL and AI*xxx*EH to the desired values (e.g., 0–22.45 feet).

Analog-Input Setting Example

Assume we installed an analog card in Slot 6. On Input 1 of this analog card, we connect a 4–20 mA pressure transmitter. The pressure sensor in this device transduces the pressure exerted by the fluid in the tank. The transmitter transmits 4 mA for 0 psi. It transmits 20 mA for 10 psi. We have already installed the correct hardware jumper (see *Section 2: Installation* for more information) for Input 1 to operate as a current input. When the SEL-2411P is turned on, allow approximately five seconds for it to boot up, perform self-diagnostics, and detect installed cards.

Table 6.7 summarizes the steps and describes the settings we will carry out in this example.

Table 6.7 Summary of Steps

	Step	Activity	Terse Description
General	1	SET AIx01NAM	Access settings for INPUT 1
	2	LEVEL_AI	Enter a Tag name
	3	I	Select type of analog input; “I” for current
Level	4	Feet	Enter Engineering unit
	5	0	Enter Engineering unit value LOW
	6	22.45	Enter Engineering unit value HIGH
Low Warning/ Alarm	7	OFF	Enter LOW WARNING 1 value
	8	OFF	Enter LOW WARNING 2 value
	9	OFF	Enter LOW ALARM value
High Warning/ Alarm	10	OFF	Enter HIGH WARNING 1 value
	11	OFF	Enter HIGH WARNING 2 value
	12	OFF	Enter HIGH ALARM value

Because the analog card is in Slot 6, type **SET AIx01NAM <Enter>** (**SET** with no setting category assumes the device setting category) to go directly to the setting for Slot 6, Input 1. Although the device accepts alphanumeric characters, the name AI*x*0*y*NAM setting must begin with an alpha character (A through Z) and not a number. The device displays the following prompt:

NOTE: The AIx0yNAM setting cannot accept the following:
Analog Quantities
Duplicate Names
Other AI Names

```
AIx01 Instrument Tag Name (8 Characters)   AIx01NAM:= LEVEL_AI ?
```

Use the Instrument Tag Name to give the analog quantity a more descriptive name. This tag name appears in reports (EVENT, METER, and SUMMARY) instead of the default name of AIx01. SELOGIC control equations, signal profiles, and Fast Message read use the default names. Use up to eight valid tag name characters to name the analog quantity. Valid tag names characters are: 0–9, A–Z, and the underscore (_). For this example, we assign LEVEL_AI as the tag name.

Because this is a 4–20 mA transducer, enter **I <Enter>** (for current driven device) at AIx01TYP, the next prompt (enter **V** if this is a voltage-driven device). The next two settings define the lower level (AIx01L) and the upper level (AIx-01H) of the transducer. In this example, the low level is 4 mA and the high level is 20 mA.

```
AIx01 Type       (I,V)                          AIx01TYP:= I        ?
```

NOTE: Because the SEL-2411P accepts current values ranging from –20.48 to 20.48 mA, be sure to enter the correct range values.

The next three settings define the applicable engineering unit (AIx01EU), the lower level in engineering units (AIx01EL) and the upper level in engineering units (AIx01EH). Engineering units refer to actual measured quantities, i.e., temperature, pressure, level, etc. Use the 16 available characters to assign descriptive names for engineering units. Because we measure the level of fluid in this example, enter “feet” (without quotation marks) as engineering units. Enter **0** for the lower level and **22.45 ft** for the upper level.

We recommend the following process to calibrate your analog level sensor and set values for AIx01L, AIx01H, AIx01EL, and AIx01EH. We also recommend using a fluid with density that closely matches the operational fluid density.

1. Empty the tank to a level that your design specifies as zero level.
2. Issue the command **MET AI 10** to obtain ten measurements for each channel.

3. Record these ten measurements, then calculate the average of these ten measurements for AIx01. This is the experimental low value.
4. Enter this value in AIx01L.
5. Measure the fluid level by using a measuring stick or another method. Enter the level in feet for AIx01EL.
6. Allow the fluid to fill up to the maximum fill level according to your design specification.
7. Issue the command **MET AI 10** to obtain ten measurements for each channel.
8. Record these ten measurements, then calculate the average of these ten measurements for AIx01. This is the experimental high value.
9. Enter this value in AIx01H.
10. Measure the fluid level by using a measuring stick or another method. Enter the level in feet for AIx01EH.

Set any other current or voltage transducers by following these same guidelines.

```
=>>SET AI301NAM TERSE <Enter>

Analog Input 501 Settings

AI501 Instrument Tag Name (8 characters 0-9,A-Z,_)
AI501NAM:= AI501
? TX_TEMP <Enter>
AI501 Type (I,V)                                AI501TYP:= I        ? <Enter>
AI501 Low Input Value (-20.480 to 20.480 mA)    AI501L  := 4.000    ? <Enter>
AI501 High Input Value (-20.480 to 20.480 mA)   AI501H  := 20.000   ? <Enter>
AI501 Engineering Units (16 characters)
AI501EU := mA
? degrees C <Enter>
AI501 Engineering Unit Low (-99999.000 to 99999.000)
                                                AI501EL := 4.000    ? -50 <Enter>
AI501 Engineering Unit High (-99999.000 to 99999.000)
                                                AI501EH := 20.000   ? 150 <Enter>
AI501 Low Warn Level 1 (OFF,-99999.000 to 99999.000)
                                                AI501LW1:= OFF      ? <Enter>
AI501 Low Warn Level 2 (OFF,-99999.000 to 99999.000)
                                                AI501LW2:= OFF      ? <Enter>
AI501 Low Alarm (OFF,-99999.000 to 99999.000)   AI501LAL:= OFF      ? <Enter>
AI501 High Warn Level 1 (OFF,-99999.000 to 99999.000)
                                                AI501HW1:= OFF      ? 65 <Enter>
AI501 High Warn Level 2 (OFF,-99999.000 to 99999.000)
                                                AI501HW2:= OFF      ? 95 <Enter>
AI501 High Alarm (OFF,-99999.000 to 99999.000)  AI501HAL:= OFF      ? 105 <Enter>

Analog Input 502 Settings

AI502 Instrument Tag Name (8 characters 0-9,A-Z,_)
AI502NAM:= AI502
? END <Enter>

Save changes (Y,N)? Y <Enter>
Settings Saved

=>>
```

Figure 6.3 Settings to Configure Input 1 as a 4–20 mA Transducer, Measuring Temperatures Between –50°C and 150°C

Analog Input Settings

Table 6.8 shows the setting prompt, setting range, and factory default settings for an analog-input card in Slot 5. For the name setting (AI501NAM, for example), enter only alphanumeric and underscore characters. Characters are not case sensitive, but the device converts all lowercase characters to uppercase. Although the device accepts alphanumeric characters, the name AI501NAM setting must begin with an alpha character (A–Z) and not a number.

Table 6.8 Analog-Input Card in Slot 5

Setting Prompt	Setting Range	Setting Name := Factory Default
AI501 Instrument Tag Name	8 characters 0–9, A–Z, _	AI501NAM := AI501
AI501 Type	I, V	AI501TYP := I[a]
AI501 Low Input Value	–20.480 to +20.480 mA	AI501L := 4.000
AI501 High Input Value	–20.480 to +20.480 mA	AI501H := 20.000
AI501 Low Input Value	–10.240 to +10.240 V	AI501L := 0.000
AI501 High Input Value	–10.240 to +10.240 V	AI501H := 10.000
AI501 Engineering Units	16 characters	AI501EU := mA
AI501 Engineering Unit Low	–99999.000 to +99999.000	AI501EL := 4.000
AI501 Engineering Unit High	–99999.000 to +99999.000	AI501EH := 20.000
AI501 Low Warn Level 1	OFF, –99999.000 to +99999.000	AI501LW1 := OFF
AI501 Low Warn Level 2	OFF, –99999.000 to +99999.000	AI501LW2 := OFF
AI501 Low Alarm	OFF, –99999.000 to +99999.000	AI501LAL := OFF
AI501 High Warn Level 1	OFF, –99999.000 to +99999.000	AI501HW1 := OFF
AI501 High Warn Level 2	OFF, –99999.000 to +99999.000	AI501HW2 := OFF
AI501 High Alarm	OFF, –99999.000 to +99999.000	AI501HAL := OFF

[a] Voltage setting range for a voltage transducer, i.e., when AI501TYP := V.

Analog Outputs

Because of the flexibility to install different cards in the rear-panel slots of the device, the setting prompt adapts to the *x* and *y* variables shown in *Figure 6.4*. Variable *y* displays the Analog Output number (1 through 8).

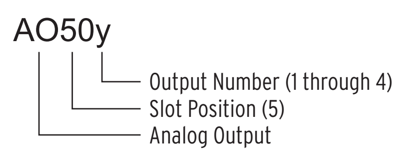


Figure 6.4 Analog Output Names

For an analog-input/output card in Slot 5, setting AO501AQ identifies the analog quantity we assign to Analog Output 1 (when set to OFF, the device hides all associated AO*x*0*y* settings and no value appears on the output). You can assign any of the analog values in *Appendix H: Analog Quantities* to an analog output.

Table 6.9 shows the setting prompt, setting range, and factory default settings for an analog card in Slot 5. For the name setting (AI501NAM, for example), enter only alphanumeric and underscore characters. Characters are not case sensitive, but the device converts all lowercase characters to uppercase. Although the device accepts alphanumeric characters, the name AO501NAM setting must begin with an alpha character (A–Z) and not a number.

NOTE: The AOxOyNAM setting cannot accept the following:
Analog Quantities
Duplicate Names
Other AI Names

Table 6.9 Output Setting for a Card in Slot 5

Setting Prompt	Description	Setting Range	Setting Name := Factory Default
AO501AQ	Analog Quantity	Analog Quantity Value	AO501AQ := OFF
AO501NAM	Instrument Tag Name	8 characters 0–9, A–Z, _	AO501NAM := AO30I
AO501TYP	Type	I, V	AO501TYP := I
AO501AQL	Analog Quantity Low	–2147483647.000 to +2147483647.000	AO501AQL := 4.000
AO501AQH	Analog Quantity High	–2147483647.000 to +2147483647.000	AO501AQH := 20.000
[a]AO501L	Low Output Value	–20.480 to +20.480 mA	AO501L := 4.000
[a]AO501H	High Output Value	–20.480 to +20.480 mA	AO501H := 20.000
[b]AO501L	Low Output Value	–10.240 to +10.240 V	AO501L := 0.000
[b]AO501H	High Output Value	–10.240 to +10.240 V	AO501H := 10.000

[a] For AO501TYP = I.
[b] For AO501TYP = V.

Pump Alternation

The SEL-2411P Pump Alternation Function Block (PAFB) provides control and alternation for as many as four pumps. Configure the inputs for the PAFB by using the settings in *Table 6.10*.

Table 6.10 Pump Alternation Settings for PAFB (x, y = 1, 2, 3, or 4)

Setting Prompt	Setting Range	Description
EPUMPS	OFF, 1–4	Number of pumps to enable
NUMSTG	1–4	Number of stages to enable (NUMSTG must be less than or equal to EPUMPS)
S*y*PUMPS	*x*,*x*,*x*,*x* or OVERRIDE(*x*,*x*,*x*,*x*)	Pumps that Stage *y* will run, where *x* represents Pumps 1–4 and *y* represents Stages 1–4.
P*x*MINRT	OFF, 1–600	Pump *x* minimum run time (seconds)
STAGSTRT	OFF, 1–300	Pump stagger-start time (seconds)
P*x*LONGRT	OFF, 1–3600	Pump *x* long run time (seconds)
PUMP*x*TO	1–300	Pump *x* timeout (seconds) before PUMP*x*FLT becomes TRUE after a pump fails to run or stop
PUMP*x*EN	SELOGIC Control Equation	Assert to enable operation of Pump *x*
PUMP*x*RUN	SELOGIC Control Equation	Assert to indicate that Pump *x* is running
STG*y*CALL	SELOGIC Control Equation	Assert to call Stage *y* to run its pump
PUMP*x*FCL	SELOGIC Control Equation	Assert to force Pump *x* to the lowest run priority that SyPUMPS allows
FRC_ALT	SELOGIC Control Equation	Assert to force stage alternation to rotate all pump run priorities (requires rising-edge input)
DIS_ALT	SELOGIC Control Equation	Assert to call disable stage alternation and lock all pumps in current stages
P*x*FLTRST	SELOGIC Control Equation	Assert to reset Pump *x* fault PUMP*x*FLT (requires rising-edge input)

Configure the number of pumps and stages for the PAFB by using EPUMPS and NUMSTG, respectively. NUMSTG must be equal to or less than EPUMPS. Assign pumps to stages by using SyPUMPS, where y represents the Stages 1, 2, 3, and 4.

Use OVERRIDE(*x*,*x*,*x*,*x*) to configure a stage to override lower stages. Only one stage may include an override assignment in its configuration.

To disable PxMINRT, STAGSTR, or PxLONGRT, set them to OFF.

Configure logic for the SELOGIC control equations in *Table 6.10* by using any logic functions and variables that SELOGIC will permit (see *Section 4: Logic Functions*).

See *Appendix J: Pump Alternation Function Block*.

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 Messenger Points phase rotation, rated frequency, CT and PT connections, date format, debounce times for each input of each installed digital input I/O card (DI card), data reset, front-panel disable setting, time-synchronization source, and voltage correction factor.

General Settings

Table 6.11 General Global Settings

Setting Prompt	Setting Range	Setting Name := Factory Default
Phase Rotation	ABC, ACB	PHROT := ABC
Rated Frequency	50, 60 Hz	FNOM := 60
Transformer Connection	DELTA, WYE	DELTA_Y := WYE
Date Format	MDY, YMD, DMY	DATE_F := MDY

The phase rotation setting tells the device your phase labeling standard. Set PHROT equal to ABC when B-phase lags A-phase by 120 degrees. Set PHROT equal to ACB when B-phase leads A-phase by 120 degrees.

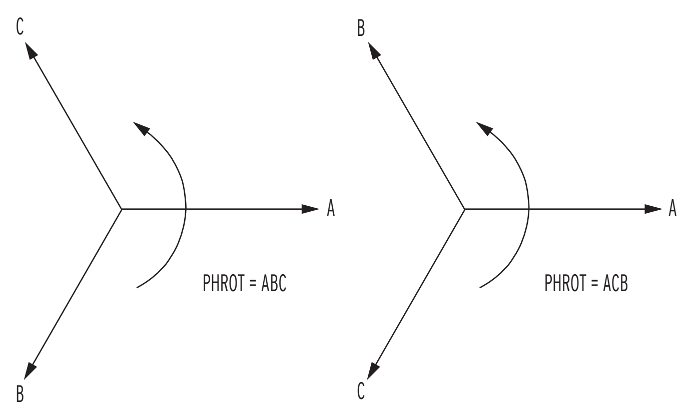


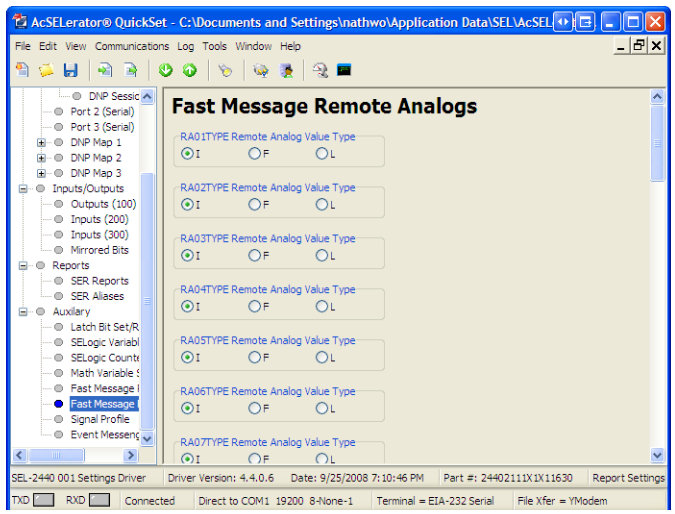
Figure 6.5 Phase Rotation Setting

Set the FNOM setting equal to your system nominal frequency. The DATE_F setting allows you to change the device date presentation format to either North American standard (Month/Day/Year), engineering standard (Year/Month/Day), or European standard (Day/Month/Year).

Fast Message Remote Analogs Settings

NOTE: When Type is set to Float, you cannot write the maximum value of 99999.99 to a remote analog. Instead, use 99999.98 as the maximum number. Similarly, use -99999.98 instead of -99999.99.

Remote devices are able to write analog quantities into the SEL-2411P using protocols such as Modbus and DNP3 (RA001 through RA128) and SEL Fast Message (RA01 through RA32). These analog quantities are available for use in Math Variable equations. If the SEL Fast Message protocol is used then the data type must be declared for each analog quantity (RA01TYPE through RA32TYPE). Choose from the analog quantities in *Appendix H: Analog Quantities*.



Event Messenger Points

Table 6.12 Event Messenger Points

Setting Prompt	Setting Range	Setting Name := Factory Default
MESSENGER POINT TRIGGER	OFF, 1 Device Word bit	MPTR1 := OFF
MESSENGER POINT ANALOG QUANTITY	NONE, 1 analog quantity	MPAQ1 := NONE
MESSENGER POINT TEXT	148 characters	MPTX1 :=
MESSENGER POINT TRIGGER	OFF, 1 Device Word bit	MPTR2 := OFF
MESSENGER POINT ANALOG QUANTITY	NONE, 1 analog quantity	MPAQ2 := NONE
MESSENGER POINT TEXT	148 characters	MPTX2 :=
MESSENGER POINT TRIGGER	OFF, 1 Device Word bit	MPTR3 := OFF
MESSENGER POINT ANALOG QUANTITY	NONE, 1 analog quantity	MPAQ3 := NONE
MESSENGER POINT TEXT	148 characters	MPTX3 :=
MESSENGER POINT TRIGGER	OFF, 1 Device Word bit	MPTR4 := OFF
MESSENGER POINT ANALOG QUANTITY	NONE, 1 analog quantity	MPAQ4 := NONE
MESSENGER POINT TEXT	148 characters	MPTX4 :=
MESSENGER POINT TRIGGER	OFF, 1 Device Word bit	MPTR5 := OFF
MESSENGER POINT ANALOG QUANTITY	NONE, 1 analog quantity	MPAQ5 := NONE
MESSENGER POINT TEXT	148 characters	MPTX5 :=

The SEL-2411P can be configured to automatically send ASCII message on a communications port when a trigger condition is satisfied. Use the **SET P** command to set PROTO := EVMSG on the desired port to select the port. This feature is designed to send messages to the SEL-3010 Event Messenger, but any device capable of receiving ASCII messages can be used.

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

Set each of MPTR*x* (*x* = 1–5) to the desired Device Word bits, the rising edge of which defines the trigger condition. Trigger conditions for Event Messenger points are updated every five seconds.

MPAQ*x* is an optional setting and can be used to specify an analog quantity to be formatted into a single message as described next.

Use MPTX*x* to construct the desired message. Note that by default the analog quantity value, if specified, will be added at the end of the message and rounded to the nearest integer value (see *Example 6.3*).

EXAMPLE 6.3 Setting MPTXx Using the Default Location of Analog Quantity

MPTX1 := THE LOAD CURRENT IS

MPAQ1 value = 157.44

Formatted message out when triggered: THE LOAD CURRENT IS 157

Location and resolution of the analog quantity value within the message can be specified by using "%.pf", where,

% defines location of the value

p defines number of digits (as many as 6, defaults to 6 if omitted)

f indicates floating-point value (use %d if nearest whole number is desired)

EXAMPLE 6.4 Setting MPTXx With a Specified Location of Analog Quantity

MPTX1 := THE LOAD CURRENT IS %.2f AMPERES

MPAQ1 value = 157.44

Formatted message out when triggered: THE LOAD CURRENT IS 157.44 AMPERES

MPTX1 := THE LOAD CURRENT IS %d AMPERES

MPAQ1 value = 157.44

Formatted message out when triggered: THE LOAD CURRENT IS 157 AMPERES

Digital Input Configuration

You can configure the SEL-2411P with as many as three DI cards, one in each of the four available slots (Slots C, D, and E). Each digital-input 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 device 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 device. *Table 6.13* shows the slot number and prompt correlation for a DI card.

Table 6.13 Slot Number and Setting Correlation

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

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 6.14* shows the rear-panel terminal number and software reference number correlation for a DI card.

Table 6.14 Rear-Panel Terminal Number and Software Reference Number Correlation (DI Card)

Rear-Panel Terminal Number	Software Reference Number[a]
01, 02	IN*x*01
03, 04	IN*x*02
05, 06	IN*x*03
07, 08	IN*x*04
09, 10	IN*x*05
11, 12	IN*x*06
13, 14	IN*x*07
15, 16	IN*x*08
17, 18	IN*x*09
19, 20	IN*x*10
21, 22	IN*x*11
23, 24	IN*x*12
25, 26	IN*x*13
27, 28	IN*x*14

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

The device 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 the appropriate settings. We then remove the card from Slot **D** and install the card into Slot 5. 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-2411P offers dc debounce as well as ac debounce modes. Therefore, if the control voltage is dc, select the dc mode of operation, and if the control voltage is ac, select the ac mode of operation. In general, debounce refers to a qualifying time delay before processing the change of state of a digital input. Normally, this delay applies to both the processing of the debounced input when used in device logic, as well as to the time stamping in the SER. 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-2411P 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 6.6 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 (internal variable), 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 (do) timers of both Debounce Timer 1 and Debounce Timer 2, i.e., you cannot 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).

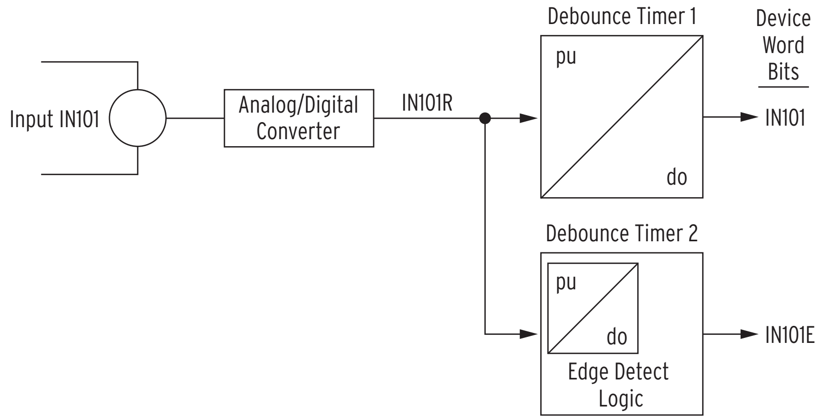


Figure 6.6 DC Mode Processing

Figure 6.7 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 IN101, be sure to enter Device Word bit IN101E in the SER. During the time when Debounce Timer 2 runs, the device ignores all edge changes. At the end of this timing period, the device evaluates the status of IN101R (either logical 0, or logical 1), and sets Device Word bit IN101E to this value. In *Figure 6.7*, IN101R has a status of logical 1 and Device Word bit IN101E remains at logical 1.

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

When changing from the asserted state to the deasserted state, the inverse operation applies, as shown in *Figure 6.8*.

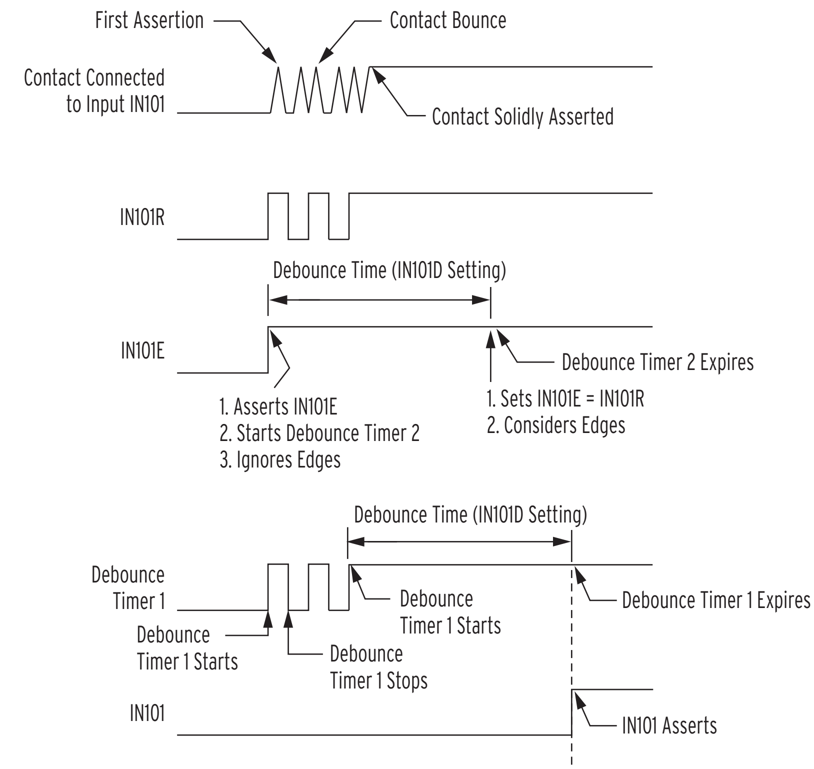


Figure 6.7 Timing Diagram When IN101R Changes From the Deasserted State to the Asserted State

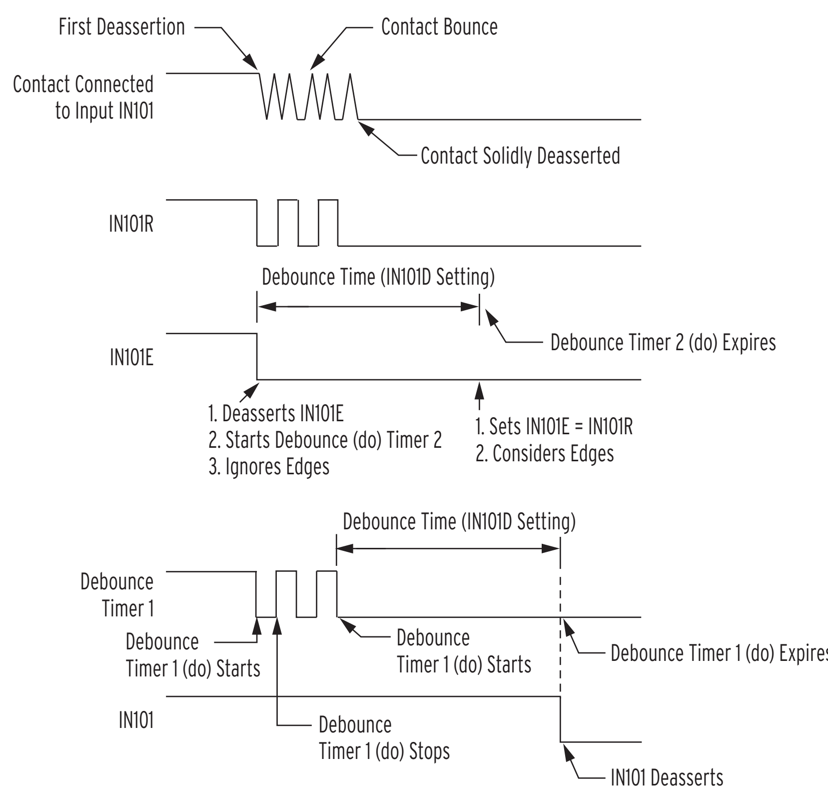


Figure 6.8 Timing Diagram When Input IN101 Changes From the Asserted State to the Deasserted State

AC Mode Processing (AC Control Voltage)

Figure 6.9 shows IN101R 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 2 ms, and the dropout time is fixed at 16 ms. Device Word bit IN101 is the output of the debounce timer. To select the ac mode of debounce, set IN101D = AC.

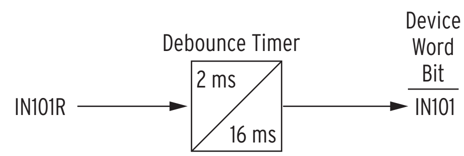


Figure 6.9 AC Mode Processing

Figure 6.10 shows a timing diagram for the ac mode of operation. On the rising edge of IN101R, the pickup timer starts timing (points marked 1 in *Figure 6.10*). If IN101R deasserts (points marked 2 in *Figure 6.10*) before expiration of the pickup 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 pickup timer setting, then Device Word bit IN101 asserts to a logical 1.

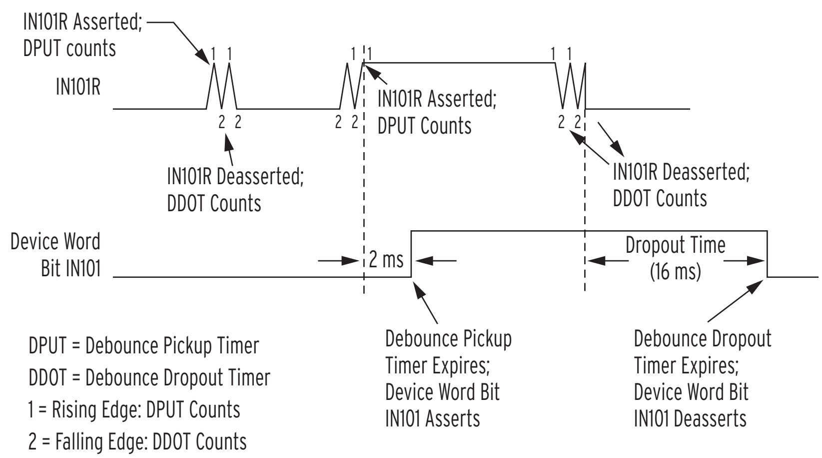


Figure 6.10 Timing Diagram for Debounce Timer Operation When Operating in AC Mode

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

Table 6.15 shows the settings prompt, setting range, and factory-default settings for the float-level-sensing card in Slot 3.

Table 6.15 General Global Settings

Setting Prompt	Setting Range	Setting Name := Factory Default
IN301 Debounce	AC, 0–65000 ms	IN301D := 10
IN302 Debounce	AC, 0–65000 ms	IN302D := 10
IN303 Debounce	AC, 0–65000 ms	IN303D := 10
IN304 Debounce	AC, 0–65000 ms	IN304D := 10
IN305 Debounce	AC, 0–65000 ms	IN305D := 10
IN306 Debounce	AC, 0–65000 ms	IN306D := 10
IN307 Debounce	AC, 0–65000 ms	IN307D := 10
IN308 Debounce	AC, 0–65000 ms	IN308D := 10
IN309 Debounce	AC, 0–65000 ms	IN309D := 10
IN310 Debounce	AC, 0–65000 ms	IN310D := 10
IN311 Debounce	AC, 0–65000 ms	IN311D := 10
IN312 Debounce	AC, 0–65000 ms	IN312D := 10
IN313 Debounce	AC, 0–65000 ms	IN313D := 10
IN314 Debounce	AC, 0–65000 ms	IN314D := 10

Data Reset

The RSTTRGT setting resets the front-panel LEDs, provided all LED initiate conditions were cleared. *Table 6.16* shows the settings prompt, setting range, and factory default settings.

Table 6.16 Target Reset Setting

Setting Prompt	Setting Range	Setting Name := Factory Default
Target Reset	SV	RSTTRGT := NA

Access Control

The DSABLSET setting defines conditions for disabling all setting changes from the front-panel interface. To disable setting changes from the front-panel interface, assign, for example, a contact input (e.g., DSABLSET := IN402) to the DSABLSET setting. When Device Word bit DSABLSET asserts, you can view the device settings from the front-panel interface, but you can only change settings using serial port commands. *Table 6.17* shows the settings prompt, setting range, and factory default settings.

Table 6.17 Setting Change Disable Setting

Setting Prompt	Setting Range	Setting Name := Factory Default
Disable FP Settings Change	SV	DSABLSET := NA

Voltage Ratio Correction Factor

Table 6.18 Voltage Ratio Correction Factor

Setting Prompt	Setting Range	Setting Name := Factory Default
VARCF	0.5 to 1.5	
VBRCF	0.5 to 1.5	
VCRCF	0.5 to 1.5	

Voltage Ratio Correction Factors for VT-Terminal Voltage Inputs

Make the VARCF, VBRCF, and VCRCF ratio correction factor Global settings for the voltage inputs (VA, VB, and VC, respectively) when the SEL-2411P is ordered with Low Energy Analog (LEA) voltage inputs on the 3 ACI/3 AVI combination card. Ratio correction factor (RCF) settings compensate for irregularities (on a per-phase basis) of voltage dividers connected between the primary voltage system and the LEA (8 V) inputs. The derivation of the RCF value for a voltage divider for a particular phase is defined as follows:

NOTE: Ratio Correction Factors serve a different purpose than Potential Transformer Ratio settings—see also following subsection Potential Transformer (PT) Ratios on page 6.6.

$$\begin{aligned} \mathrm{RCF} &= \frac{\text{true ratio}}{\text{marked ratio}} \\ &= \frac{\text{Vpri.}}{\text{Vsec.}} \bullet \frac{1}{\mathrm{PTR_{LEA}}} \\ &= \frac{\text{Vpri.}}{\text{Vsec.} \bullet \mathrm{PTR_{LEA}}} \end{aligned} \qquad \textbf{Equation 6.3}$$

where:

Vpri. = test voltage applied to the primary side of the voltage divider

Vsec. = resultant voltage measured on the secondary side of the voltage divider

true ratio = Vpri./Vsec.

marked ratio = PTR_{LEA}

= effective nominal potential transformer (PT) ratio of the voltage divider connected between the primary voltage system and the LEA (8 V) input (e.g., PTR_{LEA} = 10000).

The marked ratio of the voltage divider (PTR_{LEA}) is always provided by the manufacturer and often the per-phase RCF values are also provided.

If the voltage divider is perfect, then:

$$\frac{\text{Vpri.}}{\text{Vsec.}} = \mathrm{PTR_{LEA}} \text{ and } \mathrm{RCF} = 1.000 \qquad \textbf{Equation 6.4}$$

Thus, the measured voltage divider performance equals the marked ratio of the voltage divider, as given by the manufacturer. But such perfect conditions are usually not the case.

If the voltage divider is putting out more voltage (Vsec.) than nominally expected for an applied voltage input (Vpri.), then:

$$\frac{\text{Vpri.}}{\text{Vsec.}} < \mathrm{PTR_{LEA}} \text{ and } \mathrm{RCF} < 1.000 \qquad \textbf{Equation 6.5}$$

An example of an RCF value less than 1.000 is found in *Example 6.5*. In this example, setting VARCF := 0.883 brings down the too high voltage on voltage input VA (0.82 V is brought down to nominal 0.72 V).

If the voltage divider is putting out less voltage (Vsec.) than nominally expected for an applied voltage input (Vpri.), then:

$$\frac{\text{Vpri.}}{\text{Vsec.}} > \mathrm{PTR_{LEA}} \text{ and } \mathrm{RCF} > 1.000 \qquad \textbf{Equation 6.6}$$

An example of an RCF value greater than 1.000 is also found in following *Example 6.5*. In this example, setting VCRCF := 1.112 brings up the too low voltage on voltage input VAC (0.0.65 V is brought up to nominal 0.72 V).

In the SEL-2411P with Low Energy Analog (LEA) voltage inputs, these RCF values (settings VARCF, VBRCF, and VCRCF) are applied to respective voltage inputs VA, VB, and VC. The resultant secondary voltages from these voltage inputs are normalized by the RCF values. These normalized secondary voltages are used throughout the SEL-2411P.

NOTE: At the end of the following subsection Voltage-Related Settings and Low Energy Analog (LEA) Inputs on page 6.7 is a discussion concerning RCF values that are less than unity (1.000) and their possible effect on voltage-related settings.

EXAMPLE 6.5 Normalizing Voltages With Ratio Correction Factors

A voltage divider is connected to the LEA (8V) voltage inputs. The RCF values per phase for the voltage divider are given as:

VARCF:= 1.078 (voltage input VA; like Equation 6.6)
VBRCF:= 0.883 (voltage input VB; like Equation 6.5)
VCRCF:= 1.112 (voltage input VC; like Equation 6.6)

The marked ratio of the voltage divider is given as:

$$\mathrm{PTR}_{\mathrm{LEA}} = 10000$$

What are the true ratios of each phase of the voltage divider?

$$\text{true ratio (for a given phase)} = \frac{\text{Vpri.}}{\text{Vsec.}}$$

Vpri. and Vsec. are measured in manufacturer tests, to derive RCF values as shown in Equation 6.3 and accompanying explanation. From Equation 6.3:

$$\mathrm{RCF} \bullet \mathrm{PTR}_{\mathrm{LEA}} = \frac{\text{Vpri.}}{\text{Vsec.}} = \text{true ratio}$$

1.078 • 10000 = 10780 (true ratio for voltage input V1Y)
0.883 • 10000 = 8830 (true ratio for voltage input V2Y)
1.112 • 10000 = 11120 (true ratio for voltage input V3Y)

Note these true ratios vary from 8830 to 11120, while the marked ratio of the voltage divider is given as 10000.

Consider what is happening in this example. First, assume the primary voltage (Vpri.) is the same magnitude for each phase. When this primary voltage is run through the respective true ratios, the secondary voltage outputs vary widely. Presuming primary voltage of 12.47 kV (7.2 kV line-to-neutral), the resultant secondary voltages are:

7200 V/10780 = 0.67 V (true secondary voltage to voltage input VA)
7200 V/8830 = 0.82 V (true secondary voltage to voltage input VB)
7200 V/11120 = 0.65 V (true secondary voltage to voltage input VC)

Note that the true secondary voltages to voltage inputs VA and VC are running low (below normalized secondary voltage 0.72 V = 7200 V/10000), while the voltage to voltage input VB is running high (above normalized secondary voltage 0.72 V). But, the RCF values adjust these true secondary voltages to normalized secondary voltage:

0.67 V · 1.078 = 0.72 V (normalized voltage from voltage input VA)
0.82 V · 0.883 = 0.72 V (normalized voltage from voltage input VB)
0.65 V · 1.112 = 0.72 V (normalized voltage from voltage input VC)

Again, the normalized secondary voltage (0.72 V) is the same for all three phases in this example, because the primary voltage is assumed the same magnitude for each phase (7200 V). These normalized secondary voltages are used throughout the SEL-2411P. The true secondary voltages cannot be seen (via the SEL-2411P) unless the RCF values are set to unity (RCF = 1.000).

Station Settings (SET S Command)

Use the serial command **SET S** to access the station settings. *Table 6.19* includes all the station settings with their respective ranges and default values. These settings provide basic configurations for single, duplex, and triplex pump-alternation schemes. They also include various options for level sensing and pump voltage monitoring.

Table 6.19 Station Settings

Setting Prompt	Setting Range	Factory Default
ADV_EN	Y, N	N
STN_TYPE	DUPLEX, TRIPLEX, SINGLE_UP, SINGLE	DUPLEX
TRI_ALT	NORMAL, JOCKEY, HIGH_SERVICE	NORMAL
LVL_INPUT	FLOAT, ANALOG, ANA_WAF, ANA_W1F, ANA_W2F	FLOAT
LOW_EN	Y, N	N
HIGH_EN	Y, N	Y
VMON_SRC	NONE, INTERNAL, EXTERNAL, BOTH	NONE
VMON_IN	NC, NO	NO

ADV_EN

Activate station settings for the SEL-2411P by setting ADV_EN to N. When ADV_EN = N, station settings dictate logic and value assignments for the following setting categories and prevent any modifications to all settings within these categories:

NOTE: Setting ADV_EN to N overwrites any existing device, logic, Global, and front-panel settings. See Appendix I: Station Setting Assignments for details regarding how station settings dictate these setting groups.

- Device settings
- Logic settings
- Global settings
- Front-panel settings

Set ADV_EN to Y to enable advanced settings for applications that require customized logic or exceed the scope of station settings (e.g., quadplex alternation control schemes). When ADV_EN = Y, the SEL-2411P does not overwrite existing station settings logic and value assignments that it previously assigned for device, logic, Global, and front-panel settings. It also allows access to change any settings in these groups. Changing the settings in SET S while ADV_EN = Y asserts and deasserts the associated Device Word Bits.

STN_TYPE

STN_TYPE represents the number of pumps that the SEL-2411P operates for the station.

If Station has one pump, set STN_TYPE to SINGLE_UP or SINGLE. Single pump modes use the LEAD and STOP float to control fluid level. If activating a pump causes the fluid level to go up, then set the STN_TYPE to SINGLE_UP. When the fluid level falls below the LEAD float, the pump turns on to fill the vessel until the fluid level reaches the STOP Float. Figure 6.11 illustrates the basic pump up operations for a single pump station.

Use STN_TYPE = SINGLE if activating a pump causes the liquid level to go DOWN. When the liquid level rises above the LEAD float, the pump will turn on until the liquid falls below the STOP float. This operation is similar to DUPLEX and TRIPLEX detailed below.

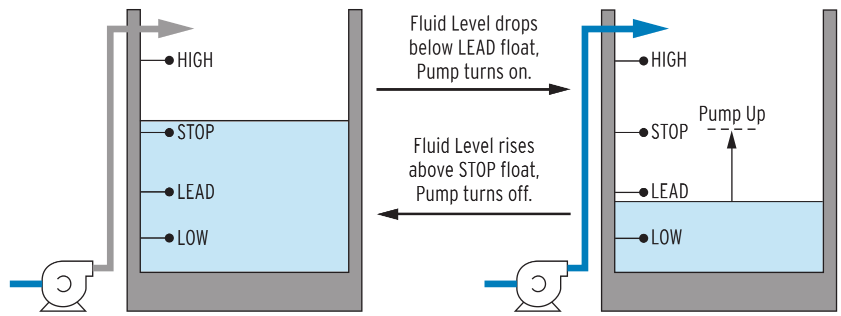


Figure 6.11 Single Pump Up and Pump Down Operations

If the station has two pumps, set STN_TYPE to DUPLEX. For a duplex station, the SEL-2411P operates two pumps by using the STOP, LEAD, and LAG1 floats. *Figure 6.12* illustrates the basic operation for duplex pump operation.

NOTE: SINGLE, DUPLEX, and TRIPLEX pump-control schemes assume that pump operation causes the fluid level to go down.

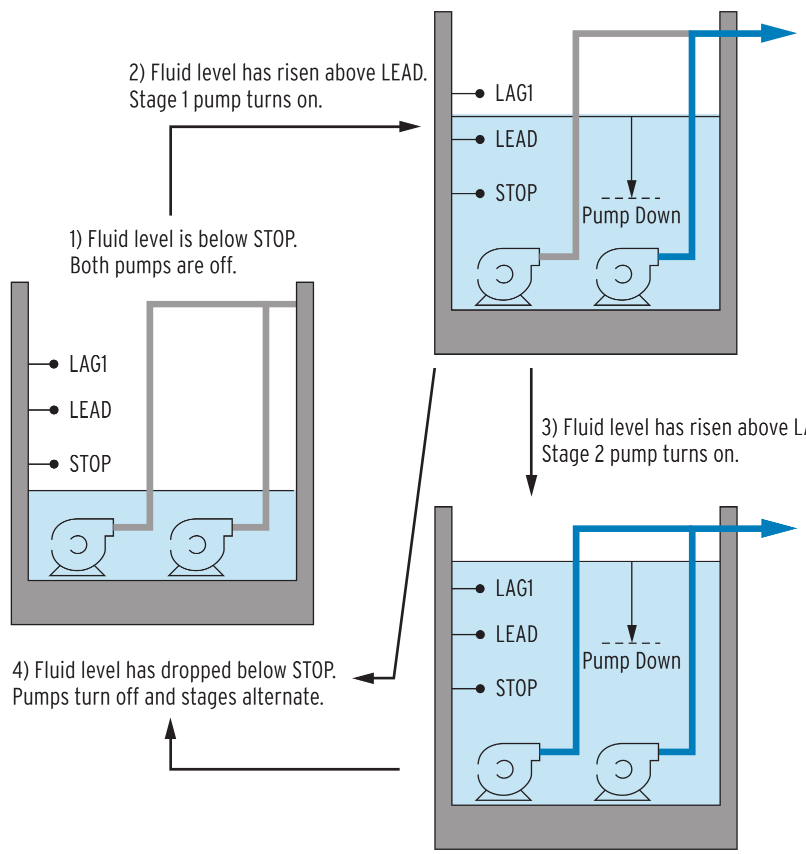


Figure 6.12 Duplex Pump Operation

If the station has three pumps, set STN_TYPE to TRIPLEX. For a triplex station, the SEL-2411P operates three pumps in a similar manner to duplex operation but with the addition of a third stage and pump that activate when the fluid level rises above the LAG2 float. *Figure 6.13* illustrates the operation for basic triplex alternation operation.

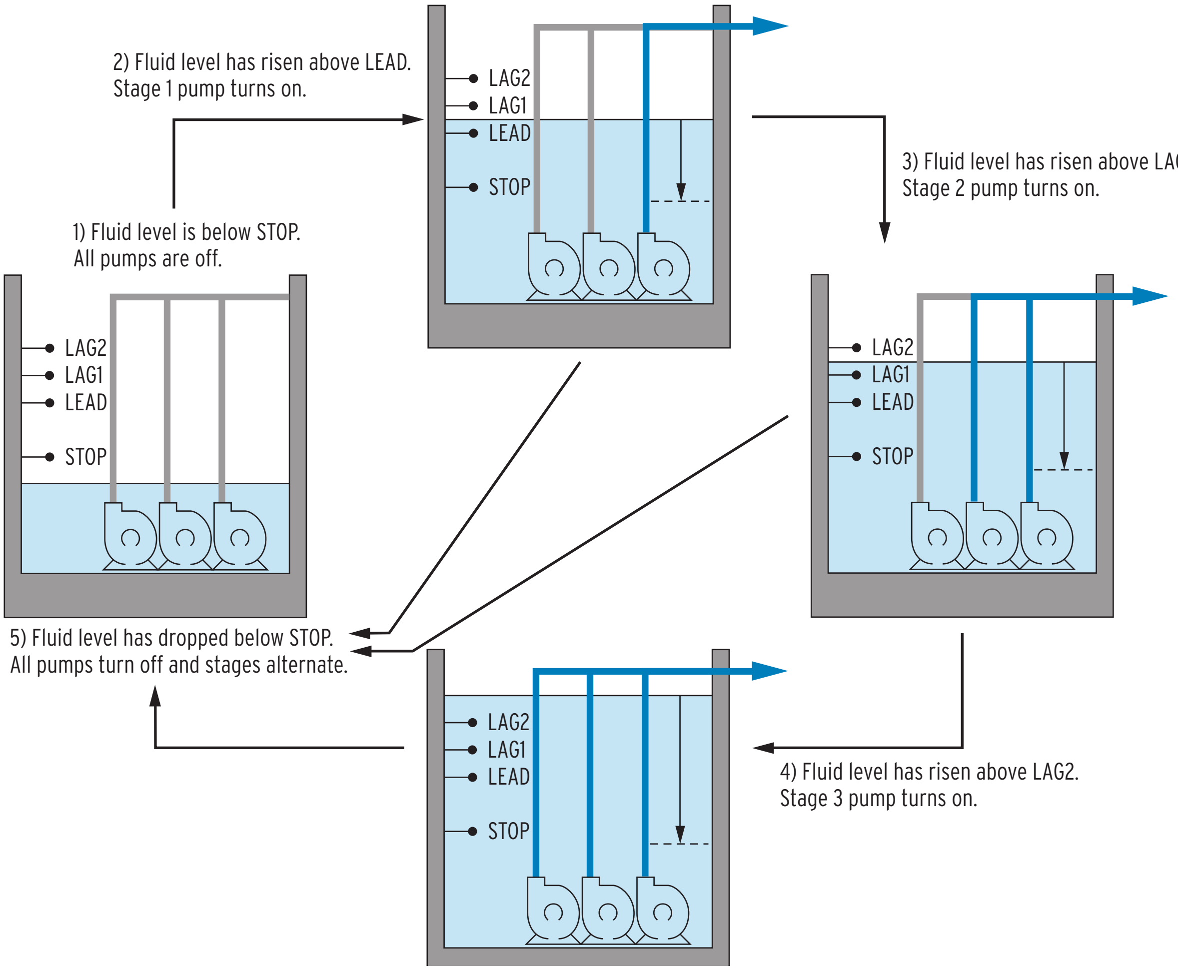


Figure 6.13 Triplex Alternation Pump Operation

TRI_ALT

TRI_ALT provides variation in pump alternation for triplex operations. TRI_ALT will assert mutually exclusive Device Word Bits: NORMAL, JOCKEY, HI_SERVC; based upon settings selected.

Set TRI_ALT to NORMAL to alternate the stages for all three pumps equally, as *Figure 6.13* illustrates.

Set TRI_ALT to JOCKEY to designate the Stage 1 pump as a jockey pump and to only alternate the Stage 2 and 3 pumps. The jockey pump is a lower-volume pump than the Stage 2 and 3 pumps and only operates on Stage 1 (LEAD). The station controller turns off the Stage 1 pump whenever the Stage 2 or 3 pumps turn on.

Set TRI_ALT to HIGH_SERVICE to designate the Stage 3 pump as a high-service pump and only alternate the Stage 1 and 2 pumps. The high-service pump is a higher-volume pump than the Stage 1 and 2 pumps and only operates on Stage 3 (LAG2). When TRI_ALT = HIGH_SERVICE, the station controller turns off the Stage 1 and 2 pumps whenever the Stage 3 pump turns on.

LVL_INPUT

The SEL-2411P measures the fluid level via float switches or analog-input sensing. *Figure 6.14* illustrates these two level-sensing methods. LVL_INPUT will assert Mutually Exclusive Device Word Bits: FLOAT, ANALOG, ANA_WAF, ANA_W1F, ANA_W2F; based upon setting selected.

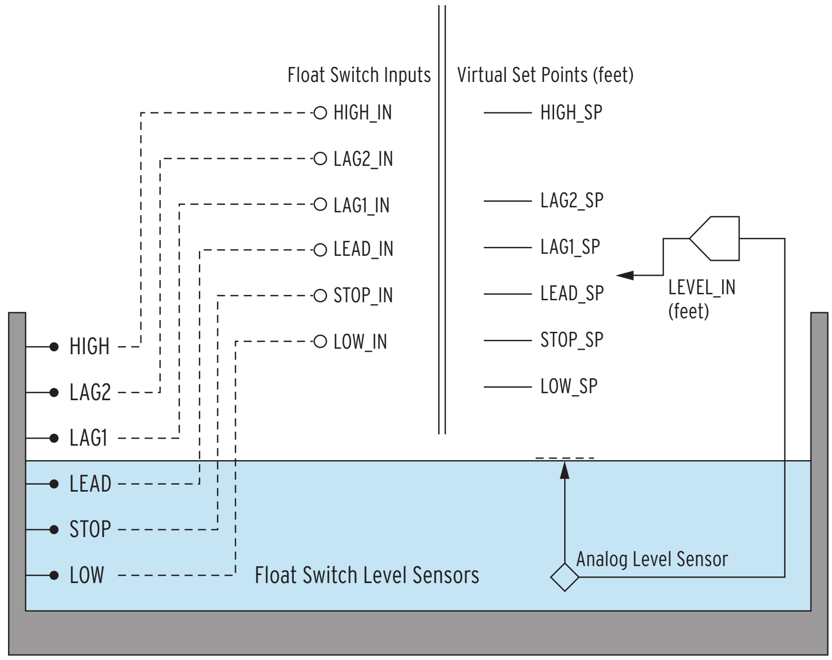


Figure 6.14 Level-Sensing Methods

NOTE: When STN_TYPE = SINGLE, DUPLEX, or TRIPLEX, the station controller assumes a 0–10 psi submersible pressure transmitter with a 4–20 mA output. The controller interprets 20 mA as 22.45 ft. When STN_TYPE = SINGLE_UP, the station controller assumes a 60 psi pressure level sensor. If this does not match your transducer, see Voltage-Related Settings and Low Energy Analog (LEA) Inputs on page 6.7 for instructions regarding field calibration. Adjust the settings for Analog Input 601 (AIx01).

For float switches, the SEL-2411P measures the status of the floats by using the SELOGIC equations LOW_IN, STOP_IN, LEAD_IN, LAG1_IN, LAG2_IN, and HIGH_IN.

For analog level sensing, the SEL-2411P measures a 4–20 mA transducer signal and converts it to the fluid level in feet. It compares the measured fluid level (LEVEL_IN) to the virtual set points (LOW_SP, STOP_SP, LEAD_SP, LAG1_SP, LAG2_SP, and HIGH_SP) to generate virtual float switches for pump control.

Set the level input sensing method by using LVL_INPUT. Use *Table 6.20* to determine the appropriate LVL_INPUT setting that matches the level-sensing method for the station.

Table 6.20 Level-Sensing Methods for LVL_INPUT

LVL_INPUT	Level-Sensing Method
FLOAT	Float switches for all levels
ANALOG	Analog sensing with virtual set points for all levels and no backup float switches
ANA_W1F	Analog sensing with virtual set points and one backup float switch (LOW or HIGH float switch)
ANA_W2F	Analog sensing with virtual set points and two backup float switches (LOW and HIGH float switches)
ANA_WAF	Analog sensing with virtual set points and backup float switches for all levels

LOW_EN

When STN_TYPE = DUPLEX or TRIPLEX, set LOW_EN to Y to use the LOW float switch for pumping the level down to LOW when the analog level sensor fails or a float out-of-sequence condition occurs.

When STN_TYPE = SINGLE, set LOW_EN to Y to use the LOW float switch as an emergency level indicator to turn off the pump when the fluid level becomes too low. In this case, the pump runs for SFLOAT_RT seconds or until the fluid level reaches the LOW float switch.

When STN_TYPE = SINGLE_UP, set LOW_EN to Y to use the LOW float switch as an emergency level indicator to run the pump when the level is too low.

To prevent the SEL-2411P from controlling pumps by using the LOW float switches, set LOW_EN to N. Setting LOW_EN = Y will assert Device Word Bit LOW_EN.

HIGH_EN

When STN_TYPE = SINGLE, DUPLEX, or TRIPLEX, set HIGH_EN to Y to use the HIGH float switch as an emergency level indicator to run all pumps when the level is too high.

When STN_TYPE = SINGLE_UP, set HIGH_EN to Y to use the HIGH float switch to prevent the pump from filling the tank too high. In this case, the pump runs for SFLOAT_RT seconds or until the fluid level reaches the HIGH float switch.

To prevent the SEL-2411P from controlling pumps by using the HIGH float switches, set HIGH_EN to N. Setting HIGH_EN = Y will assert Device Word Bit HIGH_EN.

VMON_SRC

Select the method for pump voltage monitoring by using VMON_SRC.

Set VMON_SRC to INTERNAL if the SEL-2411P measures pump voltage directly through use of the 3AVI card.This setting will cause Device Word Bit INTERNAL to assert and EXTERNAL to deassert.

Set VMON_SRC to EXTERNAL if the SEL-2411P monitors pump voltage by using the PHS_MON digital input and an external voltage monitoring device.This setting will cause Device Word Bit EXTERNAL to assert and INTERNAL to deassert.

To use both internal and external pump voltage monitoring methods, set VMON_SRC to BOTH. This setting will cause the Device Word Bits EXTERNAL and INTERNAL to assert.

To disable pump voltage monitoring, set VMON_SRC to NONE. This setting will cause the Device Word Bits EXTERNAL and INTERNAL to deassert.

See *Pump Voltage Monitoring on page 5.13* for more details.

VMON_IN

Set the nominal input state for the external voltage monitoring device connection to PHS_MON by using VMON_IN. Mutually exclusive Device Word Bits VMON_NC and VMON_NO shall assert based upon the selected setting.

Set VMON_IN to NC if the external voltage monitoring device output is normally closed.

Set VMON_IN to NO if the external voltage monitoring device output is normally open.

SEL-2411P Settings Sheets

These settings sheets include the definition and input range for each setting in the device. You can access the settings from the device front panel and the serial ports.

- Some settings require an optional module (see *Section 4: Logic Functions* for details).
- Some of the settings ranges may be more restrictive than shown, because of settings interdependency checks performed when new settings are saved. The settings are not case sensitive.

Device Settings (SET Command)

Device Identification (16 characters)	**DID**	:=
Terminal ID (16 characters)	**TID**	:=

Transformer Settings

Current Transformer Ratio (1–5000) (4 ACI)	**CTR**	:=
Neutral Current Transformer Ratio (1–5000) (4 ACI)	**CTRN**	:=
Additional Current Transformer Ratio (1–5000) (3 ACI/3 AVI)	**CTRX**	:=
Potential Transformer Ratio (1.00–10000.00)	**PTR**	:=

Demand Metering

Enable Demand Metering	**EDEM**	:=
Demand Meter Time Constant (5, 10, 15, 30, 60 min)	**DMTC**	:=

Phase Overcurrent Threshold

(hidden if 4 ACI card is not installed)

IA Overcurrent Warning Level 1 (OFF, 0.20–91.15 for 5 A nominal, 0.04–18.23 for 1 A nominal)	**IAHW1**	:=
IA Overcurrent Warning Level 2 (OFF, 0.20–91.15 for 5 A nominal, 0.04–18.23 for 1 A nominal)	**IAHW2**	:=
IA Overcurrent Alarm (OFF, 0.20–91.15 for 5 A nominal, 0.04–18.23 for 1 A nominal)	**IAHAL**	:=
IB Overcurrent Warning Level 1 (OFF, 0.20–91.15 for 5 A nominal, 0.04–18.23 for 1 A nominal)	**IBHW1**	:=
IB Overcurrent Warning Level 2 (OFF, 0.20–91.15 for 5 A nominal, 0.04–18.23 for 1 A nominal)	**IBHW2**	:=
IB Overcurrent Alarm (OFF, 0.20–91.15 for 5 A nominal, 0.04–18.23 for 1 A nominal)	**IBHAL**	:=
IC Overcurrent Warning Level 1 (OFF, 0.20–91.15 for 5 A nominal, 0.04–18.23 for 1 A nominal)	**ICHW1**	:=
IC Overcurrent Warning Level 2 (OFF, 0.20–91.15 for 5 A nominal, 0.04–18.23 for 1 A nominal)	**ICHW2**	:=
IC Overcurrent Alarm (OFF, 0.20–91.15 for 5 A nominal, 0.04–18.23 for 1 A nominal)	**ICHAL**	:=

Auxiliary Phase Overcurrent Threshold

(Hidden if 3 ACI/3 AVI card is not installed)

IAX Overcurrent Warning Level 1 (OFF, 0.20–91.15)	**IAXHW1**	:=
IAX Overcurrent Warning Level 2 (OFF, 0.20–91.15)	**IAXHW2**	:=
IAX Overcurrent Alarm (OFF, 0.20–91.15)	**IAXHAL**	:=
IBX Overcurrent Warning Level 1 (OFF, 0.20–91.15)	**IBXHW1**	:=
IBX Overcurrent Warning Level 2 (OFF, 0.20–91.15)	**IBXHW2**	:=
IBX Overcurrent Alarm (OFF, 0.20–91.15)	**IBXHAL**	:=
ICX Overcurrent Warning Level 1 (OFF, 0.20–91.15)	**ICXHW1**	:=
ICX Overcurrent Warning Level 2 (OFF, 0.20–91.15)	**ICXHW2**	:=
ICX Overcurrent Alarm (OFF, 0.20–91.15)	**ICXHAL**	:=

Phase Undervoltage Threshold

(Hidden if 3 ACI/3 AVI or 3 AVI card is not installed or if DELTA_Y = DELTA)

VA Undervoltage Warning Level 1 (OFF, 4.00–284.50)	**VALW1**	:=
VA Undervoltage Warning Level 2 (OFF, 4.00–284.50)	**VALW2**	:=
VA Undervoltage Alarm (OFF, 4.00–284.50)	**VALAL**	:=
VB Undervoltage Warning Level 1 (OFF, 4.00–284.50)	**VBLW1**	:=
VB Undervoltage Warning Level 2 (OFF, 4.00–284.50)	**VBLW2**	:=
VB Undervoltage Alarm (OFF, 4.00–284.50)	**VBLAL**	:=
VC Undervoltage Warning Level 1 (OFF, 4.00–284.50)	**VCLW1**	:=
VC Undervoltage Warning Level 2 (OFF, 4.00–284.50)	**VCLW2**	:=
VC Undervoltage Alarm (OFF, 4.00–284.50)	**VCLAL**	:=

Phase-to-Phase Undervoltage Threshold

(Hidden if 3 ACI/3 AVI card is not installed or if DELTA_Y = WYE)

VAB Undervoltage Warning Level 1 (OFF, 4.00–284.50)	**VABLW1**	:=
VAB Undervoltage Warning Level 2 (OFF, 4.00–284.50)	**VABLW2**	:=
VAB Undervoltage Alarm (OFF, 4.00–284.50)	**VABLAL**	:=
VBC Undervoltage Warning Level 1 (OFF, 4.00–284.50)	**VBCLW1**	:=
VBC Undervoltage Warning Level 2 (OFF, 4.00–284.50)	**VBCLW2**	:=
VBC Undervoltage Alarm (OFF, 4.00–284.50)	**VBCLAL**	:=
VCA Undervoltage Warning Level 1 (OFF, 4.00–284.50)	**VCALW1**	:=
VCA Undervoltage Warning Level 2 (OFF, 4.00–284.50)	**VCALW2**	:=
VCA Undervoltage Alarm (OFF, 4.00–284.50)	**VCALAL**	:=

Phase Overvoltage Threshold

(Hidden if 3 ACI/3 AVI card is not installed or if DELTA_Y = DELTA)

VA Overvoltage Warning Level 1 (OFF, 4.00–284.50)	**VAHW1**	:=
VA Overvoltage Warning Level 2 (OFF, 4.00–284.50)	**VAHW2**	:=
VA Overvoltage Alarm (OFF, 4.00–284.50)	**VAHAL**	:=
VB Overvoltage Warning Level 1 (OFF, 4.00–284.50)	**VBHW1**	:=
VB Overvoltage Warning Level 2 (OFF, 4.00–284.50)	**VBHW2**	:=

VB Overvoltage Alarm (OFF, 4.00–284.50)	**VBHAL**	:=
VC Overvoltage Warning Level 1 (OFF, 4.00–284.50)	**VCHW1**	:=
VC Overvoltage Warning Level 2 (OFF, 4.00–284.50)	**VCHW2**	:=
VC Overvoltage Alarm (OFF, 4.00–284.50)	**VCHAL**	:=

Phase-to-Phase Overvoltage Threshold

(Hidden if 3 ACI/3 AVI card is not installed or if DELTA_Y = WYE)

VAB Overvoltage Warning Level 1 (OFF, 4.00–284.50)	**VABHW1**	:=
VAB Overvoltage Warning Level 2 (OFF, 4.00–284.50)	**VABHW2**	:=
VAB Overvoltage Alarm (OFF, 4.00–284.50)	**VABHAL**	:=
VBC Overvoltage Warning Level 1 (OFF, 4.00–284.50)	**VBCHW1**	:=
VBC Overvoltage Warning Level 2 (OFF, 4.00–284.50)	**VBCHW2**	:=
VBC Overvoltage Alarm (OFF, 4.00–284.50)	**VBCHAL**	:=
VCA Overvoltage Warning Level 1 (OFF, 4.00–284.50)	**VCAHW1**	:=
VCA Overvoltage Warning Level 2 (OFF, 4.00–284.50)	**VCAHW2**	:=
VCA Overvoltage Alarm (OFF, 4.00–284.50)	**VCAHAL**	:=

For the following settings, *x* is the card position (5 or 6).

Analog Input x01 Settings

AIx01 Instrument Tag Name (8 characters 0–9, A–Z, _)	**AIx01NAM**	:=
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 to a value between Engr Low and Engr High settings.

