

SCADAPack E

535E Hardware Manual

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1 Legal Information

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.

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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.

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2 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

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Email supportTRSS@se.com

Technical Support: Australia

Inside Australia 13 73 28 (13 SEAU)

Inside New Zealand 0800 652 999

Email techsupport.pz@se.com

3 Safety Information

Important Information

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service, 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 a hazardous situation which, if not avoided, **will result in** death or serious injury.

WARNING

WARNING indicates a 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 is used to address practices not related to physical injury.

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, installation, and operation of electrical equipment 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.

 WARNING
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 death or serious injury.

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

Test all software 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 prevail:

- 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 Programmable Automation Controllers (rPACs), 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 rPACs, 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.

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.

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

WARNING

HAZARD OF ELECTRIC SHOCK

Do not disconnect while circuit is live unless area is known to be non-hazardous.

AVERTISSEMENT - Ne pas débrancher tant que le circuit est sous tension, à moins qu'il ne s'agisse d'un emplacement non dangereux.

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

4 About this Manual

Audience

This manual is written for people who need to install, troubleshoot or maintain the remote Programmable Automation Controller (rPAC) hardware. These individuals are typically:

- Systems Engineers
- Commissioning Engineers
- Maintenance Technicians

Scope

This manual describes:

- The physical design of the rPAC, including detailed hardware specifications.
- The physical design of integrated inputs and outputs (I/O) and the basic requirements for adding I/O expansion modules.
- Installation, wiring and addressing for the rPAC.
- Diagnostics capabilities on the rPAC.
- Maintenance recommendations for the rPAC.

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
The basic steps required to get your rPAC up and running	• The Quick Start Guide for your rPAC
Configuring your rPAC to communicate with other rPACs and Remote Terminal Units (RTUs) and with input and output (I/O) devices	• SCADAPack E Configurator User Manual • DNP3 Technical Manuals • Protocol Technical Manuals • Communication Interfaces Manual
Configuring security on your rPAC	• Security Quick Start Guide • Security Administrator User Manual • Security Technical Reference Manual
Operating and troubleshooting your rPAC	• SCADAPack E Operational Reference Manual
Installing SCADAPack Workbench, using it to build custom applications for the rPAC and downloading the applications to the rPAC	• SCADAPack Workbench Quick Start Guide • SCADAPack E Target 5 Technical Manuals

Installing ISaGRAF 3 Workbench, using it to build custom applications for the rPAC and downloading the applications to the rPAC	• ISaGRAF 3 Workbench Quick Start Guide • SCADAPack E Target 3 Technical Manuals
Adding I/O expansion modules	• SCADAPack E I/O Expansion Reference Manual • SCADAPack System Configuration Guide • I/O Expansion Module Hardware Manuals

5 Cybersecurity

Cybersecurity is a branch of network administration that addresses attacks on or by computer systems and through computer networks that can result in accidental or intentional disruptions. The objective of cybersecurity is to help provide increased levels of protection for information and physical assets from theft, corruption, misuse, or accidents while maintaining access for intended users.

No single cybersecurity approach is adequate. Schneider Electric recommends a defense-in-depth approach. This approach layers the network with security features, appliances, and processes. The basic components of this approach are:

- Risk assessment: A systematic security analysis of the environment and related systems.
- A security plan built on the results of the risk assessment
- A multi-phase training campaign
- Network separation and segmentation: Physical separation of the control network from other networks, and the division of the control network itself into segments and security zones.
- System Access Control: Controlling access to the system with firewalls, authentication, authorization, and other software means, and traditional physical security measures such as video surveillance, fences, locked doors and gates, and locked equipment cabinets.
- Device hardening: The process of configuring a device against communication-based threats. Device hardening measures include disabling unused network ports, password management, access control, and the disabling of all unnecessary protocols and services.
- Network monitoring and maintenance: An effective defense-in-depth campaign requires continual monitoring and system maintenance to meet the challenge of new threats as they develop.

Contact us

For more information, refer to the Schneider Electric Cybersecurity Support Portal at <http://www.schneider-electric.com/b2b/en/support/cybersecurity/overview.jsp>.

Additional Resources

Industrial Control Systems Cyber Emergency Response Team (ICS-CERT)

<https://ics-cert.us-cert.gov>

ICS-CERT Recommended Practices

<https://ics-cert.us-cert.gov/Recommended-Practices>

Center for Internet Security (CIS) Top 20 Critical Security Controls

<https://www.cisecurity.org/cybersecurity-best-practices>

FBI Cyber Crime

<https://www.fbi.gov/investigate/cyber>

Guide to Industrial Control Systems (ICS) Security

<https://www.nist.gov/publications/guide-industrial-control-systems-ics-security>

WaterISAC Water Security Network

<https://www.waterisac.org>

6 About the SCADAPack 535E

The SCADAPack 535E remote Programmable Automation Controller (rPAC) is a smart, microprocessor-based telemetry and control device that can help to remotely monitor and control physical objects. For example, in a water management environment, the SCADAPack 535E can be used to monitor and control the valves on flow-monitoring devices at pumping stations. The rPAC's 1 ms Sequence of Event (SOE) monitoring capability is well suited to telemetry applications that require high-speed time-stamping and data capture.



The rPAC Difference

The ARC Advisory Group has defined the rPAC as a new way to look at remote site automation. An rPAC combines the power of a PAC with the versatility of a Remote Terminal Unit (RTU). The SCADAPack 535E rPAC is a platform that increases performance, adheres to open standards, and can operate in harsh, remote environments.

The SCADAPack 535E provides:

- Support for open standard telemetry protocols such as DNP3 level 4 with Security Suite (Secure Authentication and/or Data Encryption) and IEC 60870-5-101/-104
- Support for open standard industrial protocols such as Modbus RTU, Modbus TCP and DF1
- An open standard IEC 61131-3 programming environment

- Data concentrator capabilities for any DNP3, Modbus or DF1 devices
- Support for up to 29 active Supervisory Control and Data Acquisition (SCADA) masters, up to 100 remote/local slave devices, and up to 100 remote DNP3 devices in peer-to-peer mode
- A remote management suite to change configurations, modify programs and update firmware remotely using open standard DNP3
- Up to 515 internal digital/analog inputs and outputs
- 1 ms resolution time-stamped digital inputs, 30 ms sampled analog inputs with 16-bit analog-to-digital conversion (ADC)
- 3 Ethernet and 4 serial ports, 1 embedded 3G modem, 1 USB Device port for local configuration
- 1 USB Host port for external storage on USB host devices up to 32 GB
- A tool-free DIN rail mounting system
- 15 g acceleration
- Support for IP2x terminal blocks
- Support for operation from -40...70 °C (-40...158 °F)
- A compact form factor

Roles

The SCADAPack 535E can be configured to play one or more of the following roles in your Supervisory Control and Data Acquisition (SCADA) environment:

- Endpoint
- DNP3 router between any combination of Ethernet and serial ports
- DNP3 peer-to-peer communications device
- Data concentrator for:
 - Remote DNP3 and DNP3 IP slaves
 - Local DNP3, DNP3 IP, Modbus RTU, Modbus TCP and DF1 serial slaves
 - Local IEC 60870-5-103 protection relays
- Protocol converter for:
 - Modbus RTU and Modbus TCP to DNP3 and DNP3 IP, and vice-versa
 - Modbus RTU and Modbus TCP to IEC 60870-5-101/-104
 - DF1 to DNP3 and DNP3 IP, IEC 60870-5-101/-104 or Modbus RTU and Modbus TCP
 - IEC 60870-5-103 to DNP3/DNP3 IP, IEC 60870-5-101/-104 or Modbus RTU and Modbus TCP

The role your SCADAPack 535E plays in your SCADA environment determines how you need to set up communications to and from the rPAC and how you need to configure the rPAC.

Communications

The SCADAPack 535E includes four serial ports and three Ethernet ports that are available for communications with the SCADA master system, with other rPACs and RTUs, with devices such as Programmable Logic Controllers (PLCs), and with the local configuration software. It also includes a USB 2.0 device port for local configuration and a USB 2.0 host port that supports plug-in media.

A socket modem port that supports GPRS, 3G or LTE communications with remote devices will be available at a later date.

The SCADAPack 535E communicates using the Distributed Network Protocol (DNP) 3, IEC 60870-5 and Modbus protocols.

Inputs and Outputs

The SCADAPack 535E provides 18 digital inputs, 9 digital outputs and 6 analog inputs. Two analog outputs are also available if the optional analog output module was purchased with the SCADAPack 535E.

I/O can be extended by adding I/O expansion modules. For details about the number of I/O expansion modules supported, see [Specifications](#)^[147].

Configuration

You can configure the SCADAPack 535E using three different methods:

- Locally or remotely using [SCADAPack E Configurator](#)^[117], a software application that runs on a desktop or laptop computer that is connected to the rPAC 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 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 rPAC. However, you can also write applications that replace the configuration functionality provided through the SCADAPack E Configurator software or the ClearSCADA software.

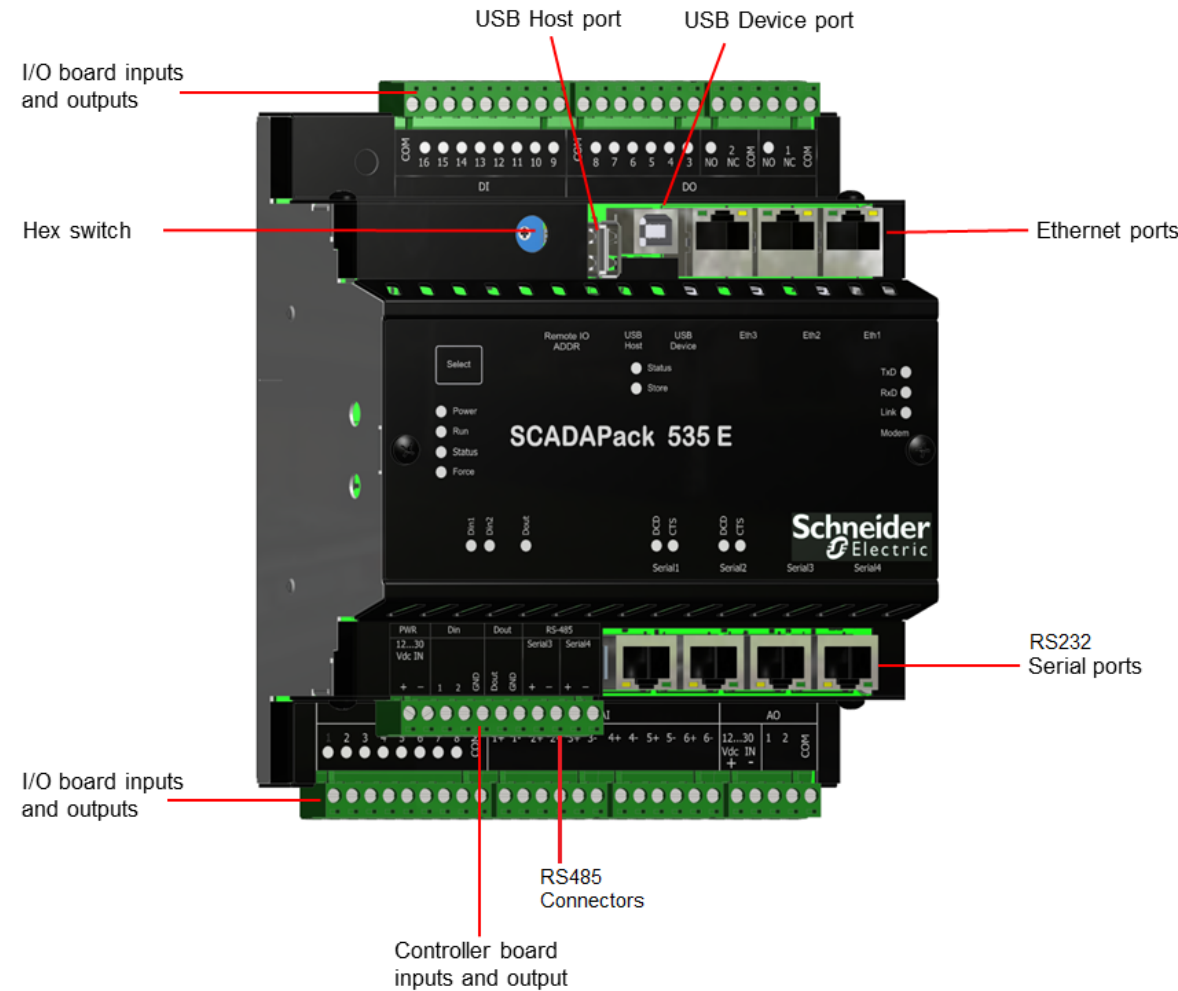
Before you begin configuring the rPAC, determine whether the ClearSCADA software will be used for any configuration tasks. This documentation assumes you are using the SCADAPack E Configurator software to configure the rPAC. For information about using the ClearSCADA software, see the ClearSCADA documentation.

Security

The SCADAPack 535E can communicate using the DNP3 protocol, which is level 4-compliant. The DNP3 protocol supports the optional DNP3 Secure Authentication (SAv2) features and AGA-12 DNP3 Data Encryption to help improve message confidentiality.

7 Hardware Overview

The figure below shows the locations of the inputs, outputs and ports on the SCADAPack 535E.



For ease of wiring and maintenance, external connections are terminated on removable connectors. If you need to remove the rPAC cover for any reason, first carefully consider the following information.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Evaluate the operational state of the equipment being monitored or controlled by the rPAC 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 rPAC before removing the rPAC cover.

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

NOTICE

STATIC ELECTRICITY DAMAGE

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

Failure to follow these instructions can result in equipment damage.

This table below provides an overview of the major hardware components that comprise the rPAC. For complete hardware specifications, see [Specifications](#)¹⁴⁵.

Controller board	
CPU ²⁴	• ST SPEAr 1380 32-bit, dual-core Cortex™ A9 microcontroller • Up to 600 MHz
Memory ²⁴	• 128 MB NAND Flash • 128 MB DDR3 RAM
Event logging	• Up to 40,000 events total • 1 ms Sequence of Event (SOE) time stamping for digital inputs • 30 ms SOE time stamping for analog inputs

Database points	Up to 20,000 points total
Power requirements ^[147]	- SCADAPack 535E: 4.8 W - USB (5 Vdc at 100 mA): 0.6 W - Serial port (5 Vdc at 250 mA): 1.5 W
Environmental requirements	-40...70 °C (-40...158 °F) operating temperature when the unit is mounted horizontally on a vertical surface -40...65 °C (-40...149 °F) operating temperature when the unit is mounted in any other position -40...85 °C (-40...185 °F) storage temperature 5...95% relative humidity, non-condensing - Pollution Degree 2, Installation Category I, Indoor use
Inputs and outputs	
Digital inputs ^[42]	18, 8 of which have an associated counter
Digital outputs ^[44]	9
Analog inputs ^[44]	6
Analog outputs ^[48]	2 (requires the optional analog output module)
I/O expansion module support ^[65]	5304 Analog Output Module 5405 Digital Input Module 5414 Digital Input Module 5415 Relay Output Module 5506 Analog Input Module 6601 Input/Output Module with optional analog output module
Communications	
Serial ports ^[26]	2 RS232 2 RS232 or RS485
Ethernet ports ^[32]	3 UTP 10/100BASE-T
USB ports ^[35]	1 USB 2.0-compliant A-type receptacle 1 USB 2.0-compliant B-type receptacle
Socket modem ports	1 (not currently active)
Serial protocols	- DNP3 level 4 in slave or master mode - IEC60870-5-101 in slave mode

	• Modbus RTU in slave or master mode • DF1 in master mode
IP protocols	• DNP3 level 4 in TCP slave or master mode • DNP3 level 4 in UDP slave or master mode • DNP3 in peer-to-peer mode • IEC60870-5-104 in slave mode • Modbus TCP in server or client mode • Modbus RTU in TCP client mode

7.1 CPU, RAM and Storage

CPU

The CPU executes a preemptive multitasking operating system, allowing simultaneous, real-time provisioning of:

- Communications protocols such as DNP3, TCP/IP, IEC 60870-5-101, IEC 60870-5-103, IEC 60870-5-104 and Modbus
- Time-stamped event processing
- Configuration management
- User-created sequence and control applications such as those created in SCADAPack Workbench or ISaGRAF 3 Workbench

RAM

The onboard battery-backed RAM is used to store:

- Configuration information such as point definitions and port configurations
- User-created sequence and control applications such as those created in SCADAPack Workbench or ISaGRAF 3 Workbench
- Time-stamped event data

Storage

The rPAC provides internal flash storage and support for USB storage media. The internal flash storage is described here. For more information about support for plug-in storage media, see [USB Ports](#) ³⁵.

Operating System Flash

The operating system flash stores the rPAC firmware. The firmware implements the communications protocols — DNP3, TCP/IP, Modbus and others — the database of point configurations and the SCADAPack Workbench or ISaGRAF 3 Workbench kernel that runs the user-created sequence and control applications.

The use of flash memory chips allows you to transfer new firmware locally through a serial port and remotely using command line instructions without removing the rPAC front cover.

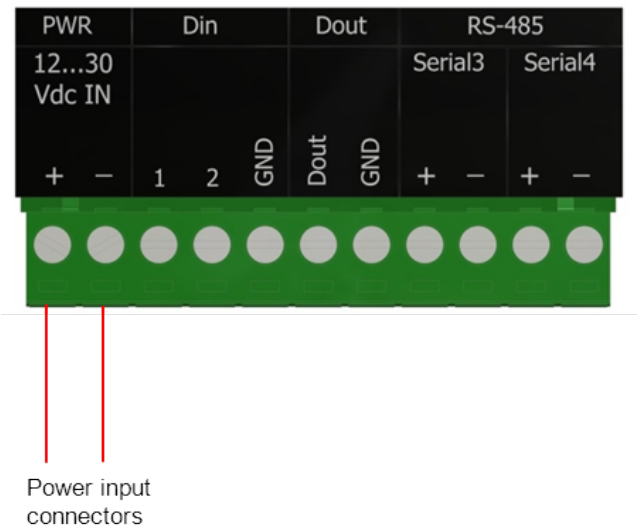
Boot Monitor Flash

The boot monitor firmware resides in a separate flash memory chip on the controller board. The boot monitor firmware is the first code executed by the CPU when power is applied to the rPAC. It configures the rPAC hardware then verifies, loads and executes the operating system firmware.

The boot monitor also provides facilities for reprogramming the operating system and boot monitor flash memory.

7.2 Power Supply and Back-Up Battery

The rPAC is powered by a 12...30 Vdc power supply that is connected to the power input connectors on the rPAC. The illustration below shows the location of the power input connectors.

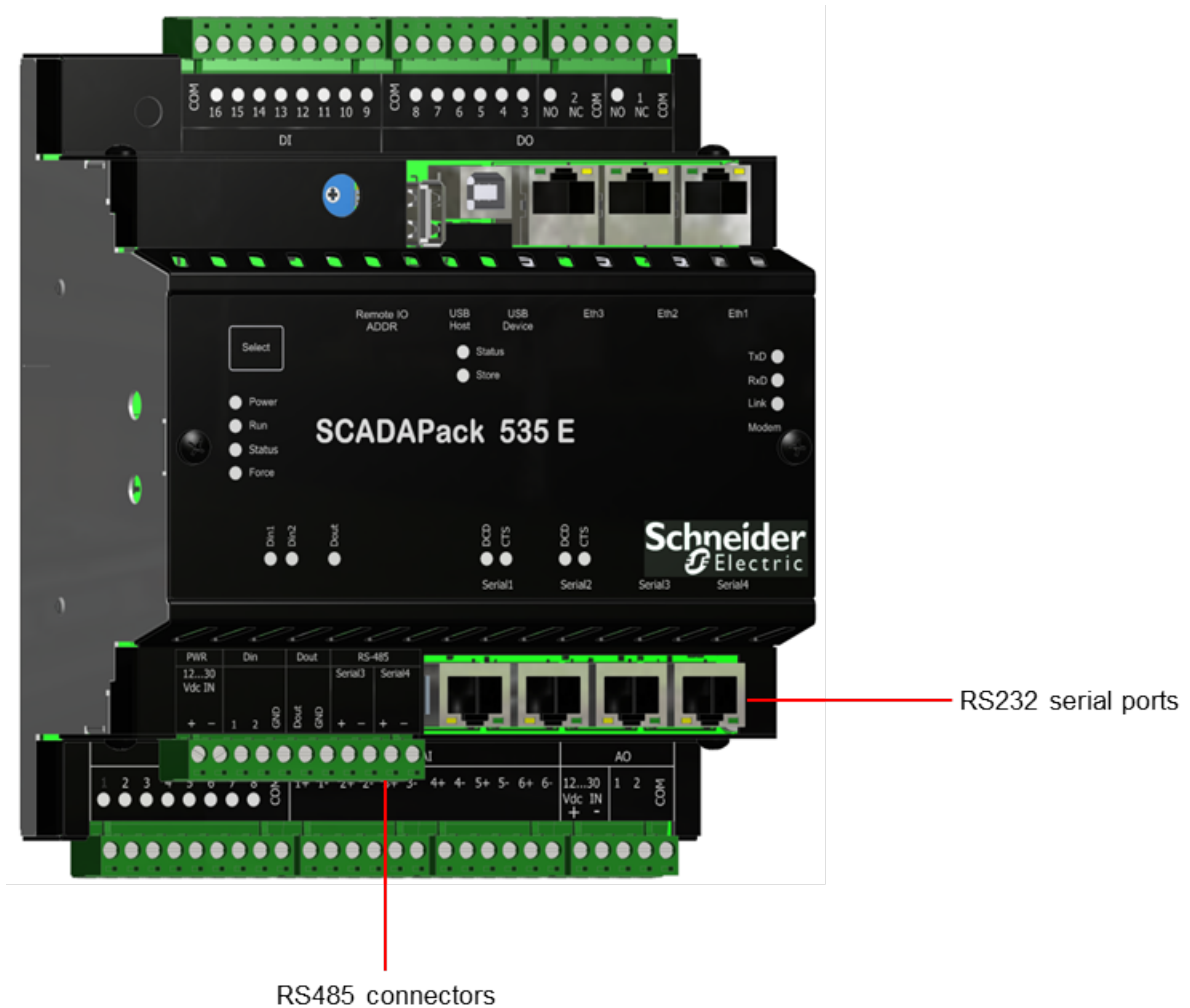


For details about power supply requirements, see [Power Supply Requirements](#)^[60].

A 3.6 V lithium battery installed on the rPAC controller board provides back-up power to the rPAC's real-time clock and RAM memory. It also maintains the rPAC configuration during a power-supply interruption.

7.3 Serial Ports

The figure below shows the location of the four RS232 serial ports and the two RS485 terminal connection points on the SCADAPack 535E.



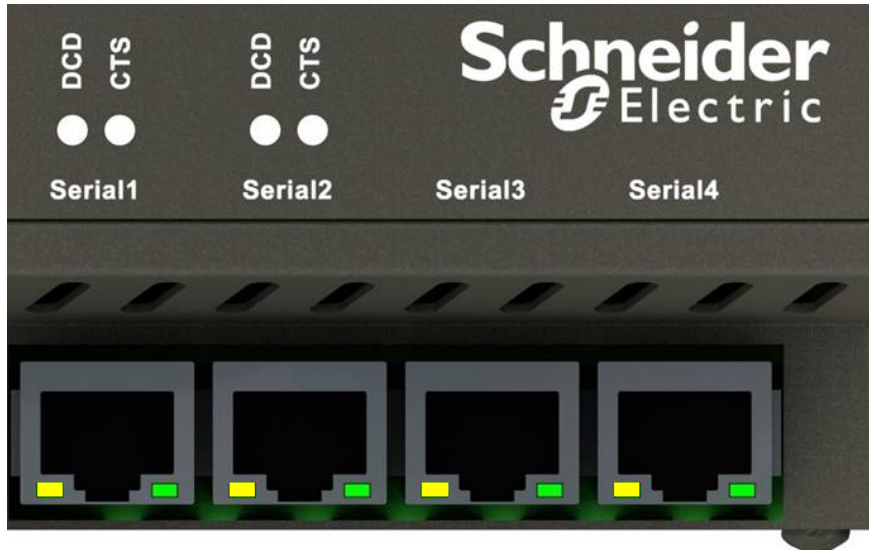
- [Serial1 and Serial2 Ports](#) ²⁷
- [Serial3 and Serial4 Ports](#) ²⁹

7.3.1 Serial1 and Serial2 Ports

Serial1 and Serial2 are general-purpose serial data communications ports that can be used for RS232 communications with the SCADA master system, with other rPACs and RTUs, with devices such as Programmable Logic Controllers (PLCs), and with the SCADAPack E Configurator computer.

