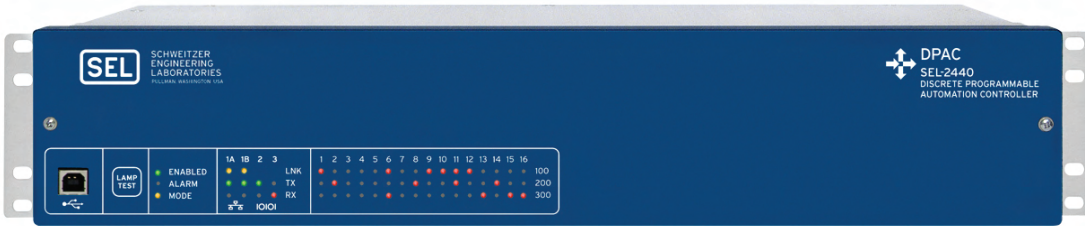




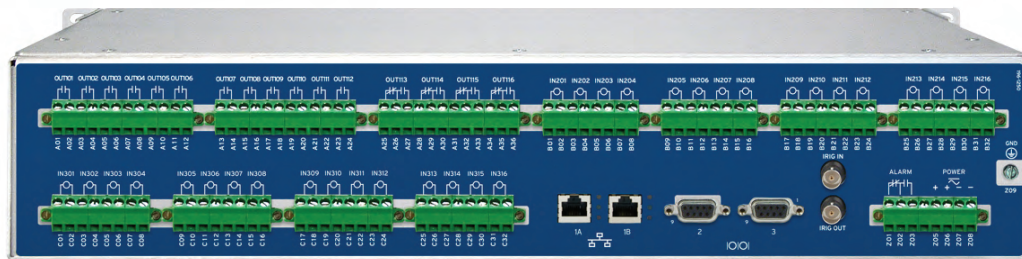
SEL-2440 Discrete Programmable Automation Controller

Complete System for Control and Monitoring



Rack
Panel
Surface
DIN Rail

32 Inputs
16 Outputs
4 Ports
(Standard)



Major Features and Benefits

Fast and Powerful I/O

- Utilize an exceptional and compact combination of inputs, outputs, and communications.
- Analyze system events with inputs and other events timed to the microsecond.
- Synchronize control with outputs that are synchronized to IRIG-B time.
- Perform actions quickly with a processing interval of 2 ms and an input to output interval of 7 ms.
- Program new features with logic, latches, timers, counters, edge-triggers, and math functions.
- Ensure safe operation by using an input with logic programmed for local/remote control.

Convenient Maintenance and Support

- LEDs provide status for every I/O point and communications port.
- Removable terminal blocks make installation and replacement quick and efficient.
- Positive retention connectors ensure that connections are not lost due to sagging cables.
- Front-panel management port makes device management convenient.

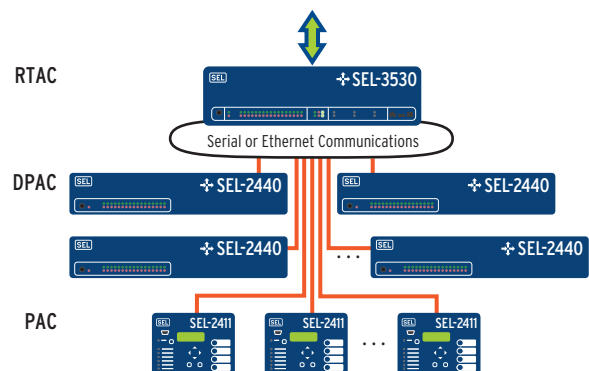
Flexible Communications and Integration

- Communicate with DNP3, Modbus®, and IEC 61850 protocols over Ethernet and serial connections. Direct and select-before-operate (SBO) outputs are supported.

- Automate systems with flexible communication options that provide easy integration with SCADA.
- Configure easily with preprogrammed register or object maps and front-panel DIP switches.
- Alternatively, configure with ACSELERATOR QuickSet® SEL-5030 Software.

SEL Quality, Standards, and Global Support

- Designed and tested for harsh physical and electrical environments.
- Designed and tested to operate with dc grounded batteries and capacitive loads, and to trip breakers and interrupt inductive loads.
- Superior specification compliance, high reliability, low price, and worldwide, ten-year warranty.



Product Summary

The SEL-2440 Discrete Programmable Automation Controller (DPAC) withstands harsh physical and electrical environments and is built and tested to meet mission-critical IEEE and IEC protective relay standards. Apply the DPAC to satisfy stand-alone or distributed input, output, and communications needs. *Figure 1* shows the DPAC functionality.

Functional Diagram

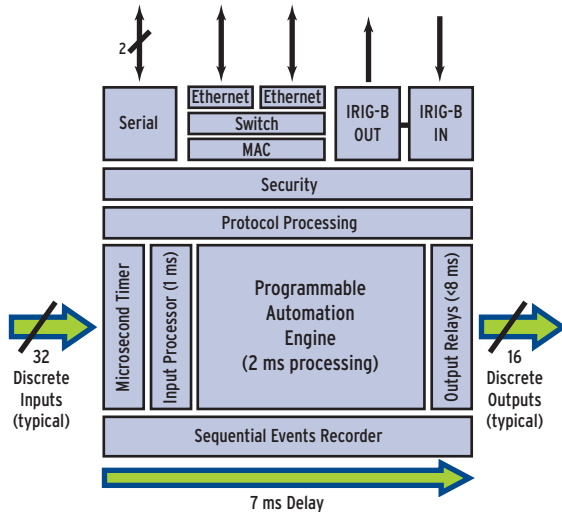


Figure 1 Functional Diagram

Configuration

- ▶ **Easy Mode.** Set address and communications parameters with DIP switches.
- ▶ **Flexible Mode.** Access additional flexibility using ACSELERATOR QuickSet software, shown in the following figure.