AIx01 Engineering Units (16 characters)	**AIx01EU**	:=
AIx01 Engineering Unit Low (–99999.000 to +99999.000)	**AIx01EL**	:=
AIx01 Engineering Unit High (–99999.000 to +99999.000)	**AIx01EH**	:=
AIx01 Low Warn Level 1 (OFF, –99999.000 to +99999.000)	**AIx01LW1**	:=
AIx01 Low Warn Level 2 (OFF, –99999.000 to +99999.000)	**AIx01LW2**	:=
AIx01 Low Alarm (OFF, –99999.000 to +99999.000)	**AIx01LAL**	:=
AIx01 High Warn Level 1 (OFF, –99999.000 to +99999.000)	**AIx01HW1**	:=
AIx01 High Warn Level 2 (OFF, –99999.000 to +99999.000)	**AIx01HW2**	:=
AIx01 High Alarm (OFF, –99999.000 to +99999.000)	**AIx01HAL**	:=

Analog Input x02 Settings

AIx02 Instrument Tag Name (8 characters 0–9, A–Z, _)	**AIx02NAM**	:=
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**	:=
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 Instrument Tag Name (8 characters 0–9, A–Z, _)	**AIx03NAM**	:=
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**	:=
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 Instrument Tag Name (8 characters 0–9, A–Z, _)	**AIx04NAM**	:=
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**	:=
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 Instrument Tag Name (8 characters 0–9, A–Z, _)	**AIx05NAM**	:=
AIx05 Type (I, V) (Does not apply to Extended Range)	**AIx05TYP**	:=
If AIx05TYP = I		
AIx05 Low (–20.480 to +20.480; mA) (Does not apply to Extended Range)	**AIx05L**	:=
AIx05 High (–20.480 to +20.480; mA) (Does not apply to Extended Range)	**AIx05H**	:=
If AIx05TYP = V		
AIx05 Low (–10.240 to +10.240 V) (–300 to +300 V Extended Range)	**AIx05L**	:=
AIx05 High (–10.240 to +10.240 V) (–300 to +300 V Extended Range)	**AIx05H**	:=
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 Instrument Tag Name (8 characters 0–9, A–Z, _)	**AIx06NAM**	:=
AIx06 Type (I, V) (Does not apply to Extended Range)	**AIx06TYP**	:=
If AIx06TYP = I		
AIx06 Low (–20.480 to +20.480; mA) (Does not apply to Extended Range)	**AIx06L**	:=
AIx06 High (–20.480 to +20.480; mA) (Does not apply to Extended Range)	**AIx06H**	:=
If AIx06TYP = V		
AIx06 Low (–10.240 to +10.240 V) (–300 to +300 V Extended Range)	**AIx06L**	:=
AIx06 High (–10.240 to +10.240 V) (–300 to +300 V Extended Range)	**AIx06H**	:=
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 Instrument Tag Name (8 characters 0–9, A–Z, _)	**AIx07NAM**	:=
AIx07 Type (I, V) (Does not apply to Extended Range)	**AIx07TYP**	:=
If AIx07TYP = I		
AIx07 Low (–20.480 to +20.480; mA) (Does not apply to Extended Range)	**AIx07L**	:=
AIx07 High (–20.480 to +20.480; mA) (Does not apply to Extended Range)	**AIx07H**	:=
If AIx07TYP = V		
AIx07 Low (–10.240 to +10.240 V) (–300 to +300 V Extended Range)	**AIx07L**	:=
AIx07 High (–10.240 to +10.240 V) (–300 to +300 V Extended Range)	**AIx07H**	:=
AIi607 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 Instrument Tag Name (8 characters 0–9, A–Z, _)	**AIx08NAM**	:=
AIx08 Type (I, V) (Does not apply to Extended Range)	**AIx08TYP**	:=
If AIx08TYP = I		
AIx08 Low (–20.480 to +20.480; mA) (Does not apply to Extended Range)	**AIx08L**	:=
AIx08 High (–20.480 to +20.480; mA) (Does not apply to Extended Range)	**AIx08H**	:=
If AIx08TYP = V		
AIx08 Low (–10.240 to +10.240 V) (–300 to +300 V Extended Range)	**AIx08L**	:=
AIx08 High (–10.240 to +10.240 V) (–300 to +300 V Extended Range)	**AIx08H**	:=
AIx08 Engr Units (16 characters)	**AIx08EU**	:=
AIx08 Engr Low (–99999.000 to +99999.000)	**AIx08EL**	:=
AIx08 Engr High (–99999.000 to +99999.000)	**AIx08EH**	:=
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**	:=

Analog Output x01 Settings

AOx01 Analog Quantity (Analog Quantity Value)	**AOx01AQ**	:=
AOx01 Instrument Tag Name (8 characters 0–9, A–Z, _)	**AOx01NAM**	:=
AOx01 Type (I, V)	**AOx01TYP**	:=
AOx01 Analog Quantity Low (–99999.000 to +99999.000)	**AOx01AQL**	:=
AOx01 Analog Quantity High (–99999.000 to +99999.000)	**AOx01AQH**	:=
If AOx01TYP = I		
AOx01 Low Output Value (–20.480 to +20.480 mA)	**AOx01L**	:=
AOx01 High Output (–20.480 to +20.480 mA)	**AOx01H**	:=
If AOx01TYP = V		
AOx01 Low Output Value (–10.240 to +10.240 V)	**AOx01L**	:=
AOx01 High Output Value (–10.240 to +10.240 V)	**AOx01H**	:=

Analog Output x02 Settings

AOx02 Analog Quantity (Analog Quantity Value)	**AOx02AQ**	:=
AOx02 Instrument Tag Name (8 characters 0–9, A–Z, _)	**AOx02NAM**	:=
AOx02 Type (I, V)	**AOx02TYP**	:=

AOx02 Analog Quantity Low (–99999.000 to +99999.000)	**AOx02AQL**	:=	________
AOx02 Analog Quantity High (–99999.000 to +99999.000)	**AOx02AQH**	:=	________

If AOx02TYP = I

AOx02 Low Output Value (–20.480 to +20.480 mA)	**AOx02L**	:=	________
AOx02 High Output (–20.480 to +20.480 mA)	**AOx02H**	:=	________

If AOx02TYP = V

AOx02 Low Output Value (–10.240 to +10.240 V)	**AOx02L**	:=	________
AOx02 High Output Value (–10.240 to +10.240 V)	**AOx02H**	:=	________

Analog Output x03 Settings

AOx03 Analog Quantity (Analog Quantity Value)	**AOx03AQ**	:=	________
AOx03 Instrument Tag Name (8 characters 0–9, A–Z, _)	**AOx03NAM**	:=	________
AOx03 Type (I, V)	**AOx03TYP**	:=	________
AOx03 Analog Quantity Low (–99999.000 to +99999.000)	**AOx03AQL**	:=	________
AOx03 Analog Quantity High (–99999.000 to +99999.000)	**AOx03AQH**	:=	________

If AOx03TYP = I

AOx03 Low Output Value (–20.480 to +20.480 mA)	**AOx03L**	:=	________
AOx03 High Output (–20.480 to +20.480 mA)	**AOx03H**	:=	________

If AOx03TYP = V

AOx03 Low Output Value (–10.240 to +10.240 V)	**AOx03L**	:=	________
AOx03 High Output Value (–10.240 to +10.240 V)	**AOx03H**	:=	________

Analog Output x04 Settings

AOx04 Analog Quantity (Analog Quantity Value)	**AOx04AQ**	:=	________
AOx04 Instrument Tag Name (8 characters 0–9, A–Z, _)	**AOx04NAM**	:=	________
AOx04 Type (I, V)	**AOx04TYP**	:=	________
AOx04 Analog Quantity Low (–99999.000 to +99999.000)	**AOx04AQL**	:=	________
AOx04 Analog Quantity High (–99999.000 to +99999.000)	**AOx04AQH**	:=	________

If AOx04TYP = I

AOx04 Low Output Value (–20.480 to +20.480 mA)	**AOx04L**	:=	________
AOx04 High Output (–20.480 to +20.480 mA)	**AOx04H**	:=	________

If AOx04TYP = V

AOx04 Low Output Value (–10.240 to +10.240 V)	**AOx04L**	:=	________
AOx04 High Output Value (–10.240 to +10.240 V)	**AOx04H**	:=	________

Pump Alternation Settings

Enable Pump Alternation, Number of Pumps (N, 1–4)	**EPUMPS**	:=	________
Number of Stages (1–4)	**NUMSTG**	:=	________
Pumps That Stage 1 May Use for Alternation (17 Characters)	**S1PUMPS**	:=	________
Call For Stage 1 (SELOGIC)	**STG1CALL**	:=	________
Pumps That Stage 2 May Use for Alternation (17 Characters)	**S2PUMPS**	:=	________

Call For Stage 2 (SELOGIC)	**STG2CALL**	:=	________________
Pumps That Stage 3 May Use for Alternation (17 Characters)	**S3PUMPS**	:=	________________
Call For Stage 3 (SELOGIC)	**STG3CALL**	:=	________________
Pumps That Stage 4 May Use for Alternation (17 Characters)	**S4PUMPS**	:=	________________
Call for Stage 4 (SELOGIC)	**STG4CALL**	:=	________________
Pump 1 Enable (SELOGIC)	**PUMP1EN**	:=	________________
Pump 1 Running Input (SELOGIC)	**PUMP1RUN**	:=	________________
Pump 1 Start Fault Timeout (1–300)	**PUMP1TO**	:=	________________
Pump 1 Minimum Run Time (OFF, 1–600)	**P1MINRT**	:=	________________
Pump 1 Long Run Time (SELOGIC)	**P1LONGRT**	:=	________________
Pump 1 Fault Reset (SELOGIC)	**P1FLTRST**	:=	________________
Force Pump 1 to Last Position (SELOGIC)	**PUMP1FCL**	:=	________________
Reset Pump 1 Short-Term Statistics (SELOGIC)	**RSTP1DAT**	:=	________________
Pump 2 Enable (SELOGIC)	**PUMP2EN**	:=	________________
Pump 2 Running Input (SELOGIC)	**PUMP2RUN**	:=	________________
Pump 2 Start Fault Timeout (1–300)	**PUMP2TO**	:=	________________
Pump 2 Minimum Run Time (OFF, 1–600)	**P2MINRT**	:=	________________
Pump 2 Long Run Time (SELOGIC)	**P2LONGRT**	:=	________________
Pump 2 Fault Reset (SELOGIC)	**P2FLTRST**	:=	________________
Force Pump 2 to Last Position (SELOGIC)	**PUMP2FCL**	:=	________________
Reset Pump 2 Short Term Statistics (SELOGIC)	**RSTP2DAT**	:=	________________
Pump 3 Enable (SELOGIC)	**PUMP3EN**	:=	________________
Pump 3 Running Input (SELOGIC)	**PUMP3RUN**	:=	________________
Pump 3 Start Fault Timeout (1-300)	**PUMP3TO**	:=	________________
Pump 3 Minimum Run Time (OFF, 1–600)	**P3MINRT**	:=	________________
Pump 3 Long Run Time (SELOGIC)	**P3LONGRT**	:=	________________
Pump 3 Fault Reset (SELOGIC)	**P3FLTRST**	:=	________________
Force Pump 3 to Last Position (SELOGIC)	**PUMP3FCL**	:=	________________
Reset Pump 3 Short Term Statistics (SELOGIC)	**RSTP3DAT**	:=	________________
Pump 4 Enable (SELOGIC)	**PUMP4EN**	:=	________________
Pump 4 Running Input (SELOGIC)	**PUMP4RUN**	:=	________________
Pump 4 Start Fault Timeout (1–300)	**PUMP4TO**	:=	________________
Pump 4 Minimum Run Time (OFF, 1–600)	**P4MINRT**	:=	________________
Pump 4 Long Run Time (SELOGIC)	**P4LONGRT**	:=	________________
Pump 4 Fault Reset (SELOGIC)	**P4FLTRST**	:=	________________
Force Pump 4 to Last Position (SELOGIC)	**PUMP4FCL**	:=	________________
Reset Pump 4 Short Term Statistics (SELOGIC)	**RSTP4DAT**	:=	________________
Pump Stager Start Timer (OFF, 1–300)	**STAGSTRT**	:=	________________
Force Pumps Alternation (SELOGIC)	**FRC_ALT**	:=	________________
Disable Pump Alternation (SELOGIC)	**DIS_ALT**	:=	________________

Logic Settings (SET L Command)

SELOGIC Enables

SELOGIC Latches (N, 1–32)	**ELAT**	:=
SELOGIC Variables/Timers (N, 1–64)	**ESV**	:=
SELOGIC Counters (N, 1–32)	**ESC**	:=
SELOGIC Math Variables Equations (N, 1–64)	**EMV**	:=

Latch Bit Set/Reset Equations

SET01 :=
RST01 :=
SET02 :=
RST02 :=
SET03 :=
RST03 :=
SET04 :=
RST04 :=
SET05 :=
RST05 :=
SET06 :=
RST06 :=
SET07 :=
RST07 :=
SET08 :=
RST08 :=
SET09 :=
RST09 :=
SET10 :=
RST10 :=
SET11 :=
RST11 :=
SET12 :=
RST12 :=
SET13 :=
RST13 :=
SET14 :=
RST14 :=
SET15 :=
RST15 :=
SET16 :=
RST16 :=
SET17 :=
RST17 :=
SET18 :=
RST18 :=

SET19	:=
RST19	:=
SET20	:=
RST20	:=
SET21	:=
RST21	:=
SET22	:=
RST22	:=
SET23	:=
RST23	:=
SET24	:=
RST24	:=
SET25	:=
RST25	:=
SET26	:=
RST26	:=
SET27	:=
RST27	:=
SET28	:=
RST28	:=
SET29	:=
RST29	:=
SET30	:=
RST30	:=
SET31	:=
RST31	:=
SET32	:=
RST32	:=

SELOGIC Variable/Timer Settings (PU and DO Upper Limit is 86400.000)

SELOGIC Variable Input (SV)	**SV01**	:=
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV01PU**	:=
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV01DO**	:=
SELOGIC Variable Input (SV)	**SV02**	:=
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV02PU**	:=
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV02DO**	:=
SELOGIC Variable Input (SV)	**SV03**	:=
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV03PU**	:=
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV03DO**	:=
SELOGIC Variable Input (SV)	**SV04**	:=
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV04PU**	:=

SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV04DO**	:= ________
SELOGIC Variable Input (SV)	**SV05**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV05PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV05DO**	:= ________
SELOGIC Variable Input (SV)	**SV06**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV06PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV06DO**	:= ________
SELOGIC Variable Input (SV)	**SV07**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV07PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV07DO**	:= ________
SELOGIC Variable Input (SV)	**SV08**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV08PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV08DO**	:= ________
SELOGIC Variable Input (SV)	**SV09**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV09PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV09DO**	:= ________
SELOGIC Variable Input (SV)	**SV10**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV10PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV10DO**	:= ________
SELOGIC Variable Input (SV)	**SV11**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV11PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV11DO**	:= ________
SELOGIC Variable Input (SV)	**SV12**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV12PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV12DO**	:= ________
SELOGIC Variable Input (SV)	**SV13**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV13PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV13DO**	:= ________
SELOGIC Variable Input (SV)	**SV14**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV14PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV14DO**	:= ________
SELOGIC Variable Input (SV)	**SV15**	:= ________

SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV15PU**	:= ________________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV15DO**	:= ________________
SELOGIC Variable Input (SV)	**SV16**	:= ________________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV16PU**	:= ________________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV16DO**	:= ________________
SELOGIC Variable Input (SV)	**SV17**	:= ________________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV17PU**	:= ________________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV17DO**	:= ________________
SELOGIC Variable Input (SV)	**SV18**	:= ________________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV18PU**	:= ________________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV18DO**	:= ________________
SELOGIC Variable Input (SV)	**SV19**	:= ________________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV19PU**	:= ________________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV19DO**	:= ________________
SELOGIC Variable Input (SV)	**SV20**	:= ________________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV20PU**	:= ________________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV20DO**	:= ________________
SELOGIC Variable Input (SV)	**SV21**	:= ________________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV21PU**	:= ________________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV21DO**	:= ________________
SELOGIC Variable Input (SV)	**SV22**	:= ________________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV22PU**	:= ________________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV22DO**	:= ________________
SELOGIC Variable Input (SV)	**SV23**	:= ________________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV23PU**	:= ________________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV23DO**	:= ________________
SELOGIC Variable Input (SV)	**SV24**	:= ________________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV24PU**	:= ________________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV24DO**	:= ________________
SELOGIC Variable Input (SV)	**SV25**	:= ________________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV25PU**	:= ________________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV25DO**	:= ________________

SELOGIC Variable Input (SV)	**SV26**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV26PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV26DO**	:= ________
SELOGIC Variable Input (SV)	**SV27**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV27PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV27DO**	:= ________
SELOGIC Variable Input (SV)	**SV28**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV28PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV28DO**	:= ________
SELOGIC Variable Input (SV)	**SV29**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV29PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV29DO**	:= ________
SELOGIC Variable Input (SV)	**SV30**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV30PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV30DO**	:= ________
SELOGIC Variable Input (SV)	**SV31**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV31PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV31DO**	:= ________
SELOGIC Variable Input (SV)	**SV32**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV32PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV32DO**	:= ________
SELOGIC Variable Input (SV)	**SV33**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV33PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV33DO**	:= ________
SELOGIC Variable Input (SV)	**SV34**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV34PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV34DO**	:= ________
SELOGIC Variable Input (SV)	**SV35**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV35PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV35DO**	:= ________
SELOGIC Variable Input (SV)	**SV36**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV36PU**	:= ________

SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV36DO**	:= ________
SELOGIC Variable Input (SV)	**SV37**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV37PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV37DO**	:= ________
SELOGIC Variable Input (SV)	**SV38**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV38PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV38DO**	:= ________
SELOGIC Variable Input (SV)	**SV39**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV39PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV39DO**	:= ________
SELOGIC Variable Input (SV)	**SV40**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV40PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV40DO**	:= ________
SELOGIC Variable Input (SV)	**SV41**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV41PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV41DO**	:= ________
SELOGIC Variable Input (SV)	**SV42**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV42PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV42DO**	:= ________
SELOGIC Variable Input (SV)	**SV43**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV43PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV43DO**	:= ________
SELOGIC Variable Input (SV)	**SV44**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV44PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV44DO**	:= ________
SELOGIC Variable Input (SV)	**SV45**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV45PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV45DO**	:= ________
SELOGIC Variable Input (SV)	**SV46**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV46PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV46DO**	:= ________
SELOGIC Variable Input (SV)	**SV47**	:= ________

SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV47PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV47DO**	:= ________
SELOGIC Variable Input (SV)	**SV48**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV48PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV48DO**	:= ________
SELOGIC Variable Input (SV)	**SV49**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV49PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV49DO**	:= ________
SELOGIC Variable Input (SV)	**SV50**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV50PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV50DO**	:= ________
SELOGIC Variable Input (SV)	**SV51**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV51PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV51DO**	:= ________
SELOGIC Variable Input (SV)	**SV52**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV52PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV52DO**	:= ________
SELOGIC Variable Input (SV)	**SV53**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV53PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV53DO**	:= ________
SELOGIC Variable Input (SV)	**SV54**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV54PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV54DO**	:= ________
SELOGIC Variable Input (SV)	**SV55**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV55PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV55DO**	:= ________
SELOGIC Variable Input (SV)	**SV56**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV56PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV56DO**	:= ________
SELOGIC Variable Input (SV)	**SV57**	:= ________
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV57PU**	:= ________
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV57DO**	:= ________

SELOGIC Variable Input (SV)	**SV58**	:=
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV58PU**	:=
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV58DO**	:=
SELOGIC Variable Input (SV)	**SV59**	:=
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV59PU**	:=
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV59DO**	:=
SELOGIC Variable Input (SV)	**SV60**	:=
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV60PU**	:=
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV60DO**	:=
SELOGIC Variable Input (SV)	**SV61**	:=
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV61PU**	:=
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV61DO**	:=
SELOGIC Variable Input (SV)	**SV62**	:=
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV62PU**	:=
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV62DO**	:=
SELOGIC Variable Input (SV)	**SV63**	:=
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV63PU**	:=
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV63DO**	:=
SELOGIC Variable Input (SV)	**SV64**	:=
SELOGIC Variable Timer Pickup (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV64PU**	:=
SELOGIC Variable Timer Dropout (0.000–86400.000 s, MV*nn*, ACV*nn*, RA*nnn*)	**SV64DO**	:=

Analog Level Set Point SELOGIC Settings

Analog Level Value Input	**LEVEL_IN**	:=
Analog Flow Value Input	**FLOW_IN**	:=
LOW_SP Analog Level Set Point	**LOW_SP**	:=
STOP_SP Analog Level Set Point	**STOP_SP**	:=
LEAD_SP Analog Level Set Point	**LEAD_SP**	:=
LAG1_SP Analog Level Set Point	**LAG1_SP**	:=
LAG2_SP Analog Level Equation	**LAG2_SP**	:=
LAG3_SP Analog Level Set Point	**LAG3_SP**	:=
HIGH_SP Analog Level Set Point	**HIGH_SP**	:=
ANA_LOW Analog Level Equation	**ANA_LOW**	:=
ANA_STOP Analog Level Equation	**ANA_STOP**	:=
ANA_LEAD Analog Level Equation	**ANA_LEAD**	:=
ANA_LAG1 Analog Level Equation	**ANA_LAG1**	:=
ANA_LAG2 Analog Level Equation	**ANA_LAG2**	:=

ANA_LAG3 Analog Level Equation	**ANA_LAG3**	:=
ANA_HIGH Analog Level Equation	**ANA_HIGH**	:=

Analog Control Variables

Enable Analog Control Variables (NA, 1–32)	**EACV**	:=
Analog Control Variable Alias (15 characters)	**ACV01A**	:=
Analog Control Variable Prompt (64 characters)	**ACV01P**	:=
Analog Control Variable Minimum	**ACV01MIN**	:=
Analog Control Variable Maximum	**ACV01MAX**	:=
Analog Control Variable Reset Value	**ACV01RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV01U**	:=
Analog Control Variable Reset Equation	**ACV01RST**	:=
Analog Control Variable Alias (15 characters)	**ACV02A**	:=
Analog Control Variable Prompt (64 characters)	**ACV02P**	:=
Analog Control Variable Minimum	**ACV02MIN**	:=
Analog Control Variable Maximum	**ACV02MAX**	:=
Analog Control Variable Reset Value	**ACV02RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV02U**	:=
Analog Control Variable Reset Equation	**ACV02RST**	:=
Analog Control Variable Alias (15 characters)	**ACV03A**	:=
Analog Control Variable Prompt (64 characters)	**ACV03P**	:=
Analog Control Variable Minimum	**ACV03MIN**	:=
Analog Control Variable Maximum	**ACV03MAX**	:=
Analog Control Variable Reset Value	**ACV03RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV03U**	:=
Analog Control Variable Reset Equation	**ACV03RST**	:=
Analog Control Variable Alias (15 characters)	**ACV04A**	:=
Analog Control Variable Prompt (64 characters)	**ACV04P**	:=
Analog Control Variable Minimum	**ACV04MIN**	:=
Analog Control Variable Maximum	**ACV04MAX**	:=
Analog Control Variable Reset Value	**ACV04RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV04U**	:=
Analog Control Variable Reset Equation	**ACV04RST**	:=
Analog Control Variable Alias (15 characters)	**ACV05A**	:=
Analog Control Variable Prompt (64 characters)	**ACV05P**	:=
Analog Control Variable Minimum	**ACV05MIN**	:=
Analog Control Variable Maximum	**ACV05MAX**	:=
Analog Control Variable Reset Value	**ACV05RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV05U**	:=
Analog Control Variable Reset Equation	**ACV05RST**	:=
Analog Control Variable Alias (15 characters)	**ACV06A**	:=
Analog Control Variable Prompt (64 characters)	**ACV06P**	:=
Analog Control Variable Minimum	**ACV06MIN**	:=
Analog Control Variable Maximum	**ACV06MAX**	:=
Analog Control Variable Reset Value	**ACV06RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV06U**	:=

Analog Control Variable Reset Equation	**ACV06RST**	:= ______
Analog Control Variable Alias (15 characters)	**ACV07A**	:= ______
Analog Control Variable Prompt (64 characters)	**ACV07P**	:= ______
Analog Control Variable Minimum	**ACV07MIN**	:= ______
Analog Control Variable Maximum	**ACV07MAX**	:= ______
Analog Control Variable Reset Value	**ACV07RV**	:= ______
Analog Control Variable Display Units (5 characters)	**ACV07U**	:= ______
Analog Control Variable Reset Equation	**ACV07RST**	:= ______
Analog Control Variable Alias (15 characters)	**ACV08A**	:= ______
Analog Control Variable Prompt (64 characters)	**ACV08P**	:= ______
Analog Control Variable Minimum	**ACV08MIN**	:= ______
Analog Control Variable Maximum	**ACV08MAX**	:= ______
Analog Control Variable Reset Value	**ACV08RV**	:= ______
Analog Control Variable Display Units (5 characters)	**ACV08U**	:= ______
Analog Control Variable Reset Equation	**ACV08RST**	:= ______
Analog Control Variable Alias (15 characters)	**ACV09A**	:= ______
Analog Control Variable Prompt (64 characters)	**ACV09P**	:= ______
Analog Control Variable Minimum	**ACV09MIN**	:= ______
Analog Control Variable Maximum	**ACV09MAX**	:= ______
Analog Control Variable Reset Value	**ACV09RV**	:= ______
Analog Control Variable Display Units (5 characters)	**ACV09U**	:= ______
Analog Control Variable Reset Equation	**ACV09RST**	:= ______
Analog Control Variable Alias (15 characters)	**ACV10A**	:= ______
Analog Control Variable Prompt (64 characters)	**ACV10P**	:= ______
Analog Control Variable Minimum	**ACV10MIN**	:= ______
Analog Control Variable Maximum	**ACV10MAX**	:= ______
Analog Control Variable Reset Value	**ACV10RV**	:= ______
Analog Control Variable Display Units (5 characters)	**ACV10U**	:= ______
Analog Control Variable Reset Equation	**ACV10RST**	:= ______
Analog Control Variable Alias (15 characters)	**ACV11A**	:= ______
Analog Control Variable Prompt (64 characters)	**ACV11P**	:= ______
Analog Control Variable Minimum	**ACV11MIN**	:= ______
Analog Control Variable Maximum	**ACV11MAX**	:= ______
Analog Control Variable Reset Value	**ACV11RV**	:= ______
Analog Control Variable Display Units (5 characters)	**ACV11U**	:= ______
Analog Control Variable Reset Equation	**ACV11RST**	:= ______
Analog Control Variable Alias (15 characters)	**ACV12A**	:= ______
Analog Control Variable Prompt (64 characters)	**ACV12P**	:= ______
Analog Control Variable Minimum	**ACV12MIN**	:= ______
Analog Control Variable Maximum	**ACV12MAX**	:= ______
Analog Control Variable Reset Value	**ACV12RV**	:= ______
Analog Control Variable Display Units (5 characters)	**ACV12U**	:= ______
Analog Control Variable Reset Equation	**ACV12RST**	:= ______
Analog Control Variable Alias (15 characters)	**ACV13A**	:= ______
Analog Control Variable Prompt (64 characters)	**ACV13P**	:= ______
Analog Control Variable Minimum	**ACV13MIN**	:= ______
Analog Control Variable Maximum	**ACV13MAX**	:= ______

Analog Control Variable Reset Value	**ACV13RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV13U**	:=
Analog Control Variable Reset Equation	**ACV13RST**	:=
Analog Control Variable Alias (15 characters)	**ACV14A**	:=
Analog Control Variable Prompt (64 characters)	**ACV14P**	:=
Analog Control Variable Minimum	**ACV14MIN**	:=
Analog Control Variable Maximum	**ACV14MAX**	:=
Analog Control Variable Reset Value	**ACV14RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV14U**	:=
Analog Control Variable Reset Equation	**ACV14RST**	:=
Analog Control Variable Alias (15 characters)	**ACV15A**	:=
Analog Control Variable Prompt (64 characters)	**ACV15P**	:=
Analog Control Variable Minimum	**ACV15MIN**	:=
Analog Control Variable Maximum	**ACV15MAX**	:=
Analog Control Variable Reset Value	**ACV15RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV15U**	:=
Analog Control Variable Reset Equation	**ACV15RST**	:=
Analog Control Variable Alias (15 characters)	**ACV01A**	:=
Analog Control Variable Prompt (64 characters)	**ACV16P**	:=
Analog Control Variable Minimum	**ACV16MIN**	:=
Analog Control Variable Maximum	**ACV16MAX**	:=
Analog Control Variable Reset Value	**ACV16RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV16U**	:=
Analog Control Variable Reset Equation	**ACV16RST**	:=
Analog Control Variable Alias (15 characters)	**ACV17A**	:=
Analog Control Variable Prompt (64 characters)	**ACV17P**	:=
Analog Control Variable Minimum	**ACV17MIN**	:=
Analog Control Variable Maximum	**ACV17MAX**	:=
Analog Control Variable Reset Value	**ACV17RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV17U**	:=
Analog Control Variable Reset Equation	**ACV17RST**	:=
Analog Control Variable Alias (15 characters)	**ACV18A**	:=
Analog Control Variable Prompt (64 characters)	**ACV18P**	:=
Analog Control Variable Minimum	**ACV18MIN**	:=
Analog Control Variable Maximum	**ACV18MAX**	:=
Analog Control Variable Reset Value	**ACV18RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV18U**	:=
Analog Control Variable Reset Equation	**ACV18RST**	:=
Analog Control Variable Alias (15 characters)	**ACV19A**	:=
Analog Control Variable Prompt (64 characters)	**ACV19P**	:=
Analog Control Variable Minimum	**ACV19MIN**	:=
Analog Control Variable Maximum	**ACV19MAX**	:=
Analog Control Variable Reset Value	**ACV19RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV19U**	:=
Analog Control Variable Reset Equation	**ACV19RST**	:=
Analog Control Variable Alias (15 characters)	**ACV20A**	:=
Analog Control Variable Prompt (64 characters)	**ACV20P**	:=

Analog Control Variable Minimum	**ACV20MIN**	:=
Analog Control Variable Maximum	**ACV20MAX**	:=
Analog Control Variable Reset Value	**ACV20RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV02U**	:=
Analog Control Variable Reset Equation	**ACV20RST**	:=
Analog Control Variable Alias (15 characters)	**ACV21A**	:=
Analog Control Variable Prompt (64 characters)	**ACV21P**	:=
Analog Control Variable Minimum	**ACV21MIN**	:=
Analog Control Variable Maximum	**ACV21MAX**	:=
Analog Control Variable Reset Value	**ACV21RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV21U**	:=
Analog Control Variable Reset Equation	**ACV21RST**	:=
Analog Control Variable Alias (15 characters)	**ACV22A**	:=
Analog Control Variable Prompt (64 characters)	**ACV22P**	:=
Analog Control Variable Minimum	**ACV22MIN**	:=
Analog Control Variable Maximum	**ACV22MAX**	:=
Analog Control Variable Reset Value	**ACV22RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV22U**	:=
Analog Control Variable Reset Equation	**ACV22RST**	:=
Analog Control Variable Alias (15 characters)	**ACV23A**	:=
Analog Control Variable Prompt (64 characters)	**ACV23P**	:=
Analog Control Variable Minimum	**ACV23MIN**	:=
Analog Control Variable Maximum	**ACV23MAX**	:=
Analog Control Variable Reset Value	**ACV23RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV23U**	:=
Analog Control Variable Reset Equation	**ACV23RST**	:=
Analog Control Variable Alias (15 characters)	**ACV24A**	:=
Analog Control Variable Prompt (64 characters)	**ACV24P**	:=
Analog Control Variable Minimum	**ACV24MIN**	:=
Analog Control Variable Maximum	**ACV24MAX**	:=
Analog Control Variable Reset Value	**ACV24RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV24U**	:=
Analog Control Variable Reset Equation	**ACV24RST**	:=
Analog Control Variable Alias (15 characters)	**ACV25A**	:=
Analog Control Variable Prompt (64 characters)	**ACV25P**	:=
Analog Control Variable Minimum	**ACV25MIN**	:=
Analog Control Variable Maximum	**ACV25MAX**	:=
Analog Control Variable Reset Value	**ACV25RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV25U**	:=
Analog Control Variable Reset Equation	**ACV25RST**	:=
Analog Control Variable Alias (15 characters)	**ACV26A**	:=
Analog Control Variable Prompt (64 characters)	**ACV26P**	:=
Analog Control Variable Minimum	**ACV26MIN**	:=
Analog Control Variable Maximum	**ACV26MAX**	:=
Analog Control Variable Reset Value	**ACV26RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV26U**	:=
Analog Control Variable Reset Equation	**ACV26RST**	:=

Analog Control Variable Alias (15 characters)	**ACV27A**	:=
Analog Control Variable Prompt (64 characters)	**ACV27P**	:=
Analog Control Variable Minimum	**ACV27MIN**	:=
Analog Control Variable Maximum	**ACV27MAX**	:=
Analog Control Variable Reset Value	**ACV27RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV27U**	:=
Analog Control Variable Reset Equation	**ACV27RST**	:=
Analog Control Variable Alias (15 characters)	**ACV28A**	:=
Analog Control Variable Prompt (64 characters)	**ACV28P**	:=
Analog Control Variable Minimum	**ACV28MIN**	:=
Analog Control Variable Maximum	**ACV28MAX**	:=
Analog Control Variable Reset Value	**ACV28RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV28U**	:=
Analog Control Variable Reset Equation	**ACV28RST**	:=
Analog Control Variable Alias (15 characters)	**ACV29A**	:=
Analog Control Variable Prompt (64 characters)	**ACV29P**	:=
Analog Control Variable Minimum	**ACV29MIN**	:=
Analog Control Variable Maximum	**ACV29MAX**	:=
Analog Control Variable Reset Value	**ACV29RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV29U**	:=
Analog Control Variable Reset Equation	**ACV29RST**	:=
Analog Control Variable Alias (15 characters)	**ACV30A**	:=
Analog Control Variable Prompt (64 characters)	**ACV30P**	:=
Analog Control Variable Minimum	**ACV30MIN**	:=
Analog Control Variable Maximum	**ACV30MAX**	:=
Analog Control Variable Reset Value	**ACV30RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV30U**	:=
Analog Control Variable Reset Equation	**ACV30RST**	:=
Analog Control Variable Alias (15 characters)	**ACV31A**	:=
Analog Control Variable Prompt (64 characters)	**ACV31P**	:=
Analog Control Variable Minimum	**ACV31MIN**	:=
Analog Control Variable Maximum	**ACV31MAX**	:=
Analog Control Variable Reset Value	**ACV31RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV31U**	:=
Analog Control Variable Reset Equation	**ACV31RST**	:=
Analog Control Variable Alias (15 characters)	**ACV32A**	:=
Analog Control Variable Prompt (64 characters)	**ACV32P**	:=
Analog Control Variable Minimum	**ACV32MIN**	:=
Analog Control Variable Maximum	**ACV32MAX**	:=
Analog Control Variable Reset Value	**ACV32RV**	:=
Analog Control Variable Display Units (5 characters)	**ACV32U**	:=
Analog Control Variable Reset Equation	**ACV32RST**	:=

SELogic Counter Settings

Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC01NV**	:=
Counter Preset Value SC*xx*PV (1–65000)	**SC01PV**	:=

Counter Reset Input SC*xx*R (SELOGIC)	**SC01R**	:= ________
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC01LD**	:= ________
Count-Up Input SC*xx*CU (SELOGIC)	**SC01CU**	:= ________
Count-Down Input SC*xx*CD (SELOGIC)	**SC01CD**	:= ________
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC02NV**	:= ________
Counter Preset Value SC*xx*PV (1–65000)	**SC02PV**	:= ________
Counter Reset Input SC*xx*R (SELOGIC)	**SC02R**	:= ________
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC02LD**	:= ________
Count-Up Input SC*xx*CU (SELOGIC)	**SC02CU**	:= ________
Count-Down Input SC*xx*CD (SELOGIC)	**SC02CD**	:= ________
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC03NV**	:= ________
Counter Preset Value SC*xx*PV (1–65000)	**SC03PV**	:= ________
Counter Reset Input SC*xx*R (SELOGIC)	**SC03R**	:= ________
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC03LD**	:= ________
Count-Up Input SC*xx*CU (SELOGIC)	**SC03CU**	:= ________
Count-Down Input SC*xx*CD (SELOGIC)	**SC03CD**	:= ________
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC04NV**	:= ________
Counter Preset Value SC*xx*PV (1–65000)	**SC04PV**	:= ________
Counter Reset Input SC*xx*R (SELOGIC)	**SC04R**	:= ________
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC04LD**	:= ________
Count-Up Input SC*xx*CU (SELOGIC)	**SC04CU**	:= ________
Count-Down Input SC*xx*CD (SELOGIC)	**SC04CD**	:= ________
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC05NV**	:= ________
Counter Preset Value SC*xx*PV (1–65000)	**SC05PV**	:= ________
Counter Reset Input SC*xx*R (SELOGIC)	**SC05R**	:= ________
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC05LD**	:= ________
Count-Up Input SC*xx*CU (SELOGIC)	**SC05CU**	:= ________
Count-Down Input SC*xx*CD (SELOGIC)	**SC05CD**	:= ________
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC06NV**	:= ________
Counter Preset Value SC*xx*PV (1–65000)	**SC06PV**	:= ________
Counter Reset Input SC*xx*R (SELOGIC)	**SC06R**	:= ________
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC06LD**	:= ________
Count-Up Input SC*xx*CU (SELOGIC)	**SC06CU**	:= ________
Count-Down Input SC*xx*CD (SELOGIC)	**SC06CD**	:= ________
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC07NV**	:= ________
Counter Preset Value SC*xx*PV (1–65000)	**SC07PV**	:= ________
Counter Reset Input SC*xx*R (SELOGIC)	**SC07R**	:= ________
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC07LD**	:= ________
Count-Up Input SC*xx*CU (SELOGIC)	**SC07CU**	:= ________
Count-Down Input SC*xx*CD (SELOGIC)	**SC07CD**	:= ________
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC08NV**	:= ________
Counter Preset Value SC*xx*PV (1–65000)	**SC08PV**	:= ________
Counter Reset Input SC*xx*R (SELOGIC)	**SC08R**	:= ________
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC08LD**	:= ________
Count-Up Input SC*xx*CU (SELOGIC)	**SC08CU**	:= ________
Count-Down Input SC*xx*CD (SELOGIC)	**SC08CD**	:= ________
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC09NV**	:= ________

Counter Preset Value SC*xx*PV (1–65000)	**SC09PV**	:=
Counter Reset Input SC*xx*R (SELOGIC)	**SC09R**	:=
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC09LD**	:=
Count-Up Input SC*xx*CU (SELOGIC)	**SC09CU**	:=
Count-Down Input SC*xx*CD (SELOGIC)	**SC09CD**	:=
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC10NV**	:=
Counter Preset Value SC*xx*PV (1–65000)	**SC10PV**	:=
Counter Reset Input SC*xx*R (SELOGIC)	**SC10R**	:=
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC10LD**	:=
Count-Up Input SC*xx*CU (SELOGIC)	**SC10CU**	:=
Count-Down Input SC*xx*CD (SELOGIC)	**SC10CD**	:=
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC11NV**	:=
Counter Preset Value SC*xx*PV (1–65000)	**SC11PV**	:=
Counter Reset Input SC*xx*R (SELOGIC)	**SC11R**	:=
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC11LD**	:=
Count-Up Input SC*xx*CU (SELOGIC)	**SC11CU**	:=
Count-Down Input SC*xx*CD (SELOGIC)	**SC11CD**	:=
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC12NV**	:=
Counter Preset Value SC*xx*PV (1–65000)	**SC12PV**	:=
Counter Reset Input SC*xx*R (SELOGIC)	**SC12R**	:=
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC12LD**	:=
Count-Up Input SC*xx*CU (SELOGIC)	**SC12CU**	:=
Count-Down Input SC*xx*CD (SELOGIC)	**SC12CD**	:=
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC13NV**	:=
Counter Preset Value SC*xx*PV (1–65000)	**SC13PV**	:=
Counter Reset Input SC*xx*R (SELOGIC)	**SC13R**	:=
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC13LD**	:=
Count-Up Input SC*xx*CU (SELOGIC)	**SC13CU**	:=
Count-Down Input SC*xx*CD (SELOGIC)	**SC13CD**	:=
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC14NV**	:=
Counter Preset Value SC*xx*PV (1–65000)	**SC14PV**	:=
Counter Reset Input SC*xx*R (SELOGIC)	**SC14R**	:=
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC14LD**	:=
Count-Up Input SC*xx*CU (SELOGIC)	**SC14CU**	:=
Count-Down Input SC*xx*CD (SELOGIC)	**SC14CD**	:=
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC015NV**	:=
Counter Preset Value SC*xx*PV (1–65000)	**SC15PV**	:=
Counter Reset Input SC*xx*R (SELOGIC)	**SC15R**	:=
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC15LD**	:=
Count-Up Input SC*xx*CU (SELOGIC)	**SC15CU**	:=
Count-Down Input SC*xx*CD (SELOGIC)	**SC15CD**	:=
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC16NV**	:=
Counter Preset Value SC*xx*PV (1–65000)	**SC16PV**	:=
Counter Reset Input SC*xx*R (SELOGIC)	**SC16R**	:=
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC16LD**	:=
Count-Up Input SC*xx*CU (SELOGIC)	**SC16CU**	:=
Count-Down Input SC*xx*CD (SELOGIC)	**SC16CD**	:=

Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC17NV**	:= ______
Counter Preset Value SC*xx*PV (1–65000)	**SC17PV**	:= ______
Counter Reset Input SC*xx*R (SELOGIC)	**SC17R**	:= ______
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC17LD**	:= ______
Count-Up Input SC*xx*CU (SELOGIC)	**SC17CU**	:= ______
Count-Down Input SC*xx*CD (SELOGIC)	**SC17CD**	:= ______
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC18NV**	:= ______
Counter Preset Value SC*xx*PV (1–65000)	**SC18PV**	:= ______
Counter Reset Input SC*xx*R (SELOGIC)	**SC18R**	:= ______
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC18LD**	:= ______
Count-Up Input SC*xx*CU (SELOGIC)	**SC18CU**	:= ______
Count-Down Input SC*xx*CD (SELOGIC)	**SC18CD**	:= ______
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC19NV**	:= ______
Counter Preset Value SC*xx*PV (1–65000)	**SC19PV**	:= ______
Counter Reset Input SC*xx*R (SELOGIC)	**SC19R**	:= ______
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC19LD**	:= ______
Count-Up Input SC*xx*CU (SELOGIC)	**SC19CU**	:= ______
Count-Down Input SC*xx*CD (SELOGIC)	**SC19CD**	:= ______
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC20NV**	:= ______
Counter Preset Value SC*xx*PV (1–65000)	**SC20PV**	:= ______
Counter Reset Input SC*xx*R (SELOGIC)	**SC20R**	:= ______
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC20LD**	:= ______
Count-Up Input SC*xx*CU (SELOGIC)	**SC20CU**	:= ______
Count-Down Input SC*xx*CD (SELOGIC)	**SC20CD**	:= ______
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC21NV**	:= ______
Counter Preset Value SC*xx*PV (1–65000)	**SC21PV**	:= ______
Counter Reset Input SC*xx*R (SELOGIC)	**SC21R**	:= ______
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC21LD**	:= ______
Count-Up Input SC*xx*CU (SELOGIC)	**SC21CU**	:= ______
Count-Down Input SC*xx*CD (SELOGIC)	**SC21CD**	:= ______
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC22NV**	:= ______
Counter Preset Value SC*xx*PV (1–65000)	**SC22PV**	:= ______
Counter Reset Input SC*xx*R (SELOGIC)	**SC22R**	:= ______
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC22LD**	:= ______
Count-Up Input SC*xx*CU (SELOGIC)	**SC22CU**	:= ______
Count-Down Input SC*xx*CD (SELOGIC)	**SC22CD**	:= ______
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC23NV**	:= ______
Counter Preset Value SC*xx*PV (1–65000)	**SC23PV**	:= ______
Counter Reset Input SC*xx*R (SELOGIC)	**SC23R**	:= ______
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC23LD**	:= ______
Count-Up Input SC*xx*CU (SELOGIC)	**SC23CU**	:= ______
Count-Down Input SC*xx*CD (SELOGIC)	**SC23CD**	:= ______
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC24NV**	:= ______
Counter Preset Value SC*xx*PV (1–65000)	**SC24PV**	:= ______
Counter Reset Input SC*xx*R (SELOGIC)	**SC24R**	:= ______
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC24LD**	:= ______
Count-Up Input SC*xx*CU (SELOGIC)	**SC24CU**	:= ______

Count-Down Input SC*xx*CD (SELOGIC)	**SC24CD**	:=	
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC25NV**	:=	
Counter Preset Value SC*xx*PV (1–65000)	**SC25PV**	:=	
Counter Reset Input SC*xx*R (SELOGIC)	**SC25R**	:=	
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC25LD**	:=	
Count-Up Input SC*xx*CU (SELOGIC)	**SC25CU**	:=	
Count-Down Input SC*xx*CD (SELOGIC)	**SC25CD**	:=	
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC26NV**	:=	
Counter Preset Value SC*xx*PV (1–65000)	**SC26PV**	:=	
Counter Reset Input SC*xx*R (SELOGIC)	**SC26R**	:=	
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC26LD**	:=	
Count-Up Input SC*xx*CU (SELOGIC)	**SC26CU**	:=	
Count-Down Input SC*xx*CD (SELOGIC)	**SC26CD**	:=	
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC27NV**	:=	
Counter Preset Value SC*xx*PV (1–65000)	**SC27PV**	:=	
Counter Reset Input SC*xx*R (SELOGIC)	**SC27R**	:=	
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC27LD**	:=	
Count-Up Input SC*xx*CU (SELOGIC)	**SC27CU**	:=	
Count-Down Input SC*xx*CD (SELOGIC)	**SC27CD**	:=	
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC28NV**	:=	
Counter Preset Value SC*xx*PV (1–65000)	**SC28PV**	:=	
Counter Reset Input SC*xx*R (SELOGIC)	**SC28R**	:=	
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC28LD**	:=	
Count-Up Input SC*xx*CU (SELOGIC)	**SC28CU**	:=	
Count-Down Input SC*xx*CD (SELOGIC)	**SC28CD**	:=	
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC29NV**	:=	
Counter Preset Value SC*xx*PV (1–65000)	**SC29PV**	:=	
Counter Reset Input SC*xx*R (SELOGIC)	**SC29R**	:=	
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC29LD**	:=	
Count-Up Input SC*xx*CU (SELOGIC)	**SC29CU**	:=	
Count-Down Input SC*xx*CD (SELOGIC)	**SC29CD**	:=	
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC30NV**	:=	
Counter Preset Value SC*xx*PV (1–65000)	**SC30PV**	:=	
Counter Reset Input SC*xx*R (SELOGIC)	**SC30R**	:=	
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC30LD**	:=	
Count-Up Input SC*xx*CU (SELOGIC)	**SC30CU**	:=	
Count-Down Input SC*xx*CD (SELOGIC)	**SC30CD**	:=	
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC31NV**	:=	
Counter Preset Value SC*xx*PV (1–65000)	**SC31PV**	:=	
Counter Reset Input SC*xx*R (SELOGIC)	**SC31R**	:=	
Counter Load PV Input SC*xx*LD (SELOGIC)	**SC31LD**	:=	
Count-Up Input SC*xx*CU (SELOGIC)	**SC31CU**	:=	
Count-Down Input SC*xx*CD (SELOGIC)	**SC31CD**	:=	
Counter Nonvolatile Storage Enable SC*xx*NV (Y, N)	**SC32NV**	:=	
Counter Preset Value SC*xx*PV (1–65000)	**SC32PV**	:=	
Counter Reset Input SC*xx*R (SELOGIC)	**SC32R**	:=	

Counter Load PV Input SC*xx*LD (SELOGIC) **SC32LD** := ______
Count-Up Input SC*xx*CU (SELOGIC) **SC32CU** := ______
Count-Down Input SC*xx*CD (SELOGIC) **SC32CD** := ______

Math Variable SELOGIC Equations

Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV01NV** := ______
MV01 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV02NV** := ______
MV02 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV03NV** := ______
MV03 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV04NV** := ______
MV04 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV05NV** := ______
MV05 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV06NV** := ______
MV06 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV07NV** := ______
MV07 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV08NV** := ______
MV08 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV09NV** := ______
MV09 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV10NV** := ______
MV10 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV11NV** := ______
MV11 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV12NV** := ______
MV12 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV13NV** := ______
MV13 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV14NV** := ______
MV14 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV15NV** := ______
MV15 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV16NV** := ______
MV16 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV17NV** := ______
MV17 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV18NV** := ______
MV18 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV19NV** := ______
MV19 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV20NV** := ______
MV20 := ______
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV21NV** := ______

MV21 := ____________________
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV22NV** := ____________
MV22 := ____________________
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV23NV** := ____________
MV23 := ____________________
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV24NV** := ____________
MV24 := ____________________
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV25NV** := ____________
MV25 := ____________________
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV26NV** := ____________
MV26 := ____________________
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV27NV** := ____________
MV27 := ____________________
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV28NV** := ____________
MV28 := ____________________
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV29NV** := ____________
MV29 := ____________________
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV30NV** := ____________
MV30 := ____________________
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV31NV** := ____________
MV31 := ____________________
Math Variable Nonvolatile Storage Enable MVxxNV (Y, N) **MV32NV** := ____________
MV32 := ____________________
MV33 := ____________________
MV34 := ____________________
MV35 := ____________________
MV36 := ____________________
MV37 := ____________________
MV38 := ____________________
MV39 := ____________________
MV40 := ____________________
MV41 := ____________________
MV42 := ____________________
MV43 := ____________________
MV44 := ____________________
MV45 := ____________________
MV46 := ____________________
MV47 := ____________________
MV48 := ____________________
MV49 := ____________________
MV50 := ____________________
MV51 := ____________________
MV52 := ____________________
MV53 := ____________________
MV54 := ____________________
MV55 := ____________________
MV56 := ____________________

MV57 := ____
MV58 := ____
MV59 := ____
MV60 := ____
MV61 := ____
MV62 := ____
MV63 := ____
MV64 := ____

Output Contacts (DO Units)

Base Unit

OUT101 := ____
OUT102 := ____
OUT103 := ____

For a card in Slot 4

OUT401 := ____
OUT402 := ____
OUT403 := ____
OUT404 := ____

Mirrored Bits

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

Pump Enable Latch Settings

Pump 1 Latch Set **P1LTSET** := ____
Pump 1 Latch Reset **P1LTRST** := ____
Pump 2 Latch Set **P2LTSET** := ____
Pump 2 Latch Reset **P2LTRST** := ____
Pump 3 Latch Set **P3LTSET** := ____
Pump 3 Latch Reset **P3LTRST** := ____

Pump 4 Latch Set	**P4LTSET**	:=
Pump 4 Latch Reset	**P4LTRST**	:=

Discrete Float Input SELOGIC Settings

Discrete Float LOW_IN Variable Input	**LOW_IN**	:=
Discrete Float STOP_IN Variable Input	**STOP_IN**	:=
Discrete Float LEAD_IN Variable Input	**LEAD_IN**	:=
Discrete Float HIGH_IN Variable Input	**HIGH_IN**	:=
Discrete Float LAG1_IN Variable Input	**LAG1_IN**	:=
Discrete Float LAG2_IN Variable Input	**LAG2_IN**	:=
Discrete Float LAG3_IN Variable Input	**LAG3_IN**	:=

Logical Float Input SELOGIC Settings

Logical Float LOW Variable Input	**LOW**	:=
Logical Float STOP Variable Input	**STOP**	:=
Logical Float LEAD Variable Input	**LEAD**	:=
Logical Float HIGH Variable Input	**HIGH**	:=
Logical Float LAG1 Variable Input	**LAG1**	:=
Logical Float LAG2 Variable Input	**LAG2**	:=
Logical Float LAG3 Variable Input	**LAG3**	:=

Digital Input SELOGIC Settings

Logical HOA1AUTO Variable Input	**HOA1AUTO**	:=
Logical HOA2AUTO Variable Input	**HOA2AUTO**	:=
Logical HOA3AUTO Variable Input	**HOA3AUTO**	:=
Logical HOA4AUTO Variable Input	**HOA4AUTO**	:=
Logical HOA1HAND Variable Input	**HOA1HAND**	:=
Logical HOA2HAND Variable Input	**HOA2HAND**	:=
Logical HOA3HAND Variable Input	**HOA3HAND**	:=
Logical HOA4HAND Variable Input	**HOA4HAND**	:=
Logical INT_DETC Variable Input	**INT_DETC**	:=
Logical UPS_ALRM Variable Input	**UPS_ALRM**	:=
Logical PHS_MON Variable Input	**PHS_MON**	:=
Logical ALRM_HORN Variable Input	**ALRM_HORN**	:=
Logical ALMLIGHT Variable Input	**ALMLIGHT**	:=
Logical AUX_OUT Variable Input	**AUX_OUT**	:=

Float Configuration Settings

Logical Float Out-of-Sequence Timer Input (SELOGIC)	**FLO_SEQ**	:=
Logical Float Out-of-Sequence Timer Pickup (0.000–86400.00 s, MV*nn*, ACV*nn*, RA*nnn*)	**FLOSEQPU**	:=
Logical Float Out-of-Sequence Timer Dropout (0.000–86400.00 s, MV*nn*, ACV*nn*, RA*nnn*)	**FLOSEQDO**	:=
Logical Single Float Run Timer Input (SELOGIC)	**SFLO_TM**	:=
Logical Single Float Run Timer Pickup (0.000–86400.00 s, MV*nn*, ACV*nn*, RA*nnn*)	**SFLOTMPU**	:=
Logical Single Float Run Timer Dropout (0.000–86400.00 s, MV*nn*, ACV*nn*, RA*nnn*)	**SFLOTMDO**	:=
LAGx Start Time Setting (0.00–86400.00 s)	**LGST_TM**	:=

Line-to-Line Voltage Low Threshold (100.00–1500.00 V)	**VLL_THRS**	:=
Logical Phase Monitor Alarm (SELOGIC)	**PHS_ALM**	:=
Logical Level Sensor Fail Timer Input (SELOGIC)	**AI_FAIL**	:=
Logical Level Sensor Fail Timer Pickup (0.000–86400.00 s, MV*nn*, ACV*nn*, RA*nnn*)	**AIFAILPU**	:=
Logical Level Sensor Fail Timer Dropout (0.000–86400.00 s, MV*nn*, ACV*nn*, RA*nnn*)	**AIFAILDO**	:=

Global Settings (SET G Command)

General Settings

Phase Rotation (ABC, ACB)	**PHROT**	:=
Rated Frequency (50, 60 Hz)	**FNOM**	:=
Transformer Connection (DELTA, WYE)	**DELTA_Y**	:=
Date Format (MDY, YMD, DMY)	**DATE_F**	:=
Voltage Channel Scaling (DEFAULT, CUSTOM) *(Hidden if Slot E is not 8V 3ACI/3AVI)*	**VSCALE**	:=

Input Debounce Settings (Base Unit)

IN101 Debounce (AC, 0–65000 ms)	**IN101D**	:=
IN102 Debounce (AC, 0–65000 ms)	**IN102D**	:=

Input Debounce Settings (Slot 3)

IN301 Debounce (AC, 0–65000 ms)	**IN301D**	:=
IN302 Debounce (AC, 0–65000 ms)	**IN302D**	:=
IN303 Debounce (AC, 0–65000 ms)	**IN303D**	:=
IN304 Debounce (AC, 0–65000 ms)	**IN304D**	:=
IN305 Debounce (AC, 0–65000 ms)	**IN305D**	:=
IN306 Debounce (AC, 0–65000 ms)	**IN306D**	:=
IN307 Debounce (AC, 0–65000 ms)	**IN307D**	:=
IN308 Debounce (AC, 0–65000 ms)	**IN308D**	:=
IN309 Debounce (AC, 0–65000 ms)	**IN309D**	:=
IN310 Debounce (AC, 0–65000 ms)	**IN310D**	:=
IN311 Debounce (AC, 0–65000 ms)	**IN311D**	:=
IN312 Debounce (AC, 0–65000 ms)	**IN312D**	:=
IN313 Debounce (AC, 0–65000 ms)	**IN313D**	:=
IN314 Debounce (AC, 0–65000 ms)	**IN314D**	:=

Input Debounce Settings (Slot 4)

IN401 Debounce (AC, 0–65000 ms)	**IN401D**	:=
IN402 Debounce (AC, 0–65000 ms)	**IN402D**	:=
IN403 Debounce (AC, 0–65000 ms)	**IN403D**	:=
IN404 Debounce (AC, 0–65000 ms)	**IN404D**	:=

Input Debounce Settings (Slot 5)

IN501 Debounce (AC, 0–65000 ms)	**IN501D**	:=
IN502 Debounce (AC, 0–65000 ms)	**IN502D**	:=
IN503 Debounce (AC, 0–65000 ms)	**IN503D**	:=
IN504 Debounce (AC, 0–65000 ms)	**IN504D**	:=
IN505 Debounce (AC, 0–65000 ms)	**IN505D**	:=
IN506 Debounce (AC, 0–65000 ms)	**IN506D**	:=
IN507 Debounce (AC, 0–65000 ms)	**IN507D**	:=
IN508 Debounce (AC, 0–65000 ms)	**IN508D**	:=
IN509 Debounce (AC, 0–65000 ms)	**IN509D**	:=
IN510 Debounce (AC, 0–65000 ms)	**IN510D**	:=
IN511 Debounce (AC, 0–65000 ms)	**IN511D**	:=
IN512 Debounce (AC, 0–65000 ms)	**IN512D**	:=
IN513 Debounce (AC, 0–65000 ms)	**IN513D**	:=
IN514 Debounce (AC, 0–65000 ms)	**IN514D**	:=

Front-Panel Access Control

Data Reset

Target Reset (SV)	**RSTTRGT**	:=
Reset Max/Min (SV)	**RSTMXMN**	:=

Access Control

Disable FP Settings Change (SV)	**DSABLSET**	:=

Port Settings (SET P Command)

Port F

Port Enable (Y, N)	**EPORT**	:=
Maximum Access Level (ACC, 2AC)	**MAXACC**	:=
Speed (300 to 38400 bps)	**SPEED**	:=
Data Bits (7, 8 bits)	**BITS**	:=
Parity (O, E, N)	**PARITY**	:=
Stop Bits (1, 2 bits)	**STOP**	:=
Port Timeout (0–30 min)	**T_OUT**	:=
Send Auto Message (Y, N)	**AUTO**	:=
Hardware Handshaking (Y, N)	**RTSCTS**	:=
Fast Operate Messages (Y, N)	**FASTOP**	:=

Port 1 (Ethernet Port in Slot B)

Port Enable (Y, N)	**EPORT**	:=
Maximum Access Level (ACC, 2AC)	**MAXACC**	:=
IP ADDRESS (zzz.yyy.xxx.www)	**IPADDR**	:=
SUBNET MASK(zzz.yyy.xxx.www)	**SUBNETM**	:=
DEFAULT ROUTER (zzz.yyy.xxx.www)	**DEFRTR**	:=

Enable TCP Keep-Alive (Y, N)	**ETCPKA**	:= ________
TCP Keep-Alive Idle Range (1–20 s) (*Hidden if ETCPKA := N*)	**KAIDLE**	:= ________
TCP Keep-Alive Interval Range (1–20 s) (*Hidden if ETCPKA := N*)	**KAINTV**	:= ________
TCP Keep-Alive Count Range (1–20 s) (*Hidden if ETCPKA := N*)	**KACNT**	:= ________
OPERATING MODE (Fixed, Failover, Switched)	**NETMODE**	:= ________
FAILOVER TIMEOUT (OFF, 0.10–65.00 s) (*Hidden if NETMODE is not FAILOVER)*	**FTIME**	:= ________
PRIMARY NET PORT (A, B, D)	**NETPORT**	:= ________
NETWRK PORTA SPD (Auto, 10, 100 Mbps)	**NETASPD**	:= ________
NETWRK PORTB SPD (Auto, 10, 100 Mbps)	**NETBSPD**	:= ________
Enable Telnet (Y, N)	**ETELNET**	:= ________
TELNET PORT (23,1025–65534)	**TPORT**	:= ________
TELNET TIME-OUT (1–30 min)	**TIDLE**	:= ________
Enable FTP (Y, N)	**EFTP**	:= ________
Enable ICMP Ping Responses (Y, N)	**EPING**	:= ________
FTP USER NAME (20 characters)	**FTPUSER**	:= ________
Enable Modbus (0–2)	**EMODBUS**	:= ________
Enable DNP Sessions (0–5) (*Hidden if DNP not supported*)	**EDNP**	:= ________
Enable SNTP Client (OFF, UNICAST, MANYCAST, BROADCAST)	**ESNTP**	:= ________
SNTP Primary Server IP Address (zzz.yyy.xxx.www)	**SNTPPSIP**	:= ________
SNTP Backup Server IP Address (zzz.yyy.xxx.www)	**SNTPBSIP**	:= ________
SNTP IP (Local) Port Number (1–65534)	**SNTPPORT**	:= ________
SNTP Client Request Update Rate (15–3600)	**SNTPRATE**	:= ________
SNTP Client Response Timeout (5–20)	**SNTPTO**	:= ________

Port 3

Port Enable (Y, N)	**EPORT**	:= ________
Maximum Access Level (ACC, 2AC)	**MAXACC**	:= ________
Protocol (SEL, DNP, MOD, MBA, MBB, MB8A, MB8B, MBTA, MBTB, EVMSG, RTD)	**PROTO**	:= ________
Speed (300 to 38400 bps)	**SPEED**	:= ________
Data Bits (7, 8 bits)	**BITS**	:= ________
Parity (O, E, N)	**PARITY**	:= ________
Stop Bits (1, 2 bits)	**STOP**	:= ________
Minutes to Port Timeout (0–30 min) *(0 is only valid for SEL protocol to disable the timeout)*	**T_OUT**	:= ________
Send Auto Message (Y, N)	**AUTO**	:= ________
Enable Hardware Handshaking (Y, N)	**RTSCTS**	:= ________
Fast Operate Messages (Y, N)	**FASTOP**	:= ________

Mirrored Bits

MB Transmit Identifier (1–4)	**TXID**	:= ________
MB Receive Identifier (1–4)	**RXID**	:= ________
MB RX Bad Pickup Time (0–10000 seconds)	**RBADPU**	:= ________
PPM MB Channel Bad Pickup (1–10000)	**CBADPU**	:= ________
MB Receive Default State (8 character string of 1s, 0s, or Xs)	**RXDFLT**	:= ________
RMB1 Pickup Debounce Messages (1–8)	**RMB1PU**	:= ________

RMB1 Dropout Debounce Messages (1–8)	**RMB1DO**	:=
RMB2 Pickup Debounce Messages (1–8)	**RMB2PU**	:=
RMB2 Dropout Debounce Messages (1–8)	**RMB2DO**	:=
RMB3 Pickup Debounce Messages (1–8)	**RMB3PU**	:=
RMB3 Dropout Debounce Messages (1–8)	**RMB3DO**	:=
RMB4 Pickup Debounce Messages (1–8)	**RMB4PU**	:=
RMB4 Dropout Debounce Messages (1–8)	**RMB4DO**	:=
RMB5 Pickup Debounce Messages (1–8)	**RMB5PU**	:=
RMB5 Dropout Debounce Messages (1–8)	**RMB5DO**	:=
RMB6 Pickup Debounce Messages (1–8)	**RMB6PU**	:=
RMB6 Dropout Debounce Messages (1–8)	**RMB6DO**	:=
RMB7 Pickup Debounce Messages (1–8)	**RMB7PU**	:=
RMB7 Dropout Debounce Messages (1–8)	**RMB7DO**	:=
RMB8 Pickup Debounce Messages (1–8)	**RMB8PU**	:=
RMB8 Dropout Debounce Messages (1–8)	**RMB8DO**	:=

Telnet

Telnet Port (23, 1025–65534)	**TPORT**	:=
Telnet Port Timeout (1–30 min)	**TIDLE**	:=
File Transfer User Name (20 characters)	**FTPUSER**	:=
IP Address [zzz.yyy.xxx.www] (15 characters)	**IPADDR**	:=
Subnet Mask (15 characters)	**SUBNETM**	:=
Default Router Gateway (15 characters)	**DEFRTR**	:=

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**	:=

LED Settings

LED 0 LATCH (Y, N)	**T00LEDL**	:=
LED0 EQUATION (SELOGIC)	**T00_LED**	:=
LED 1 LATCH (Y, N)	**T01LEDL**	:=
LED1 EQUATION (SELOGIC)	**T01_LED**	:=
LED 2 LATCH (Y, N)	**T02LEDL**	:=
LED2 EQUATION (SELOGIC)	**T02_LED**	:=
LED 3 LATCH (Y, N)	**T03LEDL**	:=
LED3 EQUATION (SELOGIC)	**T03_LED**	:=
LED 4 LATCH (Y, N)	**T04LEDL**	:=
LED4 EQUATION (SELOGIC)	**T04_LED**	:=
LED 5 LATCH (Y, N)	**T05LEDL**	:=
LED5 EQUATION (SELOGIC)	**T05_LED**	:=

LED 6 LATCH (Y, N)	**T06LEDL**	:=
LED6 EQUATION (SELOGIC)	**T06_LED**	:=
PB01 LED Equation (SELOGIC)	**PB01_LED**	:=
PB01B LED Equation (SELOGIC)	**PB01BLED**	:=
PB02 LED Equation (SELOGIC)	**PB02_LED**	:=
PB02B LED Equation (SELOGIC)	**PB02BLED**	:=
PB03 LED Equation (SELOGIC)	**PB03_LED**	:=
PB03B LED Equation (SELOGIC)	**PB03BLED**	:=
PB04 LED Equation (SELOGIC)	**PB04_LED**	:=
PB04B LED Equation (SELOGIC)	**PB04BLED**	:=

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 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)

Event Report Settings

Event Trigger (SV)	**ER**	:=
Event Length (15, 64 cyc)	**LER**	:=
Prefault Length (1–10 cyc) or (1–59 cyc)	**PRE**	:=

SER Chatter Criteria

Auto-Removal Enable (Y, N)	**ESERDEL**	:=
Number of Counts (2–20)	**SRDLCNT**	:=
Removal Time (0.1–90.0 seconds)	**SRDLTIM**	:=

SER Trigger Lists

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

SER1 :=
SER2 :=
SER3 :=
SER4 :=

Device Word Bit Aliases

15 character maximum per string. Device Word **Bit > Alias–String > Asserted–String > DEASS–String**

Enable ALIAS Settings	**EALIAS**	:=
ALIAS 1	**ALIAS01**	:=
ALIAS 2	**ALIAS02**	:=
ALIAS 3	**ALIAS03**	:=
ALIAS 4	**ALIAS04**	:=
ALIAS 5	**ALIAS05**	:=
ALIAS 6	**ALIAS06**	:=
ALIAS 7	**ALIAS07**	:=
ALIAS 8	**ALIAS08**	:=
ALIAS 9	**ALIAS09**	:=
ALIAS 10	**ALIAS10**	:=
ALIAS 11	**ALIAS11**	:=
ALIAS 12	**ALIAS12**	:=
ALIAS 13	**ALIAS13**	:=
ALIAS 14	**ALIAS14**	:=
ALIAS 15	**ALIAS15**	:=
ALIAS 16	**ALIAS16**	:=
ALIAS 17	**ALIAS17**	:=
ALIAS 18	**ALIAS18**	:=
ALIAS 19	**ALIAS19**	:=
ALIAS 20	**ALIAS20**	:=

Fast Message Read Settings

Enter up to 24 Analog Quantities separated by spaces or commas in each of the four lists.
Use NA to disable setting.