Serial1 and Serial2 can also be used for ES Remote I/O communications when the rPAC is functioning as a Main Unit in an ES Remote I/O configuration.

The figure below shows a close-up view of the RS232 serial ports and their LEDs.



For information about Serial3 and Serial4, see [Serial3 and Serial4 Ports](#) ²⁹.

Configuration

Serial1 and Serial2 support RS232 with modem control.

Using the SCADAPack E Configurator software, you can configure Serial1 and Serial2 to define the port function, mode, baud and data mode, as summarized in the table below.

Function	Mode	Baud	Data Mode
ISaGRAF (default for Serial1)	RS232 (RTS On) (default)	300 bps	8-bit No Parity 1 Stop Bit (default)
DNP3 (default for Serial2)	RS232 (RTS Keyed)	600 bps	8-bit Even Parity 1 Stop Bit
Cmd Line	Hayes Modem	1200 bps	8-bit Odd Parity 1 Stop Bit
PLC Device	GPRS	2400 bps	7-bit Even Parity 1 Stop Bit
ISaGRAF-User	1xRTT	4800 bps	7-bit Odd Parity 1 Stop Bit
ES Remote I/O	RS232 (RTS Off)	9600 bps (default)	8-bit No Parity 2 Stop Bits
PPP/TCP/IP		19200 bps	
		38400 bps	

TCP Service		57600 bps	
Modbus Master (Modbus RTU)		115,200 bps	
Modbus Slave			
DNP-VT Service			
IEC-103 Master			
IEC-101 Slave			

For more information about configuring serial ports, see the SCADAPack E Configurator User Manual and the Communication Interfaces Technical Reference Manual.

Cabling

Serial1 and Serial2 support RS232 serial cables with an eight-pin RJ45 Data Terminal Equipment (DTE) connector. For more information, see:

- [RS232 Pin Assignments and Cable Descriptions](#) ⁷⁵
- [RS232 Wiring Examples](#) ⁷⁸

LEDs

The following table describes the Serial1 and Serial2 LEDs on the rPAC front panel and on the physical ports.

LED	Color	Description
CTS	Green	Lit when the CTS input is active on this serial port.
DCD	Green	Lit when the DCD input is active on this serial port.
Left side of the physical port	Yellow	Blinks when the port is transmitting data over the RS232 serial connection.
Right side of the physical port	Green	Blinks when the port is receiving data over the RS232 serial connection.

For more information, see [LEDs](#) ¹²¹.

HMI Power Control

Pin 1 of the RJ45 connector for Serial1 and Serial2 provides switched 5 Vdc power for the SCADAPack Vision or another human-machine interface (HMI). Use the **Vision Power Pin Enabled** check box on the **Controller Settings** property page in SCADAPack E Configurator to enable and disable the voltage output for pin 1.

Binary system point 50750 indicates the status of power to pin 1. The system point is set when the power to pin 1 is on, and is cleared when the power to pin 1 is off.

For more information, see the SCADAPack E Configurator User Manual and the Configuration Technical Reference Manual

Specifications

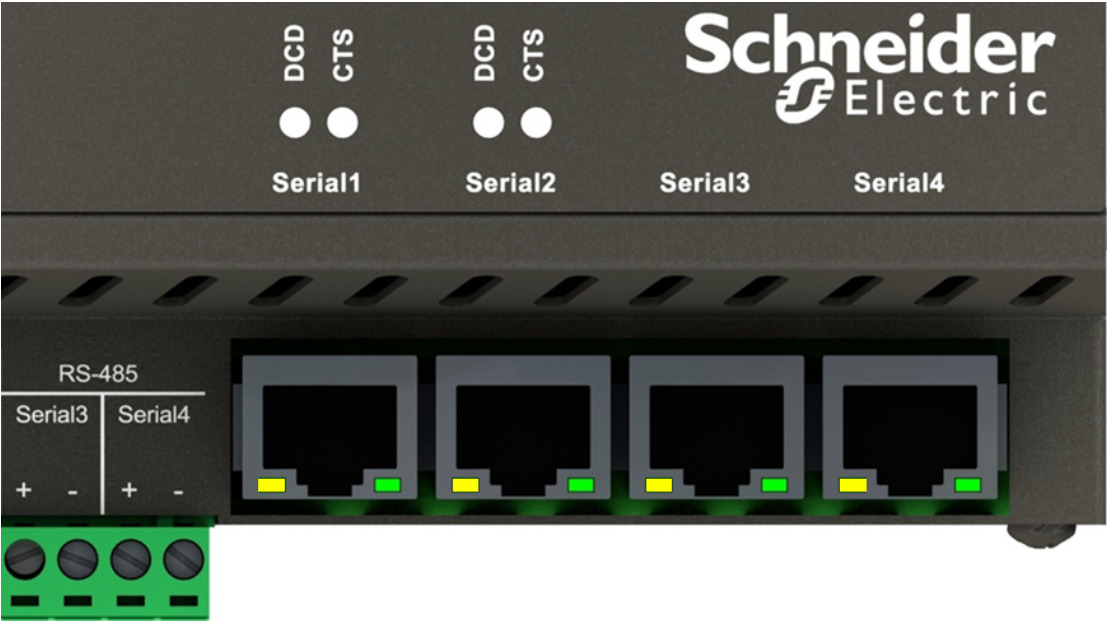
For serial port specifications, see [Communications Specifications](#) 150.

7.3.2 Serial3 and Serial4 Ports

Serial3 and Serial4 are general-purpose serial data communications ports that can be used for RS232 or RS485 communications with the SCADA master system, with other rPACs and RTUs, with devices such as Programmable Logic Controllers (PLCs), and with the SCADAPack E Configurator computer.

Serial3 and Serial4 can also be used for ES Remote I/O communications when the rPAC is functioning as a Main Unit in an ES Remote I/O configuration.

The figure below shows a close-up view of the serial ports and their LEDs along with the RS485 screw-termination connectors for Serial3 and Serial4.



For information about Serial1 and Serial2, see [Serial1 and Serial2 Ports](#) 27.

Configuration

Serial3 and Serial4 are software configurable for three-wire RS232 communications or two-wire RS485 communications. The RJ45 connectors support only RS232 communications. If you want to use RS485 communications, use the Serial3 and Serial4 screw-termination connectors.

Using the SCADAPack E Configurator software, you can configure each of the serial ports to define its function, mode, baud and data mode. The table below summarizes the available options. The Mode and Baud options presented in the user interface depend on the selected function. For example, when you select HART Master as the Port Function, the Port Mode is automatically set to RS485 2w and the only baud rates available are 1200, 9600, 19200 and 38400.

Function	Mode	Baud	Data Mode
----------	------	------	-----------

ISaGRAF	RS232 (default)	300 bps	8-bit No Parity 1 Stop Bit (default)
DNP3 (default for Serial3)	RS485 2w	600 bps	8-bit Even Parity 1 Stop Bit
Cmd Line (default for Serial4)		1200 bps	8-bit Odd Parity 1 Stop Bit
PLC Device		2400 bps	7-bit Even Parity 1 Stop Bit
ISaGRAF-User		4800 bps	7-bit Odd Parity 1 Stop Bit
ES Remote I/O		9600 bps (default)	8-bit No Parity 2 Stop Bits
TCP Service		19200 bps	
Modbus Master (Modbus RTU)		38400 bps	
Modbus Slave		57600 bps	
DNP-VT Service		115,200 bps	
IEC-103 Master			
IEC-101 Slave			
HART Master			

For more information about configuring serial ports, see the SCADAPack E Configurator User Manual and the Communication Interfaces Technical Reference Manual.

Cabling

<i>NOTICE</i>
UNINTENDED EQUIPMENT OPERATION Serial3 and Serial4 support RS232 or RS485 operation, but not both at the same time. If Serial3 or Serial4 is configured for RS485 operation, the port must remain empty. - Do not insert an RS232 cable into Serial3 if there is a two-wire RS485 connection to the screw-termination connectors labeled Serial3+ and Serial3-. - Do not insert an RS232 cable into Serial4 if there is a two-wire RS485 connection to the screw-termination connectors labeled Serial4+ and Serial4-. Failure to follow these instructions can result in equipment damage.

When configured as RS232, the Serial3 and Serial4 serial ports support RS232 serial cables with an eight-pin RJ45 Data Terminal Equipment (DTE) connector. For more information, see:

- [RS232 Pin Assignments and Cable Descriptions](#)^[75]
- [RS232 Wiring Examples](#)^[78]

When configured as RS485, the Serial3 and Serial4 screw-termination connectors support wired connections:

- If Serial3 is configured as RS485, you can create a two-wire RS485 connection to the screw-

termination connectors labeled Serial3+ and Serial3-.

- If Serial4 is configured as RS485, you can create a two-wire RS485 connection to the screw-termination connectors labeled Serial4+ and Serial4-.

A maximum of 32 rPACs and other devices can be connected to any one RS485 network.

For more information, see:

- [Wiring Screw-Termination Connectors](#) 
- [RS485 Wiring](#) 

LEDs

The following table describes the Serial3 and Serial4 LEDs.

LED	Color	Description
Left side of the physical port	Yellow	Blinks when data is being transmitted over the RS232 or RS485 serial connection. If the port is configured for RS485, the LEDs on the empty port indicate that data is being transmitted over the wired RS485 connection.
Right side of the physical port	Green	Blinks when data is being received over the RS232 or RS485 serial connection. If the port is configured for RS485, the LEDs on the empty port indicate that data is being received over the wired RS485 connection.

For more information, see [LEDs](#) .

HMI Power Control

Pin 1 of the RJ45 connector for Serial3 and Serial4 provides switched 5 Vdc power for the SCADAPack Vision or another human-machine interface (HMI). Use the **Vision Power Pin Enabled** check box on the **Controller Settings** property page in SCADAPack E Configurator to enable and disable the voltage output for pin 1.

Binary system point 50750 indicates the status of power to pin 1. The system point is set when the power to pin 1 is on, and is cleared when the power to pin 1 is off.

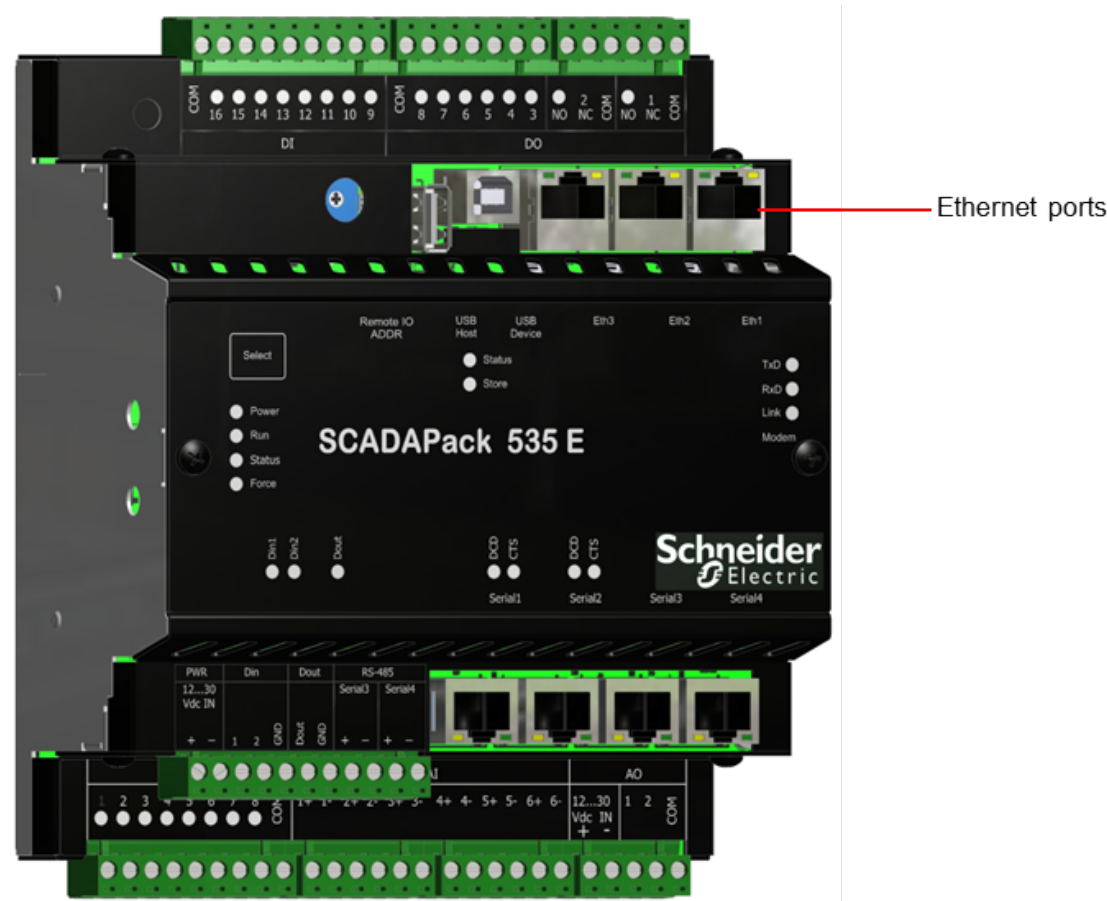
For more information, see the SCADAPack E Configurator User Manual and the Configuration Technical Reference Manual.

Specifications

For serial port specifications, see [Communications Specifications](#) .

7.4 Ethernet Ports

The figure below shows the location of the three Ethernet ports on the SCADAPack 535E.



- [Eth1, 2, 3 Ports](#) ³³

7.4.1 Eth1, 2, 3 Ports

The three Ethernet ports are UTP 10/100BASE-T LAN ports that can be used for IP communications and for ES Remote I/O communications when the rPAC is functioning as a Main Unit in an ES Remote I/O configuration. The Ethernet ports are typically used for point-to-point Ethernet connections and are usually connected to an Ethernet hub or switch, although it is also possible to connect devices together directly.

Each Ethernet port can run at 10 Mbps or 100 Mbps, at half or full duplex. The rPAC automatically detects an active Ethernet port and the supported speed of the connected device, giving preference to 100 Mbps full duplex connections.

The following figure shows a close-up view of the three Ethernet ports and their LEDs.



Configuration

Using the SCADAPack E Configurator software, you can configure each of the Ethernet ports to define its:

- Function: TCP/IP + RemIO (default) or ES Remote I/O
- IP Address
- Subnet Mask

For more information about configuring Ethernet ports, see the SCADAPack E Configurator User Manual and the TCP/IP Technical Reference Manual.

Cabling

The Ethernet ports support crossover or straight-through Ethernet cables with an eight-pin RJ45 connector. The rPAC will automatically detect the interface used and serve the cable appropriately.

For more information, see [Ethernet Pin Assignments and Cable Descriptions](#)^[81].

LEDs

The following table describes the Ethernet LED status indications.

Location	Color	Description
Left side of the physical port	Green	Activity LED. Lit when the Ethernet port is active.

		Blinks when the port is transmitting or receiving data.
Right side of the physical port	Yellow	Link LED. Lit when the 10/100 Ethernet link is active.

For more information, see [LEDs](#)¹²¹.

Specifications

For Ethernet port specifications, see [Communications Specifications](#)¹⁵⁰.

7.5 USB Ports

The USB Host and USB Device ports on the SCADAPack 535E are USB 2.0-compliant ports that support 1.5 Mb/s and 12 Mb/s communications. The USB ports automatically detect and support the data rate of the connected device. The two USB ports can be used simultaneously. USB drives with security locks are not supported.

The figure below shows the location of the two USB ports on the SCADAPack 535E.



- [USB Host Port](#) ³⁶
- [USB Device Port](#) ³⁸

7.5.1 USB Host Port

The USB Host port is a USB series A receptacle that allows the rPAC controller board to act as a host for a plug-in USB drive. For bus-powered USB devices, the USB Host port can provide up to 100 mA at 5 Vdc.

The USB Host port is not user configurable. It can be mounted and accessed through the rPAC file system at /usb0. For information about support for plug-in USB drives, see [Data Capacity](#)¹⁴⁹.

⚠ WARNING

EXPLOSION RISK

Do not use USB ports in hazardous applications or hazardous locations.

Use USB ports only for non-hazardous applications in locations that are known to be in a non-hazardous state.

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

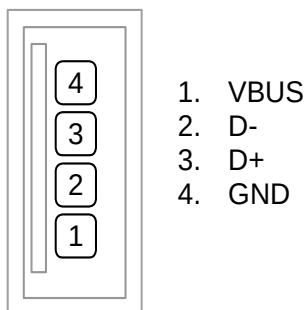
Verify that the data transfer between the rPAC and the plug-in USB drive is complete before removing the USB drive from the USB Host port.

Removing a plug-in USB drive from the USB Host port while the data transfer is in progress can impact system performance and result in a system restart.

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

The following illustration shows the connections for the USB Host port.

USB series “A”
receptacle



LEDs

The following table describes the USB Host port LEDs on the rPAC front panel.

LED	Color	Description
Status	Green	This LED is under the control of Binary System Point 50753. It can be controlled by a SCADAPack Workbench or ISaGRAF 3 Workbench application or through protocol control commands.
Store	Green	Flashes on and off alternately at a steady rate for five seconds when data from the USB mass storage device is successfully loaded into the rPAC.

7.5.2 USB Device Port

The USB Device port is a USB series B receptacle that provides DNP3 communications for local connection to a local USB device, such as the computer running the SCADAPack E Configurator software.

WARNING

EXPLOSION RISK

Do not use USB ports in hazardous applications or hazardous locations.

Use USB ports only for non-hazardous applications in locations that are known to be in a non-hazardous state.

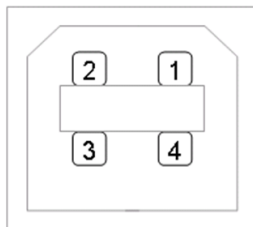
Failure to follow these instructions can result in death or serious injury.

Configuration

Using the SCADAPack E Configurator software, you can configure the USB Device port for DNP3 communications. This is the default configuration for the port. The USB Device port is referred to as Port 0 in the SCADAPack E Configurator software and in SCADAPack E diagnostics.

The following illustration shows the connections for the USB Device port.

USB series “B”
receptacle

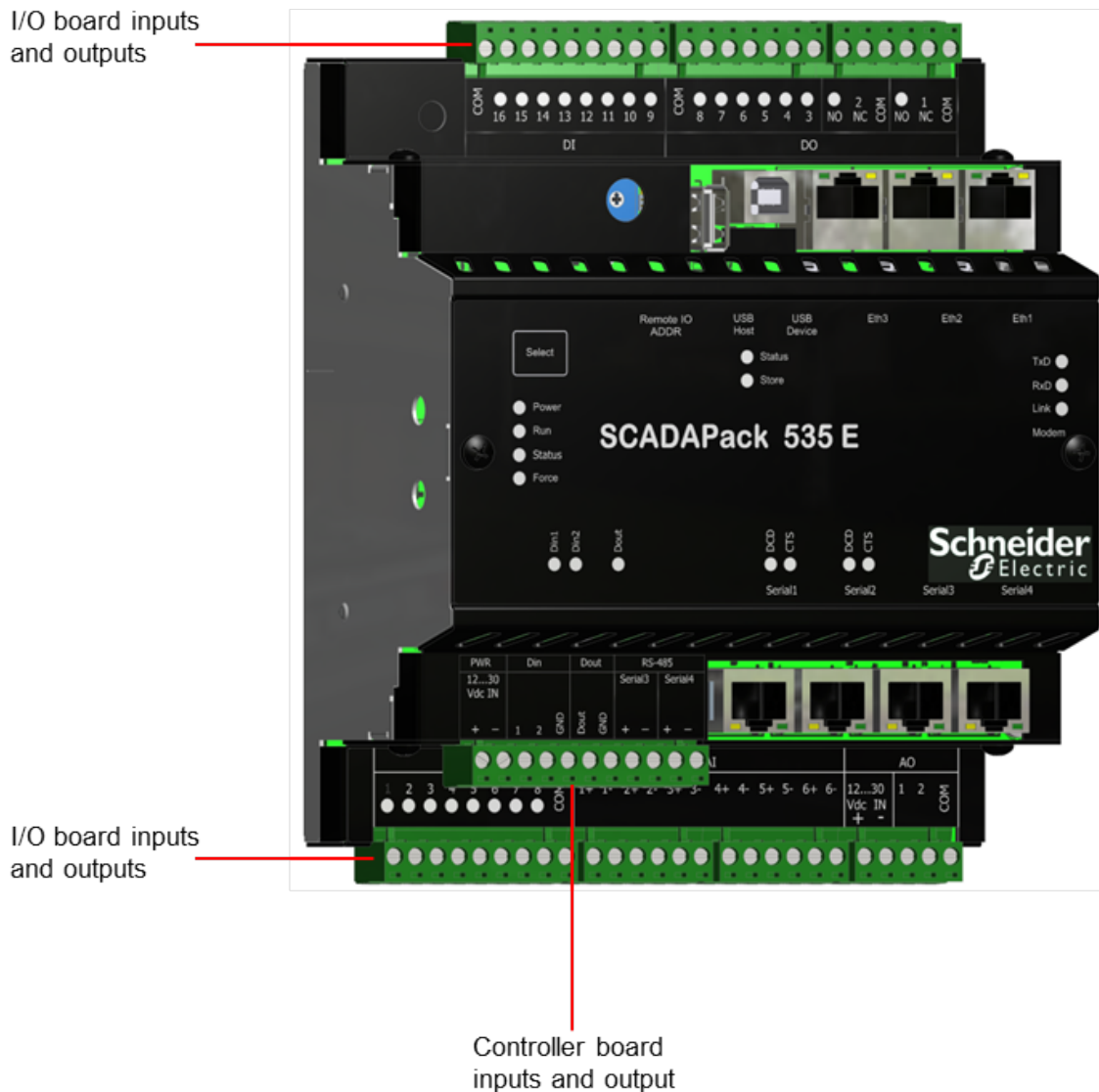


7.6 Inputs and Outputs

The SCADAPack 535E provides:

- 18 digital inputs
- 9 digital outputs
- 6 analog inputs
- 2 analog outputs (this option is selected when the SCADAPack 535E is ordered)

The figure below shows the location of the I/O on the SCADAPack 535E.



The following table describes the SCADAPack 535E input and output characteristics.

Location	Name	rPAC Label	Polarity Sensitive	Description
Controller board	Digital inputs [42] 1-2	Din1 Din2	Yes	- Digital inputs. - Not isolated from rPAC logic.
	Digital output [44] 1	Dout	Yes	- Open drain. - Not isolated from rPAC logic.
I/O board	Digital inputs [42] 1-16 Counter inputs [43] 1-8	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 [44] 1-2	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 two digital outputs and between each digital output and the device being controlled.
	Digital outputs [44] 3-8	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 [44] 1-6	AI 1+ - 6-	Yes	- Analog inputs. Jumper configurable. - Electrical isolation is provided from each channel to rPAC logic and between channels.
	Analog outputs [48] 1-2	AO 1-2	Yes	- Analog outputs are provided by the optional analog output module. - Electrical isolation is provided from each channel to rPAC logic, but not between channels.

The inputs and outputs use 5 mm (.197 in) pitch connectors. For information about wiring these connectors, see [Wiring Screw-Termination Connectors](#)⁷¹.

The inputs and outputs on the rPAC can be:

- Monitored and controlled from a SCADA master station
- Monitored and controlled from a remote outstation
- Locally controlled using an application created in ISaGRAF 3 Workbench or SCADAPack Workbench
- Any combination of the above

Data that is received and sent through the inputs and outputs can be:

- Transferred to an attached Programmable Logic Controller (PLC) for processing by that PLC
- Time-stamped and stored locally for manual or automatic retrieval

These capabilities are provided by the rPAC firmware. For more information, see the SCADAPack E Technical Overview.

I/O can be extended by adding I/O expansion modules. For details, see [Adding Inputs and Outputs](#)⁶⁵.

