SCADAPack 6601 Hardware Manual

Documentation

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I 6601 Input/Output Module

Schneider Electric

Documentation

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The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein. If you have any suggestions for improvements or amendments or have found errors in this publication, please notify us.

All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

1 Technical Support

Questions and requests related to any part of this documentation can be directed to one of the following support centers.

Technical Support: Americas, Europe, Middle East, Asia

Available Monday to Friday 8:00am – 6:30pm Eastern Time

Toll free within North America	1-888-226-6876
Direct Worldwide	+1-613-591-1943
Email	supportTRSS@schneider-electric.com

Technical Support: Australia

Inside Australia	1300 369 233
Email	au.help@schneider-electric.com

2 Safety Information

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

	The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

	This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

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

⚠WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, **can result** in death or serious injury.

⚠CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result** in minor or moderate injury.

NOTICE

NOTICE indicates a potentially hazardous situation which, if not avoided, **can result in** equipment damage.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and the installation, and has received safety training to recognize and avoid the hazards involved.

BEFORE YOU BEGIN

Do not use this product on machinery lacking effective point-of-operation guarding. Lack of effective point-of-operation guarding on a machine can result in serious injury to the operator of that machine.

⚠CAUTION

EQUIPMENT OPERATION HAZARD

- Verify that all installation and set up procedures have been completed.
- Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices.
- Remove tools, meters, and debris from equipment.

Failure to follow these instructions can result in minor or moderate injury.

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future reference.

Software testing must be done in both simulated and real environments.

Verify that the completed system is free from all short circuits and grounds, except those grounds installed according to local regulations (according to the National Electrical Code in the U.S.A, for instance). If high-potential voltage testing is necessary, follow recommendations in equipment documentation to help prevent accidental equipment damage.

OPERATION AND ADJUSTMENTS

The following precautions are from the NEMA Standards Publication ICS 7.1-1995 (English version prevails):

- Regardless of the care exercised in the design and manufacture of equipment or in the selection and ratings of components, there are hazards that can be encountered if such equipment is improperly operated.
- It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer's instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer's instructions and the machinery used with the electrical equipment.
- Only those operational adjustments actually required by the operator should be accessible to the operator. Access to other controls should be restricted to help prevent unauthorized changes in operating characteristics.

ACCEPTABLE USE

SCADAPack E Remote Terminal Units (RTUs) and input/output (I/O) modules are intended for use in monitoring and controlling non-critical equipment only. They are not intended for safety-critical applications.

⚠WARNING

UNACCEPTABLE USE

Do not use SCADAPack E RTUs or I/O modules as an integral part of a safety system. These devices are not safety products.

Failure to follow this instruction can result in death or serious injury.

⚠CAUTION

EQUIPMENT OPERATION HAZARD

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

For safe and proper operating results, use only Schneider Electric software or approved software with Schneider Electric hardware products.

Failure to follow these instructions can result in minor or moderate injury.

Important Notices for Hazardous Locations

- Class I Division 2, Groups A, B, C and D
- Ex nA IIC T4 Gc
- Class I Zone 2 AEx nA IIC T4 Gc
-  II 3 G

Applies to SCADAPack E products, models TBUP530, TBUP535 and TBUX (CSA Marked)
Those products are available for use in Class I, Division 2, Groups A, B, C & D and Class I Zone 2 Hazardous Locations. Such locations are defined in Article 500 and 505 of the US National Fire Protection Association (NFPA) publication NFPA 70, otherwise known as the National Electrical Code, in Section 18 of the Canadian Standards Association C22.1 (Canadian Electrical Code) and in IEC/EN 60079-10.

The products have been recognized for use in these hazardous locations by the Canadian Standards Association (CSA) International.

CSA certification is in accordance with Standards CSA C22.2 No. 213, CSA C22.2 60079-0, CSA C22.2 60079-15, ANSI/ISA 60079-0, ANSI/ISA 60079-15, ANSI/ISA 12.12.01, FM 3600 and FM 3611 subject to the following conditions of approval:

1. Install the product in a protective enclosure providing at least IP54 protection.
2. Confirm that the location is free from explosively hazardous gases before wiring, connecting or disconnecting the product, using any USB connection or replacing any fuses.

WARNING EXPLOSION HAZARD

Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division 2.

Refer to Articles 500 through 502 of the National Electrical Code (NFPA 70) and Appendix J of CSA C22.1 for further information on hazardous locations and approved Division 2 wiring methods.

Refer to Articles 505 of the National Electrical Code (NFPA 70) and Section 18 of CSA C22.1 for further information on hazardous locations and approved Zone 2 wiring methods.

3 About this Manual

Audience

This manual is written for people who need to install, troubleshoot or maintain the 6601 Input/Output (I/O) expansion module hardware. These individuals are typically:

- Systems Engineers

- Commissioning Engineers
- Maintenance Technicians

Scope

This manual describes:

- The physical design of the 6601 I/O expansion module, including detailed hardware specifications
- Installation, wiring and addressing for the 6601 I/O expansion module
- Diagnostics capabilities available on the 6601 I/O expansion module
- Maintenance recommendations for the 6601 I/O expansion module

Related Documents

Use this manual with other manuals included in your SCADAPack E documentation set. The table below lists the main manuals for the tasks described. However, it is not a complete list of the manuals available to you. Please see the SCADAPack E Reference Manual set for a complete listing of manuals.

For Information About	See
Using the 6601 I/O expansion module with your RTU	I/O Expansion Modules Technical Reference Manual SCADAPack 530E Hardware Manual SCADAPack 535E Hardware Manual
Configuring 6601 I/O expansion module inputs and outputs	SCADAPack E Configurator User Manual Configuration Technical User Manual

4 About the 6601 I/O Expansion Module

The 6601 I/O expansion module increases the I/O capacity of the RTU by providing:

- 16 digital inputs
- 8 digital outputs
- 6 analog inputs
- 2 analog outputs (this option is selected when the 6601 I/O expansion module is ordered)

The 6601 I/O expansion module can be used with the following SCADAPack E RTUs:

- SCADAPack 530E
- SCADAPack 535E

6601 I/O Expansion Module

Connections

The 6601 I/O expansion module includes a short intermodule cable for connecting to an RTU or to another I/O expansion module. A maximum of 16 6601 I/O expansion modules can be addressed on an I/O bus. For details on connecting 6601 I/O expansion modules, see Intermodule Cabling 37.

Screw-termination connectors are provided for connecting the inputs and outputs to the devices you want to monitor or control. For details on wiring input and output connectors, see Field Wiring 46.

Configuration

You can configure the 6601 I/O expansion module inputs and outputs using three different methods:

- Locally or remotely using SCADAPack E Configurator 43, a software application that runs on a desktop or laptop computer connected to the RTU through the USB device port or through any of the available serial or Ethernet ports.
- Remotely as part of an end-to-end SCADA system using the StruxureWare SCADA Expert ClearSCADA software.
- Locally using applications created in the SCADAPack Workbench or ISaGRAF 3 Workbench user programming tools. Typically, applications created in these tools extend and enhance the functionality provided by the 6601 I/O expansion module. However, you can also write applications that replace the configuration functionality provided through the SCADAPack E Configurator software or the SCADA Expert ClearSCADA software.

Before you begin configuring the inputs and outputs on the 6601 I/O expansion module, determine whether the ClearSCADA software will be used for any configuration tasks. This documentation assumes you are using the SCADAPack E Configurator software to configure the 6601 I/O expansion module. For information about using the ClearSCADA software, see the ClearSCADA documentation.

5 Hardware Overview

The figure below shows the location of the 6601 I/O expansion module inputs and outputs.

6601 I/O Expansion Module Inputs and Outputs

Generally, power supply ports and input/output (I/O) ports provide a level of protection against over-voltages and other conditions. For ease of wiring and maintenance, external connections are terminated on removable connectors. If you need to remove the I/O expansion module cover for any reason, first carefully consider the following information.

⚠WARNING

UNEXPECTED EQUIPMENT OPERATION

Evaluate the operational state of the equipment being monitored or controlled by the RTU or the I/O expansion module before removing power.

Failure to follow these instructions can result in death or serious injury.

⚠WARNING

HAZARD OF ELECTRIC SHOCK

Remove power from the I/O expansion module before removing the I/O expansion module cover.

Failure to follow these instructions can result in death or serious injury.

NOTICE

UNEXPECTED EQUIPMENT OPERATION

The RTU can be mounted on a horizontally oriented DIN rail or on a vertically oriented DIN rail.

The maximum temperature rating is lower when the RTU is mounted on a vertically positioned DIN rail. See the Specifications 72 for details.

Failure to follow these instructions can result in equipment damage.

NOTICE

UNEXPECTED EQUIPMENT OPERATION

The electronics inside the I/O expansion module can be damaged by static electricity. If you need to remove the I/O expansion module cover, wear an anti-static wrist strap that is connected to ground. Failing to follow this simple step can cause intermittent or total loss of I/O expansion module operation and will void the warranty.

Failure to follow these instructions can result in equipment damage.

The following table describes the 6601 I/O expansion module input and output characteristics. The inputs and outputs use 5 mm (.197 in.) pitch connectors. See the Specifications 71 section for the recommended wire sizes.

6601 I/O Hardware Summary

Input/Output Type	RTU Label	Polarity Sensitive	Description
Digital inputs 15 Counter inputs 16	DI 1-8 DI 9-16	Yes	• Digital inputs, the first eight (DI 1-8) of which have associated counters. • Organized into two groups of eight inputs: DI 1-8 and DI 9-16. • Each group shares a common return. • The two groups are optically isolated from one another and from the logic power.
Digital outputs 17	DO 1-2	Yes	• Dry contact Form C mechanical relay outputs. • Three voltage-free terminals for one relay pole: Normally Open (NO), Normally Closed (NC) and Common (COM). • Electrical isolation is provided between the digital outputs and between each digital output and the device being controlled.
	DO 3-8	Yes	• Dry contact Form A mechanical relay outputs. • Voltage-free NO contacts that share a common return. • Electrical isolation is provided between each digital output and the device being controlled.
Analog inputs 18	AI 1+ - 6-	Yes	• Analog inputs. Single-ended. Jumper configurable. • Electrical isolation is provided from each channel to RTU logic and between channels.
Analog outputs 22	AO 1-2	Yes	• Analog outputs provided by the optional analog output module. • Electrical isolation is provided from each channel to RTU logic, but not between channels.

5.1 Digital Inputs

Digital inputs are used to monitor the state of remote devices such as panel lamps, relays, motor starters, solenoid valves and other devices.

Digital inputs are available for nominal 12...24 V operation. A current-limiting resistor on each input determines the voltage range.

Wetting voltage for the volt-free contacts is usually provided by the DC power used with the RTU.

The digital inputs provide 1 ms Sequence of Event (SOE) time stamping to support Sequence Of Event (SOE) applications.

The digital inputs also support state debouncing. If debouncing is enabled on a digital input channel, then SOE time stamping on the digital point has the same resolution as the debounce resolution.

The LED for each digital input is lit when the input is active.

Configuration

Using the SCADAPack E Configurator software, you can configure each digital input to define its characteristics, including:

- DNP3 attributes
- Alarm and trend attributes
- Invert state
- Remote control interlock attributes
- Debounce time

For more information about configuring digital inputs, see the SCADAPack E Configurator User Manual and the Configuration Technical Reference Manual.

Wiring

Digital inputs support solid or stranded wires from 3.3 mm^2 to .08 mm^2 (12 AWG to 28 AWG). For more information, see Wiring Screw-Termination Connectors 47.

Specifications

For digital input specifications, see Specifications 71.

5.2 Counter Inputs

For digital inputs that have an associated counter, the counter inputs are represented as 32-bit counters.

The corresponding digital input invert settings are applied prior to counting transitions of the input.

- If configured as non-inverting (default configuration), counter input points count OFF to ON transitions.
- If configured as inverted, ON to OFF transitions are counted on the corresponding counter channel.

The LED for each counter input is lit when the input is active.

Configuration

Using the SCADAPack E Configurator software, you can configure each counter input to define its characteristics, including:

- DNP3 attributes
- Counter values
- Alarm and trend attributes
- Event attributes
- Remote control interlock attributes

For more information about configuring counter inputs, see the SCADAPack E Configurator User Manual and the Configuration Technical Reference Manual.

Wiring

Counter inputs support solid or stranded wires from 3.3 mm^2 to .08 mm^2 (12 AWG to 28 AWG). For more information, see Wiring Screw-Termination Connectors 47.

Specifications

For counter input specifications, see Specifications 71.

5.3 Digital Outputs

Digital outputs are used to control panel lamps, relays, motor starters, solenoid valves and other devices. The relay outputs are well suited to applications that cannot tolerate any off-state leakage current, that require high load currents, or that involve non-standard voltages or current ranges.

For Form A digital outputs that have a single Normally Open (NO) contact, loads can be connected to either the high or the low side of the power source.

For Form C digital outputs that have an NO contact, a Normally Closed (NC) contact and a Common (COM) contact, loads can be connected to either the NO or the NC terminal, and to either the high or the low side of the power source. A signal from the second pole on each relay provides feedback to the software to verify the correct relay activation for each operation.

The LED for each digital output is lit when the NO contact is closed, or activated, and the circuit is continuous. For Form C digital outputs, this means the NC contact is open.