FMR1 NAME (9 characters)	**FMR1NAM**	:=
FMR1	:=	
FMR2 NAME (9 characters)	**FMR2NAM**	:=
FMR2	:=	
FMR3 NAME (9 characters)	**FMR3NAM**	:=
FMR3	:=	
FMR4 NAME (9 characters)	**FMR4NAM**	:=
FMR4	:=	

Fast Message Remote Analog Settings

I = Integer, F = Float, L = Long

Remote Analog Value Type (I, F, L)	**RA01TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA02TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA03TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA04TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA05TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA06TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA07TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA08TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA09TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA10TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA11TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA12TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA13TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA14TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA15TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA16TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA17TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA18TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA19TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA20TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA21TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA22TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA23TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA24TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA25TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA26TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA27TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA28TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA29TYPE**	:=

Remote Analog Value Type (I, F, L)	**RA30TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA31TYPE**	:=
Remote Analog Value Type (I, F, L)	**RA32TYPE**	:=

Signal Profile Settings

Enter up to 16 Analog Quantities separated by spaces or commas in each list. Use NA to null.

Signal Profile List	**SPLIST1**	:=
Signal Profile List	**SPLIST2**	:=
SP Acquisition Rate (5, 10, 15, 30, 60 min)	**SPAR**	:=
Signal Profile Enable (SV)	**SPEN**	:=

DNP3 Settings (SET P Command)

DNP3 Communications

Enable DNP Sessions (0–5)	**EDNP**	:=
Device DNP Address (0–65519)	**DNPADR**	:=

Session 1 Settings

IP Address (zzz.yyy.xxx.www) NOTE: Set DNPIP1 to 0.0.0.0 for anonymous connections.	**DNPIP1**	:=
DNP TCP and UDP Port (1–65534)	**DNPNUM1**	:=
Transport Protocol (UDP, TCP)	**DNPTR1**	:=
UDP Response Port (REQ, 1–65534)	**DNPUDP1**	:=
DNP3 address of the Master to send messages to (0–65519)	**REPADR1**	:=
DNP3 Session Map (1–3)	**DNPMAP1**	:=
Analog Input Default Variation (0–6)	**DVARAI1**	:=
Frozen Counter Default Variation (1, 2, 5, 6, 9, 10)	**DVARFC1**	:=
Class for binary event data, 0 disables (0–3)	**ECLASSB1**	:=
Class for counter event data, 0 disables (0–3)	**ECLASSC1**	:=
Class for analog event data, 0 disables (0–3)	**ECLASSA1**	:=
Decimal places scaling for Current data (0–3)	**DECPLA1**	:=
Decimal places scaling for Voltage data (0–3)	**DECPLV1**	:=
Decimal places scaling for Miscellaneous data (0–3)	**DECPLM1**	:=
Analog reporting deadband for current (0–32767)	**ANADBA1**	:=
Analog reporting deadband for voltages (0–32767)	**ANADBV1**	:=
Analog reporting deadband for miscellaneous analogs (0–32767)	**ANADBM1**	:=
Time–set request interval, minutes (I, M, 1–32767)	**TIMERQ1**	:=
Select/operate time-out, seconds (0.0–30.0)	**STIMEO1**	:=
Seconds to Communications Time-Out (0–3600 sec)	**DNP_TO1**	:=
Send Data Link Heartbeat, seconds (0.0–7200)	**DNPINA1**	:=
Data link retries (0–15)	**DRETRY1**	:=
Data link time-out, seconds (0.0–5.0)	**DTIMEO1**	:=
Event message confirm time-out, seconds (1–50)	**ETIMEO1**	:=
Enable unsolicited reporting (Y, N)	**UNSOL1**	:=
Enable unsolicited reporting at power up (Y, N)	**PUNSOL1**	:=
Number of events to transmit on (1–200)	**NUMEVE1**	:=

Oldest event to transmit on, seconds (0.0–99999.0)	**AGEEVE1**	:=
Unsolicited messages maximum retry attempts (2–10)	**URETRY1**	:=
Unsolicited messages offline timeout, seconds (OFF, 1–5000)	**UTIMEO1**	:=

Session 2 Settings

IP Address (zzz.yyy.xxx.www) NOTE: Set DNPIP2 to 0.0.0.0 for anonymous connections.	**DNPIP2**	:=
DNP TCP and UDP Port (1–65534)	**DNPNUM2**	:=
Transport Protocol (UDP, TCP)	**DNPTR2**	:=
UDP Response Port (REQ, 1–65534)	**DNPUDP2**	:=
DNP3 address of the Master to send messages to (0–65519)	**REPADR2**	:=
DNP3 Session Map (1–3)	**DNPMAP2**	:=
Analog Input Default Variation (0–6)	**DVARAI2**	:=
Frozen Counter Default Variation (1, 2, 5, 6, 9, 10)	**DVARFC2**	:=
Class for binary event data, 0 disables (0–3)	**ECLASSB2**	:=
Class for counter event data, 0 disables (0–3)	**ECLASSC2**	:=
Class for analog event data, 0 disables (0–3)	**ECLASSA2**	:=
Decimal places scaling for Current data (0–3)	**DECPLA2**	:=
Decimal places scaling for Voltage data (0–3)	**DECPLV2**	:=
Decimal places scaling for Miscellaneous data (0–3)	**DECPLM2**	:=
Analog reporting deadband for current (0–32767)	**ANADBA2**	:=
Analog reporting deadband for voltages (0–32767)	**ANADBV2**	:=
Analog reporting deadband for miscellaneous analogs (0–32767)	**ANADBM2**	:=
Time-set request interval, minutes (I, M, 1–32767)	**TIMERQ2**	:=
Select/operate time-out, seconds (0.0–30.0)	**STIMEO2**	:=
Seconds to Communications Time-Out (0–3600 sec)	**DNP_TO2**	:=
Send Data Link Heartbeat, seconds (0.0–7200)	**DNPINA2**	:=
Data link retries (0–15)	**DRETRY2**	:=
Data link time-out, seconds (0.0–5.0)	**DTIMEO2**	:=
Event message confirm time-out, seconds (1–50)	**ETIMEO2**	:=
Enable unsolicited reporting (Y, N)	**UNSOL2**	:=
Enable unsolicited reporting at power up (Y, N)	**PUNSOL2**	:=
Number of events to transmit on (1–200)	**NUMEVE2**	:=
Oldest event to transmit on, seconds (0.0–99999.0)	**AGEEVE2**	:=
Unsolicited messages maximum retry attempts (2–10)	**URETRY2**	:=
Unsolicited messages offline timeout, seconds (OFF, 1–5000)	**UTIMEO2**	:=

Session 3 Settings

IP Address (zzz.yyy.xxx.www) NOTE: Set DNPIP3 to 0.0.0.0 for anonymous connections.	**DNPIP3**	:=
DNP TCP and UDP Port (1–65534)	**DNPNUM3**	:=
Transport Protocol (UDP, TCP)	**DNPTR3**	:=
UDP Response Port (REQ, 1–65534)	**DNPUDP3**	:=
DNP3 address of the Master to send messages to (0–65519)	**REPADR3**	:=
DNP3 Session Map (1–3)	**DNPMAP3**	:=
Analog Input Default Variation (0–6)	**DVARAI3**	:=
Frozen Counter Default Variation (1, 2, 5, 6, 9, 10)	**DVARFC3**	:=

Class for binary event data, 0 disables (0–3)	**ECLASSB3**	:=
Class for counter event data, 0 disables (0–3)	**ECLASSC3**	:=
Class for analog event data, 0 disables (0–3)	**ECLASSA3**	:=
Decimal places scaling for Current data (0–3)	**DECPLA3**	:=
Decimal places scaling for Voltage data (0–3)	**DECPLV3**	:=
Decimal places scaling for Miscellaneous data (0–3)	**DECPLM3**	:=
Analog reporting deadband for current (0–32767)	**ANADBA3**	:=
Analog reporting deadband for voltages (0–32767)	**ANADBV3**	:=
Analog reporting deadband for miscellaneous analogs (0–32767)	**ANADBM3**	:=
Time-set request interval, minutes (I, M, 1–32767)	**TIMERQ3**	:=
Select/operate time-out, seconds (0.0–30.0)	**STIMEO3**	:=
Seconds to Communications Time-Out (0–3600 sec)	**DNP_TO3**	:=
Send Data Link Heartbeat, seconds (0.0–7200)	**DNPINA3**	:=
Data link retries (0–15)	**DRETRY3**	:=
Data link time-out, seconds (0.0–5.0)	**DTIMEO3**	:=
Event message confirm time-out, seconds (1–50)	**ETIMEO3**	:=
Enable unsolicited reporting (Y, N)	**UNSOL3**	:=
Enable unsolicited reporting at power up (Y, N)	**PUNSOL3**	:=
Number of events to transmit on (1–200)	**NUMEVE3**	:=
Oldest event to transmit on, seconds (0.0–99999.0)	**AGEEVE3**	:=
Unsolicited messages maximum retry attempts (2–10)	**URETRY3**	:=
Unsolicited messages offline timeout, seconds (OFF, 1–5000)	**UTIMEO3**	:=

Session 4 Settings

IP Address (zzz.yyy.xxx.www) NOTE: Set DNPIP4 to 0.0.0.0 for anonymous connections.	**DNPIP4**	:=
DNP TCP and UDP Port (1–65534)	**DNPNUM4**	:=
Transport Protocol (UDP, TCP)	**DNPTR4**	:=
UDP Response Port (REQ, 1–65534)	**DNPUDP4**	:=
DNP3 address of the Master to send messages to (0–65519)	**REPADR4**	:=
DNP3 Session Map (1–3)	**DNPMAP4**	:=
Analog Input Default Variation (0–6)	**DVARAI4**	:=
Frozen Counter Default Variation (1, 2, 5, 6, 9, 10)	**DVARFC4**	:=
Class for binary event data, 0 disables (0–3)	**ECLASSB4**	:=
Class for counter event data, 0 disables (0–3)	**ECLASSC4**	:=
Class for analog event data, 0 disables (0–3)	**ECLASSA4**	:=
Decimal places scaling for Current data (0–3)	**DECPLA4**	:=
Decimal places scaling for Voltage data (0–3)	**DECPLV4**	:=
Decimal places scaling for Miscellaneous data (0–3)	**DECPLM4**	:=
Analog reporting deadband for current (0–32767)	**ANADBA4**	:=
Analog reporting deadband for voltages (0–32767)	**ANADBV4**	:=
Analog reporting deadband for miscellaneous analogs (0–32767)	**ANADBM4**	:=
Time-set request interval, minutes (I, M, 1–32767)	**TIMERQ4**	:=
Select/operate time-out, seconds (0.0–30.0)	**STIMEO4**	:=
Seconds to Communications Time-Out (0–3600 sec)	**DNP_TO4**	:=
Send Data Link Heartbeat, seconds (0.0–7200)	**DNPINA4**	:=
Data link retries (0–15)	**DRETRY4**	:=

Data link time-out, seconds (0.0–5.0)	**DTIMEO4**	:= ________
Event message confirm time-out, seconds (1–50)	**ETIMEO4**	:= ________
Enable unsolicited reporting (Y, N)	**UNSOL4**	:= ________
Enable unsolicited reporting at power up (Y, N)	**PUNSOL4**	:= ________
Number of events to transmit on (1–200)	**NUMEVE4**	:= ________
Oldest event to transmit on, seconds (0.0–99999.0)	**AGEEVE4**	:= ________
Unsolicited messages maximum retry attempts (2–10)	**URETRY4**	:= ________
Unsolicited messages offline timeout, seconds (OFF, 1–5000)	**UTIMEO4**	:= ________

Session 5 Settings

IP Address (zzz.yyy.xxx.www) **NOTE:** Set DNPIP5 to 0.0.0.0 for anonymous connections.	**DNPIP5**	:= ________
DNP TCP and UDP Port (1–65534)	**DNPNUM5**	:= ________
Transport Protocol (UDP, TCP)	**DNPTR5**	:= ________
UDP Response Port (REQ, 1–65534)	**DNPUDP5**	:= ________
DNP3 address of the Master to send messages to (0–65519)	**REPADR5**	:= ________
DNP3 Session Map (1–3)	**DNPMAP5**	:= ________
Analog Input Default Variation (0–6)	**DVARAI5**	:= ________
Frozen Counter Default Variation (1, 2, 5, 6, 9, 10)	**DVARFC5**	:= ________
Class for binary event data, 0 disables (0–3)	**ECLASSB5**	:= ________
Class for counter event data, 0 disables (0–3)	**ECLASSC5**	:= ________
Class for analog event data, 0 disables (0–3)	**ECLASSA5**	:= ________
Decimal places scaling for Current data (0–3)	**DECPLA5**	:= ________
Decimal places scaling for Voltage data (0–3)	**DECPLV5**	:= ________
Decimal places scaling for Miscellaneous data (0–3)	**DECPLM5**	:= ________
Analog reporting deadband for current (0–32767)	**ANADBA5**	:= ________
Analog reporting deadband for voltages (0–32767)	**ANADBV5**	:= ________
Analog reporting deadband for miscellaneous analogs (0–32767)	**ANADBM5**	:= ________
Time-set request interval, minutes (I, M, 1–32767)	**TIMERQ5**	:= ________
Select/operate time-out, seconds (0.0–30.0)	**STIMEO5**	:= ________
Seconds to Communications Time-Out (0–3600 sec)	**DNP_TO5**	:= ________
Send Data Link Heartbeat, seconds (0.0–7200)	**DNPINA5**	:= ________
Data link retries (0–15)	**DRETRY5**	:= ________
Data link time-out, seconds (0.0–5.0)	**DTIMEO5**	:= ________
Event message confirm time-out, seconds (1–50)	**ETIMEO5**	:= ________
Enable unsolicited reporting (Y, N)	**UNSOL5**	:= ________
Enable unsolicited reporting at power up (Y, N)	**PUNSOL5**	:= ________
Number of events to transmit on (1–200)	**NUMEVE5**	:= ________
Oldest event to transmit on, seconds (0.0–99999.0)	**AGEEVE5**	:= ________
Unsolicited messages maximum retry attempts (2–10)	**URETRY5**	:= ________
Unsolicited messages offline timeout, seconds (OFF, 1–5000)	**UTIMEO5**	:= ________

Serial Port Settings

Minimum delay from DCD to TX, seconds (0.00–1.00)	**MINDLY**	:= ________
Maximum delay from DCD to TX, seconds (0.00–1.00)	**MAXDLY**	:= ________
Settle time from RTS on to TX; Off disables PSTDLY (OFF, 0.00–30.00)	**PREDLY**	:= ________
Settle time from TX to RTS off (0.00–30.00)	**PSTDLY**	:= ________

DNP3 Serial Modem Settings

Modem connected to port (Y, N)	**MODEM**	:=____________
Modem startup string (Up to 30 characters)	**MSTR**	:=____________
Primary phone number for dial-out (Up to 30 characters)	**PH_NUM1**	:=____________
Secondary phone number for dial-out (Up to 30 characters)	**PH_NUM2**	:=____________
Primary phone number for dial-out (Up to 30 characters)	**PH_NUM1**	:=____________
Retry attempts for primary dial-out (1–20)	**RETRY1**	:=____________
Retry attempts for secondary dial-out (1–20)	**RETRY2**	:=____________
Retry attempts for secondary dial-out (1–20)	**RETRY2**	:=____________
Time from initiating call to failure due to no connection, seconds (5–300)	**MDTIME**	:=____________
Time between dial-out attempts (5–3600)	**MDRET**	:=____________

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Section 7
Communications

Overview

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

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 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 execute the 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 available. Access levels in this device are Access Level 0, Access Level 1, and Access Level 2.

Communications

Communications Ports

Table 7.1 shows the physical interfaces of the SEL-2411P Pump Automation Controller. Several options are available to provide alternative physical interfaces, including EIA-485 and fiber-optic cable (see *Section 2: Installation* for more information on the interface cards).

Table 7.1 Communications Port Physical Interfaces

Port Type	Port Interface	Usage
Port F (Serial)	EIA-232 (Nonisolated)	Use the EIA-232 port for communications distances of ≤15 m (50 feet) in low noise environments.
Port 1A, 1B (Ethernet)	10/100BASE-T (Copper & 100BASE-FX [Fiber])	*Table 7.6* shows the available Ethernet protocols. Use Telnet to emulate serial communications in a network environment.
Port 3 (Serial)	EIA-232 (Nonisolated)	Use the EIA-232 port for communications distances of ≤15 m (50 feet) in low noise environments.

Device Word bits provided for Ethernet ports are shown in *Table 7.2*.

Table 7.2 Ethernet Port Device Word Bits

Device Word Bit	Description
LINKA	Dual Ethernet link status for Port A.
LINKB	Dual Ethernet link status for Port B.
LINKFAIL	Dual Ethernet active port link status failure indicator. LINKFAIL asserts if connections fail on both ports for SWITCHED and FAILOVER operating modes. LINKFAIL asserts if the connection fails on the primary port for FIXED operating mode.
PASEL	Dual Ethernet active Port A indicator.
PBSEL	Dual Ethernet active Port B indicator.

IRIG-B

The IRIG-B interface is part of the serial Port 3 physical interface. When using serial Port 3, connect to an SEL communications processor with cable SEL-C273A (see the cable diagrams that follow in this section or use the SEL-5801 Cable Selector software).

+5 Vdc Power Supply

The SEL-2411P provides +5 Vdc serial port power on Pin 1 of EIA-232 Port 3. Serial port power can provide as much as 0.25 A from the +5 Vdc pin.

Port Connector and Communications Cables

Figure 7.1 shows the EIA-232 serial port DB-9 connector pin numbering for the SEL-2411P.

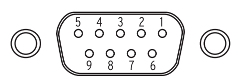

Figure 7.1 EIA-232 DB-9 Connector Pin Numbers

Table 7.3 shows the pin functions for the EIA-232 serial ports.

Table 7.3 EIA Serial Port Pin Functions

Pin[a]	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

[a] For EIA-485, the pin numbers represent device terminals C01 through C05.

The following cable diagrams show several types of EIA-232 serial communications cables that connect the SEL-2411P to other devices. These and other cables are available from SEL.

SEL-2411P Cable Connections to Communications Devices

Table 7.4 Communications Cables

Interface	Device 1 (SEL-2411P)	Device 2	Connection Description	Cable
EIA-232	DTE: 9-Pin Male D	DTE: 9-Pin Male D	Comm. Proc. without IRIG-B	SEL-C272A
EIA-232	DTE: 9-Pin Male D	DTE: 9-Pin Male D	Comm. Proc. with IRIG-B	SEL-C273A
EIA-232	DTE: 9-Pin Male D	DTE: 9-Pin Female D	Computer	SEL-C234A
EIA-232	DTE: 9-Pin Male D	DTE: 25-Pin Female D	Computer	SEL-C227A
EIA-232	DTE: 9-Pin Male D	DCE: 9-Pin Male	Wireless encrypting transceiver	SEL-C285
EIA-232	DTE: 9-Pin Male D	DCE: 9-Pin Female D	Serial encrypting transceiver	SEL-C245A
EIA-232	DTE: 9-Pin Male D	DCE: 25-Pin Female D	Modem	SEL-C222
EIA-485	DTE: 9-Pin Male D	8-Pin Compression	Multidrop network	SEL-C675
Ethernet	RJ45 Ethernet	RJ45 Ethernet	Copper Ethernet	SEL-C627
USB 2.0	DTE: 9-Pin Male D	USB Type A	EIA-232 to USB adapter	SEL-C662

Communications Protocols

Hardware Flow Control

All EIA-232 serial ports support RTS/CTS hardware handshaking (hardware flow control).

Port Setting	Effect
RTSCTS := N	Disables hardware handshaking. Permanently asserts the RTS line.
RTSCTS := Y	Deasserts RTS when unable to receive characters. Blocks character transmission until the CTS input is asserted.

Protocols

A rich collection of protocols is available with the SEL-2411P; however, not all protocols are available on all ports.

Table 7.5 Serial Port Protocols (Sheet 1 of 2)

Protocol	Description
SEL Communications Protocols	
SEL ASCII	Use this protocol to send ASCII commands and receive ASCII responses that are human-readable with an appropriate terminal emulation program.
Compressed ASCII	This protocol provides compressed versions of some of the ASCII commands. See *Appendix C: SEL Communications Processors* for details.
Fast Meter	This protocol supports binary messages to transfer metering and digital element messages.
Fast Operate	This protocol supports binary messages to transfer operation messages.
Fast SER	This protocol is used to receive binary Sequential Events Recorder unsolicited responses.
Fast Message Read	This protocol uses binary messages to transmit data to an SEL Communications Processor. See *Appendix C: SEL Communications Processors* for details.
Fast Message Unsolicited Write	This protocol uses binary messages to receive data from an SEL Communications Processor. See *Appendix C: SEL Communications Processors* for details.

Table 7.5 Serial Port Protocols (Sheet 2 of 2)

Protocol	Description
Other SEL Communications Protocols	
MIRRORED BITS	This protocol is a direct device-to-device (peer-to-peer) communications protocol that allows IEDs to exchange information quickly, securely, and with minimal expense for functions such as intertripping, remote control, and remote sensing. See *Appendix F: MIRRORED BITS Communications* for details.
Industry Standard Communications Protocols	
Modbus	Modbus is a simple manufacturer-developed, hardware-independent communications protocol. See *Appendix E: Modbus Communications*.
DNP3	DNP3 is an object-oriented manufacturer-developed, hardware-independent communications protocol. See *Appendix D: DNP3 Communications*.

Ethernet Protocols (Port 1A, 1B)

A wide collection of Ethernet protocols is available with the SEL-2411P; *Table 7.6* shows protocols available on the Ethernet ports.

Table 7.6 Ethernet Protocols

Protocol	Sessions/ Messages	Description
FTP Server	1	Use FTP to access the following files: ➤ CFG.XML (Configuration RO file) ➤ CFG.TXT (Configuration RO file) ➤ ERR.TXT (Error RO file) ➤ SET_61850.CID (IEC 61850 CID RO file) ➤ SET_*xx*.TXT (Setting RW files) FTP is a standard TCP/IP protocol for exchanging files.
Telnet Server	3	Use Telnet to connect to the device to use SEL protocols (SEL ASCII, Compressed ASCII, Fast Meter, and Fast Operate). Telnet is a terminal connection across a TCP/IP network that operates in a manner very similar to a direct serial port connection to one of the device ports. As with FTP, Telnet is a part of TCP/IP.
Ping Server	1	Use a ping client with the device ping server to verify that your network configuration is correct. ping is an application based on ICMP over an IP network.
Industry Standard Communications Protocols		
Modbus	2	Modbus is a simple manufacturer-developed, hardware independent communications protocol. See *Appendix E: Modbus Communications*.
DNP3	5	DNP3 is an object-oriented manufacturer-developed, hardware independent communications protocol. See *Appendix D: DNP3 Communications*.

Device Access

Change the Default Passwords

It is extremely important that you change the factory default passwords programmed in the SEL-2411P. Setting unique passwords for the relay access levels increases the security of your substation and the power system.

Access Levels

To provide security, commands are available on different password-protected access levels. Each command description throughout this section indicates the access level at which the command is available. There are three access levels in the device that offer varying levels of control, as shown in *Table 7.7*.

Table 7.7 Access Level

Level	Prompt	Capability
0	=	Access Level 0 commands are at the lowest security level and they support SEL Communications Processors and the **ACC** command. Entering the **ACC** command at the Access Level 0 prompt takes the SEL-2411P to Access Level 1.[a]
1	=>	Access Level 1 commands are primarily for reviewing information, not changing it. Entering the **2AC** command at the Access Level 1 prompt takes the SEL-2411P to Access Level 2.[a]
2	=>>	Access Level 2 commands are primarily for changing device settings, resetting accumulated device information, or resetting saved data.[a]

[a] See the SEL-2411P Command Summary at the end of this manual for the commands available at a particular level.

Access Commands (ACCESS and 2ACCESS)

The **ACC** and **2AC** commands provide entry to the multiple access levels, as shown in *Table 7.8*. Different commands are available at the different access levels, as shown in the *SEL-2411P Command Summary* at the end of this manual. Commands **ACC** and **2AC** are explained together because they operate similarly. The alarm contact closes for one second upon entry of **2AC** and if the incorrect password is entered three times for any access level.

Table 7.8 Access Commands

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

Password Requirements

After enabling the password function, you need to enter passwords to access each access level. See *PASSWORD Command (View/Change Passwords) on page 7.17* for the list of default passwords and for more information on changing and disabling passwords.

ASCII Commands

The following is an alphabetical listing and discussion of all the ASCII commands available in the SEL-2411P.

ANALOG Command (Test Analog Outputs)

Use the **ANA** command to test an analog output by temporarily assigning a value to an analog output channel. After entering the **ANA** command, the device suspends normal operation of the analog output channel and scales the output to a percentage of full scale. After assigning the specified value for the specified time, the device returns to normal operation. Entering any character (including pressing the space key) ends the command before reaching the specified interval completion. You can test the analog output in one of the following two modes:

- ➤ Fixed percentage: Outputs a fixed percentage of the signal for a specified duration
- ➤ Ramp: Ramps the output from minimum to maximum of full scale over the time specified

Table 7.9 ANALOG Command

Command	Description	Access Level
ANA *c p t*	Temporarily assigns a value to an analog output channel.	2

Table 7.10 ANALOG Command Format

Parameter	Description
c	Parameter *c* is the analog channel (either the channel name, e.g., AO301, or the channel number, e.g., 301).
p	Parameter *p* is either percentage of full scale, or the letter R or r to indicate ramp mode.
t	Parameter *t* is the duration (in decimal minutes) of the test.

When parameter *p* is a percentage, the device displays the following message during the test:

```
Outputting xx.xx [units] to Analog Output Port for y.y minutes.
Press any key to end test
```

where:

`xx.xx` is the calculation of percent of full scale
`[units]` is either mA or V, depending on the channel type setting
`y.y` is the time in minutes

When parameter *p* is a ramp function, the device displays the following message during the test:

```
Ramping Analog Output at xx.xx [units]/min; full scale in y.y min-
utes.
Press any key to end test
```

where:

`xx.xx` is the calculation based upon range/time t
`[units]` is either mA or V, depending on the channel type setting
`y.y` is the time in minutes

NOTE: 0% = low span, 100% = high span. For a scaled output from 4–20 mA, 0 percent is 4 mA and 100 percent is 20 mA.

For either mode of operation (percentage or ramp), when the time expires, or upon pressing a key, the analog output port returns to normal operation and the device displays the following message:

```
Analog Output Port Test Complete
```

Example 1

The following is an example of the device response to the **ANA** command in the percentage mode. For this example, we assume the analog output signal type is 4–20 mA, and we want to test the analog output at 75 percent of rating for 5.5 minutes. To check the device output, calculate the expected mA output as follows:

$$\text{Output} = \left[(20.00\text{ mA} - 4.00\text{ mA}) \bullet \frac{75}{100}\right] + 4.00\text{ mA} = 16.00\text{ mA}$$

To start the test, enter **ANA A0301 75 5.5** at the Access Level 2 prompt:

```
=>>ANA A0301 75 5.5 <Enter>
Outputting 16.00 mA to Analog Output Port for 5.5 minutes.
Press any key to end test
```

Example 2

The following is an example of the ramp mode when the analog output signal type is 4–20 mA for a 9.0 minute test.

To check the device output, calculate the current/time (mA/min) output as follows:

$$\text{Output} = \left[\frac{20.00\ \text{mA} - 4.00\ \text{mA}}{9.0\ \text{min}}\right] = 1.78\ \text{mA/min}$$

To start the test, enter **ANA AO301 R 9.0** at the Access Level 2 prompt:

```
=>>ANA A0301 R 9.0 <Enter>
Ramping Analog Output at 1.78 mA/min; full scale in 9.0 minutes.
Press any key to end test
```

BNAMES Command (Binary Names)

Use the **BNA** command to produce the names of all device status bits reported in the Fast Meter Data Block (A5D1) message in Compressed ASCII format, as shown in *Table 7.11*. This command is only available as Compressed ASCII response.

Table 7.11 BNAMES Command

Command	Description	Access Level

BNA	Displays names of all device status bits, as shown below:
	`=BNA <Enter>`
	`"*","*","*","STSET","*","*","*","*","0639"`
		0

CAL Command

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

Table 7.12 CAL Command

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

CASCII Command (Compressed ASCII)

Use the **CAS** command to produce the Compressed ASCII configuration message. This configuration instructs an external computer on the method for extracting data from other Compressed ASCII commands, as shown in *Table 7.13*. This command is only available as Compressed ASCII response.

Table 7.13 CASCII Command

Command	Description	Access Level

CAS	Return the Compressed ASCII configuration message—shown below is an extract:
	`=CAS <Enter>`
	`"CAS",113,"0208"`
	`"CMETER FUNDAMENTAL",1,"05DC"`
		0

Upon receiving the **CAS** command, the device responds with the configurations of all Compressed ASCII commands: **CME**, **CST**, **CHI**, and **CSU**.

CEVENT Command (Compressed Event Report)

Use the **CEV** command (*Table 7.14*) to obtain event report data in a Compressed ASCII response. These data are similar to those data produced by the **EVENT** command. When using the **CEV** command to retrieve event reports, the event data are in a format suitable for use by PC software to display the event in oscillographic form. See *Section 9: Analyzing Events* for further details on event reports. When the **CEV** command includes any of the parameters listed in *Table 7.14* (e.g., **CEV *n***), the report length is the number of cycles specified by the LER setting (15 or 64 cycles). When using the **CEV** command without parameters, the report length is 15 cycles.

Table 7.14 CEVENT Command

Command	Description	Access level
CEV *n*	Return the filtered ac analog data, 4 sample/cycle event report number *n*.	1
CEV *n* R	Return the raw (unfiltered) ac analog data, 16 sample/cycle raw event report number *n*. Raw reports include an extra cycle of data at the beginning of the report.	1

Parameter *n* specifies the event report number. Use the **HIS** command to determine the event report number of the event you want to display. If *n* is not specified, the device displays Event Report 1.

CHISTORY Command (Compressed History)

The device generates the Compressed ASCII history in response to the **CHI** command, as shown in *Table 7.15*.

Table 7.15 CHISTORY Command (Compressed History)

Command	Description	Access Level
CHI *x*	Generates the compressed history report	1

Parameter *x* is the number of events you want displayed. The device shows fewer than *x* events if *x* is less than the number of stored events. If *x* is greater than the number of stored events, the device displays all of the stored events.

CMETER Command (Compressed METER)

NOTE: Information displayed in parenthesis is optional.

The device generates the Compressed ASCII meter of fundamental, analog input, math variable, remote analog, and signal profile data in response to the **CME *x*** (*x* = FUN, ANA, MAT, REM) command, as shown in *Table 7.16*.

Table 7.16 CMETER Command

Command	Description	Access Level
CME F(UN)[a]	Display fundamental meter data in compressed format	1
CME A(NA)	Display analog input (transducer) data compressed format	1
CME MAT	Display SELOGIC math variable data compressed format	1
CME REM	Display remote analog data compressed format	1

[a] You can omit FUN (just type CME <Enter>) to display the fundamental meter data.

COMMUNICATIONS Command

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

- Device disabled
- Framing error
- Parity error
- Overrun
- Re-sync
- Data error
- Loopback
- Underrun

Table 7.17 COMMUNICATIONS Command

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

CONTROL Command (Control Remote Bit)

Use the **CON** command to control remote bits (Device Word bits RB01–RB32). You can use the **CON** function from the front panel (`Control > Outputs`) to pulse the outputs. Remote bits are device variables that you set via serial port communication only; you cannot navigate Remote Bits via the front-panel HMI. You can select the control operation from three states: set, clear, or pulse, as described in *Table 7.19*.

Table 7.18 CONTROL Command

Command	Description	Access Level
CON RB*nn*[a] *k*	Command to control remote bits. Replace *k* with one of the subcommands listed in *Table 7.19* to control the remote bit.	2

[a] Parameter nn = a number from 01 to 32, representing RB01 through RB32. k = S, C, or P.

Table 7.19 Three Remote Bit States

Subcommand	Description	Access Level
S	Set Remote bit (ON position)	2
C	Clear Remote bit (OFF position)	2
P	Pulse Remote bit for ¼ cycle (MOMENTARY position)	2

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

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

COUNTER Command (Counter Values)

The device generates the values of the 32 counters in response to the **COU** command, as shown in *Table 7.20*.

Table 7.20 COUNTER Command

Command	Description	Access Level
COU *n*	Display the values of the SELOGIC counters *n* times	1

CPROFILE Command (Compressed Signal Profile Values)

The **CPR** command retrieves analog signal profile data in Compressed ASCII format, as shown in *Table 7.21*.

Table 7.21 CPROFILE Command

Command	Description	Access Level
CPR	Display analog signal profile data	1

CSTATUS Command (Compressed Status)

The **CST** command generates a device status report in Compressed ASCII format, as shown in *Table 7.22*.

Table 7.22 CSTATUS Command

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

CSUMMARY Command (Compressed Summary)

The **CSU** command retrieves the event summary information from the last event report in Compressed ASCII format, as shown in *Table 7.23*.

Table 7.23 CSUMMARY Command

Command	Description	Access Level
CSU	Return the most recent event summary (with label lines) in Compressed ASCII format	1

DATE Command (View/Change Date)

Use the **DATE** command to view and set the device date, as shown in *Table 7.24*.

Table 7.24 DATE Command

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

The device 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 slashes. Set the year in 4-digit form (for dates 2000–2099). Global setting DATE_F sets the date format.

ETHERNET Command

The **ETH** command displays the status report of both Ethernet ports, including settings and performance.

```
=>>ETH <Enter>
SEL-2411P                               Date: 11/12/2010   Time: 03:11:38
DEVICE

 MAC: 00-30-A7-D3-4F-1A
 IP ADDRESS: 192.168.0.2
 SUBNET MASK: 255.255.255.0
 DEFAULT GATEWAY: 0.0.0.0

 PRIMARY PORT:  PORT 1A
 ACTIVE PORT:   PORT 1A

             LINK   SPEED  DUPLEX   MEDIA
PORT 1A      Up     100M   Full     TX
PORT 1B      Up     100M   Full     TX

=>>
```

EVENT Command (Event Reports)

Use the **EVE** command to view event reports. See *Section 9: Analyzing Events* for further details on retrieving and analyzing event reports, as shown in *Table 7.25*. See *HISTORY Command (Events List) on page 7.12* for details on clearing event reports.

Table 7.25 EVENT Command

Command	Description	Access Level
EVE *n*	Return event report number *n* with 4 samples/cycle data	1
EVE *n* R	Return event report number *n* with raw (unfiltered) 16 samples/cycle analog data and 4 samples/cycle digital data	1

Parameter *n* specifies the event report number. Use the **HIS** command to determine the event report number of the event you want to display. If *n* is not specified, the device displays Event Report 1.

FILE Command (Manage Settings Files)

The **FIL** command provides a safe and efficient means of transferring settings files between intelligent electronic devices (IEDs) and external support software (ESS). Use the **FIL** commands for sending settings to the SEL-2411P and receiving settings from the device, as shown in *Table 7.26*.

Table 7.26 FILE Command

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

HELP Command

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

HISTORY Command (Events List)

Use the **HIS** command to view a list of one-line descriptions of device events or clear the list (and corresponding event reports) from nonvolatile memory, as shown in *Table 7.27*.

Table 7.27 HISTORY Command

Command	Description	Access Level
HIS	Return event histories with the oldest at the bottom of the list and the most recent at the top of the list	1
HIS *n*	Return event histories with the oldest at the bottom of the list and the most recent at the top of the list, beginning at event *n*.	1
HIS C	Clear/reset the event history and all corresponding event reports from nonvolatile memory.	1

For more information on event reports, see *Section 9: Analyzing Events*.

IDENTIFICATION Command

Available as a compressed command only, use the **ID** command to extract device identification codes, as shown in *Table 7.28*.

Table 7.28 IDENTIFICATION Command

Command	Description	Access Level

ID	Return a list of device identification codes, as shown below:
	`=ID <Enter>`
	`"FID=SEL-2411P-R300-V0-Z001007-D20160930","45EA"`
	`"BFID=BOOTLDR-R500-V0-Z000000-D20090925","45EA"`
	`"CID=C7D8","0273"`
	`"DEVID=SEL-2411P","03F2"`
	`"DEVCODE=62","030F"`
	`"PARTNO=241101A0X5X7185100","0666"`
	`"CONFIG=111120","0389"`
		0

IRIG Command

Use the **IRI** command to read the demodulated IRIG-B time code at the serial port or IRIG-B input, and to force immediate synchronization of the internal clock with the IRIG-B signal (see *Table 7.29*). If an IRIG-B signal is present at the serial port or IRIG-B input, the device automatically synchronizes the internal clock with the IRIG-B signal in a time period not exceeding one minute. It is not necessary to issue the **IRI** command for this automatic one-minute synchronization. If you are testing the device and do not want to wait for the one-minute synchronization, then issue the **IRI** command to immediately force the device to synchronize with the IRIG-B signal. You can also use the **IRI** command to determine if the device is properly reading the IRIG-B signal.

Table 7.29 IRIG Command

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

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

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

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

```
SEL-2411P                                  Date: 04/12/2005   Time: 15:41:29
DEVICE
=>
```

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

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

L_D Command (Load Firmware)

Use the **L_D** command to load firmware, as shown in *Table 7.30*. See *Appendix A: Firmware and Manual Versions* for information on changes to the firmware and instruction manual. See *Appendix B: Firmware Upgrade Instructions* for further details on downloading firmware.

Table 7.30 L_D Command

Command	Description	Access Level
L_D	Download firmware to the device (front panel only)	2

LOOPBACK Command

The **LOO** command is used for testing the MIRRORED BITS communications channel for proper communication. For more information on MIRRORED BITS, see *Appendix F: MIRRORED BITS Communications*. With the transmitter of the communications channel physically looped back to the receiver, the MIRRORED BITS addressing will be wrong and ROK will be deasserted. The **LOO** command tells the MIRRORED BITS software to temporarily expect to see its own data looped back as its input. In this mode, LBOK will assert if error-free data are received. The **LOO** command with just the channel specifier, enables looped back mode on that channel for 5 minutes, while the inputs are forced to the default values.

Table 7.31 LOOPBACK Command

Command	Description	Access Level
LOO	Enable loopback testing of MIRRORED BITS channels	2
LOO A	Enable loopback on MIRRORED BITS Channel A for the next 5 minutes.	2
LOO B	Enable loopback on MIRRORED BITS Channel B for the next 5 minutes.	2

```
=>>LOO A <Enter>
Loopback will be enabled on Mirrored Bits channel A for the next 5 minutes.
The RMB values will be forced to default values while loopback is enabled.
Are you sure (Y/N)?

=>>
```

If only one MIRRORED BITS port is enabled, the channel specifier (A or B) may be omitted. To enable loopback mode for other than the 5-minute default, enter the desired number of minutes (1–5000) as a command parameter. To allow the loopback data to modify the RMB values, include the **DATA** parameter.

```
=>>LOO 10 DATA <Enter>
Loopback will be enabled on Mirrored Bits channel A for the next 10 minutes.
The RMB values will be allowed to change while loopback is enabled.
Are you sure (Y/N)? N <Enter>
Canceled.

=>>
```

To disable loopback mode before the selected number of minutes, re-issue the **LOO** command with the **R** parameter. The **R** parameter returns the device to normal operation. If both MIRRORED BITS channels are enabled, omitting the channel specifier in the disable command will cause both channels to be disabled.

```
=>>LOO R <Enter>
Loopback is disabled on both channels.

=>>
```

MAC Command

Use the **MAC** command to display the MAC addresses of PORT 1, as shown below.

```
Port 1 MAC Address:  00-30-A7-00-00-00
```

MAP Command (Display DNP3 Maps)

The **MAP** command is only available if DNP3 has been selected as the protocol on a serial or Ethernet port. The **MAP** command accesses the port DNP3 settings and is similar to the **SHOW DNP** command. However, unlike the **SHOW DNP** command, the **MAP** command displays DNP3 information by port number. You can issue the **MAP** command with the ***port*** parameter (from 1 to 4) to view the DNP3 settings for that port number. If you specify port number 1, you must also include the ***session*** number (from 1 to 5) to display.

Table 7.32 MAP Command

Command	Description	Access Level
MAP *port*	Show the serial DNP3 settings for port ***port*** (similar to **SHOW DN**).	1, 2
MAP 1 *session*	Show the DNP3 settings for Ethernet port 1 and session ***session*** (similar to **SHOW DN**).	1, 2

To observe Port 1 DNP3 maps and settings for session 1, type **MAP 1 1 <Enter>**.

METER Command (Metering Data)

The **MET** commands provide access to metering data. To make the extensive amount of meter information manageable, the device divides the displayed information into several groups.

- Analog Input
- Remote Analog
- Math Variable
- Fundamental
- Demand
- Maximum/Minimum
- Energy

Because you can configure the SEL-2411P with different cards, display values in response to the **MET** command is a function of the specific card combination. When a card is not installed, the headings and values are hidden.

Metering data retrieval and display is described in the following subsections. See *Section 5: Metering and Monitoring* for details on metering.

MET A Analog Input Metering

Use the **MET A** command to display values measured by one or more Analog Input cards.

Command	Description	Access Level
MET A *n*	Display Analog Input (AI) values.	1

Because values for different analog inputs vary in length, the device 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 (for example, –0.0732, 961.82, 21936, or 18493).

MET RA Remote Analog Metering

Use the **MET RA** command to display remote analog values sent by a remote device.

Command	Description	Access Level
MET RA *n*	Display Remote Analog (RA) values.	1

MET MV Math Variable Metering

Use the **MET MV** command to display math variable values calculated by the device.

Command	Description	Access Level
MET MV	Display Math Variable (MV) values.	1

MET F k Fundamental Metering

Use the **MET F *k*** command to display fundamental metering data.

Command	Description	Access Level
MET F *k*	Display instantaneous metering data *k* times.	1

The **MET F *k*** command displays instantaneous magnitudes, and angles if applicable, of the following quantities:

- Voltages
- Sequence
- Frequency

To view instantaneous metering values, use the **MET F *k*** command, where F is an optional parameter to specify fundamental and *k* is an optional parameter to specify the number of times (1–32767) to repeat the meter display. The device displays the meter report once if *k* is not specified.

MET Demand/Peak Demand Metering

Use the following commands to view or reset demand and peak demand metering values.

Command	Description	Access Level
MET D	Display demand and peak demand metering data.	1
MET RD	Reset demand metering data.	1
MET RP	Reset peak demand metering data.	1

The **MET D** command displays the demand and peak demand values of the following quantities along with the last reset times:

- Currents
- Power

MET M Maximum/Minimum Metering

Use the following commands to view or reset maximum or minimum metering values.

Command	Description	Access Level
MET M	Display maximum and minimum metering data.	1
MET RM	Reset maximum and minimum metering data. All values will display RESET until new maximum/minimum values are recorded.	1

The **MET M** command displays the maximum and minimum values of the following along with the last reset times:

- Currents
- Power

For more information on device maximum/minimum metering quantity calculations, see *Energy Metering on page 5.7*.

MET E Energy Metering

Use the following commands to view or reset energy metering values.

Command	Description	Access Level
MET E	Display energy metering data.	1
MET RE	Reset energy metering data.	1

For more information on device energy metering quantity calculations, see *Energy Metering on page 5.4*.

Device accumulated energy metering values function like those in an electromechanical energy meter. The SEL-2411P starts over at 0 after energy metering reaches 99999 MWh or 99999 MVARh.

PART Command (View/Change Part Number)

Use the **PART** command to inspect or change the existing part number after reconfiguring the installed SELECT IO cards. This is only necessary to set the second digit of a SELECT IO card that is not automatically updated. Resetting the part number is allowed twice from Access Level 2. Changing the part number more than twice requires resetting the device to default settings.

Table 7.33 PART Command

Command	Description	Access Level
PAR	Display the current part number.	1
PAR ***2411xxxxxxxxxxx***	Set a new part number after reconfiguring installed SELECT IO cards.	2

PASSWORD Command (View/Change Passwords)

Use the **PAS** command to inspect or change existing passwords, as shown in *Table 7.34* and *Table 7.35*.

Table 7.34 PASSWORD Command[a]

Command	Description	Access Level
PAS ***level new password***	Set a password *new password* for Access Level *level*.	2

[a] Parameter level represents the device Access Levels 1 or 2.

Table 7.35 Factory-Default Passwords

Access level	Password
1	OTTER
2	TAIL

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

To change the password for Access Level 2 from the default password TAIL to new password Ot3579, enter the following:

```
=>>PAS 2 <Enter>
Old PW: ? **** <Enter> (Enter TAIL)
New PW: ? ****** <Enter>  (Enter Ot3579)
Confirm PW: ? ****** <Enter>  (Enter Ot3579)
Password Changed

CAUTION: This password can be strengthened.  Strong passwords do not include a
name, date, acronym, or word.  They consist of the maximum allowable
characters, with at least one special character, number, lower-case letter, and
upper-case letter.  A change in password is recommended.

=>>
```

Similarly, use **PAS 1** to change Level 1 passwords.

Passwords can contain as many as 12 characters. Uppercase and lowercase letters are treated as different characters. Strong passwords consist of 12 characters, with at least one special character or digit and mixed-case sensitivity, 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+

Table 7.36 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	! " # $ % & ' ( ) * + , - . / : ; < = > ? @ [\ ] ^ _ ` { | } ~

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

If you forget your password, you can re-issue a new password as follows:

- ➤ In accordance with the appropriate safety regulations, power down the device and remove the rear cover.
- ➤ Disable the password function by locating Jumper JMP1 on the card in the B-slot of the base unit (see *Password and SELBOOT Jumper Selection on page 2.10*) and placing JMP1 in position A.
- ➤ Replace all covers and power up the device.
- ➤ Go to the appropriate access level and issue the **PAS *x*** (*x* = 1 or 2) command to enter a new password.
- ➤ In accordance with the appropriate safety regulations, power down the device, remove the rear cover and remove Jumper JMP1 to activate the password function.
- ➤ Replace all covers and power up the device.

PING Command

When you are setting up or testing networks, it is helpful to determine if the network is connected properly and if the other devices are powered up and configured properly. Use the **PING** command to determine if another node on the network is available and connected to the network. The SEL-2411P sends ping messages to the remote node until interrupted by pressing **Q** (if you want ping statistics) or **<Ctrl+X>** (if you do not want ping statistics) on the keyboard. The SEL-2411P will support only one **PING** command per IED from any available port.

Command options for the **PING** command are shown in *Table 7.37*.

Table 7.37 PING Command

Command	Description	Access Level
PING *addr*	Ping the IP address represented by *addr* every second	2
PING *addr n*	Ping the IP address once every *n* seconds, where *n* is a value from 1–255	2

PROFILE Command (Signal Profile Values)

Use the **PRO** command to display or clear analog signal profile data, as shown in *Table 7.38*.

Table 7.38 PROFILE Command

Command	Description	Access Level
PRO	Display analog signal profile data	1
PRO C	Clear analog signal profile data	1

PULSE Command (Test Outputs)

Use the **PUL** command to temporarily change the state of an output contact for 1 second. This command overrides the present settings for the particular output under test, as shown in *Table 7.39*.

Table 7.39 PULSE Command

Command	Description	Access Level

PUL *n*	Pulse output contact *n* for 1 second, as shown below:
	`=>PUL OUT101 <Enter>`
	`Pulse Output`
	`Are you sure (Y,N)? Y <Enter>`
	
	`=>`
		2

QUIT Command

Use the **QUIT** command to revert to Access Level 0 from either Level 1 or Level 2, as shown in *Table 7.40*.

Table 7.40 QUIT Command

Command	Description	Access Level
QUI	Go to Access Level 0	0

Access Level 0 is the lowest access level; the SEL-2411P performs no password check to descend to this level (or to remain at this level).

SER Command (Sequential Events Recorder Report)

Use the **SER** commands to view and manage the Sequential Events Recorder report, as shown in *Table 7.41* and *Table 7.42*.

Table 7.41 SER Command (Sequential Events Reorder 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 recent triggered row and Row 512 is the oldest.	1
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 7.42* below).	1
SER C	Use this command to clear/reset the SER records.	2

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

```
No SER data
```

Table 7.42 SER Command Format

Parameter	Description
row 1	Append *row 1* to return a chronological progression of the first *row 1* rows. For example, use **SER 5** to return the first five rows.
row 1 row 2	Append *row 1* and *row 2* to return all rows between *row 1* and *row 2*, beginning with *row 1* and ending with *row 2*. Enter the smaller number first to display a numeric progression of rows through the report. Enter the larger number first to display a reverse numeric progression of rows. For example, use **SER 1 10** to return the first ten rows in numeric order, or **SER 10 1** to return the same items in reverse numeric order.
date 1	Append *date 1* to return all rows with this date. For example, use **SER 1/1/2005** to return all records for January 1, 2005.
date 1 date 2	Append *date 1* and *date 2* to return all rows between *date 1* and *date 2*, beginning with *date 1* and ending with *date 2*. Enter the oldest date first to display a chronological progression through the report. Enter the newest date first to display a reverse chronological progression of rows. Date entries are dependent on the date format setting DATE_F. For example, with DATE_F set to MDY (Month Day Year), **SER 1/5/2005 1/7/2005** returns all records for January 5, 6, and 7, 2005.

SET Command (Change Settings)

The **SET** command is for viewing or changing the device settings, as shown in *Table 7.43*. Append **TERSE** to skip the settings display after the last setting. Use this parameter to speed up the **SET** command. If you want to review the settings before saving, do not use the **TERSE** option.

Table 7.43 SET Command

Command	Description	Access Level
SET *s* TERSE	Set Device settings	2
SET L *s* TERSE	Set Logic settings	2
SET G *s* TERSE	Set Global settings	2
SET POR *n s* TERSE	Set serial port settings, depending on the device configuration, *n* specifies either Port F or Ports 2 through 4; 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
SET DN *s* TERSE	Set DNP3 settings	2

Append *s* and the specific setting name you want to change in the **SET** command to immediately jump to the setting. For example if *s* is not entered, the device starts at the first setting. For example, to directly jump to the FMR1 setting in the Report setting category, enter **SET R FMR1 TERSE <Enter>**.

When you issue the **SET** command, the device presents a list of settings one at a time. Enter a new setting or press **<Enter>** to accept the existing setting, as shown in *Table 7.44*.

Table 7.44 SET Command Editing Keystrokes

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

The device checks each setting to ensure that it is within the allowed range. If the setting is not within the allowed range, the device generates an `Out of Range` message and prompts you for the setting again. When all the settings are entered, the device displays the new settings and prompts you for approval to enable them. Answer **Y <Enter>** to enable the new settings. The device is disabled for no longer than one second while saving the new settings. The SALARM Device Word bit asserts momentarily and the **ENABLED** LED extinguishes while the device is disabled.

SHOW Command (Show/View Settings)

When showing settings, the device displays the settings label and the present value from nonvolatile memory for each setting class as shown in *Table 7.45*.

Table 7.45 SHOW Command

Command	Description	Access Level
SHO ***s***	Show Device settings	1
SHO L ***s***	Show Logic settings	1
SHO G ***s***	Show Global settings	1
SHO POR ***n s***	Show serial port settings, *n* specifies either Port F or Ports 1 through 4; 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
SHO DN ***s***	Show DNP3 settings	1

Append *s* and the specific setting name you want to view in the **SHOW** command to immediately jump to the setting. If *s* (and the setting name) is not included, the device presents settings beginning with the first one in the group.

SNS Command (Displays SER Settings)

Available as a compressed command only, the **SNS** command displays the SER settings in Compressed ASCII format, as shown in *Table 7.46*.

Table 7.46 SNS Command

Command	Description	Access Level
SNS	The **SNS** command displays the SER trigger elements (entered with the SET R SER*n* (*n* = 1 through 4) command) in Compressed ASCII format.	0

The SER trigger elements are gathered in groups of eight elements to be displayed on each line of the report. The last line of the report may have fewer than eight elements. Each line is formatted as a comma-separated list of quoted SER trigger elements, followed by a quoted hexadecimal representation of the checksum. The checksum is calculated from the first quote mark of the line up to the last comma before the checksum. If there are no SER trigger elements (i.e., all SER settings are NA), no lines are generated for the report.

STATUS Command (Device Self-Test Status)

The **STA** command displays the status report, as shown in *Table 7.47*.

Table 7.47 STATUS Command (Device Self-Test Status)

Command	Description	Access Level
STA ***n***	Displays the device self-test information *n* times (*n* = 1–32767). Defaults to 1 if *n* is not specified.	1
STA S	Displays the memory and execution utilization for the SELOGIC control equations.	1
STA R or C	Reboots the device and clears self-test warning and failure status results.	2

Refer to *Section 10: Testing and Troubleshooting* for self-test thresholds and corrective actions, as well as hardware configuration conflict resolution. When voltage and current cards are installed, the response includes analog offset for the current and voltage channels.

As with all microprocessor devices, increasing the number of functions increases the processor burden. Use the **STA S** command to see the remaining processor capacity for counters and SELOGIC equations. The SEL-2411P shows the available processing capacity for programming counters and SELOGIC equations as Execution %. With no counters or SELOGIC equations running, the processor capacity (Execution (%)) is 100 percent.

Programming counters and SELOGIC equations reduce available processing capacity, and the Execution % value reflects the lower available processing capacity. When the Execution % value reaches one percent, no more processing capacity is available.

Other values indicate the available storage capacity for the different setting categories: Logic settings (Logic), Global settings (Global), Front-Panel settings (FP) and Report settings (Report).

SUMMARY Command (Summary)

The **SUM** command retrieves the event summary information from the last event report in ASCII format, as shown in *Table 7.48*.

Table 7.48 SUMMARY Command

Command	Description	Access Level
SUM *n*	Return event summary number *n* (omitting *n* returns event summary number 1) in ASCII format.	1

TARGET Command (Display Device Word Bit Status)

The **TAR** command displays the status of front-panel target LEDs or Device Word bits, whether these LEDs or Device Word bits are asserted or deasserted, as shown in *Table 7.49*.

Table 7.49 TARGET Command Definitions

Command	Description	Access Level
TAR	Use TARGET without parameters to display Device Word row 0.	1
TAR ROW	Adding ROW to the command (e.g. **TAR 23**) displays the eight Device Word bits in row 23 of the Device Word bits list (see *Appendix G: Device Word Bits*).	1
TAR *n k*	Show Device Word row number *n* (0–103) and heading, and repeat the status (0 or 1) of the eight Device Word bits in row *n k* times (1–32767). See *Appendix G: Device Word Bits* for the Device Word bit table.	1
TAR R	Displays Device Word row 0.	1

The elements are represented as Device Word bits and are listed in rows of eight, called Device Word rows. All Device Word rows are described in *Appendix G: Device Word Bits*. Device Word bits are used in SELOGIC control equations. The **TAR** command does not remap the front-panel target LEDs, as is done in some previous SEL products.

TIME Command (View/Change Time)

The **TIME** command returns information about the SEL-2411P internal clock, as shown in *Table 7.50*. You can also set the clock if you specify hours and minutes (seconds data are optional). Separate the hours, minutes, and seconds with colons.

Table 7.50 TIME Command Definitions

Command	Description	Access Level
TIME	Display the present internal clock time	1
TIME *hh:mm*	Set the internal clock to hh:mm	2
TIME *hh:mm:ss*	Set the internal clock to hh:mm:ss	2

Use the **TIME *hh:mm*** and **TIME *hh:mm:ss*** commands to set the internal clock time. The value *hh* is for hours from 0–23; the value *mm* is for minutes from 0–59; the value *ss* is for seconds from 0–59. If you enter a valid time, the device updates and saves the time in the nonvolatile memory, and displays the time you just entered. If you enter an invalid time, the SEL-2411P responds with `Invalid Time`.

TRIGGER Command (Trigger Event Report)

Use the **TRI** command to trigger an event report, as shown in *Table 7.51*.

Table 7.51 TRIGGER Command (Trigger Event Report)

Command	Description	Access Level
TRI	Trigger event report data capture.	1

When you issue the **TRI** command, the SEL-2411P responds, `Triggered`. If the event did not trigger within 1 second, the device responds, `Did not trigger`. See *Section 9: Analyzing Events* for further details on event reports.

Simple Network Time Protocol (SNTP)

When ESNTP is enabled (Port 1 setting ESNTP is not OFF), the relay internal clock conditionally synchronizes to the time of day served by a Network Time Protocol (NTP) server. The relay uses a simplified version of NTP called the Simple Network Time Protocol (SNTP). SNTP is not as accurate as IRIG-B. The relay can use SNTP as a less accurate primary time source, or as a backup to the higher accuracy IRIG-B time source.

SNTP As Primary Or Backup Time Source

If an IRIG-B time source is connected and either Relay Word bits TSOK or TIRIG assert, then the relay synchronizes the internal time-of-day clock to the incoming IRIB-G time-code signal, even if SNTP is configured in the relay and an NTP server is available. If the IRIG-B source is disconnected (TIRIG deasserted) then the relay synchronizes the internal time-of-day clock to the NTP server if available. In this way, an NTP server acts as either the primary time source or as a backup time source to the more accurate IRIG-B time source.

Creating an NTP Server

Three SEL application notes available from the SEL website describe how to create an NTP server.

- AN2009-10: Using an SEL-2401, SEL-2404, or SEL-2407 to Serve NTP Via the SEL-3530 RTAC
- AN2009-38: Using SEL Satellite-Synchronized Clocks With the SEL-3332 or SEL-3351 to Output NTP

➤ AN2010-03: Using an SEL-2401, SEL-2404, or SEL-2407 to Create a Stratum 1 Linux NTP Server

Configuring SNTP Client in the Relay

To enable SNTP in the relay, make Port 1 setting ESNTP = UNICAST, MANYCAST, or BROADCAST. *Table 7.52* shows each setting associated with SNTP.

Table 7.52 Settings Associated With SNTP

Setting	Prompt	Range	Default	Description
ESNTP	SNTP Enable (OFF, UNICAST, MANYCAST, BROADCAST)	UNICAST, MANYCAST, BROADCAST	OFF	Selects the mode of operation of SNTP. See descriptions in *SNTP Operation Modes*.
SNTPRAT[a]	SNTP Request Update Rate (15–3600 s)	15–3600 s	60	Determines the rate at which the relay asks for updated time from the NTP server when ESNTP = UNICAST or MANYCAST. Determines the time the relay will wait for an NTP broadcast when ENSTP = BROADCAST.
SNTPTO	SNTP Timeout (5–20 s)	5–20 s	5	Determines the time the relay will wait for the NTP master to respond when ENSTP = UNICAST or MANYCAST
SNTPPIP	SNTP Primary Server IP Address (w.x.y.z)[b]	Valid IP Address	192.168.1.110	Selects primary NTP server when ENSTP = UNICAST, or broadcast address when ESNTP = MANYCAST or BROADCAST
SNTPBIP	SNTP Backup Server IP Address (w.x.y.z)[c]	Valid IP Address	192.168.1.111	Selects backup NTP server when ESNTP = UNICAST.
SNTPPOR[d]	SNTP IP Local Port Number (1–65534)	1–65534	123	Ethernet port used by SNTP. Leave at default value unless otherwise required.

[a] This setting is: Hidden if ESNTP = OFF; Hidden and forced to 5 if ESNTP = BROADCAST.
[b] Where: w: 0–126, 128–239, x: 0–255, y: 0–255, z: 0–255.
[c] Where: w: 0–126, 128–223, x: 0–255, y: 0–255, z: 0–255.
[d] This setting is hidden if ESNTP ≠ UNICAST.

SNTP Operation Modes

The following sections explain the setting associated with each SNTP operation mode (UNICAST, MANYCAST, and BROADCAST).

ESNTP = UNICAST

In unicast mode of operation, the SNTP client in the relay requests time updates from the primary (IP address setting SNTPPIP) or backup (IP address setting SNTPBIP) NTP server at a rate defined by setting SNTPRAT. If the NTP server does not respond with the period defined by the sum of setting SNTPTO and SNTPRAT, then the relay tries the other SNTP server. When the relay successfully synchronizes to the primary NTP time server, Relay Word bit TSNTPP asserts. When the relay successfully synchronizes to the backup NTP time server, Relay Word bit TSNTPB asserts.