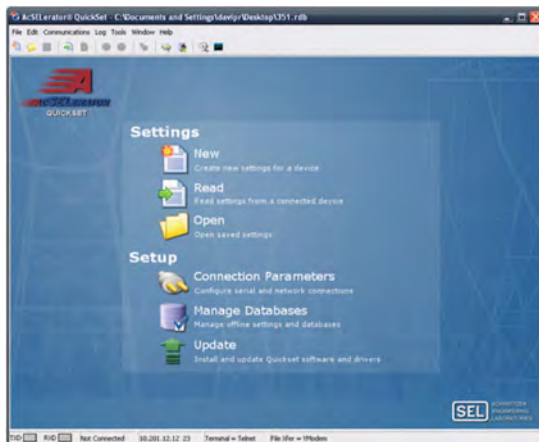


Figure 2 ACSELERATOR QuickSet Launchpad

Inputs/Outputs

DPAC devices can be ordered with different I/O and input voltage ratings as shown in the following tables.

I/O Quantity Options

	Inputs	Outputs
Standard	32	16
Option 1	16	32
Option 2	48	0
Option 3	16	32 (16 Standard and 16 High-Current Interrupting)

I/O Input Voltage Options

Digital Input Rating

24 Vac/Vdc
48 Vac/Vdc
110 Vac/Vdc
125 Vac/Vdc
220 Vac/Vdc
250 Vac/Vdc

Communications and Time

Many communications ports and protocols are provided.

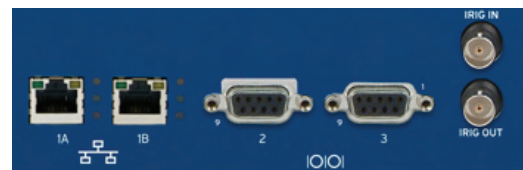


Figure 3 Rear-Panel Communications and IRIG-B Ports

Port	Port Interface
PORT F	USB 2.0 physical interface, serial port (e.g., COM1) software interface
PORT 1	Ethernet with switch/failover (copper or fiber)
PORT 2	Serial (EIA-232, EIA-485, V-pin fiber, or ST fiber)
PORT 3	Serial (EIA-232)

	Serial	Ethernet
DNP3	Yes	Yes
Modbus	Yes	Yes
IEC 61850		Yes
MIRRORED BITS®	Yes	
SEL Fast Message	Yes	

Input/Output Features

Inputs (Status and Alarms)

Use digital inputs to monitor critical alarms or status points and time-stamp to the microsecond.

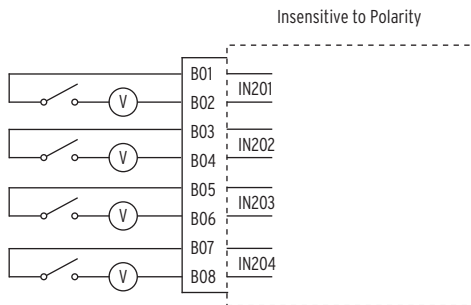


Figure 4 Independent and Isolated Inputs

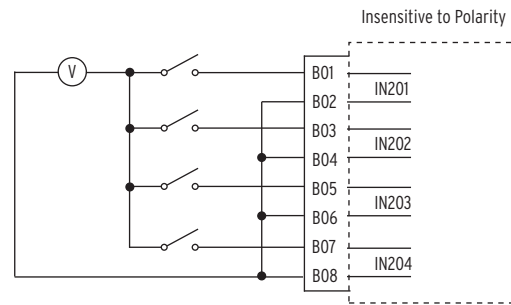


Figure 5 Bussed Inputs

SEL inputs are designed and tested to ensure they operate correctly for dc battery grounds and capacitive discharges.

The bold line in *Figure 6* shows how an earth fault completes the battery path through the input, bypassing the output. If the input is rated for both 48 and 125 Vdc then the 65 Vdc that the fault causes across the input will assert the input. SEL level-sensitive inputs are designed so that they do not operate for this condition.

The bold line in *Figure 7* shows a discharge path from the wiring capacitance through the input when a knife switch is closed. This discharge can cause a temporary assertion of an input. SEL inputs are designed with debounce timers so that they do not operate for this condition.

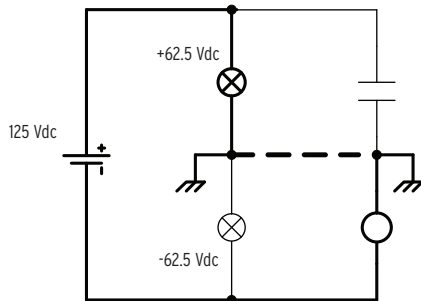


Figure 6 Secure Against DC Grounds

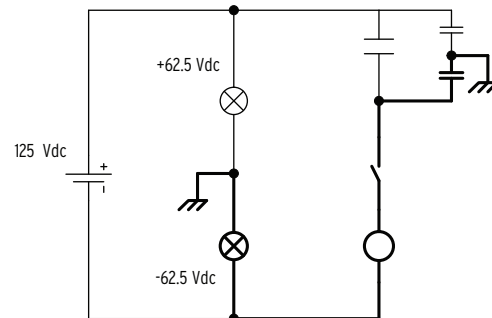


Figure 7 Secure Against Capacitive Discharges

Outputs (Relays)

Outputs are rated for 30 A make and inductive interrupt applications such as trip and close operations and motor control. See the *Output* specifications for more details.