Configuration

Using the SCADAPack E Configurator software, you can configure each digital output to define its characteristics, including:

- DNP3 attributes
- Alarm and trend attributes
- Invert state
- Remote control interlock attributes
- Output pulse time

For more information about configuring digital outputs, see the SCADAPack E Configurator User Manual and the Configuration Technical Reference Manual.

Wiring

Digital outputs support solid or stranded wires from 3.3 mm^2 to .08 mm^2 (12 AWG to 28 AWG).For more information, see Wiring Screw-Termination Connectors 47.

Specifications

For digital output specifications, see Specifications 71.

5.4 Analog Inputs

Analog inputs are used to monitor devices such as pressure, level, flow and temperature transmitters, instrumentation such as pH and conductivity sensors, and other high-level analog signal sources.

Each analog input is individually configured for the input type — current or voltage — and range. The SCADAPack 535E and the 6601 I/O expansion module use a 24-bit delta-sigma analog to digital (A/D) converter.

The RTU is factory-calibrated for 0...20 mA and 4...20 mA current inputs and for 0...5 V and 1...5 V operation. The mode of operation — current mode or voltage mode — is selected when the RTU or I/O expansion module is purchased.

- In current mode, a 250 ohm current sense resistor is used across each analog input channel. The measurement range in current mode is 0...20 mA or 4...20 mA, selectable through the SCADAPack E Configurator software. The 250 ohm resistor produces a voltage drop (input reading) of 5 V for 20 mA of current flow. Loop current will only flow in analog inputs that have been configured for 20 mA.
- In voltage mode, the analog inputs are high-impedance and single-ended with a measurement range of 0...5 V or 1...5 V, selectable through the SCADAPack E Configurator software.

The RTU also supports using a mix of current mode and voltage mode analog inputs if required. For details, see Supporting Current and Voltage Inputs 57.

Configuration

Using the SCADAPack E Configurator software, you can configure each analog input to define its characteristics, including:

- DNP3 attributes
- Current values
- Alarm and trend attributes
- Scaling
- Value deviation

For more information about configuring analog inputs, see the SCADAPack E Configurator User Manual and the Configuration Technical Reference Manual.

Wiring

Analog inputs support solid or stranded wires from 3.3 mm^2 to .08 mm^2 (12 AWG to 28 AWG). For more information, see Wiring Screw-Termination Connectors 47.

Specifications

For analog input specifications, see Specifications 71.

5.4.1 Analog Input Range and Resolution

The analog inputs have a 24-bit, unipolar, analog to digital (A/D) converter that measures input voltages from 0...5 V.

To assign RTU database points to the analog input channels, use the SCADAPack E Configurator to select the signal range for each analog input channel. Each analog input channel can be configured for one of the following signal ranges:

- 0...20 mA
- 4...20 mA
- 0...5 V
- 1...5 V

The signal range selected is scaled to the Raw Min. to Raw Max. values defined for each analog input point when point integer values are used. The Eng. Min. to Eng. Max. values for the point are used to scale the analog input Engineering Floating Point database value.

For example, if an analog input point's attributes are Raw Min. = 0, Raw Max. = 10,000 and the input channel is selected for 4...20 mA:

- A 20 mA input is 100% of the selected input signal range and corresponds to 10,000 counts.
- A 4 mA input is 0% of the selected input signal range and corresponds to 0 counts.

The following tables show the over- and under-range status for current and voltage signals. Over- and under-range status detection occurs when the measured input is outside of the specified range by more than 0.2%.

Over- and Under-Range Status for Current Signals

Input	0...20 mA Range			4...20 mA Range		
Current (mA)	Point Database Value	Count[1]	Over- or Under-Range Status	Point Database Value	Count[1]	Over- or Under-Range Status
0.00	RAW_MIN ENG_MIN	0	OFF	RAW_MIN ENG_MIN	0	ON
3.50	17.5% of range	1750	OFF	RAW_MIN ENG_MIN	0	ON
4.00	20% of range	2000	OFF	RAW_MIN ENG_MIN	0	OFF
8.00	40% of range	4000	OFF	25% of range	2500	OFF
12.00	60% of range	6000	OFF	50% of range	5000	OFF
16.00	80% of range	8000	OFF	75% of range	7500	OFF
20.00	RAW_MAX ENG_MAX	10000	OFF	RAW_MAX ENG_MAX	10000	OFF
20.01	RAW_MAX ENG_MAX	10000	ON	RAW_MAX ENG_MAX	10000	ON

Over- and Under-Range Status for Voltage Signals

Input	0...5 V Range			1...5 V Range		
Voltage (Volts)	Point Database Value	Count[1]	Over- or Under-Range Status	Point Database Value	Count[1]	Over- or Under-Range Status
0.00	RAW_MIN ENG_MIN	0	OFF	RAW_MIN ENG_MIN	0	ON
0.99	17.5% of range	1980	OFF	RAW_MIN ENG_MIN	0	ON
1.00	20% of range	2000	OFF	RAW_MIN ENG_MIN	0	OFF
2.00	40% of range	4000	OFF	25% of range	2500	OFF

3.00	60% of range	6000	OFF	50% of range	5000	OFF
4.00	80% of range	8000	OFF	75% of range	7500	OFF
5.00	RAW_MAX ENG_MAX	10000	OFF	RAW_MAX ENG_MAX	10000	OFF
5.01	RAW_MAX ENG_MAX	10000	ON	RAW_MAX ENG_MAX	10000	ON

[1] Over- and under-range point status may also be asserted by SCADAPack E analog input point configuration parameters. For more information see the SCADAPack E I/O Expansion Reference Manual and the Data Processing Technical Reference Manual.

5.5 Analog Outputs

Analog outputs are used to control remote devices that require varying input information, rather than simply on or off operations.

If the optional analog output module was selected when the SCADAPack 535E or the 6601 I/O expansion module was ordered, two 20 mA analog outputs are available for use.

The analog output channels are powered with an external 12...30 Vdc (nominally 12 Vdc or 24 Vdc) power supply. They can be configured for 4...20 mA current or 0...20 mA current. The outputs provide a level of transient and over-voltage protection. Analog output resolution is 12 bits. The outputs share a common return with each other and with the analog inputs.

Configuration

Using the SCADAPack E Configurator software, you can configure each analog output to define its characteristics, including:

- DNP3 attributes
- Current values
- Trend inhibit state
- Scaling
- Value deviation

For more information about configuring analog outputs, see the SCADAPack E Configurator User Manual and the Configuration Technical Reference Manual.

Wiring

Analog outputs support solid or stranded wires from 3.3 mm^2 to .08 mm^2 (12 AWG to 28 AWG).For more information, see Wiring Screw-Termination Connectors 47.

Specifications

For analog output specifications, see Specifications 71.

5.5.1 Analog Output Range and Resolution

The optional analog output module, which is selected when the SCADAPack 535E or the 6601 I/O expansion module is ordered, has a 12-bit, unipolar, digital to analog (D/A) converter.

You can select one of the following **Output Type** ranges on the **SCADAPack I/O** property page in the SCADAPack E Configurator software. Both analog output channels use the same range:

- 0...20 mA
- 4...20 mA

The 0...20 mA output range resolution is 4.88 µA per D/A count.

Configuration for points attached to the analog output module channels uses the SCADAPack E Raw Min. to Raw Max. and Eng. Min. to Eng. Max. parameters for integer and engineering scaling, respectively.

These scaling ranges automatically apply to the analog input signal range selected in SCADAPack E Configurator for the 6601 I/O expansion module analog **Output Type** (0...20 mA or 4...20 mA).

5.5.2 Analog Output Load Resistance Requirements

The load resistance for any given power supply voltage is limited:

- On the high resistance end by the requirement for proper operation of the analog output circuit
- On the low resistance end by the power dissipation in the analog output

The table below lists the analog output load resistance range. The operating range is within the area defined as resistance limits.

Power Supply Voltage and Load Resistance Requirements

Power Supply	Load Resistance Required
12 Vdc	0...475 ohms
24 Vdc	0...1075 ohms
30 Vdc	250...1375 ohms

5.6 Isolation and Protection Summary

The 6601 I/O expansion module provides isolation and protection from external connections as described in the table below.

6601 I/O Expansion Module Isolation and Protection

Connections	Isolation	Protection
Digital inputs	Optical	Current-limiting resistor and reverse polarity diode
Digital outputs	Relay	None
Analog inputs	Optical (channel-to-channel and channel-to-RTU)	TVS diode
Analog outputs[1]	Optical (channel-to-RTU)	TVS diode

[1] The optional analog outputs are selected when the 6601 I/O expansion module is ordered.

6 Installation

The following sections describe specific aspects of installing the 6601 I/O expansion module.

The 6601 I/O expansion module is factory-configured and under normal conditions does not require removal or insertion of any peripherals or components. The I/O configurations are stored in a combination of battery-backed RAM and flash memory on the SCADAPack 530E or SCADAPack 535E RTU.

NOTICE

UNEXPECTED EQUIPMENT OPERATION

I/O configuration information can be lost if the RTU's onboard RAM back-up battery goes flat, is disconnected, if the RTU is damaged, or if there has been a firmware upgrade.

Verify the voltage of the RTU's onboard RAM back-up battery before connecting the I/O expansion module to the RTU.

Failure to follow these instructions can result in equipment damage.

NOTICE

UNEXPECTED EQUIPMENT OPERATION

Installing the I/O expansion module in an environment where the electromagnetic compatibility (EMC) rating exceeds the certified EMC rating for the module can lead to unpredictable operation and unexpected results.

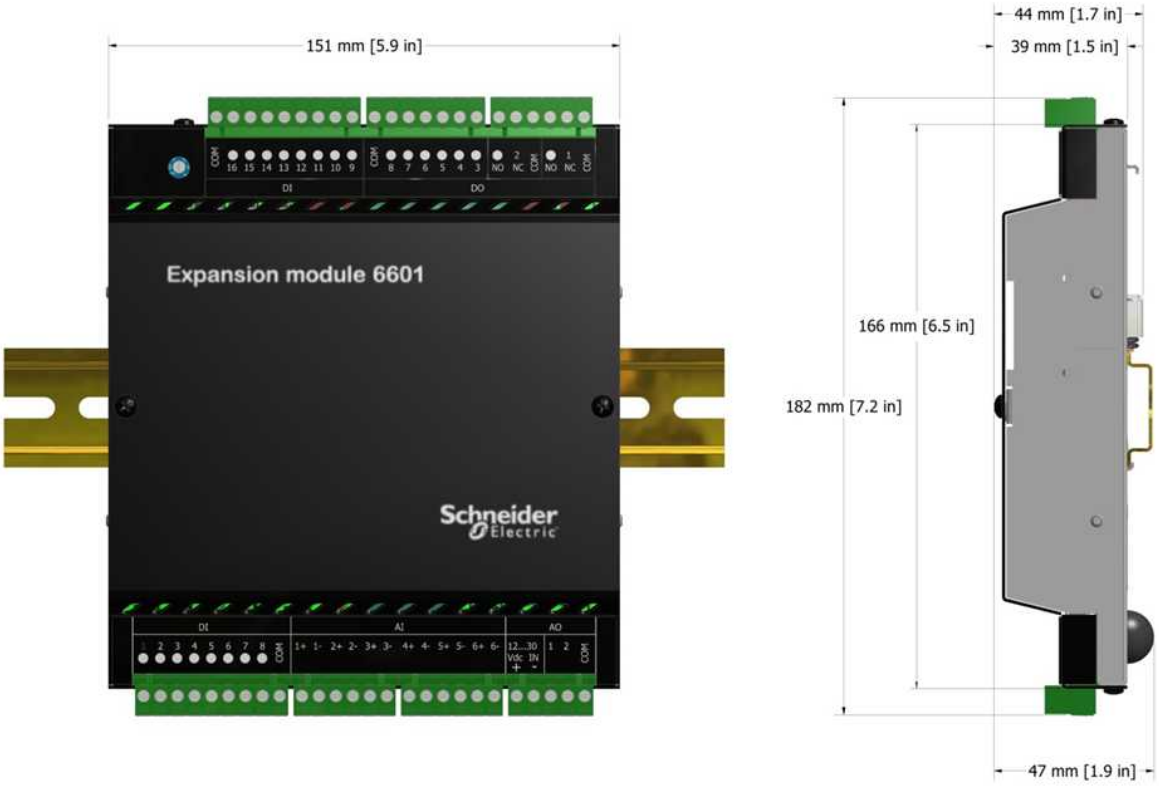
Failure to follow these instructions can result in equipment damage.

- Mounting the 6601 27
- Power Supply Requirements 32
- Intermodule Cabling 37

6.1 Mounting the 6601 I/O Expansion Module

The 6601 I/O expansion module is mounted on a 7.5 mm by 35 mm (0.3 in. x 1.4 in.) DIN rail then connected to the SCADAPack E RTU or to another 6601 I/O expansion module. Up to 16 6601 I/O expansion modules can be addressed on a single RTU I/O bus.

The figures below show the I/O module dimensions when mounted.



6601 I/O Expansion Module Dimensions

> **⚠WARNING**
>
> **UNEXPECTED EQUIPMENT OPERATION**
>
> Evaluate the operational state of the equipment being monitored or controlled by the SCADAPack E RTU and the I/O expansion module before removing power.
>
> **Failure to follow these instructions can result in death or serious injury.**

⚠WARNING

HAZARD OF ELECTRIC SHOCK

Remove power from the I/O expansion module before mounting it on a DIN rail.