7.6.1 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 Vdc 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 rPAC.

The digital inputs provide 1 ms Sequence of Event (SOE) time stamping to support 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...0.08 mm² (12...28 AWG). For more information, see [Wiring Screw-Termination Connectors](#) ⁷¹.

Specifications

For digital input specifications, see [Specifications](#) ¹⁴⁵.

7.6.2 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...0.08 mm² (12...28 AWG). For more information, see [Wiring Screw-Termination Connectors](#) .

Specifications

For counter input specifications, see [Specifications](#) .

7.6.3 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...0.08 mm² (12...28 AWG). For more information, see [Wiring Screw-Termination Connectors](#) .

Specifications

For digital output specifications, see [Specifications](#) .

7.6.4 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 rPAC is factory-calibrated for 0...20 mA and 4...20 mA current inputs and for 0...5 Vdc and 1...5 Vdc operation. The mode of operation — current mode or voltage mode — is selected when the rPAC 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 Vdc 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 Vdc or 1...5 Vdc, selectable through the SCADAPack E Configurator software.

The rPAC also supports using a mix of current mode and voltage mode analog inputs if required. For details, see [Supporting Current and Voltage Inputs](#)^[98].

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...0.08 mm² (12...28 AWG). For more information, see [Wiring Screw-Termination Connectors](#)^[71].

Specifications

For analog input specifications, see [Specifications](#)^[145].

7.6.4.1 Analog Input Range and Resolution

The analog inputs have two 24-bit, unipolar, analog-to-digital converters (ADC) that measure input currents from 0...20 mA or input voltages from 0...5 Vdc.

Use 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 Vdc
- 1...5 Vdc

The signal range selected is scaled to the **Raw Minimum** to **Raw Maximum** values defined for each analog input. The **Engineering Minimum** to **Engineering Maximum** values for the input are used to scale the analog input **Engineering Floating Point** database value.

NOTICE

UNINTENDED EQUIPMENT OPERATION

6601 I/O modules running firmware version 1.77 and lower always activate the over-range property at 20.05 mA, even if you have configured a higher over-range value in SCADAPack E Configurator.

6601 I/O modules that have been upgraded to firmware version 1.80 and higher activate the over-range property at 20.05 mA, unless the analog inputs have been recalibrated. To have your analog inputs recalibrated, contact your Schneider Electric representative.

6601 I/O modules that ship from the factory with firmware version 1.80 and higher are already calibrated to support the over-range values listed in the tables below.

Failure to follow these instructions can result in equipment damage.

Current signals

The following table shows the behavior when using Default Configuration for current signals.

Input Current	Default Current Integer Value (0 - 10000)		Default Current Eng. Value (0 - 100)		Over Range Limit Point Attribute
	0...20 mA	4...20 mA	0...20 mA	4...20 mA	
0.0	0	-2500	0	-25	OFF
3.5	1750	-312	17.5	-3.12	OFF
4.0	2000	0	20	0	OFF
8.0	4000	2500	40	25	OFF
12.0	6000	5000	60	50	OFF
16.0	8000	7500	80	75	OFF
20.0	10000	10000	100	100	OFF
20.5	10250	10312	102.5	103.12	OFF
22.0	11000	11250	110	112.5	ON

Over Range and Under Range detection occurs when the measured input is outside of the Engineering Out of Range Limits, described in Point Attributes in the Configuration Technical Reference Manual.

Since Analog values above 22 mA cannot be read accurately on a 6601 I/O Expansion Module with firmware version 1.80 or newer, the Engineering over range point property will also be on at 22 mA and greater.

Voltage signals

The following table shows the behavior when using Default Configuration for voltage signals.

Input Voltage	Default Current Integer Value (0 - 10000)		Default Current Eng. Value (0 - 100)		Over Range Limit Point Attribute
	Vdc	0...5 Vdc	1...5 Vdc	0...5 Vdc	1...5 Vdc
0	0	-2500	0	-25	OFF
0.5	1000	-1250	10	-12.5	OFF
1.0	2000	0	20	0	OFF
2.0	4000	2500	40	25	OFF
3.0	6000	5000	60	50	OFF
4.0	8000	7500	80	75	OFF
5.0	10000	10000	100	100	OFF
5.1	10200	10250	102	102.5	OFF
5.5	11000	11250	110	112.5	ON

Over Range and Under Range detection occurs when the measured input is outside of the Engineering Out of Range Limits, described in Point Attributes in the Configuration Technical Reference Manual.

Since analog values above 5.5 Vdc cannot be read accurately on a 6601 I/O Expansion module with firmware version 1.80 or newer, the Engineering over range point property will also be on at 5.5 Vdc and greater.

7.6.5 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 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...0.08 mm² (12...28 AWG). For more information, see [Wiring Screw-Termination Connectors](#)⁷¹.

Specifications

For analog output specifications, see [Specifications](#)¹⁴⁵.

7.6.5.1 Analog Output Range and Resolution

The optional analog output module 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 μ A 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).

7.6.5.2 Analog Output Load Resistance Requirements

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

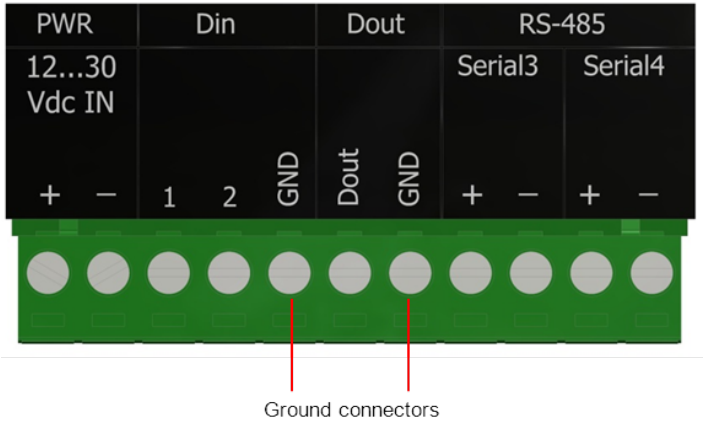
- On the high resistance end by the requirement for proper operation of the analog output circuit
- On the low resistance end by the power dissipation in the analog output

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

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

7.7 Ground Connectors

The rPAC provides two ground connectors labeled GND on the controller board I/O terminal block. The ground terminals are typically used with connections to analog input and analog output devices.



The GND connectors can be used in individual connections, or they can be connected to a terminal strip that provides additional ground connection points.

7.8 Isolation and Protection Summary

The SCADAPack 535E provides isolation and protection from external connections as described in the table below.

Location	Connections	Isolation	Protection
Controller board	Digital inputs	None	High-resistance current-limiting resistor
	Digital output	None	Over-voltage (TVS)
	Serial ports	None	ESD
	Ethernet ports	Transformer	None
	USB ports	None	ESD
I/O board	Digital inputs	Optical	Current-limiting resistor and reverse polarity diode
	Digital outputs	Relay	None
	Analog inputs	Optical (channel-to-channel and channel-to-rPAC)	TVS diode
	Analog outputs ¹	Optical (channel-to-rPAC)	TVS diode

¹ The optional analog outputs are selected when the SCADAPack 535E is ordered.

8 Installation

The SCADAPack 535E is factory-configured and under normal conditions does not require removal or insertion of any peripherals or components. The configurations are stored in a combination of battery-backed RAM and flash memory.

The lithium-powered RAM back-up battery has a shelf life of approximately two years when the rPAC is not connected to a power source. Battery life can be increased to more than eight years when the rPAC is permanently connected to a power source.

NOTICE

DATA LOSS

rPAC configuration information can be lost if the onboard RAM back-up battery goes flat, is disconnected, if the rPAC is damaged, or if there has been a firmware upgrade.

Before installing the rPAC, verify the voltage of the onboard RAM back-up battery

Failure to follow these instructions can result in equipment damage.

NOTICE

UNINTENDED EQUIPMENT OPERATION

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

Before installing the rPAC, check the Standards and Certifications topic to verify the EMC rating.

Failure to follow these instructions can result in equipment damage.

- [Mounting the SCADAPack 535E](#)  55
- [Power Supply Requirements](#)  60
- [Adding Inputs and Outputs](#)  65

8.1 ATEX and IECEx Requirements

The information in this topic applies when the unit is being used for ATEX and IECEx applications.

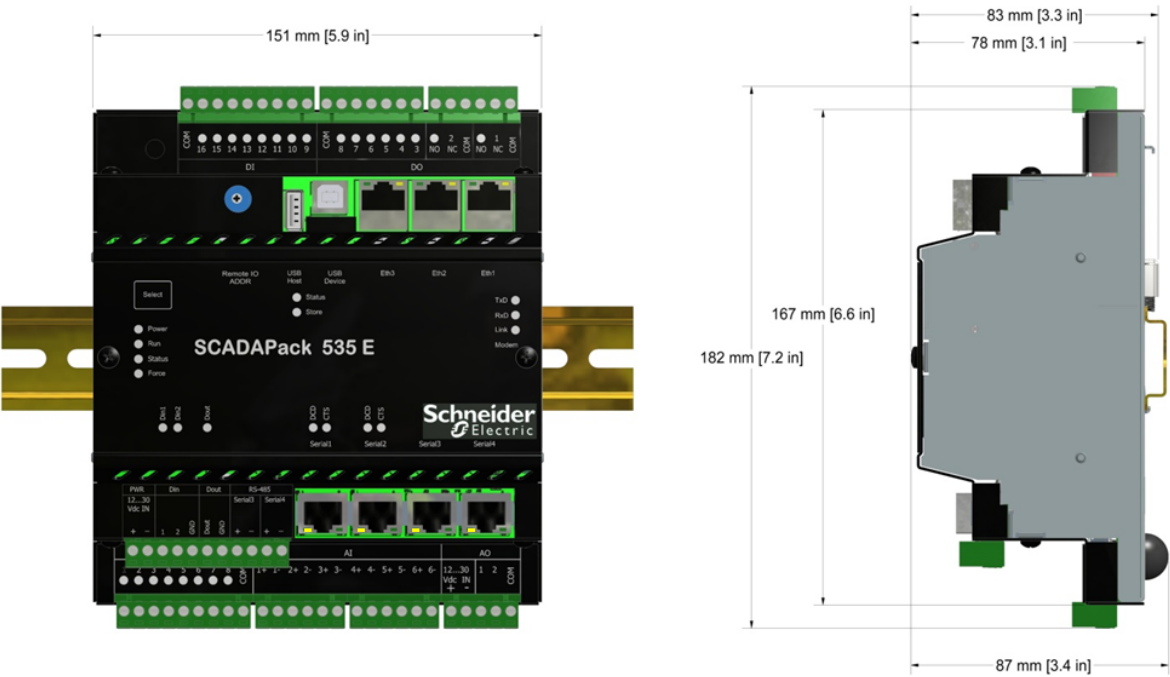
Conditions of Safe Use

Before installing the equipment, carefully review the instructions in the warning message below.

 WARNING
EXPLOSION HAZARD Only install this equipment when the following conditions are met: • USB, Ethernet and Serial sockets can only have connectors fitted within them during service or maintenance when an explosive atmosphere is not present. • The device is provided with external transient protection of up to 40% (42 Vdc) of the maximum supply voltage ($30 \text{ Vdc} \times 1.4 < 42 \text{ Vdc}$). • The battery in the device is never to be replaced by the user. • Address switches A and B are not to be operated in a hazardous area or when an explosive atmosphere is present. • The unit is installed in a certified Control Panel or enclosure, in conformity with type of protection Ex n or Ex e, providing a degree of protection of at least IP54 as defined in IEC 60529 and in an area of Pollution Degree 2 or better as defined in IEC 60664-1. Failure to follow these instructions can result in death or serious injury.

8.2 Mounting the SCADAPack 535E

The SCADAPack 535E mounts on a 7.5 x 35 mm (0.3 x 1.4 in) DIN rail. The figures below show the SCADAPack 535E dimensions when mounted.



⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Carefully review and follow all instructions in the Important Notices for Hazardous Locations section of the Safety Information when installing the rPAC in a hazardous location.

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

⚠ WARNING**UNINTENDED EQUIPMENT OPERATION**

Evaluate the operational state of the equipment being monitored or controlled by the SCADAPack 535E before removing power.

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

⚠ WARNING**HAZARD OF ELECTRIC SHOCK**

Remove power from the rPAC before mounting it on a DIN rail.

Do not remove the rPAC cover when mounting the rPAC. The rPAC 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**UNINTENDED EQUIPMENT OPERATION**

The mounting position can affect the maximum operating temperature for the rPAC and the current rating for the digital outputs on the I/O board.

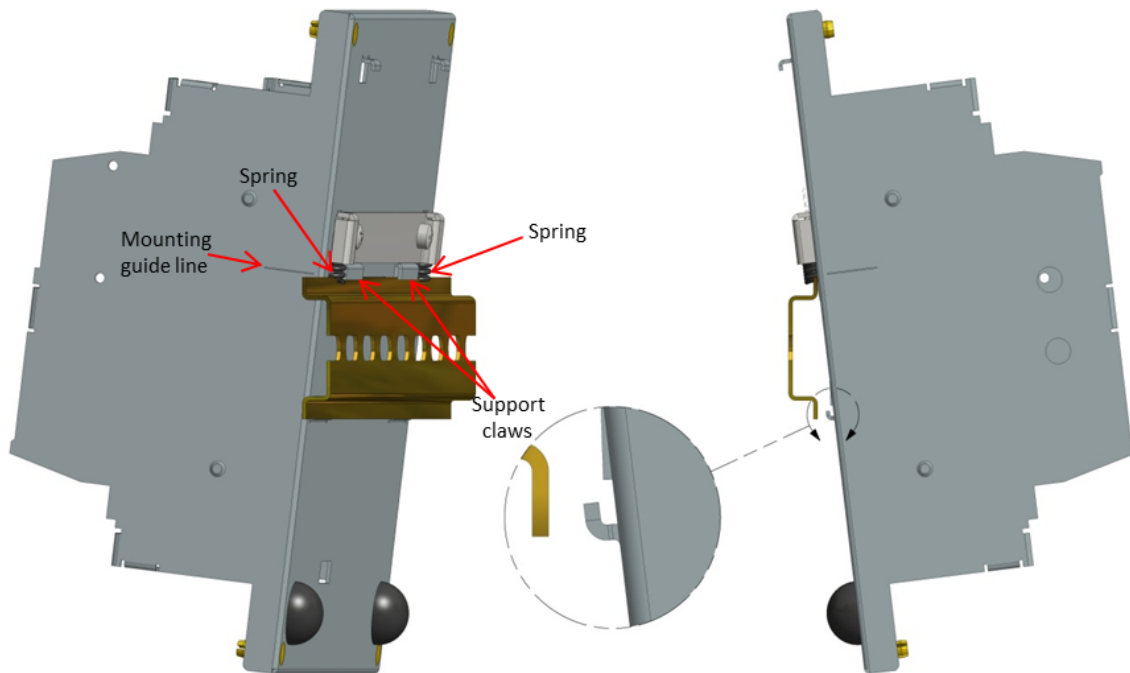
Before mounting the rPAC, check the Specifications topic to confirm the maximum operating temperature and digital output current rating for your mounting position.

Failure to follow these instructions can result in equipment damage.

To Mount a SCADAPack 535E

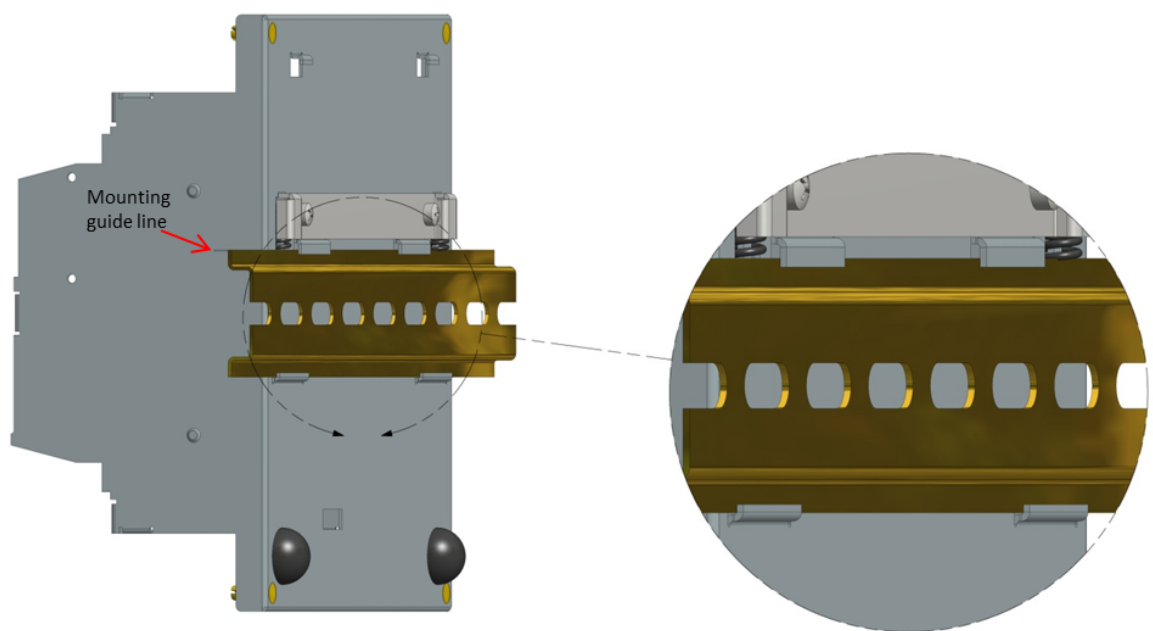
The illustrations below show how to mount the SCADAPack 535E on a horizontally oriented DIN rail. The steps to mount the rPAC on a vertically oriented DIN rail are the same.

1. With the lower part of the rPAC tilted away from the DIN rail, position the mounting guide line on the side of the rPAC so that it is just above the top edge of the DIN rail. Verify that the springs on the back of the rPAC rest on the DIN rail and that the edge of the DIN rail is under the support claws that are adjacent to the springs, as shown below.

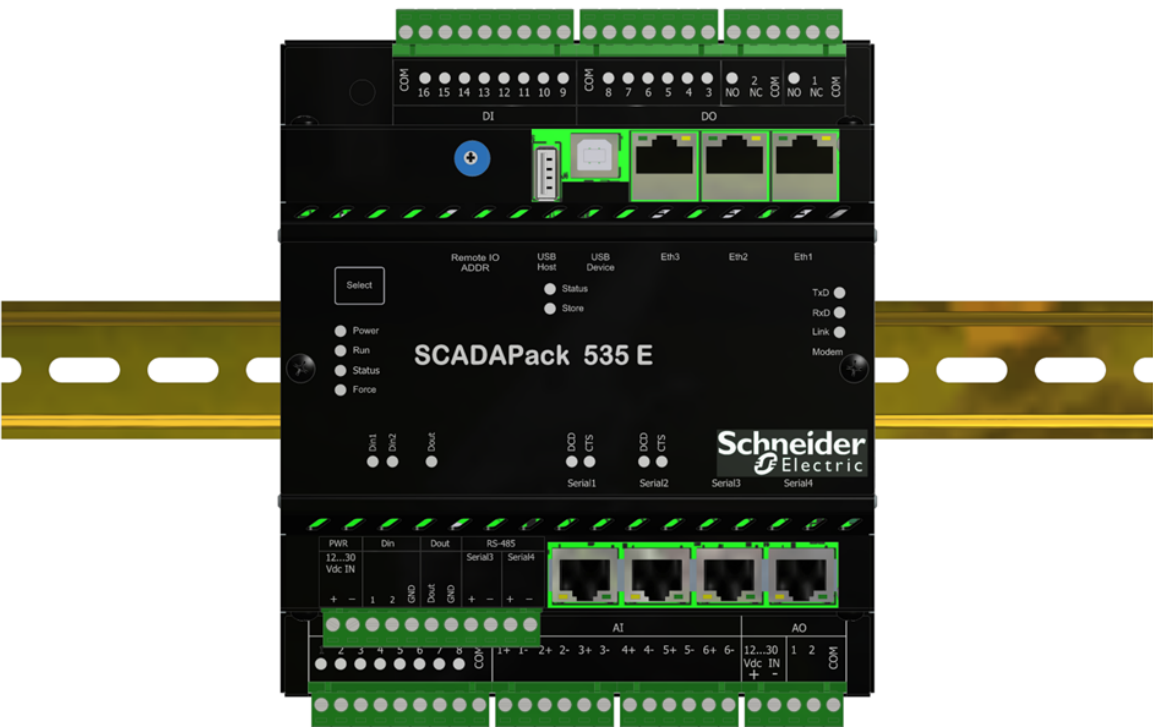


2. Push firmly on the rPAC while tilting it toward the DIN rail until the DIN rail is positioned under both the upper and lower claws on the back of the rPAC.
3. Verify that the mounting guide line is aligned with the edge of the DIN rail, then release the pressure on the springs so that the DIN rail is held firmly in place between the upper and lower claws.

The figure below shows a SCADAPack 535E with the DIN rail correctly positioned in the upper and lower claws on the back of the rPAC.



The figure below shows the front view of a SCADAPack 535E that is mounted horizontally.



8.3 Power Supply Requirements

This topic describes the power requirements for a SCADAPack 535E with no I/O expansion modules.

The SCADAPack 535E is designed for 12...30 Vdc operating voltages and is powered through an 11-terminal connector.

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 and the number of analog outputs.

The table below summarizes the base power requirements for the SCADAPack 535E when no I/O expansion modules are connected to it. For information about power supply requirements when I/O expansion modules are connected to the SCADAPack 535E, see [I/O Expansion Module Power Supply Requirements](#) ⁶⁷.

Volts In	SCADAPack 535E		
Volts (Vdc)	Base Power (W)	USB Host Port (W) (5 Vdc at 100 mA)	Serial port (W) (5 Vdc at 250 mA)
11.5	4.1	0.6	1.5
13.8	4.1	0.6	1.5
24	4.5	0.6	1.5
30	4.8	0.6	1.5

⚠ WARNING

UNINTENDED 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

UNINTENDED 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.

Analog Output Power Supply Requirements

If the optional analog output module was selected when the SCADAPack 535E 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 [Power Supply Wiring](#).⁶²

8.3.1 Power Supply Wiring

This topic describes power supply wiring for:

- SCADAPack 535E without the optional analog output module
- SCADAPack 535E with the optional analog output module

SCADAPack 535E Power Supply Wiring

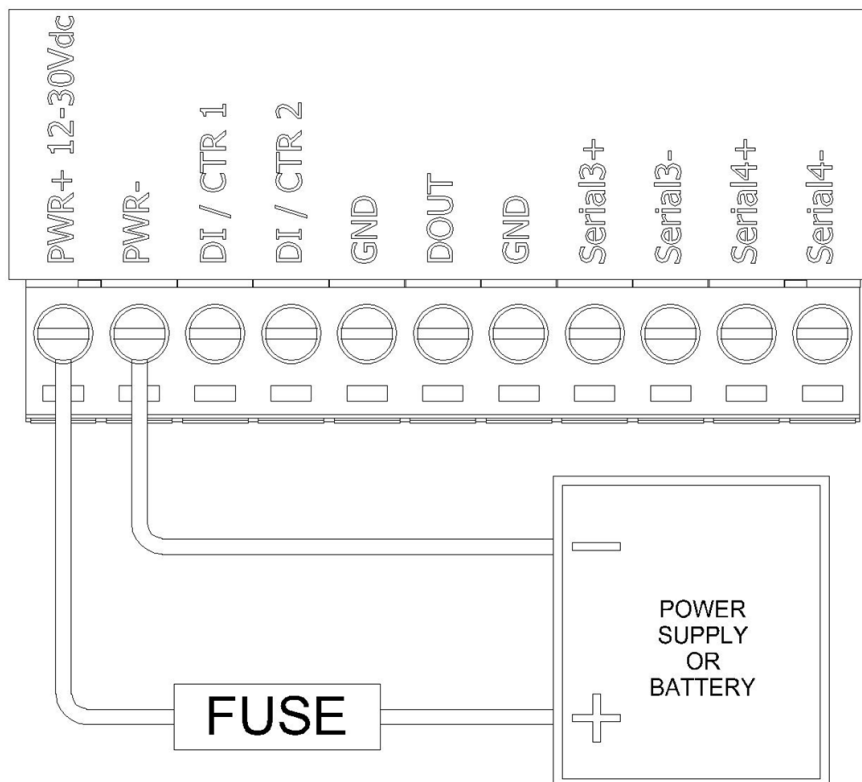
NOTICE

UNINTENDED EQUIPMENT OPERATION

Install an external 1.6 A fast-acting fuse on the input voltage side of the power supply connection.

