## SEL-2411P Pump Automation Controller

### Rugged Controller for Automating Water/Wastewater Stations

**High Reliability, Low Price**
- Ten-Year, Worldwide Warranty
- -40° to +85°C Operating Temperature
- Ruggedized to Meet Industrial and Utility Standards
- Class I, Division 2 Hazardous Location Approval

**Automated Station Control and Monitoring**
- Pump alternation supports as many as four pumps and four stages
- Pump-operation history including run times and start counts
- Pump-voltage monitoring

**Flexible Input, Output, and Logic Choices**
- Powerful Logic, Math, and Timer Functions
- Fast 4 ms Logic Loop Time
- Dual Ethernet and EIA-232 Communications
- Modbus RTU, Modbus TCP, DNP3, DNP3 LAN/WAN, MIRRORED BITS®, and SEL ASCII and Binary Communications

**Simple Commissioning Tools**
- Station settings provide fast and easy configuration
- Front-Panel Configuration and Measurement Display and Access
- Local LCD Display of Settings, Calculated Values, and Statuses
- Programmable Front-Panel Indication and Control
- Simple Programming With ACSELERATOR QuickSet® SEL-5030 Software
Product Summary

The SEL-2411P Pump Automation Controller automates continuous and discrete processes. A standalone SEL-2411P is a simple solution to monitor and control pump-up and pump-down applications such as lift stations (wastewater) and wells or reservoirs (pump-up). The SEL-2411P is capable of controlling constant speed/variable speed pumps, alternating pumps, pump delays, and high/low level alarms. Station settings offer selectable pump-alternation schemes for single, duplex, and triplex pumping applications. Measure fluid level by using float switches or an analog fluid-level sensor (or both).

Automation and Control Features

Standard Features

➤ Chassis
➤ Front panel
➤ LCD display
   ➤ Four programmable pushbuttons with LEDs
   ➤ Seven programmable LEDs
   ➤ Operator control interface
   ➤ EIA-232 port
➤ Main board
   ➤ EIA-232 port
   ➤ Dual 10/100BASE-T
➤ Power supply
➤ 2 DI, 3 DO on power-supply board
➤ QuickSet software

➤ Instruction manual, printed or on CD-ROM
➤ Protocols
   ➤ DNP3
   ➤ Modbus RTU
   ➤ SEL MIRRORED BITS
   ➤ SEL ASCII and Compressed ASCII
   ➤ SEL Fast Protocols
➤ Float-Level-Sensing Card (14 digital inputs)
   ➤ Float-switch inputs
   ➤ Auto/hand pump control
   ➤ Intrusion detection input
   ➤ Power-supply alarm input
➤ Pump Control and Status Card (4 DI/4 DO)
   ➤ Start/stop pump outputs
   ➤ Pump-running feedback inputs
Additional Ordering Options

The following options can be ordered for any SEL-2411P model (see the SEL-2411P Model Option Table for details):

<table>
<thead>
<tr>
<th>Digital Inputs</th>
<th>14 DI (PN 1476)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog I/O</td>
<td>8 AI (PN9762), 4 AI/4 AO (PN 9763)</td>
</tr>
<tr>
<td>Pump-Voltage Monitoring</td>
<td>3 AVI (PN 9771)</td>
</tr>
<tr>
<td>Environment</td>
<td>Conformal coating for chemically harsh and high-moisture environments</td>
</tr>
</tbody>
</table>

Flexible Control Logic and Integration Features

The SEL-2411P is equipped with two independently operated serial ports: one EIA-232 port on the front and one EIA-232 port on the rear. The device does not require special communications software. Use any system that emulates a standard terminal system for engineering access to the device. 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-2411P. Included communications protocols are listed.

Standard Protocols
➤ DNP3
➤ Modbus
➤ SEL ASCII
➤ SEL Compressed ASCII
➤ SEL Fast Protocols
➤ SEL MIRRORED BITS

Simplify Your Setup and Commissioning

The SEL-2411P front panel simplifies commissioning and troubleshooting with the following features:
➤ Configure pump control and alternation by using as few as three station settings
➤ View field data and calculated values
➤ Diagnose data flow problems in seconds instead of hours
➤ Dramatically reduce troubleshooting time
➤ Eliminate the need for out-of-service time
Front-Panel Visualization and Control

Build your own custom displays. Rotating displays show device configuration, detailed I/O status, alarms, and measured values with easy-to-use controls for operator interface.