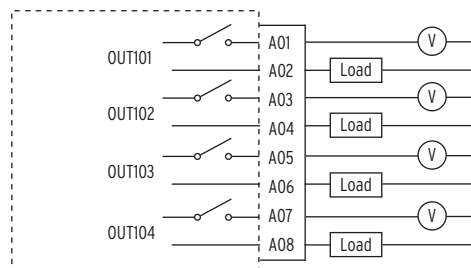
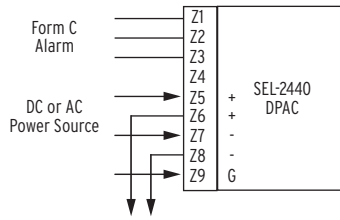


Figure 8 Independent and Isolated Outputs

Power

The **POWER** terminals on the rear panel must connect to 120–230 Vac or 24–250 Vdc with the proper polarity. These terminals are isolated from chassis ground. Extra terminals are provided so power can be daisy-chained from DPAC to DPAC.



IRIG-B

A demodulated IRIG-B input and output are provided so this signal can be daisy-chained between DPAC devices.



Connectors

Removable terminal block connectors make installation and replacement quick and efficient but can result in intermittent or lost connections if positive retention means aren't provided. The following diagram shows one of the pluggable connectors used on the DPAC and points out the retention screws that ensure connections remain in place.

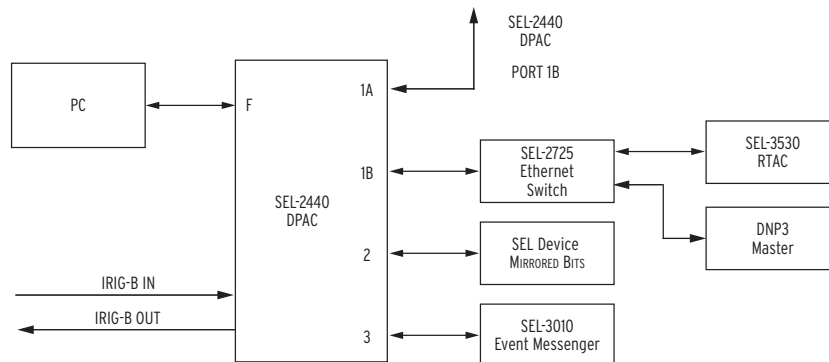


Conformal Coating

The optional conformal coating protects the DPAC printed circuit board from moisture and corrosive elements found in harsh installations. This conformal coating option conforms to Mil-1-46058C Type UR conformal coating requirements.

Communications Ports

A rich collection of communications ports and protocols are available with the DPAC as shown in the following figure, which also includes connection examples.



Analyze Sequence-of-Events

Record sequence-of-events with the Sequential Events Recorder (SER) function. With this function, you can analyze assertions and deassertions of digital inputs and outputs—as many as 512 state changes to the microsecond for as many as 96 different digital points. The function also captures when the device powers up and a settings change occurs.

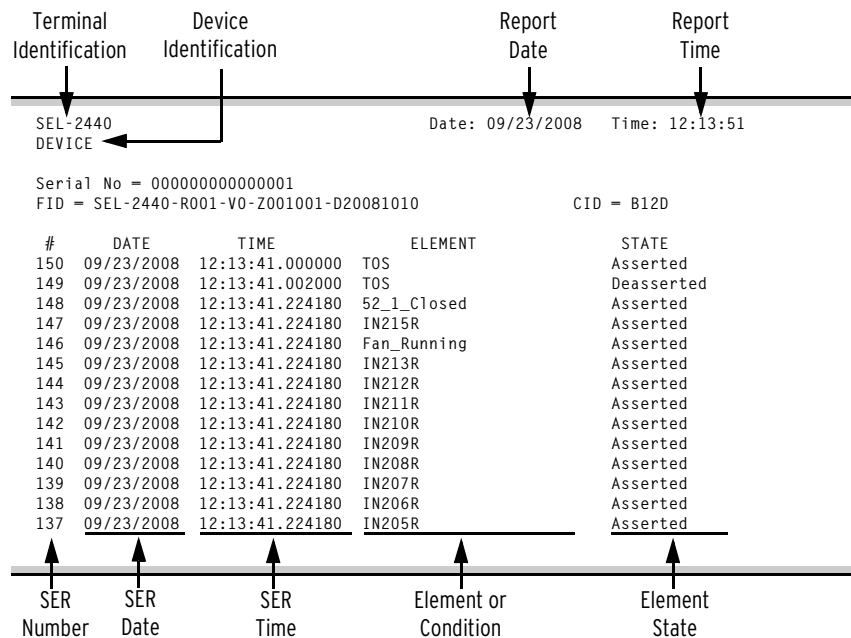


Figure 9 Sample SER Report

Combine SER data from individual SEL-2440 DPAC devices into a system-wide log. Synchronize the system with IRIG-B time code and the report data will align perfectly.



Figure 10 Combine SER Data From Multiple SEL-2440 DPAC devices for a System-Wide Log and Display

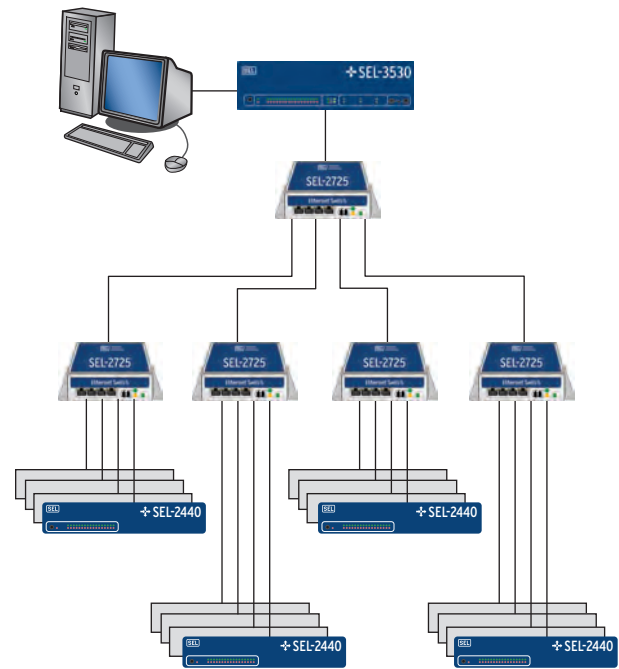


Figure 11 Example SER Collection Architecture

Automation Features

Flexible Control Logic and Integration Features

Eases Configuration

The DPAC does not require special communications software. Use any system that emulates a standard terminal system for engineering access to the device.