ESNTP = MANYCAST

In manycast mode of operation, the relay initially sends an NTP request to the broadcast address contained in setting SNTPPIP. The relay continues to broadcast requests at a rate defined by setting SNTPRAT. When a server replies, the relay considers that server to be the primary NTP server, switches to UNICAST mode, asserts Relay Word bit TSNTPP, and thereafter requests updates from the primary server. If the NTP server stops responding for time SNTPTO, the relay deasserts TSNTPP and begins to request time from the broadcast address again until a server responds.

ESNTP = BROADCAST

Setting SNTPPIP = 0.0.0.0 while ESNTP = BROADCAST, the relay will listen for and synchronize to any broadcasting NTP server. If setting SNTPPIP is set to a specific IP address while setting ESNTP = BROADCAST, then the relay will listen for and synchronize to only NTP server broadcasts from that address. When synchronized, the relay asserts Relay Word bit TSNTPP. Relay Word bit TNSTPP deasserts if the relay does not receive a valid broadcast within the SNTPT0 setting value after the period defined by setting SNTPRAT.

SNTP Accuracy Considerations

SNTP time synchronization accuracy is limited by the accuracy of the SNTP Server and by the networking environment. The highest degree of SNTP time synchronization can be achieved by minimizing the number of switches and routers between the SNTP Server and the relay.

When installed on a network with low burden configured with one Ethernet switch between the relay and the SNTP Server, and when using ESNTP = UNICAST or MANYCAST, the relay time-synchronization error to the SNTP server is typically less than ±5 ms.

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Section 8
Front-Panel Operations

Front-Panel Overview

The SEL-2411P Pump Automation Controller front panel makes data collection and control quick and efficient. Use the front panel to analyze operating information, view and change device settings, and perform control functions. The SEL-2411P features a straightforward menu-driven control structure presented on the front-panel liquid crystal display (LCD). Front-panel targets and other LED indicators provide a fast means of checking operation status.

Figure 8.1 shows the many features of the versatile front-panel.

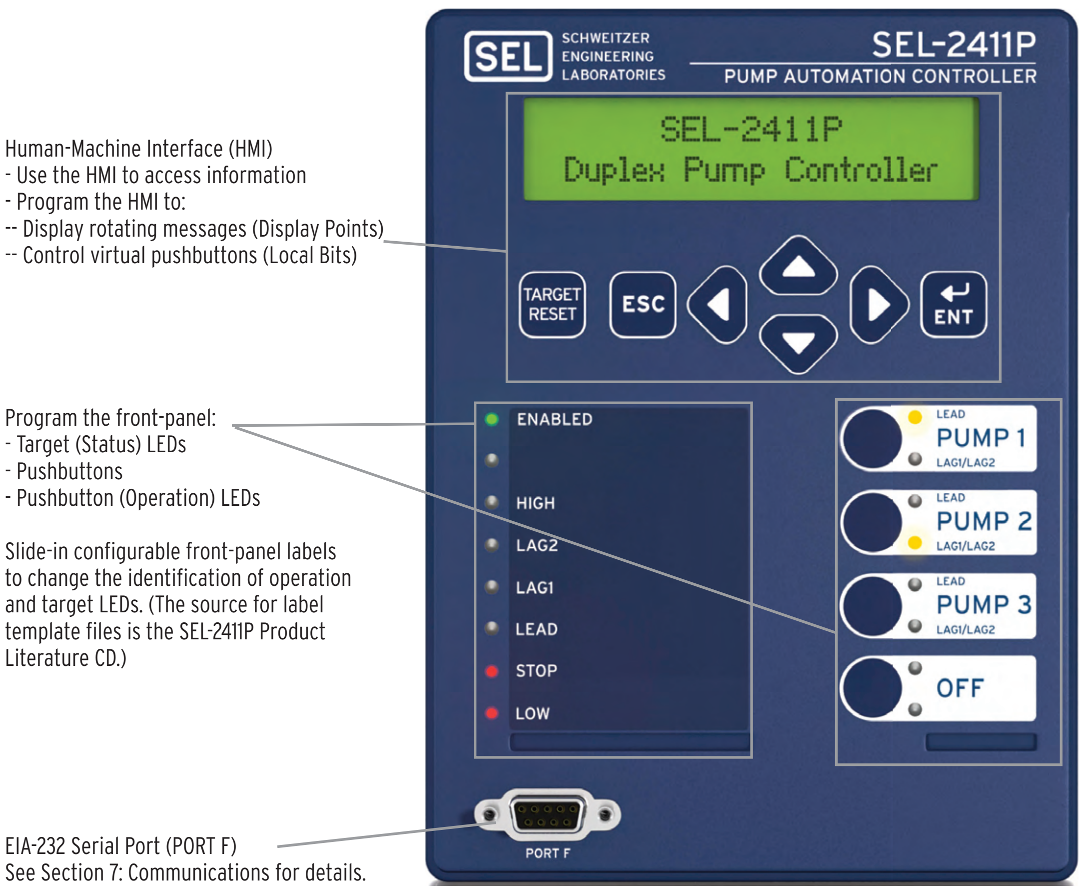


Figure 8.1 Front-Panel Overview

Human-Machine Interface

Front-Panel Automatic Messages

The device displays automatic messages (type of latest failure) when detecting any failure (see *Section 10: Testing and Troubleshooting*).

Display Points

NOTE: Valid string characters are 0–9, A–Z, -, /, ", {, }, space.

Configure the digital (Boolean) and analog information you want to view on the 2x16 LCD screen by setting Display Points. Although the LCD displays a maximum of 16 characters at a time, you can enter up to 60 valid characters. For text exceeding 16 characters, the LCD displays the first 16 characters, then scrolls through the remaining text.

When your SEL-2411P arrives, two display points are already configured with defaults if no setting template was selected. The results of these defaults are shown in *Figure 8.3*.

Figure 8.2 LCD Default Display

Boolean Display Point

Boolean information is the status of Device Word bits (see *Appendix G: Device Word Bits*). In general, the syntax for Boolean display points consists of the following four fields or strings, separated by commas:

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

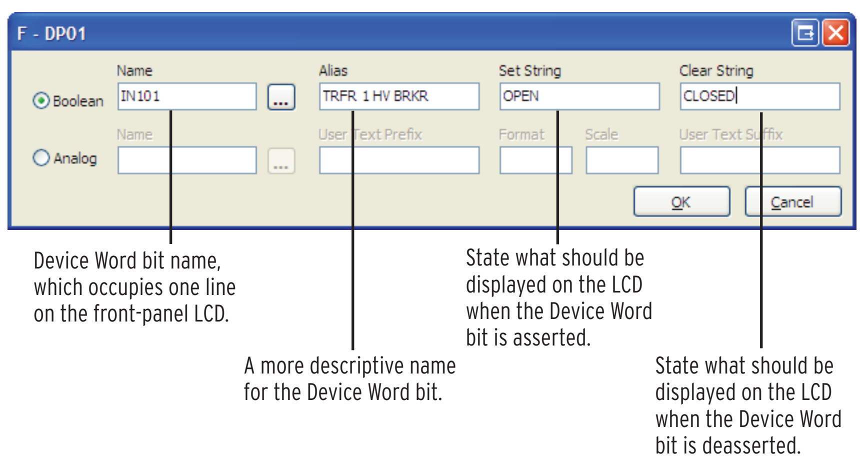


Figure 8.3 QuickSet—Settings for an Device Word Bit (Boolean)

Examples using the settings in *Table 8.1* are shown in *Figure 8.4* and *Figure 8.5*.

Table 8.1 Entries for the Four Strings

Name	Alias	Clear String	Set String
IN101	TRFR 1 HV BRKR	OPEN[a]	CLOSED[b]
IN102	TRFR 1 LV BRKR	OPEN	CLOSED

[a] When the circuit breaker is closed the form a [normally open] status output closes, which sets or asserts Device Word bit IN101.

[b] When the circuit breaker is open the form a [normally open] status output opens, which clears or deasserts Device Word bit IN101.

Figure 8.4 shows the display when both HV and LV breakers are open (both IN101 and IN102 deasserted). *Figure 8.5* shows the display when the HV breaker is closed, and the LV breaker is open (IN101 asserted, but IN102 still deasserted).

```
TRFR 1 HV BRKR:= OPEN
TRFR 1 LV BRKR:= OPEN
```

Figure 8.4 Front-Panel Display—Both HV and LV Breakers Open

```
TRFR 1 HV BRKR:= CLOSED
TRFR 1 LV BRKR:= OPEN
```

Figure 8.5 Front-Panel Display—HV Breaker Closed, LV Breaker Open

Display Points are not always displayed on the LCD. *Table 8.2* shows the rules for ensuring that the desired information is always or conditionally displayed. *Table 8.3* shows the rules for when Display Points will always be hidden, which is usually a setting mistake.

Table 8.2 When Display Points Are Conditionally Hidden

Name	Alias	Set String	Clear String	Comment	Example
1	•	Empty	Empty	Never hidden	DP01:=1,ALIAS1
•	•	–	–	Never hidden	DP01:=IN101,ALIAS1
•	•	Null	•	Hidden if true	DP01:=IN101,ALIAS1,,CLEAR
•	•	•	Null	Hidden in false	DP01:=IN101,ALIAS1,SET,
•	•	•	•	Never hidden	DP01:=IN101,ALIAS1,SET,CLEAR

Table 8.3 When Display Points Are Always Hidden

Name	Alias	Set String	Clear String	Comment	Example
0	–	–	–	Always hidden	DP01:=0
–	–	–	–	Always hidden	DP01:=
•	Null	Null	Null	Always hidden	DP01:=IN101,,,
•	•	Null	Null	Always hidden	DP01:=IN101,ALIAS1,,

Analog Display Point

In general, the syntax for analog display points consists of the following two fields or strings: Name, “User Text and Formatting.” Unlike binary quantities, the device displays analog quantities on both display lines.

NOTE: The format field specifies the total width of the numeric value (includes the sign character and decimal point) and the optional scale field specifies the number of places after the decimal point.

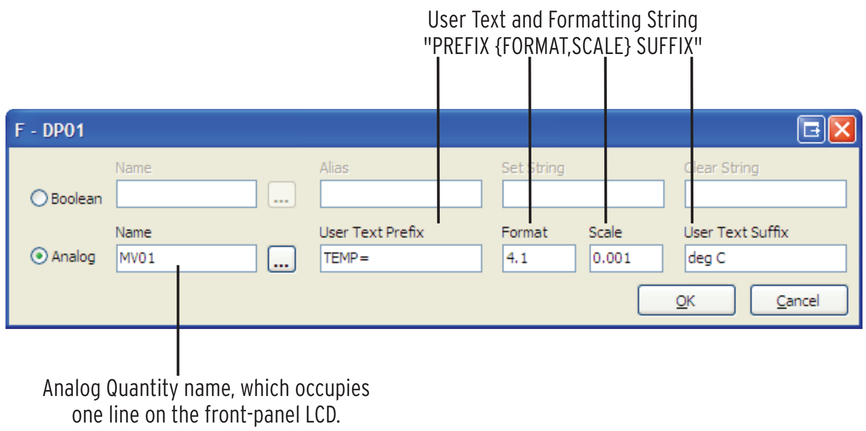


Figure 8.6 QuickSet—Settings for an Analog Quantity

Figure 8.7 shows the front-panel display for a setting with a Name string only. If the User Text and Formatting string is left void then the analog quantity name will always be displayed on the first line and the value and units (if available) will always be displayed on the second line.

Figure 8.8 shows the front-panel display for a setting with a Name string, a "TEMPERATURE" User Text Prefix string, and known engineering units.

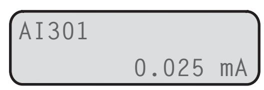


Figure 8.7 Front-Panel Display for an Analog Entry in the Name String Only

Figure 8.8 Analog Name and User Text and Formatting Strings

Table 8.4 Example Settings and Displays

Example Display Point Setting Value	Example Display
MV01,"TEMP {4}deg C"	TEMP 1234 deg C
MV01,"TEMP = {4.1}"	TEMP =xx.x
MV01,"TEMP = {5}"	TEMP = 1230
MV01,"TEMP={4.2,0.001} C"	TEMP=1.23 C
MV01,"TEMP HV HS1={4,1000}"	TEMP HV HS1=1234000
1,{}	Empty line

NOTE: Format and Scale
The format 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.

NOTE: If the message length is maximized then $$$$ are displayed when the number is too large to display

Rotating Display

With more than two display points enabled, the device scrolls through all enabled display points, thereby forming a rotating display, as shown in *Figure 8.9*.

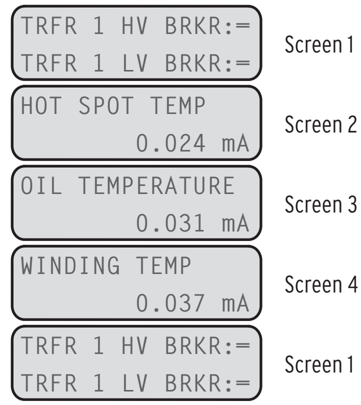


Figure 8.9 Rotating Display

Local Bits

Local bits are variables (LB*nn*, where *nn* means LB01–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 SWITCH) 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. If SLB*nn* and PLB*nn* are both set then PLB*nn* is ignored.

For the example in *Figure 8.10*, 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 (SWITCH) 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.

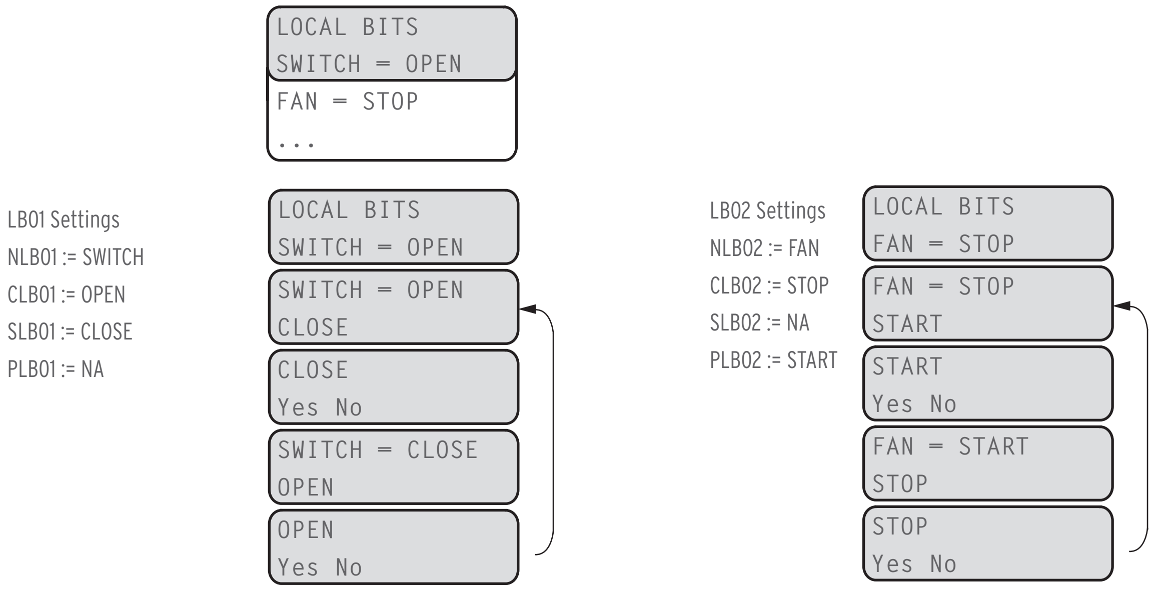


Figure 8.10 Local Bit Examples

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-2411P 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.

Table 8.5 shows the timeout and contrast settings. Use the front-panel LCD timeout setting (FP_TO) as a security measure. If the display is within an Access Level 2 function when a timeout occurs, the function is automatically terminated. After terminating the function, the front-panel display returns to the default display. To disable the front-panel timeout function, set the LCD timeout equal to OFF. Use the front-panel LCD contrast setting (FP_CONT) to adjust the contrast of the liquid crystal display.

Table 8.5 LCD Display Settings

Setting	Setting Prompt	Range	Default
FP_TO	LCD Timeout (OFF,1–30; min)	OFF, 1–30; min	15
FP_CONT	LCD Contrast (1–8)	1–8	5

Front-Panel Security

Front-Panel Access Levels

The SEL-2411P front panel typically operates at Access Level 1 and provides viewing of device measurements and settings. Some activities, such as editing settings and controlling output contacts, are restricted to those operators who know the Access Level 2 password.

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

Access Level 2 Password Entry

When you try to perform an Access Level 2 activity, the device determines whether you have entered the correct Access Level 2 password since the front-panel inactivity timer expired. If you have not, the device displays the screen shown in *Figure 8.11* for you to enter the password.

```
Password=
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 8.11 Password Entry Screen

See *PASSWORD Command (View/Change Passwords) on page 7.17* for the list of default passwords and for more information on changing passwords.

Front-Panel Time-Out

To help prevent unauthorized access to password-protected functions, the SEL-2411P provides a front-panel time-out, setting FP_TO. A timer (5 minutes default setting) 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.

Front-Panel Menus and Screens

Navigating the Front-Panel Menus

The SEL-2411P front panel gives you access to most of the information that the device measures and stores. You can also use front-panel controls to view or modify device settings. All of the front-panel functions are accessible through use of the six-button keypad and LCD display, as shown in *Figure 8.12*.

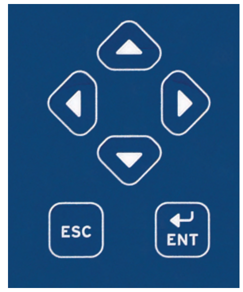
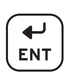


Figure 8.12 Front-Panel Navigation Pushbuttons

Use the front-panel keypad pushbuttons to maneuver within the front-panel menu structure. *Table 8.6* describes the function of each front-panel navigation pushbutton.

Table 8.6 Front-Panel Pushbutton Functions

Pushbutton		Function
	Up Arrow	Move up within a menu or data list. While editing a setting value, increase the value of the underlined digit. Holding this key down moves the cursor up one line every 1.3 seconds.
	Down Arrow	Move down within a menu or data list. While editing a setting value, decrease the value of the underlined digit. Holding this key down moves the cursor down one line every 1.3 seconds.
	Left Arrow	Move the cursor to the left. Holding this key down repeats the cursor left movement every 1.3 seconds.
	Right Arrow	Move the cursor to the right. Holding this key down repeats the cursor right movement every 1.3 seconds.
	ESC	Escape from the present menu or display without saving changed information. Move from the default display to the `MAIN` display. Hold for 2 seconds to display contrast adjustment screen.
	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.

The SEL-2411P 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.

Menu Structure

Figure 8.13 shows the `MAIN` menu screen. Using the **Up Arrow** or **Down Arrow** and **ENT** pushbuttons, you can navigate to specific menu item in the `MAIN` menu. Each menu item is explained in detail in the following paragraphs.

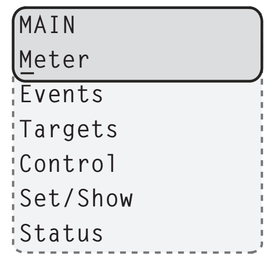


Figure 8.13 MAIN Menu

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 (Metering Data) on page 7.14* for formatting information.

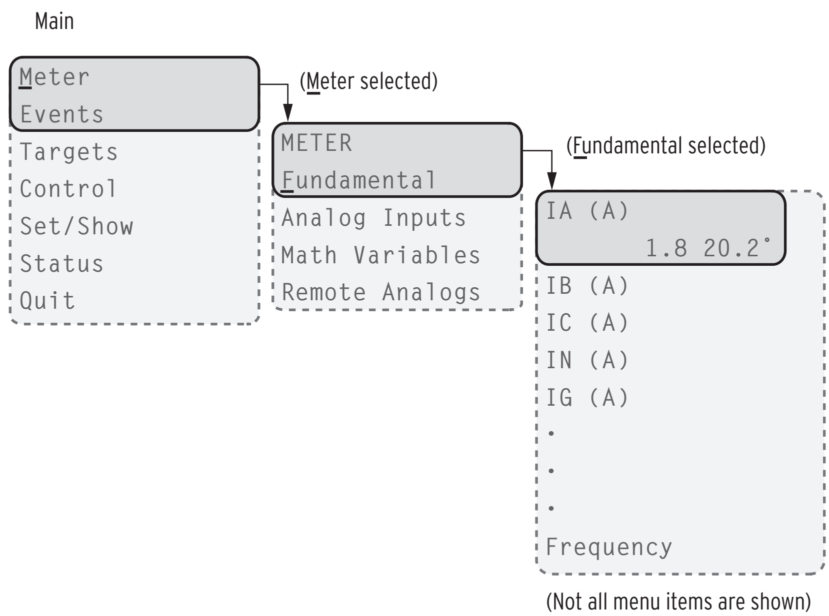


Figure 8.14 MAIN Menu and METER Submenu

If the device contains no analog cards, then the device displays the message shown in *Figure 8.15*.

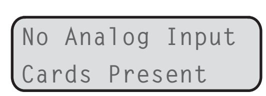


Figure 8.15 Device Response When No Analog Cards Are Installed

Events Menu

NOTE: For the next selection, Math Variables, only values of enabled math variables and remote analogs appear. Enable math variables and remote analogs under the **Set/Show Logic** menu, or the **SET L** serial port command.

Figure 8.16 shows the EVENTS menu of the SEL-2411P. With this selection you can see an event summary, trigger an event and clear existing events.

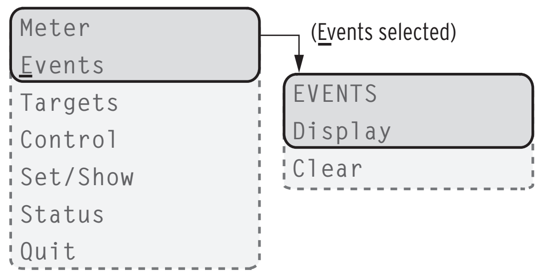


Figure 8.16 MAIN Menu and EVENTS Submenu

If there are no event data available, the device displays No Data Available on the LCD display.

Use the **Left Arrow** and **Right Arrow** pushbuttons to read the date and time of the event.

Use the **Clear Events** command to clear all saved events in the device

Targets Menu

Figure 8.17 shows the TARGETS menu item on the MAIN menu and the submenus to access the target rows (Device Word bits).

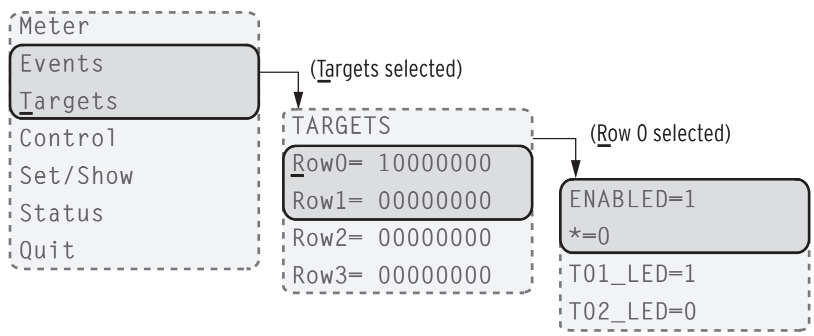


Figure 8.17 MAIN Menu and TARGET Submenu

Device Word bits are variables that are either asserted (logical 1) or deasserted (logical 0). *Table 8.7* shows an extract from the Device Word bit table (*Appendix G*). Target rows display eight Device Word bits from left to right as these appear in *Appendix G*. For example, Row 2 shows RB01–RB09 and Row 3 shows RB09–RB16, as shown in *Table 8.7*.

Table 8.7 Row 2 and Row 3 of the Device Word Bits

Row	7	6	5	4	3	2	1	0
2	RB01	RB02	RB03	RB04	RB05	RB06	RB07	RB08
3	RB09	RB10	RB11	RB12	RB13	RB14	RB15	RB16

Control Menu

The SEL-2411P provides a means to assert selected output contact through the MAIN > CONTROL menu as shown in *Figure 8.18*. For control from the front panel, the device uses variables known as local bits. Local bits take the place of traditional panel switches, and perform isolation, open, close or pulse operations. With the settings as per the example in *Section 6* (see *Local Bits on page 8.5* for more information), Local bit 1 replaces a supervisory switch. *Figure 8.18* 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 8.18*.

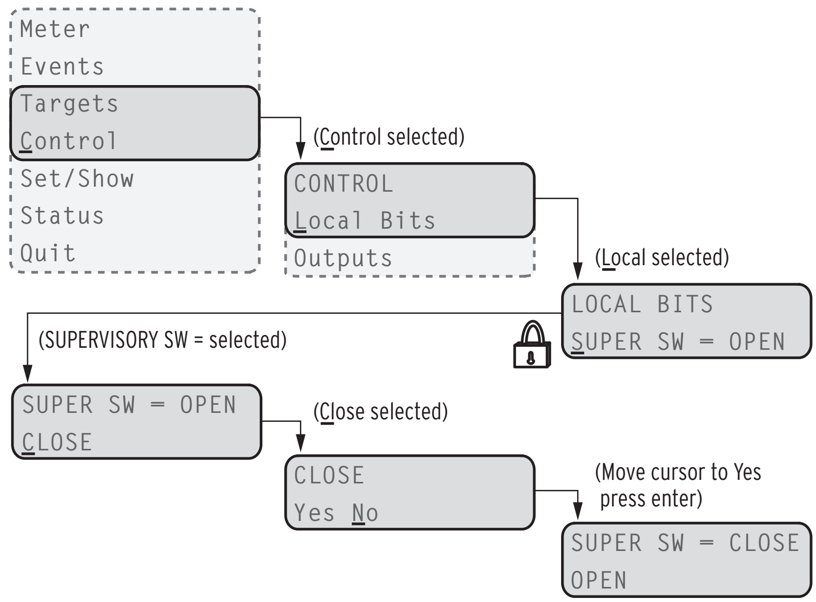


Figure 8.18 MAIN Menu and CONTROL Submenu

Set/Show Menu

Figure 8.19 shows the SET/SHO menu of the SEL-2411P.

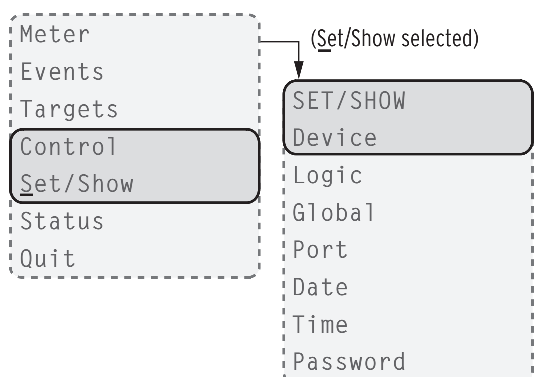


Figure 8.19 MAIN Menu and SET/SHO Submenu

Each settings class includes headings that create subgroups of associated settings. Select the heading that contains the setting of interest, then navigate to the particular setting. View or edit the setting by pressing **ENT**. For text settings, use the four navigation pushbuttons to scroll through the 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.

Status

Display SEL-2411P status indicators or reboot the device as shown in *Figure 8.20*.

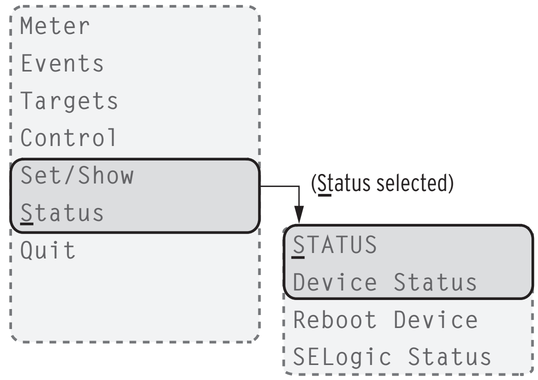


Figure 8.20 MAIN Menu and STATUS Submenu

Quit

Exit the present access level and return to Access Level 1.

Operation and Target LEDs

Enabled LED

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 device displays a message on the LCD describing why the LED is not illuminated.

Programmable LEDs

The SEL-2411P provides quick confirmation of device conditions via eight operation and seven target LEDs. You can use SELOGIC control equations to program all 15 LEDs. Target LEDs differ from the pushbutton LEDs only in that they also include a latch function. *Figure 8.21* shows this region with factory-default text on the front-panel configurable labels.

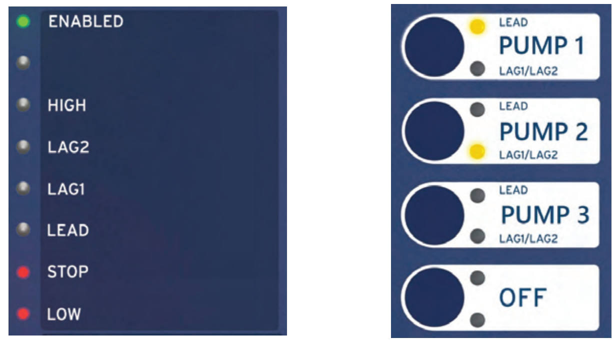


Figure 8.21 Factory-Default Front-Panel LEDs

Target LEDs

Settings T*n*_LEDL (*n* = 00–06) and T*n*_LED (*n* = 00–06) control the seven front-panel LEDs. With T*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.

With T*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 T*n*_LED SELOGIC control equation (SV) settings. When these Device Word bits assert, the corresponding LED also asserts.

Table 8.8 Target LED Settings

Settings Prompt	Setting Range	Default Settings
LED 1 LATCH T01LEDL :=	(Y, N)	Y
LED1 EQUATION T01_LED := [Present Setting]	(SELOGIC)	0

Pushbutton LEDs

Enter any of the Device Word bits (or combinations of Device Word bits) as conditions in the PB*p*_LED (*p* = 01–04B, B LEDs do not use the underscore) SELOGIC control equation (SV) settings. When these Device Word bits assert, the corresponding LED also asserts. *Figure 8.9* shows the setting prompts, setting ranges, and default settings.

Table 8.9 Pushbutton LED Settings

Settings Prompt	Setting Range	Default Settings
PB01 LED Equation PB01_LED := [Present Setting]	(SELOGIC)	0

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 device 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 device inputs. If the conditions have cleared, the latched target LEDs turn off. If the conditions remain, the device re-illuminates the corresponding target LEDs.

Lamp Test

The **TARGET RESET** pushbutton also provides a front-panel lamp test. Pressing and holding the **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 7.22* 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 9
Analyzing Events

Overview

The SEL-2411P Pump Automation Controller provides several tools (listed below) to analyze the cause of device operations. Use these tools to help diagnose the cause of device operations.

- Event Reporting
  - Summary Reports
  - History Reports
  - Event Reports
- Sequential Events Recorder Report
  - Resolution: 1 ms
  - Accuracy: ±1/4 cycle

All reports are stored in nonvolatile memory, ensuring that a loss of power to the SEL-2411P will not result in lost data (see *Event Reporting* for more information on number and length of reports).

Event Reporting

Analyze events with the following event reporting functions:

- Event Summaries—A summary provides a quick overview of an event. You can retrieve the stored summaries by using the **SUMMARY** command. With the automatic messaging enabled (port setting AUTO := Y), the device sends event summaries out a serial port when an event occurs.
- Event History—The SEL-2411P stores an indexed history of event reports in nonvolatile memory. Use the **HISTORY** command to obtain the event history. The event history includes some of the event summary information with which you can identify a specific event report.
- Event Reports—These detailed reports are stored in nonvolatile memory for later retrieval and detailed analysis. Use the **EVENT *n*** command to obtain an event report.

Each time an event occurs, the device creates a new event summary, event history record, and event report. Event report information includes the following:

- Date and time of the event
- Individual sample analog inputs (currents and voltages, if installed)
- Digital states of selected Device Word bits (listed in *Appendix G*)

- ➤ Event summary, including the front-panel target states at the time of trigger
- ➤ Device, Logic, and Global settings (that were in service when the event was recorded)

Compressed ASCII Event Reports, Event Summaries, and History

The SEL-2411P provides Compressed ASCII event reports to facilitate event report storage and display. SEL communications processors and the ACSELERATOR Analytic Assistant SEL-5601 Software take advantage of the Compressed ASCII format, as shown in *Table 9.1*.

Table 9.1 Compressed ASCII Event Commands

Command	Description
CHI	Displays Compressed ASCII event history information.
CSU *n*	Displays Compressed ASCII event summary information.
CEV *n*	Displays Compressed ASCII event reports.

See the *CEVENT Command (Compressed Event Report) on page 7.8* and *SEL Compressed ASCII Commands on page C.1* for further information. Compressed ASCII Event Reports contain all of the Device Word bits.

Sequential Events Recorder (SER)

The SER report captures detailed digital element state changes. Settings allow as many as 96 Device Word bits to be monitored, in addition to the automatically generated triggers for device power up and settings changes. State changes are time-stamped to the nearest millisecond. SER report data are useful in commissioning tests and during operation for system monitoring and control. SER information is stored when state changes occur.

Event Reporting

Length

IMPORTANT NOTE: Changing the LER setting clears all events in memory. Be sure to save critical event data prior to changing the LER setting.

The SEL-2411P provides selectable event report length (LER) and prefault length (PRE). Filtered event report length is either 15 or 64 cycles. Raw event reports display one extra cycle of data at the beginning of the report. Prefault length is the first part of the total event report length and precedes the event report triggering point. Prefault length is 1–10 cycles for LER = 15 and 1–59 cycles for LER = 64. See the *Event Reports on page 9.4* and *Report Settings (SET R Command) on page SET.39* of the *SEL-2411P Settings Sheets* for instructions on setting the LER and PRE settings. Changing the PRE setting has no effect on the stored reports.

Triggering

The SEL-2411P triggers (generates) an event report when any of the following occur:

- ➤ Programmable SELOGIC control equation setting ER asserts to logical 1 (in Report settings)
- ➤ The device receives the serial port command **TRI** (Trigger Event Reports)

Programmable SELOGIC Control Equation Setting ER

Enter as many as 15 elements (as many as 14 nested parentheses) in the programmable SELOGIC control equation event report trigger setting ER to trigger event reports (**SET R**). When any of the elements in the ER equation asserts from a logical 0 to logical 1, the device generates an event report (if the SEL-2411P is not already generating a report that encompasses the new transition).

TRI (Trigger Event Report) Command

The sole function of the **TRI** serial port command is to generate event reports, primarily for testing purposes. See *TRIGGER Command (Trigger Event Report) on page 7.23* for more information on the **TRI** (Trigger Event Report) command.

Event Summaries

For every triggered event, the device generates and stores an event summary. The device stores the most recent 17 (if event report length setting LER := 15) or 4 (if LER := 64) event summaries. When the device stores a new event summary, it discards the oldest event and event summary if the event memory is full. Event summaries contain the following information:

- ➤ Device and Terminal Identification (DID and TID)
- ➤ Event number, date, time, and event type (event type is either Trigger or ER Trigger)
- ➤ The primary magnitudes of line and neutral currents, optional current inputs and card required
- ➤ The primary magnitudes of the line-to-neutral voltage (if DELTA_Y := WYE) or phase-to-phase voltages (if DELTA_Y := DELTA), optional voltage inputs card required
- ➤ The device includes the event summary in the event report. The identifiers, date, and time information is at the top of the event report, and the remaining information follows at the end.

The device sends event summaries to all serial ports with setting AUTO := Y each time an event triggers.

Currents and Voltages

With an optional current card installed, the Currents fields display the primary current magnitudes at the instant the ER equation asserted. The currents displayed are listed below:

- ➤ Line Currents (IA, IB, IC)
- ➤ Line Currents (IAX, IBX, ICX) with 3 ACI/3 AVI Combination Card
- ➤ Ground Current (IG) with 3 ACI/3 AVI Combination Card

With an optional voltage card installed, the Voltages fields display the primary voltage magnitudes at the instant the ER equation asserts. The voltages displayed are listed below:

- ➤ DELTA_Y := WYE

  Phase-to-Neutral Voltages (VAN, VBN, VCN)
- ➤ DELTA_Y := DELTA

  Phase-to-Phase Voltages (VAB, VBC, VCA)

Event History

The event history report gives you a quick look at recent activity. The SEL-2411P labels each new event in reverse chronological order with 1 as the most recent event. Use this report to view the events that are presently stored in the SEL-2411P. The event history contains the following:

- ➤ Standard report header
  - ➢ Device and terminal identification
  - ➢ Date and time of report
- ➤ Event number, date, time, event (type), current, frequency, and targets
- ➤ Because the device generates an event resulting from either assertion of **ER** or the **TRIGGER** command, the Event field in the Event History report contains either of these functions.

Viewing the Event History

Access the history report from the communications ports, using the **HIS** command or the analysis menu within ACSELERATOR QuickSet SEL-5030 Software. View and download history reports from Access Level 1 and higher.

Use the **HIS** command from a terminal to obtain the event history. You can specify the number of the most recent events that the device returns (see *HISTORY Command (Events List) on page 7.12* for more information on the **HIS** command).

Use the front-panel **MAIN > Events > Display** menu to display event history data on the SEL-2411P front-panel display.

Clearing

IMPORTANT NOTE: Clearing the history report with the **HIS C** command also clears all event data within the SEL-2411P event memory.

Use the **HIS C** command to clear or reset history data from Access Levels 1 and higher. Clear/reset history data at any communications port. This will clear all event summaries, history records, and reports.

Event Reports

The latest event reports are stored in nonvolatile memory. Each event report includes four sections:

- ➤ Analog values of current and voltage
- ➤ Digital states of the protection and control elements, including overcurrent and voltage elements, plus status of digital output and input states
- ➤ Event Summary
- ➤ Settings in service at the time of event trigger, consisting of Device, Logic, Global, and Report settings classes

Use the **EVE** command to retrieve the reports. There are several options to customize the report format.

Because you can configure the SEL-2411P in many different ways, the event report is not fixed, but a function of the device configuration. For example, if the device configuration excludes a voltage card, the event report also excludes voltage information.

Filtered and Unfiltered Event Reports

The SEL-2411P provides both filtered and unfiltered (raw) event reports, either at 16 (raw) samples per cycle or 4 samples (filtered) per cycle; each event report includes the following:

- ➤ Analog (current and/or voltage)/Digital Section
- ➤ Event Summary (including transducer information)
- ➤ Global Settings
- ➤ Device Settings
- ➤ Logic Settings

Depending on the PT connections, the report shows either phase-to-ground voltages (VA, VB, VC) or line-to-line voltages (VAB, VBC, VCA).

Both raw and filtered event reports show values for either phase-to-ground voltages or line-to-line voltages VA [VAB], VB [VBC], and VC [VCA]. For the 16-samples-per-cycle filtered event reports, the digital outputs are repeated for four 1/16-cycle rows to make up the 1/4-cycle information.

Column Definitions

To optimize data reporting, the event report generally provides only one placeholder for more than one digital variable. For example, there is only one "dot" in the event report for both output contact OUT101 and output contact OUT102. To indicate device operation, the placeholder displays one of the following (applicable to all input and output cards):

- ➤ 1—only output contact OUT101 asserted
- ➤ 2—only output contact OUT102 asserted
- ➤ b—both output contact OUT101 and output contact OUT102 asserted

Table 9.2 shows the digital column definitions for the base unit (100) and the optional I/O boards (300 through 600).

Table 9.2 Digital Column Definitions (Sheet 1 of 3)

Column Designation	Column Symbols	Description
100 OUT 12	1 2 b	OUT101 OUT102 Both
100 OUT 3	3	OUT103
100 IN 12	1 2 b	IN101 IN102 Both
300 IN 12	1 2 b	IN301 IN302 Both
300 IN 34	3 4 b	IN303 IN304 Both
300 IN 56	5 6 b	IN305 IN306 Both

Table 9.2 Digital Column Definitions (Sheet 2 of 3)

Column Designation	Column Symbols	Description
300 IN 78	7 8 b	IN307 IN308 Both
400 IN 12	1 2 b	IN401 IN402 Both
400 IN 34	3 4 b	IN403 IN404 Both
400 IN 56	5 6 b	IN405 IN406 Both
400 IN 78	7 8 b	IN407 IN408 Both
500 IN 12	1 2 b	IN501 IN502 Both
500 IN 34	3 4 b	IN503 IN504 Both
500 IN 56	5 6 b	IN505 IN506 Both
500 IN 78	7 8 b	IN507 IN508 Both
600 IN 12	1 2 b	IN601 IN602 Both
600 IN 34	3 4 b	IN603 IN604 Both
600 IN 56	5 6 b	IN605 IN606 Both
600 IN 78	7 8 b	IN607 IN608 Both
300 OUT 12	1 2 b	OUT301 OUT302 Both
300 OUT 34	3 4 b	OUT303 OUT304 Both
300 OUT 56	5 6 b	OUT305 OUT306 Both
300 OUT 78	7 8 b	OUT307 OUT308 Both
400 OUT 12	1 2 b	OUT401 OUT402 Both

Table 9.2 Digital Column Definitions (Sheet 3 of 3)

Column Designation	Column Symbols	Description
400 OUT 34	3 4 b	OUT403 OUT404 Both
400 OUT 56	5 6 b	OUT405 OUT406 Both
400 OUT 78	7 8 b	OUT407 OUT408 Both
500 OUT 12	1 2 b	OUT501 OUT502 Both
500 OUT 34	3 4 b	OUT503 OUT504 Both
500 OUT 56	5 6 b	OUT505 OUT506 Both
500 OUT 78	7 8 b	OUT507 OUT508 Both
600 OUT 12	1 2 b	OUT601 OUT602 Both
600 OUT 34	3 4 b	OUT603 OUT604 Both
600 OUT 56	5 6 b	OUT605 OUT606 Both
600 OUT 78	7 8 b	OUT607 OUT608 Both

Example 15-Cycle Event Report

The trigger row includes a “>” character following immediately after the last analog column to indicate the trigger point. This row is also used for the event summary information.

Because you can configure your SEL-2411P to suit your application, the format of the event report adapts to the specific configuration of the device. For installations where less than four cards are necessary, the event report displays only the information for installed cards. *Figure 9.1* shows the event report when the SEL-2411P configuration includes a voltage card, an analog card, and a digital input card. This is a composite event report that shows the data for both wye-connected and delta-connected PTs (shaded heading); you will see only one of these rows in an actual installation.

```
=>>EVE <Enter>

SEL-2411P                                  Date: 09/30/2016 Time: 06:51:33.307
DEVICE


Serial Number=2005XXXXXXXXXXX
FID=SEL-2411P-R300-V0-Z001007-D20160930 CID=D5A7

                                                 100    400        ← DI Card in Slot 4
                                                 OUT IN IN
Voltages (V Pri) 13  1  1357
 VA    VB    VC  2   2  2468
 VAB   VBC   VCA  2   2  2468

[1]
-1621  -406  2017 ..  .  ....                                      ← No outputs or
 1381 -2089   673 ..  .  ....                                        inputs asserted
 1620   407 -2017 ..  .  ....
-1383  2086  -673 ..  .  ....
[2]
-1619  -408  2019 ..  .  ....
 1383 -2088   672 ..  .  ....
 1619   408 -2022 ..  .  ....
-1385  2087  -671 ..  .  ....
[3]
-1621  -411  2019 ..  .  ....
 1385 -2088   668 ..  .  ....
 1619   411 -2020 ..  .  ....
-1387  2086  -669 ..  .  ....
[4]
-1617  -412  2021 ..  .  ....
 1387 -2086   667 ..  .  ....
 1616   412 -2022 ..  .  ....
-1388  2087  -666>..  .  ....                                      ← Trigger row
.
.
.

[15]
-1600  -438  2029 ..  .  ....
 1405 -2080   645 ..  .  ....
 1600   437 -2030 ..  .  ....
-1406  2081  -644 ..  .  ....
EVENT = Trigger
TARGETS = 00000000
FREQ (Hz) =  60.0

Voltage Mag
       VA     VB     VC
(V)    2130   2128   2127

Analog Input Slot 3
AI301 (mA)    0.000
AI302 (mA)    0.000
AI303 (mA)    0.000
AI304 (mA)    0.000
AI305 (mA)    0.000 ← Analog Card in Slot 3
AI306 (mA)    0.000
AI307 (mA)    0.000
AI308 (mA)    0.000


PARTNO=2411XXXXXXXXXXXXXXX

Global Settings

PHROT   := ABC     FNOM    := 60
DELTA_Y := WYE
DATE_F  := MDY
IN101D  := 10      IN102D  := 10
IN401D  := 10      IN402D  := 10      IN403D  := 10      IN404D  := 10
IN405D  := 10      IN406D  := 10      IN407D  := 10      IN408D  := 10
RSTTRGT := NA

DSABLSET:= NA
```

Figure 9.1 Event Report for a Voltage Card, an Analog Card, and a Digital Input Card

```
Device Settings

DID     := SEL-2411P
TID     := DEVICE

PTR     := 35.00
AI301NAM:=AI301    AI301TYP:= I       AI301L  := 4.000   AI301H  := 20.000
AI301EU := mA               AI301EL := 4.000   AI301EH := 20.000  AI301LW1:= OFF

AI301LW2:= OFF     AI301LAL:= OFF     AI301HW1:= OFF     AI301HW2:= OFF
AI301HAL:= OFF
AI302NAM:=AI302    AI302TYP:= I       AI302L  := 4.000   AI302H  := 20.000
AI302EU := mA               AI302EL := 4.000   AI302EH := 20.000  AI302LW1:= OFF

AI302LW2:= OFF     AI302LAL:= OFF     AI302HW1:= OFF     AI302HW2:= OFF
AI302HAL:= OFF
AI303NAM:=AI303    AI303TYP:= I       AI303L  := 4.000   AI303H  := 20.000
AI303EU := mA               AI303EL := 4.000   AI303EH := 20.000  AI303LW1:= OFF

.
.
.