Failure to follow these instructions can result in equipment damage.

The following figure illustrates power supply wiring. For details on wiring the power supply connectors, see [Wiring Screw-Termination Connectors](#) ⁷¹.



SCADAPack 535E with Optional Analog Output Module

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 rPAC 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 rPAC. In this configuration, the analog outputs are not isolated from the system logic.

NOTICE

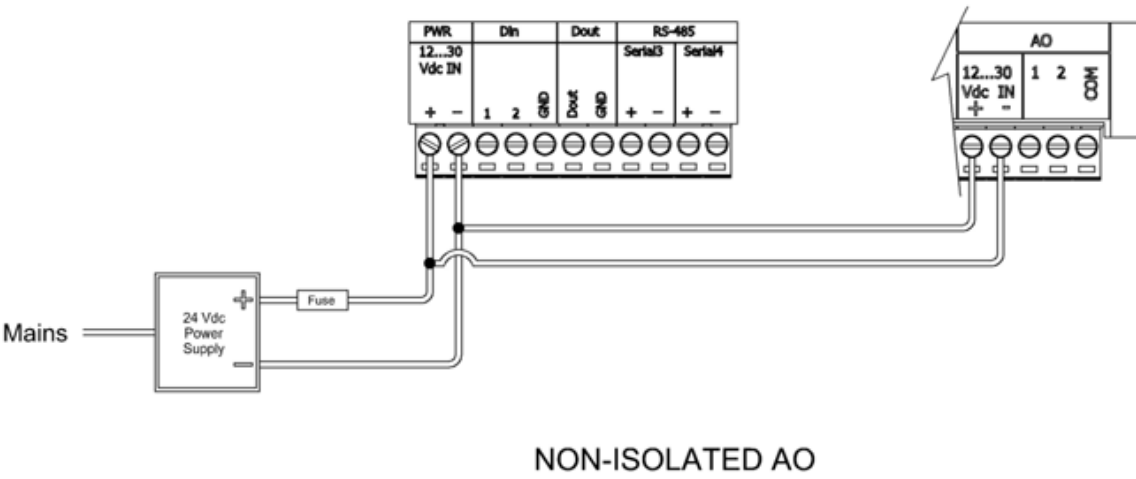
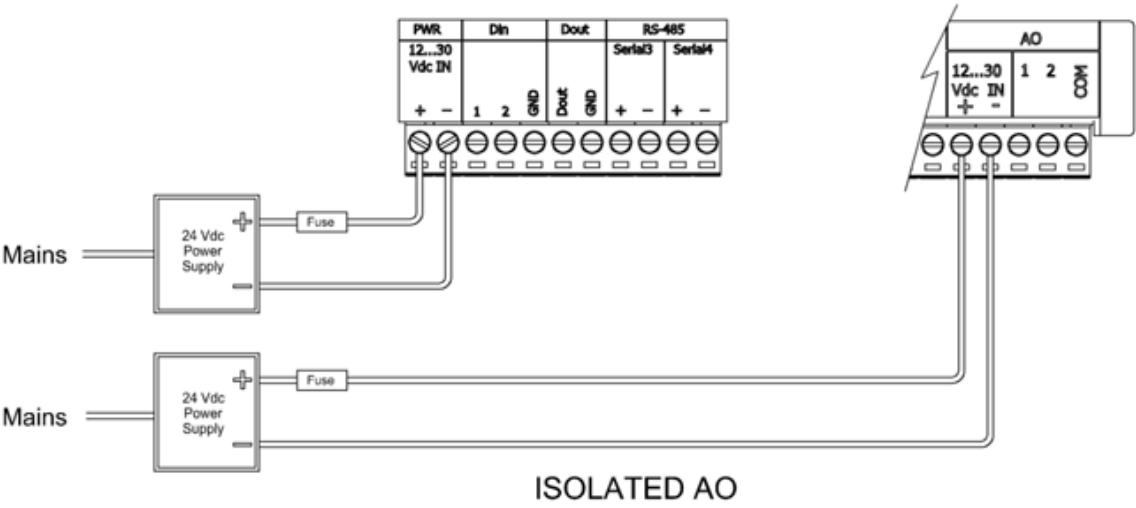
UNINTENDED EQUIPMENT OPERATION

Install an external 1.6 A fast-acting fuse on the input voltage side of the rPAC 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 about wiring the power supply connectors, see [Wiring Screw-Termination Connectors](#) ⁷¹.



8.4 Adding Inputs and Outputs

I/O expansion modules allow you to increase the number of inputs and outputs the rPAC monitors and controls.

The following table lists the I/O expansion modules that can be connected to the rPAC.

I/O Expansion Module	Type	I/O Capacity
5304	Analog output	4 analog outputs
5405	Digital input	32 digital inputs
5414	Digital input	16 digital inputs
5415	Relay output	12 relay outputs
5506	Analog input	8 analog inputs
6601	Composite I/O	16 digital inputs, 8 of which have an associated counter 8 digital (relay) outputs 6 analog inputs 2 analog outputs (this option is selected when the 6601 I/O expansion module is ordered)

Power Requirements

Each I/O expansion module requires 1.1 W at 5 Vdc, which is provided by the rPAC.

Each analog output module requires an additional 24 Vdc power supply to power the field-side circuitry. Each analog output module requires 50 mA current regardless of the system voltage.

For more information, see:

- [I/O Expansion Module Power Supply Requirements](#) 
- I/O expansion module hardware manual

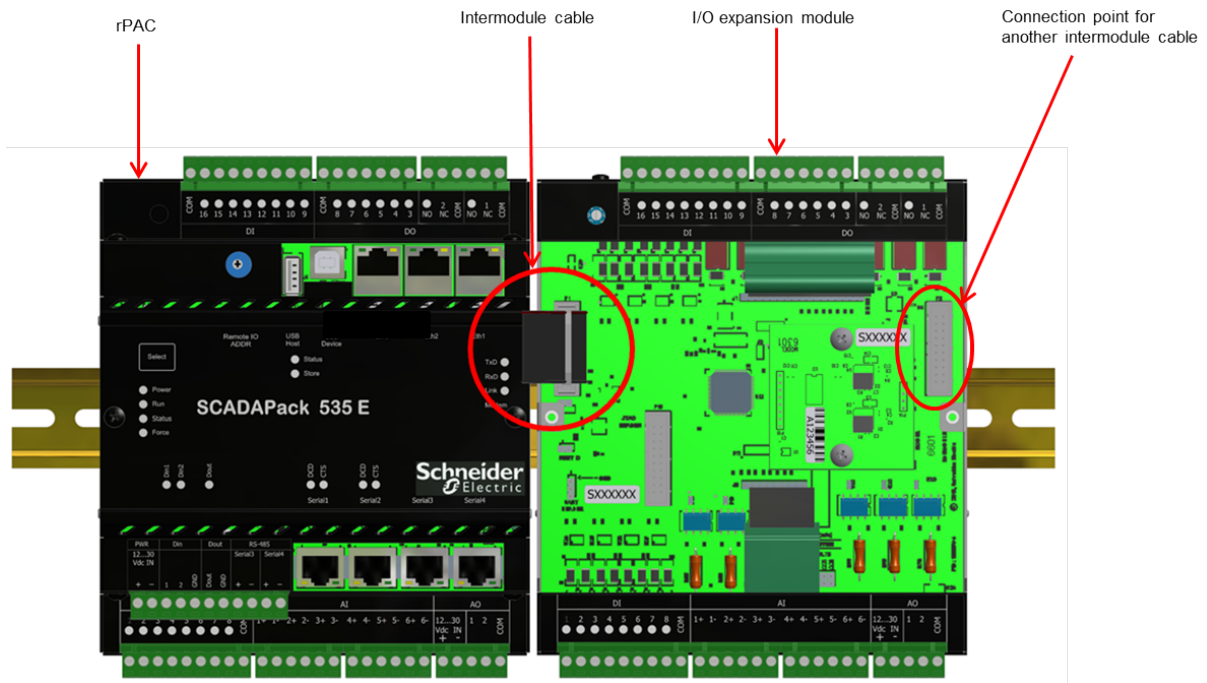
Mounting

I/O expansion modules are mounted on a 7.5 x 35 mm (0.3 x 1.4 in) DIN rail then connected to the rPAC. For more information, see the I/O expansion module hardware manual.

Connecting

I/O expansion modules are connected to the rPAC or to another I/O expansion module using intermodule cables. The intermodule cable is a ribbon cable that distributes power and communications signals from the rPAC to the I/O expansion modules. These power and communication signals are referred to as the I/O bus.

The figure below shows an rPAC with an I/O expansion module connected to it.



Before connecting I/O expansion modules, read the following topics in the SCADAPack E I/O Expansion Reference Manual:

- Precautions
- General Connection Rules
- SCADAPack 530E and SCADAPack 535E Connection Rules
- Attaching Intermodule Cables

Addressing

I/O expansion modules can be addressed on the rPAC bus. Module addresses are configured using a switch on the module. For more information, see Addressing I/O Expansion Modules in the SCADAPack E I/O Expansion Reference Manual.

Configuring

Use SCADAPack E Configurator to configure the inputs and outputs on the I/O expansion module. For more information, see:

- SCADAPack E Configurator User Manual
- Configuration Technical Reference Manual
- SCADAPack E I/O Expansion Reference Manual

8.4.1 I/O Expansion Module Power Supply Requirements

A total of 4.3 W of power is available for the SCADAPack 535E serial port, the USB Host port and I/O expansion modules.

Use the table below to determine the combination that suits your needs within the 4.3 W available. These requirements are valid for any input voltage within the ranges listed in the [Power Supply Specifications](#) ¹⁴⁷.

Port or Module	Power Requirement (W)
SCADAPack 530E serial port	1.5
SCADAPack 530E USB host port	0.6
5304 analog output module	0.15
5405 digital Input module	0.1
5414 digital input module	0.25
5415 relay output module Dry contacts	1.6
5415 relay output module Solid state relays	0.8
5506 analog input module	0.25
5606 input output module Dry contacts	3.4
5606 input output module Solid state relays	2.3
5607 input output module Dry contacts	2.3
5607 input output module Solid state relays	1.6
6601 I/O expansion module	1.1

9 Addressing

The SCADAPack 530E or SCADAPack 535E address only needs to be set when the rPAC is replacing a SCADAPack ES that was operating as a Main Unit for ES Remote I/O Units.

In every other configuration, leave the rPAC address at its default setting of 0. That means:

- The physical hex switch on the rPAC is set to 0.
- The read-only analog system point 50002 displays 0 in the SCADAPack E Configurator **Point Browser** property page.

For more information, see [Setting the rPAC Address for ES Remote I/O Operation](#) ⁶⁸.

9.1 Setting the rPAC Address for ES Remote I/O Operation

If the SCADAPack 530E or SCADAPack 535E is replacing a SCADAPack ES that was operating as a Main Unit for ES Remote I/O Units, you need to define the ES Remote I/O Group number and the Main Unit number for the rPAC:

- To define the ES Remote I/O Group number, set the Remote I/O Group parameter on the **ES Remote I/O** property page in SCADAPack E Configurator, as described below.
- To define the Main Unit number, leave the hex switch on the rPAC at its default setting of 0.

To Set the ES Remote I/O Group Number

1. In SCADAPack E Configurator, select the **I/O > ES Remote I/O** property page.
2. On the **ES Remote I/O** property page, set the value of the **Remote I/O Group** parameter in the range 0-14.

Changes to the **Remote I/O Group** parameter take effect after the rPAC is restarted.

 WARNING
UNINTENDED EQUIPMENT OPERATION Evaluate the operational state of the equipment being monitored or controlled by the rPAC before restarting it. Failure to follow these instructions can result in death or serious injury.

3. Restart the rPAC when prompted.

Related System Points

The analog system points described below reflect the value of the ES Remote I/O settings.

System Point	Value Reflects	Operation
50017	Remote I/O Group number	The value is displayed on the SCADAPack E Configurator Point Browser property page and is updated after the rPAC is restarted.
50002	Remote I/O Group number Main Unit number	The value is displayed on the SCADAPack E Configurator Point Browser property page and is updated when you read point information from the rPAC. Example: A hex value of 20 on the SCADAPack E Configurator Point Browser property means the Remote I/O Group number is 2 and the Main Unit number is 0.

For more information about reading and writing system points on the SCADAPack E Configurator Point Browser property page, see the SCADAPack E Configurator User Manual.

10 Field Wiring

The serial and Ethernet ports on the SCADAPack 535E can be connected to:

- A SCADA master system such as ClearSCADA
- Other SCADAPack E rPACs and RTUs
- Devices such as Programmable Logic Controllers (PLCs)
- The SCADAPack E Configurator computer

For information about cabling for serial and Ethernet ports, see:

- [Serial Port Wiring](#)^[74]
- [Ethernet Port Wiring](#)^[81]

The inputs and outputs on the SCADAPack 535E are connected to the device that you want to monitor or control. In general, inputs are used to monitor devices, while outputs are used to control devices.

For information about wiring inputs and outputs see:

- [Wiring Screw-Termination Connectors](#)^[71]
- [Digital Input Wiring](#)^[84]
- [Digital Output Wiring](#)^[88]
- [Analog Input Wiring](#)^[94]
- [Analog Output Wiring](#)^[104]

10.1 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...0.08 mm² (12...28 AWG).

WARNING

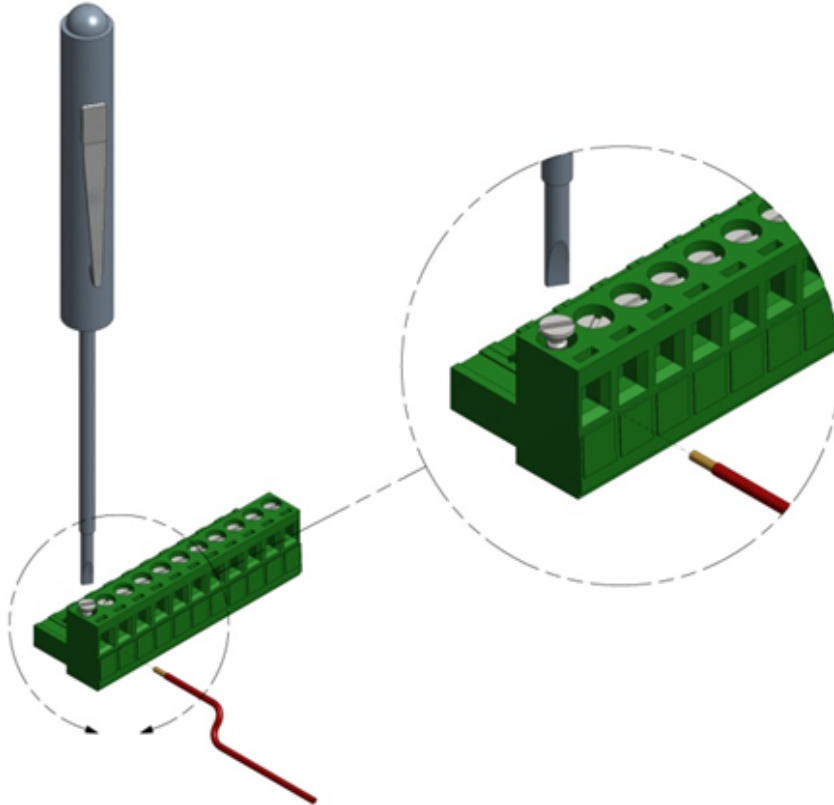
ELECTRICAL HAZARD

Remove power from the rPAC before servicing.

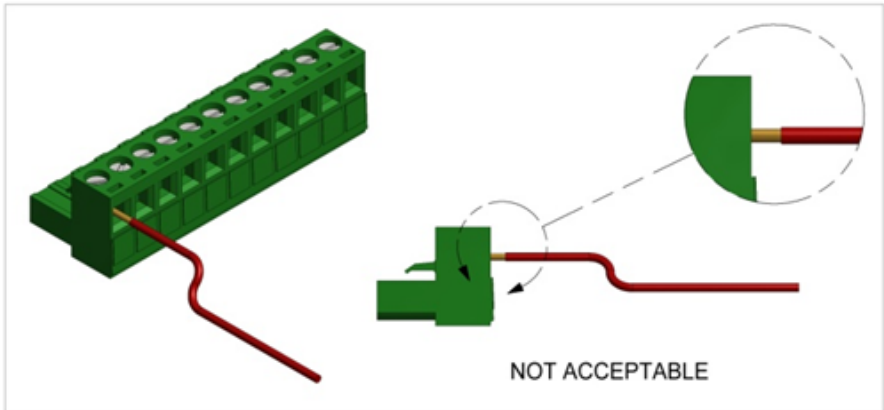
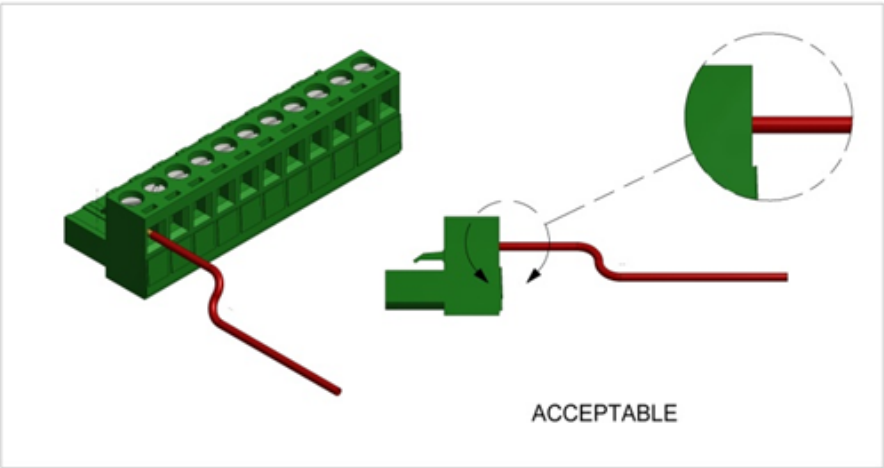
Failure to follow these instructions can result in death or serious injury.

To Wire a Connector

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



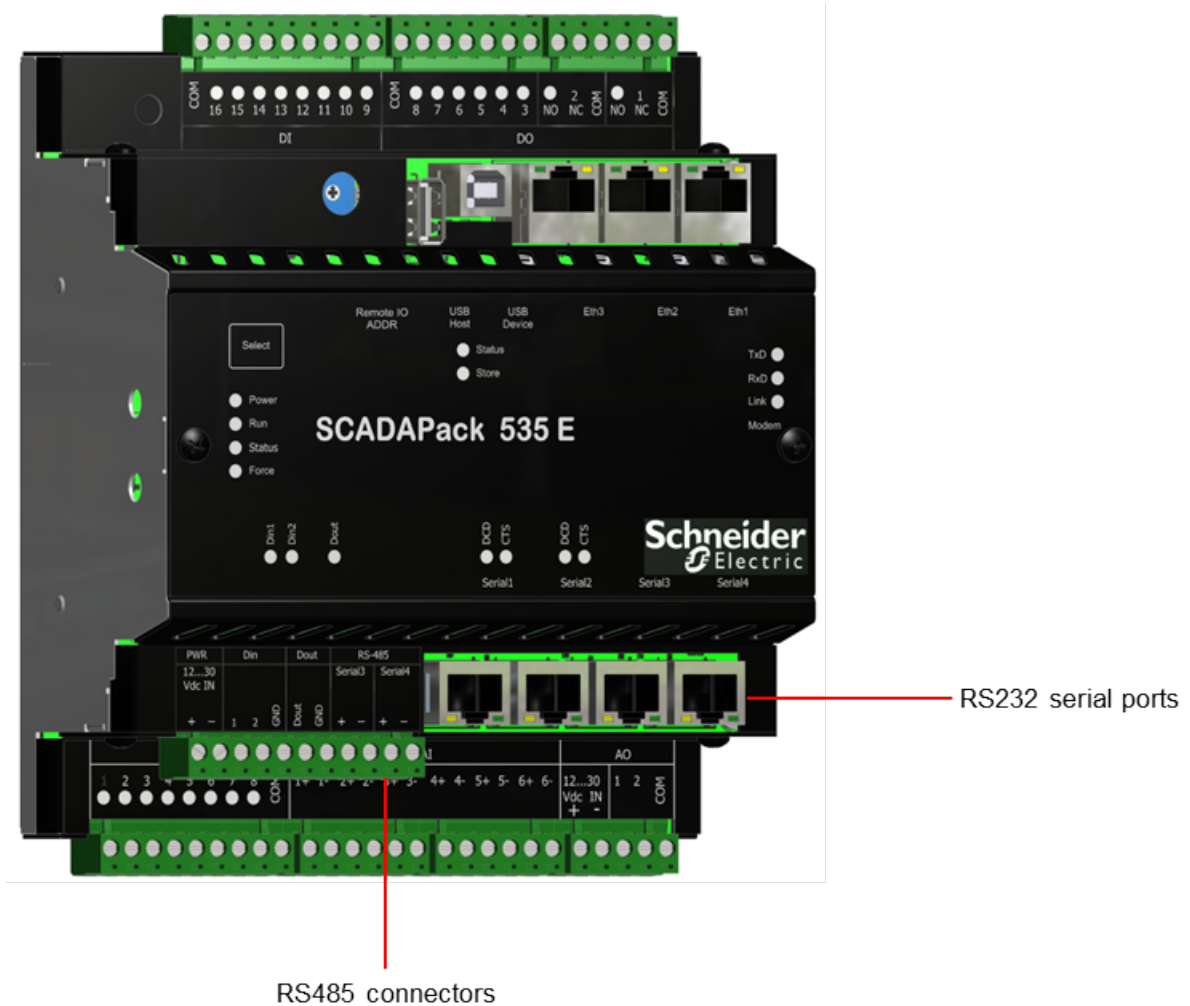
2. Insert the stripped wire into the connector so that the bared wire is located under the screw.
Verify that the bared wire is placed fully within the connector, as illustrated below.



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

10.2 Serial Port Wiring

The topics in this section describe the wiring for the RS232 serial ports and RS485 screw-termination connectors on the SCADAPack 535E.



RS232 Serial Port Wiring

- [RS232 Pin Assignments and Cable Descriptions](#) ⁷⁵
- [RS232 Wiring Examples](#) ⁷⁸

RS485 Connector Wiring

- [Wiring Screw-Termination Connectors](#) ⁷¹
- [RS485 Wiring](#) ⁸⁰

10.2.1 RS232 Pin Assignments and Cable Descriptions

NOTICE

UNINTENDED EQUIPMENT OPERATION

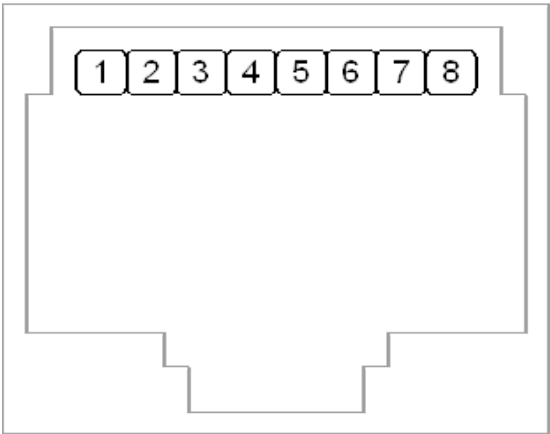
Serial3 and Serial4 support RS232 or RS485 operation, but not both at the same time. If Serial3 or Serial4 is configured for RS485 operation, the port must remain empty.

- Do not insert an RS232 cable into Serial3 if there is a two-wire RS485 connection to the screw-termination connectors labeled Serial3+ and Serial3-.
- Do not insert an RS232 cable into Serial4 if there is a two-wire RS485 connection to the screw-termination connectors labeled Serial4+ and Serial4-.

Failure to follow these instructions can result in equipment damage.

RS232 Pin Assignments

The serial ports on the rPAC support serial cables with eight-pin RJ45 modular connectors. The illustration below shows the pin numbers and assignments for the RJ45 connector.