Simplifies Communications

The SEL-2440 is equipped with three independently operated serial ports. Establish communication by connecting computers, modems, protocol converters, printers, an SEL Communications Processor, SCADA serial port, and an RTU for local or remote communication. Apply an SEL communications processor as the hub of a star network, with point-to-point fiber or copper connection between the hub and the SEL-2440.

Supports Standard Protocols

As with most SEL devices, the DPAC comes standard with the communications protocols listed below.

- DNP3
- Modbus
- SEL ASCII
- SEL Compressed ASCII
- SEL Fast Meter
- SEL Fast Operate
- SEL Fast SER
- SEL Fast Message
- SEL MIRRORED BITS

Simplifies SCADA

SEL devices provide proprietary but open, binary “fast” protocols. These protocols are self-describing and are interleaved with ASCII protocols on the same port. Simplify configuration, minimize communications wiring, and improve performance between the DPAC and other devices (e.g., communications processors) with these protocols.

Provides Annunciation

Indicators (LEDs) provide annunciation of I/O status for each input and output. In addition, device status and port activity indicators simplify commissioning and troubleshooting.

Performs Logic and Math

Eliminate PLCs with Boolean logic, rising/falling edge triggers, and math (+, -, *, /).

Replaces Traditional Latching Relays

Replace as many as 32 traditional latching relays for such functions as “remote control enable” with latches. Program latch set and latch reset conditions with SELOGIC® control equations. Set or reset the nonvolatile latches using optoisolated inputs, Remote Bits, latches, or any programmable logic condition. The latches retain their state when the device loses power.

Eliminates External Timers

Eliminate external timers for custom protection or control schemes with 32 general purpose SELOGIC control equation timers. Each timer has independent time-delay pickup and dropout settings. Program each timer input with any desired element. Assign the timer output to trip logic, transfer trip communications, or other control scheme logic.

Eliminates External Counters

Eliminate external counters for custom control schemes with 32 counters, updated every 2 ms processing interval. Each counter element consists of five inputs (preset value; load preset value, count up, count down, and reset to zero) and three outputs (counter value; count as many as preset reached, count down to zero reached).

Eliminates RTU-to-Device Wiring

Eliminate RTU-to-Device wiring with 32 Remote Bits. Set, clear, or pulse Remote Bits using serial or Ethernet port commands. Program the Remote Bits into your control scheme with SELOGIC control equations. Use Remote Bits for SCADA-type control operations such as trip, close, and settings group selection.