AI308LW2:= OFF     AI308LAL:= OFF     AI308HW1:= OFF     AI308HW2:= OFF
AI308HAL:= OFF

Logic Settings

ELAT    := N       ESV     := N       ESC     := N       EMV     := N


OUT101  := HALARM OR SALARM
OUT102  := RB01
OUT103  := 0


=>>
```

Figure 9.1 Event Report for a Voltage Card, an Analog Card, and a Digital Input Card (Continued)

Sequential Events Recorder (SER) Report

The SEL-2411P SER (Sequential Events Recorder) report gives you detailed information on device element state changes over an extended period of time. The SER captures and time-stamps state changes of Device Word bits and device conditions. These conditions include power up, device enable and disable, settings changes, and SER automatic removal and reinsertion.

The SER records up to 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-2411P will not result in lost data.

Inputs

The SER guaranteed time-stamp accuracy is ±1 millisecond for physical inputs.

The SEL-2411P samples at 250 Hz or as a function of frequency; you select frequency tracking by installing an optional voltage card.

Chatter Filtering

The SER includes a filter function to prevent overfilling of the SER buffer with chattering information. When enabled, the device automatically deletes these oscillating items from SER recording.

Setting SRDLTIM declares a time interval during which the device qualifies an input by comparing the changes of state of each input against the SRDLCNT setting. When an item changes state more than SRDLCNT times in an SRDLTIM interval, the device automatically removes these Device Word bits from SER recording.

SER Triggering

Settings SER1 through SER4 are used to select entries in the SER report. To capture device state changes in the SER report, the Device Word bits must be programmed into one of the four SER trigger equations. Each of the four programmable trigger equations allows entry of as many as 24 Device Word bits; the SER report can monitor a total of 96 Device Word bits.

The device adds a message to the SER to indicate power up or settings change conditions.

Each entry in the SER includes the SER row number, date, time, element name, and element state.

SER Aliases

Aliases are provided for the name, asserted state, and deasserted state of Device Word bits selected for SER recording. These aliases simplify analysis of sequences. As many as 96 Device Word bits can be selected as triggers and as many as 20 of these can be assigned aliases.

Define the alias by using the following format, where each field can be as many as 15 characters long: name assert deassert. You can use capital letters (A–Z), numbers (0–9), and the underscore character (_) within each string. Do not use a space within a string because the device will interpret a space as the break between two strings. If you wish to clear a string, simply type **NA**.

Viewing and Clearing SER Reports

The device displays the SER records in ASCII format. To retrieve SER information, type **SER <Enter>** at Access Level 1 or higher. Type **SER <Enter>** to clear the SER report.

Example SER Report

Figure 9.2 shows the data contained in the SER report.

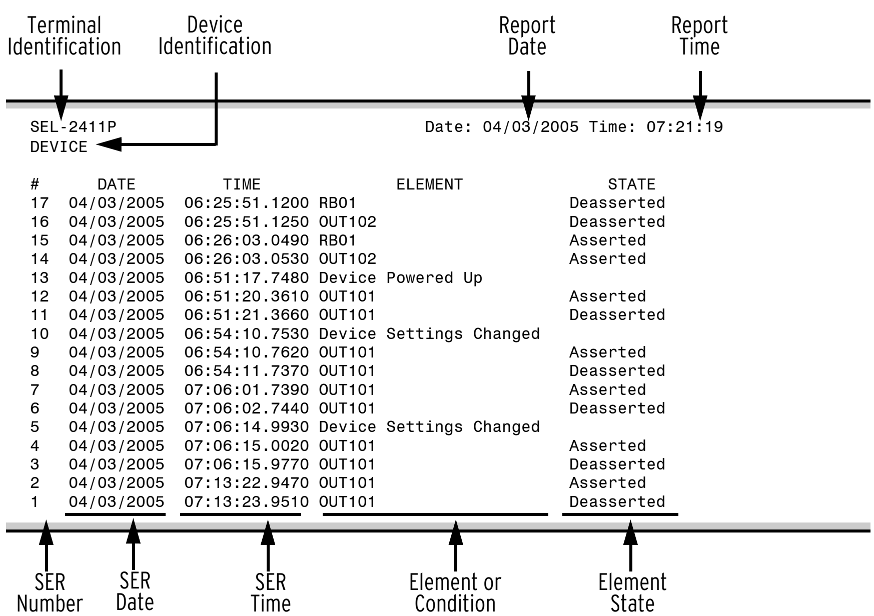


Figure 9.2 Sample SER Report

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 9.2*). When using a computer terminal you can change the order of the SER records in the SER report. See *SER Command (Sequential Events Recorder Report) on page 7.19* for more information.

Section 10
Testing and Troubleshooting

Overview

Device testing is typically divided into two categories:

- ➤ Tests performed at the time the device is installed or commissioned.
- ➤ Tests performed periodically once the device is in service.

This section provides information on both types of testing for the SEL-2411P Pump Automation Controller. Because the SEL-2411P 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 *Troubleshooting* section provides a guide to isolating and correcting the problem.

Testing

Because the SEL-2411P is equipped with extensive self-tests, the most effective maintenance task is to monitor the front-panel messages after a self-test failure. In addition, each device event report generated by a fault should be reviewed. Such reviews frequently reveal problems with equipment external to the device, such as instrument transformers and control wiring.

The SEL-2411P does not require specific routine tests, but your operation standards may require some degree of periodic device verification. If you need or want to perform periodic device verification, the following checks are recommended.

Device Status Verification

Use the front-panel **STATUS** or serial port **STATUS** command to verify that the device self-tests have not detected any WARN or FAIL conditions.

Meter Verification

Verify that the device is correctly measuring voltage (if included) by comparing the device meter readings to separate external meters.

Input Verification

Using the front-panel **MAIN > TARGETS > ROW 48** function, check the control input status in the device. As you apply rated voltage to each input, the position in Row 48 corresponding to that input should change from zero (0) to one (1).

Output Verification

For each output contact, set the input to Logic 1. This causes the output contact to close. For example, setting OUT101 = 1 causes the output **OUT101** contact to close. Repeat the process for all contact outputs.

Make sure that each contact closure does what you want it to do in the annunciation, control, or trip circuit associated with that contact closure.

METER Command

Use the **MET** command to display fundamental, analog input, math variable, remote analog and signal profile data, as shown in *MET F k Fundamental Metering on page 7.15*. Because you can configure the SEL-2411P with different cards, display values in response to the **MET** command is a function of the specific card combination. When a card is not installed, the headings and values are hidden. Compare these quantities against other devices of known accuracy. The **METER** command is available at the serial ports and front-panel display.

EVENT Command

The device generates a 15- or 64-cycle event report in response to faults or disturbances. Each report contains current and voltage information and input/output contact information. If you question the device response or your test method, use the event report for more information. The **EVENT** command is available at the serial ports. See *Table 7.25*.

SER Command

The device provides a Sequential Events Recorder (SER) event report that timestamps changes in device element and input/output contact states. The SER provides a convenient means to verify the pickup/dropout of any element in the device. *Table 7.41* shows the **SER** commands to view and manage the Sequential Events Recorder report. The **SER** command is available at the serial ports.

TARGET Command

Use the **TARGET** command to view the state of device control inputs, device outputs, and device elements individually during a test. The **TAR** command displays the status of front-panel target LEDs or Device Word bits, whether these LEDs or Device Word bits are asserted or deasserted, as shown in *Table 7.49*. The **TARGET** command is available at the serial ports and the front panel.

The elements are represented as Device Word bits and are listed in rows of eight, called Device Word rows. All Device Word rows are described in *Appendix G: Device Word Bits*. The **TAR** command does not remap the front-panel target LEDs, as is done in some previous SEL products.

Self-Test

The SEL-2411P runs a variety of self-tests. Two Device Word bits, HALARM and SALARM, signal self-test problems. SALARM is pulsed for software-programmed conditions such as settings changes, access level changes, and three consecutive unsuccessful password entry attempts. HALARM is pulsed for hardware self-test warnings. HALARM is continuously asserted (set to logical 1) for hardware self-test failures.

NOTE: After a device failure, all digital output contacts revert to their de-energized state, i.e., all normally open contacts (a contacts) open and all normally closed contacts (b contacts) close.

Table 10.1 lists hardware self-tests. In the Alarm Status column, Latched indicates that HALARM is continuously asserted, Not Latched indicates that HALARM is pulsed for 5 seconds, and NA indicates that HALARM is not asserted. All hardware self-test failures generate a front-panel message that is automatically sent to the serial port. All hardware self-test failures (Latched entry in Alarm Status column) disable the device.

Table 10.1 Device Self-Tests (Sheet 1 of 2)

Self-Test	Description	Automation Disabled on Failure	Alarm Status	Status Command	Front-Panel Message
Main Board FPGA (power up)	Fail if main board Field Programmable Gate Array does not accept program or the version number is incorrect	Yes	Latched	FPGA OK/FAIL	`Status Fail FPGA Failure`
Main Board FPGA (run time)	Fail on lack of data acquisition interrupts or on detection of a CRC error in the FPGA code	Yes	Latched	FPGA OK/FAIL	`Status Fail FPGA Failure`
GPSB (back-plane) communications	Fail if GPSB is busy on entry to processing interval	Yes	Latched	GPSB OK/FAIL	`Status Fail GPSB Failure`
Front-Panel HMI (power up)	Fail if ID registers do not match expected or if FPGA programming is unsuccessful	No	Not Latched	HMI OK/WARN	
External RAM (power up)	Performs a read/write test on system RAM	Yes	Latched	RAM OK/FAIL	`Status Fail RAM Failure`
External RAM (run time)	Performs a read/write test on system RAM	Yes	Latched	RAM OK/FAIL	`Status Fail RAM Failure`
Internal RAM (power up)	Performs a read/write test on system CPU RAM	Yes	Latched	RAM OK/FAIL	`Status Fail RAM Failure`
Internal RAM (run time)	Performs a read/write test on system CPU RAM	Yes	Latched	RAM OK/FAIL	`Status Fail RAM Failure`
Code Flash (power up)	SELBOOT qualifies code with a checksum	NA	NA	NA	
Code Flash (run time)	Checksum is computed on the entire code base	Yes	Latched	ROM OK/FAIL	`Status Fail ROM Failure`
Data Flash (power up)	Checksum is computed on critical data	Yes	Latched	NON_VOL OK/FAIL	`Status Fail Non_Vol Failure`
Data Flash (run time)	Checksum is computed on critical data	Yes	Latched	NON_VOL OK/FAIL	`Status Fail Non_Vol Failure`
Critical RAM (settings)	Performs a checksum test on the active copy of settings	Yes	Latched	CR_RAM OK/FAIL	`Status Fail CR_RAM Failure`
Critical RAM (run time)	Verifies instruction (code) matches Flash image	Yes	Latched	CR_RAM OK/FAIL	`Status Fail CR_RAM Failure`
Clock Battery	Check battery voltage level	No	Not Latched	BATT OK/WARN	

Table 10.1 Device Self-Tests (Sheet 2 of 2)

Self-Test	Description	Automation Disabled on Failure	Alarm Status	Status Command	Front-Panel Message
Clock Chip	Unable to communicate with clock or fails time-keeping test	No	Not Latched	CLOCK OK/WARN	
Clock Chip RAM	Clock chip static RAM fails	No	Not Latched	CLOCK OK/WARN	
CID (Configured IED Description) file (access)	Fail if unable to access/read the file.	NA	NA	CID_FILE OK/FAIL	`Status Fail`
+3.3 V Warn	Monitor +3.3 V power supply 3.16 to 3.43 V	No	Pulse, 5 sec	+3.3 V OK/WARN	
+3.3 V Fail	Monitor +3.3 V power supply 3.07 to 3.53 V	Yes	Latched	+3.3 V OK/FAIL	`Status Fail` `+3.3 V Failure`
+5 V Warn	Monitor +5 V power supply 4.75 to 5.25 V	No	Pulse, 5 sec	+5 V OK/WARN	
+5 V Fail	Monitor +5 V power supply 4.65 to 5.35 V	Yes	Latched	+5 V OK/FAIL	`Status Fail` `+5 V Failure`
+2.5 V Warn	Monitor +2.5 V power supply 2.40 to 2.6 V	No	Pulse, 5 sec	+2.5 V OK/WARN	
+2.5 V Fail	Monitor +2.5 V power supply 2.32 to 2.68 V	Yes	Latched	+2.5 V OK/FAIL	`Status Fail` `+2.5 V Failure`
+3.75 V Warn	Monitor +3.75 V power supply 3.6 to 3.9 V	No	Pulse, 5 sec	+3.75 V OK/WARN	
+3.75 V Fail	Monitor +3.75 V power supply 3.48 to 4.02 V	Yes	Latched	+3.75 V OK/FAIL	`Status Fail` `+3.75 V Failure`
–1.25 V Warn	Monitor -1.25 V power supply –1.2 to –1.30 V	No	Pulse, 5 sec	–1.25 V OK/WARN	
–1.25 V Fail	Monitor -1.25 V power supply –1.16 to –1.34 V	Yes	Latched	–1.25 V OK/FAIL	`Status Fail` `-1.25 V Failure`
–5 V Warn	Monitor -5 V power supply –4.75 to –5.25 V	No	Pulse, 5 sec	–5 V OK/WARN	
–5 V Fail	Monitor -5 V power supply –4.65 to –5.35 V	Yes	Latched	–5 V OK/FAIL	`Status Fail` `-5 V Failure`
VT Board A/D Offset Warn	Measure dc offset at each input channel >50 mV	No	Not Latched	OFFSETS OK/WARN	
I/O Board Failure (power up)	Check if ID register matches part number	Yes	Latched	CARD_C CARD_D CARD_E CARD_Z OK/FAIL	`Status Fail` `I/O Card Failure`
Exception Vector	CPU Error	Yes	Latched	NA	`Vector nn Disabled`

Troubleshooting

Refer to *Table 10.2* for troubleshooting instructions for particular situations.

Table 10.2 Troubleshooting

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

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Appendix A

Firmware and Manual Versions

Firmware

Determining the Firmware Version

To determine the firmware version, view the status report by using the serial port **STATUS** command or the front panel. The status report displays the Firmware Identification (FID) number.

The firmware version will be either a standard release or a point release. A standard release adds new functionality to the firmware beyond the specifications of the existing version. A point release is reserved for modifying firmware functionality to conform to the specifications of the existing version.

A standard release is identified by a change in the R-number of the device FID number.

Existing firmware:

FID=SEL-2411P-**R300**-V0-Z001007-Dxxxxxxxx

Standard release firmware:

FID=SEL-2411P-**R301**-V0-Z002008-Dxxxxxxxx

A point release is identified by a change in the V-number of the device FID number.

Existing firmware:

FID=SEL-2411P-R301-**V0**-Z002008-Dxxxxxxxx

Point release firmware:

FID=SEL-2411P-R301-**V1**-Z002008-Dxxxxxxxx

The date code is after the D. For example, the following is firmware version number R100, release date September 30, 2016.

FID=SEL-2411P-R300-V0-Z001007-**D20160930**

Revision History

Table A.1 lists the firmware versions, revision descriptions, and corresponding instruction manual date codes.

Starting with revisions published after March 1, 2022, changes that should be evaluated for potential cybersecurity impact are marked with “[Cybersecurity]”.

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

Firmware Identification (FID) Number	Summary of Revisions	Manual Date Code
SEL-2411P-R302-V1-Z003008-D20220311	Includes all the functions of SEL-2411P-R302-V0-Z003008-D20210317 with the following addition: ➤ Revised the firmware to allow replacement of the field-programmable gate array (FPGA) part.	20220311

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

Firmware Identification (FID) Number	Summary of Revisions	Manual Date Code
SEL-2411P-R302-V0-Z003008-D20210317	➤ Expanded slot E support for the 3AVI/3ACI, 4DI/4DO, 4DI/3DO, 8DO, 8DI, and 8AI cards. ➤ Expanded slot Z support for the 4DI/4DO, 4DI/3DO, 8DO, 8DI, and 4AI/4AO cards. ➤ Enhanced DNP analog buffer to support 1024 events per session. ➤ Added new Station Setting device word bits. ➤ Added default values to SER report settings including Station Setting device word bits and station status. ➤ Added Station Setting device word bits to default DNP map. ➤ Enhanced Pump Alternation Function block to prevent pump faults when a pump disables while running (e.g., PUMP1FLT will no longer assert when PUMP1EN evaluates to FALSE while PUMP1RUN is TRUE). ➤ Expanded pump statistic restart (e.g. RSTP1DAT) functionality to reset 24 and 48 hour pump statistics. ➤ Enhanced Station Setting logic to prevent pump faults after detecting a phase alarm. ➤ Enhanced Station Setting logic to inhibit all pump enable inputs (e.g. PUMP1EN) while a phase alarm is active. ➤ Enhanced Station Setting logic to automatically enable a pump after a phase alarm becomes inactive. ➤ Enhanced Station Setting logic to prevent float out-of-sequence alarms when a stage alarm occurs. ➤ Enhanced Station Setting logic to prevent float out-of-sequence alarms when the analog input for level detection has failed. ➤ Enhanced Station Setting logic to operate the single float timer as an emergency override that will operate all available pumps until the timer expires following a HIGH float (pump down) or LOW float (pump up) assertion. ➤ Enhanced Station Setting logic to ensure that remote OFF commands latch and persist across a target reset. ➤ Enhanced Station Settings to allow users to modify the settings and affect the Station Setting device word bits when ADV_EN = Y. ➤ Enhanced Station Settings for single pump stations (i.e., when STN_TYPE = SINGLE or SINGLE_UP) to use the STOP input to turn off the pumps rather than the single float timer. ➤ Consolidated and simplified various Station Setting logic assignments using the Station Setting device word bits.	20210317
SEL-2411P-R301-V1-Z002008-D20201028	Includes all the functions of SEL-2411P-R301-V0-Z002008-D20191115 with the following addition: ➤ Resolved an issue introduced in R301-V0 that may cause the DNP server to stop communicating after approximately 25 days.	20201028
SEL-2411P-R301-V0-Z002008-D20191115	➤ Added support for the following features: ➢ Station settings ➢ Pump alternation function block ➢ Pump-operation status ➢ Pump-voltage monitoring ➤ Added new Device Word bits and SELOGIC control equations to support new features. ➤ Revised DNP and Modbus default data maps.	20191115
SEL-2411P-R300-V0-Z001007-D20160930	➤ Initial version.	20160930

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 versions and revision descriptions. The most recent instruction manual version is listed first.

Table A.2 Instruction Manual Revision History (Sheet 1 of 4)

Date Code	Summary of Revisions
20241120	Preface ➤ Updated *Product Compliance Label for Hazardous Locations Approval*.
20230310	Preface ➤ Updated *Hazardous Locations Approval*. ➤ Updated *Product Compliance Label for Hazardous Locations Approval*. Section 2 ➤ Updated *Physical Location*.
20221221	Section 1 ➤ Added *UKCA Mark* in *Specifications*.
20220520	Section 2 ➤ Updated *Power Connections*.
20220311	Appendix A ➤ Updated for firmware version R302-V1.
20210831	Section 1 ➤ Updated *Type Tests* in *Specifications*.
20210702	Section 1 ➤ Updated *Dielectric Strength and Impulse Tests* in *Specifications*.
20210317	Section 1 ➤ Updated *Physical* and *Metering* in *Features*. ➤ Added *AC Current Input Phase to Inputs in Specifications*. ➤ Added *Current, Frequency, Power and Power Factor to AC Metering Accuracy* in *Specifications*. Section 2 ➤ Updated *Table 2.1 Slot Allocations for Different Option Cards.* ➤ Added *Current/Voltage Card (3 ACI/3 AVI).* ➤ Added *Digital Input Card (8 DI).* ➤ Added *Digital Output Card (8 DO).* ➤ Added *Digital Input/Output Card (4 DI/3 DO).* ➤ Added *Current Connections.* ➤ Updated *Analog-Input/Output Card (4 AI/4 AO).* Section4 ➤ Updated *Fast Analog Logic.*

Table A.2 Instruction Manual Revision History (Sheet 2 of 4)

Date Code	Summary of Revisions
	Section 5 ➤ Updated *Overview.* ➤ Updated *Metering.* ➤ Updated *Fundamental metering.* ➤ Added *Energy Metering.* ➤ Updated *Maximum and Minimum Metering.* ➤ Updated *Demand Metering.* Setting Sheets ➤ Updated SEL-2411P Settings Sheets. Section 7 ➤ Updated *METER Command (Metering Data).* ➤ Added *MET Demand/Peak Demand Metering.* ➤ Added *MET E Energy Metering.* Section 9 ➤ Updated *Event Reporting.* ➤ Updated *Event Summaries.* ➤ Updated *Event Reports.* Appendix A ➤ Updated for firmware version R302-V0. Appendix D ➤ Updated *Event Data.* ➤ Updated *Table D.7 DNP3 Reference Data Map.* ➤ Updated *Table D.8 DNP3 Default Data Map.* ➤ Updated *Group Settings (SET Command).* Appendix E ➤ Updated *Table E.16 Modbus Register Map.* Appendix G ➤ Updated *Table G.1 SEL-2411P Device Word Bits.* ➤ Updated *Table G.2 Device Word Bit Definitions.* Appendix H ➤ Updated *Table H.1 Available Analog Qualities.* Appendix I ➤ Updated Appendix to include new logic assignments. Appendix J ➤ Updated *PUMPxEN—Pump Enable.*
20201028	Appendix A ➤ Updated for firmware version R301-V1.
20191115	➤ Revised entire manual with a settings category change from *Group* to *Device*. Preface ➤ Updated *Safety Marks* and *General Information* for current certifications.

Table A.2 Instruction Manual Revision History (Sheet 3 of 4)

Date Code	Summary of Revisions
	Section 1 ➤ Updated *Figure 1.1: Block Diagram*. ➤ Updated *Features* and *Models, Options, and Accessories*. ➤ Updated *Specifications* and added a derating curve for digital inputs. Section 2 ➤ Updated the product image. ➤ Updated *Device Placement* for ATEX compliance. ➤ Updated *Card Configuration* and *Rear-Panel Connections*. Section 4 ➤ Updated *Table 4.1: Setting Categories* and *Figure 4.2: Detailed Program Model*. ➤ Updated *General Logic Functions* and *Fast Analog Logic*. Section 5 ➤ Added *Pump Operation Status* and *Pump Voltage Monitoring*. ➤ Updated *Overview* and *Metering*. Section 6 ➤ Updated *Figure 6.1: Front-Panel Setting Entry Example*. ➤ Updated *View/Change Settings Over Communications Port*. ➤ Added *Pump Alternation* to *Device Settings (SET Command)*. ➤ Added *Station Settings (SET S Command)*. ➤ Added *Pump Alternation Settings* to *SEL-2411P Settings Sheets*. ➤ Updated *Device Settings (SET Command)*, *Logic Settings (SET L Command), and Global Settings (SET G Command)*. Section 7 ➤ Updated *Communications* and *ASCII Commands*. Section 8 ➤ Updated *Figure 8.1: Front-Panel Overview* and *Figure 8.21: Factory-Default Front-Panel LEDs*. ➤ Updated *Table 8.4: Example Settings and Displays*. Section 9 ➤ Updated *Overview*, *Event Reporting*, and *Sequential Events Recorder (SER) Report*. Section 10 ➤ Updated *Testing*. ➤ Removed *Commissioning Testing*. Appendix A ➤ Updated for firmware version R301-V0. Appendix C ➤ Updated *SEL Communications Processor Example*. Appendix D ➤ Updated *DNP3 in the SEL-2411P*. Appendix E ➤ Updated *Table E.16: Modbus Register Map*. Appendix G ➤ Updated *Table G.1: SEL-2411P Device Word Bits* and *Table G.2: Device Word Bit Definitions*. Appendix H ➤ Updated *Table H.1 Available Analog Quantities*.

Table A.2 Instruction Manual Revision History (Sheet 4 of 4)

Date Code	Summary of Revisions
	Appendix I ➤ Added new appendix. Appendix J ➤ Added new appendix. Glossary ➤ Removed *Power, P*, *Power Factor* and *Residual Current*.
20180601	Section 1 ➤ Updated *Specifications*.
20170303	➤ Revised entire manual for product name update.
20160930	➤ Initial version.

Appendix B
Firmware Upgrade Instructions

Overview

These instructions guide you through the process of upgrading firmware in the device. The firmware upgrade will be either a standard release or a point release. A standard release adds new functionality to the firmware beyond the specifications of the existing version. A point release is reserved for modifying firmware functionality to conform to the specifications of the existing version.

A standard release is identified by a change in the R-number of the device firmware identification (FID) number.

Existing firmware:

FID=SEL-2411P-**R300**-V0-Z001001-Dxxxxxxxx

Standard release firmware:

FID=SEL-2411P-**R301**-V0-Z001001-Dxxxxxxxx

A point release is identified by a change in the V-number of the device FID number.

Existing firmware:

FID=SEL-2411P-R300-**V0**-Z001001-Dxxxxxxxx

Point release firmware:

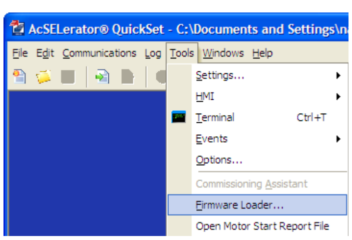
FID=SEL-2411P-R300-**V1**-Z001001-Dxxxxxxxx

The release date is after the D. For example, the following is firmware version number R300, release date September 30, 2016.

FID=SEL-2411P-R300-V0-Z001001-**D20160930**

Firmware Upgrade Instructions

Select **Tools > Firmware Loader** from the ACSELERATOR QuickSet SEL-5030 Software menu bar to launch a wizard that walks you through the steps to load firmware into your SEL device.



Firmware Loader will not start if:

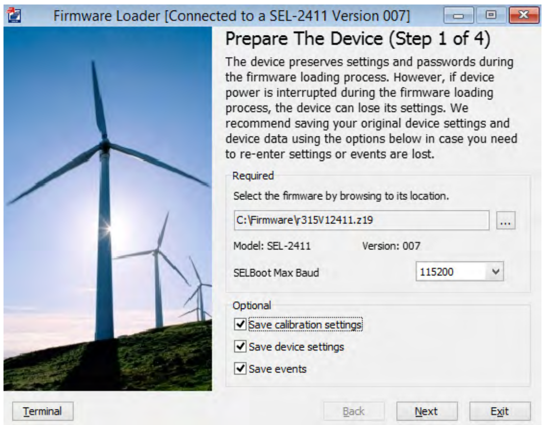
- The device is unsupported by QuickSet.
- The device is not connected to the computer with a communications cable.
- The connected port does not support SELBOOT.
- The device is disabled.

Step 1: Prepare Device

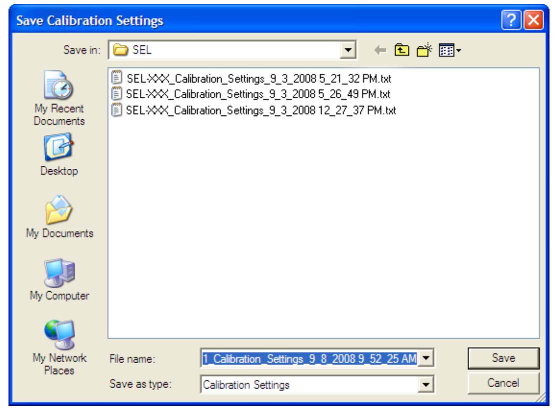
a) Select the firmware to be loaded using the browse control and select whether you want to save calibration settings, device settings, and event report files. Select **Next** to continue the wizard.

NOTE: If you are downgrading firmware, be certain to save device settings as they can be lost during a downgrade. Additionally, you may need to use the PART command to restore some MOT fields after a downgrade.

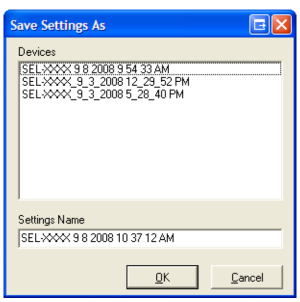
NOTE: Be certain to save SERs before upgrading or downgrading firmware as they can be lost during the process.



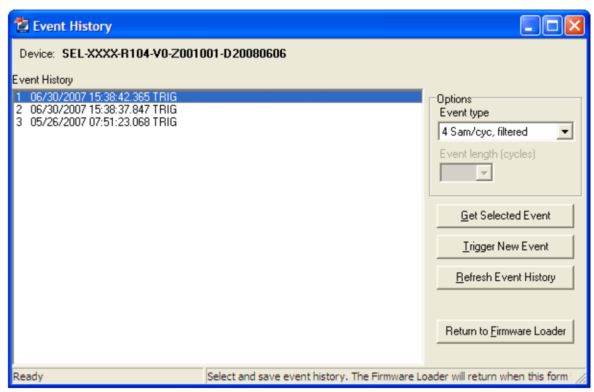
b) Select a file name and path to save the settings or accept the defaults as shown. Click **Save**.



c) After the device settings are downloaded, select a file name and path to save the settings or accept the default, as shown.

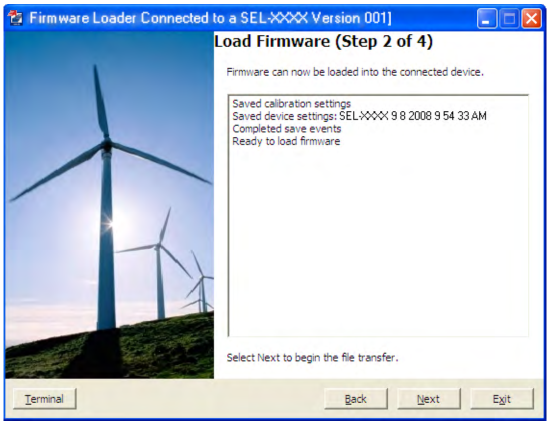


d) Select events and click **Get Selected Event** to save any events. After saving all events, select **Return to Firmware Loader**.

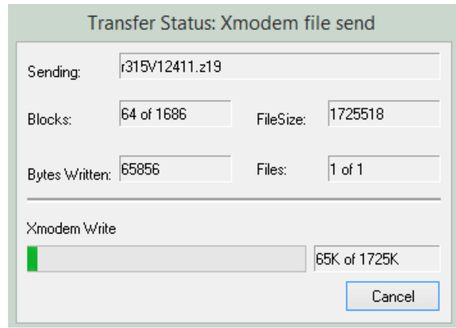


Step 2: Transfer Firmware

Click **Next** to begin the firmware transfer.

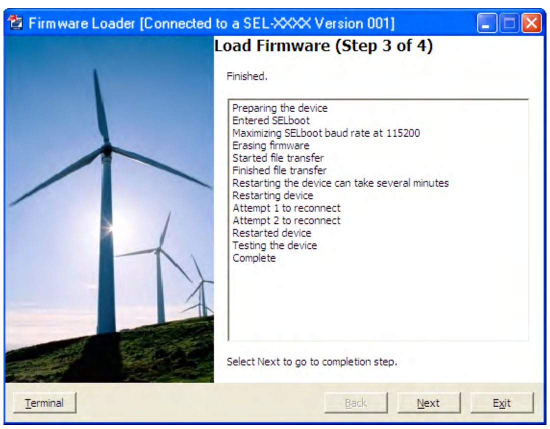


The **Transfer Status: Xmodem file send** window shows the transfer progress of the firmware file. Clicking **Cancel** will stop the transfer.



Step 3: Prepare Device

During this step, the device will be put in SELBOOT. The transfer speed will be maximized and the firmware transfer begun.



Step 4: Verify Device

Four verification options are provided and when enabled these options perform as follows.

Test Device Communications. If the device cannot be restarted then device power should be cycled and the device reset. Once the device is enabled, this option will reconnect and re-initialize the device.

Compare Device Settings. This option verifies settings by reading them from the device and comparing them with settings saved to the database.

Restore Device Settings. This option restores settings by writing settings saved to the database to the device, settings will be converted automatically if needed.

Load Firmware into Another Device. Returns the wizard to *Step 1: Prepare Device* to repeat the firmware loading process with another device.

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Appendix C
SEL Communications Processors

SEL Communications Protocols

The SEL-2411P Pump Automation Controller 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 Fast SER	Use this protocol to send binary Sequential Events Recorder unsolicited responses.
SEL Fast Message	Use this protocol to write Remote Analog data via unsolicited writes.

SEL ASCII Commands

We originally designed SEL ASCII commands for communication between the device 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 device, collect data, and issue commands.

SEL Compressed ASCII Commands

The SEL-2411P supports a subset of SEL ASCII commands identified as Compressed ASCII commands. Each of these commands results in a comma-delimited message that includes a checksum field. Most spreadsheet and database programs can directly import comma-delimited files. Devices with embedded processors connected to the device can execute software to parse and interpret comma-delimited messages without expending the customization and maintenance labor needed to interpret nondelimited messages. The device calculates a checksum for each line by numerically summing all of the bytes that precede the checksum field in the message. The program that uses the data can detect transmission errors in the message by summing the characters of the received message and comparing this sum 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 level 1 and above	1
CEVENT	Event report	1
CHISTORY	List of events	1
CMETER	Metering data, including fundamental, analog inputs, math variables, remote analogs, and signal profile data	1
CSTATUS	Device status	1
CSUMMARY	Summary of event report	1
DNAME	ASCII names of digital I/O reported in Fast Meter	0
ID	Device identification	0
SNS	ASCII names for SER data reported in Fast Meter	0

Interleaved ASCII and Binary Messages

SEL devices have two separate data streams that share the same physical serial port. Human data communications with the device consist of ASCII character commands and reports that 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-2411P 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-2411P and use the ASCII data stream for commands and responses.

SEL Fast Meter, Fast Operate, Fast SER, and Unsolicited Write

SEL Fast Meter is a binary message that you solicit with binary commands. Fast Operate is a binary message for control. The device can also send unsolicited SEL Fast Message (used in the SEL-2411P for Remote Analogs) and Fast SER messages automatically. If the device is connected to an SEL communications processor, these messages provide the mechanism that the communications processor uses for SCADA 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*.

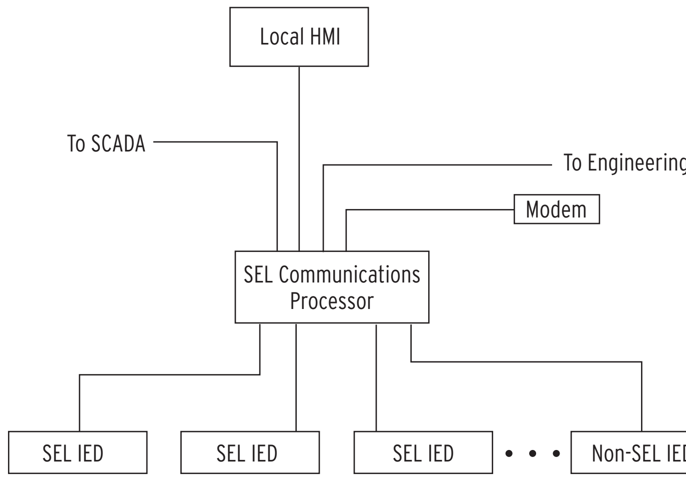

Figure C.1 SEL Communications Processor Star Integration Network

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, Human Machine Interface (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

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.

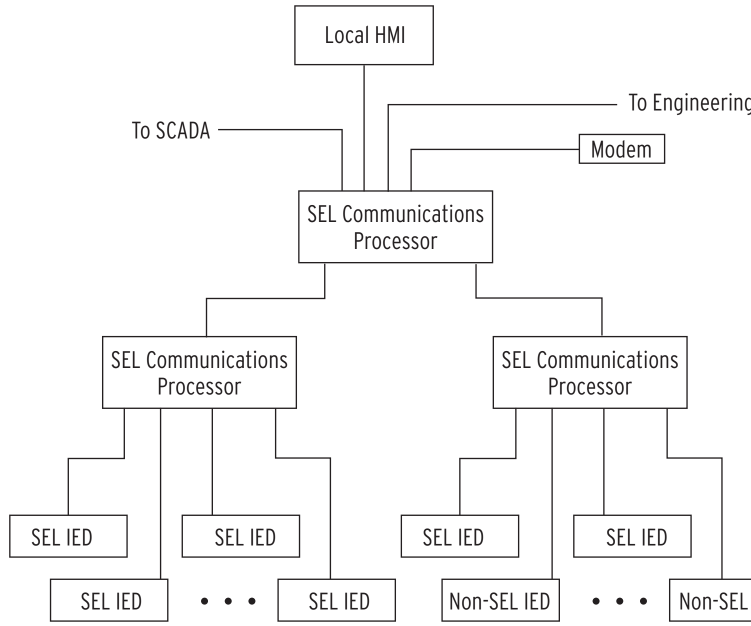

Figure C.2 Multitiered SEL Communications Processor Architecture

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 Outstation	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 devices
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 Device Architecture

You can apply SEL communications processors and SEL devices in a limitless variety of applications that integrate, automate, and improve station operation. Most system integration architectures utilizing SEL communications processors involve either developing a star network or enhancing a multidrop network.

Developing Star Networks

Figure C.1 shows the simplest architecture using both the SEL-2411P and an SEL communications processor. In this architecture, the SEL communications processor collects data from the SEL-2411P 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 devices and other station IEDs. This insulation of the protective devices from the communications interface assists greatly in situations where different departments are responsible for SCADA operation, communication, and protection.

SEL communications processors equipped with an SEL-2701 Ethernet Processor can provide a UCA2 interface to the SEL-2411P and other serial IEDs. The SEL-2411P 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 devices in the field.

Enhancing Multidrop Networks

You can also use an SEL communications processor to enhance a multidrop architecture similar to the one shown in *Figure C.3*. In this example, the SEL communications processor enhances a system that uses the 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.

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

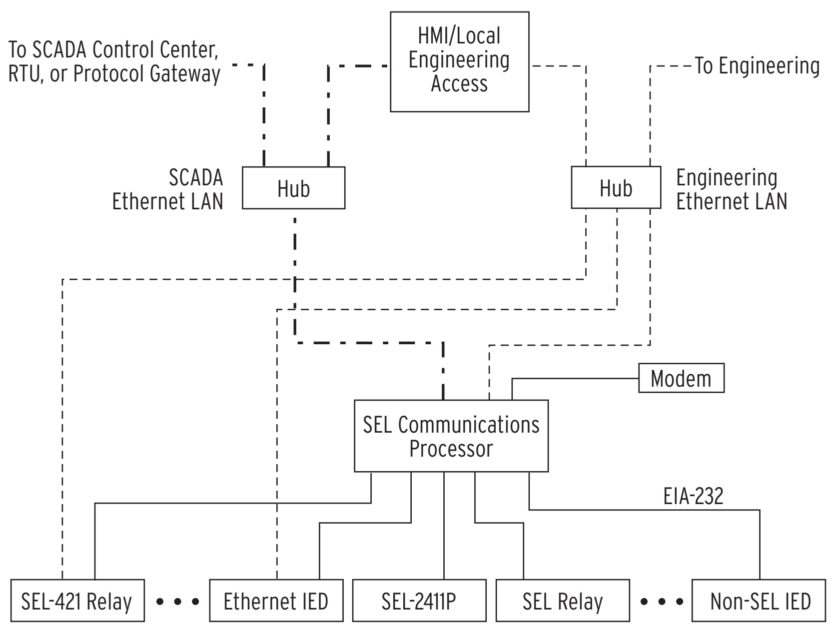

Figure C.3 Enhancing Multidrop Networks With SEL Communications Processors

SEL Communications Processor Example

This example demonstrates the data and control points available in the SEL communications processor when you connect an SEL-2411P. The physical configuration used in this example is shown in *Figure C.4*.

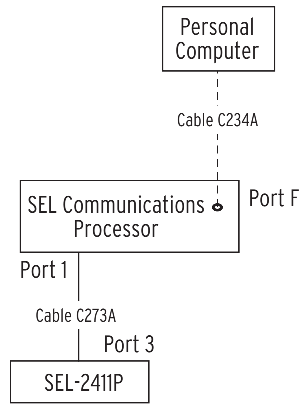

Figure C.4 Example SEL Device and SEL Communications Processor Configuration

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	Device 1	Name of connected device[a]
BAUD	19200	Channel speed of 19200 bits per second[a]
DATABIT	8	Eight data bits[a]
STOPBIT	1	One stop bit
PARITY	N	No parity
RTS_CTS	N	Hardware flow control enabled
TIMEOUT	30	Idle timeout that terminates transparent connections of 30 seconds

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

Data Collection

The SEL communications processor is configured to collect data from the SEL-2411P, using the list in *Table C.5*.

Table C.5 SEL Communications Processor Data Collection Auto-Messages

Message	Data Collected
20METER	Power system metering data (Binary)
20TARGET	Selected Device Word bit elements (Binary)
20HISTORY	History Command (CASCII)
20STATUS	Status Command (CASCII)

Table C.6 shows the SEL communications processor automessage (Set A) settings for data collection from the SEL-2411P.

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 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
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-2411P. Use the **MAP *n*** command to view these data.

Table C.7 SEL Communications Processor Port 1 Region Map

Region	Data Collection Message Type	Region Name	Description
D1	Binary	METER	Device metering data
D2	Binary	TARGET	Device Word bit data
D3–D8	n/a	n/a	Unused
A1–A3	n/a	n/a	Unused
USER	n/a	n/a	Unused

Device Metering Data

Table C.8 shows the list of SEL-2411P meter data available in the SEL communications processor and the location and data type for the memory areas within D1 (Data Region 1) for a device configured with voltage card only. 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** (*n* = port number) command to view these data.

Table C.8 Communications Processor SEL-2411P METER Region Map for Voltage Cards Only (Wye-Delta Connected PTs)

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
VA / VAB	200Bh	float
VB / VBC	200Dh	float
VC / VCA	200Fh	float
VG / (0 for delta)	2011h	float
3V2	2013h	float
FREQ	2015h	float

Device Word Bits Information

Table C.9 lists the Device Word bit data available in the SEL communications processor TARGET data region 2 (D2).

Table C.9 Communications Processor TARGET Region (Sheet 1 of 2)

Address	Device Word Bits (in Bits 7–0)							
	7	6	5	4	3	2	1	0
2804h				STSET				
2805h	See *Table G.1*, Row 0							
2806h	See *Table G.1*, Row 1							
2807h	See *Table G.1*, Row 2							
2808h	See *Table G.1*, Row 3							
2809h	See *Table G.1*, Row 4							
280Ah	See *Table G.1*, Row 5							
280Bh	See *Table G.1*, Row 6							
280Ch	See *Table G.1*, Row 6							
280Dh	See *Table G.1*, Row 8							
280Eh	See *Table G.1*, Row 9							
280Fh	See *Table G.1*, Row 10							

Table C.9 Communications Processor TARGET Region (Sheet 2 of 2)

Address	Device Word Bits (in Bits 7–0)							
	7	6	5	4	3	2	1	0
• • •	• • •							
2866h	See *Table G.1*, Row 119							

Control Points

The SEL communications processor can automatically pass control messages, called Fast Operate messages, to the SEL-2411P. You must enable Fast Operate messages by using the FASTOP setting in the SEL-2411P port settings for the port connected to the SEL communications processor. You must also enable Fast Operate messages in the SEL communications processor by setting the automessage setting SEND_OPER equal to Y.

When you enable Fast Operate functions, the SEL communications processor automatically sends messages to the device for changes in remote bits 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-2411P.

There are no breaker bits in the SEL-2411P.

SEL Communications Processor to SEL-2411P Unsolicited Write Remote Analog Example

From the perspective of the SEL-2411P, Remote Analogs (RA01 through RA32) are specific, pre-allocated memory addresses. These memory addresses are available to accept and store values from remote devices such as an SEL-2032, SEL-2030, or SEL-2020 Communications Processor. Once these values from the remote devices are written into the memory addresses in the SEL-2411P, you can use these values similar to any other analog quantity in the SEL-2411P. When using the SEL communications processor to send the Remote Analogs to the SEL-2411P, we use the Unsolicited Write setting string and send the information using the SEL Fast Message protocol. This example shows how to configure the Unsolicited Write message in the SEL communications processor to move data stored in the USER region of Port 6 of the SEL communications processor to an SEL-2411P connected to Port 3 of the SEL communications processor. We also show how to select the correct Remote Analog data type in the SEL-2411P to match the information in the Fast Message.

Although the SEL communications processor caters to static and dynamic data, this example uses static data in the SEL communications processor (entering the Unsolicited Write setting string is the same for static and dynamic data; see the SEL communications processor manual for dynamic data storing techniques). Assume the data are already stored in the USER region of Port 6 in the SEL communications processor. The Unsolicited Write message must be set in the Automatic messages on the SEL communications processor port to which the SEL-2411P is connected. Because the SEL-2411P is connected to Port 3 of the SEL communications processor, we use the Unsolicited Write Automatic (MESG1) message setting of Port 3 to build the Fast Message string, as shown in *Figure C.5* (see the SEL communications processor manual for in-depth discussions regarding the SEL communications processor Automatic message settings)

Setting the SEL Communications Processor

```
*>>SET A 3 <Enter>

Automatic message settings for Port 3


Save Unsolicited Messages (Y/N)              AUTOBUF = Y     ? <Enter>

Port Startup String
STARTUP ="?"
 ? <Enter>

Enable Automatic Sequential Events Recorder Collection (Y/N)REC_SER = N     ? <Enter>

Block external connections to this port
NOCONN  = NA
 ? <Enter>


Auto-message Settings

How many auto-message sequences (0-12)       MSG_CNT = 0     ? 1 <Enter>

Item 1 trigger D1
ISSUE1  = NA
 ? R1 <Enter>

Item 1 message
MESG1   = ""
 ? \W;06:USER:0000h;20,03:USER:0000h/ <Enter>


Archive Settings

Enable use of archive data items (Y/N)       ARCH_EN = N     ? END <Enter>

AUTOBUF = Y
STARTUP ="?"
REC_SER = N
NOCONN  = NA

MSG_CNT = 1

ISSUE1  = R1
MESG1   = "\W;06:USER:0000h;20,03:USER:0000h/"

ARCH_EN = N

USER    = 0

Save changes (Y/N) ? Y <Enter>

Port 3 Settings Changed


*>>
```

Figure C.5 Unsolicited Write Settings

The Unsolicited Write message string \W;06:USER:0000h;20,03:USER:0000h/ contains all the information necessary to send the remote analog data to the SEL-2411P. Following is a discussion on the elements of the Unsolicited Write message string.

- **\W** indicates this is an Unsolicited Write Message
- **06:User:0000H** indicates where the data are stored in the SEL communications processor (06 is the User regions port number where the data are stored, the beginning of the User region starts at F800H on each port, 0000H indicates what register in the User region to start at).
- **;20** indicates how many 16-bit registers from the SEL communications processor User region to send.
- **,03:USER:** is an SEL communications processor Unsolicited Write message compatibility requirement. 03 is the SEL communications processor port the SEL-2411P is connected and the second parameter should always be USER, or F800h.

- **0000H/** indicates the first SEL-2411P Remote Analog to begin writing to (0000H = RA01 – 003EH = RA32)
- The \ and / frames the message.

See the SEL communications processor manual for more information regarding the Unsolicited Write message string.

Below are 16-bit register data that are stored in the User region of port 6 which we will send to the SEL-2411P on Port 3. Remember that F800H is synonymous with the start of the USER region in the SEL communications processor. One register stores one Integer and 2 registers store one Float or Long data type.

```
*>>VIE 6:F800h NR 20 <Enter>

6:F800h

7FFFh 8001h FFFFh 0000h 447Ah 25C3h C47Ah 270Ah
4516h B029h 4516h AFD7h 0001h 7FFFh FFFEh 8001h
FFFFh 6A00h FFFFh 0000h

Starting at register 0000h, the first 4 registers contain 4 Integer data values
7FFFh 8001h FFFFh 0000h

Starting at register 0004h the next 8 registers contain 4 Float data values
447Ah 25C3h C47Ah 270Ah 4516h B029h 4516h AFD7h

Starting at register 000Ch the next 8 registers contain 4 Long data Values.
0001h 7FFFh FFFEh 8001h FFFFh 6A00h FFFFh 0000h
```

Setting the SEL-2411P

The SEL-2411P interprets Remote Analogs as Integer, Float, or Long data types. For correct remote analog data transfer, the data type sent from the SEL communications processor must match the data type of each of the SEL-2411P Remote Analogs. Use the RA*nn*TYPE settings (Report settings) to declare the Remote Analog type (I = Integer, F = Float, L = Long). Assume in our example we need only RA01 through RA12. In this example, we send 4 Integers, 4 Floats, and 4 Longs to the SEL-2411P. *Figure C.6* shows the correct settings for RA01 through RA13 accordingly, starting at RA01.

```
=>>SET R TERSE <Enter>

Report

SER Chatter Criteria

Auto-Removal EN (N,Y)                          ESERDEL := N        ? <Enter>

SER Trigger Lists
SERn = Up to 24 Device-Word elements separated by spaces or commas.
Use NA to disable setting.


SER Trigger List SER1 (24 Device Word bits)
SER1    := NA
? <Enter>
SER Trigger List SER2 (24 Device Word bits)
SER2    := NA
? <Enter>
SER Trigger List SER3 (24 Device Word bits)
SER3    := NA
? <Enter>
SER Trigger List SER4 (24 Device Word bits)
SER4    := NA
? <Enter>

Event Report Set

Event Trigger (SELogic)
ER      := NA
? <Enter>
Event Length (15,64 cyc)                       LER     := 15       ? <Enter>
Prefault Length (OFF,1-10 cyc)                 PRE     := 4        ? <Enter>

Fast Message Remote Analog Settings

Remote Analog Value Type (I,F,L)               RA01TYPE:= I        ? I <Enter>
Remote Analog Value Type (I,F,L)               RA02TYPE:= I        ? I <Enter>
Remote Analog Value Type (I,F,L)               RA03TYPE:= I        ? I <Enter>
Remote Analog Value Type (I,F,L)               RA04TYPE:= I        ? I <Enter>
Remote Analog Value Type (I,F,L)               RA05TYPE:= I        ? F <Enter>
Remote Analog Value Type (I,F,L)               RA06TYPE:= I        ? F <Enter>
Remote Analog Value Type (I,F,L)               RA07TYPE:= I        ? F <Enter>
Remote Analog Value Type (I,F,L)               RA08TYPE:= I        ? F <Enter>
Remote Analog Value Type (I,F,L)               RA09TYPE:= I        ? L <Enter>
Remote Analog Value Type (I,F,L)               RA10TYPE:= I        ? L <Enter>
Remote Analog Value Type (I,F,L)               RA11TYPE:= I        ? L <Enter>
Remote Analog Value Type (I,F,L)               RA12TYPE:= I        ? L <Enter>
Remote Analog Value Type (I,F,L)               RA13TYPE:= I        ? END <Enter>
Save changes (Y,N)? Y <Enter>
Settings Saved