Do not remove the I/O expansion module cover when mounting the module. The I/O expansion module is designed so that it can be mounted on a DIN rail with the cover in place.

Failure to follow these instructions can result in death or serious injury.

NOTICE

UNEXPECTED EQUIPMENT OPERATION

The I/O expansion module can be mounted on a horizontally oriented DIN rail or on a vertically oriented DIN rail.

The operating temperature for the I/O module and the current rating for the digital outputs are lower when the I/O expansion module is mounted on a vertically oriented DIN rail.

Read and understand the temperature specifications before mounting the I/O module. See the Specifications 71 for details.

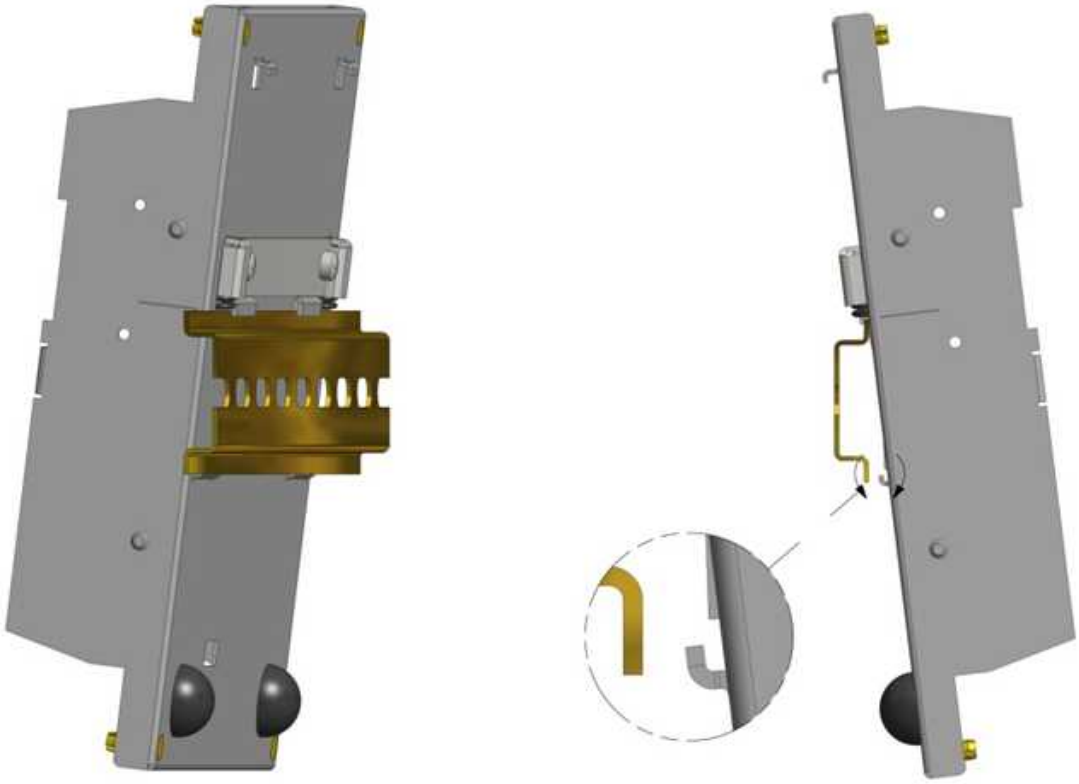
Failure to follow these instructions can result in equipment damage.

To Mount the 6601 I/O Expansion Module

The illustrations below show how to mount the I/O expansion module on a horizontally oriented DIN rail. The steps to mount the I/O expansion module on a vertically oriented DIN rail are the same.

1. With the lower part of the module tilted away from the DIN rail, position the mounting guide line on the side of the module so that it is just above the top edge of the DIN rail.

   The springs on the back of the module should rest on the DIN rail and the edge of the DIN rail should be under the support claws that are adjacent to the springs, as shown below.



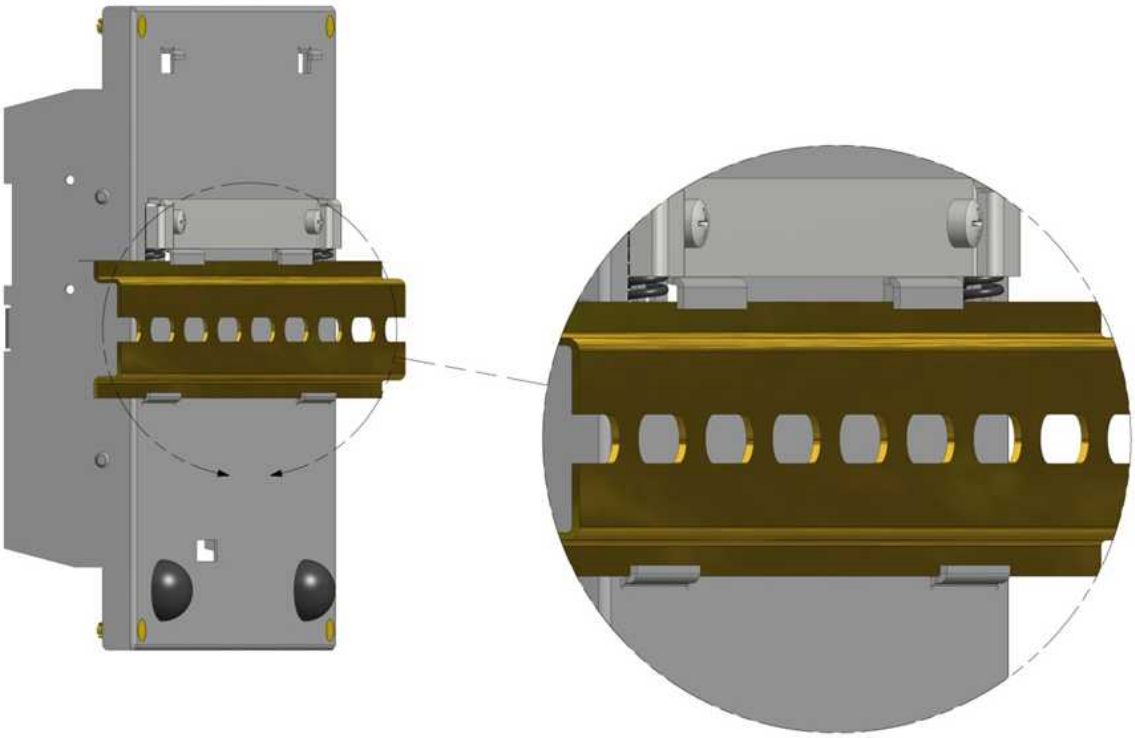
DIN Rail Alignment for Module Mounting

2. Push firmly on the module while tilting it toward the DIN rail until the DIN rail is positioned under both the upper and lower claws on the back of the module.

3 Release the pressure on the springs so that the DIN rail is held firmly in place between the upper and lower claws.

The mounting guide line should be aligned with the edge of the DIN rail.

The figure below shows a DIN rail correctly positioned in the upper and lower claws on the back of the I/O module.



Rear View of a Correctly Mounted Module

The figure below shows a 6601 I/O expansion module that is mounted on a horizontally oriented DIN rail.

6601 I/O Expansion Module on a Horizontally Oriented DIN Rail

6.2 Power Supply Requirements

The 6601 I/O expansion module requires 5 V power, which is provided by the RTU through the I/O bus cable that connects the units. If the optional analog output module was selected when the 6601 I/O expansion module was ordered, an additional 24 Vdc power supply is required to power the field-side circuitry. Each analog output module requires 50 mA current regardless of the system voltage. For information on the configuration options for the analog output power supply, see Analog Output Power Supply Configuration Options 35.

Power requirements are determined by a combination of factors, including the number of relays energized, the number of LEDs activated, the number of Ethernet connections from the RTU and the number of analog outputs. The tables below summarizes the power requirements for the SCADAPack 530E and SCADAPack 535E with the 6601 I/O expansion module.

Power Requirements for SCADAPack 530E with the 6601 I/O Expansion Module

Volts In	SCADAPack 530E Plus One 6601 I/O Expansion Module	SCADAPack 530E Plus Two 6601 I/O Expansion Modules	SCADAPack 530E Plus Three 6601 I/O Expansion Modules	SCADAPack 530E Plus Four 6601 I/O Expansion Modules
Volts (V)	Power (W)	Power (W)	Power (W)	Power (W)
11	4.1	5.2	6.3	7.4
13.8	4.1	5.2	6.3	7.4
24	4.5	5.6	6.7	7.8
30	4.8	5.9	7.0	8.1

Power Requirements for SCADAPack 535E with the 6601 I/O Expansion Module

Volts In	SCADAPack 535E Plus One 6601 I/O Expansion Module	SCADAPack 535E Plus Two 6601 I/O Expansion Modules	SCADAPack 535E Plus Three 6601 I/O Expansion Modules
Volts (V)	Power (W)	Power (W)	Power (W)
11	5.2	6.3	7.4
13.8	5.2	6.3	7.4
24	5.6	6.7	7.8
30	5.9	7.0	8.1

⚠WARNING

UNEXPECTED EQUIPMENT OPERATION

The input power supply must be a filtered DC supply.

Failure to follow these instructions can result in death or serious injury.

⚠WARNING

UNEXPECTED EQUIPMENT OPERATION

Safety Extra Low Voltage (SELV) or Protective Extra Low Voltage (PELV) power supplies are required on the power input and I/O points. Power supplies with 100...240 Vac inputs that comply with safety standard IEC/EN 60950 generally have SELV outputs. Check with the manufacturer or the agency certification listing to confirm that they have SELV outputs.

Failure to follow these instructions can result in death or serious injury.

The following Schneider Electric power supply can be used:

- Schneider Electric Phaseo regulated power supply, part number ABL 7RM24025, providing 100...240 Vac in and 24 Vdc, 2.5 A out.

System Grounding

Ground the system by connecting the system power supply common to the chassis or panel ground. On the 6601 I/O expansion module, the power supply common (the "-" connector for the 12...30 Vdc supply) is connected to the chassis internally within the CPU card. As a result, it is not isolated.

None of the 6601 I/O expansion module pins, including any of the commons, are connected to chassis ground. As a result, they are isolated.

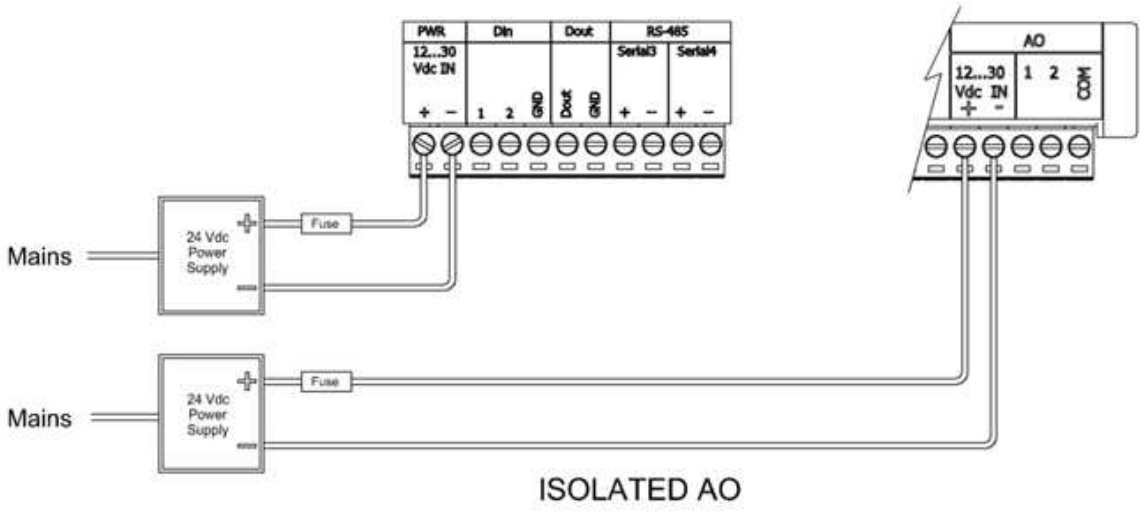
6.2.1 Analog Output Power Supply Configuration Options

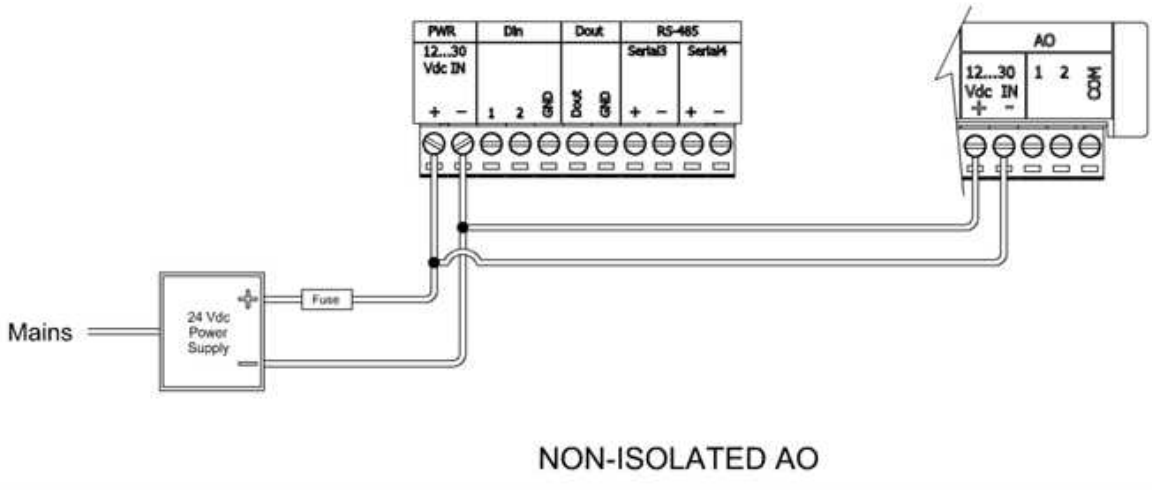
There are two configuration options for the external 24 Vdc power supply that is required when the optional analog output module is installed:

- The analog output module and the RTU can each have their own 24 Vdc power supply. In this configuration, the analog outputs are isolated from the system logic.
- The analog output module can share an external 24 Vdc power supply with the RTU. In this configuration, the analog outputs are not isolated from the system logic.