Figure 12 Annunciation Indicators

Communications Architectures

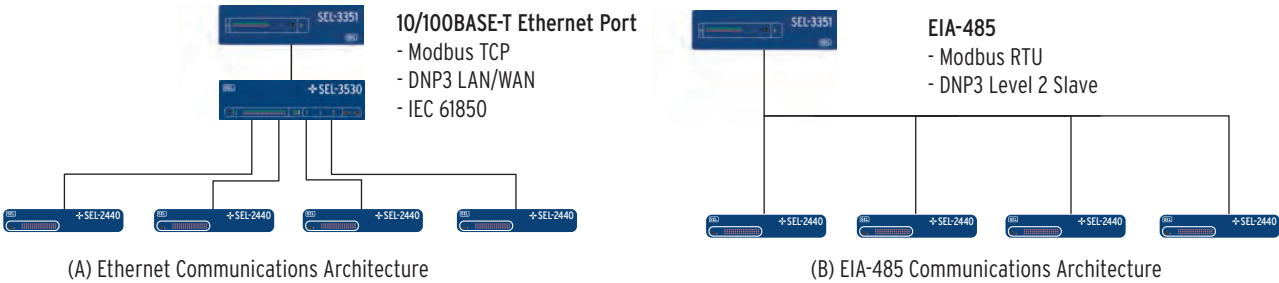


Figure 13 Typical Ethernet and EIA-485 Communications Architectures

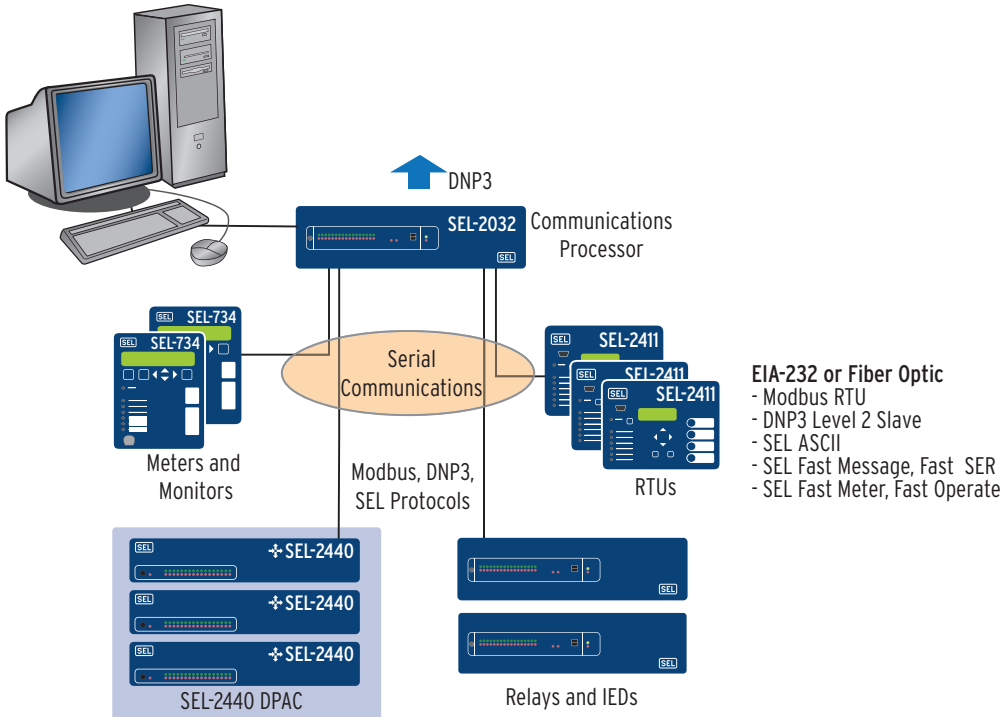


Figure 14 Typical EIA-232 and Fiber-Optic Communications Architecture

Additional Ordering Options

The following options can be ordered for any SEL-2440 model (see the SEL-2440 Model Option Table for details):

Port 2 Physical Interface
EIA-232
EIA-485
V-pin fiber
ST fiber

Mounting
Rack
Panel
Surface
DIN Rail

Front- and Rear-Panel Diagrams

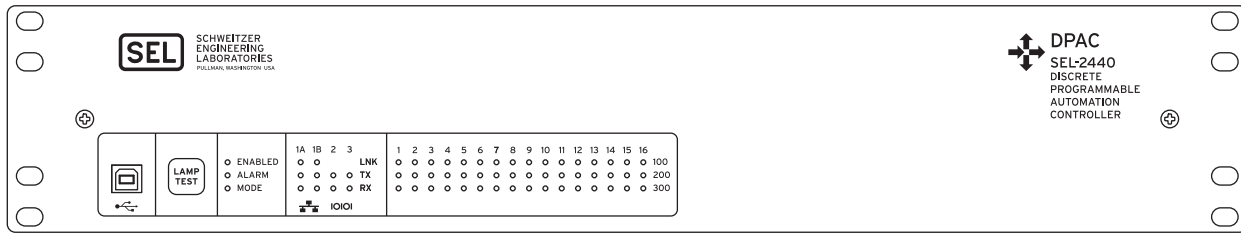


Figure 15 Rack-Mount Drawing

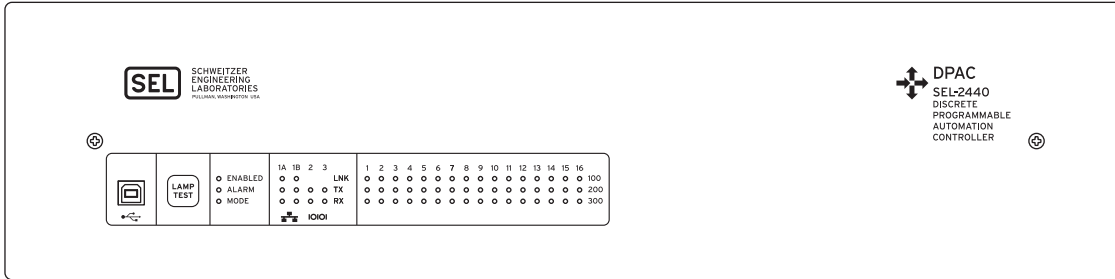


Figure 16 Panel-Mount Drawing

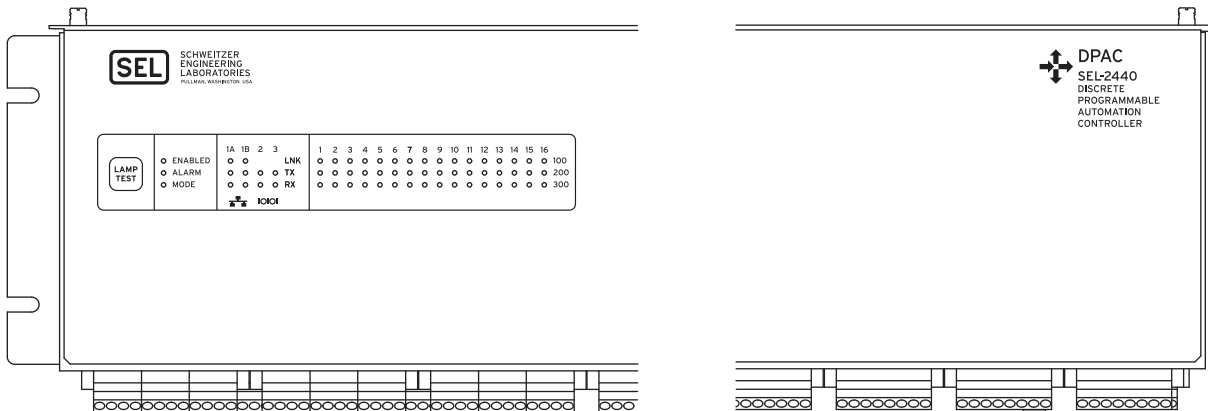


Figure 17 Surface (Left) and DIN Rail (Right) Mount Drawings

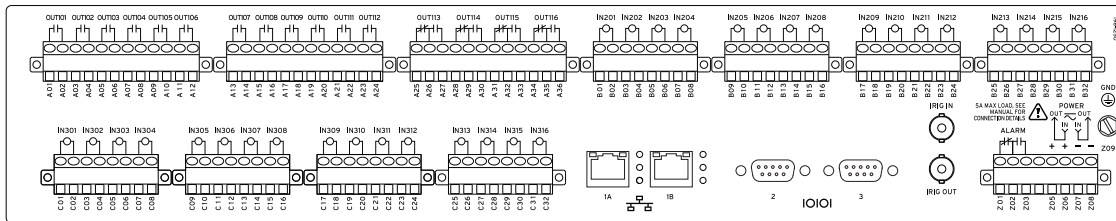


Figure 18 32 Input, 16 Output Rear-Panel Drawing

High-current interrupting outputs are polarity sensitive. This is indicated with a + next to the contact on the overlay to indicate the positive side of the contact.