=>>
```

Figure C.6 Setting Remote Analogs RA01 Through RA13

Now every time the ISSUE1 condition in the Automatic Messages on Port 3 is true, the SEL communications processor will send an Unsolicited Write message to the SEL-2411P and populate Remote Analogs 1–12 with the corresponding stored data in the SEL communications processor User region on Port 6.

Execute a **MET RA** or **CME RA** in the SEL-2411P to retrieve the Remote Analog data.

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Appendix D
DNP3 Communications

Overview

The SEL-2411P Programmable Automation Controller provides a Distributed Network Protocol Version 3.0 (DNP3) Level 2 Outstation interface for direct serial and LAN/WAN network connections to the device.

The DNP Users Group maintains and publishes DNP3 standards. See the DNP Users Group website, www.dnp.org, for more information on standards, implementers, and tools for working with DNP3.

Objects

DNP3 object types, commonly referred to as objects, specifies the type of data the object carries. An object can include a single value or more complex data.

If there can be more than one instance of an object type, then each instance has an index that makes it unique. Each object also includes multiple versions called variations. A master initiates all DNP3 message exchanges except unsolicited data, with all points described from the perspective of the master.

Function Codes

Each DNP3 message includes a function code. Each object has a limited set of function codes that a master may use to manipulate the object. The most common DNP3 function codes are listed in *Table D.1*.

Table D.1 Selected DNP3 Function Codes

Function Code	Function	Description
1	Read	Request data from the remote
2	Write	Send data to the remote
3	Select	First part of a select-before-operate operation
4	Operate	Second part of a select-before-operate operation
5	Direct operate	One-step operation with reply
6	Direct operate, no reply	One-step operation with no reply

Qualifier Codes and Ranges

DNP3 masters use qualifier codes and ranges to make requests for specific objects by index. Qualifier codes specify the style of range, and the range specifies the indices of the objects of interest. DNP3 masters use qualifier codes to compose the shortest, most concise message possible when requesting points from a DNP3 remote.

Ethernet Operation

The DNP-IP response is identical to the serial response, but it requires the communications-specific settings shown in *Table D.2*.

Table D.2 DNP-IP Specific Settings

Setting	Definition	Range	Default Value
EDNP	Enable DNP-IP sessions. Set this value to 0 to disable DNP-IP in the SEL-2411P.	0–5	0
DNPNUM*n*	DNP TCP and UDP port. Identifies the TCP and UDP port between the master and the SEL-2411P. DNPNUM must be unique for each anonymous DNP session.	1–65534 excluding 20, 21, 502, and the TPORT setting.	2000
DNPIP*n*	Master IP Address. Set DNPIP = 0.0.0.0 to accept requests from any DNP-IP address.	zzz.yyy.xxx.www	192.168.0.3
DNPTR*n*	Transport Protocol. Selects between TCP and UDP protocols.	TCP, UDP	TCP
DNPUDP*n*	UDP Response Port. Selects the port to which the SEL-2411P responds. If DNPUDP = REQ, the SEL-2411P responds to the port number from the master's UDP request.	REQ, 1–65534	2000

If the UNSOL setting is set to Y, the SEL-2411P transmits unsolicited data when either of the following are true:

- ➤ Initialization is complete and DNPTR = UDP, or
- ➤ The master has established a session, if DNPTR = TCP.

DNP3 in the SEL-2411P

The SEL-2411P is a DNP3 Level 2 Outstation device. See *DNP3 Communications* for additional documentation describing DNP3.

Data Access

Table D.3 lists DNP3 data access methods along with corresponding SEL-2411P settings. You must select a data access method and configure each DNP3 master for polling as specified.

NOTE: Because unsolicited messaging is problematic in most circumstances, SEL recommends using the polled report-by-exception access method to maximize performance and minimize risk of configuration problems.

NOTE: In the settings below, the suffix n represents the DNP3 session number from 1 to 5. All settings with the same numerical suffix comprise the complete DNP3 session configuration.

Table D.3 DNP3 Access Methods

Access Method	Master Polling	SEL-2411P Settings
Polled static	Class 0	Set ECLASSB*n*, ECLASSC*n*, ECLASSA*n* to 0; UNSOL*n* to No
Polled report-by-exception	Class 0 occasionally, Class 1, 2, 3 frequently	Set ECLASSB*n*, ECLASSC*n*, ECLASSA*n* to the desired event class; UNSOL*n* to No
Unsolicited report-by-exception	Class 0 occasionally, optional Class 1, 2, 3 less frequently; mainly relies on unsolicited messages	Set ECLASSB*n*, ECLASSC*n*, ECLASSA*n* to the desired event class; set UNSOL*n* to Yes and PUNSOL*n* to Yes or No
Quiescent	Class 0, 1, 2, 3 never; relies completely on unsolicited messages	Set ECLASSB*n*, ECLASSC*n*, ECLASSA*n* to the desired event class; set UNSOL*n* and PUNSOL*n* to Yes.

If the master does not acknowledge the unsolicited data with an Application Confirm, the device will resend the data until it is acknowledged. It will wait for ETIMEO*n* seconds and then repeat the unsolicited message. To prevent clogging of the network with unsolicited data retries, the SEL-2411P uses the URETRY*n* and UTIMEO*n* settings to increase retry time when the number of retries set in URETRY*n* is exceeded. After URETRY*n* has been exceeded, the SEL-2411P pauses UTIMEO*n* seconds and then transmits the unsolicited data again. *Figure D.1* provides an example with URETRY*n* = 2. If UTIMEO*n* is set to OFF, the retry interval will be 10 * ETIMEO*n*.

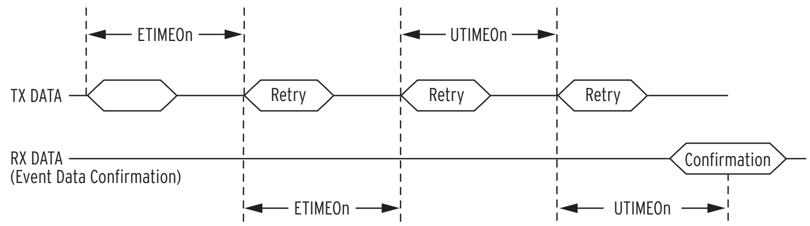

Figure D.1 Application Confirmation Timing With URETRYn = 2

Collision Avoidance

If your application uses unsolicited reporting on a serial network, you must select a half-duplex medium or a medium that includes carrier detection to avoid data collisions. EIA-485 two-wire networks are half-duplex. EIA-485 four-wire networks do not provide carrier detection, while EIA-232 systems can support carrier detection. DNP3 LAN/WAN uses features of the IP suite for collision avoidance.

The SEL-2411P uses Application Confirmation messages to guarantee delivery of unsolicited event data before erasing the local event data buffer. Data collisions are typically resolved when messages are repeated until confirmed.

The SEL-2411P pauses for a random delay between the settings MAXDLY and MINDLY when it detects a carrier through data on the receive line or the CTS pin. For example, if you use settings of 0.05 and 0.10 s, the SEL-2411P will insert a random delay of 50 to 100 ms, as shown in *Figure D.2*.

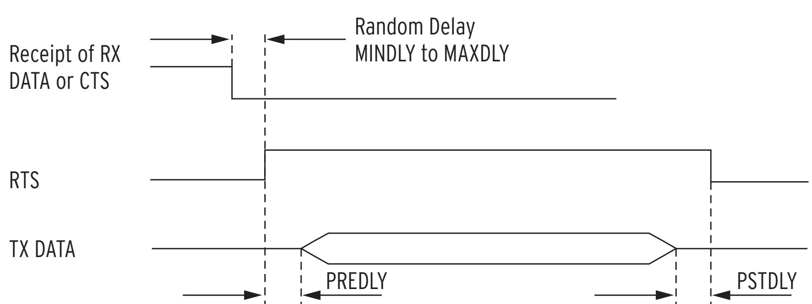

Figure D.2 Message Transmission Timing

Transmission Control

NOTE: PREDLY and POSTDLY settings are only available for EIA-232 and EIA-485 serial port sessions.

If you use a media transceiver (for example, EIA-232 to EIA-485) or a radio system for your DNP3 network, you may need to adjust data transmission properties. Use the PREDLY and POSTDLY settings to provide a delay between RTS signal control and data transmission (see *Figure D.2*). For example, an EIA-485 transceiver typically requires 10 to 20 ms to change from receive to transmit. If you set the pre-delay to 30 ms, you will avoid data loss resulting from data transmission beginning at the same time as RTS signal assertion.

Event Data

DNP3 event data objects contain change-of-state and time-stamp information that the SEL-2411P collects and stores in a buffer. Points assigned in the Binary Input Map that are also assigned in the Sequential Events Recorder (SER) settings carry the time stamp of actual occurrence. Binary input points not assigned in the SER settings will carry a time stamp based on the DNP map scan time. This may be significantly delayed from when the original source changed and should not be used for sequence-of-events determination. The DNP map is scanned approximately once per second to generate events. You can configure the SEL-2411P to either report the data without a polling request from the master (unsolicited data) or hold the data until the master requests it with an event poll message.

The SEL-2411P uses the NUMEVE*n* and AGEEVE*n* settings to decide when to send unsolicited data to the master. The device sends an unsolicited report when the total number of events accumulated in the event buffer for master *n* reaches NUMEVE*n*. The device also sends an unsolicited report if the age of the oldest event in the master *n* buffer exceeds AGEEVE*n*. The SEL-2411P has the buffer capacities listed in *Table D.4*.

Table D.4 SEL-2411P Event Buffer Capacity

Type	Maximum Number of Events
Binary	1024
Analog	1024
Counters	32

Time Synchronization

By default, the SEL-2411P accepts and ignores time set requests (TIMERQ*n* = I). (This mode allows the SEL-2411P to use a high accuracy, IRIG time source, but still interoperate with DNP3 masters that send time-synchronization messages.) It can be set to request time synchronization periodically by setting the TIMERQ*n* setting to the desired period. It can also be set to not request, but accept time synchronization (TIMERQ*n* = M).

Configurable Data Mapping

One of the most powerful features of the SEL-2411P implementation is the ability to remap DNP3 data and, for analog values, specify per-point scaling and deadbands. deadbands are applied to the scaled value. Remapping is the process of selecting data from the reference map and organizing it into a data subset optimized for your application. The SEL-2411P uses object and point labels, rather than point indices, to streamline the remapping process. This enables you to quickly create a custom map without having to search for each point index in a large reference map.

You may use any of the three available DNP3 maps simultaneously with up to five unique DNP3 masters. Each map is initially populated with default data points, as described in *Default Data Map on page D.12*.

Device Profile

Table D.5 contains the standard DNP3 device profile information. Rather than check boxes in the example Device Profile in the DNP3 Subset Definitions, only the relevant selections are shown.

Table D.5 SEL-2411P DNP3 Device Profile (Sheet 1 of 2)

Parameter	Value
Vendor name	Schweitzer Engineering Laboratories
Device name	SEL-2411P
Highest DNP request level	Level 2
Highest DNP response level	Level 2
Device function	Slave

Table D.5 SEL-2411P DNP3 Device Profile (Sheet 2 of 2)

Parameter	Value
Notable objects, functions, and/or qualifiers supported	Analog Deadband Objects (Object 34)
Maximum data link frame size transmitted/ received (octets)	292
Maximum data link retries	Configurable, range 0–15
Requires data link layer confirmation	Configurable by setting (Preference is to not use link layer confirmation)
Maximum application fragment size transmitted/ received (octets)	2048
Maximum application layer retries	None
Requires application layer confirmation	When reporting Event Data
Data link confirm time-out	Configurable
Complete application fragment time-out	None
Application confirm time-out	Configurable
Complete Application response time-out	None
Executes control WRITE binary outputs	Always
Executes control SELECT/OPERATE	Always
Executes control DIRECT OPERATE	Always
Executes control DIRECT OPERATE-NO ACK	Always
Executes control count greater than 1	Never
Executes control Pulse On	Always
Executes control Pulse Off	Always
Executes control Latch Off	Always
Executes control Latch On	Always
Executes control Queue	Never
Executes control Clear Queue	Never
Reports binary input change events when no specific variation requested	Only time-stamped
Reports time-stamped binary input change events when no specific variation requested	Binary Input change with time
Sends unsolicited responses	Configurable with unsolicited message enable settings. Increases retry time (configurable) when a maximum retry setting is exceeded.
Sends static data in unsolicited responses	Never
Default counter object/variation	Object 20, Variation 6
Counter roll-over	16 bits
Sends multifragment responses	No

In response to the delay measurement function code, the SEL-2411P will return a time delay accurate to within 50 ms.

Object List

Table D.6 lists the objects and variations with supported function codes and qualifier codes available in the SEL-2411P. The list of supported objects conforms to the format laid out in the DNP specifications and includes both supported and unsupported objects. Those that are supported include the function and qualifier codes. The objects that are not supported are shown without any corresponding function and qualifier codes. If any device attributes are modified, it is necessary to issue the **STA C** command prior to those changes being reflected in any DNP query for device attributes.

Table D.6 SEL-2411P DNP Object List (Sheet 1 of 4)

Obj.	Var.	Description	Request[a]		Response[b]	
			Funct. Codes[c]	Qual. Codes[d]	Funct. Codes[c]	Qual. Codes[d]
0	242	Device Attributes—Device manufacturer's software version	1	0	129	0, 17
0	243	Device Attributes—Device manufacturer's hardware version	1	0	129	0, 17
0	246	Device Attributes—User assigned ID code/number	1	0	129	0, 17
0	248	Device Attributes—Device serial number	1	0	129	0, 17
0	250	Device Attributes—Device manufacturer's product name and model	1	0	129	0, 17
0	252	Device Attributes—Device manufacturer's name	1	0	129	0, 17
0	254	Device Attributes—Non-specific all attributes request	1	0, 6		
0	255	Device Attributes—List of attribute variations	1	0, 6	129	0, 17
1	0	Binary Input—All Variations	1	0, 1, 6, 7, 8, 17, 28		
1	1	Binary Input	1	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
1	2[e]	Binary Input With Status	1	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
2	0	Binary Input Change—All Variations	1	6, 7, 8		
2	1	Binary Input Change Without Time	1	6, 7, 8	129	17, 28
2	2[e]	Binary Input Change With Time	1	6, 7, 8	129, 130	17, 28
2	3	Binary Input Change With Relative Time	1	6, 7, 8	129	17, 28
10	0	Binary Output—All Variations	1	0, 1, 6, 7, 8		
10	1	Binary Output				
10	2[e]	Binary Output Status	1	0, 1, 6, 7, 8	129	0, 1
12	0	Control Block—All Variations				
12	1	Control Relay Output Block	3, 4, 5, 6	17, 28	129	echo of request
12	2	Pattern Control Block—Not Supported				
12	3	Pattern Mask—Not Supported				
20	0	Binary Counter—All Variations	1, 7, 8, 9, 10	0, 1, 6, 7, 8, 17, 28		
20	1	32-Bit Binary Counter	1, 7, 8, 9, 10	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
20	2	16-Bit Binary Counter	1, 7, 8, 9, 10	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
20	3	32-Bit Delta Counter				
20	4	16-Bit Delta Counter				
20	5	32-Bit Binary Counter Without Flag	1, 7, 8, 9, 10	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
20	6[e]	16-Bit Binary Counter Without Flag	1, 7, 8, 9, 10	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
20	7	32-Bit Delta Counter Without Flag				
20	8	16-Bit Delta Counter Without Flag				
21	0	Frozen Counter—All Variations	1	0, 1, 6, 7, 8, 17, 28		
21	1	32-Bit Frozen Counter	1	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
21	2	16-Bit Frozen Counter	1	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
21	3	32-Bit Frozen Delta Counter	1		129	
21	4	16-Bit Frozen Delta Counter	1		129	
21	5	32-Bit Frozen Counter With Time of Freeze	1	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28

Table D.6 SEL-2411P DNP Object List (Sheet 2 of 4)

Obj.	Var.	Description	Request[a] Funct. Codes[c]	Request[a] Qual. Codes[d]	Response[b] Funct. Codes[c]	Response[b] Qual. Codes[d]
21	6	16-Bit Frozen Counter With Time of Freeze	1	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
21	7	32-Bit Frozen Delta Counter With Time of Freeze	1		129	
21	8	16-Bit Frozen Delta Counter With Time of Freeze	1		129	
21	9	32-Bit Frozen Counter Without Flag	1	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
21	10	16-Bit Frozen Counter Without Flag	1	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
21	11	32-Bit Frozen Delta Counter Without Flag				
21	12	16-Bit Frozen Delta Counter Without Flag				
22	0	Counter Change Event—All Variations	1	6, 7, 8		
22	1	32-Bit Counter Change Event Without Time	1	6, 7, 8	129	17, 28
22	2[e]	16-Bit Counter Change Event Without Time	1	6, 7, 8	129, 130	17, 28
22	3	32-Bit Delta Counter Change Event Without Time				
22	4	16-Bit Delta Counter Change Event Without Time				
22	5	32-Bit Counter Change Event With Time	1	6, 7, 8	129	17, 28
22	6	16-Bit Counter Change Event With Time	1	6, 7, 8	129	17, 28
22	7	32-Bit Delta Counter Change Event With Time				
22	8	16-Bit Delta Counter Change Event With Time				
23	0	Frozen Counter Event—All Variations	1	6,7, 8		
23	1	32-Bit Frozen Counter Event Without Time	1	6,7, 8	129	17, 28
23	2	16-Bit Frozen Counter Event Without Time	1	6,7, 8	129, 130	17, 28
23	3	32-Bit Frozen Delta Counter Event Without Time				
23	4	16-Bit Frozen Delta Counter Event Without Time				
23	5	32-Bit Frozen Counter Event With Time	1	6,7, 8	129	17, 28
23	6	16-Bit Frozen Counter Event With Time	1	6,7, 8	129	17, 28
23	7	32-Bit Delta Counter Change Event With Time				
23	8	16-Bit Delta Counter Change Event With Time				
30	0	Analog Input—All Variations	1	0, 1, 6, 7, 8, 17, 28		
30	1	32-Bit Analog Input	1	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
30	2	16-Bit Analog Input	1	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
30	3	32-Bit Analog Input Without Flag	1	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
30	4[e]	16-Bit Analog Input Without Flag	1	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
30	5	Short Floating Point Analog Input	1	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
30	6	Long Floating Point Analog Input	1	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
31	0	Frozen Analog Input—All Variations				
31	1	32-Bit Frozen Analog Input				
31	2	16-Bit Frozen Analog Input				
31	3	32-Bit Frozen Analog Input With Time of Freeze				
31	4	16-Bit Frozen Analog Input With Time of Freeze				
31	5	32-Bit Frozen Analog Input Without Flag				
31	6	16-Bit Frozen Analog Input Without Flag				

Table D.6 SEL-2411P DNP Object List (Sheet 3 of 4)

Obj.	Var.	Description	Request[a] Funct. Codes[c]	Request[a] Qual. Codes[d]	Response[b] Funct. Codes[c]	Response[b] Qual. Codes[d]
31	7	Short Floating Point Frozen Analog Input				
31	8	Long Floating Point Frozen Analog Input				
32	0	Analog Change Event—All Variations	1	6, 7, 8		
32	1	32-Bit Analog Change Event Without Time	1	6, 7, 8	129	17, 28
32	2	16-Bit Analog Change Event Without Time	1	6, 7, 8	129, 130	17, 28
32	3	32-Bit Analog Change Event With Time	1	6, 7, 8	129	17, 28
32	4[e]	16-Bit Analog Change Event With Time	1	6, 7, 8	129	17, 28
32	5	Short Floating Point Analog Change Event	1	6, 7, 8	129	17, 28
32	6	Long Floating Point Analog Change Event	1	6, 7, 8	129	17, 28
32	7	Short Floating Point Analog Change Event With Time	1	6, 7, 8	129	17, 28
32	8	Long Floating Point Analog Change Event With Time	1	6, 7, 8	129	17, 28
33	0	Frozen Analog Event—All Variations				
33	1	32-Bit Frozen Analog Event Without Time				
33	2	16-Bit Frozen Analog Event Without Time				
33	3	32-Bit Frozen Analog Event With Time				
33	4	16-Bit Frozen Analog Event With Time				
33	5	Short Floating Point Frozen Analog Event				
33	6	Long Floating Point Frozen Analog Event				
33	7	Short Floating Point Frozen Analog Event With Time				
33	8	Long Floating Point Frozen Analog Event With Time				
34	0	Analog deadband—All Variations				
34	1[e]	16-Bit Analog Input Reporting Deadband Object	1, 2	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
34	2	32-Bit Analog Input Reporting Deadband Object	1, 2	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
34	3	Floating Point Analog Input Reporting Deadband Object	1, 2	0, 1, 6, 7, 8, 17, 28	129	0, 1, 17, 28
40	0	Analog Output Status—All Variations	1	0, 1, 6, 7, 8	129	
40	1	32-Bit Analog Output Status	1	0, 1, 6, 7, 8	129	0, 1, 17, 28
40	2[e]	16-Bit Analog Output Status	1	0, 1, 6, 7, 8	129	0, 1, 17, 28
40	3	Short Floating Point Analog Output Status	1	0, 1, 6, 7, 8	129	0, 1, 17, 28
40	4	Long Floating Point Analog Output Status	1	0, 1, 6, 7, 8	129	0, 1, 17, 28
41	0	Analog Output Block—All Variations				
41	1	32-Bit Analog Output Block	3, 4, 5, 6	17, 28	129	echo of request
41	2[e]	16-Bit Analog Output Block	3, 4, 5, 6	17, 28	129	echo of request
41	3	Short Floating Point Analog Output Block	3, 4, 5, 6	17, 28	129	echo of request
50	0	Time and Date—All Variations				
50	1	Time and Date	1, 2	7, 8 index=0	129	07, quantity=1
50	2	Time and Date With Interval				
50	3	Time and Date Last Recorded	2	7, 8		
51	0	Time and Date CTO—All Variations				

Table D.6 SEL-2411P DNP Object List (Sheet 4 of 4)

Obj.	Var.	Description	Request[a] Funct. Codes[c]	Request[a] Qual. Codes[d]	Response[b] Funct. Codes[c]	Response[b] Qual. Codes[d]
51	1	Time and Date CTO				
51	2	Unsynchronized Time and Date CTO			129	07, quantity=1
52	0	Time Delay—All Variations				
52	1	Time Delay, Coarse				
52	2	Time Delay, Fine			129	7, quantity=1
60	0	All Classes of Data	1, 20, 21	6, 7, 8		
60	1	Class 0 Data	1, 20, 21	6, 7, 8		
60	2	Class 1 Data	1, 20, 21	6, 7, 8		
60	3	Class 2 Data	1, 20, 21	6, 7, 8		
60	4	Class 3 Data	1, 20, 21	6, 7, 8		
70	1	File Identifier				
70	2	Authentication Object				
70	3	File Command Object				
70	4	File Command Status Object				
70	5	File Transport Object				
70	6	File Transport Status Object				
70	7	File Descriptor Object				
80	1	Internal Indications	1, 2	0, 1 index=7		
81	1	Storage Object				
82	1	Device Profile				
83	1	Private Registration Object				
83	2	Private Registration Object Descriptor				
90	1	Application Identifier				
100	1	Short Floating Point				
100	2	Long Floating Point				
100	3	Extended Floating Point				
101	1	Small Packed Binary-Coded Decimal				
101	2	Medium Packed Binary-Coded Decimal				
101	3	Large Packed Binary-Coded Decimal				
110	all	Octet String				
111	all	Octet String Event				
112	All	Virtual Terminal Output Block	2	6	129	
113	All	Virtual Terminal Event Data	1	6	129, 130	17, 28
N/A		No object required for the following function codes: 13 cold start;14 warm start; 23 delay measurement	13, 14, 23			

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

Reference Data Map

Table D.7 shows the SEL-2411P reference data map. The reference map shows the data available to a DNP3 master. You can use the default map or the custom DNP3 mapping functions of the SEL-2411P to retrieve only the points required by your application.

NOTE: Deadband changes via Object 34 are not stored in nonvolatile memory. Make sure to reissue the Object 34 deadbands after a warm (**STA C**) or cold start (power cycle).

The SEL-2411P scales analog values by the indicated settings or fixed scaling indicated in the description. Analog deadbands for event reporting use the indicated settings, or ANADBM if you have not specified a setting.

Table D.7 DNP3 Reference Data Map[a] (Sheet 1 of 3)

Object	Labels	Description	
Binary Inputs			
01, 02	STFAIL	Device Diagnostic Failure	
01, 02	STWARN	Device Diagnostic Warning	
01, 02	STSET	Device Settings Changed Warning	
01, 02	Enabled–T06_LED	Device Word Elements, Row 0, Targets (see *Table G.1*)	
01, 02	PB01_LED to PB04BLED	Device Word Elements, Row 1 to Row 123 (see *Table G.1*)	
01, 02	PFLX	Power Factor Leading for Three-Phase Currents	b
Binary Outputs			
10, 12	RB*xx*	Remote Bits (RB01 to RB32)	
Counters			
20, 21, 22, 23	SC*xx*	SELOGIC Counter Values (SC01 to SC32)	
Analog Inputs			
General Analog Inputs			
30, 32, 34	AI50*x*	Analog Inputs (AI501 to AI508)—Slot E	
30, 32, 34	RA*xxx*	Remote Analogs (RA001 to RA032)	
30, 32, 34	RA*xxx*	Remote Analogs (RA033 to RA064)	
30, 32, 34	RA*xxx*	Remote Analogs (RA065 to RA096)	
30, 32, 34	RA*xxx*	Remote Analogs (RA097 to RA128)	
30, 32, 34	MV*xx*	Math Variables (MV01 to MV32)	
30, 32, 34	MV*xx*	Math Variables (MV33 to MV64)	
30, 32, 34	ACV*xx*	Analog Control Variables (ACV01 to ACV32)	
Fundamental Metering			
30, 32, 34	FREQ	Instantaneous, Frequency	c
30, 32, 34	V*x*_MAG	Instantaneous, Voltage Magnitude (*x* = A, B, C and G)	c
30, 32, 34	V*x*_ANG	Instantaneous, Voltage Angle (*x* = A, B, C and G)	c
30, 32, 34	3V2	Instantaneous, Negative-Sequence Voltage	c
30, 32, 34	I*x*_MAG	Instantaneous, Current Magnitude (*x* = A, B, C, N and G)	d
30, 32, 34	I*x*_ANG	Instantaneous, Current Angle (*x* = A, B, C, N and G)	d
30, 32, 34	P	Instantaneous, Three-Phase Real Power	e
30, 32, 34	P*x*	Instantaneous, Real Power (*x* = A, B and C)	e
30, 32, 34	Q	Instantaneous, Three-Phase Reactive Power	e
30, 32, 34	Q*x*	Instantaneous, Reactive Power (*x* = A, B and C)	e
30, 32, 34	S	Instantaneous, Three-Phase Apparent Power	e
30, 32, 34	S*x*	Instantaneous, Apparent Power (*x* = A, B and C)	e
30, 32, 34	PF	Instantaneous, Three-Phase Power Factor	e
30, 32, 34	PF*x*	Instantaneous, Power Factor (*x* = A, B and C)	e
30, 32, 34	3I2	Instantaneous, Current, Negative-Sequence	d
30, 32, 34	I*x*X_MAG	Instantaneous, Current Magnitude (*x* = A, B, C and G)	f
30, 32, 34	I*x*X_ANG	Instantaneous, Current Angle (*x* = A, B, C and G)	f
30, 32, 34	PX	Instantaneous, Three-Phase Real Power	f
30, 32, 34	P*x*X	Instantaneous, Real Power (*x* = A, B and C)	f
30, 32, 34	QX	Instantaneous, Three-Phase Reactive Power	f
30, 32, 34	Q*x*X	Instantaneous, Reactive Power (*x* = A, B and C)	f
30, 32, 34	SX	Instantaneous, Three-Phase Apparent Power	f
30, 32, 34	S*x*X	Instantaneous, Apparent Power (*x* = A, B and C)	f

Table D.7 DNP3 Reference Data Map[a] (Sheet 2 of 3)

Object	Labels	Description	
30, 32, 34	PFX	Instantaneous, Three-Phase Power Factor	f
30, 32, 34	PF*x*X	Instantaneous, Power Factor (*x* = A, B and C)	f
30, 32, 34	3I2X	Instantaneous, Current, Negative-Sequence	f
Demand Metering			
30, 32, 34	I*x*D	Demand, Current Magnitude (*x* = A, B, C, N and G)	d
30, 32, 34	3I2D	Demand, Current, Negative Sequence	d
30, 32, 34	I*x*XD	Demand, Current Magnitude X (*x* = A, B, C and G)	f
30, 32, 34	3I2XD	Demand, Current, Negative Sequence X	f
Peak Demand Metering			
30, 32, 34	I*x*PD	Peak Demand, Current Magnitude (*x* = A, B, C, N and G)	d
30, 32, 34	3I2PD	Peak Demand, Current, Negative Sequence	d
30, 32, 34	I*x*XPD	Peak Demand, Current Magnitude X (*x* = A, B, C and G)	f
30, 32, 34	3I2XPD	Peak Demand, Current, Negative Sequence X	f
Energy Metering			
30, 32, 34	MWH3PI	Energy, Real (MWh), In: energy flow towards busbar	e
30, 32, 34	MQH3PI	Energy, Reactive (MVARh) In	e
30, 32, 34	MSH3PI	Energy, Apparent (MVAh) In	e
30, 32, 34	MWH3PO	Energy, Real (MWh), Out: energy flow from busbar away	e
30, 32, 34	MQH3PO	Energy, Reactive (MVARh) Out	e
30, 32, 34	MSH3PO	Energy, Apparent (MVAh) Out	e
30, 32, 34	MWH3PIX	Energy, Real (MWh) In	f
30, 32, 34	MQH3PIX	Energy, Reactive X (MVARh) In	f
30, 32, 34	MSH3PIX	Energy, Apparent X (MVAh) In	f
30, 32, 34	MWH3POX	Energy, Real X (MWh) Out	f
30, 32, 34	MQH3POX	Energy, Reactive X (MVARh) Out	f
30, 32, 34	MSH3POX	Energy, Apparent X (MVAh) Out	f
Maximum Metering			
30, 32, 34	FREQMX	Maximum Frequency	c
30, 32, 34	V*x*MX	Maximum, Voltage (*x* = A, B and C)	c
30, 32, 34	V*xx*MX	Maximum, Voltage (*xx* = AB, BC and CA)	c
30, 32, 34	I*x*MX	Maximum, Current Magnitude (*x* = A, B, C, N and G)	d
30, 32, 34	3I2MX	Maximum, Current, Negative Sequence	d
30, 32, 34	KS3PMX	Maximum, Apparent Power	e
30, 32, 34	KW3PMX	Maximum, Real Power	e
30, 32, 34	KQ3PMX	Maximum, Reactive Power	e
30, 32, 34	I*x*XMX	Maximum, Current Magnitude X (*x* = A, B, C and G)	f
30, 32, 34	3I2XMX	Maximum, Current, Negative Sequence X	f
30, 32, 34	KS3PXMX	Maximum, Apparent Power X	f
30, 32, 34	KW3PXMX	Maximum, Real Power X	f
30, 32, 34	KQ3PXMX	Maximum, Reactive Power X	f
Minimum Metering			
30, 32, 34	FREQMN	Minimum Frequency	c
30, 32, 34	V*x*MN	Minimum, Voltage (*x* = A, B and C)	c
30, 32, 34	V*xx*MN	Minimum, Voltage (*xx* = AB, BC and CA)	c
30, 32, 34	I*x*MN	Minimum, Current Magnitude (*x* = A, B, C, N and G)	d
30, 32, 34	3I2MN	Minimum, Current, Negative Sequence	d
30, 32, 34	KS3PMN	Minimum, Apparent Power	e
30, 32, 34	KW3PMN	Minimum, Real Power	e
30, 32, 34	KQ3PMN	Minimum, Reactive Power	e
30, 32, 34	I*x*XMN	Minimum, Current Magnitude X (*x* = A, B, C and G)	f
30, 32, 34	3I2XMN	Minimum, Current, Negative Sequence X	f
30, 32, 34	KS3PXMN	Minimum, Apparent Power X	f

Table D.7 DNP3 Reference Data Map[a] (Sheet 3 of 3)

Object	Labels	Description	
30, 32, 34	KW3PXMN	Minimum, Real Power X	f
30, 32, 34	KQ3PXMN	Minimum, Reactive Power X	f
Analog Outputs			
40, 41	RA*xxx*	Remote Analogs (RA001 to RA032)	
40, 41	RA*xxx*	Remote Analogs (RA033 to RA064)	
40, 41	RA*xxx*	Remote Analogs (RA065 to RA096)	
40, 41	RA*xxx*	Remote Analogs (RA097 to RA128)	
40, 41	ACV*xx*	Control Variables (ACV01 to ACV32)	
Pump Operational Status			
30, 32, 34	P*x*RT2H	Pump *x* two-hour run time (*x* = 1, 2, 3, and 4)	
30, 32, 34	P*x*RT1D	Pump *x* one-day run time (*x* = 1, 2, 3, and 4)	
30, 32, 34	P*x*RT2D	Pump *x* two-day run time (*x* = 1, 2, 3, and 4)	
30, 32, 34	P*x*RTTOT	Pump *x* total run time (*x* = 1, 2, 3, and 4)	
30, 32, 34	P*x*STC1H	Pump *x* one-hour start count (*x* = 1, 2, 3, and 4)	
30, 32, 34	P*x*STC2H	Pump *x* two-hour start count (*x* = 1, 2, 3, and 4)	
30, 32, 34	P*x*STC1D	Pump *x* one-day start count (*x* = 1, 2, 3, and 4)	
30, 32, 34	P*x*STC2D	Pump *x* two-day start count (*x* = 1, 2, 3, and 4)	
30, 32, 34	P*x*STCTOT	Pump *x* total start count (*x* = 1, 2, 3, and 4)	
30, 32, 34	P*x*LASTST	Pump *x* time since last start (*x* = 1, 2, 3, and 4)	
Analog Level Virtual Float Set Points			
30, 32, 34	LOW_SP	LOW virtual float set point	
30, 32, 34	STOP_SP	STOP virtual float set point	
30, 32, 34	LEAD_SP	LEAD virtual float set point	
30, 32, 34	LAG1_SP	LAG1 virtual float set point	
30, 32, 34	LAG2_SP	LAG2 virtual float set point	
30, 32, 34	HIGH_SP	HIGH virtual float set point	

[a] Although not shown as part of the reference maps, you may use any Device Word bit label when creating custom maps.
[b] Valid data only if 3 CT/3 PT card is installed in Slot E.
[c] Valid data only if the 3 AVI card is installed in Slot E.
[d] Valid data only if 4 CT card is installed in Slot Z.
[e] Valid data only if 4 CT and 3 PT cards are installed in Slots Z and E respectively.
[f] Valid data only if 3 CT/3 PT card is installed in Slot E.

Default Data Map

The default data map is an automatically generated subset of the reference map. All data maps are initialized to the default values, based on the SEL-2411P part number. *Table D.8* shows the SEL-2411P default data map. If the default maps are not appropriate, you can also use the custom DNP mapping commands **SET DN** and **SHOW DN** to create the map required for your application.

Table D.8 DNP3 Default Data Map (Sheet 1 of 5)

Object	Default Index	Point Label	Description
01,02	BI_00	P1ELT	Pump 1 status indication
	BI_01	HOA1AUTO	Switch feedback Position 1
	BI_02	LT03	Pump 1 remote hand
	BI_03	HOA1HAND	Switch feedback Position 3
	BI_04	PUMP1	Output indication
	BI_05	PUMP1RUN	Contactor feedback
	BI_06	PUMP1FLT	Pump 1 fault status
	BI_07	P1LONGRT	Pump 1 long run time indication
	BI_08	LT02	Station disabled

Table D.8 DNP3 Default Data Map (Sheet 2 of 5)

Object	Default Index	Point Label	Description
	BI_09	AI_FAILT	Local transducer failed
	BI_10	UPS_ALM	Power fail
	BI_11	INT_DETC	Intrusion detection
	BI_12	PHS_ALM	Phase monitor alarm indication
	BI_13	P2ELT	Pump 2 status indication
	BI_14	HOA2AUTO	Switch feedback Position 1
	BI_15	LT04	Pump 2 remote hand
	BI_16	HOA2HAND	Switch feedback Position 3
	BI_17	PUMP2	Output indication
	BI_18	PUMP2RUN	Contactor feedback
	BI_19	PUMP2FLT	Pump 2 fault status
	BI_20	P2LONGRT	Pump 2 long run time indication
	BI_21	DIS_ALT	Alternation disabled indication
	BI_22	HIGH	Logical float value
	BI_23	STOP	Logical float value
	BI_24	LEAD	Logical float value
	BI_25	LAG1	Logical float value
	BI_26	LOW	Logical float value
	BI_27	FLO_SEQT	Float out-of-sequence indication
	BI_28	LAG2	Logical float value
	BI_29	P3ELT	Pump 3 status indication
	BI_30	HOA3AUTO	Switch feedback Position 1
	BI_31	LT05	Pump 3 remote hand
	BI_32	HOA3HAND	Switch feedback Position 3
	BI_33	PUMP3	Pump 3 status indication
	BI_34	PUMP3RUN	Contactor feedback
	BI_35	PUMP3FLT	Pump 3 fault alarm
	BI_36	P3LONGRT	Pump 3 long run time indication
	BI_37	FLOAT	LVL_INPUT is set to FLOAT
	BI_38	ANALOG	LVL_INPUT is set to ANALOG
	BI_39	ANA_W1F	LVL_INPUT is set to ANA_W1F
	BI_40	ANA_W2F	LVL_INPUT is set to ANA_W2F
	BI_41	ANA_WAF	LVL_INPUT is set to ANA_WAF
	BI_42	VMON_NC	VMON_IN is set to NC
	BI_43	VMON_NO	VMON_IN is set to NO
	BI_44	INTERNAL	VMON_SRC is set to INTERNAL or BOTH
	BI_45	EXTERNAL	VMON_SRC is set to EXTERNAL or BOTH
	BI_46	LOW_EN	LOW_EN is set to Y
	BI_47	HIGH_EN	HIGH_EN is set to Y
	BI_48	DUPLEX	STN_TYPE is set to DUPLEX

Table D.8 DNP3 Default Data Map (Sheet 3 of 5)

Object	Default Index	Point Label	Description
	BI_49	TRIPLEX	STN_TYPE is set to TRIPLEX
	BI_50	SINGLEUP	STN_TYPE is set to SINGLEUP
	BI_51	SINGLE	STN_TYPE is set to SINGLE
	BI_52	NORMAL	TRI_ALT is set to NORMAL
	BI_53	JOCKEY	TRI_ALT is set to JOCKEY
	BI_54	HI_SERVC	TRI_ALT is set to HI_SERVICE
BO_00	BO_00	RB01	Pump 1 remote hand
	BO_01	RB02	Station disable
	BO_02	RB03	Spare
	BO_03	RB04	Spare
	BO_04	RB05	Station enable
	BO_05	RB06	Spare
	BO_06	RB07	Pump 1 disable
	BO_07	RB08	Pump 2 disable
	BO_08	RB09	Pump 3 disable
	BO_09	RB10	Spare
	BO_10	RB11	Short term timers reset
	BO_11	RB12	General reset
	BO_12	RB13	Pump 2 remote hand
	BO_13	RB14	Pump 1 enable/remote auto
	BO_14	RB15	Pump 2 enable/remote auto
	BO_15	RB16	Pump 3 remote hand
	BO_16	RB17	Pump 3 enable/remote auto
	BO_17	RB18	Remote alternation disable
	BO_18	RB19	Remote alternation enable
	BO_19	RB20	Spare
	BO_20	RB21	Force alternation
	BO_21	RB22	Spare
	BO_22	RB23	Spare
	BO_23	RB24	Spare
	BO_24	RB25	Spare
	BO_25	RB26	Spare
	BO_26	RB27	Spare
	BO_27	RB28	Spare
	BO_28	RB29	Spare
	BO_29	RB30	Spare
	BO_30	RB31	Spare
	BO_31	RB32	Spare
30, 32, 34	AI_00	P1RT2H	Pump 1 runtime in minutes last 2 hours
	AI_01	P1RT1D	Pump 1 runtime in minutes last 24 hours
	AI_02	P1RT2D	Pump 1 runtime in minutes last 48 hours

Table D.8 DNP3 Default Data Map (Sheet 4 of 5)

Object	Default Index	Point Label	Description
	AI_03	P1RTTOT	Pump 1 total runtime
	AI_04	P1STC2H	Pump 1 starts last 2 hours
	AI_05	P1STC1D	Pump 1 starts last 24 hours
	AI_06	P1STC2D	Pump 1 starts last 48 hours
	AI_07	P1STCTOT	Pump 1 total start count
	AI_08	P1LASTST	Pump 1 Last Start Time
	AI_09	P2RT2H	Pump 2 runtime in minutes last 2 hours
	AI_10	P2RT1D	Pump 2 runtime in minutes last 24 hours
	AI_11	P2RT2D	Pump 2 runtime in minutes last 48 hours
	AI_12	P2RTTOT	Pump 2 total runtime
	AI_13	P2STC2H	Pump 2 starts last 2 hours
	AI_14	P2STC1D	Pump 2 starts last 24 hours
	AI_15	P2STC2D	Pump 2 starts last 48 hours
	AI_16	P2STCTOT	Pump 2 total start count
	AI_17	P2LASTST	Pump 2 last start time
	AI_18	HIGH_SP	HIGH virtual float set point
	AI_19	LOW_SP	LOW virtual float set point
	AI_20	STOP_SP	STOP virtual float set point
	AI_21	LEAD_SP	LEAD virtual float set point
	AI_22	LAG1_SP	LAG1 virtual float set point
	AI_23	LAG2_SP	LAG2 virtual float set point
	AI_24	LEVEL_IN	LEVEL_IN feedback
	AI_25	FLOW_IN	FLOW_IN feedback
	AI_26	P3RT2H	Pump 3 runtime in minutes last 2 hours
	AI_27	P3RT1D	Pump 3 runtime in minutes last 24 hours
	AI_28	P3RT2D	Pump 3 runtime in minutes last 48 hours
	AI_29	P3RTTOT	Pump 3 total runtime
	AI_30	P3STC2H	Pump 3 starts last 2 hours
	AI_31	P3STC1D	Pump 3 starts last 24 hours
	AI_32	P3STC2D	Pump 3 starts last 48 hours
	AI_33	P3STCTOT	Pump 3 total start count
	AI_34	P3LASTST	Pump 3 last start time
	AI_35	VAB_MAG	VAB line-to-line
	AI_36	VBC_MAG	VBC line-to-line
	AI_37	VCA_MAG	VCA line-to-line
	AI_38	VG_MAG	VG line-to-neutral
	AI_39	VA_MAG	VA line-to-neutral
	AI_40	VB_MAG	VB line-to-neutral
	AI_41	VC_MAG	VC line-to-neutral

Table D.8 DNP3 Default Data Map (Sheet 5 of 5)

Object	Default Index	Point Label	Description
40, 41	AO_00	ACV02	HIGH_SP virtual float set point
	AO_01	ACV03	LOW_SP virtual float set point
	AO_02	ACV04	STOP_SP float set point
	AO_03	ACV05	LEAD_SP virtual float set point
	AO_04	ACV06	LAG1_SP virtual float set point
	AO_05	ACV07	LAG2_SP virtual float set point
	AO_06	ACV01	Remote fluid level measurement from external analog sensor (NETWORK LEVEL)
	AO_07	ACV08	Single float run time
	AO_08	ACV09	Backspin timer

Control Point Operation

You can define any two RB points as a pair for Trip/Close or Code Selection operations with Object 12 control device output block command messages. The SEL-2411P assigns some special operations to the code portion of the control device output block command. *Table D.9* demonstrates how you can use this functionality for both paired and non-paired points. Pulse operations for remote bits provide a pulse with duration of one protection-processing interval.

Table D.9 Example Object 12 Trip/Close or Code Selection Operation

Control Points	Trip/Close		Code Selection Operation		
	Close/PULSE_ON	Trip/PULSE_ON	Null/LATCH_ON	Null/LATCH_OFF	Null/PULSE_ON
RB01:RB02	PULSE ON RB02	PULSE ON RB01	NOT_SUPPORTED	NOT_SUPPORTED	NOT_SUPPORTED
RB03	PULSE ON RB03	PULSE ON RB03	SET RB03	CLEAR RB03	PULSE ON RB03

Appendix E
Modbus Communications

Overview

This appendix describes Modbus RTU and Modbus TCP communications features supported by the SEL-2411P Pump Automation Controller. Complete specifications for the Modbus protocol are available from the Modbus website at www.modbus.org.

Modbus TCP is automatically available with the Ethernet port. Modbus TCP uses the device IP address as the Modbus identifier and accesses the data in the SEL-2411P using the same function codes and data maps as Modbus RTU. The TCP port for Modbus TCP is 502.

Modbus Queries

Modbus RTU master devices initiate all exchanges by sending a query. The SEL-2411P SLAVEID setting defines the device address. Set this value to a unique number for each device on the Modbus network. For Modbus communication to operate properly, each slave device must have a different address.

Modbus Responses

The slave device sends a response message after it performs the action the query specifies. If the slave device cannot execute the query command for any reason, it sends an error response. Otherwise the slave device response is formatted similarly to the query and includes the slave address, function code, data (if applicable), and a cyclical redundancy check value.

Supported Modbus Function Codes

The SEL-2411P supports the Modbus function codes shown in *Table E.1*.

Table E.1 SEL-2411P Modbus Function Codes

Codes	Modbus Description	Device Description
01h	Read Discrete Output Coil Status	Read the status of the digital output and remote bits.
02h	Read Discrete Input Status	Read the status of the digital inputs.
03h	Read Holding Registers	Read data from the Modbus map.
04h	Read Input Register	Read data from the Modbus map similarly to function code 03.
05h[a]	Force Single Coil	Control the status of the digital outputs and remote bits.
06h[a]	Preset Single Register	Write data directly to a single register in the Modbus map.
08h	Diagnostic Command	Test the Modbus communications channel.
10h[a]	Preset Multiple Register	Preset Multiple Register.

[a] The SEL-2411P supports the Broadcast function on these functions.

Function Code Details

01h Read Discrete Output Coil Status Command

Use function code 01h to read the On/Off status of the selected bits (coils) (see the Modbus Register Map shown in *Table E.16*). Note that the SEL-2411P coil addresses start at 0 (e.g., Coil 1 is located at address zero). The coil status is packed one coil per bit of the data field. The Least Significant Bit (LSB) of the first data byte contains the starting coil address in the query. The other coils follow towards the high order end of this byte and from low order to high order in subsequent bytes.

To build the response, the SEL-2411P calculates the number of bytes required to contain the number of bits requested. If the number of bits requested is not evenly divisible by eight, the device adds one more byte to maintain the balance of bits, padded by zeros to make an even byte. *Table E.2* includes the coil number and lists all possible coils (identified as Outputs and Remote bits) available in the device. Note that the command depends on the device hardware configuration; the device responds only to installed cards.

Table E.2 01h SEL-2411P Outputs

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description	Note
0	0	01h	OUT101	
1	1	01h	OUT102	
2	2	01h	OUT103	
19–22	13–16	01h	OUT501–OUT504	a
27–30	1B–1E	01h	OUT601–OUT604	
35–50	23–32	01h	RB01–RB16	
51–66	33–42	01h	RB17–RB32	

[a] Returns 0 if not installed.

The device responses to errors in the query are shown in *Table E.3*.

Table E.3 Response to 01h Read Discrete Output Coil Status Query Errors

Error	Error Code Returned	Communication Counter Increments
Invalid bit to read	Illegal Data Address (02h)	Invalid Address
Invalid number of bits to read	Illegal Data Value (03h)	Illegal Register
Format error	Illegal Data Value (03h)	Bad Packet Format

02 Read Input Status Command

Use function code 02h to read the On/Off status of the selected bits (inputs). You can read the status of as many as 2000 bits per query. Note that input addresses start at 0 (e.g., Input 1 is located at address zero). The input status is packed one input per bit of the data field. The LSB of the first data byte contains the starting input address in the query. The other inputs follow towards the high order end of this byte, and from low order to high order in subsequent bytes.

Table E.4 02h Read Input Status Command

Bytes	Field
Requests from the master must have the following format:	
1 byte	Slave Address
1 byte	Function Code (02h)
2 bytes	Address of the first bit
2 bytes	Numbers of bits to read
2 bytes	CRC-16
A successful response from the slave will have the following format:	
1 byte	Slave Address
1 byte	Function Code (02h)
1 byte	Bytes of data (*n*)
n bytes	Data
2 bytes	CRC-16

To build the response, the device calculates the number of bytes required to contain the number of bits requested. If the number of bits requested is not evenly divisible by eight, the device adds one more byte to maintain the balance of bits, padded by zeros to make an even byte.

NOTE: Refer to Appendix G: Device Word Bits for individual elements.

In each row, the input numbers are assigned from the right-most input to the left-most input (i.e., Input 1 is N and Input 8 is EN). Input addresses start at 0000 (i.e., Input 1 is located at Input Address 0000). *Table E.5* includes the coil address in decimal and hex and lists all possible inputs (Device Word bits) available in the device. Note that the command depends on the device hardware configuration; the device responds only to installed cards. The device responses to errors in the query are shown in *Table E.6*.

Table E.5 SEL-2411P Inputs

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description	Notes
0–7	0–7	02h	Device Element Status Row 0	The input numbers are assigned from the right-most input to the left-most input in the device row as shown in an example below. Address 7 = Enabled Address 6 = T00_LED Address 5 = T01_LED Address 4 = T02_LED Address 3 = T03_LED Address 2 = T04_LED Address 1 = T05_LED Address 0 = T06_LED
8–15	8–F	02h	Device Element Status Row 1	
16–1059	10–447	02h	Device Element Status Row 2–136[a]	

[a] Returns 0 if associated hardware is not installed.

Table E.6 Responses to 02h Read Input Query Errors

Error	Error Code Returned	Communication Counter Increments
Invalid bit to read	Illegal Data Address (02h)	Invalid Address
Invalid number of bits to read	Illegal Data Value (03h)	Illegal Register
Format Error	Illegal Data Value (03h)	Bad Packet Format

03h Read Holding Register Command

Use function code 03h to read directly from the Modbus Register Map shown in *Table E.16*.

You can read a maximum of 125 registers at once with this function code. Most masters use 4X references with this function code. For five-digit addressing, add 40001 to the standard database address.

The device responses to errors in the query are shown in *Table E.7*.

Table E.7 Responses to 03h Read Holding Registry Query Errors

Error	Error Code Returned	Communication Counter Increments
Invalid register to read	Illegal Data Address (02h)	Invalid Address
Invalid number of registers to read	Illegal Data Value (03h)	Illegal Register
Format Error	Illegal Data Value (03h)	Bad Packet Format

04h Read Input Register Command

Use function code 04h to read directly from the Modbus Register Map shown in *Table E.16*. You can read a maximum of 125 registers at once with this function code. Most masters use 4X references with this function code. For five-digit addressing, add 40001 to the standard database address.

The device responses to errors in the query are shown in *Table E.8*.

Table E.8 Responses to 04h Read Holding Registry Query Errors

Error	Error Code Returned	Communication Counter Increments
Invalid register to read	Illegal Data Address (02h)	Invalid Address
Invalid number of registers to read	Illegal Data Value (03h)	Illegal Register
Format Error	Illegal Data Value (03h)	Bad Packet Format

05h Force Single Coil Command

Use function code 05h to set or clear a coil. In *Table E.9*, the command response is identical to the command request.

Table E.9 lists the coil numbers supported by the SEL-2411P. The physical coils (Coils 1–34) are self-resetting. Pulsing a Set remote bit (decimal address 68–99) causes the remote bit to be cleared at the end of the pulse.

Table E.9 05 Force Single Coil Command

Coil Address in Decimal	Coil Address in Hex	Function Code Supported	Coil Description
0–34	0–22	05h	Pulse OUT101–OUT608 1 second
35–66	23–42	05h	RB01–RB32
67–98	43–62	05h	Pulse RB01–RB32 (1 SELOGIC Processing Interval)

Coil addresses start at 0000 (i.e., Coil 1 is located at Coil address 0000). If the device is disabled it will respond with Error Code 4 (Device Error). In addition to Error Code 4, the device responses to errors in the query are shown in *Table E.10*.

Table E.10 Responses to 05h Force Single Coil Query Errors

Error	Error Code Returned	Communication Counter Increments
Invalid bit (coil) to read	Illegal Data Address (02h)	Invalid Address
Invalid bit state requested	Illegal Data Value (03h)	Illegal Register
Format Error	Illegal Data Value (03h)	Bad Packet Format

06h Preset Single Register Command

The SEL-2411P uses this function to allow a Modbus master to write directly to a database register. Refer to the Modbus Register Map in *Table E.16* for a list of registers that can be written by using this function code. For six-digit addressing, add 400001 to the standard database addresses.

The device responses to errors in the query are shown in *Table E.11*.

Table E.11 Responses to 06h Preset Single Register Query Errors

Error	Error Code Returned	Communication Counter Increments
Invalid register address	Illegal Data Address (02h)	Invalid Address Illegal Write
Illegal register value	Illegal Data Value (03h)	Illegal Write
Format Error	Illegal Data Value (03h)	Bad Packet Format

10h Preset Multiple Registers Command

This function code works much like code 06h, except that it allows you to write multiple registers at once, as many as 100 per operation. For six-digit addressing, simply add 400001 to the standard database addresses.

The device responds to errors in the query as shown in *Table E.12*.

Table E.12 10h Preset Multiple Register Query Error Messages

Error	Error Code Returned	Communication Counter Increments
Illegal register to set	Illegal Data Address (02h)	Invalid Address Illegal Write
Illegal number of registers to set	Illegal Data Value (03h)	Illegal Register Illegal Write
Incorrect number of bytes in query data region	Illegal Data Value (03h)	Bad Packet Format Illegal Write
Invalid register data value	Illegal Data Value (03h)	Illegal Write

Reading History Data Using Modbus

Through use of the Modbus Register Map (*Table E.16*), you can download a complete history of the last five events via Modbus. The history contains the date and time stamp, type of event that triggered the report, currents, and voltages at the time of the event. Refer to the Historical Data section in the map.

To use Modbus to download history data, write the event number (1–5) to the EVENT LOG SEL register at address 0176h. Then read the history of the specific event number you requested from the registers shown in the Historical Data section of the Modbus Register Map (*Table E.16*).

Controlling Output Contacts and Remote Bits Using Modbus

The SEL-2411P Modbus Register Map (*Table E.16*) includes three fields that allow a Modbus master to force the device to perform a variety of operations. Use Modbus function codes 06h or 10h to write the appropriate command codes and parameters into the registers shown in *Table E.13*. If function code 06h is used to write to a command code that has parameters, the parameters must be written before the command code. After issuing a command, parameters 1 and 2 are cleared and must be rewritten prior to the next command. *Table E.13* defines the command codes in decimal and hex and their functions and associated parameter(s).

Table E.13 Device Outputs

Command Code in Decimal	Command Code in Hex	Function	Parameter 1	Parameter 2
1	1	Reset Targets	N/A	N/A
2	2	Trigger	N/A	N/A
3–5	3–5	Pulse OUT101–OUT103	[a]	N/A
22–25	16–19	Pulse OUT501–OUT504	[a]	N/A
30–34	1E–22	Pulse OUT601–OUT604	[a]	N/A
38	26	Reset Data Regions	[b]	N/A
39	27	Control Remote Bits 1–16	[c]	[d]
40	28	Control Remote Bits 17–32	[c]	[d]
44	2C	Reset Min/Max	N/A	N/A

[a] Pulse output for 1–30 s, default is 1 s.
[b] This parameter determines the type of operation with the following values: 01—Modbus Communication Counters.
[c] This parameter determines the type of operation with the following values: 01 Set, 02 Clear, 03 Pulse (one processing interval).
[d] This parameter is bitmasked for the remote bits. If more than one bit occurs in the parameter, then the highest numbered bit will be controlled. For example, for a parameter 2 value of 0003h, only RB02 will be controlled.

Table E.14 SEL-2411P Modbus Command Region

Parameter 2 for Command Code 39	Parameter 2 for Command Code 40
0000 0000 0000 0001—RB01	0000 0000 0000 0001—RB17
0000 0000 0000 0010—RB02	0000 0000 0000 0010—RB18
0000 0000 0000 0100—RB03	0000 0000 0000 0100—RB19
0000 0000 0000 1000—RB04	0000 0000 0000 1000—RB20
0000 0000 0001 0000—RB05	0000 0000 0001 0000—RB21
0000 0000 0010 0000—RB06	0000 0000 0010 0000—RB22
0000 0000 0100 0000—RB07	0000 0000 0100 0000—RB23
0000 0000 1000 0000—RB08	0000 0000 1000 0000—RB24
0000 0001 0000 0000—RB09	0000 0001 0000 0000—RB25
0000 0010 0000 0000—RB10	0000 0010 0000 0000—RB26
0000 0100 0000 0000—RB11	0000 0100 0000 0000—RB27
0000 1000 0000 0000—RB12	0000 1000 0000 0000—RB28
0001 0000 0000 0000—RB13	0001 0000 0000 0000—RB29
0010 0000 0000 0000—RB14	0010 0000 0000 0000—RB30
0100 0000 0000 0000—RB15	0100 0000 0000 0000—RB31
1000 0000 0000 0000—RB16	1000 0000 0000 0000—RB32

Table E.15 shows the Modbus Command Region.

Table E.15 SEL-2411P Modbus Command Region

Decimal Address	HEX Address	Function Code Supported	Field
2000	7D0	06h, 10h	Parameter 2
2001	7D1	06h, 10h	Parameter 1
2002	7D2	06h, 10h	Command Code

Conversion Table

One way to present data in a suitable range and resolution is to scale the data before transmission, normally by dividing or multiplying by powers of 10. Use the information in *Table E.17* to convert the units of the received data into the appropriate scale for further processing or display.

Modbus Register Map

Table E.16 Modbus Register Map (Sheet 1 of 15)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
Device ID								
0–21	00–15	03h, 04h	12				FID Char (1–44)	
22–43	16–2B	03h, 04h	12				BFID Char (1–44)	
44–45	2C–2D	03h, 04h	12				CID Char (1–4)	
46–53	2E–35	03h, 04h	12				DEVID Char (1–16)	
54	36	03h, 04h	1				DEVCODE	
55–64	37–40	03h, 04h	12				Part Number Char (1–20)	
65–67	41–43	03h, 04h	12				Config (1–6)	
68–149	44–95	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
Device Status								
150	96	03h, 04h	0	0	1		IA Status 0-OK, 1-WARN	
151	97	03h, 04h	0	0	1		IB Status 0-OK, 1-WARN	
152	98	03h, 04h	0	0	1		IC Status 0-OK, 1-WARN	
157	9D	03h, 04h	0	8000	8000	8000	Reserved = 8000 Hex	
158	9E	03h, 04h	0	0	1		FPGA Status 0-OK, 2-FAIL	
159	9F	03h, 04h	0	0	1		GPSB Status 0-OK, 2-FAIL	
160	A0	03h, 04h	0	0	1		HMI Status 0-OK, 1-WARN	
161	A1	03h, 04h	0	0	1		RAM Status 0-OK, 2-FAIL	
162	A2	03h, 04h	0	0	1		ROM Status 0-OK, 2-FAIL	
163	A3	03h, 04h	0	0	1		CR_RAM Status 0-OK, 2-FAIL	
164	A4	03h, 04h	0	0	1		NON_VOL Status 0-OK, 2-FAIL	
165	A5	03h, 04h	0	0	1		CLK_BAT Status 0-OK, 1-WARN	
166	A6	03h, 04h	0	0	1		CLOCK Status 0-OK, 1-WARN	
167	A7	03h, 04h	0	0	1		CARD C Status 0-OK, 2-FAIL	
168	A8	03h, 04h	0	0	1		CARD D Status 0-OK, 2-FAIL	

Table E.16 **Modbus Register Map** (Sheet 2 of 15)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
169	A9	03h, 04h	0	0	1		CARD E Status 0-OK, 2-FAIL	
170	AA	03h, 04h	0	0	1		CARD Z Status 0-OK, 2-FAIL	
171	AB	03h, 04h	0	0	1		ENABLED 0-Enabled, 2-Disabled	
178	B2	03h, 04h	0	0	1		3.3V Status 0-OK, 1-Warn, 2-Fail	
179	B3	03h, 04h	0	0	1		5.0V Status 0-OK, 1-Warn, 2-Fail	
180	B4	03h, 04h	0	0	1		2.5V Status 0-OK, 1-Warn, 2-Fail	
181	B5	03h, 04h	0	0	1		3.75V Status 0-OK, 1-Warn, 2-Fail	
182	B6	03h, 04h	0	0	1		-1.25V Status 0-OK, 1-Warn, 2-Fail	
183	B7	03h, 04h	0	0	1		-5.0V Status 0-OK, 1-Warn, 2-Fail	
184	B8	03h, 04h	0	0	1		0.9V Status 0-OK, 1-Warn, 2-Fail	
185	B9	03h, 04h	0	0	1		1.2V Status 0-OK, 1-Warn, 2-Fail	
186	BA	03h, 04h	0	0	1		1.5V Status 0-OK, 1-Warn, 2-Fail	
187	BB	03h, 04h	0	0	1		1.8V Status 0-OK, 1-Warn, 2-Fail	
188–199	BC–C7	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
211	D3	03h, 04h	1	0	65535	0	IAX Magnitude	A
212	D4	03h, 04h	7	–1800	1800	0	IAX Angle	deg
213	D5	03h, 04h	1	0	65535	0	IBX Magnitude	A
214	D6	03h, 04h	7	–1800	1800	0	IBX Angle	deg
215	D7	03h, 04h	1	0	65535	0	ICX Magnitude	A
216	D8	03h, 04h	7	–1800	1800	0	ICX Angle	deg
217	D9	03h, 04h	1	0	65535	0	IGX Magnitude	A
218	DA	03h, 04h	7	–1800	1800	0	IGX Angle	deg
219	DB	03h, 04h	1	0	65535	0	312X Magnitude	A
Voltage Data								
250	FA	03h, 04h	13	0	5200000	0	VAB Magnitude—UW[a]	V
251	FB	03h, 04h				0	VAB Magnitude—LW[b]	V
252	FC	03h, 04h	7	–1800	1800	0	VAB Angle	deg
253	FD	03h, 04h	13	0	5200000	0	VBC Magnitude—UW	V
254	FE	03h, 04h				0	VBC Magnitude—LW	V
255	FF	03h, 04h	7	–1800	1800	0	VBC Angle	deg
256	100	03h, 04h	13	0	5200000	0	VCA Magnitude—UW	V
257	101	03h, 04h				0	VCA Magnitude—LW	V
258	102	03h, 04h	7	–1800	1800	0	VCA Angle	deg
259	103	03h, 04h	13	0	5200000	0	VAN Magnitude—UW	V
260	104	03h, 04h				0	VAN Magnitude—LW	V
261	105	03h, 04h	7	–1800	1800	0	VAN Angle	deg
262	106	03h, 04h	13	0	5200000	0	VBN Magnitude—UW	V
263	107	03h, 04h				0	VBN Magnitude—LW	V
264	108	03h, 04h	7	–1800	1800	0	VBN Angle	deg
265	109	03h, 04h	13	0	5200000	0	VCN Magnitude—UW	V
266	10A	03h, 04h				0	VCN Magnitude—LW	V

Table E.16 Modbus Register Map (Sheet 3 of 15)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
267	10B	03h, 04h	7	–1800	1800	0	VCN Angle	deg
268	10C	03h, 04h	13	0	5200000	0	VG Magnitude—UW	V
269	10D	03h, 04h				0	VG Magnitude—LW	V
270	10E	03h, 04h	7	–1800	1800	0	VG Angle	deg
271	10F	03h, 04h	13	0	5200000	0	3V2 Magnitude—UW	V
272	110	03h, 04h				0	3V2 Magnitude—LW	V
273–299	111–12B	03h, 04h	5	8000	8000	0	Reserved = 8000 Hex	
Power Data								
328	148	03h, 04h	13	–200000000	200000000	0	Phase A Real PowerX^c—UW	kW
329	149	03h, 04h				0	Phase A Real PowerX^c—LW	kW
330	14A	03h, 04h	13	–200000000	200000000	0	Phase A Reactive PowerX^c—UW	kVAR
331	14B	03h, 04h				0	Phase A Reactive PowerX^c—LW	kVAR
332	14C	03h, 04h	13	–200000000	200000000	0	Phase A Apparent PowerX^c—UW	kVA
333	14D	03h, 04h				0	Phase A Apparent PowerX^c—LW	kVA
334	14E	03h, 04h	8	–100	100	0	Phase A PowerX^c Factor	
335	14F	03h, 04h	13	–200000000	200000000	0	Phase B Real PowerX^c—UW	kW
336	150	03h, 04h				0	Phase B Real PowerX^c—LW	kW
337	151	03h, 04h	13	–200000000	200000000	0	Phase B Reactive PowerX^c—UW	kVAR
338	152	03h, 04h				0	Phase B Reactive PowerX^c—LW	kVAR
339	153	03h, 04h	13	–200000000	200000000	0	Phase B Apparent PowerX^c—UW	kVA
340	154	03h, 04h				0	Phase B Apparent PowerX^c—LW	kVA
341	155	03h, 04h	8	–100	100	0	Phase B PowerX^c Factor	
342	156	03h, 04h	13	–200000000	200000000	0	Phase C Real PowerX^c—UW	kW
343	157	03h, 04h				0	Phase C Real PowerX^c—LW	kW
344	158	03h, 04h	13	–200000000	200000000	0	Phase C Reactive PowerX^c—UW	kVAR
345	159	03h, 04h				0	Phase C Reactive PowerX^c—LW	kVAR
346	15A	03h, 04h	13	–200000000	200000000	0	Phase C Apparent PowerX^c—UW	kVA
347	15B	03h, 04h				0	Phase C Apparent PowerX^c—LW	kVA
348	15C	03h, 04h	8	–100	100	0	Phase C PowerX^c Factor	
349	15D	03h, 04h	13	–200000000	200000000	0	3 Phase Real PowerX^c—UW	kW
350	15E	03h, 04h				0	3 Phase Real PowerX^c—LW	kW
351	15F	03h, 04h	13	–200000000	200000000	0	3 Phase Reactive PowerX^c—UW	kVAR

Table E.16 Modbus Register Map (Sheet 4 of 15)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
352	160	03h, 04h				0	3 Phase Reactive PowerXc—LW	kVAR
353	161	03h, 04h	13	–200000000	200000000	0	3 Phase Apparent PowerXc—UW	kVA
354	162	03h, 04h				0	3 Phase Apparent PowerXc—LW	kVA
355	163	03h, 04h	8	–100	100	0	3 Phase PowerXc Factor	
356	164	03h, 04h	13	–200000000	200000000	0	3 Phase Real Power Delta 2 Voltage 2 Current Method—UW	kW
357	165	03h, 04h				0	3 Phase Real Power Delta 2 Voltage 2 Current Method—LW	kW
363	16B	03h, 04h	13	–200000000	200000000	0	3 Phase Real PowerX Delta 2 Voltage 2 Current Method—UW	kW
364	16C	03h, 04h				0	3 Phase Real PowerX Delta 2 Voltage 2 Current Method—LW	kW
365	16D	03h, 04h	13	–200000000	200000000	0	3 Phase Reactive PowerX Delta 2 Voltage 2 Current Method—UW	kVAR
366	16E	03h, 04h				0	3 Phase Reactive PowerX Delta 2 Voltage 2 Current Method—LW	kVAR
367	16F	03h, 04h	13	–200000000	200000000	0	3 Phase Apparent PowerX Delta 2 Voltage 2 Current Method—UW	kVA
368	170	03h, 04h				0	3 Phase Apparent PowerX Delta2 Voltage 2 Current Method—LW	kVA
369	171	03h, 04h	8	–100	100	0	Power FactorX Delta 2 Voltage 2 Current Method	
Frequency								
380	17C	03h, 04h	7	440	660	600	Frequency	Hz
381–399	17D–18F	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
Historical Data								
400	190	03h, 04h	1	0	30	0	Number of Event Records	
401	191	03h, 04h, 06h, 10h	1	0	30	0	Event Summary Record Selected	
402	192	03h, 04h	3	0	5999	0	Event Time ss.ss	
403	193	03h, 04h	1	0	59	0	Event Time mm	
404	194	03h, 04h	1	0	23	0	Event Time hh	
405	195	03h, 04h	1	1	31	1	Event Day DD	
406	196	03h, 04h	1	1	12	1	Event Month MM	
407	197	03h, 04h	1	0	2999	0	Event Year YYYY	
408	198	03h, 04h	10	0	2	0	Event Type 0 = No Event 1 = Trigger 2 = ER Trigger	
409	199	03h, 04h	3	4400	6600		Event Frequency	Hz
414	19E	03h, 04h	13	0	5200000	0	Event VAB/VAN—UW	V
415	19F	03h, 04h				0	Event VAB/VAN—LW	V
416	1A0	03h, 04h	13	0	5200000	0	Event VBC/VBN—UW	V

Table E.16 Modbus Register Map (Sheet 5 of 15)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
417	1A1	03h, 04h				0	Event VBC/VBN—LW	V
418	1A2	03h, 04h	13	0	5200000	0	Event VCA/VCN—UW	V
419	1A3	03h, 04h				0	Event VCA/VCN—LW	V
420	1A4	03h, 04h	10	0	1	0	0 = Delta 1 = Wye	
469	1D5	03h, 04h	16	–2147483648	+2147483647	0	Event AIx01—UW	EU
470	1D6	03h, 04h				0	Event AIx01—LW	EU