NOTICE
UNEXPECTED EQUIPMENT OPERATION Install an external 1.6 A fast-acting fuse on the input voltage side of the RTU power supply connection. Install an external 0.063 A fast-acting fuse on the input voltage side of the analog output power supply connection. **Failure to follow these instructions can result in equipment damage.**

The following figure illustrates the power supply configurations for isolated and non-isolated analog outputs. For details on wiring the power supply connectors, see Wiring Screw-Termination Connectors 47.





Power Supply Configurations for Isolated and Non-Isolated Analog Outputs

6.3 Intermodule Cabling

SCADAPack E RTUs and 6601 I/O expansion modules are supplied with a short intermodule cable that connects the unit to an RTU or to an I/O expansion module.

⚠WARNING

UNEXPECTED EQUIPMENT OPERATION

Evaluate the operational state of the equipment being monitored or controlled by the RTU or the I/O expansion module before removing power.

Failure to follow these instructions can result in death or serious injury.

⚠WARNING

HAZARD OF ELECTRIC SHOCK

Remove power from the I/O expansion module before removing the I/O expansion module cover.

Remove power from the RTU before removing the RTU cover.

Failure to follow these instructions can result in death or serious injury.

NOTICE

UNEXPECTED EQUIPMENT OPERATION

The electronics inside the I/O expansion module and the RTU can be damaged by static electricity. If you need to remove the I/O expansion module or the RTU cover, wear an anti-static wrist strap that is connected to ground.

Failing to follow this simple step can cause intermittent or total loss of I/O expansion module and RTU operation and will void the warranty.

Failure to follow these instructions can result in equipment damage.

If you need to supply your own intermodule cable, follow these recommendations:

- Use the shortest length intermodule cable possible.
- The maximum total length of intermodule cables is 1.2 m (48 in.). This length restriction does not include the short intermodule cable supplied with the I/O expansion module. The maximum number of modules is 16.
- Intermodule cables should not be located near any electrical noise sources such as inductive load switching or variable frequency drives.
- Intermodule cables should not be installed in the same cable tray or in parallel with field wiring. Intermodule cables may cross field wiring at 90° if necessary.

- Connect the shielding wire on the intermodule cable to a convenient chassis ground point. There is a small hole in the I/O expansion module for grounding the shielding wire.
- Confirm that the power supply is rated for the total number of modules in the system.

For additional details, refer to the SCADAPack E I/O Expansion Reference manual.

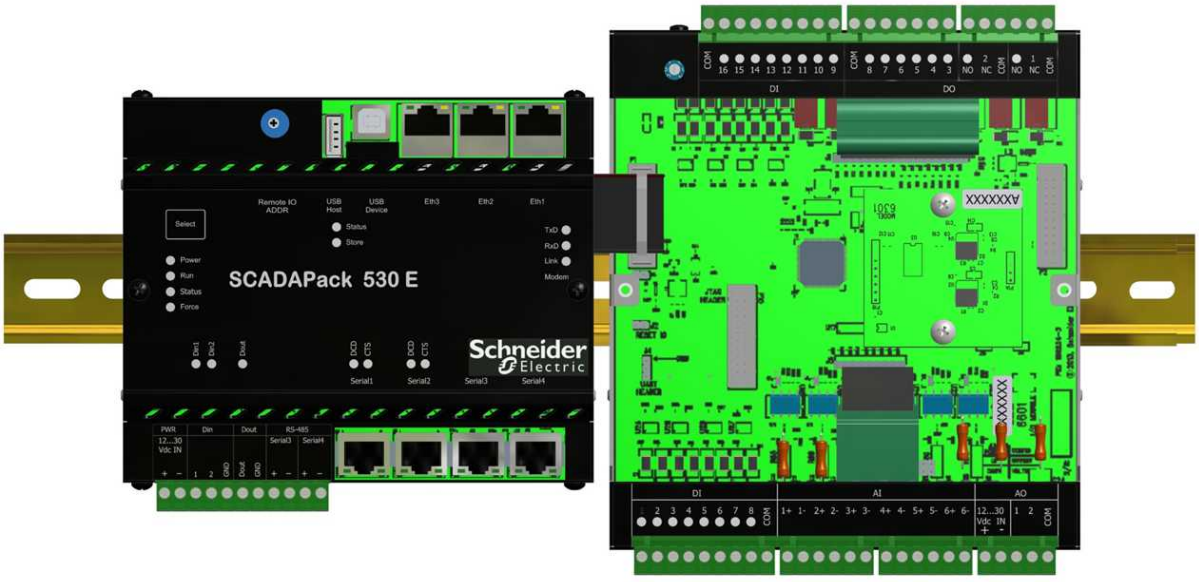
The intermodule cable is connected from the SCADAPack E RTU to the 6601 I/O expansion module connector as shown in the illustrations below.

NOTICE

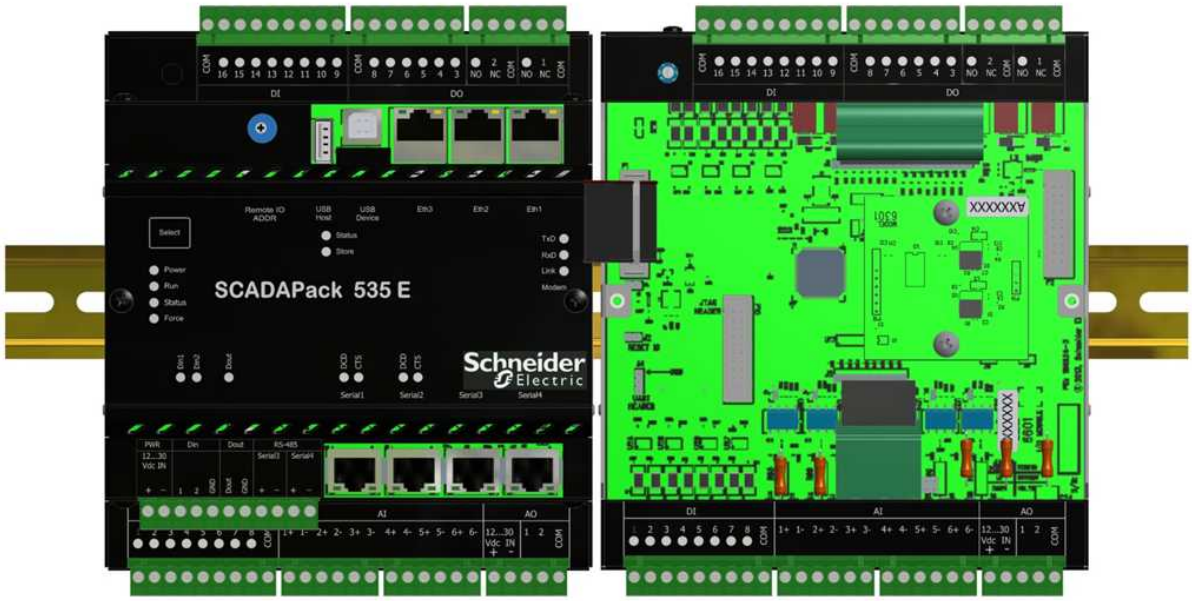
UNEXPECTED EQUIPMENT OPERATION

To help adequate air flow through the I/O expansion module, mount it upright on a DIN rail in the position shown below. Mounting the I/O expansion module in other positions can affect its operation at high temperatures, leading to unexpected results.

Failure to follow these instructions can result in equipment damage.



6601 I/O Expansion Module Connected to a SCADAPack 530E



6601 I/O Expansion Module Connected to a SCADAPack 535E

7 Addressing and Configuration

Addressing

⚠WARNING

UNEXPECTED EQUIPMENT OPERATION

Review the power requirements for 6601 I/O expansion modules before combining modules.

Failure to follow these instructions can result in death or serious injury.

For information about the power requirements for 6601 I/O expansion modules, see Power Supply Requirements 32.

6601 I/O modules can be combined in any manner up to the maximum number supported by the RTU:

- The SCADAPack 530E supports up to 16 6601 I/O expansion modules.
- The SCADAPack 535E includes one integrated 6601 I/O expansion module and supports up to 15 additional 6601 I/O expansion modules.

Each 6601 I/O expansion module connected to the RTU's I/O bus is assigned a unique I/O expansion module address.

Configuration

The inputs and outputs on the 6601 I/O expansion module can be configured:

- Locally or remotely using SCADAPack E Configurator 43, a software application that runs on a desktop or laptop computer.
- Remotely as part of an end-to-end SCADA system using the StruxureWare SCADA Expert ClearSCADA software.
- Locally using applications created in SCADAPack Workbench or ISaGRAF 3 Workbench 45.

Before you begin configuring the inputs and outputs on the 6601 I/O expansion module, determine whether the SCADA Expert ClearSCADA software will be used for any configuration tasks. This documentation assumes you are using the SCADAPack E Configurator software to configure the 6601 I/O expansion module. For information about using the ClearSCADA software, see the ClearSCADA documentation.

7.1 Setting the I/O Expansion Module Address

By default, the 6601 I/O expansion module physical address is set to 0. To avoid conflict with the addresses of other 6601 I/O expansion modules on the same RTU I/O bus, the address can be set anywhere in the range 0-F.

⚠WARNING

UNEXPECTED EQUIPMENT OPERATION

Evaluate the operational state of the equipment being monitored or controlled by the RTU and the I/O expansion module before removing power.

Failure to follow these instructions can result in death or serious injury.

⚠WARNING

UNEXPECTED EQUIPMENT OPERATION

Remove power from the I/O expansion module before initially setting the I/O expansion module address and before changing the I/O expansion module address.

Failure to follow these instructions can result in death or serious injury.

⚠WARNING

UNEXPECTED EQUIPMENT OPERATION

Be very careful that you do not set the I/O expansion module address to an address that is assigned to another 6601 I/O expansion module connected to the same RTU I/O bus.

If two 6601 I/O expansions modules have the same address, you will lose communications with both modules.

Failure to follow these instructions can result in death or serious injury.

To Set or Change an I/O Expansion Module Address

1. Remove power from the I/O expansion module.

2. Insert a 2.4 mm (3/32 in.) slotted screwdriver into the inner circle of the rotary hex switch.

6601 I/O Expansion Module Hex Switch

3. Slowly turn the screwdriver until the small arrowhead points to the correct address.

4. Reconnect power to the I/O expansion module.

7.2 Configuring with SCADAPack E Configurator

The SCADAPack E Configurator software provides a graphical user interface that allows you to configure the inputs and outputs and to load those settings onto the RTU. It also integrates with SCADAPack Workbench and ISaGRAF 3 Workbench so you can build and diagnose IEC61131-3 sequences that extend the RTU capabilities.

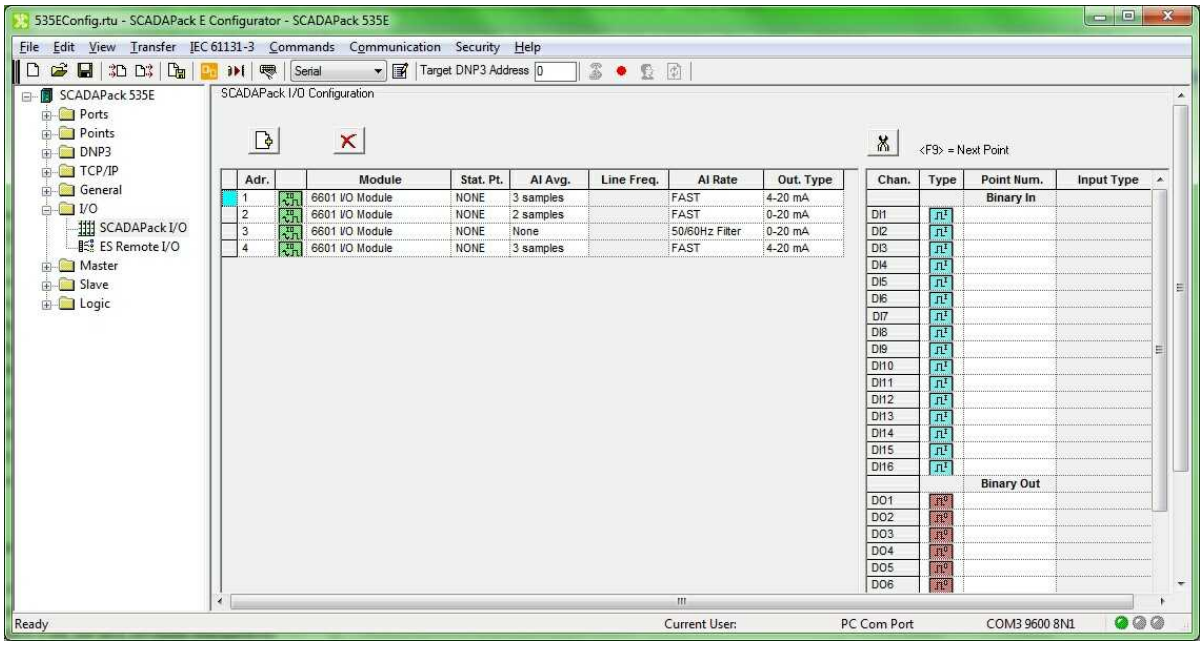
If you begin configuration in the SCADAPack E Configurator software, you cannot switch to the StruxureWare SCADA Expert ClearSCADA software. Similarly, if you begin configuration in the SCADA Expert ClearSCADA software, you cannot switch to the SCADAPack E Configurator software.