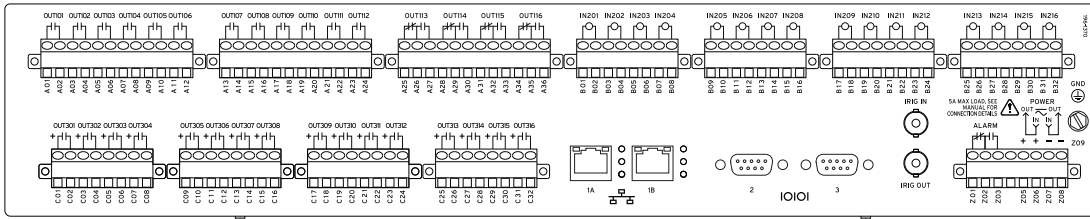


Figure 19 High-Current Interrupting Option Rear-Panel Drawing

i4961b

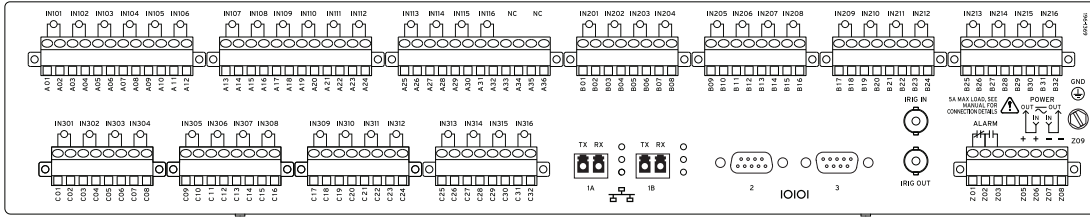


Figure 20 Port 2 EIA-485 and Fiber-Optic Ethernet Option Rear-Panel Drawing

i4846c

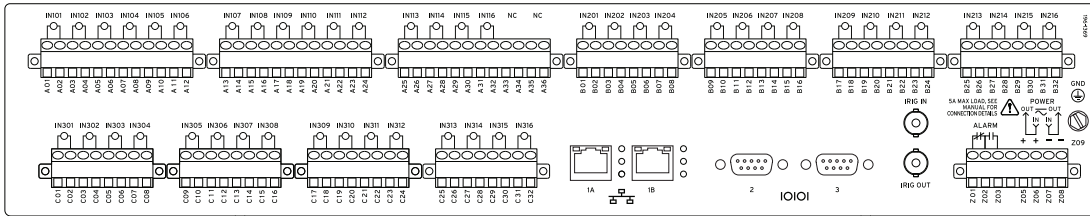


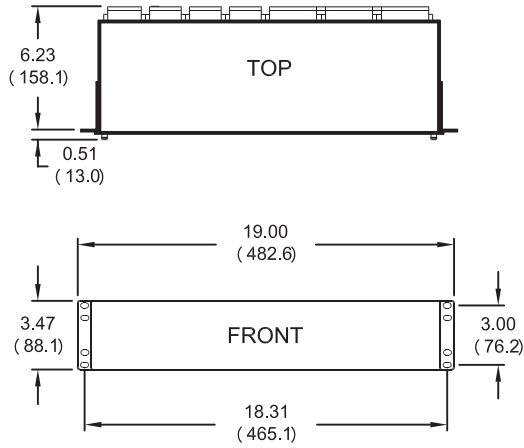
Figure 21 48DI Option Rear-Panel Drawing

i4875c

Dimensions

RACK-MOUNT CHASSIS

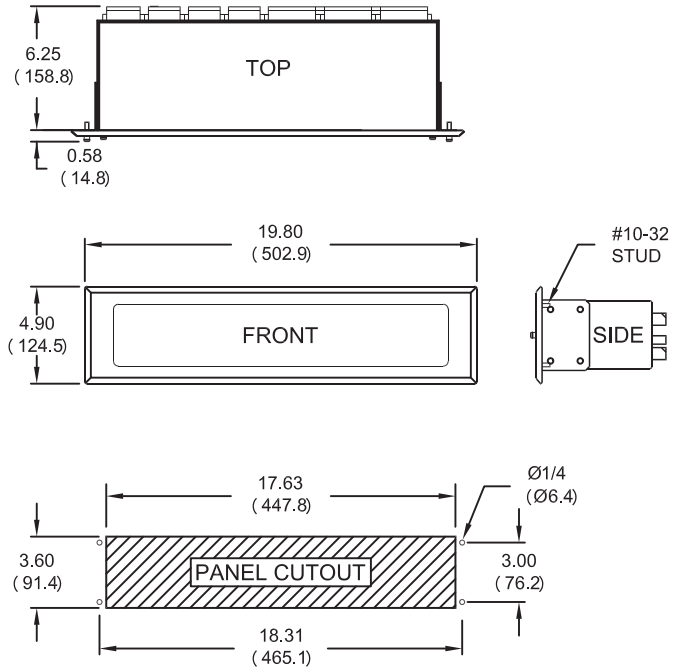
RACK MOUNT



LEGEND
 in
 (mm)