The table below lists the RS232 pin assignments for Serial1 and Serial2.

Pin No.	Pin Function
1	+5V
2	DCD
3	DTR
4	GND
5	RxD
6	TxD
7	CTS

8	RTS
---	-----

The table below lists the RS232 pin assignments for Serial3 and Serial4.

Pin No.	Pin Function
1	+5V
2	
3	
4	GND
5	RxD
6	TxD
7	
8	

RS232 Cable Descriptions

The tables below describe the pin functions for the following connections:

- RJ45 to DE-9S Data Terminal Equipment (DTE) for Serial1, Serial2, Serial3 and Serial4
- RJ45 to DE-9P Data Communication Equipment (DCE) for Serial1 and Serial2

RJ45 to DE-9S DTE

This cable is used to connect from any of the four RS232 serial ports on the rPAC to a DE-9S connector on a DTE device, such as a PC. A 3 m (10 ft) long cable is available from Schneider Electric using part number TBUM297217.

RJ45 8 Pins	rPAC DTE Function	DE-9S DTE Function	DE-9S
			Shield connects to shell
6	TxD	RxD	2
5	RxD	TxD	3
4	GND	GND	5
1, 2, 3, 7 and 8 are not connected at this end.			Wires not connected at this end.

RJ45 to DE-9P DCE

This cable is used to connect from the Serial1 or Serial2 RS232 port on the rPAC to a DE-9P connector on a DCE device such as a modem. A 38 cm (15 in) cable is available from Schneider Electric using part number TBUM297218.

RJ45	rPAC DTE Function	DE-9P DCE Function	DE-9P
			Shield connects to shell
3	DTR	DTR	4
6	TxD	TxD	3
5	RxD	RxD	2
2	DCD	DCD	1
4	GND	GND	5
7	CTS	CTS	8
8	RTS	RTS	7
1	+5V	+5V	9

10.2.2 RS232 Wiring Examples

The illustrations in this topic show different wiring options for the RS232 serial ports. The wiring options you can use depend on the serial port signaling capabilities:

- Serial1 and Serial2: TxD, RxD, CTS, RTS, DCD, DTR
- Serial3 and Serial4: TxD, RxD

 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.

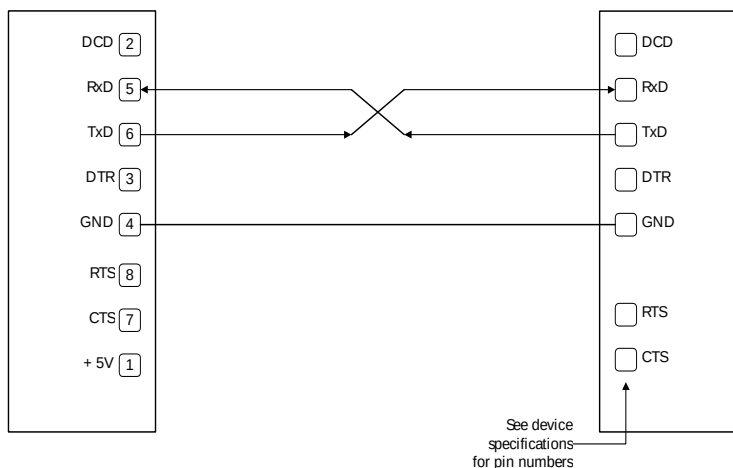
DTE to DTE without Handshaking

This wiring option can be used with any of the four RS232 serial ports.

There are several methods for wiring an RS232 serial port to Data Terminal Equipment (DTE) and Data Communications Equipment (DCE) devices. The simplest connection requires only three wires: RxD, TxD and signal ground. The following diagram shows the wiring between two DTE devices when handshaking is not required.

RS-232 COM port (DTE)

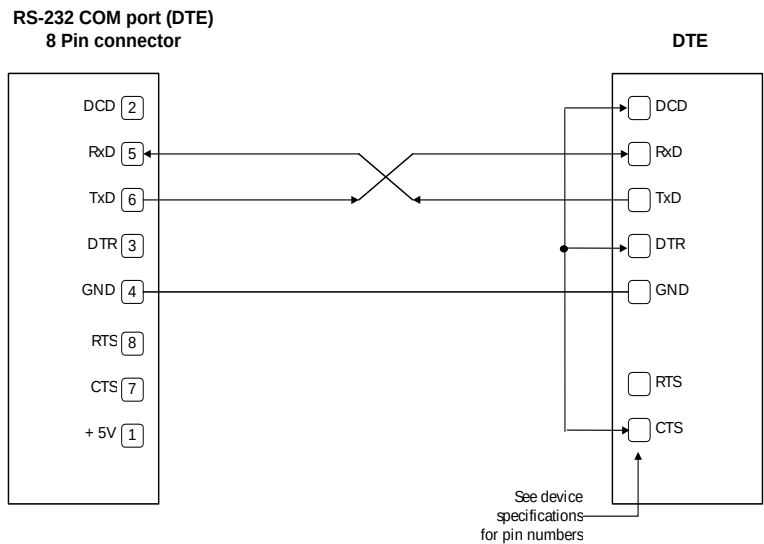
8 Pin connector



DTE to DTE with Handshaking

This wiring option can be used with Serial1 and Serial2 RS232 ports.

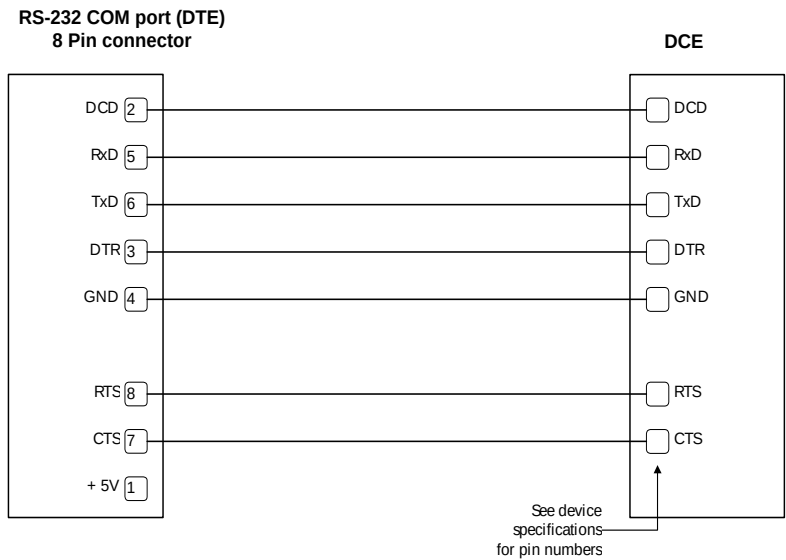
Some DTE devices may require hardware handshaking lines. The CTS and RTS lines are commonly used for handshaking. The DTR and DCD lines are less commonly used. The rPAC does not require these lines. Refer to the specifications for the external device for exact requirements. The following diagram shows the wiring between two DTE devices when handshaking is required.



DTE to DCE with Handshaking

This wiring option can be used with Serial1 and Serial2 RS232 ports.

DCE devices require different wiring. The handshaking lines need to be connected. Many DCE devices are half-duplex. Select half-duplex operation with these devices. The diagram below shows the wiring between a DTE device and a DCE device with handshaking.



10.2.3 RS485 Wiring

WARNING

ELECTRICAL HAZARD

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

UNINTENDED EQUIPMENT OPERATION

Serial3 and Serial4 support RS232 or RS485 operation, but not both at the same time. If Serial3 or Serial4 is configured for RS485 operation, the port must remain empty.

- Do not insert an RS232 cable into Serial3 if there is a two-wire RS485 connection to the screw-termination connectors labeled Serial3+ and Serial3-.
- Do not insert an RS232 cable into Serial4 if there is a two-wire RS485 connection to the screw-termination connectors labeled Serial4+ and Serial4-.

Failure to follow these instructions can result in equipment damage.

The Serial3 and Serial4 RS485 screw-termination connectors support solid or stranded wires from 3.3...0.08 mm² (12...28 AWG). The table below describes the polarity assignment for these connectors.

Connector Name	Polarity Assignment
Serial3 +	Positive
Serial3 -	Negative
Serial4 +	Positive
Serial4 -	Negative

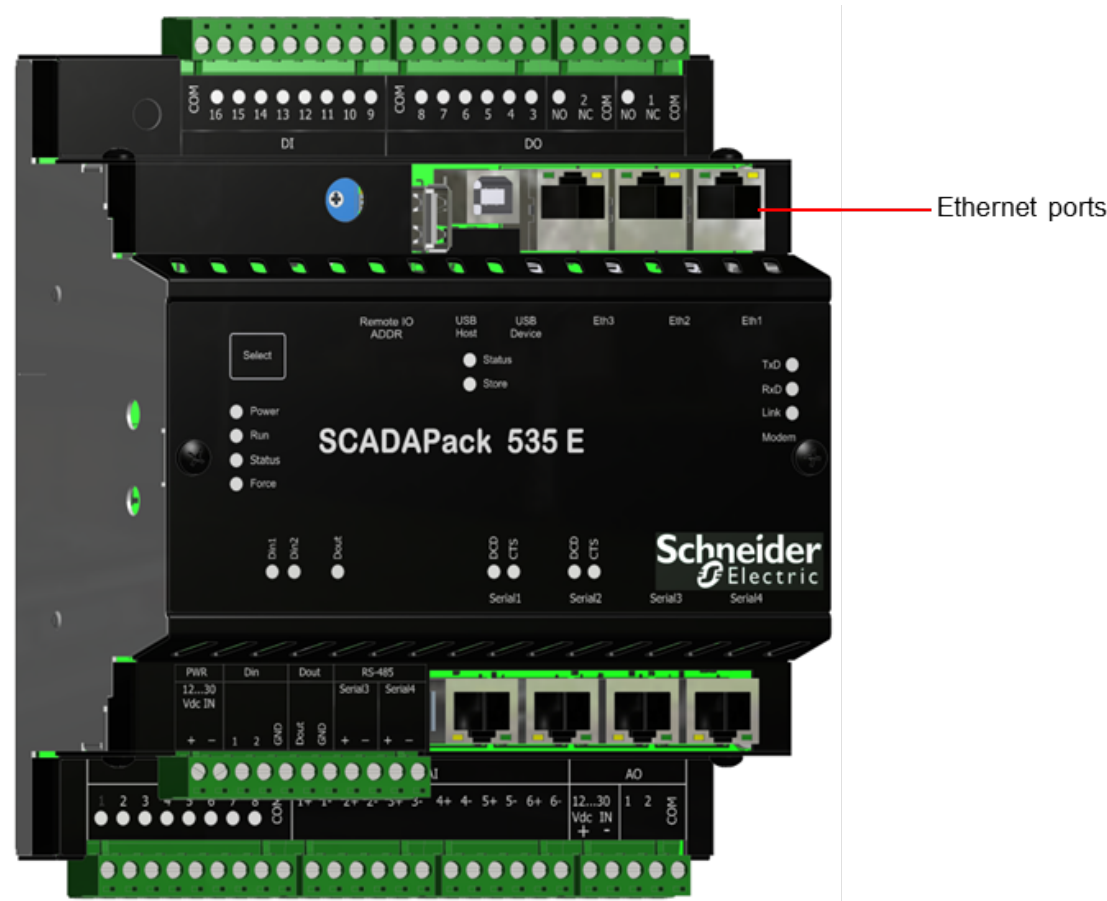
Either of the terminal connections labeled GND (ground) can be used with RS485 screw-termination connections.

For instructions on inserting wires into the RS485 connectors, see [Wiring Screw-Termination Connectors](#)

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10.3 Ethernet Port Wiring

The topic in this section describes the wiring for the Ethernet ports on the SCADAPack 535E.

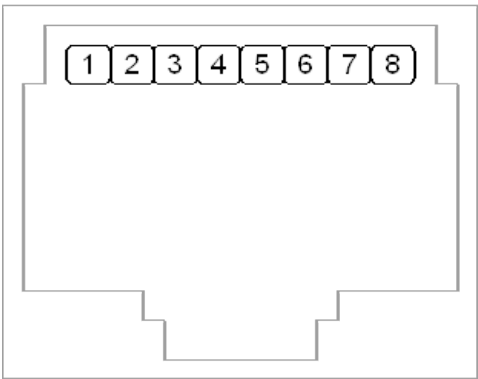


- [Ethernet Pin Assignments and Cable Description](#) ⁸¹

10.3.1 Ethernet Pin Assignments and Cable Description

Ethernet Pin Assignments

The Ethernet ports on the rPAC can be connected to an Ethernet wall jack or hub using standard RJ45 Category 5 patch cables. The illustration and table below show the pin assignments for the RJ45 modular connector.



Pin No.	Pin Function
1	+Tx
2	-Tx
3	+Rx
4	
5	
6	-Rx
7	
8	

Ethernet Cable Description

Ethernet cables are used in 10/100 BASE-T LANs. These networks are also known as unshielded twisted pair (UTP), copper wire, Category 3, 4 and 5 Ethernet wire or twisted pair.

NOTICE

UNINTENDED EQUIPMENT OPERATION

The IEEE 802.3 10 BASE-T specification requires that 10 BASE-T and 100 BASE-T devices support UTP 100-120 unshielded twisted pair cables up to 100 m (328 ft) in length. However, this requirement does not factor in losses due to connectors, patch panels, punch-down blocks, or other cable management hardware, which introduce additional loss.

For each connector or other intrusive cable management device along the link, subtract 12 m (39 ft) from the total allowable link length.

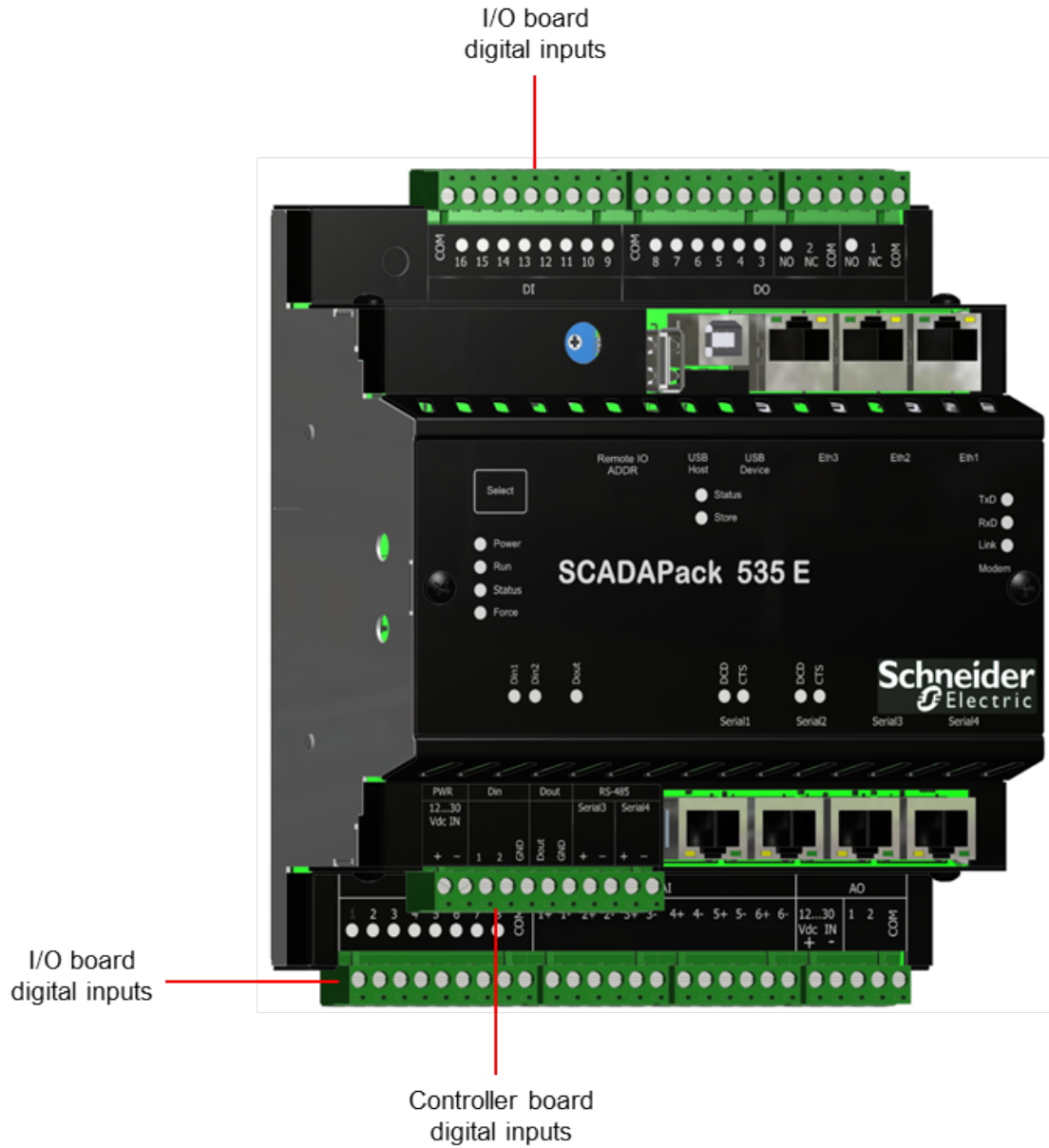
Failure to follow these instructions can result in equipment damage.

As long as specifications are met for the entire length of the cable, UTP cable segments can be run up to a maximum allowable length of 200 m (656 ft).

The Ethernet ports on the rPAC automatically configure themselves for Medium Dependent Interface (MDI) or MDI-X. This means that either a crossover or a straight-through Ethernet cable can be used. The rPAC will automatically detect the interface used and serve the cable appropriately.

10.4 Digital Input Wiring

The topic in this section describes the wiring for the digital and counter inputs on the SCADAPack 535E.



- [Digital Input Wiring Example](#) ⁸⁵

10.4.1 Controller Board Digital Input Wiring Example

⚠ 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

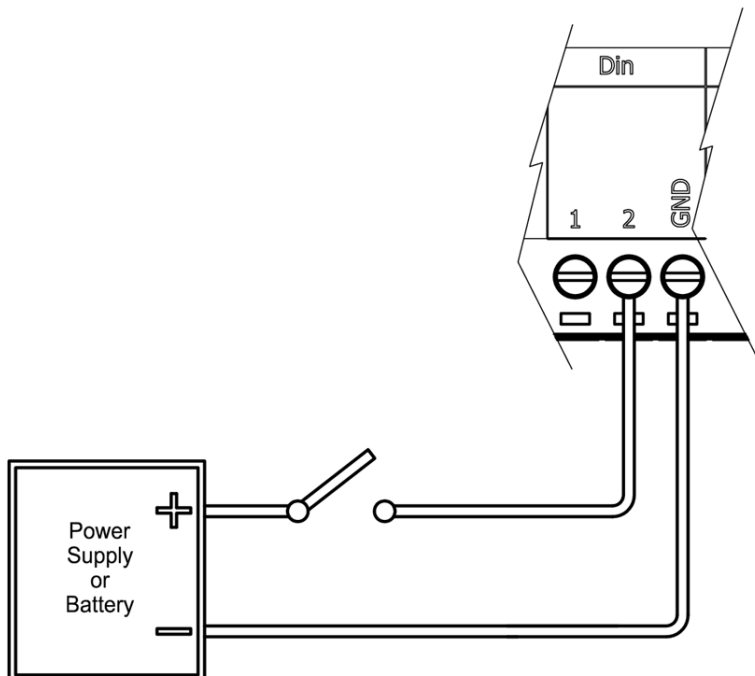
UNINTENDED EQUIPMENT OPERATION

When wiring digital inputs:

- Confirm that the connection to the digital input does not exceed the ratings for the digital input. See the Specifications topic 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.

The figure below shows a connection from Din 2 and a ground connector to a power supply or battery.



10.4.2 I/O Board Digital and Counter Input Wiring Example

⚠ 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

UNINTENDED 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 topic 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.

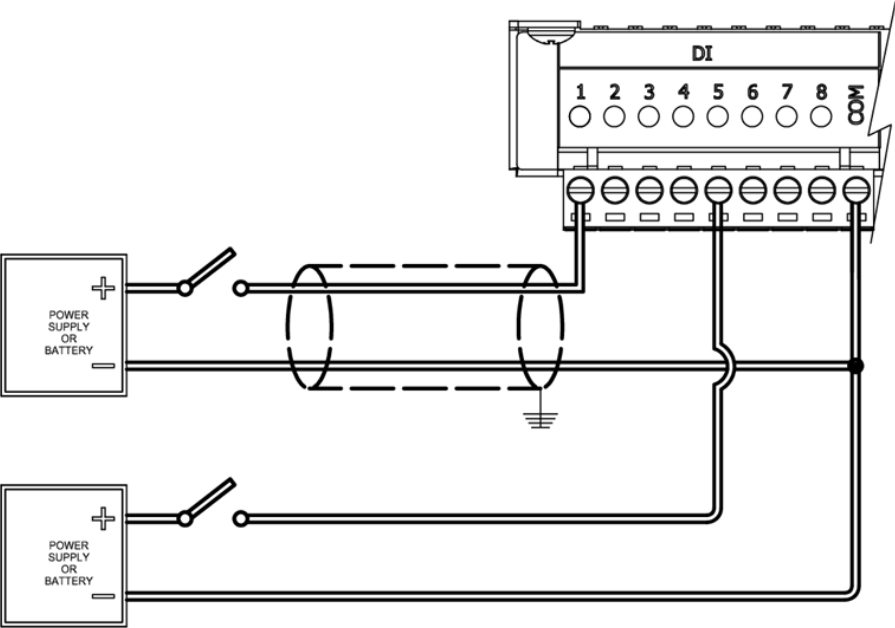
NOTICE

SIGNAL INTERFERENCE DUE TO NOISE

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.



10.5 Digital Output Wiring

The topics in this section describe the wiring for the digital outputs on the SCADAPack 535E.



Controller Board Digital Output Wiring

- [Controller Board Digital Output Wiring Example](#) ⁸⁹
- [Controlling Grounded Devices with the Controller Board Digital Output](#) ⁹¹

I/O Board Digital Output Wiring

- [I/O Board Digital Output Wiring Examples](#) ⁹²

10.5.1 Controller Board Digital Output Wiring Example

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

RELAY CONTACT DAMAGE

Incandescent lamps and other loads may have inrush currents that exceed the rated maximum current of the relay contacts. This inrush current can damage the relay contacts. Use interposing relays in these situations.

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.

NOTICE

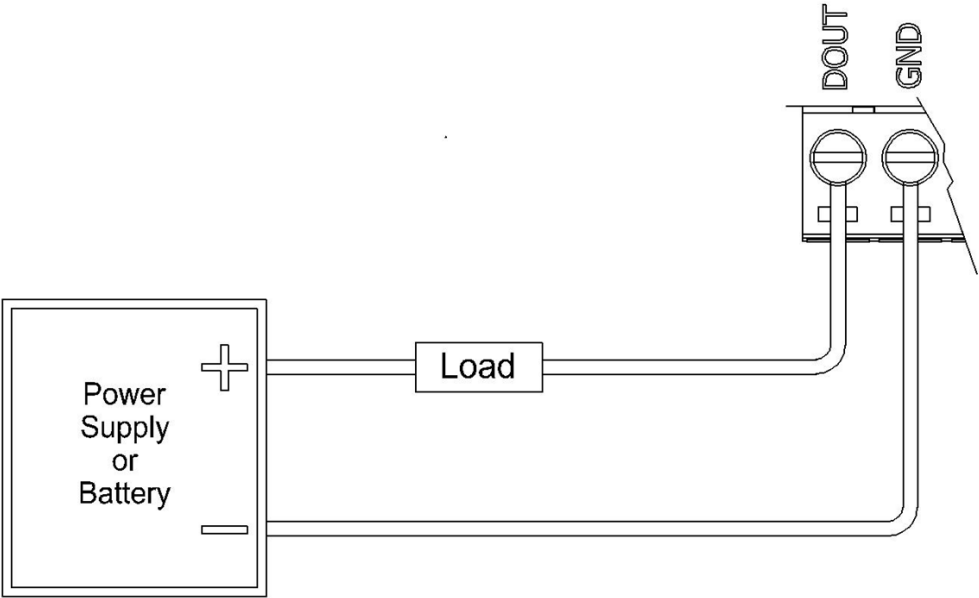
UNINTENDED EQUIPMENT OPERATION

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

Failure to follow these instructions can result in equipment damage.