The following table summarizes where in the SCADAPack E Configurator software you will find the configurable attributes for the 6601 I/O expansion module inputs and outputs. The configuration fields are displayed when you double click on the input or output in the table.

6601 I/O Configuration Parameters in SCADAPack E Configurator

Hardware Label	SCADAPack E Configurator Folder	SCADAPack E Configurator Property Pages
DI	Points	Binary Points Counter Points
	I/O	SCADAPack IO
DO	Points	Binary Points
	I/O	SCADAPack IO
AI	Points	Analog Points
	I/O	SCADAPack IO
AO	Points	Analog Points
	I/O	SCADAPack IO

The figure below illustrates the SCADAPack I/O property page and the location of the other property pages listed in the table. For details about using SCADAPack E Configurator, refer to the SCADAPack E Configurator User Manual.



SCADAPack E Configurator User Interface

7.3 Reading and Writing Data with Logic Programs

IEC 61131-3 applications use I/O connections to the SCADAPack E RTU point database to access physical I/O points and derived data.

Reading and Writing Digital I/O Data

SCADAPack Workbench applications can read digital data, including digital input/output points:

- Use SCADAPack Workbench RTU_BIN_READ I/O devices to read digital input points.
- Use SCADAPack Workbench RTU_BIN_READ_OUTPUT I/O devices for reading digital output point states.

To write digital data, including digital output points, use SCADAPack Workbench RTU_BIN_WRITE I/O devices.

To read or write data to the digital inputs or outputs in ISaGRAF 3 Workbench applications, use rtuxxdi, rtuxxdo or rtuxxdos I/O boards.

Reading and Writing Analog Input Data

SCADAPack Workbench applications can read analog data, including analog input points, using RTU_RAW_READ or RTU_ENG_READ I/O devices.

For ISaGRAF 3 Workbench applications, use rtuxxai I/O boards to read the analog inputs.

Configuration for points attached to the analog input channels uses the SCADAPack E RAW_MIN, RAW_MAX and ENG_MIN, ENG_MAX parameters for integer and engineering scaling, respectively. These scaling ranges apply to the analog input signal range selected in SCADAPack E Configurator for each analog input channel.

Reading and Writing Analog Output Data

The I/O board includes two analog output channels if the optional analog output module was ordered with the unit.

SCADAPack Workbench applications can write analog data, including analog input points, using RTU_RAW_WRITE or RTU_ENG_WRITE I/O devices. They can also can read analog outputs using RTU_RAW_READ_OUTPUT and RTU_ENG_READ_OUTPUT I/O devices.

For ISaGRAF 3 Workbench applications, use rtuxxao I/O boards to write to the analog inputs and rtuxxaos I/O boards to read analog outputs.

More Information

Refer to the SCADAPack E Target 5 Technical Reference Manuals, ISaGRAF 3 Technical Manuals, or the SCADAPack E Configurator User Manual for information about how to assign RTU points.

8 Field Wiring

Each input and output on the 6601 I/O expansion module can be connected to a device that you want to monitor or control. In general, inputs are used to monitor devices, while outputs are used to control devices.

- Wiring Screw-Termination Connectors 47
- Digital Input Wiring 50
- Digital Output Wiring 52
- Analog Input Wiring 55
- Analog Output Wiring 64

8.1 Wiring Screw-Termination Connectors

Screw-termination style connectors are provided to terminate wiring from:

- Power supplies
- RS485 devices
- Input/output (I/O) devices

These 5 mm (0.197 in.) pitch connectors support solid or stranded wires from 3.3 mm^2 to .08 mm^2 (12 AWG to 28 AWG).

⚠WARNING

UNEXPECTED EQUIPMENT OPERATION

Evaluate the operational state of the equipment being monitored or controlled by the RTU or the I/O expansion module before removing power.

Failure to follow these instructions can result in death or serious injury.

NOTICE

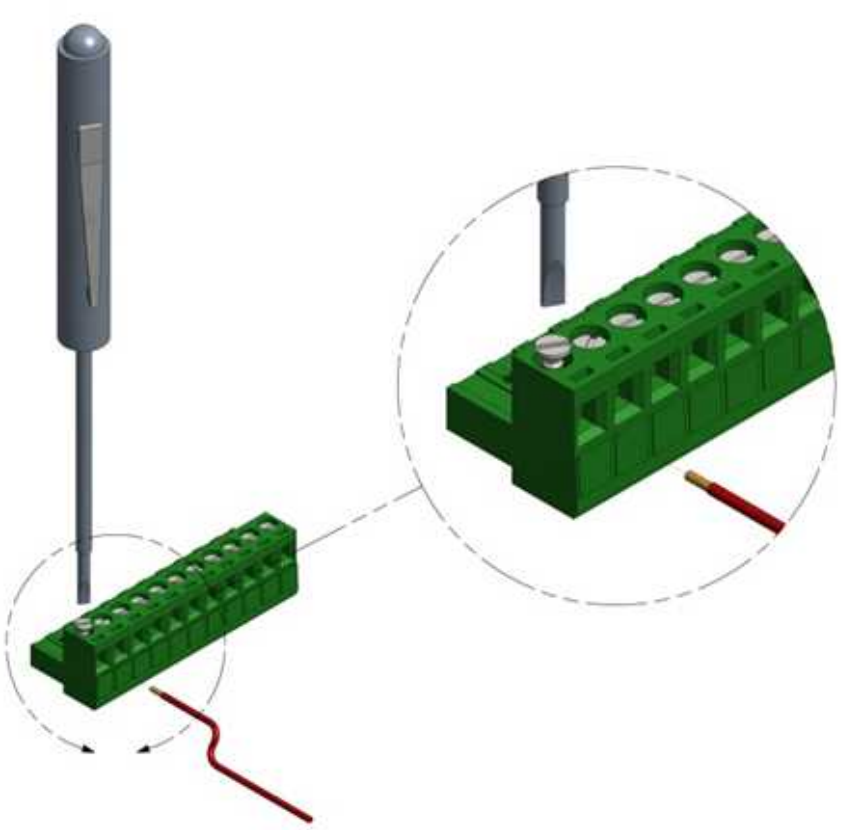
UNEXPECTED EQUIPMENT OPERATION

Remove power from the RTU before servicing.

Failure to follow these instructions can result in equipment damage.

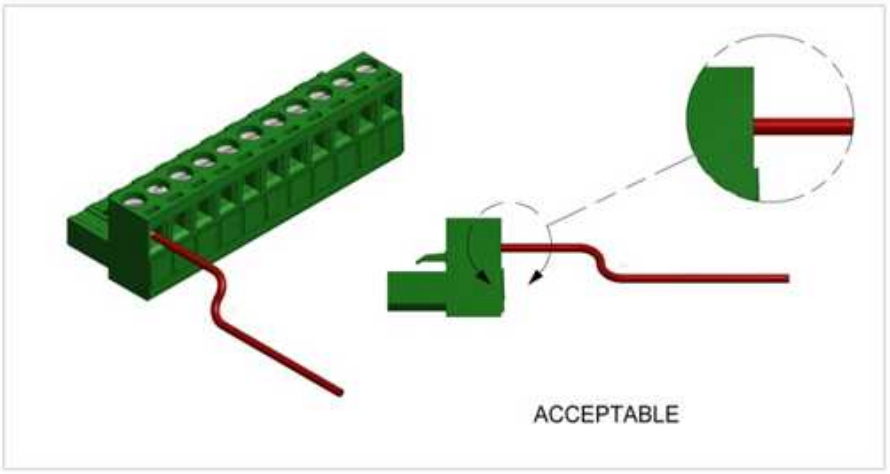
To Wire a Connector

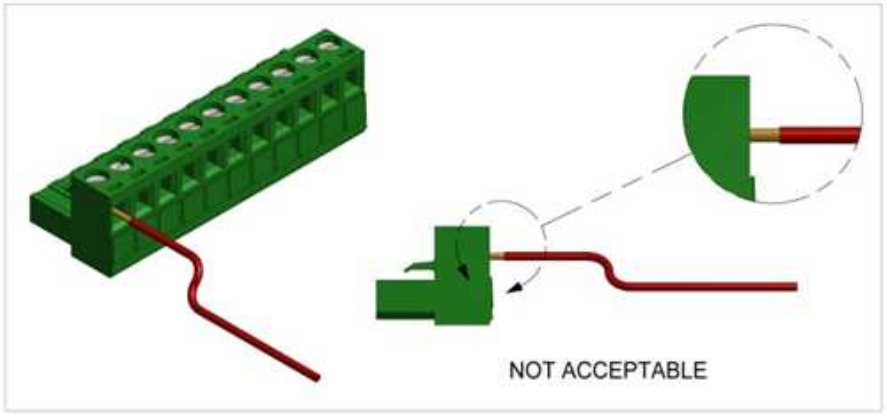
1. Use a slotted screwdriver to loosen the termination screw.



Loosening the Termination Screw

2. Insert the stripped wire into the connector so that the bared wire is located under the screw. As illustrated below, the bared wire should be placed fully within the connector.



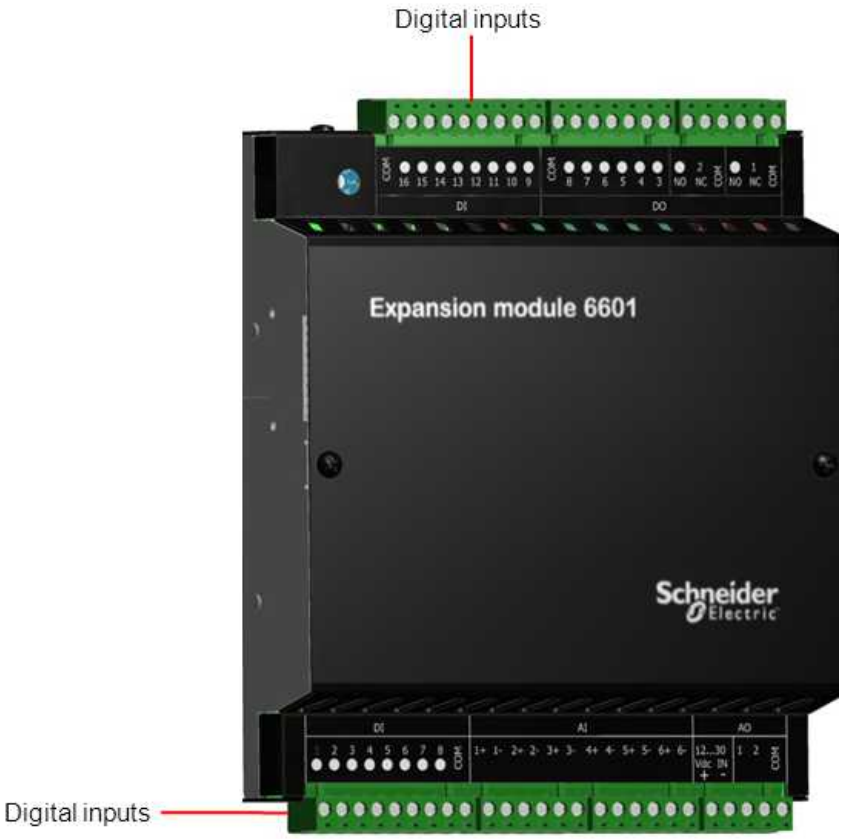


Inserting the Wire into the Connector

3. Apply 0.5 Nm (4.5 lb-in.) torque to tighten the screw so the wire is held firmly in place.

8.2 Digital and Counter Input Wiring

The topic in this section describes the wiring for the digital and counter inputs.