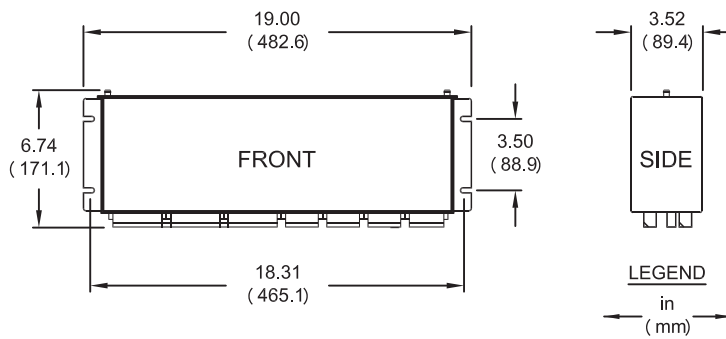
PANEL-MOUNT CHASSIS

PANEL MOUNT

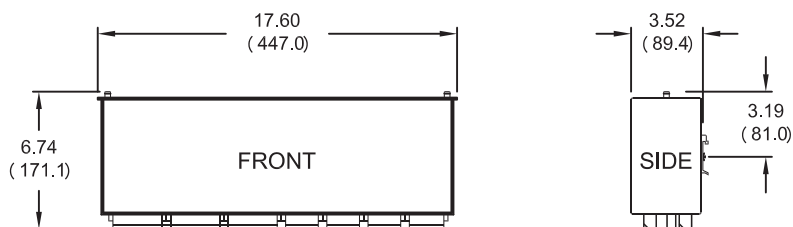


i9180a

SURFACE-MOUNT CHASSIS



DIN RAIL-MOUNT CHASSIS



i9181a

Specifications

Compliance

Designed and manufactured under an ISO 9001 certified quality management system

UL Listed to U.S. and Canadian safety standards (File E2220228; NRAQ, NRAQ7).

CE Mark

General

Operating Temperature Range

-40° to +85°C (-40° to +185°F)
(not applicable to UL installations. UL rated 40°C per UL 508)

When powered by 24 V, the SEL-2440 supports the following conditions:

70°C: Operate 32 outputs and 2.5 W max on +5 V pin (Port 2/3)

Conformal Coated: Derate operating temperature by 10°C.

Operating Environment

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

Weight

2.0 kg (4.4 lbs)

Inputs

Optoisolated Control Inputs

When used with dc control signals:

250 V	ON for 200–275 Vdc	OFF below 150 Vdc
220 V	ON for 176–242 Vdc	OFF below 132 Vdc
125 V	ON for 100–135.5 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 Vdc	OFF below 46.6 Vdc
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)

Outputs

Mechanical Durability

10 M no load operations

When powered by 24 V, the SEL-2440 supports the following conditions:

70°C: Operate 32 outputs and 2.5 W max on +5 V pin (Port 2/3)

DC Output Ratings

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
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/Dropout time ≤ 8 ms typical

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

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

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

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

High-Current Interrupting Output Option

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: 330 Vdc/145 J
Pickup Time: Less than 5 ms
Dropout Time: Less than 8 ms, typical

Breaking Capacity (10000 operations):

24 V	10 A	L/R = 40 ms
48 V	10 A	L/R = 40 ms
125 V	10 A	L/R = 40 ms
250 V	10 A	L/R = 20 ms

Cyclic Capacity (4 cycles in 1 second, followed by 2 minutes idle for thermal dissipation):

24 V	10 A	L/R = 40 ms
48 V	10 A	L/R = 40 ms
125 V	10 A	L/R = 40 ms
250 V	10 A	L/R = 20 ms

Note: Make per IEEE C37.90-1989.

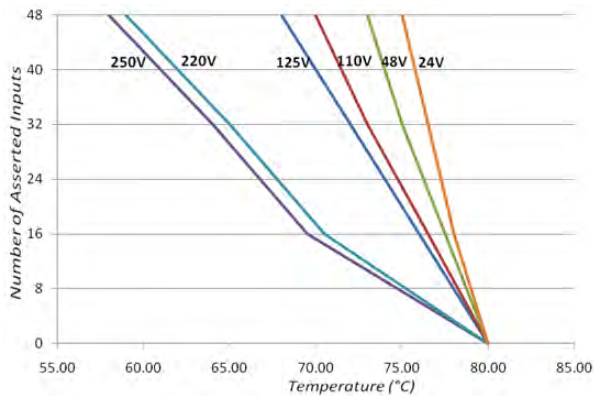
Note: Do not use high-current interrupting output contacts to switch ac control signals. These outputs are polarity dependent.

Note: Breaking and Cyclic Capacity per IEC 60255-0-20:1974.

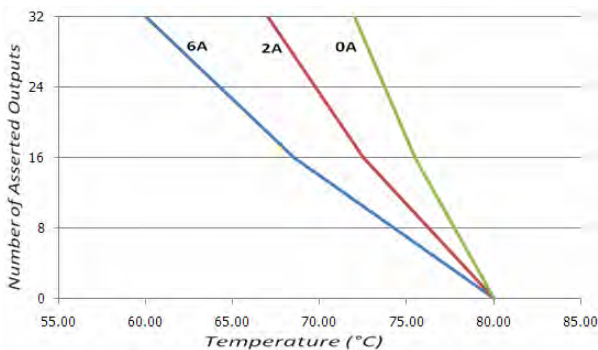
AC Output Ratings

Rated Operational Voltage: 240 Vac
Rated Insulation Voltage: 300 Vac
Utilization Category: AC-15 (control of electromagnetic loads > 72 VA)
Contact Rating Designation: B300 (B = 5 A, 300 = rated insulation voltage)
Contact Protection: 270 Vac, 40 J
Continuous Carry: 3 A @ 120 Vac
1.5 A @ 240 Vac
Rated Frequency: 50/60 ± 5 Hz
Operating Time (coil energization to contact closure): Pickup/Dropout Time: ≤ 8 ms
Electrical Durability Make VA Rating: 3600 VA, cosφ = 0.3
Electrical Durability Break VA Rating: 360 VA, cosφ = 0.3