The figure below shows a wiring example for the controller board digital output which provides an open drain metal-oxide semiconductor field-effect transistor (MOSFET) for controlling loads such as relays or lamps. See [Specifications](#) ^[145] for details about the power rating for this digital output.

For information about controlling devices with this digital output, see [Controlling Devices with the Controller Board Digital Output](#) ^[91].



10.5.2 Controlling Devices with the Controller Board Digital Output

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

RELAY CONTACT DAMAGE

Incandescent lamps and other loads may have inrush currents that exceed the rated maximum current of the relay contacts. This inrush current can damage the relay contacts. Use interposing relays in these situations.

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.

NOTICE

UNINTENDED EQUIPMENT OPERATION

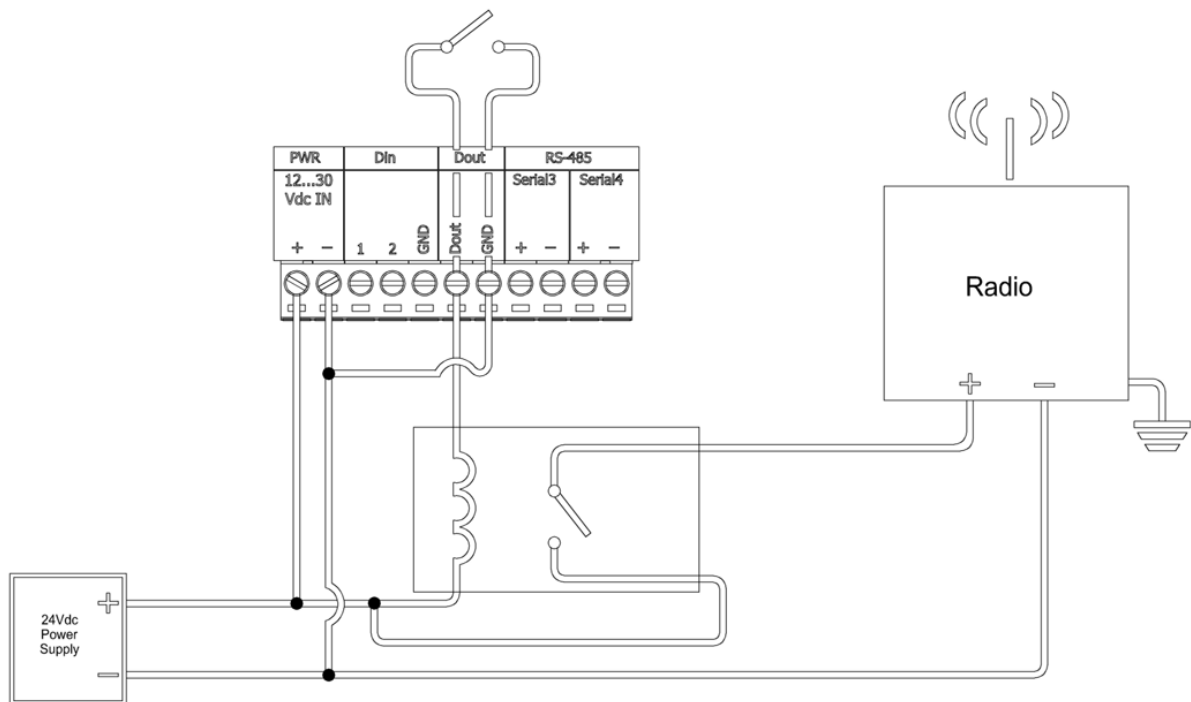
External lightning protection is required if the device being controlled is outside the physical area (cubicle or building) in which the rPAC is located.

Failure to follow these instructions can result in equipment damage.

The single digital output on the controller board does not include an internal relay. As a result, this digital output needs an external interposing relay to control devices.

Add the external interposing relay between the digital output and the device that you want to control. The example below shows the wiring needed to control a grounded device, such as a radio.

See [Specifications](#) ¹⁴⁵ for details about the power rating for this digital output.



10.5.3 I/O Board Digital Output Wiring Examples

⚠ 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

RELAY CONTACT DAMAGE

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. Use interposing relays in these situations.

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.

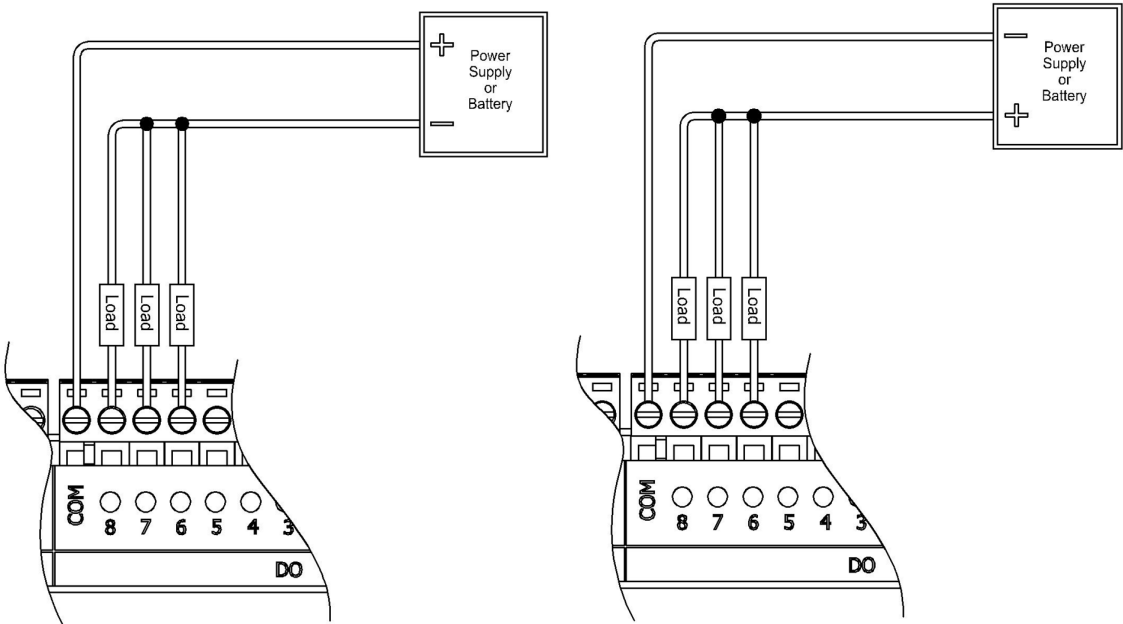
Failure to follow these instructions can result in equipment damage.

NOTICE

UNINTENDED EQUIPMENT OPERATION
External lightning protection is required if the device being controlled is outside the physical area (cubicle or building) in which the rPAC is located.
Failure to follow these instructions can result in equipment damage.

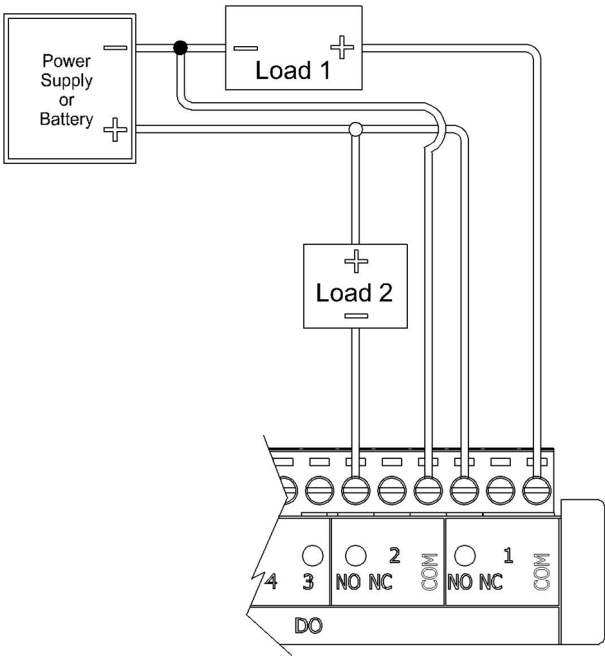
Form A Digital Output Wiring

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



Form C Digital Output Wiring

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



10.6 Analog Input Wiring

The topics in this section describe the wiring for the analog inputs on the SCADAPack 535E.



Analog inputs

- [Analog Input Wiring Example](#) ⁹⁶
- [Supporting Current and Voltage Inputs](#) ⁹⁸
- [Helping to Prevent Interruption of the Current Loop](#) ¹⁰³

10.6.1 Analog Input Wiring Example

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

⚠ 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

LIGHTNING SURGE THROUGH ANALOG INPUTS

If a transducer or transmitter connected to an analog channel is placed outside of the building or structure where the rPAC 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.

NOTICE

UNINTENDED EQUIPMENT OPERATION

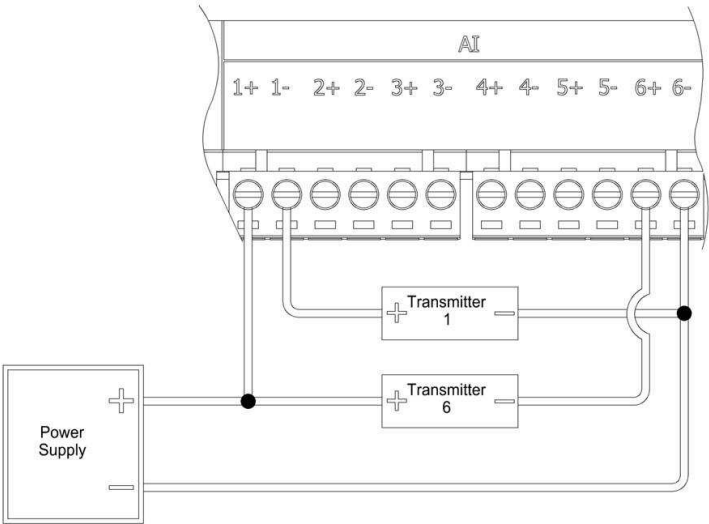
Do not exceed the maximum input range specified for each analog input. For details, see the Specifications topic.

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.



10.6.2 Supporting a Mix of Current and Voltage Inputs

The unit is shipped with the six analog inputs configured for DC Current or DC Voltage. 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 Vdc and 1...5 Vdc operation so there is no need to adjust the calibration when you change the input mode for an analog input.

The table below summarizes the options for supporting a mix of current and voltage analog inputs.

Analog Inputs Configured For	Ways to Support a Mix of Current and Voltage Inputs	Considerations	Instructions
DC Voltage	Add an external resistor to measure current	- 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.	Converting Current Input to Voltage Input ⁹⁸
	Move the DIP switch for one or more analog inputs to DC Current.	- Typically, 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.	Changing the Input Mode for an Analog Input ¹⁰⁰
DC Current	Move the DIP switch for one or more analog inputs to DC Voltage.	- Typically, 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.	Changing the Input Mode for an Analog Input ¹⁰⁰

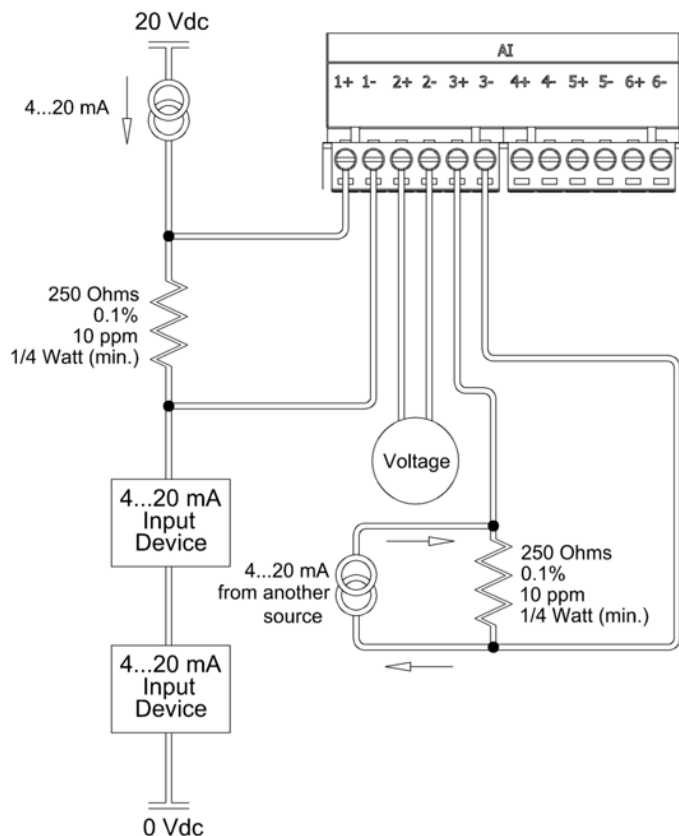
Converting Current Input to Voltage Input

In following illustration, the six analog inputs are configured for DC Voltage, but a mix of current and voltages inputs are supported:

- On analog inputs 1 and 3, an external resistor is used to convert current input to voltage input before it reaches the physical input.

- On analog input 2, the voltage input flows directly into the physical input.

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](#) ¹⁰³.



Changing the Input Mode for an Analog Input

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 to DC Current, or from DC Current 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 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 input mode for an analog input

WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

WARNING

ELECTRICAL HAZARD

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

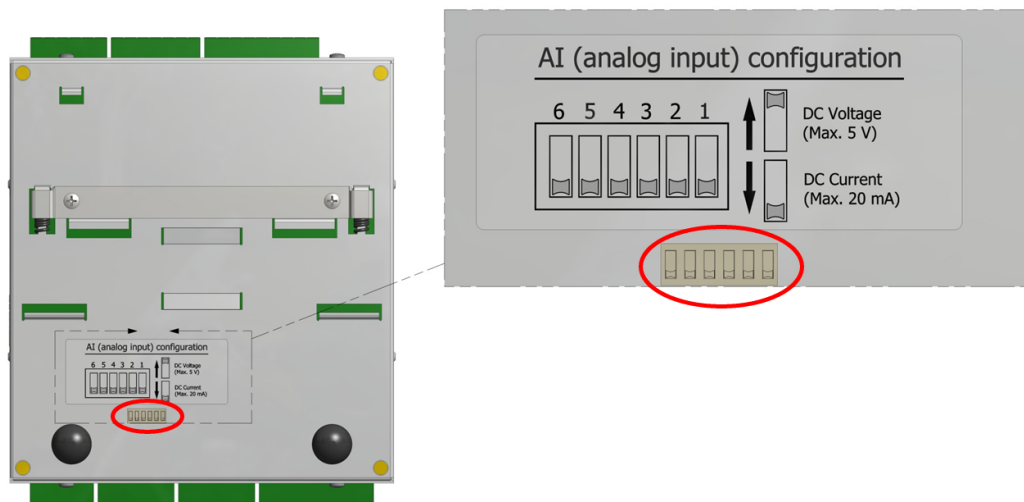
Failure to follow these instructions can result in death or serious injury.

1. Remove power from the unit.
2. Disconnect 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 rPAC, 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.

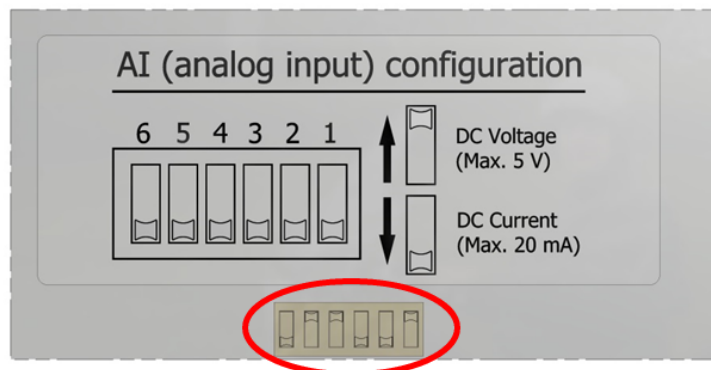
The dip switch numbers correspond to the analog input numbers. For example, to change the input mode for analog input 1, move dip switch 1. The figure below shows the six dip switches configured for DC Current.



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 (Vdc), slide the dip switch to the upper position.

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



6. Remount the unit on the DIN rail.

NOTICE

UNINTENDED 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 Vdc.

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.

10.6.3 Helping to Prevent Interruption of the Current Loop

⚠ WARNING

ELECTRICAL HAZARD

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

UNINTENDED EQUIPMENT OPERATION

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

Failure to follow these instructions can result in equipment damage.

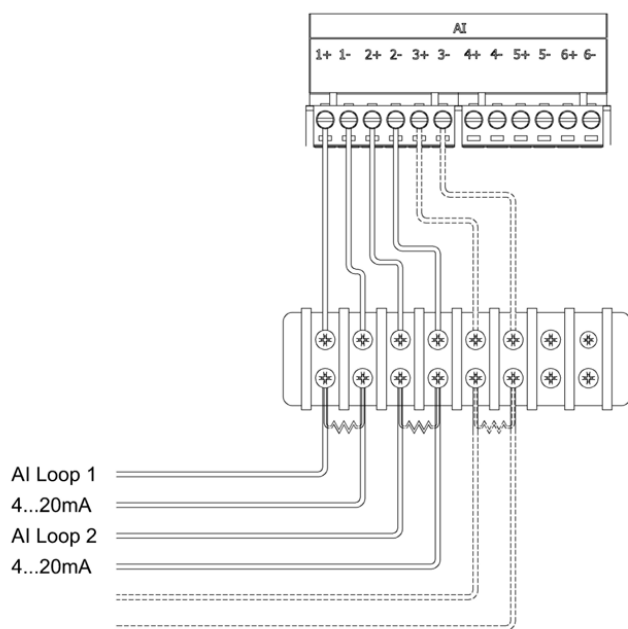
NOTICE

UNINTENDED EQUIPMENT OPERATION

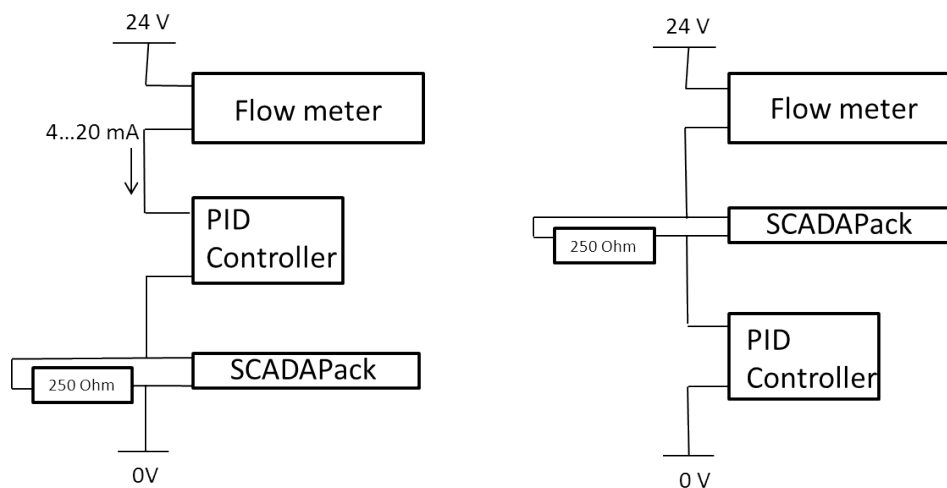
The rPAC or I/O expansion module must be the only loop current measurement device in the loop when using the analog inputs in the 20 mA measurement mode. If power to the module is removed, the module reverts to voltage mode and results in an open current loop. Applications that cannot tolerate this possibility need to use 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 rPAC 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.

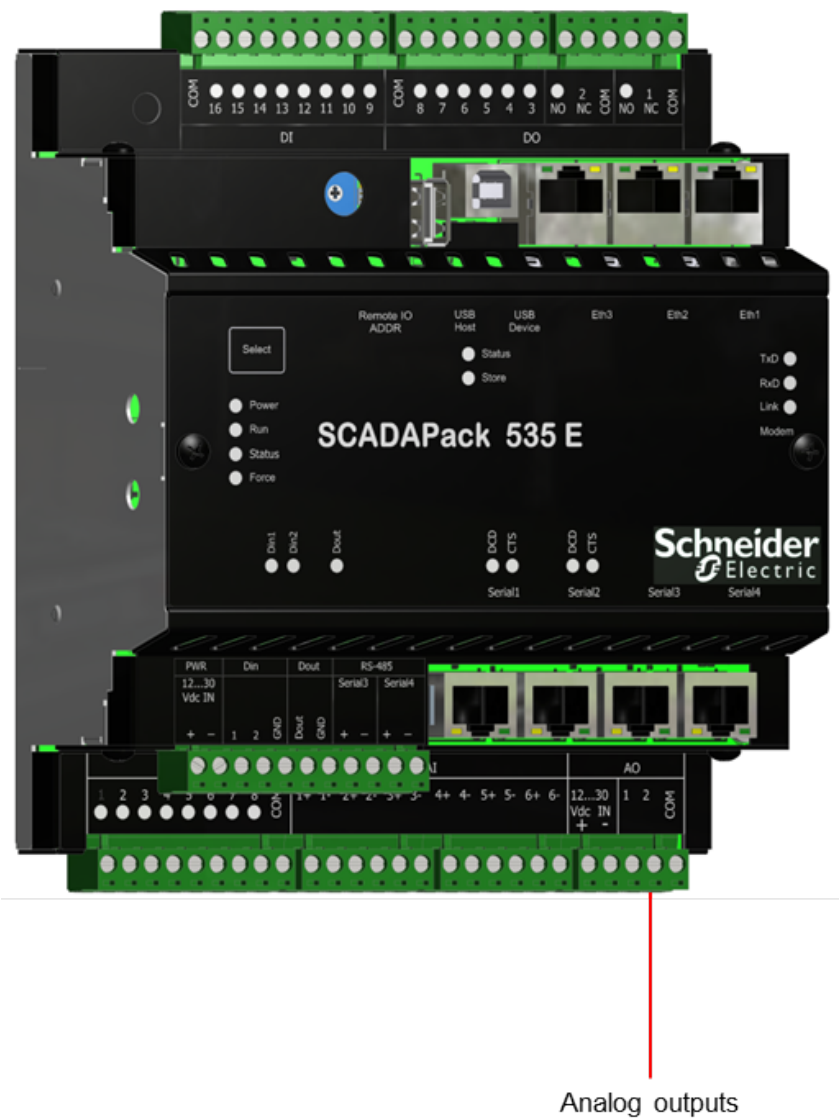


As illustrated below, the rPAC or I/O expansion module providing the analog inputs does not need to be the last device in the current loop.



10.7 Analog Output Wiring

The topics in this section describe the wiring for the analog outputs on the SCADAPack 535E.