6601 I/O Expansion Module Digital Inputs

- Digital Input Wiring Example 50

8.2.1 Digital and Counter Input Wiring Example

NOTICE
UNEXPECTED EQUIPMENT OPERATION When wiring digital and counter inputs: • Confirm that the connection to the digital or counter input does not exceed the ratings for the input. See the specifications 71 section for details. • Confirm that the polarity of the connection is correct with the two positive terminals wired together and the two negative terminals wired together. **Failure to follow these instructions can result in equipment damage.**

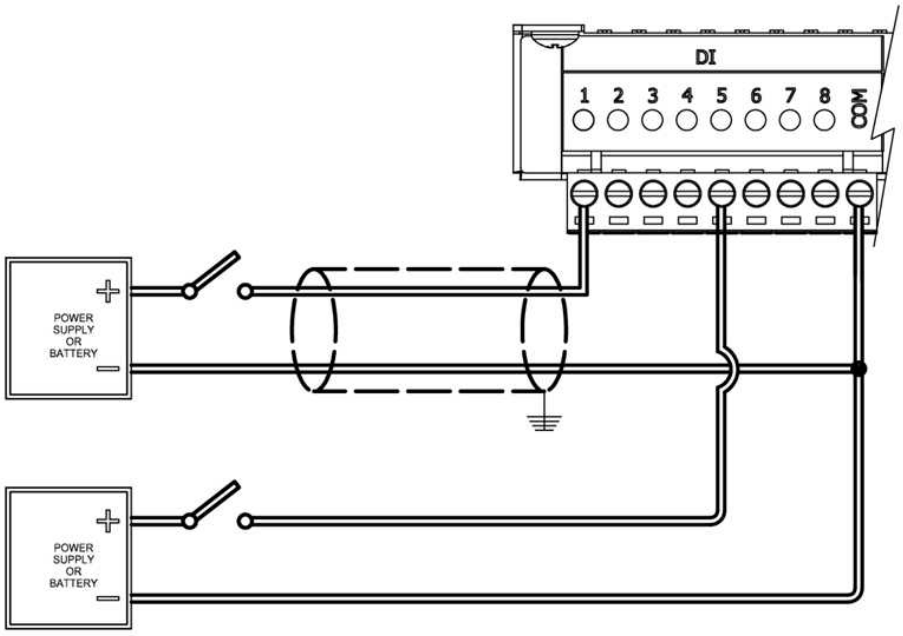
NOTICE

UNEXPECTED EQUIPMENT OPERATION

When the unit is operating in an electrically noisy environment use shielded wires on connections to digital and counter inputs 1-4.

Failure to follow these instructions can result in equipment damage.

The figure below shows a shielded connection to DI 1 and an unshielded connection to DI 5. Both connections are wired to the common for digital inputs 1-8 and to a power supply or battery.



I/O Board Digital and Counter Input Wiring Example

8.3 Digital Output Wiring

The topic in this section describes the wiring for the digital outputs.

6601 I/O Expansion Module Digital Outputs

- Digital Output Wiring Examples 52

8.3.1 Digital Output Wiring Examples

NOTICE
UNEXPECTED EQUIPMENT OPERATION Incandescent lamps and other loads may have inrush currents that will exceed the rated maximum current of the relay contacts. This inrush current may damage the relay contacts. Interposing relays need to be used in these situations. **Failure to follow these instructions can result in equipment damage.**

NOTICE

UNEXPECTED EQUIPMENT OPERATION

External lightning protection is required if the device being controlled is outside the physical area (cubicle or building) in which the RTU is located.

Failure to follow these instructions can result in equipment damage.

NOTICE

UNEXPECTED EQUIPMENT OPERATION

When controlling inductive loads, the relay contacts on digital outputs must be protected. The energy stored in the coil can generate significant electrical noise when the relay contacts are opened.

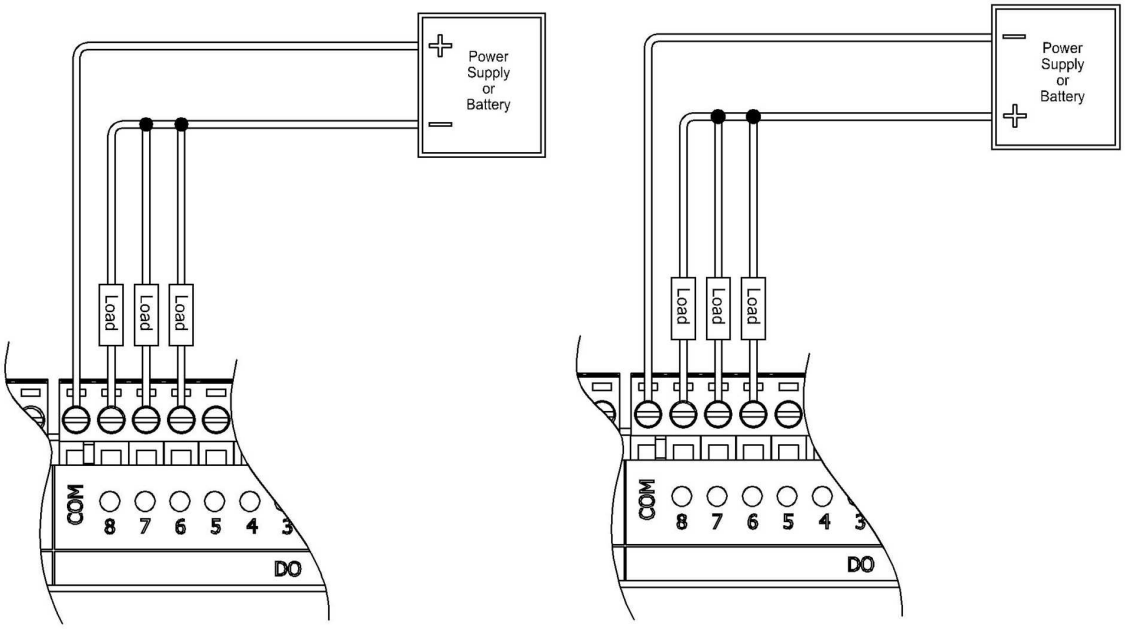
To suppress the noise in DC circuits, place a diode across the coil.

To suppress the noise in AC circuits, place a metal-oxide varistor (MOV) across the coil.

Failure to follow these instructions can result in equipment damage.

Form A Digital Output Wiring

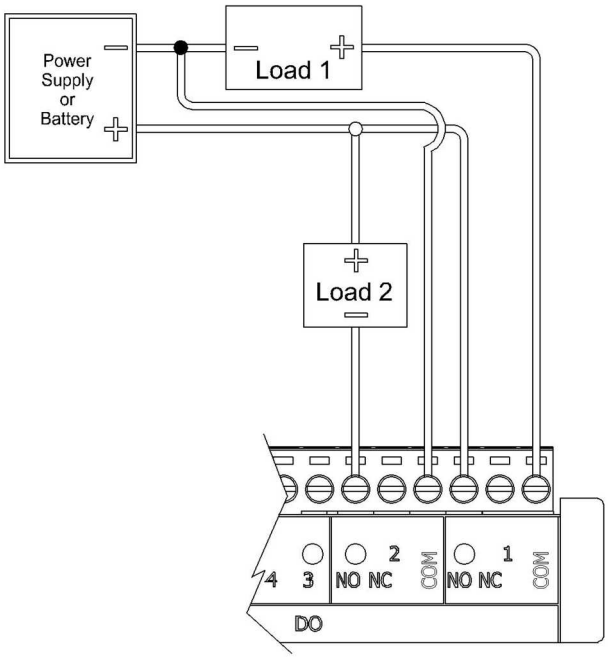
The figures below show wiring examples for the I/O board Form A digital outputs (DO 3-8).



Wiring Examples for I/O Board Form A Digital Outputs

Form C Digital Output Wiring

The figure below shows a wiring example for the I/O board Form C digital outputs (DO 1-2).



Wiring Example for I/O Board Form C Digital Outputs

8.4 Analog Input Wiring

The topics in this section describe the wiring for the analog inputs.

6601 I/O Expansion Module Analog Inputs

- Analog Input Wiring Example 55
- Supporting Current and Voltage Inputs 57
- Helping to Prevent Interruption of the Current Loop 62

8.4.1 Analog Input Wiring Example

The analog inputs support loop-powered and self-powered transmitters.

NOTICE
UNEXPECTED EQUIPMENT OPERATION If a transducer or transmitter connected to an analog channel is placed outside of the building or structure where the RTU or I/O expansion module that provides the analog inputs is installed, there is an increased possibility of extremely severe power surges caused by lightning. In these cases, additional surge protection must

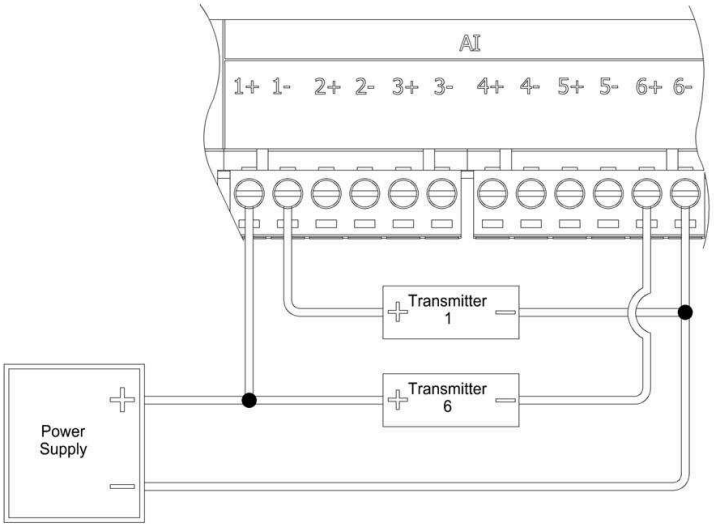
be supplied by the user.

Failure to follow these instructions can result in equipment damage.

- Loop-powered transmitters are two-terminal devices that are connected between a power supply and the analog input. The loop current from the power supply passes through the transmitter and returns to the power supply through a 250 ohm resistor in the 20 mA input circuit.
- Self-powered transmitters have three terminals:
  - Power In connects to a power supply
  - Signal Out connects to the analog input channel
  - Common connects to COM

Self-powered transmitters can have a current or voltage output.

In the wiring example below, Transmitter 1 is grounded and connected to AI 1-. Transmitter 6 is connected to the positive power supply and to AI 6+. These two connections are possible because the analog inputs are isolated.



Analog Input Wiring Example

8.4.2 Supporting a Mix of Current and Voltage Inputs

Overview

The unit is shipped with the six analog inputs operating either in DC current mode or in DC voltage mode. However, you can change the input mode for individual analog inputs to support a mix of current and voltage analog inputs if needed.

The unit is factory-calibrated for 0...20 mA and 4...20 mA current inputs and for 0...5 V and 1...5 V operation so there is no need to adjust the calibration when you change the input mode for an analog input.

Changing voltage inputs to current inputs

If the analog inputs are operating in DC voltage mode, there are two ways to support DC current input:

- Add an external resistor to convert the current input to voltage input. This is the recommended approach because:
  - You do not need to remove the unit from the DIN rail or disconnect the wiring.
  - The current loop can be configured so it is not interrupted if you need to service the unit.

  For details, see Converting Current Input to Voltage Input 57.
- Move the appropriate analog input dip switches from the voltage position to the current position. This approach is not recommended because:
  - In most situations you need to remove the unit from the DIN rail and disconnect the wiring.
  - The current loop is interrupted if you need to service the unit.

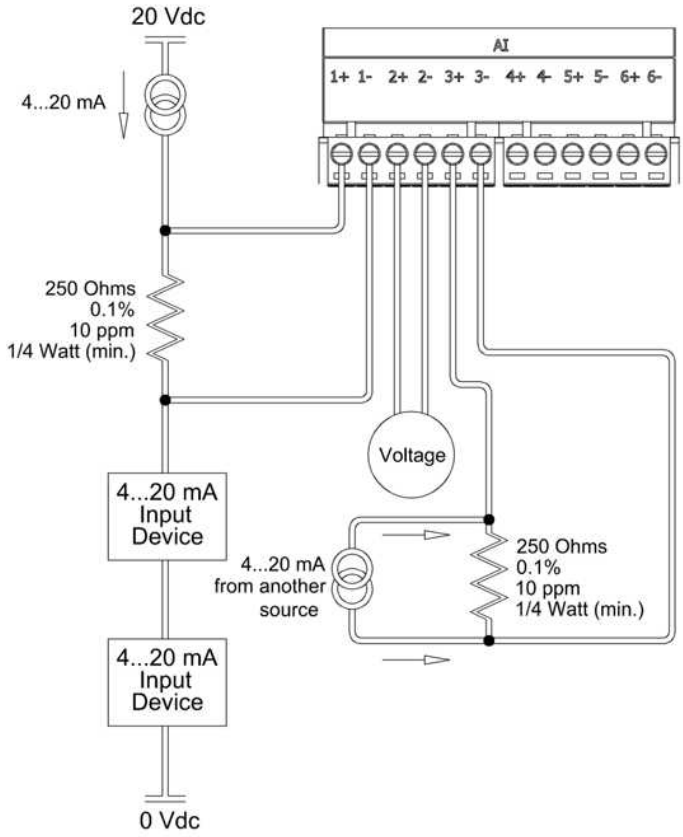
  If you choose this approach, carefully consider the precautions below before proceeding. For details, see Moving the Analog Input DIP Switch to Change the Input Mode 59.

Changing current inputs to voltage inputs

If the analog inputs are operating in DC current mode, you can move the appropriate analog input dip switches to the voltage position to support DC voltage inputs. Carefully consider the precautions below before proceeding. For details, see Moving the Analog Input DIP Switch to Change the Input Mode 59.

Converting Current Input to Voltage Input

In the following illustration, the analog inputs are configured to operate in voltage mode and an external resistor is used to convert current input to voltage input where necessary. This wiring approach allows you to configure the current loop so it is not interrupted if the unit requires servicing. For details, see Helping to Prevent Interruption of the Current Loop 62.



Wiring to Support a Mix of Current and Voltage Inputs

Moving the Analog Input DIP Switch to Change the Input Mode

The procedure below describes how to move the dip switches on the back of the unit to change the analog input mode from DC voltage mode to DC current mode, or from DC current mode to DC voltage mode.