48DI Input Derating Curve:



32DO/16DI Output Derating Curve:



Time-Code Input (Demodulated IRIG-B)

On (1) State:	$V_{ih} \geq 2.2 \text{ V}$
Off (0) State:	$V_{il} \leq 0.8 \text{ V}$
Input Impedance:	2 k Ω
Accuracy:	microsecond

Time-Code Input (SNTP)

High-Priority Server Accuracy:	$\pm 5 \text{ ms}$
Low-Priority Server Accuracy:	$\pm 25 \text{ ms}$

Time-Code Output (Demodulated IRIG-B)

On (1) State:	$V_{oh} \geq 2.4 \text{ V}$
Off (0) State:	$V_{ol} \leq 0.8 \text{ V}$
Load:	50 Ω

Communications

Communications Ports

USB 2.0 Port:	Port F; front-panel port
Ethernet Ports:	Port 1A, 1B; rear-panel 10/100BASE-T or 100BASE-FX ports
Optional Port:	Port 2; rear panel available as: EIA-232 with IRIG-B EIA-485 with IRIG-B V-pin fiber with IRIG-B ST fiber with IRIG-B
EIA-232 Port:	Port 3; rear-panel port with IRIG-B

Fiber-Optic Ports Characteristics

Port 1 (or 1A, 1B) Ethernet	
Wavelength:	1300 nm
Optical Connector Type:	LC
Fiber Type:	Multimode
Link Budget:	16.1 dB
Typical TX Power:	-15.7 dBm

RX Min. Sensitivity:	-31.8 dBm
Fiber Size:	50-200 μm
Approximate Range:	~6.4 Km
Data Rate:	100 Mb
Typical Fiber Attenuation:	-2 dB/Km
Port 2 Serial ST (SEL-2812 Compatible)	
Wavelength:	850 nm
Optical Connector Type:	ST
Fiber Type:	Multimode
Link Budget:	8 dB
Typical TX Power:	-16 dBm
RX Min. Sensitivity:	-24 dBm
Fiber Size:	50-200 μm
Approximate Range:	~4 Km with 62.5 μm , ~1 Km with 200 μm
Data Rate:	5 Mb
Typical Fiber Attenuation:	-4 dB/Km

Communications Protocols

Modbus Slave (TCP and RTU)
DNP3 Level 2 Outstation (LAN/WAN and Serial)
IEC 61850 communications
FTP
Telnet
SEL MIRRORING BITS
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
SEL Event Messenger points

Maximum Concurrent Connections

Modbus Slave:	2
DNP3 Level 2 Slave:	5 ^a
Ethernet FTP:	2
Telnet:	2

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

Power Supply

Input Voltage

Rated Supply Voltage:	24-250 Vdc 110-230 Vac, 50/60 Hz
Input Voltage Range:	19.2-275 Vdc 85-264 Vac

Power Consumption

AC:	<40 VA
DC:	<15 W

Interruptions:

10 ms @ 24 Vdc
50 ms @ 48 Vdc
50 ms @ 125 Vac/Vdc
100 ms @ 250 Vac/Vdc

Fuse Rating:

3.15 A, high breaking capacity, time lag T, 250 V (5x20 mm, T3.15AH 250 V)

Processing Specifications

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

Seismic:	IEC 60255-21-3:1993, Class 2
Cold:	IEC 60068-2-1:2007 -40°C, 16 hours
Damp Heat, Steady State:	IEC 60068-2-78:2001 40°C, 93% relative humidity, 4 days
Damp Heat, Cyclic:	IEC 60068-2-30:2005 25°C-55°C, 6 cycles, 95% relative humidity
Dry Heat:	IEC 60068-2-2:2007 85°C, 16 hours

Power Interruption Tests

AC Power:	61000-4-11:2004
DC Power:	61000-4-29:2001

Dielectric Strength and Impulse Tests

Dielectric (HiPot):	IEC 60255-5:2000 IEEE C37.90-2005 3.1 kVdc on power supply 2.5 kVac on contact I/O 2.1 kVdc on Ethernet/IRIG IN
Impulse:	IEC 60255-5:2000 0.5 J, 4.7 kV on power supply, contact I/O

RFI and Interference Tests

EMC Immunity

Electrostatic Discharge Immunity:	IEC 61000-4-2:2001 Severity Level 4 8 kV contact discharge 15 kV air discharge
Radiated RF Immunity:	IEC 61000-4-3:2006, 10 V/m IEEE C37.90.2-2004, 35 V/m
Fast Transient, Burst Immunity:	IEC 61000-4-4:2004 + A1:2001 4 kV @ 5 kHz 2 kV @ 5 kHz for comm. ports
Surge Immunity:	IEC 61000-4-5:2005 1 kV line-to-line 2 kV line-to-earth
Surge Withstand Capability:	IEC 60255-22-1:2007 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 61000-4-6:2006, 10 Vrms
Power Frequency Magnetic Field:	IEC 61000-4-8 1000A/m for 3 s 100A/m for 1 min

EMC Emissions

Conducted Emissions:	EN 55011:1998 + A1:1999 + A2:2002, Class A
Radiated Emissions:	EN 55011:1998 + A1:1999 + A2:2002, Class A

Notes

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