471	1D7	03h, 04h	16	–2147483648	+2147483647	0	Event AIx02—UW	EU
472	1D8	03h, 04h				0	Event AIx02—LW	EU
473	1D9	03h, 04h	16	–2147483648	+2147483647	0	Event AIx03—UW	EU
474	1DA	03h, 04h				0	Event AIx03—LW	EU
475	1DB	03h, 04h	16	–2147483648	+2147483647	0	Event AIx04—UW	EU
476	1DC	03h, 04h				0	Event AIx04—LW	EU
477	1DD	03h, 04h	16	–2147483648	+2147483647	0	Event AIx05—UW	EU
478	1DE	03h, 04h				0	Event AIx05—LW	EU
479	1DF	03h, 04h	16	–2147483648	+2147483647	0	Event AIx06—UW	EU
480	1E0	03h, 04h				0	Event AIx06—LW	EU
481	1E1	03h, 04h	16	–2147483648	+2147483647	0	Event AIx07—UW	EU
482	1E2	03h, 04h				0	Event AIx07—LW	EU
483	1E3	03h, 04h	16	–2147483648	+2147483647	0	Event AIx08—UW	EU
484	1E4	03h, 04h				0	Event AIx08—LW	EU
509	1FD	03h, 04h	16	–2147483648	+2147483647	0	Event AOx01—UW	EU
510	1FE	03h, 04h				0	Event AOx01—LW	EU
511	1FF	03h, 04h	16	–2147483648	+2147483647	0	Event AOx02—UW	EU
512	200	03h, 04h				0	Event AOx02—LW	EU
513	201	03h, 04h	16	–2147483648	+2147483647	0	Event AOx03—UW	EU
514	202	03h, 04h				0	Event AOx03—LW	EU
515	203	03h, 04h	16	–2147483648	+2147483647	0	Event AOx04—UW	EU
516	204	03h, 04h				0	Event AOx04—LW	EU
520–549	208–225	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
Analog Inputs								
598	256	03h, 04h	16	–2147483648	+2147483648	0	AIx01—UW	EU
599	257	03h, 04h				0	AIx01—LW	EU
600	258	03h, 04h	16	–2147483648	+2147483648	0	AIx02—UW	EU
601	259	03h, 04h				0	AIx02—LW	EU
602	25A	03h, 04h	16	–2147483648	+2147483648	0	AIx03—UW	EU
603	25B	03h, 04h				0	AIx03—LW	EU
604	25C	03h, 04h	16	–2147483648	+2147483648	0	AIx04—UW	EU
605	25D	03h, 04h				0	AIx04—LW	EU
614–649	266–289	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
682–699	2AA–2BB	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
Math Variables								
700–731	2BC–2DB	03h, 04h	15	–1677721599	+1677721599	0	MV01 [0: UW], [1: LW] to MV16 [0: UW], [1: LW]	
732–763	2DC–2FB	03h, 04h	15	–1677721599	+1677721599	0	MV17 [0: UW], [1: LW] to MV32 [0: UW], [1: LW]	
764–794	2FC–31A	03h, 04h	15	–1677721599	+1677721599	0	MV33 [0: UW], [1: LW] to MV48 [0: UW], [1: LW]	
795–827	31B–33B	03h, 04h	15	–1677721599	+1677721599	0	MV49 [0: UW], [1: LW] to MV64 [0: UW], [1: LW]	
828–899	33C–383	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	

Table E.16 Modbus Register Map (Sheet 6 of 15)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
Device Counters								
900–915	384–393	03h, 04h	1	0	65000	0	SC01–SC16	
916–931	394–3A3	03h, 04h	1	0	65000	0	SC17–SC32	
932–949	3A4–3B5	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
Device Date/Time								
950	3B6	03h, 04h, 06h, 10h	3	0	59		ss	
951	3B7	03h, 04h, 06h, 10h	1	0	59		mm	
952	3B8	03h, 04h, 06h, 10h	1	0	23		HH	
953	3B9	03h, 04h, 06h, 10h	1	1	31		DD	
954	3BA	03h, 04h, 06h, 10h	1	1	12		MM	
955	3BB	03h, 04h, 06h, 10h	1	2000	2999		YY	
956–999	3BC–3E7	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
Device Element Status								
1000	3E8	03h, 04h	11	0	65281		Row 0 Bit 0 = 1 if any bits 1–15 are asserted Bits 1–7 = 0 Bit 8 = T06_LED Bit 9 = T05_LED Bit 10 = T04_LED Bit 11 = T03_LED Bit 12 = T02_LED Bit 13 = T01_LED Bit 14 = T00_LED Bit 15 = Enabled	
1001–1144	3E9–478	03h, 04h	11	0	65281		Row 1–144	
1145–1149	479–47D	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
Modbus Communications Counters								
1150	47E	03h, 04h	11	0	65535	0	Number of Message Received	
1151	47F	03h, 04h	11	0	65535	0	Number of Messages to Other devices	
1152	480	03h, 04h	11	0	65535	0	Invalid Address	
1153	481	03h, 04h	1	0	65535	0	Bad CRC	
1154	482	03h, 04h	1	0	65535	0	UART Error	
1155	483	03h, 04h	1	0	65535	0	Illegal Function	
1156	484	03h, 04h	1	0	65535	0	Illegal Register	
1157	485	03h, 04h	1	0	65535	0	Illegal Write	
1158	486	03h, 04h	1	0	65535	0	Bad Packet Format	
1159	487	03h, 04h	1	0	65535	0	Bad Packet Length	
1160–1199	488–4AF	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
Remote Analogs								
1200–1263	4B0–4EF	03h, 04h, 06h, 10h	15	–9999999	9999999	0	RA001 [0: UW], [1: LW] to RA032 [0: UW], [1: LW]	
1264–1327	440–52F	03h, 04h, 06h, 10h	15	–9999999	9999999	0	RA033 [0: UW], [1: LW] to RA064 [0: UW], [1: LW]	

Table E.16 Modbus Register Map (Sheet 7 of 15)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
1328–1391	530–56F	03h, 04h, 06h, 10h	15	–9999999	9999999	0	RA065 [0: UW], [1: LW] to RA096 [0: UW], [1: LW]	
1392–1455	570–5AF	03h, 04h, 06h, 10h	15	–9999999	9999999	0	RA097 [0: UW], [1: LW] to RA128 [0: UW], [1: LW]	
1456–1999	5B0–7CF	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
Command Region								
2000	7D0	03h, 04h, 06h[d], 10h	11				Parameter 2[e]	
2001	7D1	03h, 04h, 06h[d], 10h	11				Parameter 1[e]	
2002	7D2	03h, 04h, 06h[d] 10h	11				Command Code[e]	
2222	8AE	03h, 04h	13	0	5200000	0	VAB MAX—UW	V
2223	8AF	03h, 04h		0		0	VAB MAX—LW	V
2224	8B0	03h, 04h	13	0	5200000	0	VAB MIN—UW	V
2225	8B1	03h, 04h		0		0	VAB MIN—LW	V
2226	8B2	03h, 04h	13	0	5200000	0	VBC MAX—UW	V
2227	8B3	03h, 04h		0		0	VBC MAX—LW	V
2228	8B4	03h, 04h	13	0	5200000	0	VBC MIN—UW	V
2229	8B5	03h, 04h		0		0	VBC MIN—LW	V
2230	8B6	03h, 04h	13	0	5200000	0	VCA MAX—UW	V
2231	8B7	03h, 04h		0		0	VCA MAX—LW	V
2232	8B8	03h, 04h	13	0	5200000	0	VCA MIN—UW	V
2233	8B9	03h, 04h		0		0	VCA MIN—LW	V
2234	8BA	03h, 04h	13	0	5200000	0	VA MAX—UW	V
2235	8BB	03h, 04h		0		0	VA MAX—LW	V
2236	8BC	03h, 04h	13	0	5200000	0	VA MIN—UW	V
2237	8BD	03h, 04h		0		0	VA MIN—LW	V
2238	8BE	03h, 04h	13	0	5200000	0	VB MAX—UW	V
2239	8BF	03h, 04h		0		0	VB MAX—LW	V
2240	8C0	03h, 04h	13	0	5200000	0	VB MIN—UW	V
2241	8C1	03h, 04h		0		0	VB MIN—LW	V
2242	8C2	03h, 04h	13	0	5200000	0	VC MAX—UW	V
2243	8C3	03h, 04h		0		0	VC MAX—LW	V
2244	8C4	03h, 04h	13	0	5200000	0	VC MIN—UW	V
2245	8C5	03h, 04h		0		0	VC MIN—LW	V
2270	8DE	03h, 04h	1	440	660	0	Frequency MAX	Hz
2271	8DF	03h, 04h	1	440	660	0	Frequency MIN	Hz
2272–2499	8E0–9C3	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
Demand Data								
2106	83A	03h, 04h	1	0	65535	0	Demand IAX	A
2107	83B	03h, 04h	1	0	65535	0	Demand IBX	A
2108	83C	03h, 04h	1	0	65535	0	Demand ICX	A
2109	83D	03h, 04h	1	0	65535	0	Demand IGX	A
2110	83E	03h, 04h	1	0	65535	0	Demand 3I2X	A
2111–2149	83F–865	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
Peak Demand Data								
2156	86C	03h, 04h	1	0	65535	0	Peak Demand IAX	A
2157	86D	03h, 04h	1	0	65535	0	Peak Demand IBX	A
2158	86E	03h, 04h	1	0	65535	0	Peak Demand ICX	A

Table E.16 Modbus Register Map (Sheet 8 of 15)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
2159	86F	03h, 04h	1	0	65535	0	Peak Demand IGX	A
2160	870	03h, 04h	1	0	65535	0	Peak Demand 3I2X	A
2161–2199	871–897	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
Min/Max Data								
2212	8A4	03h, 04h	1	0	65535	0	IAX MAX	A
2213	8A5	03h, 04h	1	0	65535	0	IAX MIN	A
2214	8A6	03h, 04h	1	0	65535	0	IBX MAX	A
2215	8A7	03h, 04h	1	0	65535	0	IBX MIN	A
2216	8A8	03h, 04h	1	0	65535	0	ICX MAX	A
2217	8A9	03h, 04h	1	0	65535	0	ICX MIN	A
2218	8AA	03h, 04h	1	0	65535	0	IGX MAX	A
2219	8AB	03h, 04h	1	0	65535	0	IGX MIN	A
2220	8AC	03h, 04h	1	0	65535	0	3I2X MAX	A
2221	8AD	03h, 04h	1	0	65535	0	3I2X MIN	A
2258	8D2	03h, 04h	13	–200000000	200000000	0	3-Phase Real Power X MAX – Upper Word	kW
2259	8D3	03h, 04h		0		0	3-Phase Real Power X MAX – Lower Word	kW
2260	8D4	03h, 04h	13	–200000000	200000000	0	3-Phase Real Power X MIN – Upper Word	kW
2261	8D5	03h, 04h		0		0	3-Phase Real Power X MIN – Lower Word	kW
2262	8D6	03h, 04h	13	–200000000	200000000	0	3-Phase Reactive Power X MAX – Upper Word	kVAR
2263	8D7	03h, 04h		0		0	3-Phase Reactive Power X MAX – Lower Word	kVAR
2264	8D8	03h, 04h	13	–200000000	200000000	0	3-Phase Reactive Power X MIN – Upper Word	kVAR
2265	8D9	03h, 04h		0		0	3-Phase Reactive Power X MIN – Lower Word	kVAR
2266	8DA	03h, 04h	13	–200000000	200000000	0	3-Phase Apparent Power X MAX – Upper Word	kVA
2267	8DB	03h, 04h		0		0	3-Phase Apparent Power X MAX – Lower Word	kVA
2268	8DC	03h, 04h	13	–200000000	200000000	0	3-Phase Apparent Power X MIN – Upper Word	kVA
2269	8DD	03h, 04h		0		0	3-Phase Apparent Power X MIN – Lower Word	kVA
Energy Data								
2508	9CC	03h, 04h	13	0	1000000	0	Real Energy 3-Phase Real Power X In – Upper Word	MWh
2509	9CD	03h, 04h					Real Energy 3-Phase Real Power X In – Lower Word	MWh
2510	9CE	03h, 04h	13	0	1000000	0	Real Energy 3-Phase Real Power X Out – Upper Word	MWh
2511	9CF	03h, 04h					Real Energy 3-Phase Real Power X Out – Lower Word	MWh
2512	9D0	03h, 04h	13	0	1000000	0	Reactive Energy 3-Phase Reactive Power X In – Upper Word	MVARh
2513	9D1	03h, 04h					Reactive Energy 3-Phase Reactive Power X In – Lower Word	MVARh

Table E.16 Modbus Register Map (Sheet 9 of 15)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
2514	9D2	03h, 04h	13	0	1000000	0	Reactive Energy 3-Phase Reactive Power X Out – Upper Word	MVARh
2515	9D3	03h, 04h					Reactive Energy 3-Phase Reactive Power X Out – Lower Word	MVARh
Device Counters								
2516	9D4	03h, 04h	1	0	16777215	0	SC01—UW	
2517	9D5					0	SC01—LW	
2518	9D6	03h, 04h	1	0	16777215	0	SC02—UW	
2519	9D7					0	SC02—LW	
2520	9D8	03h, 04h	1	0	16777215	0	SC03—UW	
2521	9D9					0	SC03—LW	
2522	9DA	03h, 04h	1	0	16777215	0	SC04—UW	
2523	9DB					0	SC04—LW	
2524	9DC	03h, 04h	1	0	16777215	0	SC05—UW	
2525	9DD					0	SC05—LW	
2526	9DE	03h, 04h	1	0	16777215	0	SC06—UW	
2527	9DF					0	SC06—LW	
2528	9E0	03h, 04h	1	0	16777215	0	SC07—UW	
2529	9E1					0	SC07—LW	
2530	9E2	03h, 04h	1	0	16777215	0	SC08—UW	
2531	9E3					0	SC08—LW	
2532	9E4	03h, 04h	1	0	16777215	0	SC09—UW	
2533	9E5					0	SC09—LW	
2534	9E6	03h, 04h	1	0	16777215	0	SC10—UW	
2535	9E7					0	SC10—LW	
2536	9E8	03h, 04h	1	0	16777215	0	SC11—UW	
2537	9E9					0	SC11—LW	
2538	9EA	03h, 04h	1	0	16777215	0	SC12—UW	
2539	9EB					0	SC12—LW	
2540	9EC	03h, 04h	1	0	16777215	0	SC13—UW	
2541	9ED					0	SC13—LW	
2542	9EE	03h, 04h	1	0	16777215	0	SC14—UW	
2543	9EF					0	SC14—LW	
2544	9F0	03h, 04h	1	0	16777215	0	SC15—UW	
2545	9F1					0	SC15—LW	
2546	9F2	03h, 04h	1	0	16777215	0	SC16—UW	
2547	9F3					0	SC16—LW	
2548	9F4	03h, 04h	1	0	16777215	0	SC17—UW	
2549	9F5					0	SC17—LW	
2550	9F6	03h, 04h	1	0	16777215	0	SC18—UW	
2551	9F7					0	SC18—LW	
2552	9F8	03h, 04h	1	0	16777215	0	SC19—UW	
2553	9F9					0	SC19—LW	
2554	9FA	03h, 04h	1	0	16777215	0	SC20—UW	
2555	9FB					0	SC20—LW	
2556	9FC	03h, 04h	1	0	16777215	0	SC21—UW	
2557	9FD					0	SC21—LW	
2558	9FE	03h, 04h	1	0	16777215	0	SC22—UW	
2559	9FF					0	SC22—LW	
2560	A00	03h, 04h	1	0	16777215	0	SC23—UW	

Table E.16 Modbus Register Map (Sheet 10 of 15)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
2561	A01					0	SC23—LW	
2562	A02	03h, 04h	1	0	16777215	0	SC24—UW	
2563	A03					0	SC24—LW	
2564	A04	03h, 04h	1	0	16777215	0	SC25—UW	
2565	A05					0	SC25—LW	
2566	A06	03h, 04h	1	0	16777215	0	SC26—UW	
2567	A07					0	SC26—LW	
2568	A08	03h, 04h	1	0	16777215	0	SC27—UW	
2569	A09					0	SC27—LW	
2570	A0A	03h, 04h	1	0	16777215	0	SC28—UW	
2571	A0B					0	SC28—LW	
2572	A0C	03h, 04h	1	0	16777215	0	SC29—UW	
2573	A0D					0	SC29—LW	
2574	A0E	03h, 04h	1	0	16777215	0	SC30—UW	
2575	A0F					0	SC30—LW	
2576	A10	03h, 04h	1	0	16777215	0	SC31—UW	
2577	A11					0	SC31—LW	
2578	A12	03h, 04h	1	0	16777215	0	SC32—UW	
2579	A13				0		SC32—LW	
2580–2643	A14–A53	03h, 04h	5	8000	8000	8000	Reserved = 8000	
Analog Control Variables								
2644	A54	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV01—UW	
2645	A55	03h, 04h, 06h[d] 10h				0	ACV01—LW	
2646	A56	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV02—UW	
2647	A57	03h, 04h, 06h[d] 10h				0	ACV02—LW	
2648	A58	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV03—UW	
2649	A59	03h, 04h, 06h[d] 10h				0	ACV03—LW	
2650	A5A	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV04—UW	
2651	A5B	03h, 04h, 06h[d] 10h				0	ACV04—LW	
2652	A5C	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV05—UW	
2653	A5D	03h, 04h, 06h[d] 10h				0	ACV05—LW	
2654	A5E	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV06—UW	
2655	A5F	03h, 04h, 06h[d] 10h				0	ACV06—LW	
2656	A60	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV07—UW	
2657	A61	03h, 04h, 06h[d] 10h				0	ACV07—LW	
2658	A62	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV08—UW	
2659	A63	03h, 04h, 06h[d] 10h				0	ACV08—LW	

Table E.16 Modbus Register Map (Sheet 11 of 15)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
2660	A64	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV09—UW	
2661	A65	03h, 04h, 06h[d] 10h				0	ACV09—LW	
2662	A66	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV10—UW	
2663	A67	03h, 04h, 06h[d] 10h				0	ACV10—LW	
2664	A68	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV11—UW	
2665	A69	03h, 04h, 06h[d] 10h				0	ACV11—LW	
2666	A6A	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV12—UW	
2667	A6B	03h, 04h, 06h[d] 10h				0	ACV12—LW	
2668	A6C	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV13—UW	
2669	A6D	03h, 04h, 06h[d] 10h				0	ACV13—LW	
2670	A6E	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV14—UW	
2671	A6F	03h, 04h, 06h[d] 10h				0	ACV14—LW	
2672	A70	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV15—UW	
2673	A71	03h, 04h, 06h[d] 10h				0	ACV15—LW	
2674	A72	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV16—UW	
2675	A73	03h, 04h, 06h[d] 10h				0	ACV16—LW	
2676	A74	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV17—UW	
2677	A75	03h, 04h, 06h[d] 10h				0	ACV17—LW	
2678	A76	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV18—UW	
2679	A77	03h, 04h, 06h[d] 10h				0	ACV18—LW	
2680	A78	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV19—UW	
2681	A79	03h, 04h, 06h[d] 10h				0	ACV19—LW	
2682	A7A	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV20—UW	
2683	A7B	03h, 04h, 06h[d] 10h				0	ACV20—LW	
2684	A7C	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV21—UW	
2685	A7D	03h, 04h, 06h[d] 10h				0	ACV21—LW	
2686	A7E	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV22—UW	
2687	A7F	03h, 04h, 06h[d] 10h				0	ACV22—LW	

Table E.16 Modbus Register Map (Sheet 12 of 15)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
2688	A80	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV23—UW	
2689	A81	03h, 04h, 06h[d] 10h				0	ACV23—LW	
2690	A82	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV24—UW	
2691	A83	03h, 04h, 06h[d] 10h				0	ACV24—LW	
2692	A84	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV25—UW	
2693	A85	03h, 04h, 06h[d] 10h				0	ACV25—LW	
2694	A86	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV26—UW	
2695	A87	03h, 04h, 06h[d] 10h				0	ACV26—LW	
2696	A88	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV27—UW	
2697	A89	03h, 04h, 06h[d] 10h				0	ACV27—LW	
2698	A8A	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV28—UW	
2699	A8B	03h, 04h, 06h[d] 10h				0	ACV28—LW	
2700	A8C	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV29—UW	
2701	A8D	03h, 04h, 06h[d] 10h				0	ACV29—LW	
2702	A8E	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV30—UW	
2703	A8F	03h, 04h, 06h[d] 10h				0	ACV30—LW	
2704	A90	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV31—UW	
2705	A91	03h, 04h, 06h[d] 10h				0	ACV31—LW	
2706	A92	03h, 04h, 06h[d] 10h	15	–1677721599	1677721599	0	ACV32—UW	
2707	A93	03h, 04h, 06h[d] 10h				0	ACV32—LW	
2708–2899	A94–B53	03h, 04h	5	8000	8000	8000	Reserved = 8000 Hex	
Pump Operating Statistics								
2900	B54	3, 4	1	0	65535	0	P1STC2H—Pump 1 two-hour start count	
2901	B55	3, 4	1	0	65535	0	P2STC2H—Pump 2 two-hour start count	
2902	B56	3, 4	1	0	65535	0	P3STC2H—Pump 3 two-hour start count	
2903	B57	3, 4	1	0	65535	0	P4STC2H—Pump 4 two-hour start count	
2904	B58	3, 4	1	0	65535	0	P1STC1D—Pump 1 one-day start count	
2905	B59	3, 4	1	0	65535	0	P2STC1D—Pump 2 one-day start count	

Table E.16 Modbus Register Map (Sheet 13 of 15)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
2906	B5A	3, 4	1	0	65535	0	P3STC1D—Pump 3 one-day start count	
2907	B5B	3, 4	1	0	65535	0	P4STC1D—Pump 4 one-day start count	
2908	B5C	3, 4	1	0	65535	0	P1STC2D—Pump 1 two-day start count	
2909	B5D	3, 4	1	0	65535	0	P2STC2D—Pump 2 two-day start count	
2910	B5E	3, 4	1	0	65535	0	P3STC2D—Pump 3 two-day start count	
2911	B5F	3, 4	1	0	65535	0	P4STC2D—Pump 4 two-day start count	
2912	B60	3, 4	13	0	16777215	0	P1STTOT—Pump 1 total start count—UW	
2913	B61	3, 4				0	P1STTOT—Pump 1 total start count—LW	
2914	B62	3, 4	13	0	16777215	0	P2STTOT—Pump 2 total start count—UW	
2915	B63	3, 4				0	P2STTOT—Pump 2 total start count—LW	
2916	B64	3, 4	13	0	16777215	0	P3STTOT—Pump 3 total start count—UW	
2917	B65	3, 4				0	P3STTOT—Pump 3 total start count—LW	
2918	B66	3, 4	13	0	16777215	0	P4STTOT—Pump 4 total start count—UW	
2919	B67	3, 4				0	P4STTOT—Pump 4 total start count—LW	
2920	B68	3, 4	2	0	1200	0	P1RT2H—Pump 1 two-hour run time	
2921	B69	3, 4	2	0	1200	0	P2RT2H—Pump 2 two-hour run time	
2922	B6A	3, 4	2	0	1200	0	P3RT2H—Pump 3 two-hour run time	
2923	B6B	3, 4	2	0	1200	0	P4RT2H—Pump 4 two-hour run time	
2924	B6C	3, 4	2	0	14400	0	P1RT1D—Pump 1 one-day run time	
2925	B6D	3, 4	2	0	14400	0	P2RT1D—Pump 2 one-day run time	
2926	B6E	3, 4	2	0	14400	0	P3RT1D—Pump 3 one-day run time	
2927	B6F	3, 4	2	0	14400	0	P4RT1D—Pump 4 one-day run time	
2928	B70	3, 4	2	0	28800	0	P1RT2D—Pump 1 two-day run time	
2929	B71	3, 4	2	0	28800	0	P2RT2D—Pump 2 two-day run time	
2930	B72	3, 4	2	0	28800	0	P3RT2D—Pump 3 two-day run time	
2931	B73	3, 4	2	0	28800	0	P4RT2D—Pump 4 two-day run time	
2932	B74	3, 4	15	0	1677721599	0	P1RTTOT—Pump 1 total run time—UW	
2933	B75	3, 4				0	P1RTTOT—Pump 1 total run time—LW	

Table E.16 Modbus Register Map (Sheet 14 of 15)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
2934	B76	3, 4	15	0	1677721599	0	P2RTTOT—Pump 2 total run time—UW	
2935	B77	3, 4				0	P2RTTOT—Pump 2 total run time—LW	
2936	B78	3, 4	15	0	1677721599	0	P3RTTOT—Pump 3 total run time—UW	
2937	B79	3, 4				0	P3RTTOT—Pump 3 total run time—LW	
2938	B7A	3, 4	15	0	1677721599	0	P4RTTOT—Pump 4 total run time—UW	
2939	B7B	3, 4				0	P4RTTOT—Pump 4 total run time—LW	
2940	B7C	3, 4	1	0	65535	0	STG1CRTM—Stage 1 cycle run time	
2941	B7D	3, 4	1	0	65535	0	STG2CRTM—Stage 2 cycle run time	
2942	B7E	3, 4	1	0	65535	0	STG3CRTM—Stage 3 cycle run time	
2943	B7F	3, 4	1	0	65535	0	STG4CRTM—Stage 4 cycle run time	
2944-3099	B80-C1B	3, 4	5	8000	8000	8000	Reserved = 8000 Hex	
2411P Analog Logic Settings								
3100	C1C	3, 4	15	–1677721599	1677721599	0	LEVEL_IN—analog level—UW	
3101	C1D	3, 4				0	LEVEL_IN—analog level—LW	
3102	C1E	3, 4	15	–1677721599	1677721599	0	FLOW_IN—analog flow—UW	
3103	C1F	3, 4				0	FLOW_IN—analog flow—LW	
3104	C20	3, 4	15	–1677721599	1677721599	0	LOW_SP—level set point—UW	
3105	C21	3, 4				0	LOW_SP—level set point—LW	
3106	C22	3, 4	15	–1677721599	1677721599	0	STOP_SP—level set point—UW	
3107	C23	3, 4				0	STOP_SP—level set point—LW	
3108	C24	3, 4	15	–1677721599	1677721599	0	LEAD_SP—level set point—UW	
3109	C25	3, 4				0	LEAD_SP—level set point—LW	
3110	C26	3, 4	15	–1677721599	1677721599	0	LAG1_SP—level set point—UW	
3111	C27	3, 4				0	LAG1_SP—level set point—LW	
3112	C28	3, 4	15	–1677721599	1677721599	0	LAG2_SP—level set point—UW	
3113	C29	3, 4				0	LAG2_SP—level set point—LW	
3114	C2A	3, 4	15	–1677721599	1677721599	0	LAG3_SP—level set point—UW	
3115	C2B	3, 4				0	LAG3_SP—level set point—LW	

Table E.16 Modbus Register Map (Sheet 15 of 15)

Address in Decimal	Address in Hex	Function Code Supported	Conversion	Min	Max	Default	Name/Enums	Units
3116	C2C	3, 4	15	–1677721599	1677721599	0	HIGH_SP—level set point—UW	
3117	C2D	3, 4				0	HIGH_SP—level set point—LW	
3118	C2E	3, 4	15	–1677721599	1677721599	0	VLL_THRS—line-to-line low V threshold—UW	
3119	C2F	3, 4				0	VLL_THRS—line-to-line low V threshold—LW	
3120	C30	3, 4	15	0	8640000	0	LGST_TM—lag start time—UW	
3121	C31	3, 4				0	LGST_TM—lag start time—LW	
3122-3999	C32-F9F	3, 4	5	8000	8000	8000	Reserved = 8000 Hex	
4000-65535	FA0-FFFF	3, 4	5	8000	8000	8000	Reserved = 8000 Hex	

[a] UW = Upper Word.
[b] LW = Lower Word.
[c] Available if 3 ACI/3 AVI I/O card is installed in Slot E.
[d] If function code 6 is used to write to the command code region that has parameters, the parameters must be written first.
[e] Once the command code is written, the parameters 1 and 2 are cleared and must be rewritten prior to the next command.

Table E.17 Conversion Table

Index[a]	Type	Multiply	Divide	Offset	Base
0	Boolean	1	1	0	1
1	Unsigned Integer	1	1	0	1
2	Unsigned Integer	1	10	0	1
3	Unsigned Integer	1	100	0	1
4	HEX	1	1000	0	1
5	Integer	1	1	0	1
6	Integer	1	1	0	1
7	Integer	1	10	0	1
8	Integer	1	100	0	1
9	Integer	1	1000	0	1
10	Enumeration	1	1	0	1
11	Bit Enumeration	1	1	0	1
12	Two 8 bit ASCII characters	1	1	0	1
13	Long Integer	1	1	0	1
14	Long Integer	1	10	0	1
15	Long Integer	1	100	0	1
16	Long Integer	1	1000	0	1

[a] Refers to the conversion column in Table E.16.

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Appendix F
MIRRORED BITS Communications

Overview

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

MIRRORED BITS is a direct device-to-device communications protocol that allows IEDs to exchange information quickly, securely, and with minimal expense. Use MIRRORED BITS for functions such as remote control and remote sensing. The SEL-2411P Pump Automation Controller supports two MIRRORED BITS communications channels, designated A and B. Use the port setting PROTO to assign one of the MIRRORED BITS communications channels to a serial port; PROTO := MBA for MIRRORED BITS communications Channel A or PROTO := MBB for MIRRORED BITS communications Channel B. MIRRORED BITS are either Transmit MIRRORED BITS (TMB) or Received MIRRORED BITS (RMB). Transmit MIRRORED BITS include TMB1A–TMB8A (Channel A) and TMB1B–TMB8B (Channel B). The last letter (A or B) designates with which channel the bits are associated. Received bits include RMB1A–RMB8A and RMB1B–RMB8B. Control the transmit MIRRORED BITS in SELOGIC control equations. Use the received MIRRORED BITS as arguments in SELOGIC control equations. The channel status bits are ROKA, RBADA, CBADA, LBOKA, ROKB, RBADB, CBADB, and LBOKB. You can also use these channel status bits as arguments in SELOGIC control equations. Use the **COM** command (see *Section 7: Communications*) for additional channel status information.

Because of different applications, the SEL product range supports several variations of the MIRRORED BITS communications protocol. Through port settings, you can set the SEL-2411P for compatible operation with SEL-300 series devices, SEL-2505 Remote I/O Modules, and SEL-2100 Logic Processors. When communicating with an SEL-400 series relay, be sure to set the transmission mode setting in the SEL-400 series relay to paced transmission (TXMODE: = P).

Operation

Message Transmission

In the SEL-2411P, the MIRRORED BITS transmission rate is a function of both the baud rate and the power system cycle. At baud rates below 9600, the SEL-2411P transmits MIRRORED BITS as fast as possible for the given baud. At rates at and above 9600 baud the SEL-2411P self-paces, using a technique similar to the SEL-400 series pacing mode. There are no settings to enable or disable the self-pacing mode; the SEL-2411P automatically enters the self-pacing mode at baud rates of 9600, 19200, and 38400. *Table F.1* shows the transmission rates of the MIRRORED BITS messages at different baud.

Table F.1 Number of MIRRORED BITS Messages for Different Baud

Baud Rate	Transmission Rate of MIRRORED BITS Packets
2400	15 ms
4800	7.5 ms
9600	4 times a power system cycle (automatic pacing mode)
19200	4 times a power system cycle (automatic pacing mode)
38400	4 times a power system cycle (automatic pacing mode)

Transmitting at longer intervals for baud rates above 9600 avoids overflowing devices that receive MIRRORED BITS at a slower rate.

Message Reception Overview

During synchronized MIRRORED BITS communications with the communications channel in normal state, the device decodes and checks each received message. If the message is valid, the device sends each received logic bit (RMB*n*, where *n* = 1 through 8) to the corresponding pickup and dropout security counters, that in turn set or clear the RMB*n*A and RMB*n*B device element bits.

Message Decoding and Integrity Checks

Set the RX_ID of the local SEL-2411P to match the TX_ID of the remote SEL-2411P. The SEL-2411P provides indication of the status of each MIRRORED BITS communications channel with Device Word bits ROKA (receive OK) and ROKB. During normal operation, the device sets the ROK*c* (*c* = A or B). Upon detecting any of the following conditions, the device clears the ROK*c* bit:

- The device is disabled.
- MIRRORED BITS are not enabled.
- Parity, framing, or overrun errors.
- Receive message identification error.
- No message received in the time that three messages have been sent when PROTO = MB*c*, or seven messages have been sent when PROTO = MB8*c*.
- Loopback is enabled.

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

While ROK*c* is deasserted, the device does not transfer new RMB data to the pickup-dropout security counters described below. Instead, the device sends one of the user-definable default values to the security counter inputs. For each RMB*n*, use the RXDFLT setting to determine the default state the MIRRORED BITS should use in place of received data if an error condition is detected. The setting is a mask of 1s, 0s, and/or Xs (for RMB1A–RMB8A), where X represents the most recently received valid value. The positions of the 1s and 0s correspond to the respective positions of the MIRRORED BITS in the Device Word bits (see *Appendix G: Device Word Bits*). *Table F.2* is an extract of *Appendix G: Device Word Bits*, showing the positions of the MIRRORED BITS.

Table F.2 Positions of the MIRRORED BITS

Bit/ Row	7	6	5	4	3	2	1	0
97	RMB8A	RMB7A	RMB6A	RMB5A	RMB4A	RMB3A	RMB2A	RMB1A
99	RMB8B	RMB7B	RMB6B	RMB5B	RMB4B	RMB3B	RMB2B	RMB1B

Table F.3 MIRRORED BITS Values for a RXDFLT Setting of 10100111

Bit/ Row	7	6	5	4	3	2	1	0
97	1	0	1	0	0	1	1	1

Table F.3 shows an example of the values of the MIRRORED BITS for a RXDFLT setting of 10100111.

Individual pickup and dropout security counters supervise the movement of each received data bit into the corresponding RMB*n* element. You can set each pickup/dropout security counter from 1 to 8. A setting of 1 causes a security counter to pass every occurrence, while a setting of 8 causes a counter to wait for eight consecutive occurrences in the received data before updating the data bits. The pickup and dropout security count settings are separate. Control the security count settings with the settings RMB*n*PU and RMB*n*DO.

A pickup/dropout security counter operates identically to a pickup/dropout timer, except that the counter uses units of counted received messages instead of time. Select a setting for the security counter in accordance with the transmission rate (see *Table F.1*). For example, when transmitting at 2400 baud, a security counter set to 2 counts delays a bit by about 30 ms. However, when operating at 9600 baud, a setting of 2 counts delays a bit by about 8.5 ms.

You must consider the impact of the security counter settings in the receiving device to determine the channel timing performance, particularly when two devices of different processing rates are communicating via MIRRORED BITS, such as an SEL-321 and an SEL-2411P. The SEL-321 processes power system information each 1/8 power system cycle, but, when transmitting at 19200 baud, the SEL-2411P processes MIRRORED BITS messages at 4.15 ms at 60 Hz (4 times per power system cycle at 60 Hz). Although the SEL-321 processes power system information each 1/8 power system cycle, the device processes the MIRRORED BITS pickup/dropout security counters as MIRRORED BITS messages are received. Because the SEL-2411P transmits messages at approximately 1/4-cycle processing interval (9600 baud and above, see *Table F.1*), a counter set to two in the SEL-321 delays a received bit by another approximately 1/2 cycle. However, a security counter in the SEL-2411P with a setting of two delays a received bit from the SEL-321 by 1/4 cycle, because the SEL-2411P is receiving new MIRRORED BITS messages each 1/8 cycle from the SEL-321.

Channel Synchronization

When an SEL-2411P detects a communications error, it deasserts ROKA or ROKB. If an SEL-2411P detects two consecutive communications errors, it transmits an attention message, which includes the TXID setting. The device transmits an attention message until it receives an attention message that includes a match to the TXID setting value. If the attention message is successful, the device has properly synchronized and data transmission resumes. If the attention message is not successful, the device repeats the attention message until it is successful.

In summary, when a device detects an error, it transmits an attention message until it receives an attention message with its own TX_ID included. If three or four devices are connected in a ring topology, the attention message will go all the way around the loop until the originating device receives it. The message then dies and data transmission resumes. This method of synchronization allows the devices to reliably determine which byte is the first byte of the message. It also forces unsynchronized UARTs to become resynchronized. On the down side, this method takes down the entire loop for a receive error at any device in the loop. This decreases availability. It also makes one-way communications impossible.

Loopback Testing

Use the **LOOP** command to enable loopback testing. In the loopback mode, you loop the transmit port to the receive port of the same device to verify transmission messages. While in loopback mode, ROK*c* is deasserted, and another user-accessible Device Word bit, LBOK*c* (Loop Back OK) asserts and deasserts based on the received data checks (see *Section 7: Communications* for the ASCII commands).

Channel Monitoring

Based on the results of data checks (described above), the device collects information regarding the 255 most recent communications errors. Each record contains at least the following fields:

- DATE—Date when the dropout occurred
- TIME—Time when the dropout occurred
- RECOVERY_DATE—Date when the channel returned to service (if the channel is currently failed, it is displayed and included in the calculations, as if its recovery were to occur at the time the report was requested)
- RECOVERY_TIME—Time when the channel returned to service (if the channel is currently failed, it is displayed and included in the calculations, as if its recovery were to occur at the time the report was requested)
- DURATION—Time elapsed during dropout
- CAUSE—Reason for dropout (see *Message Decoding and Integrity Checks on page F.2*)

There is a single record for each outage, but an outage can evolve. For example, the initial cause could be a data disagreement, but framing errors can extend the outage. If the channel is currently failed, it is displayed and included in the calculations, as if its recovery were to occur at the time the report was requested.

NOTE: Combine error conditions, including RBADA, RBADB, CBADA, and CBADB, with other alarm conditions using SELOGIC control equations. You can use these alarm conditions to program the device to take appropriate action when it detects a communications channel failure.

When the duration of an outage on Channel A or B exceeds a user-definable threshold, the device asserts a user-accessible Device Word bit, RBADA or RBADB. When channel unavailability exceeds a user-definable threshold for Channel A or B, the device asserts a user-accessible Device Word bit, CBADA or CBADB. Use the **COMM** command to generate a long or summary report of the communications errors.

Use the RBADPU setting to determine how long a channel error must last before the meter element RBADA is asserted. RBADA is deasserted when the channel error is corrected. RBADPU is accurate to ±1 second.

Use the CBADPU setting to determine the ratio of channel downtime to the total channel time before the meter element CBADA is asserted. The times used in the calculation are those that are available in the COM records. See *COMMUNICATIONS Command on page 7.8* for more information.

MIRRORED BITS Protocol for the Pulsar 9600 Baud Modem

To use a Pulsar MBT modem, set setting PROTO := MBTA or MBTB (Port settings). Setting PROTO := MBTA or MBTB hides setting SPEED (forces the baud to 9600), hides setting PARITY (forces parity to a value of 0), hides setting RTSCTS (forces RTSCTS to a value of N), and forces the transmit time to be faster than double the power system cycle. *Table F.4* shows the difference in message transmission periods when not using the Pulsar modem (PROTO ≠ MBTA or MBTB) and when using the Pulsar MBT modem (PROTO = MBTA or MBTB).

NOTE: You must consider the idle time in calculations of data transfer latency through a Pulsar MBT modem system.

Table F.4 MIRRORED BITS Communications Message Transmission Period

Baud	PROTO ≠ MBTA or MBTB	PROTO = MBTA or MBTB
38400	4 times a power system cycle	n/a
19200	4 times a power system cycle	n/a
9600	4 times a power system cycle	2 times a power system cycle
4800	7.5 ms	n/a

The device sets RTS to a negative voltage at the EIA-232 connector to signify that MIRRORED BITS communications matches this specification.

Appendix G
Device Word Bits

Overview

The protection and control element results are represented by Device Word bits in the SEL-2411P. Each Device Word bit has a label name and can be in either of the following states:

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

Logical 1 represents an element being picked up or otherwise asserted. Logical 0 represents an element being dropped out or otherwise deasserted. *Table G.1* and *Table G.2* show a list of Device Word bits and corresponding descriptions. The Device Word bit row numbers correspond to the row numbers used in the **TAR** command (see *TARGET Command (Display Device Word Bit Status) on page 7.22*).

Use any Device Word bit (except Row 0) in SELOGIC control equations (see *Section 4: Logic Functions*) and the Sequential Events Recorder (SER) trigger list settings (see *Section 9: Analyzing Events*).

Table G.1 SEL-2411P Device Word Bits (Sheet 1 of 4)

Bit/Row	Device Word Bits							
	7	6	5	4	3	2	1	0
TAR 0	ENABLED	T00_LED[a]	T01_LED	T02_LED	T03_LED	T04_LED	T05_LED	T06_LED
1	PB01_LED	PB02_LED	PB03_LED	PB04_LED	FREQTRK	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
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

Table G.1 SEL-2411P Device Word Bits (Sheet 2 of 4)

Bit/ Row	Device Word Bits							
	7	6	5	4	3	2	1	0
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	RTS02	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	SC01QU	SC02QU	SC03QU	SC04QU	SC05QU	SC06QU	SC07QU	SC08QU
39	SC01QD	SC02QD	SC03QD	SC04QD	SC05QD	SC06QD	SC07QD	SC08QD
40	SC09QU	SC10QU	SC11QU	SC12QU	SC13QU	SC14QU	SC15QU	SC16QU
41	SC09QD	SC10QD	SC11QD	SC12QD	SC13QD	SC14QD	SC15QD	SC16QD
42	SC17QU	SC18QU	SC19QU	SC20QU	SC21QU	SC22QU	SC23QU	SC24QU
43	SC17QD	SC18QD	SC19QD	SC20QD	SC21QD	SC22QD	SC23QD	SC24QD
44	SC25QU	SC26QU	SC27QU	SC28QU	SC29QU	SC30QU	SC31QU	SC32QU
45	SC25QD	SC26QD	SC27QD	SC28QD	SC29QD	SC30QD	SC31QD	SC32QD
46	RSTENRGY	DSABLSET	RSTTRGT	ER	TRGTR	SPEN	MATHSTRT	MATHTSK
47	RELAY_EN	RSTMXMN	RSTDEM	RSTPKDM	MATHERR	ERTDIN	ERTDFLT	IRTDFLT[b]
48	IN101	IN102	*	*	*	*	*	*
49	IN301[c]	IN302[c]	IN303[c]	IN304[c]	IN305[c]	IN306[c]	IN307[c]	IN308[c]
50	IN401[c]	IN402[c]	IN403[c]	IN404[c]	IN405[c]	IN406[c]	IN407[c]	IN408[c]
51	IN501	IN502	IN503	IN504	IN505	IN506	IN507	IN508
52	IN601	IN602	IN603	IN604	IN605[c]	IN606[c]	IN607[c]	IN608[c]
53	OUT101	OUT102	OUT103	*	*	*	*	*
54	OUT301[c]	OUT302[c]	OUT303[c]	OUT304[c]	OUT305[c]	OUT306[c]	OUT307[c]	OUT308[c]
55	OUT401[c]	OUT402[c]	OUT403[c]	OUT404[c]	OUT405[c]	OUT406[c]	OUT407[c]	OUT408[c]
56	OUT501	OUT502	OUT503	OUT504	OUT505[c]	OUT506[c]	OUT507[c]	OUT508[c]
57	OUT601	OUT602	OUT603	OUT604	OUT605[c]	OUT606[c]	OUT607[c]	OUT608[c]
58	AILW1	AILW2	AILAL	*	AIHW1	AIHW2	AIHAL	*
59	AI301LW1[c]	AI301LW2[c]	AI301LAL[c]	*	AI301HW1[c]	AI301HW2[c]	AI301HAL[c]	*
60	AI302LW1[c]	AI302LW2[c]	AI302LAL[c]	*	AI302HW1[c]	AI302HW2[c]	AI302HAL[c]	*
61	AI303LW1[c]	AI303LW2[c]	AI303LAL[c]	*	AI303HW1[c]	AI303HW2[c]	AI303HAL[c]	*
62	AI304LW1[c]	AI304LW2[c]	AI304LAL[c]	*	AI304HW1[c]	AI304HW2[c]	AI304HAL[c]	*
63	AI305LW1[c]	AI305LW2[c]	AI305LAL[c]	*	AI305HW1[c]	AI305HW2[c]	AI305HAL[c]	*
64	AI306LW1[c]	AI306LW2[c]	AI306LAL[c]	*	AI306HW1[c]	AI306HW2[c]	AI306HAL[c]	*
65	AI307LW1[c]	AI307LW2[c]	AI307LAL[c]	*	AI307HW1[c]	AI307HW2[c]	AI307HAL[c]	*
66	AI308LW1[c]	AI308LW2[c]	AI308LAL[c]	*	AI308HW1[c]	AI308HW2[c]	AI308HAL[c]	*
67	AI401LW1[c]	AI401LW2[c]	AI401LAL[c]	*	AI401HW1[c]	AI401HW2[c]	AI401HAL[c]	*
68	AI402LW1[c]	AI402LW2[c]	AI402LAL[c]	*	AI402HW1[c]	AI402HW2[c]	AI402HAL[c]	*
69	AI403LW1[c]	AI403LW2[c]	AI403LAL[c]	*	AI403HW1[c]	AI403HW2[c]	AI403HAL[c]	*
70	AI404LW1[c]	AI404LW2[c]	AI404LAL[c]	*	AI404HW1[c]	AI404HW2[c]	AI404HAL[c]	*
71	AI405LW1[c]	AI405LW2[c]	AI405LAL[c]	*	AI405HW1[c]	AI405HW2[c]	AI405HAL[c]	*

Table G.1 SEL-2411P Device Word Bits (Sheet 3 of 4)

Bit/ Row	Device Word Bits							
	7	6	5	4	3	2	1	0
72	AI406LW1[c]	AI406LW2[c]	AI406LAL[c]	*	AI406HW1[c]	AI406HW2[c]	AI406HAL[c]	*
73	AI407LW1[c]	AI407LW2[c]	AI407LAL[c]	*	AI407HW1[c]	AI407HW2[c]	AI407HAL[c]	*
74	AI408LW1[c]	AI408LW2[c]	AI408LAL[c]	*	AI408HW1[c]	AI408HW2[c]	AI408HAL[c]	*
75	AI501LW1	AI501LW2	AI501LAL	*	AI501HW1	AI501HW2	AI501HAL	*
76	AI502LW1	AI502LW2	AI502LAL	*	AI502HW1	AI502HW2	AI502HAL	*
77	AI503LW1	AI503LW2	AI503LAL	*	AI503HW1	AI503HW2	AI503HAL	*
78	AI504LW1	AI504LW2	AI504LAL	*	AI504HW1	AI504HW2	AI504HAL	*
79	AI505LW1	AI505LW2	AI505LAL	*	AI505HW1	AI505HW2	AI505HAL	*
80	AI506LW1	AI506LW2	AI506LAL	*	AI506HW1	AI506HW2	AI506HAL	*
81	AI507LW1	AI507LW2	AI507LAL	*	AI507HW1	AI507HW2	AI507HAL	*
82	AI508LW1	AI508LW2	AI508LAL	*	AI508HW1	AI508HW2	AI508HAL	*
83	AIx01LW1[c]	AIx01LW2[c]	AIx01LAL[c]	*	AIx01HW1[c]	AIx01HW2[c]	AIx01HAL[c]	*
84	AIx02LW1[c]	AIx02LW2[c]	AIx02LAL[c]	*	AIx02HW1[c]	AIx02HW2[c]	AIx02HAL[c]	*
85	AIx03LW1[c]	AIx03LW2[c]	AIx03LAL[c]	*	AIx03HW1[c]	AIx03HW2[c]	AIx03HAL[c]	*
86	AIx04LW1[c]	AIx04LW2[c]	AIx04LAL[c]	*	AIx04HW1[c]	AIx04HW2[c]	AIx04HAL[c]	*
87	AIx05LW1[c]	AIx05LW2[c]	AIx05LAL[c]	*	AIx05HW1[c]	AIx05HW2[c]	AIx05HAL[c]	*
88	AIx06LW1[c]	AIx06LW2[c]	AIx06LAL[c]	*	AIx06HW1[c]	AIx06HW2[c]	AIx06HAL[c]	*
89	AIx07LW1[c]	AIx07LW2[c]	AIx07LAL[c]	*	AIx07HW1[c]	AIx07HW2[c]	AIx07HAL[c]	*
90	AIx08LW1[c]	AIx08LW2[c]	AIx08LAL[c]	*	AIx08HW1[c]	AIx08HW2[c]	AIx08HAL[c]	*
91	LINKA	LINKB	LINKFAIL	PASEL	PBSEL	*	*	*
92	IN101E	IN102E	*	*	*	*	*	*
93	IN301E	IN302E	IN303E	IN304E	IN305E	IN306E	IN307E	IN308E
94	IN401E	IN402E	IN403E	IN404E	IN405E	IN406E	IN407E	IN408E
95	IN501E	IN502E	IN503E	IN504E	IN505E	IN506E	IN507E	IN508E
96	IN601E	IN602E	IN603E	IN604E	IN605E[c]	IN606E[c]	IN607E[c]	IN608E[c]
97	RMB8A	RMB7A	RMB6A	RMB5A	RMB4A	RMB3A	RMB2A	RMB1A
98	TMB8A	TMB7A	TMB6A	TMB5A	TMB4A	TMB3A	TMB2A	TMB1A
99	RMB8B	RMB7B	RMB6B	RMB5B	RMB4B	RMB3B	RMB2B	RMB1B
100	TMB8B	TMB7B	TMB6B	TMB5B	TMB4B	TMB3B	TMB2B	TMB1B
101	LBOKB	CBADB	RBADB	ROKB	LBOKA	CBADA	RBADA	ROKA
102	PB01	PB02	PB03	PB04	*	*	*	*
103	PB01_PUL	PB02_PUL	PB03_PUL	PB04_PUL	*	*	*	*
104	VB001	VB002	VB003	VB004	VB005	VB006	VB007	VB008
105	VB009	VB010	VB011	VB012	VB013	VB014	VB015	VB016
106	VB017	VB018	VB019	VB020	VB021	VB022	VB023	VB024
107	VB025	VB026	VB027	VB028	VB029	VB030	VB031	VB032
108	VB033	VB034	VB035	VB036	VB037	VB038	VB039	VB040
109	VB041	VB042	VB043	VB044	VB045	VB046	VB047	VB048
110	VB049	VB050	VB051	VB052	VB053	VB054	VB055	VB056
111	VB057	VB058	VB059	VB060	VB061	VB062	VB063	VB064
112	VB065	VB066	VB067	VB068	VB069	VB070	VB071	VB072
113	VB073	VB074	VB075	VB076	VB077	VB078	VB079	VB080
114	VB081	VB082	VB083	VB084	VB085	VB086	VB087	VB088
115	VB089	VB090	VB091	VB092	VB093	VB094	VB095	VB096
116	VB097	VB098	VB099	VB100	VB101	VB102	VB103	VB104
117	VB105	VB106	VB107	VB108	VB109	VB110	VB111	VB112
118	VB113	VB114	VB115	VB116	VB117	VB118	VB119	VB120
119	VB121	VB122	VB123	VB124	VB125	VB126	VB127	VB128
120	PB01BLED[a]	PB02BLED[a]	PB03BLED[a]	PB04BLED[a]	*	*	*	*
121	*	*	*	*	*	*	*	*
122	TSNTPB	TSNTPP	*	*	*	*	*	*

Table G.1 SEL-2411P Device Word Bits (Sheet 4 of 4)

Bit/ Row	Device Word Bits							
	7	6	5	4	3	2	1	0
123	IRIGOK	*	*	*	*	*	*	*
124	*	*	*	*	*	*	*	*
125	IAHW1[c]	IAHW2[c]	IAHAL[c]	*	IBHW1[c]	IBHW2[c]	IBHAL[c]	*
126	ICHW1[c]	ICHW2[c]	ICHAL[c]	*	INHW1[c]	INHW2[c]	INHAL[c]	*
127	IAXHW1	IAXHW2	IAXHAL	*	IBXHW1	IBXHW2	IBXHAL	*
128	ICXHW1	ICXHW2	ICXHAL	*	*	*	*	*
129	VAHW1	VAHW2	VAHAL	*	VBHW1	VBHW2	VBHAL	*
130	VCHW1	VCHW2	VCHAL	FLOAT	ANALOG	ANA_W1F	ANA_W2F	ANA_WAF
131	VALW1	VALW2	VALAL	*	VBLW1	VBLW2	VBLAL	*
132	VCLW1	VCLW2	VCLAL	*	*	*	*	*
133	VABHW1	VABHW2	VABHAL	*	VBCHW1	VBCHW2	VBCHAL	*
134	VCAHW1	VCAHW2	VCAHAL	*	*	*	*	*
135	VABLW1	VABLW2	VABLAL	*	VBCLW1	VBCLW2	VBCLAL	*
136	VCALW1	VCALW2	VCALAL	*	*	*	*	*
137	ACV01RST	ACV02RST	ACV03RST	ACV04RST	ACV05RST	ACV06RST	ACV07RST	ACV08RST
138	ACV09RST	ACV10RST	ACV11RST	ACV12RST	ACV13RST	ACV14RST	ACV15RST	ACV16RST
139	ACV17RST	ACV18RST	ACV19RST	ACV20RST	ACV21RST	ACV22RST	ACV23RST	ACV24RST
140	ACV25RST	ACV26RST	ACV27RST	ACV28RST	ACV29RST	ACV30RST	ACV31RST	ACV32RST
141	DNP1_TO	DNP2_TO	DNP3_TO	DNP4_TO	DNP5_TO	P2_TO	P3_TO	P4_TO
142	MOD1_TO	MOD2_TO	VMON_NC	VMON_NO	INTERNAL	EXTERNAL	LOW_EN	HIGH_EN
143	PUMP1EN	PUMP2EN	PUMP3EN	PUMP4EN	PUMP1RUN	PUMP2RUN	PUMP3RUN	PUMP4RUN
144	PUMP1FLT	PUMP2FLT	PUMP3FLT	PUMP4FLT	PUMP1FCL	PUMP2FCL	PUMP3FCL	PUMP4FCL
145	STG1CALL	STG2CALL	STG3CALL	STG4CALL	STAGE1	STAGE2	STAGE3	STAGE4
146	PUMP1	PUMP2	PUMP3	PUMP4	STG1ALM	STG2ALM	STG3ALM	STG4ALM
147	FRC_ALT	DIS_ALT	STAGSTRT	P1LONGRT	P2LONGRT	P3LONGRT	P4LONGRT	*
148	P1MINRT	P2MINRT	P3MINRT	P4MINRT	PUMP1STP	PUMP2STP	PUMP3STP	PUMP4STP
149	IN309	IN310	IN311	IN312	IN313	IN314	*	*
150	IN409	IN410	IN411	IN412	IN413	IN414	*	*
151	IN509	IN510	IN511	IN512	IN513	IN514	*	*
152	IN609	IN610	IN611	IN612	IN613	IN614	*	*
153	IN309E	IN310E	IN311E	IN312E	IN313E	IN314E	*	*
154	IN409E	IN410E	IN411E	IN412E	IN413E	IN414E	*	*
155	IN509E	IN510E	IN511E	IN512E	IN513E	IN514E	*	*
156	IN609E	IN610E	IN611E	IN612E	IN613E	IN614E	*	*
157	P1LEAD	P1LAG1	P1LAG2	P1LAG3	P2LEAD	P2LAG1	P2LAG2	P2LAG3
158	P3LEAD	P3LAG1	P3LAG2	P3LAG3	P4LEAD	P4LAG1	P4LAG2	P4LAG3
159	P1FLTRST	P2FLTRST	P3FLTRST	P4FLTRST	RSTP1DAT	RSTP2DAT	RSTP3DAT	RSTP4DAT
160	STOP	LEAD	LAG1	LAG2	LAG3	LOW	HIGH	*
161	STOP_IN	LEAD_IN	LAG1_IN	LAG2_IN	LAG3_IN	LOW_IN	HIGH_IN	AI_FAILT
162	ANA_STOP	ANA_LEAD	ANA_LAG1	ANA_LAG2	ANA_LAG3	ANA_LOW	ANA_HIGH	AI_FAIL
163	P1ELT	P2ELT	P3ELT	P4ELT	FLO_SEQ	FLO_SEQT	SFLO_TM	SFLO_TMT
164	P1LTSET	P2LTSET	P3LTSET	P4LTSET	P1LTRST	P2LTRST	P3LTRST	P4LTRST
165	HOA1AUTO	HOA2AUTO	HOA3AUTO	HOA4AUTO	HOA1HAND	HOA2HAND	HOA3HAND	HOA4HAND
166	INT_DETC	UPS_ALM	PHS_MON	ALM_HORN	ALMLIGHT	AUX_OUT	PHS_ALM	UP_DN
167	DUPLEX	TRIPLEX	SINGLEUP	SINGLE	*	NORMAL	JOCKEY	HI_SERVC

[a] PB01BLED–PB04BLED and T00_LED apply only to vertical SEL-2411P controllers.
[b] IRTDFLT also applies to internal general purpose RTD/TC card.
[c] Not available for orderable card options.

Definitions

Table G.2 Device Word Bit Definitions (Sheet 1 of 11)

Row	Bit	Definition
0	ENABLED	Device Enabled
	T00_LED	SELOGIC Equation: Drives LED T00 (only available in vertical SEL-2411Ps)
	T01_LED	SELOGIC Equation: Drives LED T01
	T02_LED	SELOGIC Equation: Drives LED T02
	T03_LED	SELOGIC Equation: Drives LED T03
	T04_LED	SELOGIC Equation: Drives LED T04
	T05_LED	SELOGIC Equation: Drives LED T05
	T06_LED	SELOGIC Equation: Drives LED T06
1	PB01_LED	SELOGIC Equation: Drives LED PB01
	PB02_LED	SELOGIC Equation: Drives LED PB02
	PB03_LED	SELOGIC Equation: Drives LED PB03
	PB04_LED	SELOGIC Equation: Drives LED PB04
	FREQTRK	Frequency tracking status bit
	SALARM	Software Alarms: invalid password, changing access levels, settings changes
	IRIGOK	IRIG-B Time Synchronism-Check Input Data are valid
	HALARM	Diagnostics Failure
2	RB01–RB08	Remote Bits RB01–RB08
3	RB09–RB16	Remote Bits RB09–RB16
4	RB17–RB24	Remote Bits RB17–RB24
5	RB25–RB32	Remote Bits RB25–RB32
6	LB01–LB08	Local Bits LB01–LB08
7	LB09–LB16	Local Bits LB09–LB16
8	LB17–LB24	Local Bits LB17–LB24
9	LB25–LB32	Local Bits LB25–LB32
10	SV01–SV08	SELOGIC variables SV01–SV08
11	SV01T–SV08T	SELOGIC variables SV01T–SV08T with settable pickup and dropout time delay
12	SV09–SV16	SELOGIC variables SV09–SV16
13	SV09T–SV16T	SELOGIC variables SV09T–SV16T with settable pickup and dropout time delay
14	SV17–SV24	SELOGIC variables SV17–SV24
15	SV17T–SV24T	SELOGIC variables SV17T–SV24T with settable pickup and dropout time delay
16	SV25–SV32	SELOGIC variables SV25–SV32
17	SV25T–SV32	SELOGIC variables SV25T–SV32T with settable pickup and dropout time delay
18	SV33–SV40	SELOGIC variables SV33–SV40
19	SV33T–SV40T	SELOGIC variables SV33T–SV40T with settable pickup and dropout time delay
20	SV41–SV48	SELOGIC variables SV41–SV48
21	SV41T–SV48T	SELOGIC variables SV41T–SV48T with settable pickup and dropout time delay
22	SV49–SV56	SELOGIC variables SV49–SV56
23	SV49T–SV56T	SELOGIC variables SV49T–SV56T with settable pickup and dropout time delay
24	SV57–SV64	SELOGIC variables SV57–SV64
25	SV57T–SV64T	SELOGIC variables SV57T–SV64T with settable pickup and dropout time delay
26	SET01–SET08	SELOGIC Set latch bit variables SET01–SET08
27	RST01–RST08	SELOGIC Reset latch bit variables RST01–RST08
28	SET09–SET16	SELOGIC Set latch bit variables SET09–SET16
29	RST09–RST16	SELOGIC Reset latch bit variables RST09–RST16
30	SET17–SET24	SELOGIC Set latch bit variables SET17–SET24
31	RST17–RST24	SELOGIC Reset latch bit variables RST17–RST24
32	SET25–SET32	SELOGIC Set latch bit variables SET25–SET32
33	RST25–RST32	SELOGIC Reset latch bit variables RST25–RST32

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

Row	Bit	Definition
34	LT01–LT08	Latch bit variables LT01–LT08
35	LT09–LT16	Latch bit variables LT09–LT16
36	LT17–LT25	Latch bit variables LT17–LT24
37	LT25–LT32	Latch bit variables LT25–LT32
38	SC01QU–SC08QU	SELOGIC Counters 01–08 asserted when counter = preset value
39	SC01QD–SC08QD	SELOGIC Counters 01–08 asserted when counter = 0
40	SC09QU–SC16QU	SELOGIC Counters 09–16 asserted when counter = preset value
41	SC09QD–SC17QU	SELOGIC Counters 09–16 asserted when counter = 0
42	SC17QU–SC24QU	SELOGIC Counters 17–24 asserted when counter = preset value
43	SC17QD–SC24QD	SELOGIC Counters 17–24 asserted when counter = 0
44	SC25QU–SC32QU	SELOGIC Counters 25–32 asserted when counter = preset value
45	SC25QD–SC32QD	SELOGIC Counters 25–32 asserted when counter = 0
46	RSTENRGY	SELOGIC Equation: Reset Energy Metering Values.
	DSABLSET	SELOGIC Equation: Do not allow settings changes from the front panel when asserted.
	RSTTRGT	SELOGIC Equation: Reset targets when asserted. (Remote target reset via rising-edge of this RW)
	ER	SELOGIC Equation ER.
	TRGTR	Target Reset. Asserts for one-quarter cycle if front-panel or serial port target reset is executed.
	SPEN	SELOGIC Equation SPEN. (Enables Signal Profiling when set).
	MATHSTRT	One processing interval pulse when SELMath starts.
	MATHTSK	Asserts when SELMath is running.
47	RELAY_EN	IEC 61850 Data Quality Bit
	RSTMXMN	SELOGIC Equation: Reset Min/Max Metering Values.
	RSTDEM	SELOGIC Equation: Reset Demand Metering Values
	RSTPKDM	SELOGIC Equation: Reset Peak Demand Metering Values.
	MATHERR	SELOGIC control equation math error: asserts when there is an overflow, NAN or divide by zero condition.
	ERTDIN	State of contact input on external RTD unit (2600A).
	ERTDFLT	Asserts on if any failure on any external RTD including open-circuit or shorted RTDs or communication loss of the SEL-2600.
	IRTDFLT	Asserts on if any failure on any internal RTD card or internal general purpose RTD/TC card including open-circuit or shorted RTDs.
48	IN101	Digital input slot 1 Input 101
	IN102	Digital input slot 1 Input 102
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
49	IN301–IN308	Digital inputs slot 3
50	IN401–IN408	Digital inputs slot 4
51	IN501–IN508	Digital inputs slot 5
52	IN601–IN608	Digital inputs slot 6
53	OUT101	Digital output slot 1 Output 101
	OUT102	Digital output slot 1 Output 102
	OUT103	Digital output slot 1 Output 103
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved

Table G.2 Device Word Bit Definitions (Sheet 3 of 11)

Row	Bit	Definition
54	OUT301–OUT308	Digital outputs slot 3
55	OUT401–OUT408	Digital outputs slot 4
56	OUT501–OUT508	Digital outputs slot 5
57	OUT601–OUT608	Digital outputs slot 6
58	AILW1	Analog inputs Low Warning, Level 1. If any AI*xxx*LW1 = 1, then AILW1 = 1.
	AILW2	Analog inputs Low Warning, Level 2. If any AI*xxx*LW2 = 1, then AILW2 = 1.
	AILAL	Analog inputs Low Alarm Limit. If any AI*xxx*LAL = 1, then AILAL = 1.
	*	Reserved
	AIHW1	Analog inputs High Warning, Level 1. If any AI*xxx*HW1 = 1, then AIHW1 = 1.
	AIHW2	Analog inputs High Warning, Level 2. If any AI*xxx*HW2 = 1, then AIHW2 = 1.
	AIHAL	Analog inputs High Alarm Limit. If any AI*xxx*HAL = 1, then AIHAL = 1.
	*	Reserved
59–90		Analog inputs 301-608 Warnings/Alarms (where *xxx* = 301–608)
	AI*xxx*LW1	Low Warning, Level 1
	AI*xxx*LW2	Low Warning, Level 2
	AI*xxx*LAL	Low Alarm Limit
	*	Reserved
	AI*xxx*HW1	High Warning, Level 1
	AI*xxx*HW2	High Warning, Level 2
	AI*xxx*HAL	High Alarm Limit
	*	Reserved
91	LINKA	Dual Ethernet link status for Port A.
	LINKB	Dual Ethernet link status for Port B.
	LINKFAIL	Dual Ethernet active port link status failure indicator.
	PBASEL	Dual Ethernet active Port A indicator.
	PBBSEL	Dual Ethernet active Port B indicator.
	*	*
	*	*
	*	*
92	IN101E	Edge detect digital input slot 1 Input 101
	IN102E	Edge detect digital input Slot 1 Input 102
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
93	IN301E–IN308E	Edge detect digital inputs Slot 3
94	IN401E–IN408E	Edge detect digital inputs Slot 4
95	IN501E–IN508E	Edge detect digital inputs Slot 5
96	IN601E–IN608E	Edge detect digital inputs Slot 6
97	RMB8A–RMB1A	Channel A receive MIRRORED BITS RMB1A–RMB8A
98	TMB8A–TMB1A	Channel A transmit MIRRORED BITS TMB1A–TMB8A
99	RMB8B–RMB1B	Channel B receive MIRRORED BITS RMB1B–RMB8B
100	TMB8B–TMB1B	Channel B transmit MIRRORED BITS TMB1B–TMB8B
101	LBOKB	Channel B, looped back ok
	CBADB	Channel B, channel unavailability over threshold
	RBADB	Channel B, outage duration over threshold
	ROKB	Channel B, received data ok
	LBOKA	Channel A, looped back ok
	CBADA	Channel A, channel unavailability over threshold
	RBADA	Channel A, outage duration over threshold
	ROKA	Channel A, received data ok

Table G.2 Device Word Bit Definitions (Sheet 4 of 11)

Row	Bit	Definition
102	PB01	Front-panel Pushbutton 1 bit
	PB02	Front-panel Pushbutton 2 bit
	PB03	Front-panel Pushbutton 3 bit
	PB04	Front-panel Pushbutton 4 bit
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
103	PB01_PUL	Front-panel Pushbutton 1 pulse bit (asserted for one processing interval when PB01 is pressed)
	PB02_PUL	Front-panel Pushbutton 2 pulse bit (asserted for one processing interval when PB02 is pressed)
	PB03_PUL	Front-panel Pushbutton 3 pulse bit (asserted for one processing interval when PB03 is pressed)
	PB04_PUL	Front-panel Pushbutton 4 pulse bit (asserted for one processing interval when PB04 is pressed)
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
104	VB001–VB008	Virtual Bits used for Incoming GOOSE messages
105	VB009–VB016	Virtual Bits used for Incoming GOOSE messages
106	VB017–VB024	Virtual Bits used for Incoming GOOSE messages
107	VB025–VB032	Virtual Bits used for Incoming GOOSE messages
108	VB033–VB040	Virtual Bits used for Incoming GOOSE messages
109	VB041–VB048	Virtual Bits used for Incoming GOOSE messages
110	VB049–VB056	Virtual Bits used for Incoming GOOSE messages
111	VB057–VB064	Virtual Bits used for Incoming GOOSE messages
112	VB065–VB072	Virtual Bits used for Incoming GOOSE messages
113	VB073–VB080	Virtual Bits used for Incoming GOOSE messages
114	VB081–VB088	Virtual Bits used for Incoming GOOSE messages
115	VB089–VB096	Virtual Bits used for Incoming GOOSE messages
116	VB097–VB104	Virtual Bits used for Incoming GOOSE messages
117	VB105–VB112	Virtual Bits used for Incoming GOOSE messages
118	VB113–VB120	Virtual Bits used for Incoming GOOSE messages
119	VB121–VB128	Virtual Bits used for Incoming GOOSE messages
120	PB01BLED	SELOGIC Equation: Drives LED PB01B (only available in vertical SEL-2411Ps)
	PB02BLED	SELOGIC Equation: Drives LED PB02B (only available in vertical SEL-2411Ps)
	PB03BLED	SELOGIC Equation: Drives LED PB03B (only available in vertical SEL-2411Ps)
	PB04BLED	SELOGIC Equation: Drives LED PB04B (only available in vertical SEL-2411Ps)
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
121	*	Reserved Bits
122	TSNTPB	SNTP Secondary Server is active.
	TSNTPP	SNTP Primary Server is active.
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
123	IRIGOK	IRIG-B Time Sync Input Data are valid.
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved

Table G.2 Device Word Bit Definitions (Sheet 5 of 11)

Row	Bit	Definition
	*	Reserved
	*	Reserved
124	*	Reserved Bits
125	IAHW1	IA Overcurrent Warning, Level 1
	IAHW2	IA Overcurrent Warning, Level 2
	IAHAL	IA Overcurrent Alarm
	*	Reserved
	IBHW1	IB Overcurrent Warning, Level 1
	IBHW2	IB Overcurrent Warning, Level 2
	IBHAL	IB Overcurrent Alarm
	*	Reserved
126	ICHW1	IC Overcurrent Warning, Level 1
	ICHW2	IC Overcurrent Warning, Level 2
	ICHAL	IC Overcurrent Alarm
	*	Reserved
	INHW1	IN Overcurrent Warning, Level 1
	INHW2	IN Overcurrent Warning, Level 2
	INHAL	IN Overcurrent Alarm
	*	Reserved
127	IAXHW1	IAX Overcurrent Warning, Level 1
	IAXHW2	IAX Overcurrent Warning, Level 2
	IAXHAL	IAX Overcurrent Alarm
	*	Reserved
	IBXHW1	IBX Overcurrent Warning, Level 1
	IBXHW2	IBX Overcurrent Warning, Level 2
	IBXHAL	IBX Overcurrent Alarm
	*	Reserved
128	ICXHW1	ICX Overcurrent Warning, Level 1
	ICXHW2	ICX Overcurrent Warning, Level 2
	ICXHAL	ICX Overcurrent Alarm
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
129	VAHW1	VA Overvoltage Warning, Level 1
	VAHW2	VA Overvoltage Warning, Level 2
	VAHAL	VA Overvoltage Alarm
	*	Reserved
	VBHW1	VB Overvoltage Warning, Level 1
	VBHW2	VB Overvoltage Warning, Level 2
	VBHAL	VB Overvoltage Alarm
	*	Reserved
130	VCHW1	VC Overvoltage Warning, Level 1
	VCHW2	VC Overvoltage Warning, Level 2
	VCHAL	VC Overvoltage Alarm
	FLOAT	Indicates when LVL_INPUT is set to FLOAT
	ANALOG	Indicates when LVL_INPUT is set to ANALOG
	ANA_W1F	Indicates when LVL_INPUT is set to ANA_W1F
	ANA_W2F	Indicates when LVL_INPUT is set to ANA_W2F
	ANA_WAF	Indicates when LVL_INPUT is set to ANA_WAF
131	VALW1	VA Undervoltage Warning, Level 1
	VALW2	VA Undervoltage Warning, Level 2

Table G.2 Device Word Bit Definitions (Sheet 6 of 11)

Row	Bit	Definition
	VALAL	VA Undervoltage Alarm
	*	Reserved
	VBLW1	VB Undervoltage Warning, Level 1
	VBLW2	VB Undervoltage Warning, Level 2
	VBLAL	VB Undervoltage Alarm
	*	Reserved
132	VCLW1	VC Undervoltage Warning, Level 1
	VCLW2	VC Undervoltage Warning, Level 2
	VCLAL	VC Undervoltage Alarm
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
133	VABHW1	VAB Overvoltage Warning, Level 1
	VABHW2	VAB Overvoltage Warning, Level 2
	VABHAL	VAB Overvoltage Alarm
	*	Reserved
	VBCHW1	VBC Overvoltage Warning, Level 1
	VBCHW2	VBC Overvoltage Warning, Level 2
	VBCHAL	VBC Overvoltage Alarm
	*	Reserved
134	VCAHW1	VCA Overvoltage Warning, Level 1
	VCAHW2	VCA Overvoltage Warning, Level 2
	VCAHAL	VCA Overvoltage Alarm
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
135	VABLW1	VAB Undervoltage Warning, Level 1
	VABLW1	VAB Undervoltage Warning, Level 2
	VABLAL	VAB Undervoltage Alarm
	*	Reserved
	VBCLW1	VBC Undervoltage Warning, Level 1
	VBCLW2	VBC Undervoltage Warning, Level 2
	VBCLAL	VBC Undervoltage Alarm
	*	Reserved
136	VCALW1	VCA Undervoltage Warning, Level 1
	VCALW2	VCA Undervoltage Warning, Level 2
	VCALAL	VCA Undervoltage Alarm
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
	*	Reserved
137	ACV01RST	Analog Control Variable 1
	ACV02RST	Analog Control Variable 2
	ACV03RST	Analog Control Variable 3
	ACV04RST	Analog Control Variable 4
	ACV05RST	Analog Control Variable 5
	ACV06RST	Analog Control Variable 6
	ACV07RST	Analog Control Variable 7

Table G.2 Device Word Bit Definitions (Sheet 7 of 11)

Row	Bit	Definition
	ACV08RST	Analog Control Variable 8
138	ACV09RST	Analog Control Variable 9
	ACV10RST	Analog Control Variable 10
	ACV11RST	Analog Control Variable 11
	ACV12RST	Analog Control Variable 12
	ACV13RST	Analog Control Variable 13
	ACV14RST	Analog Control Variable 14
	ACV15RST	Analog Control Variable 15
	ACV16RST	Analog Control Variable 16
139	ACV17RST	Analog Control Variable 17
	ACV18RST	Analog Control Variable 18
	ACV19RST	Analog Control Variable 19
	ACV20RST	Analog Control Variable 20
	ACV21RST	Analog Control Variable 21
	ACV22RST	Analog Control Variable 22
	ACV23RST	Analog Control Variable 23
	ACV24RST	Analog Control Variable 24
140	ACV25RST	Analog Control Variable 25
	ACV26RST	Analog Control Variable 26
	ACV27RST	Analog Control Variable 27
	ACV28RST	Analog Control Variable 28
	ACV29RST	Analog Control Variable 29
	ACV30RST	Analog Control Variable 30
	ACV31RST	Analog Control Variable 31
	ACV32RST	Analog Control Variable 32
141	DNP1_TO	Port 1 DNP Session 1 time out
	DNP2_TO	Port 1 DNP Session 2 time out
	DNP3_TO	Port 1 DNP Session 3 time out
	DNP4_TO	Port 1 DNP Session 4 time out
	DNP5_TO	Port 1 DNP Session 5 time out
	P2_TO	Port 2 time out for DNP or Modbus
	P3_TO	Port 3 time out for DNP or Modbus
	P4_TO	Port 4 time out for DNP or Modbus
142	MOD1_TO	Port 1 Modbus Session 1 time out
	MOD2_TO	Port 1 Modbus Session 2 time out
	VMON_NC	Indicates when VMON_IN is set to NC
	VMON_NO	Indicates when VMON_IN is set to NO
	INTERNAL	Indicates when VMON_SRC is set to INTERNAL or BOTH
	EXTERNAL	Indicates when VMON_SRC is set to EXTERNAL or BOTH
	LOW_EN	Indicates when LOW_EN is set to Y
	HIGH_EN	Indicates when HIGH_EN is set to Y
143	PUMP1EN	Pump 1 enabled
	PUMP2EN	Pump 2 enabled
	PUMP3EN	Pump 3 enabled
	PUMP4EN	Pump 4 enabled
	PUMP1RUN	Pump 1 running
	PUMP2RUN	Pump 2 running
	PUMP3RUN	Pump 3 running
	PUMP4RUN	Pump 4 running
144	PUMP1FLT	Pump 1 fault alarm
	PUMP2FLT	Pump 2 fault alarm
	PUMP3FLT	Pump 3 fault alarm
	PUMP4FLT	Pump 4 fault alarm

Table G.2 Device Word Bit Definitions (Sheet 8 of 11)

Row	Bit	Definition
	PUMP1FLC	Pump 1 force to lowest allowed priority
	PUMP2FLC	Pump 2 force to lowest allowed priority
	PUMP3FLC	Pump 3 force to lowest allowed priority
	PUMP4FLC	Pump 4 force to lowest allowed priority
145	STG1CALL	Stage 1 input equation
	STG2CALL	Stage 2 input equation
	STG3CALL	Stage 3 input equation
	STG4CALL	Stage 4 input equation
	STAGE1	Stage 1 output call
	STAGE2	Stage 2 output call
	STAGE3	Stage 3 output call
	STAGE4	Stage 4 output call
146	PUMP1	PUMP1
	PUMP2	PUMP2
	PUMP3	PUMP3
	PUMP4	PUMP4
	STG1ALM	STG1ALM
	STG2ALM	STG2ALM
	STG3ALM	STG3ALM
	STG4ALM	STG4ALM
147	FRC_ALT	Pump alternation forced
	DIS_ALT	Pump alternation disabled
	STAGSTRT	Minimum stagger-start time not exceeded
	P1LONGRT	Pump 1 runs longer than maximum defined runtime
	P2LONGRT	Pump 2 runs longer than maximum defined runtime
	P3LONGRT	Pump 3 runs longer than maximum defined runtime
	P4LONGRT	Pump 4 runs longer than maximum defined runtime
	*	Reserved
148	P1MINRT	Pump 1 runs less than minimum defined runtime
	P2MINRT	Pump 2 runs less than minimum defined runtime
	P3MINRT	Pump 3 runs less than minimum defined runtime
	P4MINRT	Pump 4 runs less than minimum defined runtime
	PUMP1STP	Pump 1 failed to stop alarm
	PUMP2STP	Pump 2 failed to stop alarm
	PUMP3STP	Pump 3 failed to stop alarm
	PUMP4STP	Pump 4 failed to stop alarm
149	IN309	Extended Digital Inputs Slot 3
	IN310	
	IN311	
	IN312	
	IN313	
	IN314	
	*	
	*	
150	IN409	Extended Digital Inputs Slot 4
	IN410	
	IN411	
	IN412	
	IN413	
	IN414	
	*	
	*	