If you have open access to the back of the unit, where the dip switches are located, you do not need to remove the unit from the DIN rail or the wiring from the unit to access the dip switches. In this case, skip to step 4 in the procedure below.

If you do not have open access to the back of the unit, you will need to remove the unit from the DIN rail and you will likely need to remove the wiring from the unit to access the dip switches. In this case, follow the procedure below from step 1. Carefully consider the precautions below before proceeding.

To change the operating mode for an analog input

⚠WARNING

UNEXPECTED EQUIPMENT OPERATION

Evaluate the operational state of the equipment being monitored or controlled by the SCADAPack E RTU and the I/O expansion module before removing power.

Failure to follow these instructions can result in death or serious injury.

⚠WARNING

HAZARD OF ELECTRIC SHOCK

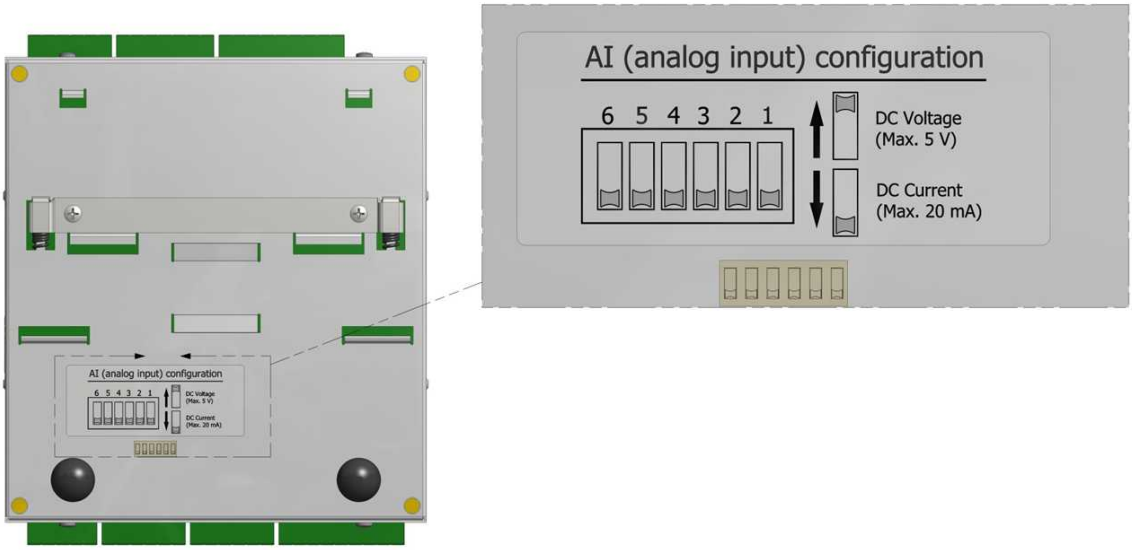
Remove power from all devices before connecting or disconnecting inputs or outputs to any terminal or installing or removing any hardware.

Failure to follow these instructions can result in death or serious injury.

1. Remove power from the unit.
2. Disconnect all power, I/O and serial port wiring.
3. Remove the unit from the DIN rail.

   To remove the unit from the DIN rail, press down on the top of the unit to compress the mounting springs while tilting the bottom of the unit toward you. When the DIN rail is free of the lower claws on the back of the RTU, gently lift the unit away from the DIN rail.
4. On the back of the unit, locate the dip switch for the analog input that you want to reconfigure.

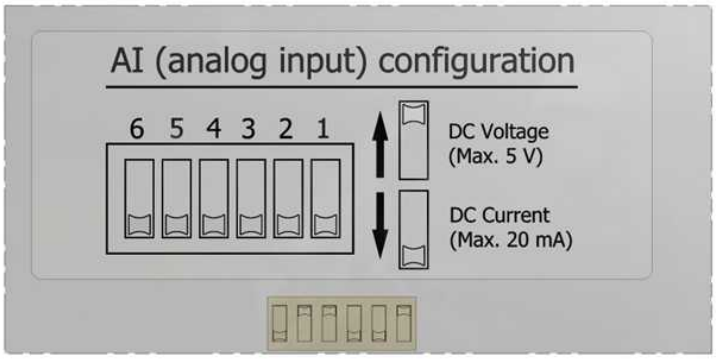
   The dip switch numbers correspond to the analog input numbers. For example, to change the input mode for analog input 1, move dip switch 1. The figure below shows the six dip switches set for DC current mode.



Analog Input Dip Switches Set for Current Mode

5. Move the dip switch to the alternate mode of operation:
   - For DC current (mA), slide the dip switch to the lower position.
   - For DC voltage (V), slide the dip switch to the upper position.

   In the figure below, analog inputs 2, 3 and 6 are configured for DC voltage while analog inputs 1, 4 and 5 are configured for DC current.



Analog Inputs Configured for a Mix of Current and Voltage Inputs

6. Remount the unit on the DIN rail.

NOTICE
UNEXPECTED EQUIPMENT OPERATION Do not connect I/O devices that exceed the maximum current or voltage for an analog input. The maximum DC current for an analog input is 20 mA.

The maximum DC voltage for an analog input is 5 V.

Failure to follow these instructions can result in equipment damage.

7. Reconnect the inputs and outputs.
8. Reconnect the power connectors and reapply power to the unit.
9. In SCADAPack E Configurator, go to the SCADAPack IO property page and change the **Input Type** for the analog inputs that were reconfigured.

8.4.3 Helping to Prevent Interruption of the Current Loop

⚠WARNING

HAZARD OF ELECTRIC SHOCK

Remove power from all devices before connecting or disconnecting inputs or outputs to any terminal or installing or removing any hardware.

Failure to follow these instructions can result in death or serious injury.

NOTICE

UNEXPECTED EQUIPMENT OPERATION

Do not exceed the maximum voltage specified for each analog input.

Failure to follow these instructions can result in equipment damage.

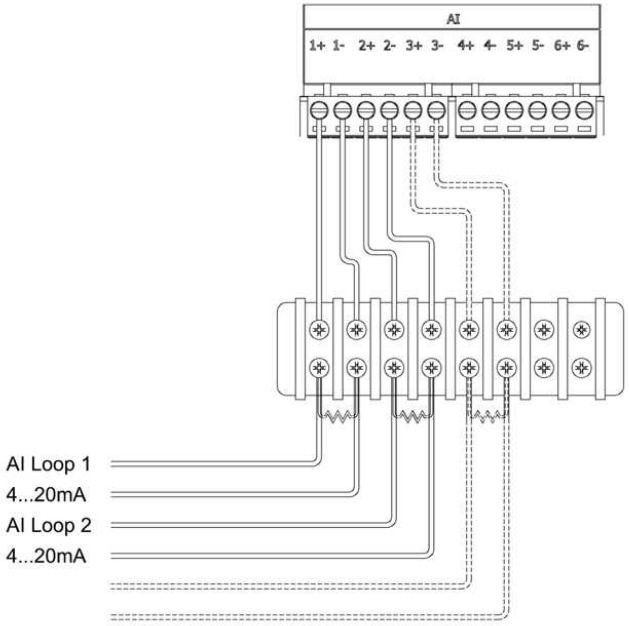
NOTICE

UNEXPECTED EQUIPMENT OPERATION

The RTU or I/O expansion module must be the only loop current measurement device in the loop when using the analog inputs in the 20 mA measurement mode. If power to the module is removed, the module reverts to voltage mode and results in an open current loop. Applications that cannot tolerate this possibility need to utilize external current sense resistors with the module input range set to voltage.

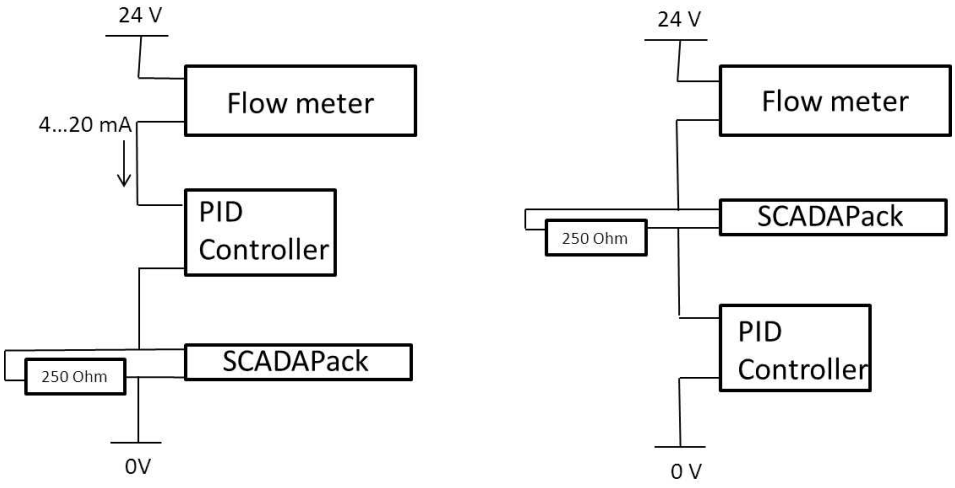
Failure to follow these instructions can result in equipment damage.

Add 250 ohm external resistors to the current loop at the terminal strip to help prevent interruption of the current loop if the RTU or I/O expansion module is being serviced. The physical wiring of the external 250 ohm external resistors at the terminal strip is illustrated below.



Wiring to Help Prevent Interruption of the Analog Input Current Loop

As illustrated below, the RTU or I/O expansion module providing the analog inputs does not need to be the last device in the current loop.



Valid SCADAPack E RTU Positions in the Current Loop

8.5 Analog Output Wiring

The topics in this section describe the wiring for the analog outputs.

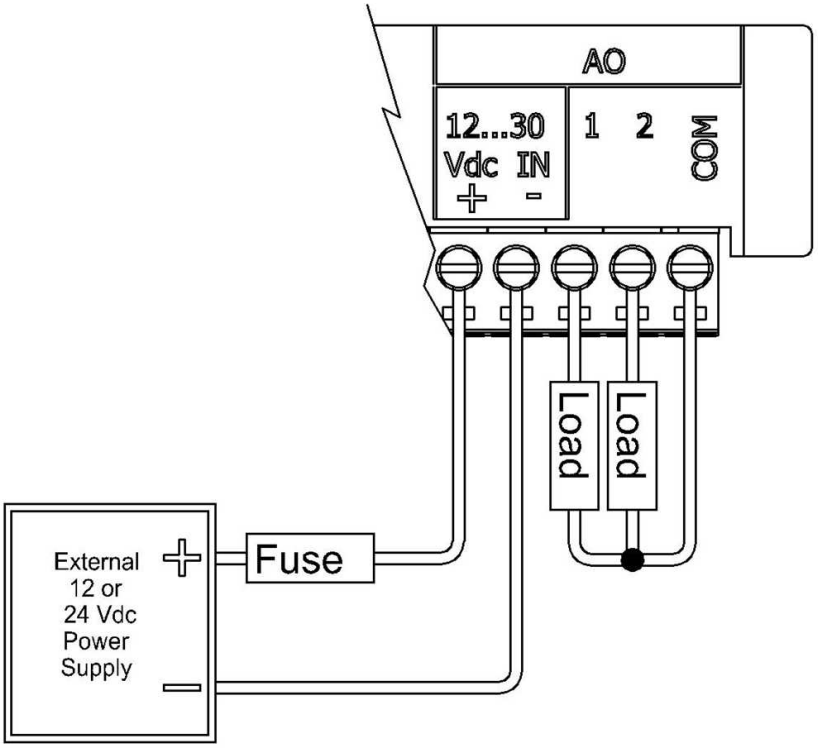
6601 I/O Expansion Module Analog Outputs

- Analog Output Wiring Example 64
- Supporting Current and Voltage Outputs 67

8.5.1 Analog Output Wiring Example

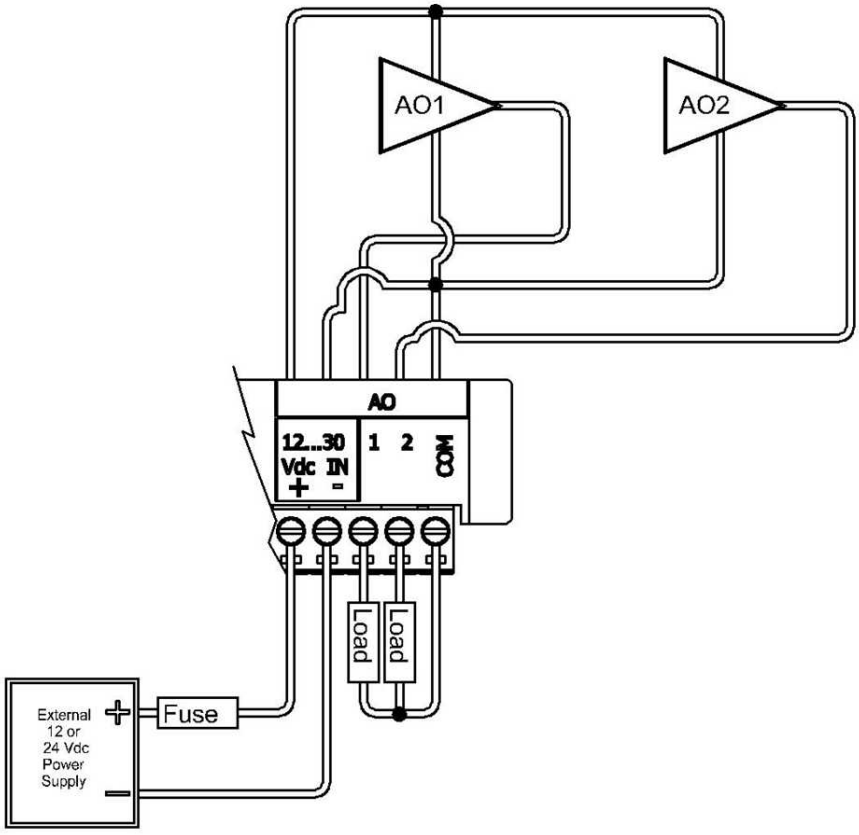
The figure below shows loads connected to the two analog outputs.