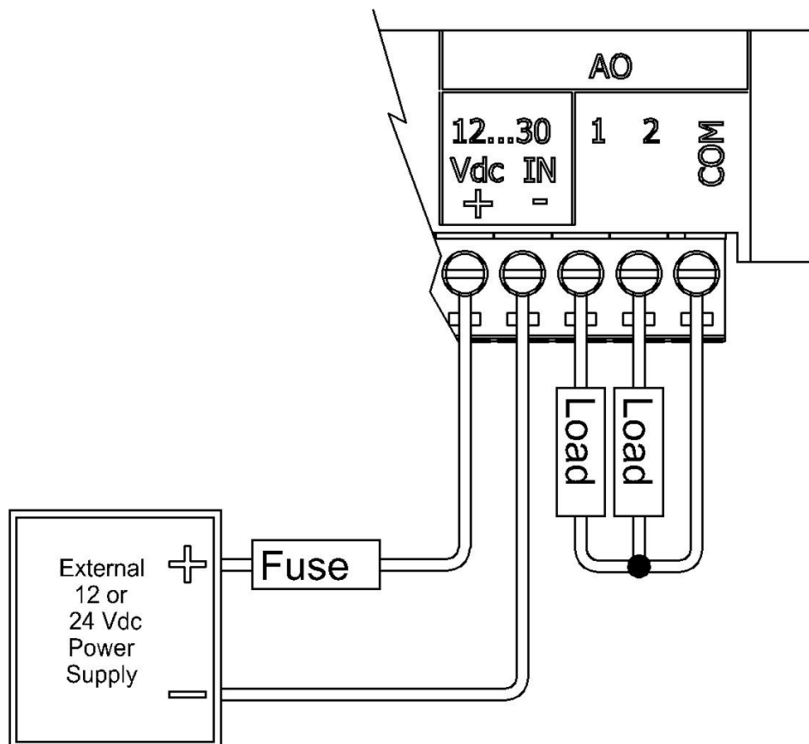
- [Analog Output Wiring Example](#)¹⁰⁶
- [Supporting Current and Voltage Outputs](#)¹⁰⁸

10.7.1 Analog Output Wiring Example

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

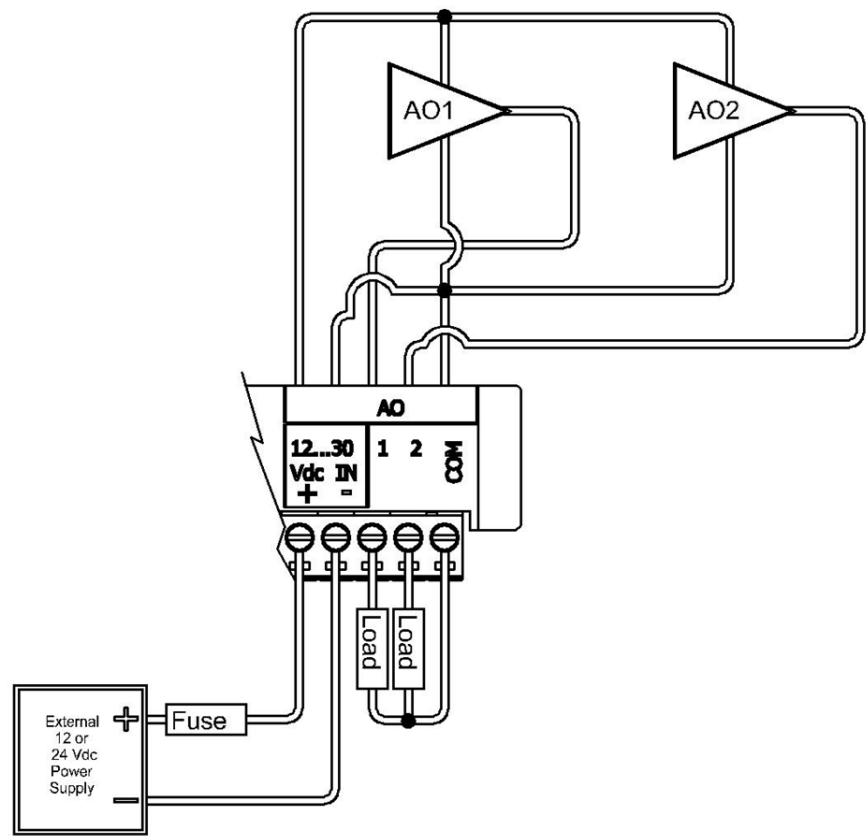
⚠ WARNING
HAZARD OF ELECTRIC SHOCK Remove power from all devices before connecting or disconnecting inputs or outputs to any terminal or installing or removing any hardware. Failure to follow these instructions can result in death or serious injury.

NOTICE
UNINTENDED 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.



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 rPAC logic.



10.7.2 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 Vdc, 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 rPAC, 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	Output Range	Voltage Range
250 ohm	0...20 mA	0...5 Vdc
	4...20 mA	1...5 Vdc
500 ohm	0...20 mA	0...10 Vdc

11 Startup Modes

SCADAPack 530E or SCADAPack 535E rPACs can be started in four different operating modes:

- [Run mode](#)¹¹¹
- [Service Boot mode](#)¹¹¹
- [Cold Boot mode](#)¹¹³
- [Factory Boot mode](#)¹¹⁵

By default, the rPAC starts in Run mode when power is applied. Run mode is used for normal day-to-day operations.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Evaluate the operational state of the equipment being monitored or controlled by the rPAC before restarting the rPAC in a new mode of operation.

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

Holding down the **Select** button on the rPAC front cover allows you to start the rPAC in other modes of operation. The startup mode is determined by the length of time the **Select** button is depressed when power is applied to the rPAC or a controller board reset occurs. The longer the **Select** button is depressed, the more actions are applied to the rPAC.

Because the startup mode is not determined until the **Select** button is released, you can cancel the startup mode selection by removing power to the rPAC while the **Select** button is depressed. This can be a useful tactic to avoid starting up in modes where more actions are applied if you have held the **Select** button down longer than your preferred startup mode requires.

Startup Mode Actions

NOTICE

CONFIGURATION AND APPLICATION LOSS

Starting the rPAC in Cold Boot mode or Factory Boot mode returns rPAC configuration parameters to their default settings and erases applications created in SCADAPack Workbench and ISaGRAF 3 Workbench. This information must be reloaded into the rPAC for correct rPAC operation.

Before starting the rPAC in Cold Boot mode or Factory Boot mode, save a copy of the rPAC configuration information, user-created applications, logs and other data to an external drive so it can be reloaded when the procedure is complete.

Failure to follow these instructions can result in equipment damage.

Action	Run Mode	Service Boot Mode	Cold Boot Mode	Factory Boot Mode
DNP node address set to zero (0)		X	X	X
Serial port protocol set to DNP3		X		
IEC 61131-3 applications stopped		X		
Modbus Scanner stopped		X		
Serial port parameters set to Service Boot settings		X		
Ethernet port parameters set to Service Boot settings		X		
Serial port parameters set to defaults			X	X
Ethernet port parameters set to defaults			X	X
LED power set to default			X	X
Database initialized			X	X
SCADAPack Workbench and ISaGRAF 3 Workbench applications erased			X	X
Files erased				X
Flash file system reformatted				X
SCADAPack Workbench and ISaGRAF 3 Workbench applications started	X			
Settings retained in non-volatile memory		X		
SCADAPack Workbench and ISaGRAF 3 Workbench applications in flash erased			X	X
Protocols set to defaults			X	X

11.1 Starting in Run Mode

Run mode is the normal operating mode for SCADAPack 530E and SCADAPack 535E rPACs. The rPAC automatically starts in Run mode when power is applied or when a board reset occurs. No action is required to select Run mode.

When a SCADAPack 530E or SCADAPack 535E rPAC starts in Run mode, it loads:

- The defined serial and Ethernet communication parameters for every port.
- The rPAC database configuration and point attributes.
- IEC 61131-3 applications then executes them. If there are no user-created applications in RAM, but there are applications in flash ROM, then the flash ROM application is loaded in RAM and executed.

When the rPAC is operating in Run mode, the Run LED on the rPAC front cover blinks approximately once every three seconds.

11.2 Starting in Service Boot Mode

Service Boot mode is used for configuration, programming and maintenance work, usually when the communication settings are unknown.

When a SCADAPack 530E or SCADAPack 535E rPAC starts in Service Boot mode:

- DNP3 node address zero (0) is set, enabling communications with SCADAPack E Configurator at a known DNP address. Connect SCADAPack E Configurator to the USB Device port or to a serial communications port.
- Any IEC 61131-3 applications that are running are stopped.
- Modbus Scanner operations are stopped.
- Programs and configurations are retained in non-volatile memory.
- Serial, USB, Ethernet, and IP Routing parameters are set to the values listed in the tables below. This allows you to connect to the rPAC for configuration, programming, and maintenance tasks without knowing the port settings used for daily operations. Only Serial3 retains its pre-Service Boot settings when you start the rPAC in Service Boot mode.

Service Boot Serial and USB Port Settings for SCADAPack 530E and SCADAPack 535E rPACs

Parameter	USB (Port 0)	Serial1 (Port 1)	Serial2 (Port 2)	Serial3 (Port 3)	Serial4 (Port 4)
Function	DNP3	DNP3	DNP3	Unchanged	Cmd Line
Mode	USB	RS232 (RTS On)	RS232 (RTS On)	Unchanged	RS232
Baud		9600 bps	9600 bps	Unchanged	9600 bps
Data Mode		8-bit No Parity	8-bit No Parity	Unchanged	8-bit No Parity
Stop Bits		1	1	1	1
Duplex		Full	Full	Full	Full

Service Boot Ethernet Port Settings for SCADAPack 530E and SCADAPack 535E rPACs

Parameter	Ethernet 1	Ethernet 2	Ethernet 3
Function	TCP/IP+RemIO	TCP/IP+RemIO	TCP/IP+RemIO
IP Address	172.16.1.200	172.16.2.200	172.16.3.200
Subnet Mask	255.255.255.0	255.255.255.0	255.255.255.0

Service Boot IP Routing Settings for SCADAPack 530E and SCADAPack 535E rPACs

Parameter	Address
Gateway IP	0.0.0.0

To Start a SCADAPack 530E or SCADAPack 535E rPAC in Service Boot Mode**⚠ WARNING****UNINTENDED EQUIPMENT OPERATION**

Evaluate the operational state of the equipment being monitored or controlled by the rPAC before removing power.

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

1. Remove power from the rPAC.
2. Hold down the **Select** button.
3. Apply power to the rPAC.
4. Continue holding the **Select** button down until the **Status** LED turns on.

To cancel the startup mode selection at this point, remove power from the rPAC before you proceed to step 5. This can be a useful tactic to avoid starting up in modes where more actions are applied if you have held the **Select** button down longer than this mode requires.

5. Release the **Select** button.

If you release the **Select** button before the **Status** LED turns on, the rPAC will start in Run mode.

11.3 Starting in Cold Boot Mode

Cold Boot mode is used when you need to clear a configuration from the rPAC. It is optional after installing new SCADAPack E controller firmware.

Cold Boot mode does not format the flash file system. Start in Factory Boot mode to do this.

When a SCADAPack 530E or SCADAPack 535E rPAC starts in Cold Boot mode:

- IEC 61131-3 applications are erased.
- The rPAC points database is cleared.
- rPAC configuration settings are returned to default.
- The DNP3 Device Address is set to 0.
- Serial, USB, Ethernet, and IP Routing parameters are restored to the default settings listed in the tables below.

Cold Boot Serial and USB Port Settings for SCADAPack 530E and SCADAPack 535E rPACs

Parameter	USB (Port 0)	Serial1 (Port 1)	Serial2 (Port 2)	Serial3 (Port 3)	Serial4 (Port 4)
Function	DNP3	ISaGRAF	DNP3	DNP3	Cmd Line
Mode	USB	RS232 (RTS On)	RS232 (RTS On)	RS232	RS232
Baud		9600 bps	9600 bps	9600 bps	9600 bps
Data Mode		8-bit No Parity	8-bit No Parity	8-bit No Parity	8-bit No Parity
Stop Bits		1	1	1	1
Duplex		Full	Full	Full	Full

Cold Boot Ethernet Port Settings for SCADAPack 530E and SCADAPack 535E rPACs

Parameter	Ethernet 1	Ethernet 2	Ethernet 3
Function	TCP/IP+RemIO	TCP/IP+RemIO	TCP/IP+RemIO
IP Address	172.16.1.200	0.0.0.0	0.0.0.0
Subnet Mask	255.255.255.0	0.0.0.0	0.0.0.0

Cold Boot IP Routing Settings for SCADAPack 530E and SCADAPack 535E rPACs

Parameter	Address
Gateway IP	0.0.0.0

To Start a SCADAPack 530E or SCADAPack 535E rPAC in Cold Boot Mode

WARNING

UNINTENDED EQUIPMENT OPERATION

Evaluate the operational state of the equipment being monitored or controlled by the rPAC before removing power.

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

NOTICE

CONFIGURATION AND APPLICATION LOSS

Starting the rPAC in Cold Boot mode returns rPAC configuration parameters to their default settings and erases applications created in SCADAPack Workbench and ISaGRAF 3 Workbench. This information must be reloaded into the rPAC for correct rPAC operation.

Before starting the rPAC in Cold Boot mode, save a copy of the rPAC configuration information, user-created applications, logs and other data to an external drive so it can be reloaded when the procedure is complete.

Failure to follow these instructions can result in equipment damage.

1. Remove power from the rPAC.
2. Hold down the Select button.
3. Apply power to the rPAC.
4. Continue holding down the Select button for 20 seconds until the Status LED begins blinking on and off.

If you release the Select button before the Status LED begins blinking on and off, the rPAC starts in Service Boot mode.

To cancel the startup mode selection, remove power from the RTU while the Select button is depressed. This can be a useful tactic to avoid starting up in Factory Boot mode if you have held the Select button down longer than 20 seconds.

5. Release the Select button.
6. Reload the rPAC configuration and user-created applications from backup.

11.4 Starting in Factory Boot Mode

Factory Boot mode is used to reformat the flash file system and initialize the rPAC to its factory default settings.

When a SCADAPack 530E or SCADAPack 535E rPAC starts in Factory Boot mode:

- IEC 61131-3 applications are erased.
- The rPAC points database is cleared.
- rPAC configurations are returned to their default settings.
- The flash file system is reformatted.
- Serial, USB, Ethernet, and IP Routing parameters are restored to the default settings listed in the tables below.

Factory Boot Serial and USB Port Parameters for SCADAPack 530E and SCADAPack 535E rPACs

Parameter	USB (Port 0)	Serial1 (Port 1)	Serial2 (Port 2)	Serial3 (Port 3)	Serial4 (Port 4)
Function	DNP3	ISaGRAF	DNP3	DNP3	Cmd Line
Mode	USB	RS232 (RTS On)	RS232 (RTS On)	RS232	RS232
Baud		9600 bps	9600 bps	9600 bps	9600 bps
Data Mode		8-bit No Parity	8-bit No Parity	8-bit No Parity	8-bit No Parity
Stop Bits		1	1	1	1
Duplex		Full	Full	Full	Full

Factory Boot Ethernet Port Parameters for SCADAPack 530E and SCADAPack 535E rPACs

Parameter	Ethernet 1	Ethernet 2	Ethernet 3
Function	TCP/IP+RemIO	TCP/IP+RemIO	TCP/IP+RemIO
IP Address	172.16.1.200	0.0.0.0	0.0.0.0
Subnet Mask	255.255.255.0	0.0.0.0	0.0.0.0

Factory Boot IP Routing Settings for SCADAPack 530E and SCADAPack 535E rPACs

Parameter	Address
Gateway IP	0.0.0.0

To Start a SCADAPack 530E or SCADAPack 535E rPAC in Factory Boot Mode

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Evaluate the operational state of the equipment being monitored or controlled by the rPAC before removing power.

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

NOTICE

CONFIGURATION AND APPLICATION LOSS

Starting the rPAC in Factory Boot mode returns rPAC configuration parameters to their default settings and erases applications created in SCADAPack Workbench and ISaGRAF 3 Workbench. This information must be reloaded into the rPAC for correct rPAC operation.

Before starting the rPAC in Factory Boot mode, save a copy of the rPAC configuration information, user-created applications, logs and other data to an external drive so it can be reloaded when the procedure is complete.

Failure to follow these instructions can result in equipment damage.

1. Remove power from the rPAC.
2. Hold down the Select button.
3. Apply power to the rPAC.
4. Continue holding down the Select button for longer than 30 seconds until the Status LED stops blinking on and off and remains lit.

If you release the Select button while the Status LED is still blinking, the rPAC will start in Cold Boot mode.

To cancel the startup mode selection, remove power from the RTU while the Select button is depressed.

5. Release the Select button.

The Factory Boot will take approximately 60 seconds to complete. During this time, the rPAC may appear unresponsive while the file system is being formatted. The Status LED will remain lit until the Factory Boot has completed and the rPAC restarts.

6. Reload the rPAC configuration and user-created applications from backup.

12 Configuration

The rPAC can be configured:

- Locally or remotely using [SCADAPack E Configurator](#)^[117], a software application that runs on a desktop or laptop computer.
- Remotely as part of an end-to-end SCADA system using the ClearSCADA software.
- [Locally using applications created in SCADAPack Workbench or ISaGRAF 3 Workbench.](#)^[119]

Before you begin configuring the rPAC, 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 rPAC. For information about using the ClearSCADA software, see the ClearSCADA documentation.

12.1 SCADAPack E Configurator

The SCADAPack E Configurator software provides a graphical user interface that allows you to configure the rPAC settings and to load those settings into the rPAC. It also integrates with SCADAPack Workbench and ISaGRAF 3 Workbench so you can build and diagnose IEC 61131-3 sequences that extend the rPAC capabilities.

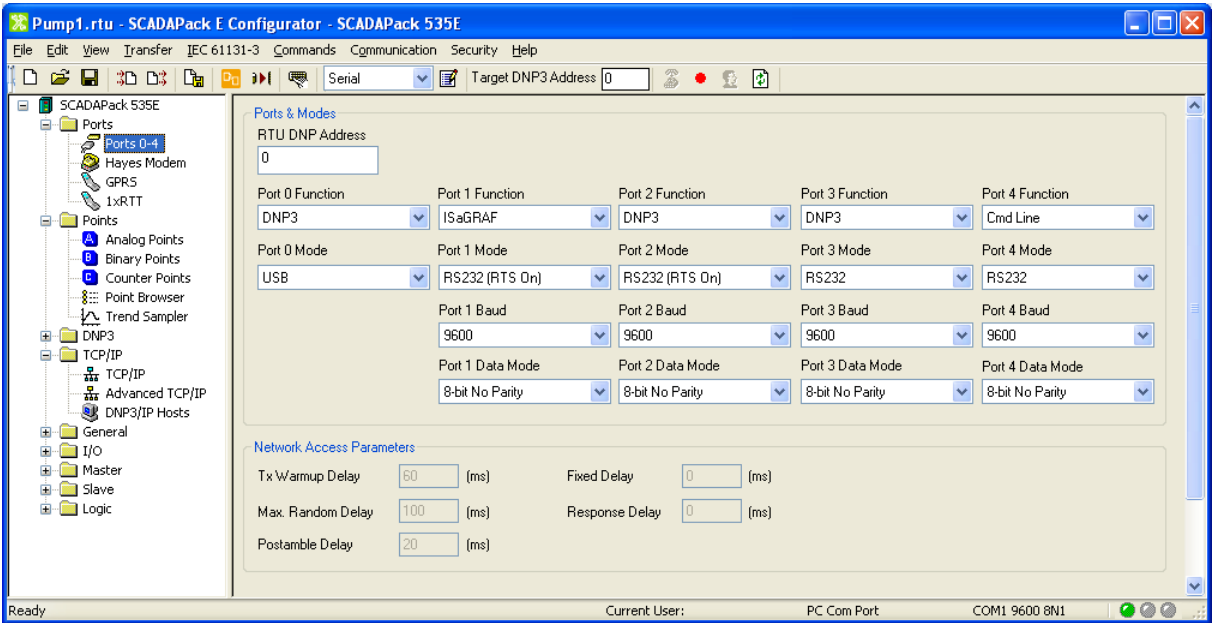
If you begin rPAC configuration in the SCADAPack E Configurator software, you cannot switch to the ClearSCADA software. Similarly, if you begin rPAC configuration in the ClearSCADA software, you cannot switch to the SCADAPack E Configurator software.

The following table summarizes where in the SCADAPack E Configurator software you will find the configurable attributes for each hardware element on the SCADAPack 530E and SCADAPack 535E.

Hardware Label	SCADAPack E Configurator Folder	SCADAPack E Configurator Property Page(s)	SCADAPack E Configurator Label
Serial1 Serial2 Serial3 Serial4	Ports	Ports 0-4	Port 1 Port 2 Port 3 Port 4
Eth1 Eth2 Eth3	TCP/IP	TCP/IP	Ethernet 1 Ethernet 2 Ethernet 3
USB Device	Ports	Ports 0-4	Port 0
DI DO AI ¹ AO ¹	Points	Binary Points Counter Points ¹ Analog Points ¹	Binary Points Counter Points ¹ Analog Points ¹

¹ The SCADAPack 530E does not provide counter inputs, analog inputs or analog outputs. Add an I/O expansion module if you need these input or output types.

The figure below illustrates the Ports 0-4 property page for the SCADAPack 530E and SCADAPack 535E and shows 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.



12.2 Reading and Writing Data With Logic Programs

IEC 61131-3 applications use I/O connections to the SCADAPack E rPAC points 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 output points, using RTU_RAW_WRITE or RTU_ENG_WRITE I/O devices. They can also 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 rtuxxao 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 rPAC points.

13 Diagnostics

The rPAC provides a number of capabilities that can help you monitor rPAC operations and perform troubleshooting tasks. They include:

- LEDs that indicate the status of rPAC ports and communications
- Diagnostics for several aspects of rPAC communications and exceptional rPAC operating conditions
- System points that measure internal rPAC temperature and provide power supply and battery status
- System points that provide communications status information
- Status codes that provide information about system, communication and device status

The following topics provide an overview of the diagnostics capabilities on the rPAC:

- [LEDs](#) ¹²¹
- [Accessing Diagnostics](#) ¹²³
- [Startup Diagnostics](#) ¹²⁵
- [Battery Voltage, Supply Voltage, and Internal Temperature](#) ¹²⁶
- [Power Supply and Battery Status](#) ¹²⁸
- [Communication Statistics](#) ¹²⁹
- [Status Codes](#) ¹³⁰

13.1 LEDs

The table below describes the LEDs on the rPAC.

Type	Name or Location	Color	Description
General	Power	Green	Lit when correct voltage is applied to the power terminals. Does not indicate whether the CPU is running.
	Run	Green	Blinks when the CPU is running.
	Status	Red	Blinks to indicate a new status code has been generated. To view the status code and its description, go to the General > Controller Status property page in the SCADAPack E Configurator software. The status code is also available through analog system point 50020.
	Force	Red	Lit when an I/O point is being forced into a state that does not represent its actual state. This typically occurs during debugging exercises or when a SCADAPack Workbench or ISaGRAF 3 Workbench application locks the I/O point for its own use.
Input and Output	Digital input	Green	Lit when the digital input is active. Blinks when pulses are applied if the digital input is configured to be a counter (SCADAPack 535E only).
	Digital output	Green	Lit when the digital output is active.
USB Host	Status	Green	This LED is under the control of Binary System Point 50753. It can be controlled by a SCADAPack Workbench or ISaGRAF 3 Workbench application or through protocol control commands.
	Store	Green	Blinks when automatic loading of security files from the USB mass storage device into the rPAC is successfully completed.
Eth1, Eth2, Eth3	Left side of the physical port	Green	Activity LED. Lit when the Ethernet port is active. Blinks when the port is transmitting or receiving data.
	Right side of the physical port	Yellow	Link LED. Lit when 10/100 Ethernet link is active.

Modem ¹	TxD	Green	Lit when the (optional) cellular modem is transmitting data.
	RxD	Green	Lit when the (optional) cellular modem is receiving data.
	Link	Green	Lit when the (optional) cellular modem has an active network connection.
Serial1 and Serial2	CTS	Green	Lit when the CTS input is active on the port.
	DCD	Green	Lit when the DCD input is active on this serial port.
	Left side of the physical port	Yellow	Blinks when the port is transmitting data over the RS232 serial connection.
	Right side of the physical port	Green	Blinks when the port is receiving data over the RS232 serial connection.
Serial3 and Serial4	Left side of the physical port	Yellow	Blinks when data is being transmitted over the RS232 or RS485 serial connection. If the port is configured for RS485, the LEDs on the empty port indicate that data is being transmitted over the wired RS485 connection.
	Right side of the physical port	Green	Blinks when data is being received over the RS232 or RS485 serial connection. If the port is configured for RS485, the LEDs on the empty port indicate that data is being received over the wired RS485 connection.

¹ The cellular modem is expected to be available in a future release.

13.2 Accessing Diagnostics

The rPAC provides diagnostics for several aspects of rPAC communications and exceptional operating conditions. The following operational diagnostics are specifically supported:

- DNP3 diagnostics at each protocol layer, including network routing.
- TCP/IP diagnostics including DNP3 over IP, IP servers and TCP service ports.
- PLC communication diagnostics including protocol packet displays, communication status and device status for serial and network PLC services.
- rPAC system diagnostics.

The operational information provided during a diagnostic display session can assist in troubleshooting. To sort these diagnostics from normal operational messages, it may be advantageous to disable DNP, TCP/IP, PLC and system diagnostics using the DNPDIAG, TCPDIAG, PLCDIAG and SYSDIAG commands from the command line. Other rPAC diagnostics use the following format to assist in identifying messages from various rPAC tasks:

Task-name>>diagnostic text

To Access Diagnostics

Use a command line in a diagnostic display session to query the rPAC's operational status. The commands available are detailed in the SCADAPack E Operational Reference Manual.