Table G.2 Device Word Bit Definitions (Sheet 9 of 11)

Row	Bit	Definition
151	IN509 IN510 IN511 IN512 IN513 IN514 * *	Extended Digital Inputs Slot 5
152	IN609 IN610 IN611 IN612 IN613 IN614 * *	Extended Digital Inputs Slot 6
153	IN309E IN310E IN311E IN312E IN313E IN314E * *	Extended Edge Digital Inputs Slot 3
154	IN409E IN410E IN411E IN412E IN413E IN414E * *	Extended Edge Digital Inputs Slot 4
155	IN509E IN510E IN511E IN512E IN513E IN514E * *	Extended Edge Digital Inputs Slot 5
156	IN609E IN610E IN611E IN612E IN613E IN614E * *	Extended Edge Digital Inputs Slot 6
157	P1LEAD P1LAG1 P1LAG2 P1LAG3 P2LEAD	Pump 1 occupies Stage 1 start role Pump 1 occupies Stage 2 start role Pump 1 occupies Stage 3 start role Pump 1 occupies Stage 4 start role Pump 2 occupies Stage 1 start role

Table G.2 Device Word Bit Definitions (Sheet 10 of 11)

Row	Bit	Definition
	P2LAG1	Pump 2 occupies Stage 2 start role
	P2LAG2	Pump 2 occupies Stage 3 start role
	P2LAG3	Pump 2 occupies Stage 4 start role
158	P3LEAD	Pump 3 occupies Stage 1 start role
	P3LAG1	Pump 3 occupies Stage 2 start role
	P3LAG2	Pump 3 occupies Stage 3 start role
	P3LAG3	Pump 3 occupies Stage 4 start role
	P4LEAD	Pump 4 occupies Stage 1 start role
	P4LAG1	Pump 4 occupies Stage 2 start role
	P4LAG2	Pump 4 occupies Stage 3 start role
	P4LAG3	Pump 4 occupies Stage 4 start role
159	P1FLTRST	Pump 1 fault reset
	P2FLTRST	Pump 2 fault reset
	P3FLTRST	Pump 3 fault reset
	P4FLTRST	Pump 4 fault reset
	RSTP1DAT	Reset Pump 1 short term statistics
	RSTP2DAT	Reset Pump 2 short term statistics
	RSTP3DAT	Reset Pump 3 short term statistics
	RSTP4DAT	Reset Pump 4 short term statistics
160	STOP	Logical stop
	LEAD	Logical lead
	LAG1	Logical Lag1
	LAG2	Logical Lag2
	LAG3	Logical Lag3
	LOW	Logical low
	HIGH	Logical high
	*	Reserved
161	STOP_IN	Discrete stop float input
	LEAD_IN	Discrete lead float input
	LAG1_IN	Discrete Lag1 float input
	LAG2_IN	Discrete Lag2 float input
	LAG3_IN	Discrete Lag3 float input
	LOW_IN	Discrete low float input
	HIGH_IN	Discrete high float input
	AI_FAILT	Logical level sensor fail timer output
162	ANA_STOP	Analog stop Point
	ANA_LEAD	Analog lead Point
	ANA_LAG1	Analog Lag1 Point
	ANA_LAG2	Analog Lag2 Point
	ANA_LAG3	Analog Lag3 Point
	ANA_LOW	Analog low Point
	ANA_HIGH	Analog high Point
	AI_FAIL	Logical level sensor fail timer input
163	P1ELT	Pump 1 in service latch enabled
	P2ELT	Pump 2 in service latch enabled
	P3ELT	Pump 3 in service latch enabled
	P4ELT	Pump 4 in service latch enabled
	FLO_SEQ	Float out-of-sequence timer input
	FLO_SEQT	Float out-of-sequence timer input
	SFLO_TM	Single float timer input
	SFLO_TMT	Single float timer output
164	P1LTSET	Pump 1 in service latch set
	P2LTSET	Pump 2 in service latch set

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

Row	Bit	Definition
	P3LTSET	Pump 3 in service latch set
	P4LTSET	Pump 4 in service latch set
	P1LTRST	Pump 1 in service latch reset
	P2LTRST	Pump 2 in service latch reset
	P3LTRST	Pump 3 in service latch reset
	P4LTRST	Pump 4 in service latch reset
165	HOA1AUTO	Hand Off Auto Switch 1 in auto position
	HOA2AUTO	Hand Off Auto Switch 2 in auto position
	HOA3AUTO	Hand Off Auto Switch 3 in auto position
	HOA4AUTO	Hand Off Auto Switch 4 in auto position
	HOA1HAND	Hand Off Auto Switch 1 in hand position
	HOA2HAND	Hand Off Auto Switch 2 in hand position
	HOA3HAND	Hand Off Auto Switch 3 in hand position
	HOA4HAND	Hand Off Auto Switch 4 in hand position
166	INT_DETC	Intrusion detection
	UPS_ALM	External UPS status alarm
	PHS_MON	Phase monitor
	ALM_HORN	Alarm horn
	ALMLIGHT	Alarm light
	AUX_OUT	Alarm output
	PHS_ALM	Logical phase monitor alarm
	*	Reserved
167	DUPLEX	Indicates when STN_TYPE is set to DUPLEX
	TRIPLEX	Indicates when STN_TYPE is set to TRIPLEX
	SINGLE UP	Indicates when STN_TYPE is set to SINGLEUP
	SINGLE	Indicates when STN_TYPE is set to SINGLE
	*	Reserved
	NORMAL	Indicates when TRI_ALT is set to NORMAL
	JOCKEY	Indicates when TRI_ALT is set to JOCKEY
	HI_SERVC	Indicates when TRI_ALT is set to HI_SERVICE

Appendix H
Analog Quantities

NOTE: AC metering quantities are listed as primary values.

NOTE: Analog quantities are only available if the appropriate analog cards are installed.

Table H.1 shows the analog quantities available in the device.

Table H.1 Available Analog Quantities (Sheet 1 of 2)

Analog Quantity	Description	
Analog Input and Miscellaneous Quantities		
AI501–AI508	Analog inputs for 3AVI analog card in Slot E	a
RA001–RA128	Remote analog inputs	
MV01–MV64	Math variables	
ACV01–ACV32	Analog control variables	
SC01–SC32	SELOGIC counters	
FID	Firmware identifier	
Date/Time Quantities		
YEAR	Year number (0000–9999)	
DAYY	Day of year number (1–366)	
WEEK	Week number (1–52)	
MONTH	Month number (1–12)	
DAYM	Day of month (1–31)	
DAYW	Day of week number (1–7)	
HOUR	Hour number (0–23)	
MIN	Minutes number (0–59)	
MINSM	Minutes since midnight	
SEC	Seconds number (0–59)	
Instantaneous (Fundamental) Metering Quantities		
I*x*X_MAG	Current X Magnitude (*x* = A, B, C, and G)	b
I*x*X_ANG	Current X Angle (*x* = A, B, C, and G)	b
3I2X	Current X, negative-sequence, magnitude	b
V*x*_MAG	Voltage magnitude (*x* = A, B, C, and G)	a
V*x*_ANG	Voltage angle (*x* = A, B, C, and G)	a
V*xx*_MAG	Voltage magnitude (*xx* = AB, BC, and CA)	a
V*xx*_ANG	Voltage angle (*xx* = AB, BC, and CA)	a
3V2	Voltage, negative-sequence magnitude	a
P*x*X	Real power X, magnitude (*x* = A, B, and C)	b
Q*x*X	Reactive power X, magnitude (*x* = A, B, and C)	b
S*x*X	Apparent power X, magnitude (*x* = A, B, and C)	b
PF*x*X	Power factor X, magnitude (*x* = A, B, and C)	b
PX	Real power X, magnitude, 3-phase	b
QX	Reactive power X, magnitude, 3-phase	b
SX	Apparent power X, magnitude, 3-phase	b
PFX	Power factor X, magnitude, 3-phase	b
FREQ	Frequency	a
Demand Metering Quantities		
I*x*XD	Current X Demand (*x* = A, B, C, and G)	b
3I2XD	Negative-Sequence Current X Demand	b
I*x*XPD	Current Peak X Demand (*x* = A, B, C, and G)	b
3I2XPD	Negative-Sequence Current Peak X Demand	b

Table H.1 Available Analog Quantities (Sheet 2 of 2)

Analog Quantity	Description	
Maximum/Minimum Metering Quantities		
L*x*XMN	Current, minimum magnitude (*x* = A, B, C, and G)	b
3I2XMN	Current, negative sequence, minimum magnitude	b
V*xx*MX	Voltage, maximum magnitude (*xx* = AB, BC, and CA)	a
V*x*MX	Voltage, maximum magnitude (*x* = A, B, and C)	a
V*xx*MN	Voltage, minimum magnitude (*xx* = AB, BC, and CA)	a
V*x*MN	Voltage, minimum magnitude (*x* = A, B, and C)	b
K*x*3PXMX	Power magnitude, 3-phase, maximum (*x* = S, W, and Q)	b
K*x*3PXMN	Power magnitude, 3-phase, minimum (*x* = S, W, and Q)	b
FREQMX	Maximum frequency	a
FREQMN	Minimum frequency	a
Energy Metering Quantities		
MWHXI	Real energy X, 3-phase IN	b
MWHXO	Real energy X, 3-phase OUT	b
MVARHXI	Reactive energy X, 3-phase IN	b
MVARHXO	Reactive energy X, 3-phase OUT	b
Pump Operating Statistics (x = 1, 2, 3, and 4)		
P*x*STC2H	Pump *x* two-hour start count	
P*x*STC1D	Pump *x* one-day start count	
P*x*STC2D	Pump *x* two-day start count	
P*x*STCTOT	Pump *x* total start count	
P*x*RT2H	Pump *x* two-hour run time	
P*x*RT1D	Pump *x* one-day run time	
P*x*RT2D	Pump *x* two-day run time	
P*x*RTTOT	Pump *x* total run time	
P*x*LASTST	Pump *x* last start time	
STG*x*CRTM	Stage *x* cycle run time	
Pump Controller Analog Logic Settings		
LEVEL_IN	Analog level value input	
FLOW_IN	Analog flow value input	
LOW_SP	Low level analog set point	
STOP_SP	Stop level analog set point	
LEAD_SP	Lead level analog set point	
LAG1_SP	Lag1 level analog set point	
LAG2_SP	Lag2 level analog set point	
LAG3_SP	Lag3 level analog set point	
HIGH_SP	High level analog set point	
VLL_THRS	Line-to-line voltage low threshold	
LGST_TM	Lag start time	

[a] Valid data only if 3 AVI card is installed in Slot E.
[b] Valid data only if 3 CT/3 PT card is installed in Slot E.

Appendix I
Station Setting Assignments

This appendix includes all logic and value assignments that station settings dictate for Device, logic, Global, and front-panel setting groups.

ADV_EN

Table I.1 includes settings that apply when ADV_EN = N.

Table I.1 Common Settings for ADV_EN = N (Sheet 1 of 7)

Setting	Assignment
Logic	
ESV	15
EMV	4
EACV	9
ELAT	8
ALMLIGHT	PHS_ALM OR HIGH AND NOT SINGLEUP OR LOW AND SIN-GLEUP
ALM_HORN	PHS_ALM OR HIGH AND NOT SINGLEUP OR LOW AND SIN-GLEUP
PHS_ALM	(PHS_MON AND EXTERNAL) OR ((SV05T OR SV06T) AND INTERNAL)
LGST_TM	86400
FLO_SEQ	(SV09T AND NOT SINGLEUP AND (ANA_WAF OR FLOAT)) OR (SV10T AND ANA_W2F) OR SV15 OR ((NOT SINGLEUP AND (LOW_IN AND LOW_EN) OR (STOP_IN AND NOT LOW_EN)) AND FLO_SEQT)
FLOSEQPU	0.5
FLOSEQDO	0.5
SV01	NOT SV01T # OSCILLATOR FOR LED BLINK RATE
SV01PU	0.5
SV01DO	0.5
SV02	PB01 # FORCE PUMP1 TO LAST
SV02PU	5
SV02DO	0.5
SV03	PB02 # FORCE PUMP2 TO LAST
SV03PU	5
SV03DO	0.5
SV04	PB03 # FORCE PUMP3 TO LAST
SV04PU	5

Table I.1 Common Settings for ADV_EN = N (Sheet 2 of 7)

Setting	Assignment
SV04DO	0.5
SV09	((STOP_IN AND NOT LOW_IN AND LOW_EN) OR (LEAD_IN AND NOT STOP_IN) OR (LAG1_IN AND NOT LEAD_IN) OR (HIGH_IN AND NOT LAG1_IN) OR (TRIPLEX AND ((HIGH_IN AND NOT LAG2_IN) OR (LAG2_IN AND NOT LAG1_IN)))) # FLOAT OUT OF SEQUENCE SELECT LOGIC FLOATS OR ANA_WAF
SV10	(HIGH_IN AND NOT LOW_IN AND LOW_EN) OR (HIGH_IN AND NOT STOP_IN AND NOT LOW_EN) # FLOAT OUT OF SEQUENCE SELECT LOGIC ANA_W2F
SV11	RSTTRGT AND PUMP1FLT # PUMP 1 RESET
SV11DO	0.02
SV12	RSTTRGT AND PUMP2FLT # PUMP 2 RESET
SV12DO	0.02
SV13	RSTTRGT AND PUMP3FLT # PUMP 3 RESET
SV13DO	0.02
SV14	F_TRIG PUMP1 # BACKSPIN LOCKOUT TIMER TRIGGER
SV14PU	0
SV14DO	ACV09
SV15	SINGLEUP AND LEAD_IN AND NOT STOP_IN OR (LEAD_IN AND NOT LOW_IN AND LOW_EN)
SV15PU	0
SV15DO	0
P1LTSET	PB01_PUL AND NOT P1ELT OR R_TRIG HOA1AUTO OR SV11T OR R_TRIG RB14 OR R_TRIG RB01
P1LTRST	PUMP1FLT OR PB01_PUL AND P1ELT OR NOT HOA1AUTO OR R_TRIG RB07
P2LTSET	PB02_PUL AND NOT P2ELT OR R_TRIG HOA2AUTO OR SV12T OR R_TRIG RB15 OR R_TRIG RB13
P2LTRST	PUMP2FLT OR PB02_PUL AND P2ELT OR NOT HOA2AUTO OR R_TRIG RB08 OR SINGLE OR SINGLEUP
P3LTSET	PB03_PUL AND NOT P3ELT OR R_TRIG HOA3AUTO OR SV13T OR R_TRIG RB17 OR R_TRIG RB16
P3LTRST	PUMP3FLT OR PB03_PUL AND P3ELT OR NOT HOA3AUTO OR R_TRIG RB09 OR NOT TRIPLEX
SFLO_TM	(HIGH_IN AND NOT ANALOG AND HIGH_EN AND NOT SINGLEUP) OR (LOW_IN AND NOT ANALOG AND LOW_EN AND SINGLEUP)
SFLOTMPU	0
SFLOTMDO	ACV08
LAG2_IN	IN301 AND (TRIPLEX AND (FLOAT OR ANA_WAF))
LAG1_IN	IN302 AND ((DUPLEX OR TRIPLEX) AND (FLOAT OR ANA_WAF))
LEAD_IN	((IN303 AND NOT SINGLEUP) OR (NOT IN303 AND SINGLEUP)) AND (FLOAT OR ANA_WAF)
STOP_IN	((IN304 AND NOT SINGLEUP) OR (NOT IN304 AND SINGLEUP)) AND ((NOT LOW_EN AND ANA_W2F) OR (FLOAT OR ANA_WAF))

Table I.1 Common Settings for ADV_EN = N (Sheet 3 of 7)

Setting	Assignment
LOW_IN	IN305 AND LOW_EN
HIGH_IN	IN306 AND (HIGH_EN AND NOT ANALOG)
LOW_SP	ACV03
STOP_SP	ACV04
LEAD_SP	ACV05
LAG1_SP	ACV06
LAG2_SP	ACV07
HIGH_SP	ACV02
ANA_LOW	LEVEL_IN > LOW_SP
ANA_STOP	LEVEL_IN > STOP_SP AND NOT SINGLEUP OR LEVEL_IN < STOP_SP AND SINGLEUP
ANA_LEAD	LEVEL_IN > LEAD_SP AND NOT SINGLEUP OR LEVEL_IN < LEAD_SP AND SINGLEUP
ANA_LAG1	LEVEL_IN > LAG1_SP AND (DUPLEX OR TRIPLEX)
ANA_LAG2	(LEVEL_IN > LAG2_SP) AND TRIPLEX
ANA_HIGH	LEVEL_IN > HIGH_SP
ACV*xx*MIN[a]	0
ACV*xx*MAX[a]	250
ACV*xx*U[a]	feet
ACV01A	Remote Level
ACV01P	REMOTE LEVEL INPUT FROM SCADA
ACV02A	HIGH_SP
ACV02P	HIGH VIRTUAL FLOAT SETPOINT
ACV02RV	8
ACV03A	LOW_SP
ACV03P	LOW VIRTUAL FLOAT SETPOINT
ACV03RV	1.5
ACV04A	STOP_SP
ACV04P	STOP VIRTUAL FLOAT SETPOINT
ACV04RV	3
ACV05A	LEAD_SP
ACV05P	LEAD VIRTUAL FLOAT SETPOINT
ACV05RV	4
ACV06A	LAG1_SP
ACV06P	LAG1 VIRTUAL FLOAT SETPOINT
ACV06RV	5
ACV07A	LAG2_SP
ACV07P	LAG2 VIRTUAL FLOAT SETPOINT
ACV07RV	6
ACV08A	SGL_FLT_TMR
ACV08P	SINGLE FLOAT RUN TIMER IN SECONDS
ACV08MIN	0

Table I.1 Common Settings for ADV_EN = N (Sheet 4 of 7)

Setting	Assignment
ACV08MAX	300
ACV08RV	20
ACV08U	SEC
ACV08RST	NA
ACV09A	BACK_SPIN_TIMER
ACV09P	BACKSPIN LOCKOUT TIMER
ACV09RV	30
ACV09U	sec
ACV09MIN	0
LOW	(NOT AI_FAILT AND NOT FLOAT AND ANA_LOW) OR (AI_FAILT OR FLOAT) AND LOW_IN
STOP	(NOT AI_FAILT AND NOT FLOAT AND ANA_STOP) OR (AI_FAILT OR FLOAT) AND STOP_IN
LEAD	(NOT AI_FAILT AND NOT FLOAT AND ANA_LEAD) OR (AI_FAILT OR FLOAT) AND LEAD_IN
HIGH	(NOT AI_FAILT AND NOT FLOAT AND ANA_HIGH) OR HIGH_IN
LAG1	(NOT AI_FAILT AND NOT FLOAT AND ANA_LAG1) OR (AI_FAILT OR FLOAT) AND LAG1_IN
LAG2	(NOT AI_FAILT AND NOT FLOAT AND ANA_LAG2 AND TRIPLEX) OR (AI_FAILT AND LAG2_IN AND TRIPLEX)
SET01	R_TRIG RB18 OR NOT LT01 AND LB01 # REMOTE ALTERNATION DISABLED
RST01	R_TRIG RB19 OR LT01 AND LB01
SET02	RB02 OR PB04_PUL AND NOT LT02 # DISABLE STATION
RST02	RB05 OR PB04_PUL AND LT02 # CLEAR IS ENABLED
RST03	LT02 OR R_TRIG RB14 OR (NOT LOW AND LOW_EN) OR (NOT STOP AND NOT LOW_EN) OR F_TRIG P1ELT OR NOT HOA1AUTO # PUMP1 RETURN TO AUTO
SET03	NOT LT02 AND R_TRIG RB01 AND ((LOW AND LOW_EN) OR (STOP AND NOT LOW_EN))# PUMP1 GO TO REMOTE HAND
RST04	LT02 OR R_TRIG RB15 OR (NOT LOW AND LOW_EN) OR (NOT STOP AND NOT LOW_EN) OR F_TRIG P2ELT OR NOT HOA2AUTO # PUMP2 RETURN TO AUTO
SET04	NOT LT02 AND R_TRIG RB13 AND ((LOW AND LOW_EN) OR (STOP AND NOT LOW_EN)) # PUMP2 GO TO REMOTE HAND
SET05	NOT LT02 AND R_TRIG RB16 AND ((LOW AND LOW_EN) OR (STOP AND NOT LOW_EN)) # PUMP3 GO TO REMOTE HAND
RST05	LT02 OR R_TRIG RB17 OR (NOT LOW AND LOW_EN) OR (NOT STOP AND NOT LOW_EN) OR F_TRIG P3ELT OR NOT HOA3AUTO # PUMP3 RETURN TO AUTO
SET06	NOT LT06 AND R_TRIG SV02T # FORCE PUMP1 TO LAST POSITION
RST06	LT06 AND R_TRIG SV02T
SET07	NOT LT07 AND R_TRIG SV03T # FORCE PUMP2 TO LAST POSITION
RST07	LT07 AND R_TRIG SV03T

Table I.1 Common Settings for ADV_EN = N (Sheet 5 of 7)

Setting	Assignment
SET08	NOT LT08 AND R_TRIG SV04T # FORCE PUMP3 TO LAST POSITION
RST08	LT08 AND R_TRIG SV04T
OUT401	NOT PHS_ALM AND (PUMP1 OR LT03)
OUT402	NOT PHS_ALM AND (PUMP2 OR LT04)
OUT403	NOT PHS_ALM AND (PUMP3 OR LT05)
LEVEL_IN[b]	AIx01
AI_FAIL[b]	LEVEL_IN < -1.0 # ON BROKEN WIRE, 4-20MA TRANSMITTER READS NEGATIVE
AIFAILPU[b]	10
AIFAILDO[b]	2
LEVEL_IN[c]	ACV01
AI_FAIL[c]	DNP1_TO # ACVS ARE NO LONGER BEING UPDATED BY DNP
AIFAILPU[c]	1
AIFAILDO[c]	1
Device	
AIx01NAM[b]	LEVEL_AI
AIx01TYP[b]	I
AIx01L[b]	4
AIx01H[b]	20
AIx01EU[b]	feet
AIx01EL[b]	0
AIx01EH[b,d]	22.45
FLOW_IN[b]	AIx02
AIx02NAM[b]	FLOW_AI
AIx02TYP[b]	I
AIx02L[b]	4
AIx02H[b]	20
AIx02EU[b]	GPM
AIx02EL[b]	0
AIx02EH[b]	100
EPUMPS	3
NUMSTG	3
S1PUMPS	1,2,3 1 [TRI_ALT = JOCKEY] 1,2 [TRI_ALT - HIGH_SERVICE]
S2PUMPS	1,2,3 OVERRIDE(2,3) [TRI_ALT = JOCKEY] 1,2 [TRI_ALT - HIGH_SERVICE]
S3PUMPS	1,2,3 2,3 [TRI_ALT = JOCKEY] OVERRIDE(3) [TRI_ALT - HIGH_SERVICE]
DIS_ALT	LT01

Table I.1 Common Settings for ADV_EN = N (Sheet 6 of 7)

Setting	Assignment
FRC_ALT	RB21
P1FLTRST	SV11T
P2FLTRST	SV12T
P3FLTRST	SV13T
PUMP1EN	P1ELT AND NOT PHS_ALM
PUMP2EN	P2ELT AND NOT PHS_ALM
PUMP3EN	P3ELT AND NOT PHS_ALM
STG1CALL	((NOT LT02 AND SINGLEUP AND NOT SV14T) OR (NOT LT02 AND NOT SINGLEUP)) AND (((STOP OR (LOW AND LOW_EN AND ANA_W2F)) AND (LEAD OR STAGE1)) OR FLO_SEQT OR SFLO_TMT)
STG2CALL	(NOT LT02 AND (LAG1 OR (HIGH AND HIGH_EN) OR FLO_SEQT AND STG1ALM OR (STOP AND STG1CRTM > LGST_TM) OR SFLO_TMT)) AND (DUPLEX OR TRIPLEX)
STG3CALL	(NOT LT02 AND (LAG2 OR (HIGH AND HIGH_EN) OR FLO_SEQT AND STG2ALM OR (STOP AND STG2CRTM > LGST_TM) OR SFLO_TMT)) AND TRIPLEX
PUMP1FCL	LT06
PUMP2FCL	LT07
PUMP3FCL	LT08
RSTP1DAT	R_TRIG RB11
RSTP2DAT	R_TRIG RB11
RSTP3DAT	R_TRIG RB11
Front Panel	
PB01_LED	P1LEAD
PB01BLED	P1LAG1 OR P1LAG2 AND SV01T
PB02_LED	P2LEAD
PB02BLED	P2LAG1 OR P2LAG2 AND SV01T
PB03_LED	P3LEAD
PB03BLED	P3LAG1 OR P3LAG2 AND SV01T
T*xx*LEDL	N (where *xx* is 01–06)
T01_LED	HIGH
T02_LED	LAG2
T03_LED	LAG1
T04_LED	LEAD AND NOT SINGLEUP OR NOT STOP AND SINGLEUP
T05_LED	STOP AND NOT SINGLEUP OR NOT LEAD AND SINGLEUP
T06_LED	LOW
EDP	14
DP01	PUMP1FLT,,"Pump1 Fault"
DP02	PUMP2FLT,,"Pump2 Fault"
DP03	PUMP3FLT,,"Pump3 Fault"
DP04	LT02,,"Station Disabled","Station Enabled"
DP05	DIS_ALT,,"Alternation Disabled","Alternation Enabled"

Table I.1 Common Settings for ADV_EN = N (Sheet 7 of 7)

Setting	Assignment
DP06	FLO_SEQT,,"Float Out of Sequence Error"
DP09	PUMP1FCL,,"Pump 1 Forced to Last Start Position"
DP10	PUMP2FCL,,"Pump 2 Forced to Last Start Position"
DP11	PUMP3FCL,,"Pump 3 Forced to Last Start Position"
DP12	PHS_MON,,"Phase Monitor Alarm"
DP13	SV05T,,"Pump Voltage Loss"
DP14	SV06T,,"Pump Voltage Phase Reversal"
ELB	1
NLB01	DISABLE ALT
CLB01	?
PLB01	TOGGLE
Global	
RSTTRGT	R_TRIG RB12 OR TRGTR
IN301D–IN314D	10
IN401D–IN404D	AC

[a] Where xx = 02 to 07.
[b] When Leve_SRC != FLOAT and Analog Input present in Slot Z.
[c] Whene Leve_SRC != FLOAT and Analog Input is NOT present in Slot Z.
[d] When STN_TYPE = SINGLE, DUPLEX, or TRIPLEX, Engineer high value assumes a 10 psi sensor (10 psi • 33 ft / 14.7 psi = 22.45 ft).

VMON_SRC

Table I.2 includes all the *Table I.1* setting assignments that are overwritten when VMON_SRC != NONE.

Table I.2 VMON_SRC Settings for ADV_EN = N (Sheet 1 of 2)

Setting	Assignment			
	Internal	Both	External	None
Device				
SV05	VBC_MAG < MV02 OR VBC_MAG > MV03 OR VCA_MAG < MV02 OR VCA_MAG > MV03 OR VAB_MAG < VLL_THRS # ASSERTION INDICATES VOLTAGE LOSS DETECTION			0
SV05PU	1		–	–
SV05DO	1		–	–
SV06	NOT SV05 AND 3V2 > VA_MAG # ASSERTION INDICATES PHASE REVERSAL			0
SV06PU	0.5		–	–
SV06DO	0.5		–	–
SV07	NOT SV05 AND VG_MAG >= MV04 # ASSERTION INDICATES HIGH-LEG DELTA CONFIGURATION			0

Table I.2 VMON_SRC Settings for ADV_EN = N (Sheet 2 of 2)

Setting	Assignment			
	Internal	Both	External	None
SV07PU	0.5		–	–
SV07DO	0.5		–	–
SV08	NOT SV05 AND VG_MAG < MV04 # ASSERTION INDICATES WYE CONFIGURATION			0
SV08PU	0.5		–	–
SV08DO	0.5		–	–
VLL_THRS	200		–	–
MV01	10 # PERCENT DROP INDICATING VOLTAGE LOSS		–	–
MV02	VAB_MAG * (100 - MV01)/100 # MV01 PERCENTAGE VARIANCE		–	–
MV03	VAB_MAG * (100 + MV01)/100 # MV01 PERCENTAGE VARIANCE		–	–
MV04	VA_MAG * 0.5 # MATH FOR SV08 TO EVALUATE IF VG_MAG IS LESS THAN 1/2 VA_MAG		–	–
PHS_MON	0	(IN404 AND VMON_NO) OR (NOT IN404 AND VMON_NC)		0

STN_TYPE

Table 1.4 includes all Table 1.1 Settings assignments that are overwritten when STN_TYPE = SINGLE or SINGLE_UP

Table I.3 STN_TYPE = SINGLE or SINGLE_UP and ADV_EN = N (Sheet 1 of 2)

Station Type Setting	Single Assignment	Single Up Assignment
Logic		
SFLO_TM		NOT LOW_IN AND LOW_EN OR (STOP AND NOT LOW_EN AND (ANA_W2F OR ANA_W1F)) OR FLO_SEQT
FLO_SEQ		LEAD_IN AND NOT STOP_IN OR (LEAD_IN OR STOP_IN) AND NOT LOW_IN AND LOW_EN
ACV02RV	8	120
ACV03RV	1.5	50
ACV04RV	3	90
ACV05RV	4	80

Table I.3 STN_TYPE = SINGLE or SINGLE_UP and ADV_EN = N (Sheet 2 of 2)

Station Type Setting	Single Assignment	Single Up Assignment
Device		
AIx01EH[a]	22.45	135
STG1CALL		NOT LT02 AND NOT SV14T AND (((STOP OR NOT HIGH AND HIGH_EN AND NOT FLOAT AND NOT ANA_WAF AND AI_-FAILT) AND (NOT LOW AND LOW_EN OR LEAD OR STAGE1)) OR FLO_SEQT OR SFLO_TMT)
Front		
DP03	0	0
DP05	0	0
DP09	0	0
DP10	0	0
DP11	0	0

[a] When STN_TYPE = SINGLE Engineer high value assumes a 10 psi sensor (10 psi • 33 ft / 14.7 psi = 22.45 ft). When STN_TYPE = SINGLE_UP, AIx10EH assumes a 60 psi sensor (60 psi • 33 ft / 14.7 psi = 135 ft).

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Appendix J

Pump Alternation Function Block

Overview

A simple lift station consists of one or more level-sensing floats and one or more pumps to maintain fluid level. The Pump Automation Controller measures the fluid level and operates pumps to either raise or lower the fluid level, depending on the direction that the pumps move fluid. The SEL-2411P Pump Alternation Function Block (PAFB) provides control and alternation for as many as four pumps and four stages. For stations that have more than one pump, the PAFB alternates pump roles within the stage assignments whenever one or more pumps operate. The alternation balances pump starts, maximizes pump life, reduces wear on equipment, and makes maintenance more predictable. *Figure J.1* illustrates the PAFB with all inputs and outputs. Configure the PAFB inputs through use of the settings from *Table 6.10*.

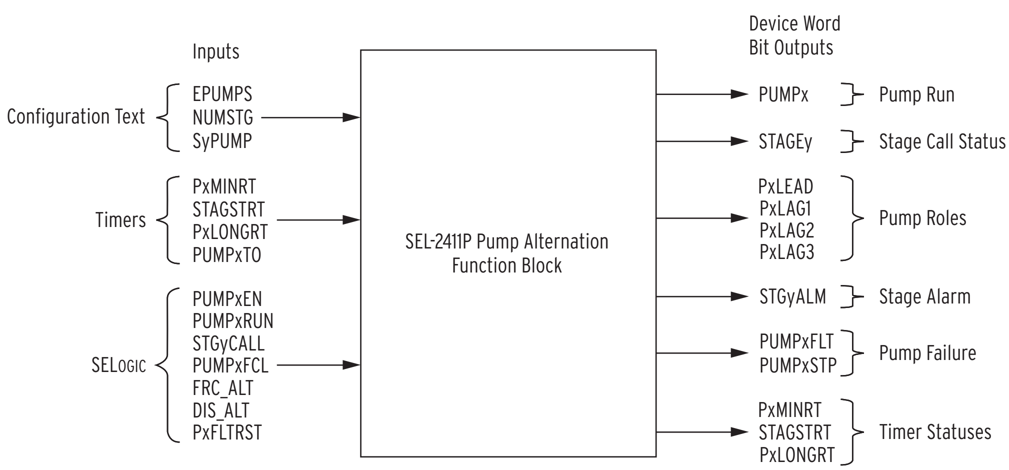

Figure J.1 Pump Alternation Function Block (x, y = 1, 2, 3, or 4

The following list includes relevant definitions of terms that apply to the PAFB:

- **Stage.** A fluid level that requires pump(s) to run
- **Alternation.** A process of assigning pumps to different stages to balance pump starts
- **Lead.** Primary stage synonymous with Stage 1
- **Lag1.** Secondary stage synonymous with Stage 2
- **Lag2.** Tertiary stage synonymous with Stage 3
- **Lag3.** Quaternary stage synonymous with Stage 4
- **Lead Pump.** Pump occupying Stage 1
- **Lag1 Pump.** Pump occupying Stage 2

- **Lag2 Pump.** Pump occupying Stage 3
- **Lag3 Pump.** Pump occupying Stage 4
- ***x*.** Represents Pumps 1, 2, 3, and 4
- ***y*.** Represents Stages 1, 2, 3, and 4, where Stage 1 is the lowest and Stage 4 is the highest

Device Word Bit Outputs

The PAFB provides the following Device Word bit outputs in *Table J.1*.

Table J.1 PAFB Outputs

Device Word Bit	Description
PUMP*x*	Asserts when the PAFB calls Pump *x* to start
P*x*LEAD	Asserts when Pump *x* is presently the Lead pump (Stage 1 pump assignment)
P*x*LAG1	Asserts when Pump *x* is presently the Lag1 pump (Stage 2 pump assignment)
P*x*LAG2	Asserts when Pump *x* is presently the Lag2 pump (Stage 3 pump assignment)
P*x*LAG3	Asserts when Pump *x* is presently the Lag3 pump (Stage 4 pump assignment)
STG*y*ALM	Stage *y* alarm that asserts when a stage-out-of-sequence condition occurs or when a pump is not available to start following a STG*y*CALL assertion
PUMP*x*FLT	Logical value of TRUE indicates that Pump x failed to start within PUMPxTO seconds
STAGE*y*	Asserts when the STG*y*CALL SELOGIC control equation input evaluates to TRUE
PUMP*x*STP	Asserts when Pump *x* fails to stop within PUMP*x*TO seconds
P*x*MINRT	Asserts while Pump *x* has been running for less than P*x*MINRT seconds
STAGSTRT	Asserts for STAGSTRT seconds while PAFB is enforcing stagger start behavior to delay a pump start
P*x*LONGRT	Asserts when Pump *x* has been running longer than P*x*LONGRT seconds

Pump Alternation

Pump and Stage Assignments

The PAFB operates and alternates pumps according to the S*y*PUMPS stage assignments for EPUMPS pumps and NUMSTG stages. S*y*PUMPS limits the pumps that Stage *y* can use, with a maximum of four pumps per stage. Each stage in the PAFB includes pump assignments (S*y*PUMPS) that define what pumps the stage can use for alternation. Stages always have unique pumps to operate (i.e., each pump never occupies more than one stage). Additionally, the PAFB always assigns pumps to stages in ascending order from 1 to 4, with all pump roles initializing according to the order in which they enable (see *PUMPxEN—Pump Enable on page J.7*). The PAFB indicates the stage assignment of a pump by using the Device Word bits P*x*LEAD, P*x*LAG1, P*x*LAG2, and P*x*LAG3 for Stages 1, 2, 3 and 4, respectively.

Alternation of Pumps

The PAFB alternates pumps when any of the following input conditions occurs:

- All STG*x*CALL equations evaluate to FALSE when one or more STAGE*x* outputs are TRUE
- A stage out-of-sequence condition ends (see *STGyCALL—Stage Call on page J.8*)
- The FRC_ALT equation evaluates to a rising edge

NOTE: STAGEx is be TRUE when STGxCALL evaluates to TRUE (see STGyCALL—Stage Call on page J.8).

When alternation initiates, the PAFB alternates pumps for all available stages in order from 1 to NUMSTG. Additionally, the PAFB maintains unique pump assignments for each stage when alternation occurs. A stage first alternates to a pump that did not start previously; afterwards, a stage alternates to the next available pump that the S*x*PUMPS settings allow.

Example Duplex Alternation

Figure J.2 illustrates an example for a typical duplex station that triggers alternation when the fluid level drops below the STOP float switch. The station uses the following configuration that includes two stages and two pumps in each stage:

EPUMPS = 2

NUMSTG = 2

S1PUMPS = 1,2

S2PUMPS = 1,2

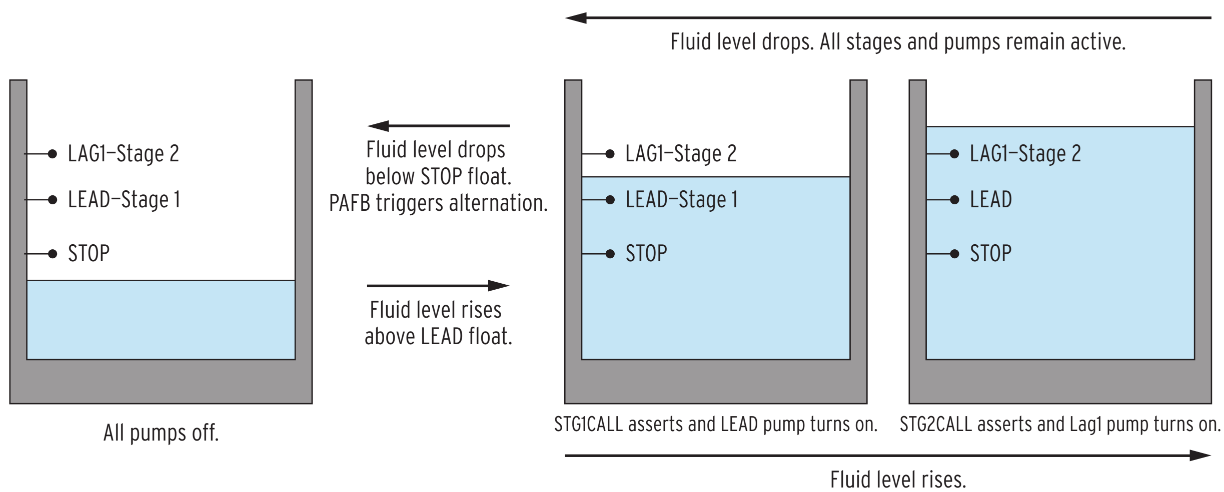

Figure J.2 Duplex Station Operation

Each time the fluid level returns to below the STOP float switch after a pump runs, the PAFB alternates the two pumps within their stage assignments. To accomplish this method for triggering alternation, STG1CALL must include logic that latches to TRUE when the fluid level is above the STOP and LEAD float switches and resets to FALSE when the fluid level drops below the STOP float switch. Similarly, STG2CALL must include logic that latches to TRUE when the fluid level is above the STOP and LAG1. Both stage calls must evaluate to FALSE when the fluid level drops below the STOP float. The following logic equations demonstrate one way to accomplish this:

STG1CALL = STOP AND (LEAD OR STAGE1)

STG2CALL = STOP AND (LAG1 OR STAGE2)

Using the STAGE1 output in these equations effectively latches STG1CALL after the STOP and LEAD float switches assert. Additionally, using the STAGE2 output with the LAG1 float switch has a similar result for STG2CALL. These equations require STOP to become FALSE to recall the stages, thus causing the PAFB to only turn off and alternate the pumps after the level drops below the STOP float switch. *Table J.2* provides the stage assignments and Device Word bit assertions for the first two pump alternations that occur after initialization. Because there are only two stages, Pumps 1 and 2 alternate between Stages 1 and 2 on every alternation.

Table J.2 Example of Alternating Pump Assignments for Duplex Station

	Stage 1	Stage 2	Device Word Bit Assertions
Initial pump assignments	1	2	P1LEAD, P2LAG1
First alternation pump assignments	2	1	P2LEAD, P1LEAD
Second alternation pump assignments	1	2	P1LAG1, P2LEAD

Example Triplex Alternation

This example includes a triplex station with three stages and three pumps in each stage with the following station configuration:

EPUMPS = 3

NUMSTG = 3

S1PUMPS = 1,2,3

S2PUMPS = 1,2,3

S3PUMPS = 1,2,3

Table J.3 provides the stage assignments and Device Word bit assertions for the first three pump alternation cycles that occur after initialization. The pump assignments for each stage rotate after every alternation, beginning with their initial assignments and moving the Stage 1 pump to Stage 2, the Stage 2 pump to Stage 3, and the Stage 3 pump to Stage 1.

Table J.3 Example Alternating Pump Assignments for Triplex Station

	Stage 1	Stage 2	Stage 3	Device Word Bit Assertions
Initial pump assignments	1	2	3	P1LEAD, P2LAG1, P3LAG2
First alternation pump assignments	2	3	1	P2LEAD, P3LAG1, P1LEAD
Second alternation pump assignments	3	1	2	P3LEAD, P1LAG1, P2LEAD
Third alternation pump assignments	1	2	3	P1LEAD, P2LAG1, P3LEAD

Stage Override

Use the override setting for a stage assignment to allow the stage to recall lower stages when it is active. The override stage recalls lower stages that are active by forcing their PUMPx values to FALSE; however, it does not prevent future activation of higher stages. Additionally, if all stages higher then the override stage do not have pumps available to run when they are active, any overridden stages become active again.

Example Triplex Station With High Service

This example includes a triplex station with three stages and three pumps. The first two pumps share Stages 1 and 2. The third pump is a high-service pump that only operates in Stage 3. The following configuration settings apply for this example:

EPUMPS = 3

NUMSTG = 3

S1PUMPS = 1,2

S2PUMPS = 1,2

S3PUMPS = OVERRIDE(3)

In this case, when STG3CALL evaluates to TRUE after STG1CALL and STG2CALL have both evaluated to TRUE, STAGE3 and PUMP3 assert. Additionally, PUMP1 and PUMP2 become FALSE when Stage 3 overrides Stages 1 and 2. *Figure J.3* illustrates this example further. Notice that when STG3CALL evaluates to TRUE, STAGE1 and STAGE2 remain TRUE while PUMP1 and PUMP2 become FALSE.

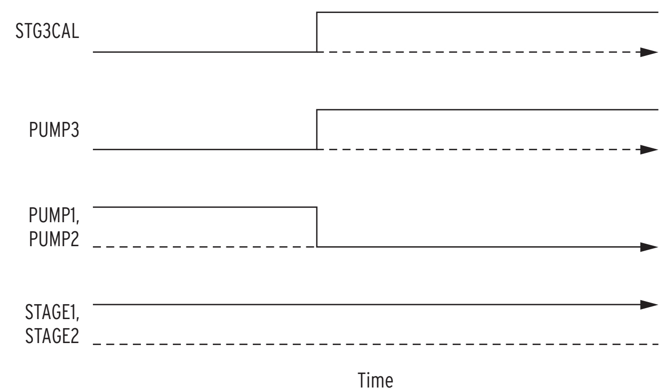

Figure J.3 High-Service Stage Override

Timers

PxMINRT—Minimum Run Time

To require a pump to run for a minimum amount of time after it starts, configure P*x*MINRT to a value between 1 and 600 seconds. When a stage call for Pump *x* occurs, the stage asserts PUMP*x* for at least the P*x*MINRT time. The P*x*MIINRT Device Word bit remains TRUE for the duration of the P*x*MINRT setting. If P*x*MINRT = OFF, PUMP*x* becomes FALSE immediately after the respective stage is no longer active. *Figure J.4* illustrates the minimum run-time behavior for P*x*MINRT, where PUMP*x* is the pump assignment for Stage *y* and STG*y*-CALL does not remain TRUE for longer than P*x*MINRT.

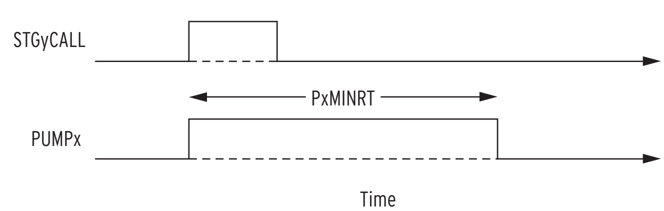

Figure J.4 Minimum Run Time Behavior

STAGSTRT—Stagger-Start Time

Prevent pumps from starting simultaneously by setting the STAGSTRT to a value between 1 and 300 seconds. After asserting a PUMP*x* output, the PAFB requires STAGSTRT seconds to expire before it asserts the next PUMP*x* output. PUMP*x* outputs assert in ascending order of stage assignments. *Figure J.5* illustrates an example of the stagger-start time behavior for three pumps, where PUMP2, PUMP3, and PUMP1 are the pump assignments for Stages 1, 2 and 3, respectively. The STAGSTRT Device Word bit will remain TRUE for the duration of STAGSTRT time for each PUMP*x* output that asserts. The PAFB does not allow the next pump to start until the STAGSTRT Device Word bit output becomes FALSE.

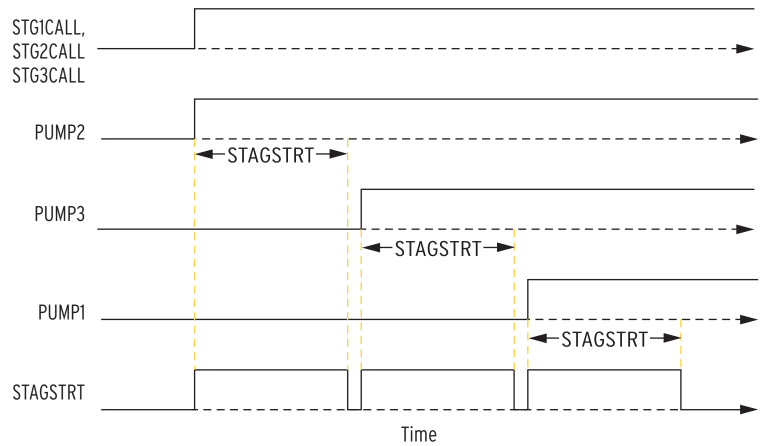

Figure J.5 Stagger-Start Time Behavior

PxLONGRT—Long-Run Time

To detect when a pump has been running for an abnormally long time, set P*x*LONGRT to a value between 1 and 3600 seconds. The P*x*LONGRT Device Word bit becomes TRUE when PUMP*x*RUN remains TRUE after the P*x*LONGRT time has expired, indicating that Pump *x* has run longer than the PxLONGRT setting. As soon as PUMP*x*RUN becomes FALSE, P*x*LONGRT also becomes FALSE. *Figure J.6* illustrates the long-run time behavior for Pump *x*.

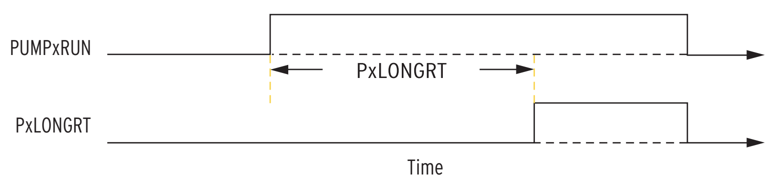

Figure J.6 Long-Run Time Behavior

PUMPxTO—Pump-Failure Timeout

Set the start and stop failure timeout to a value between 1 and 300 seconds for Pump *x* by using PUMP*x*TO. PUMP*x*FLT asserts when the PUMP*x*RUN input does not assert within PUMP*x*TO seconds after PUMPx asserts, indicating that Pump *x* has failed to start. *Figure J.7* illustrates PUMP*x*FLT behavior when a pump fails to start after PUMP*x* asserts and PUMP*x*RUN remains FALSE for PUMP*x*TO seconds.

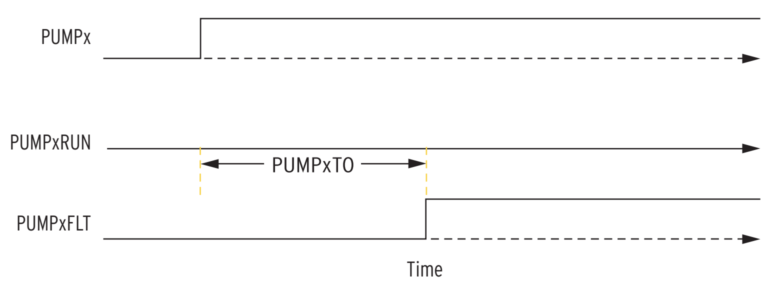

Figure J.7 PUMPxFLT Start Failure Behavior

When PUMPxFLT asserts, the PAFB turns off Pump *x* by setting PUMP*x* to FALSE. If PUMP*x*FLT asserts while the stage call (STG*y*CALL) of the pump is TRUE, the PAFB promotes and runs the pump in the next highest stage to operate in place of Pump *x*.

PUMP*x*STP asserts when the PUMP*x*RUN input does not become FALSE within PUMP*x*TO seconds after PUMP*x* becomes FALSE, indicating that Pump *x* failed to stop. After a pump stop failure occurs, PUMP*x*STP becomes FALSE as soon as PUMP*x*RUN becomes FALSE. *Figure J.8* illustrates PUMP*x*STP behavior when a pump fails to stop after PUMP*x* becomes false and PUMP*x*RUN remains TRUE.

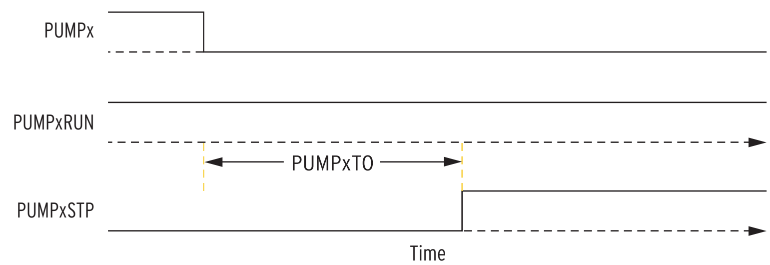

Figure J.8 PUMPxSTP Stop Failure Behavior

SELOGIC Inputs

PUMPxEN—Pump Enable

Configure logic to enable or disable Pump *x* by using PUMP*x*EN. When PUMP*x*EN evaluates to TRUE, the PAFB considers Pump *x* active and allows stages to use it for operation and alternation. On a rising-edge input for PUMP*x*EN, the PAFB assigns Pump *x* to the next lowest stage available, where Stage 1 is the lowest and Stage 4 is the highest.

Conversely, when PUMP*x*EN evaluates to FALSE, the PAFB considers Pump *x* inactive and does not allow any stages to use it for operation or alternation. On a falling-edge input for PUMP*x*EN, the PAFB removes Pump *x* from its alternation role and sets PUMP*x* to FALSE. The PAFB also promotes the pump with the next highest role in accordance with stage assignments and alternates all other pumps as necessary.

When more than one PUMP*x*EN input evaluates to TRUE on the same processing interval, the PAFB assigns roles for pumps in numerical order of *x*. For example, assume that Stages 1 and 2 include Pumps 3 and 4 in their stage assignments (e.g., S1PUMPS and S2PUMPS = 3,4) when PUMP3EN and PUMP4EN assert simultaneously. P3LEAD and P4LAG1 Device Word bits assert on the following processing interval to indicate that Pump 3 is the Lead pump and Pump 4 is the Lag1 pump..

PUMPxRUN—Pump-Running Status

Configure logic for PUMP*x*RUN to provide feedback on the running status of Pump *x*. The PAFB uses PUMP*x*RUN to detect Pump *x* start or stop timeout and assert the PUMP*x*FLT or PUMP*x*STP Device Word bit outputs when such conditions occur. The PAFB also uses PUMP*x*RUN to detect long run times for Pump *x*. PUMP*x*RUN evaluating to TRUE indicates to the PAFB that Pump *x* is running. Conversely, PUMP*x*RUN evaluating to FALSE indicates to the PAFB that Pump *x* is off.

If PUMP*x*RUN evaluates to a falling edge while the STG*y*CALL input of the pump is TRUE, PUMP*x*FLT asserts.

STGyCALL—Stage Call

To operate the PAFB properly, configure logic to assert STG*y*CALL values in order from lowest to highest stages, where Stage 1 is the lowest and Stage 4 is the highest. When STG*y*CALL evaluates to TRUE, the PAFB asserts STAGE*y* and PUMP*x* according to the existing pump assignment for Stage *y*. STAGE*y* and PUMP*x* remain TRUE until all STG*y*CALL equations evaluate to FALSE.

If STG*y*CALL evaluates to TRUE while Stage *y* does not have any pumps available to run, the PAFB asserts the STG*y*ALM stage alarm for Stage *y*. Additionally, the PAFB automatically attempts to call the next highest stage (Stage [*y*+1]) in place of Stage *y*.

A stage out-of-sequence condition occurs when a higher stage call asserts while a lower stage call is FALSE (e.g., STG3CALL evaluates to TRUE while STG1CALL or STG2CALL remains FALSE). When this happens, the PAFB treats any missed stages as if they had evaluated to TRUE and runs the pumps in those missed stages. The PAFB also asserts the STAGE*y* and STG*y*ALM outputs for the missed stages. While STG*y*ALM for a missed stage is TRUE, the PAFB ignores the STG*y*CALL input for that stage. The stage out-of-sequence condition ends when the initiating, out-of-sequence stage call evaluates to FALSE, causing the PAFB to turn off and alternate the pumps. Additionally, all alarms become FALSE after the stage out-of-sequence condition ends.

PUMPxFCL—Force Pump To Lowest Priority

Force a pump to the lowest possible stage by using PUMP*x*FCL. When PUMP*x*FCL evaluates to TRUE, the PAFB forces Pump *x* to the lowest stage that S*y*PUMPS allows. If PUMP*x*FCL evaluates to TRUE when PUMP*x* is TRUE, PUMP*x* becomes FALSE and the stage that Pump *x* occupied promotes the next available pump to replace Pump *x*. The PAFB only honors the first PUMP*x*FCL input that evaluates to TRUE and ignores all others.

FRC_ALT—Force Alternation

Configure logic for FRC_ALT to force the PAFB to alternate all pump roles according to S*y*PUMPS stage assignments. The PAFB alternates pump roles on a rising-edge input from FRC_ALT.

DIS_ALT—Disable Alternation

Use DIS_ALT to prevent the PAFB from alternating pump roles. When DIS_ALT evaluates to TRUE, the PAFB disables alternation and locks all pumps to their current stage assignments.

PxFLTRST—PumpFault Reset

Configure logic for P*x*FLTRST to reset PUMP*x*FLT for Pump *x*. The PAFB resets PUMP*x*FLT on a rising-edge input from P*x*FLTRST.

Glossary

A Abbreviation for amps or amperes; units of electrical current magnitude.

ACSELERATOR Architect SEL-5032 ACSELERATOR Architect is an add-on to the ACSELERATOR Suite that utilizes the IEC 61850 Substation Configuration Language to configure SEL IEDs.

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

Analog In this instruction manual, Analog is synonymous with Transducer.

ASCII Abbreviation for American Standard Code for Information Interchange. Defines a standard way to communicate text characters between two electronic devices. The SEL-2411P uses ASCII text characters to communicate using the device 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-2411P input. To set a logic condition to the true state (logical 1). To close a normally open output contact. To open a normally closed output contact.

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

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

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

Data Object In the IEC 61850 protocol, part of a logical node representing specific information (status or measurement, for example). From an object-oriented point of view, a data object is an instance of a data class.

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-2411P 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.

Delta (Open) A phase-to-phase connection of voltage transformers for electrical measuring purposes. Typically, two voltage transformers are used with one primary lead of the first transformer connected to A-phase and the other lead connected to B-phase. The second voltage transformer is connected to measure the voltage from B-phase to C-phase. When two transformers are used, this connection is frequently called "Open-Delta."

Dropout Time The time measured from the removal of an input signal until the output signal deasserts. The time can be settable, as in the case of a logic variable timer, or can be a result of the characteristics of an element algorithm, as in the case of an overcurrent element dropout time.

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

Device Word Bit A single device element or logic result that the device updates once each processing interval. A Device Word bit can be equal to either logical 1 or logical 0. Logical 1 represents a true logic condition, picked up element, or asserted contact input or contact output. Logical 0 represents a false logic condition, dropped out element, or deasserted contact input or contact output. You can use Device Word bits in SELOGIC control equations to control event triggering, output contacts, as well as other functions.

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

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

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

Event History A quick look at recent device activity that includes a standard report header; event number, date, time, and type; maximum fault phase current; and targets.

Event Report A text-based collection of data stored by the device in response to a triggering condition, such as a fault or command. The data show device measurements before and after the trigger, in addition to the states of protection elements, device inputs, and device outputs each processing interval. After an electrical system fault, use event reports to analyze device and system performance.

Event Summary A shortened version of stored event reports. An event summary includes items such as event date and time, event type, fault voltages, currents, etc. The device sends an event report summary (if auto messaging is enabled) to the device serial port a few seconds after an event.

Fast Hybrid Control Output A control output similar to, but faster than, the hybrid control output. The fast hybrid output uses an insulated gate bipolar junction transistor (IGBT) to interrupt (break) high inductive dc currents and to very rapidly make and hold the current until a metallic contact operates, at which time the IGBT turns off and the metallic contact holds the current. Unlike the hybrid control output, this output is not polarity sensitive; reversed polarity causes no misoperations.

Fast Meter, Fast Operate Binary serial port commands that the device recognizes at the device front-and rear-panel EIA-232 serial ports. These commands and the responses from the device make device data collection by a communications processor faster and more efficient than transfer of the same data through use of formatted ASCII text commands and responses.

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

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

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

Function In IEC 61850, task(s) performed by the substation automation system, i.e., by application functions. Generally, functions exchange data with other functions. Details are dependent on the functions involved.

Functions are performed by IEDs (physical devices). A function may be split into parts residing in different IEDs but communicating with each other (distributed function) and with parts of other functions. These communicating parts are called logical nodes.

Fundamental Frequency The component of the measured electrical signal for which frequency is equal to the normal electrical system frequency, usually 50 or 60 Hz. Generally used to differentiate between the normal system frequency and any harmonic frequencies present.

Fundamental Meter Type of meter data presented by the SEL-2411P that includes the present values measured at the device ac inputs. The word "Fundamental" is used to indicate that the values are Fundamental Frequency values and do not include harmonics.

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

LCD Abbreviation for Liquid Crystal Display. Used as the device front-panel alphanumeric display.

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

MAC Address The Media Access Control (hardware) address of a device connected to a shared network medium, most often used with Ethernet networks.

NEMA Abbreviation for National Electrical Manufacturers Association.

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

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

Phase Rotation The sequence of voltage or current phasors in a multiphase electrical system. In an ABC phase rotation system, the B-phase voltage lags the A-phase voltage by 120 degrees and the C-phase voltage lags B-phase voltage by 120 degrees. In an ACB phase rotation system, the C-phase voltage lags the A-phase voltage by 120 degrees and the B-phase voltage lags the C-phase voltage by 120 degrees.

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.

PT Abbreviation for potential transformer. Also referred to as a voltage transformer or VT.

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

Remote Bit A Device Word bit for which state is controlled by serial port commands, including the CONTROL command, binary Fast Operate command, or Modbus® RTU, Modbus TCP, DNP3, or DNP3 LAN/WAN command.

RMS Abbreviation for Root-Mean-Square. Refers to the effective value of the sinusoidal current and voltage measured by the device, accounting for the fundamental frequency and higher order harmonics in the signal.

ROM Abbreviation for Read-Only Memory. Nonvolatile memory where the device 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-2411P is equipped with self-tests that validate the device power supply, microprocessor, memory, and other critical systems.

SELOGIC Control Equation A device setting that allows you to control a device function (such as an output contact) by using a logical combination of device element outputs and fixed logic outputs. Logical AND, OR, 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 A device function that stores a record of the date and time of each assertion and deassertion of every Device Word bit in a settable list. Provides a useful way to determine the order and timing of events following a device operation.

SER Abbreviation for Sequential Events Recorder or the device 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).

UCA2 Utility Communications Architecture. A network-independent protocol suite that serves as an interface for individual intelligent electronic devices.

Unbuffered Report IEC 61850 IEDs can issue immediate unbuffered reports of internal events (caused by trigger options data-change, quality-change, and data-update) on a “best efforts” basis. If no association exists, or if the transport data flow is not fast enough to support it, events may be lost.

V Abbreviation for volts or voltage; units of electrical voltage magnitude.

VA, VB, VC Measured A-, B-, and C-phase-to-neutral voltages.

VAB, VBC, VCA Measured or calculated phase-to-phase voltages.

VG Residual voltage calculated from the sum of the three phase-to-neutral voltages, if connected.

VT Abbreviation for voltage transformer. Also referred to as a potential transformer or PT.

Wye As used in this instruction manual, a phase-to-neutral connection of voltage transformers for electrical measuring purposes. Three voltage transformers are used with one primary lead of the first transformer connected to A-phase and the other lead connected to ground. The second and third voltage transformers are connected to measure the voltage from B-phase and C-phase-to-ground, respectively. This connection is frequently called “four-wire wye,” alluding to the three phase leads plus the neutral lead.

Z-Number That portion of the device FID string that identifies the proper QuickSet software device driver version when creating or editing device settings files.

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SEL-2411P Command Summary

The table below lists the front serial port ASCII commands associated with particular activities. The commands are shown in uppercase letters, but they can also be entered using lowercase letters.

Serial Port Command	Command Description
Access Level 0 Commands	
ACC	Go to Access Level 1.
BNA	Display ASCII names of all the Device Word bits returned in the Fast Meter Data Block.
CAS	Return the Compressed ASCII configuration message.
DNA	Display ASCII names of Device Word bits reported in Fast Meter.
ID	Device identification code.
QUI	Go to Access Level 0.
SNS	Display SER settings in Compressed ASCII format.
Access Level 1 Commands	
2AC	Go to Access Level 2.
CEV *n*	Display compressed event report, 15 cycles (*n* is the event report).
CEV *n* R	Display compressed event report with raw (unfiltered) data, 16 or 65 cycles.
CHI	Display compressed history report.
CME A	Display fundamental metering data in compressed format.
CME F	Display fundamental metering data in compressed format.
CME M	Display math variable metering data in compressed format.
CME RE	Display remote analog metering data in compressed format.
COM A	Return a summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel A.
COM B	Return a summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel B.
COM C	Clear all communications records. If both MIRRORED BITS channels are enabled, omitting the channel specifier (A or B) clears both channels.
COM C A	Clear all communications records for Channel A.
COM C B	Clear all communications records for Channel B.
COM L	Append a long report to the summary report of the last 255 records in the MIRRORED BITS communications buffer.
COM L A	Append a long report to the summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel A.
COM L B	Append a long report to the summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel B.
COM S	Return a summary report of the last 255 records in the MIRRORED BITS communications buffer.
COU *n*	Display the values of the SELOGIC counters *n* times.
CPR	Display analog signal profile data.
CST	Display compressed status report.
CSU	Display compressed event summary.
DAT	View the date.

Serial Port Command	Command Description
DAT ***dd/mm/yyyy***	Enter date in DMY format if DATE_F setting is DMY.
DAT ***mm/dd/yyyy***	Enter date in MDY format if DATE_F setting is MDY.
DAT ***yyyy/mm/dd***	Enter date in YMD format if DATE_F setting is YMD.
EVE ***n***	Show event report *n* with 4 samples per cycle. If *n* is omitted, most recent report is displayed.
EVE ***n*****R**	Show event report *n* with raw (unfiltered) 16 samples per cycle analog data and 4 samples per cycle digital data.
FIL DIR	Return a list of files.
FIL READ ***filename***	Transfer settings file *filename* from the device to the PC.
FIL SHOW ***filename***	Filename 1 displays contents of the file filename.
HEL	Display a short description of selected commands.
HIS ***n***	Show summary of *n* latest event reports, where *n* = 1 is the most recent entry. If *n* is not specified, all event report summaries are displayed.
HIS C or R	Clear or reset history buffer.
IRIG	Force synchronization of internal control clock to IRIG-B time-code input.
MAC	Display the MAC address of the Ethernet port (PORT 1).
MAP ***x y***	Display DNP3 map for port *x*, session *y*.
MET	Display pump operation status data.
MET A	Display analog input metering data.
MET ACV	Display analog control variable data.
MET F ***k***	Display fundamental metering data *k* times, where *k* is between 1 and 32767.
MET MATH	Display math variable metering data.
MET MAX	Display maximum/minimum metering data.
MET RA	Display remote analog metering data.
MET RD	Reset demand metering data.
MET RE	Reset energy metering data.
MET RM	Reset maximum/minimum metering data.
MET RP	Reset peak demand metering data.
PAR	Display the current part number.
PRO	Display analog signal profile data.
PRO C	Clears analog signal profile data.
SER	Display all Sequential Events Recorder (SER) data.
SER ***date1***	Display all **SER** records made on *date1*.
SER ***date1 date2***	Display all **SER** records made from dates *d2* to *d1*, inclusive, starting with *d2*.
SER ***row1***	Display the *n* most recent SER records starting with record *n*.
SER ***row1 row2***	Display SER records *n2* to *n1*, starting with *n2*.
SER C or R	Clear/Reset SER data.
SER D	Delete SER data.
SHO	Show device settings.
SHO DN	Show DNP3 settings
SHO F	Show front-panel settings.
SHO G	Show global settings.
SHO L	Show general logic settings.

Serial Port Command	Command Description
SHO P *n*	Show serial port settings, where *n* specifies the port (3, 4, or F); *n* defaults to the active port if not listed.
SHO R	Show report (event and SER) settings.
SHO S	Show station settings
STA	Display device self-test status.
STA S	Display SELOGIC usage status report.
SUM	Display an event summary.
TAR	Display Device Word Row 0 (front-panel target LEDs).
TAR *n k*	Display Device Word Row *n* (*n* = 0 to 65). Repeat *k* times (1–32767).
TAR *name k*	Display Device Word Row containing Device Word *name*. Repeat *k* times.
TAR R	Reset front-panel trip/target LEDs.
TAR … ROW	Adding ROW to the command displays the Device Word Row number at the start of each line.
TIM	View time.
TIM *hh:mm:ss*	Set time by entering **TIM** followed by hours, minutes, and seconds, as shown (24-hour clock).
TRI	Trigger an event report data capture.
Access Level 2 Commands	
ANA *p t*	Test analog output port where *p* is a percentage of full scale between 0–100% and *t* is time in 1.0–10.0 minutes
CAL	Go to Access Level C.
CON *n*	Set, clear, or pulse an internal remote bit (*n* is the remote bit number from 1–32).
FIL WRITE *filename*	Transfer settings file *filename* from the PC to the device.
L_D	Load new firmware.
LOO	Enable loopback testing of MIRRORED BITS channels.
LOO A	Enable loopback on MIRRORED BITS Channel A for the next five minutes.
LOO B	Enable loopback on MIRRORED BITS Channel B for the next five minutes.
PAR *2411xxxxxxxxxxxxxxx*	Enter/change the part number.
PAS	Show existing Access Level 1 and Level 2 passwords.
PAS 1 *xxxxxxxxxxxx*	Change Access Level 1 password to *xxxxxxxxxxxx*.
PAS 2 *xxxxxxxxxxxx*	Change Access Level 2 password to *xxxxxxxxxxxx*.
PUL *n*	Pulse output contact *n* for one second.
SET	Enter/change device settings.
SET DN	Enter/change DNP3 settings.
SET F	Enter/change front-panel settings.
SET G	Enter/change global settings.
SET L	Enter/change SELOGIC variable and timer settings.
SET *name*	For all **SET** commands, jump ahead to a specific setting by entering the setting name.
SET P *n*	Enter/change serial Port *n* settings (*n* = 2, 3, 4, or F; if not specified, the default is the active port).
SET R	Enter/change report (event and SER) settings.
SET S	Enter/change station settings.
SET … TERSE	For all **SET** commands, **TERSE** disables the automatic **SHO** command after the settings entry.
STA R or C	Clear self-test status and restart device.

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SEL-2411P Command Summary

The table below lists the front serial port ASCII commands associated with particular activities. The commands are shown in uppercase letters, but they can also be entered using lowercase letters.

Serial Port Command	Command Description
Access Level 0 Commands	
ACC	Go to Access Level 1.
BNA	Display ASCII names of all the Device Word bits returned in the Fast Meter Data Block.
CAS	Return the Compressed ASCII configuration message.
DNA	Display ASCII names of Device Word bits reported in Fast Meter.
ID	Device identification code.
QUI	Go to Access Level 0.
SNS	Display SER settings in Compressed ASCII format.
Access Level 1 Commands	
2AC	Go to Access Level 2.
CEV *n*	Display compressed event report, 15 cycles (*n* is the event report).
CEV *n* R	Display compressed event report with raw (unfiltered) data, 16 or 65 cycles.
CHI	Display compressed history report.
CME A	Display fundamental metering data in compressed format.
CME F	Display fundamental metering data in compressed format.
CME M	Display math variable metering data in compressed format.
CME RE	Display remote analog metering data in compressed format.
COM A	Return a summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel A.
COM B	Return a summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel B.
COM C	Clear all communications records. If both MIRRORED BITS channels are enabled, omitting the channel specifier (A or B) clears both channels.
COM C A	Clear all communications records for Channel A.
COM C B	Clear all communications records for Channel B.
COM L	Append a long report to the summary report of the last 255 records in the MIRRORED BITS communications buffer.
COM L A	Append a long report to the summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel A.
COM L B	Append a long report to the summary report of the last 255 records in the communications buffer for MIRRORED BITS communications Channel B.
COM S	Return a summary report of the last 255 records in the MIRRORED BITS communications buffer.
COU *n*	Display the values of the SELOGIC counters *n* times.
CPR	Display analog signal profile data.
CST	Display compressed status report.
CSU	Display compressed event summary.
DAT	View the date.

Serial Port Command	Command Description
DAT ***dd/mm/yyyy***	Enter date in DMY format if DATE_F setting is DMY.
DAT ***mm/dd/yyyy***	Enter date in MDY format if DATE_F setting is MDY.
DAT ***yyyy/mm/dd***	Enter date in YMD format if DATE_F setting is YMD.
EVE ***n***	Show event report *n* with 4 samples per cycle. If *n* is omitted, most recent report is displayed.
EVE ***n*****R**	Show event report *n* with raw (unfiltered) 16 samples per cycle analog data and 4 samples per cycle digital data.
FIL DIR	Return a list of files.
FIL READ ***filename***	Transfer settings file *filename* from the device to the PC.
FIL SHOW ***filename***	Filename 1 displays contents of the file filename.
HEL	Display a short description of selected commands.
HIS ***n***	Show summary of *n* latest event reports, where *n* = 1 is the most recent entry. If *n* is not specified, all event report summaries are displayed.
HIS C or R	Clear or reset history buffer.
IRIG	Force synchronization of internal control clock to IRIG-B time-code input.
MAC	Display the MAC address of the Ethernet port (PORT 1).
MAP ***x y***	Display DNP3 map for port *x*, session *y*.
MET	Display pump operation status data.
MET A	Display analog input metering data.
MET ACV	Display analog control variable data.
MET F ***k***	Display fundamental metering data *k* times, where *k* is between 1 and 32767.
MET MATH	Display math variable metering data.
MET MAX	Display maximum/minimum metering data.
MET RA	Display remote analog metering data.
MET RD	Reset demand metering data.
MET RE	Reset energy metering data.
MET RM	Reset maximum/minimum metering data.
MET RP	Reset peak demand metering data.
PAR	Display the current part number.
PRO	Display analog signal profile data.
PRO C	Clears analog signal profile data.
SER	Display all Sequential Events Recorder (SER) data.
SER ***date1***	Display all **SER** records made on *date1*.
SER ***date1 date2***	Display all **SER** records made from dates *d2* to *d1*, inclusive, starting with *d2*.
SER ***row1***	Display the *n* most recent SER records starting with record *n*.
SER ***row1 row2***	Display SER records *n2* to *n1*, starting with *n2*.
SER C or R	Clear/Reset SER data.
SER D	Delete SER data.
SHO	Show device settings.
SHO DN	Show DNP3 settings
SHO F	Show front-panel settings.
SHO G	Show global settings.
SHO L	Show general logic settings.

Serial Port Command	Command Description
SHO P *n*	Show serial port settings, where *n* specifies the port (3, 4, or F); *n* defaults to the active port if not listed.
SHO R	Show report (event and SER) settings.
SHO S	Show station settings
STA	Display device self-test status.
STA S	Display SELOGIC usage status report.
SUM	Display an event summary.
TAR	Display Device Word Row 0 (front-panel target LEDs).
TAR *n k*	Display Device Word Row *n* (*n* = 0 to 65). Repeat *k* times (1–32767).
TAR *name k*	Display Device Word Row containing Device Word *name*. Repeat *k* times.
TAR R	Reset front-panel trip/target LEDs.
TAR … ROW	Adding ROW to the command displays the Device Word Row number at the start of each line.
TIM	View time.
TIM *hh:mm:ss*	Set time by entering **TIM** followed by hours, minutes, and seconds, as shown (24-hour clock).
TRI	Trigger an event report data capture.
Access Level 2 Commands	
ANA *p t*	Test analog output port where *p* is a percentage of full scale between 0–100% and *t* is time in 1.0–10.0 minutes
CAL	Go to Access Level C.
CON *n*	Set, clear, or pulse an internal remote bit (*n* is the remote bit number from 1–32).
FIL WRITE *filename*	Transfer settings file *filename* from the PC to the device.
L_D	Load new firmware.
LOO	Enable loopback testing of MIRRORED BITS channels.
LOO A	Enable loopback on MIRRORED BITS Channel A for the next five minutes.
LOO B	Enable loopback on MIRRORED BITS Channel B for the next five minutes.
PAR *2411xxxxxxxxxxxxxxx*	Enter/change the part number.
PAS	Show existing Access Level 1 and Level 2 passwords.
PAS 1 *xxxxxxxxxxxx*	Change Access Level 1 password to *xxxxxxxxxxxx*.
PAS 2 *xxxxxxxxxxxx*	Change Access Level 2 password to *xxxxxxxxxxxx*.
PUL *n*	Pulse output contact *n* for one second.
SET	Enter/change device settings.
SET DN	Enter/change DNP3 settings.
SET F	Enter/change front-panel settings.
SET G	Enter/change global settings.
SET L	Enter/change SELOGIC variable and timer settings.
SET *name*	For all **SET** commands, jump ahead to a specific setting by entering the setting name.
SET P *n*	Enter/change serial Port *n* settings (*n* = 2, 3, 4, or F; if not specified, the default is the active port).
SET R	Enter/change report (event and SER) settings.
SET S	Enter/change station settings.
SET … TERSE	For all **SET** commands, **TERSE** disables the automatic **SHO** command after the settings entry.
STA R or C	Clear self-test status and restart device.

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