NOTICE
UNEXPECTED EQUIPMENT OPERATION Install a 0.063A fast-acting fuse on the input voltage side of the analog output power supply connection. **Failure to follow these instructions can result in equipment damage.**



Analog Output Wiring Example

The analog output circuitry is configured internally to receive power from an external power supply on pins 1 and 2 of the removable terminal block. Pin 5 (Com 1-2) and pin 2 (power input –) are connected internally. As illustrated in the following figure, the two analog outputs are not isolated from each other, but are isolated from the RTU logic.



Analog Output Internal Wiring

8.5.2 Supporting Current and Voltage Outputs

The analog outputs can be configured for 4...20 mA current or 0...20 mA current.

If a voltage output is required (1...5 V, for example), run the 4...20 mA or 0...20 mA signal to the device that requires voltage input and place a 250 ohm resistor across the input terminals on the device. With this resistor in place, the analog output is electrically isolated from the rest of the RTU, but is not isolated from the power supply.

The table below lists resistance values and output range settings for common voltage ranges. The resistance value listed is the parallel resistance of the device and the load resistor.

Resistance Values and Output Ranges

Resistance	Output Range	Voltage Range
250 ohm	0...20 mA 4...20 mA	0...5 V 1...5 V
500 ohm	0...20 mA	0...10 V

9 Diagnostics and Troubleshooting

The 6601 I/O expansion module provides LEDs that indicate the status of inputs and outputs. There are also a number of troubleshooting actions you can take to determine the cause of unexpected activities. For more information, see:

- LEDs 68
- Analog Inputs and Outputs 69
- Digital Inputs and Outputs 70

9.1 LEDs

The 6601 I/O expansion module provides an LED for each digital input and digital output. When the LED is on, the input or output is energized, meaning it has an active connection. Digital input LEDs blink when pulses are applied if the digital input is configured to be a counter.

9.2 Analog Inputs and Outputs

Analog Inputs

Condition	Action
20 mA inputs read 0.	Check transmitter power.
Reading is at or near 0 for every input signals.	Check if the input transient suppressors are damaged.
20 mA readings are not accurate.	Check for a damaged 250 ohm current sense resistor.
Reading is constant.	Check that the analog input is not forced.
Reading seems out of calibration for small inputs but improves as input increases.	Check the input range setting.
In Current Loop Mode, there can be an open circuit in the Current Loop.	See Configuring Analog Inputs as Current Inputs 62.
Other devices are not functional after installation of the 6601 I/O expansion module.	In Current Loop mode, make the 6601 I/O expansion module the last device in the loop or use a signal isolator as described in Configuring Analog Inputs as Current Inputs 62.

Analog Outputs

Condition	Action
Outputs are 0 mA.	Check the 24 V power supply.
The full-scale output is less than 20 mA.	Check the 24 V power supply. Check that the load resistance is within specification.
Output is constant and should be changing.	Check that the analog outputs are not forced.

9.3 Digital Inputs and Outputs

Digital Inputs

Condition	Action
Input LED does not come on when input signal is applied.	Check the input signal at the termination block. It should be at least 50% of the digital input range. If this is a DC input, check the polarity of the signal.
Input is on when no signal is applied. The LED is off.	Check that the digital inputs are not forced on.
Input is off when a signal is applied. The LED is on.	Check that the digital inputs are not forced off.

Digital Outputs

Condition	Action
Output LED does not come on when output is turned on.	Check the Power LED on the RTU.
Output LED comes on but the output does not close.	Check if the relay is stuck. If so, return the board for repair.
Output LED comes on and output is closed, but the field device is not activated.	Check the field wiring. Check the external device.
Output LED and relay are on when they should be off.	Check that the output is not forced on.
Output LED and relay are off when they should be on.	Check that the output is not forced off.

10 Calibration

The 6601 I/O expansion module is electronically calibrated at the factory during the manufacturing process and after any repair procedures.

There are no user calibration procedures.

11 Maintenance

The 6601 I/O expansion module requires no routine maintenance. If the module is not functioning correctly, contact Schneider Electric Technical Support 5 for more information and instructions for returning the module for repair.

Firmware Updates

You can update the firmware on the 6601 I/O expansion module as described in the SCADAPack E Firmware Update User Manual.

NOTICE
UNEXPECTED EQUIPMENT OPERATION Before you install any firmware updates, check the Release Notes for the firmware update to determine the most suitable I/O board firmware version for your controller board firmware version and the functionality you are using. **Failure to follow these instructions can result in equipment damage.**

12 Specifications

The following topics provide detailed hardware specifications for the 6601 I/O expansion module and its inputs and outputs.

- General 72
- Power Supply 73
- Digital and Counter Inputs 73
- Digital Outputs 75
- Analog Inputs 76
- Analog Outputs 78

12.1 General

Environment	-40°C … 70°C (-40°F…158°F) operating temperature when mounted on a horizontally oriented DIN rail -40°C … 65°C (-40°F…149°F) operating temperature when mounted on a vertically oriented DIN rail -40°C … 85°C (-40°F…185°F) storage temperature 5% to 95% relative humidity, non-condensing Pollution Degree 2, Installation Category I, Indoor use
Elevation	3,000 m (9,842 ft)
Terminations	3.3 mm^2 to .08 mm^2 (12 AWG to 28 AWG), solid or stranded
Packaging	Corrosion-resistant and RoHS-compliant clear zinc-plated steel with black enamel paint
SCADAPack 535E Dimensions	151 mm (5.9 in.) wide 182 mm (7.2 in.) high 87 mm (3.4 in.) deep
SCADAPack 530E Dimensions	151 mm (5.9 in.) wide 135 mm (5.3 in.) high 75 mm (3.0 in.) deep
6601 I/O Expansion Module Dimensions	151 mm (5.9 in.) wide 182 mm (7.2 in.) high 47 mm (1.9 in.) deep
Shock	IEC 61131-2 ½ sine, 15 ms, 15 g
Vibration	IEC 61131-2 5 – 8.4 Hz: Amplitude controlled, 7.0 mm (0.28 in.) peak-to-peak 8.4 – 150 Hz: Acceleration controlled, 1.0 g peak

12.2 Power Supply

Input Voltage	Rated voltage: 12…30 Vdc Limit voltage: 11.5...32 Vdc Turn-on voltage: 10…11.5 Vdc Turn-off voltage: 9..10 Vdc
Maximum Power	SCADAPack 530E plus 4 6601 I/O expansion modules plus USB: 8.6 W
Power Requirements	SCADAPack 530E: 3.7 W SCADAPack 535E with integrated I/O: 4.8 W 6601 I/O expansion module: 1.1 W USB (5 V at 100 mA): 0.6 W Serial port (5 V at 250 mA): 1.5 W Also see Power Supply Requirements 32
Maximum System Configuration	SCADAPack 535E plus 3 6601 I/O expansion modules SCADAPack 530E plus 4 6601 I/O expansion modules SCADAPack 535E plus 2 6601 I/O expansion modules plus serial port 5 V SCADAPack 530E plus 3 6601 I/O expansion modules plus serial port 5 V USB 5 V at 100 mA permissible in any configuration
Isolation	Controller power input, USB and serial communication ports are not isolated from the enclosure See the relevant specifications for I/O point isolation information
Protection	Protected up to 60 Vdc for over-voltages and reverse polarity voltages Inrush current limited
Cable Length	Maximum: 30 m (98.4 ft)

12.3 Digital and Counter Inputs

Digital Inputs

Normal Operation Range	12…24 Vdc
Turn-on Voltage	Minimum: 9 Vdc
Turn-off Voltage	Maximum: 4 Vdc
Over-Voltage Tolerance	150% sustained over-voltage without foreseeable damage
DC Input Current	0.9…1.2 mA at 12 Vdc 2.1…2.4 mA at 24 Vdc
Isolation	Isolation is in 2 groups of 8 Isolation from RTU logic and chassis 1000 Vac/1500 Vdc
Time Stamping	1 ms Sequence of Event (SOE)

Counter Inputs

Electrical Characteristics	Shared with digital input channels
Reporting	16-bit and 32-bit counters Deviation Time-stamped events Polled, unsolicited reporting
Frequency	Up to 8 channels: DI 1 to 4: 0...1.5 kHz DI 5 to 8: 0...150 Hz

12.4 Digital Outputs

Type	2 Form C SPDT relays available to the application Separate Normally Open/Normally Closed/Common 6 Form A relays available to the application Normally Open, one Common
Isolation	500 Vac minimum to RTU logic
Maximum Switching Voltage	30 Vdc or 25 Vac
Maximum Switching Load	60 W or 50 VA per relay 2 A per relay 2 A per common on digital outputs 1-2 12 A per common on digital outputs 3-8
Status and Reporting	Individual relay pole feedback to software Output state poll
Temperature De-rating	Horizontally oriented DIN rail mounting: - 2 A maximum per relay at 60°C (140°F) - De-rate by 0.1 A per 1°C to 1 A maximum per relay at a maximum ambient temperature of 70°C (158°F) Vertically oriented DIN rail mounting: - 2 A maximum per relay at 60°C (140°F) - De-rate by 0.1 A per 1°C to 1.5 A maximum per relay at a maximum ambient temperature of 65°C (149°F)
Controls	Direct Operate Select Before Operate Trip/Close Latch Pulse

12.5 Analog Inputs

Type	Uni-polar, differential, voltage or current
Resolution (filtered)	24-bit conversion yields an effective 19 bits of resolution during filtered conversions 10 uV on the 5 V range 40 nA resolution on the 20 mA range
Resolution (fast)	24-bit conversion yields an effective 13 bits of resolution during unfiltered conversions. 0.6 mV resolution on the 5 V range 2.4 uA resolution on the 20 mA range
Accuracy	±0.1% of full scale at 25ºC (77ºF) ±0.2% over-temperature range
Isolation	250 Vac from RTU logic and chassis 60 Vdc between inputs Transformer
Input Resistance	250 ohms 800 kohms in current/voltage configurations
Ranges	Input Type: 4...20 mA, 0...20 mA, 1...5 V, or 0...5 V Under-range: 4...20 mA measures to 0 mA Individual inputs are current or voltage jumper selectable. Calibration in voltage mode 1...5 V is available as an option. Contact factory for custom calibrations
Sampling Rate	Filtered: 500 ms per 6 channels Fast: 30 ms per 6 channels
Common Mode Rejection	80 dB
Normal Mode Rejection	Filtered: 86 dB (50/60 Hz) Fast: Not applicable
Status	ADC reference check
Reporting	Deviation 8 alarm limits Under- and over-range events Quality flags Integer/floating point Time-stamped events Polled, unsolicited reporting on deviation and per alarm limit

Time Stamping	30 ms Sequence of Event (SOE)
Cable Length	Maximum: 30 m (98.4 ft)

12.6 Analog Outputs

Type	Uni-polar
Resolution	12-bit over 0...20 mA range
Accuracy	±0.15% at 25°C (77ºF) ±0.35% of full scale over-temperature range
Response Time	Less than 10 µs for 10% to 90% signal change
Power Supply (External)	12…30 Vdc
Power Supply Cable Length	Maximum: 30 m (98.4 ft)
Power (Current) Requirements	10 mA plus up to 20 mA per output
Isolation	Transformer 500 Vdc maximum to RTU logic and chassis
Range	0...20 mA 4...20 mA Voltage output may be accomplished with external precision resistor
Status & Reporting	Power missing Temperature too high Open loop detected Values out of range ADC reference check
Controls	Direct Operate Select Before Operate
Load Range	12 Vdc: 0…475 ohms 24 Vdc: 0…1075 ohms 30 Vdc: 250…1375 ohms

13 Standards and Certifications

Introduction

SCADAPack E RTUs have been designed to comply with the relevant standards and rules for electrical equipment in an industrial automation environment.

Industrial Standards

Requirements specific to the PAC functional characteristics, immunity, robustness, and safety:

- IEC/EN 61131-2
- CSA 22.2 No.142 completed by CSA-E 61131-2
- UL 508

European Directives for EC Marking

- Low voltage: 2006/95/EC (not applicable)
- Electromagnetic compatibility: 2004/108/EC

Installation in Classified Ex Area

- Hazardous locations class I, division 2, groups A, B, C, and D and class I, zone 2 according to CSA C22.2 No. 213, CSA C22.2 60079-0, CSA C22.2 60079-15, ANSI/ISA 60079-0, ANSI/ISA 60079-15, ANSI/ISA 12.12.01, FM 3600 and FM 3611
- EC ATEX (european directive 94/9/EC) in defined atmosphere zone 2 according to EN 60079-0 and EN 60079-15

Specific Countries

For Australia and New Zealand: ACMA requirements for RCM marking

For United States: FCC Part 15 Subpart B Class A

More details on certifications are available on the Schneider Electric website: www.schneider-electric.com.