Station Enabled
Alternation Enabled

Level
10.0 ft

FLOW SET POINT
65.0

Powered properly and self-tests are okay
Configure six programmable LEDs to indicate I/O activity and device status
EIA-232 Port

Station Enabled
Alternation Enabled

TARGET
ESC
ENT

ELE
PUMP 1
LAG2
LEAD
STOP
HIGH
OFF

Station Enabled
Alternation Enabled

Program LEDs to indicate control state
Program four pushbuttons to perform direct user controls
Make your own labels by hand or with included Microsoft® Word template

Figure 1 Simplify Your Commissioning
Configuration Software

The included QuickSet software program simplifies device configuration in addition to providing commissioning and analysis support for the SEL-2411P.

➤ Access settings creation help online.
➤ Organize settings with the device database manager.
➤ Load and retrieve settings by using a simple PC communications link.
➤ Customize logic to optimize lift-station operation and control.

Monitoring and Metering

The SEL-2411P provides extensive metering capabilities. See Specifications on page 8 for metering accuracies. As shown in Table 1, metering includes pump-operation status, voltage-based metering and analog input, math variable and remote analog metering. Pump-operation status includes two-hour, one-day, two-day, and total pump start-count and run-time quantities. Fundamental, maximum, and minimum metering includes phase voltages, line-to-line voltages, sequence voltages, and voltage frequency.

Table 1 Metering Types

<table>
<thead>
<tr>
<th>Standard</th>
<th>Run-time, start-count, time since last start, and stage cycle run-time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump Operation Status</td>
<td>Run-time, start-count, time since last start, and stage cycle run-time</td>
</tr>
<tr>
<td>Fundamental</td>
<td>VA, VB, VC</td>
</tr>
<tr>
<td>Maximum and Minimum</td>
<td>Frequency, Voltages (VA, VB, VC)</td>
</tr>
<tr>
<td>Analog Input</td>
<td>A1601–A1608</td>
</tr>
<tr>
<td>Math Variable</td>
<td>MV01–MV64</td>
</tr>
<tr>
<td>Remote Analog</td>
<td>RA001–RA128</td>
</tr>
</tbody>
</table>
Application

Pump Controller

Regulate the level in tanks for lift stations and reservoirs for single, duplex, or triplex pumping applications. Alternate pumps to balance starts, maximize longevity, reduce wear on equipment, and make maintenance more predictable. Use both analog level sensors and float switches to provide redundancy in fluid-level sensing and increase reliability for station control.

Front- and Rear-Panel Diagrams

![Front Panel Diagram](image)

**Figure 2** Front Panel With Default Configurable Labels
Figure 3  Rear-Panel Connections and Labels

Dimensions

Figure 4  Pump Automation Controller Vertical Panel Mount
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 47583; NRAQ, NRAQ7)

CE Mark

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

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 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 Ω
Input Range (Maximum): ±20 mA (transducers: 4–20 mA, 0–20 mA, or 0–1 mA typical)
±10 V (transducers: 0–3 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 52.8–60 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
General

OUT103 is Form C Trip Output, all other outputs are Form A.
Dielectric Test Voltage: 2000 Vac
Impulse Withstand Voltage ($V_{imp}$): 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
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: 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: ±0.5% of full-scale at 25°C
Step Response: 100 ms

Communications

Communications Ports

Standard EIA-232 (2 Ports)
Location (fixed): Front 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
- DNP3 Level 2 Outstation: 5
- Ethernet FTP: 2
- Telnet: 3

Power Supply

Rated Supply Voltage
- Low-Voltage Model: 24/48 Vdc
- High-Voltage Model: 125/250 Vdc

Input Voltage Range
- Low-Voltage Model: 18–60 Vdc
- High-Voltage Model: 85–275 Vdc

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

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

Fast Analog Alarm Pickup
- Voltage: ±5% of setting ±0.5 V

Sampling and Processing Specifications

Without Voltage 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 Voltage Card
- 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 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: 4 times per power system cycle or 4 ms if no 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
  - -40°C, 16 hours
  - 40°C, 93% relative humidity, 4 days
  - 25–55°C, 6 cycles, 95% relative humidity
  - 85°C, 16 hours
### Dielectric Strength and Impulse Tests

**Dielectric (HIPOT):**
- IEC 60255-5:2000
- IEEE C37.90-1989
  - 2.0 kVac on analog inputs, contact I/O
  - 2.5 kVac on ac current inputs
  - 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:**
  - 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

**Conducted Emissions:**

**Radiated Emissions:**