There are three main ways to access command line diagnostics:

- Using an ASCII terminal connected to any rPAC serial port configured for the **Cmd Line** function. This is the method used to display startup diagnostics. For details, see [Startup Diagnostics](#)¹²⁵. To access a diagnostic display session, use the **DIAG** command as described in the SCADAPack E Operational Reference manual.
- Using an ASCII terminal connected to any rPAC serial port configured for the **ISaGRAF** function. Enable the SCADAPack Workbench or ISaGRAF 3 Workbench functionality to enter command line mode through an ISaGRAF port. To access the command line, press the **Enter** key three times. To return to SCADAPack Workbench or ISaGRAF 3 Workbench debugging mode, type the **BYE** command.

NOTICE

UNINTENDED EQUIPMENT OPERATION

For correct SCADAPack Workbench or ISaGRAF 3 Workbench operation, issue the BYE command prior to disconnecting the ASCII terminal.

Failure to follow these instructions can result in equipment damage.

- Using Telnet over TCP/IP links. Multiple Telnet sessions may be established with the rPAC on the same TCP/IP interface, or multiple sessions may be simultaneously established on multiple TCP/IP interfaces.

Where a direct serial connection or Telnet is not available, diagnostics can be directed to an rPAC file. This is achieved using the **FILEDIAG** command described in the SCADAPack E Operational Reference Manual. This diagnostics log file can then be retrieved for analysis using DNP3 file transfer.

You can also use the **Transfer > Remote Command Line** menu option in SCADAPack E Configurator to access the command line interface for remote SCADAPack ES units through a virtual terminal window over DNP3 links. The rPAC does not need to be configured with a **Cmd Line** or **ISaGRAF** port to access this functionality.

13.3 Startup Diagnostics

At startup, the rPAC displays information about its startup sequence and configuration in ASCII text format through any port configured for the **Cmd Line** function. By default, Serial4 (Port 4) on the rPAC is configured for the **Cmd Line** function.

Once startup is complete, the rPAC terminates the diagnostic session and enters command mode unless you have configured it to remain in the diagnostic display session. Use the SYSDIAG **OVERRIDE** command described in the SCADAPack E Operational Reference Manual to configure the rPAC to remain in the diagnostic display session when startup is complete.

To access command line mode from a diagnostic display session, press the **Esc** (Escape) key on your keyboard.

13.4 Battery Voltage, Supply Voltage, and Internal Temperature

Analog system points are used to measure rPAC battery voltage, input supply voltage, and the ambient temperature of the rPAC controller board. Use the SCADAPack E Configurator software to add the system points you want to measure to the rPAC points database.

Once defined, system points can be accessed directly from a user application or through remote communications.

Battery Voltage

Analog System Point 50061

This analog system point measures the available battery voltage. It is useful for measuring the operating environment of the RTU and returns a floating point value in the range 0...32.767 Vdc.

- Use the system point directly by assigning a point of this point number (50061) in the RTU database.
- Read the system point into a user-created SCADAPack Workbench or ISaGRAF 3 Workbench application as an integer or real variable from an input board connection.

Supply Voltage

Analog System Point 50060

This analog system point measures the incoming power supply. It is useful for measuring the operating environment of the RTU and returns a floating point value in the range 0...32.767 Vdc.

- Use the system point directly by assigning a point of this point number (50060) in the RTU database.
- Read the system point into a user-created SCADAPack Workbench or ISaGRAF 3 Workbench application as an integer or real variable from an input board connection.

Internal Temperature

Internal Temperature °C

Analog System Point 50062

This analog system point measures the ambient temperature at the controller board in degrees Celsius. It is useful for measuring the operating environment of the controller board and returns an integer value in the range -40...75. Temperatures outside this range cannot be measured.

- Use the system point directly by defining an analog system point with the point number 50062 in the rPAC points database.
- Read the system point into a user-created SCADAPack Workbench or ISaGRAF 3 Workbench application as an Integer or Real variable from an input board connection.

Internal Temperature °F

Analog System Point 50063

This analog system point measures the ambient temperature at the controller board in degrees Fahrenheit. It is useful for measuring the operating environment of the controller board and returns an

integer value in the range $-40\dots167$. Temperatures outside this range cannot be measured.

- Use the system point directly by assigning an analog system point with the point number 50063 in the rPAC points database
- Read the system point into a user-created SCADAPack Workbench or ISaGRAF 3 Workbench application as an Integer or Real variable from an input board.

13.5 Power Supply and Battery Status

Internal binary system points are used to indicate the status of the rPAC power supply and the onboard back-up RAM battery. These can be accessed from a user-created application or through remote communications.

Use the SCADAPack E Configurator software to add the system points you want to measure to the rPAC points database.

Local Input Power Supply Low

Binary System Point 50206

This internal binary point indicates the condition of the input power supply. It compares the Supply Voltage System Analog Point 50060 with the low voltage notification level set in SCADAPack E Configurator **General > Controller Settings** property page. If the input power supply is lower than the low voltage notification level then this Binary System Point is activated.

- Use the system point directly by assigning a binary point to this point number (50206) in the rPAC database.
- For SCADAPack Workbench and ISaGRAF 3 Workbench applications, read the status point through an input board connection.

Local On Board Battery Low

Binary System Point 50207

This internal binary point indicates the condition of a monitor on the lithium battery that maintains the non-volatile RAM in the controller. If active, the point indicates that the onboard controller battery needs replacement.

- Use the system point directly by assigning a binary point to this point number (50207) in the rPAC database.
- For SCADAPack Workbench and ISaGRAF 3 Workbench applications, read the status point through an input board connection.

13.6 Communication Statistics

The rPAC provides three types of communication statistics through analog system points:

- SCADAPack E (global) communication statistics
- Port communication statistics
- TCP/IP communication statistics

The analog system points for communication statistics can be read from the rPAC using specific DNP3 point range read requests. Alternatively, they can be read into a SCADAPack Workbench or ISaGRAF 3 Workbench user-created application through input boards or function blocks.

Communication statistics point values can be reset at any time by controlling the relevant system point value and setting it to 0. This may be done by a SCADAPack Workbench or ISaGRAF 3 Workbench application or through DNP3 point controls.

The communication statistics analog system points cannot be directly added to the rPAC points database and returned in DNP3 Class data polls. To map communication statistics points to a SCADA master, the values can be imported into a SCADAPack Workbench or ISaGRAF 3 Workbench application, manipulated if required, then exported to a derived point, which can be configured for access by a SCADA master.

Communication statistics analog system points can be accessed as 16-bit or 32-bit analog input points. For details, see the SCADAPack E Operational Reference Manual.

13.7 Status Codes

This section describes the following rPAC status codes

- [System Status Codes](#) ¹³¹
- [Communication and Device Status Codes](#) ¹³³

13.7.1 System Status Codes

SCADAPack E rPACs provide system status codes through analog system points. The latest status is retained as the value of the system status. DNP3 event reporting may be configured for the system status point to provide a time-stamped history of status codes.

User-defined status codes may be generated through SCADAPack Workbench or ISaGRAF 3 Workbench using the **RTUPARAM** function block with the **SYS_ERR_CODE** parameter.

The status of SCADAPack Workbench and ISaGRAF 3 Workbench applications are reported:

- To the SCADAPack Workbench or ISaGRAF 3 Workbench Debugger if connected locally or remotely
- Through the SCADAPack E system status point
- Through a SCADAPack E diagnostic display session

Status Code	Name	Description
0	Normal	Normal status.
1-99	ISaGRAF target status	See the SCADAPack E Target 3 Technical Reference Manual and the SCADAPack E Target 5 Technical Reference Manual.
100-999	User-defined status	For SCADAPack Workbench, see the RTUPARAM function block in the SCADAPack E Target 5 Function Block Reference Manual. For ISaGRAF 3 Workbench, see the RTUPARAM function block in the Target 5 Function Blocks Reference Manual.
1001-1009	ISaGRAF application load status	Did not load SCADAPack Workbench or ISaGRAF 3 Workbench application files or memory application for targets.
1010-1019	Configuration status	Configuration file status codes.
1020-1029	Profile status	Profile configuration status codes.
1030-1039	Event and trend status	Event storage threshold status codes.
1040-1049	Data processing status	Runtime data processing status codes.
1050-1058	Remote I/O status	Firmware mismatch status codes.
1059	Bootloader status	Bootloader file is corrupt or not valid for this device type.
1400-1401	Mounting status (SCADAPack 530E and SCADAPack 535E only)	Root folder mounting status codes.
1500-1502	Unlicensed application or feature status	A SCADAPack Workbench application (I5P) file written to the device includes functionality that is not licensed on the device.
2000-2999	TCP/IP status	TCP/IP configuration and runtime status. See the SCADAPack E TCP/IP Technical Reference Manual for details.
3000-3099	Extended status	Additional configuration file and firmware update status

Status Code	Name	Description
		codes.

For details about SCADAPack E system status codes, see the Operations Technical Reference Manual.

13.7.2 Communication and Device Status Codes

DNP3 Communication Status

DNP3 communication status is reported by the rPAC through a diagnostic display session as DNP3 driver diagnostic information. These status codes are also reported through the SCADAPack Workbench or ISaGRAF Workbench Peer Communication function blocks in the output **STATUS** variable.

DNP3 communication status is not reported through the system status point.

See the SCADAPack E DNP3 Technical Reference Manual for a complete list of DNP3 communication status codes.

TCP/IP Status

TCP/IP communication and configuration status is reported by the rPAC through a diagnostic display session as TCP/IP diagnostic information. These status codes are also reported through the SCADAPack Workbench or ISaGRAF Workbench TCP/IP function blocks in the output **STATUS** variable.

TCP/IP status is reported through the system status point for incorrect TCP/IP configuration.

See the SCADAPack E TCP/IP Technical Reference Manual for a complete list of TCP/IP communication status codes.

PLC Device Communication Status

Status codes from PLC device drivers on the rPAC are reported through analog system points. These analog system points represent the status of communications between a SCADAPack Workbench or ISaGRAF Workbench PLC device I/O board and a PLC device.

PLC device communication status is not reported through the SCADAPack E system status point.

PLC device communication status codes are detailed in the following manuals:

SCADAPack E Target 3 Technical Reference Manual

SCADAPack E Target 5 Technical Reference Manual

SCADAPack E Modbus Protocol Technical Reference Manual

14 Maintenance

The following sections describe the recommended maintenance activities for the rPAC:

- [Calibration](#)  136
- [Preventive Maintenance](#)  136
- [Routine Maintenance](#)  138
- [Replacing the Battery](#)  141

14.1 Calibration

The rPAC is electronically calibrated at the factory during the manufacturing process and after any repair procedures.

There are no user calibration procedures.

14.2 Preventive Maintenance

Keep circuit boards free from contaminants such as dust and moisture.

WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

WARNING

ELECTRICAL HAZARD

Remove power from the rPAC before removing the rPAC cover.

Remove power from the rPAC before servicing.

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

Battery Handling Procedures

NOTICE

UNINTENDED EQUIPMENT OPERATION

- Treat batteries with care.
- Follow the manufacturers' instructions concerning battery storage, use and disposal.
- Keep batteries clean and free from contaminants or other materials that could short the terminals.
- Connect new batteries using the correct polarity.
- Replace batteries with new units of the same chemistry, capacity and make.
- Observe the manufacturers' instructions regarding disposal of batteries. Considerable energy remains in the battery.

Failure to follow these instructions can result in equipment damage.

Electrostatic Discharge (ESD) Procedures

NOTICE

STATIC ELECTRICITY DAMAGE

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

Failure to follow these instructions can result in equipment damage.

14.3 Routine Maintenance

WARNING

UNINTENDED EQUIPMENT OPERATION

Evaluate the operational state of the equipment being monitored or controlled by the rPAC 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 rPAC before removing the rPAC cover.

Remove power from the rPAC before servicing.

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

NOTICE

STATIC ELECTRICITY DAMAGE

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

Failure to follow these instructions can result in equipment damage.

Primary Power Supply

The primary power for the rPAC is a DC power supply. If this is a mains-operated power supply charger with battery backup, replace the batteries every 36 months or earlier if necessary.

Real-Time Clock and Onboard RAM Back-up Battery

The rPAC includes a lithium-powered back-up battery on the controller board. The main task of the battery is to back-up the microprocessor RAM chips and the real-time clock. However, the back-up battery also maintains the rPAC configuration during a power-supply interruption.

rPAC memory contents are lost when:

- The onboard RAM back-up battery goes flat.
- The onboard RAM back-up battery is replaced while power to the rPAC is disconnected.

When memory contents are lost, you will need to reload rPAC configuration information and user-created applications for correct rPAC operation.

NOTICE

DATA LOSS

Before replacing the onboard RAM back-up battery, save a copy of the rPAC configuration information, user-created applications, logs and other data to an external drive so it can be reloaded when the procedure is complete.

Failure to follow these instructions can result in equipment damage.

The onboard RAM back-up battery will retain the rPAC configuration for at least two years if the unit is not powered. Replace the battery after every five years of continuous use, or earlier if necessary.

RAM back-up batteries are not rechargeable.

Power Supply Notifications

The rPAC provides notifications for the following:

- [Onboard lithium battery low](#)¹²⁸
- [Input power supply low](#)¹²⁸

If an Input Power Supply low notification is generated, it may be due to power supply interruption, and/or low voltage on primary DC backup batteries.

Cleaning

There are no special cleaning instructions for this product.

Routine Maintenance Schedule

The frequency of routine maintenance depends on the specific piece of equipment and the environment in which it is installed. Routine maintenance is recommended at two time-intervals:

- Every three years
- Every five years

The following table summarizes the recommended frequency for maintenance procedures. In some cases, the period stated is the maximum interval between maintenance activities. Experience, or the high usage of a particular piece of equipment, may determine that maintenance procedures need to be performed more frequently than indicated in the table

Items requiring re-calibration may not be suitable for user servicing. [Contact Schneider Electric for advice](#)

8.

Routine Maintenance Schedule

Component	Every Three Years	Every Five Years
Connections and ground points	Check and replace if necessary	
Power supply units		Check and replace if necessary
Modems	Check and replace if necessary	
RAM back-up battery	Check and replace if necessary	Replace the battery when it has been installed for five years

14.4 Replacing the Battery

WARNING

EXPLOSION HAZARD

Do not attempt to replace the onboard battery when the device is being used for ATEX or IECEx applications.

If the battery needs to be replaced, contact Schneider Electric Technical Support.

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

A flat-package lithium battery located on the controller board provides back-up power to the rPAC's real-time clock and RAM memory.

Replace this battery with one of the following 3.6 V lithium batteries recommended by Schneider Electric as soon as possible after the rPAC reports that the RAM battery status is low and at the intervals recommended in the [Routine Maintenance](#) ¹³⁸ section.

- Tadiran TL-5186
- Omni Cell ER22G68
- Eve Energy ER22G68

The RAM battery status is provided on the Controller Status property page in the SCADAPack E Configurator software. Take care not to confuse this status with an external power supply low condition. The procedure below requires the rPAC to be powered off briefly. It also requires restarting the rPAC in Cold Boot mode. Before proceeding, carefully review the precautions below.

Back-Up Data Before Replacing the Battery

rPAC memory contents are lost when:

- The onboard RAM back-up battery goes flat.
- The onboard RAM back-up battery is replaced while power to the rPAC is disconnected, as required in the procedure below.
- The rPAC is started in Factory Boot mode or in Cold Boot mode. Starting in Cold Boot mode is required in the procedure below.

When memory contents are lost, you will need to reload rPAC configuration information and user-created applications for correct rPAC operation.

NOTICE

DATA LOSS

Before replacing the onboard RAM back-up battery or starting the rPAC in Factory Boot mode or Cold Boot mode, save a copy of the rPAC configuration information, user-created applications, logs and other data to an external drive so it can be reloaded when the procedure is complete.

Failure to follow these instructions can result in equipment damage.

To Replace the Onboard RAM Back-up Battery

1. Back-up configuration information, user-created applications, logs and other data to an external drive.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Evaluate the operational state of the equipment being monitored or controlled by the rPAC before removing power.

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

2. Remove power from the rPAC.

NOTICE

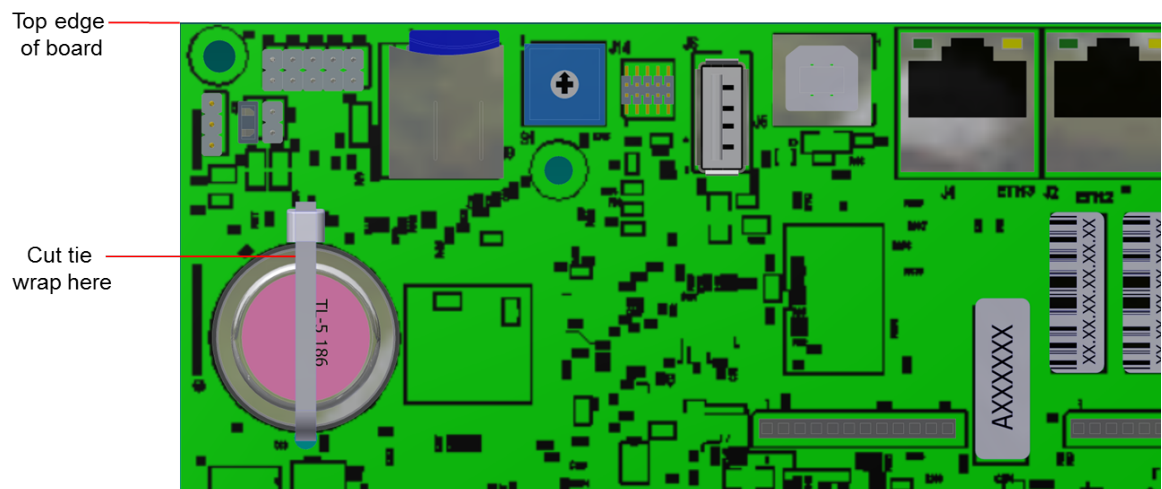
STATIC ELECTRICITY DAMAGE

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

Failure to follow these instructions can result in equipment damage.

3. Put on an anti-static wrist strap and verify that it is connected to ground.
4. Remove the rPAC cover.
5. Keeping your cutting tool away from the circuit board, carefully cut the tie wrap on the side of the battery that is closest to the top edge of the board.

The figure below indicates where to cut the tie wrap.



6. Gently remove the battery from its socket.
7. Insert the new 3.6 V lithium battery. The tie wrap is intended to keep the battery in place during

shipping and does not need to be replaced.

8. Reattach the rPAC cover.
9. Apply power to the rPAC and start it in Cold Boot mode by holding the **Select** button down for 20 seconds until the **Status** LED begins blinking on and off.
10. In SCADAPack E Configurator, use the **Transfer > Set RTU** time to reset the time on the rPAC.
11. Reload the rPAC configuration and user-created applications from back-up.

14.5 Updating Firmware

On the SCADAPack 535E, you can update:

- Controller board operating system firmware in offline or online mode
- Controller board boot monitor firmware in offline or online mode
- I/O board firmware

NOTICE

INCOMPATIBLE FIRMWARE VERSIONS

Before you install any firmware updates, check the Release Notes for the firmware update to determine the most suitable firmware versions for the functionality you are using and to confirm version compatibility.

Failure to follow these instructions can result in equipment damage.

For the procedures to update firmware, see the SCADAPack E Firmware Update User Manual.

15 Specifications

Disclaimer: Schneider Electric reserves the right to change product specifications without notice. If you have questions about any of the specifications, contact [Technical Support](#)  8.

The following topics provide detailed hardware specifications for the SCADAPack 535E, its ports and its inputs and outputs.

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15.1 General

Environment	-40...70 °C (-40...158 °F) operating temperature when the unit is mounted horizontally on a vertical surface -40...65 °C (-40...149 °F) operating temperature when the unit is mounted in any other position -40...85 °C (-40...185 °F) storage temperature 5...95% relative humidity, non-condensing Pollution Degree 2, Installation Category I, Indoor use
Elevation	3,000 m (9,842 ft)
Terminations	3.3...0.08 mm ² (12...28 AWG), solid or stranded
Packaging	Corrosion-resistant zinc-plated steel with black enamel paint
SCADAPack 530E Dimensions	151 mm (5.9 in) wide 135 mm (5.3 in) high 75 mm (3.0 in) deep
SCADAPack 535E Dimensions	151 mm (5.9 in) wide 182 mm (7.2 in) high 87 mm (3.4 in) deep
Mechanical 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

15.2 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
Power Requirements at 30 Vdc	SCADAPack 530E: 3.7 W SCADAPack 535E: 4.8 W USB Host port (5 Vdc at 100 mA): 0.6 W Serial port (5 Vdc at 250 mA): 1.5 W
Maximum System Configuration with 6000 Series I/O Expansion Modules Only	SCADAPack 530E plus 4 6601 I/O expansion modules SCADAPack 530E plus 3 6601 I/O expansion modules plus serial port 5 Vdc SCADAPack 535E plus 3 6601 I/O expansion modules SCADAPack 535E plus 2 6601 I/O expansion modules plus serial port 5 Vdc USB 5 Vdc at 100 mA permissible in any configuration
Maximum System Configuration with a Mix of 5000 Series and 6000 Series I/O Expansion Modules	SCADAPack 530E using 3.7 W plus any combination of serial port, USB Host port, and I/O expansion modules up to 5.4 W SCADAPack 535E using 4.8 W plus any combination of serial port, USB Host port, and I/O expansion modules up to 4.3 W
Maximum Power Requirements	SCADAPack 530E: 9.1 W SCADAPack 535E: 9.1 W
Isolation	Controller board 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)

15.3 Controller Board

Processor	ST SPEAr 1380 32-bit, dual-core Cortex™ A9 microcontroller
Floating Point	Integrated Hardware Floating Point Unit
CPU Speed	Up to 600 MHz
Memory	128 MB NAND Flash 128 MB DDR3 RAM
Non-volatile RAM	Non-volatile CMOS SRAM with lithium battery retains content for up to two years when not connected to an active power source
Internal Analog Inputs	Power input: 37 Vdc full scale. Accuracy is 0.5% of full scale. Onboard lithium battery: 4 Vdc full scale. Accuracy is 0.5% of full scale. 5 Vdc power supply: 6 Vdc full scale. Accuracy is 0.5% of full scale. 3.3 Vdc power supply: 4 Vdc full scale. Accuracy is 0.5% of full scale
Internal Temperature Monitor	Controller temperature: -40...75 °C (-40...167 °F)
Clock Calendar	±15 seconds per month at -15...60 °C (5...140 °F)

15.4 Data Capacity

Maximum Database Points	Approximately 20,000, which can be DNP3 points, Modbus registers, or both Reduced if event pool increased above approximately 7,000 events
Maximum DNP3 Events	40,000 Reduced if database points increased above approximately 10,000 points
Maximum Data Concentrator Points	Approximately 15,000 Reduced if Maximum Database Points is less than 15,000
Maximum Data Concentrator Devices	Approximately 100, which can be DNP3, Modbus, or DF1
File System Typical Storage	10 MB
Maximum Trend Sample Files	400 (when no user programming used)
Remote Upload Trend Data: Integers	100,000
Remote Upload Trend Data: Floats	50,000
Trend Aggregation	Up to 10 MB with Restart History used in ISaGRAF 3 or SCADAPack Workbench See the SCADAPack E Trend Sampler Technical Manual for details
Local Access Aggregated Trend Data: Integers	2,500,000
Local Access Aggregated Trend Data: Floats	1,250,000
USB Host Storage	Single-partition plug-in USB mass storage devices up to 32 GB File format: FAT32

15.5 Communications

Serial1...4	5 Vdc at 250 mA available 8-pin modular jack connector (RJ45) Baud rates up to 115,200 bps
Serial1, 2	RS232 signals: TxD, RxD, CTS, RTS, DCD, DTR
Serial3, 4	RS232 signals: TxD, RxD RS485: 2-wire half-duplex operation
Cable Length	RS232: Maximum 15 m (50 ft) RS485: Maximum 1200 m (3937 ft)
Protection	RS232 ports are rated to ± 15 kV (IEC 61000-4-2, Air Discharge) static protection
Ethernet 1, 2, 3	10/100 Mbps UTP (10/100Base-T) transformer isolated
USB Host Port	USB 2.0-compliant A-type receptacle Supports USB mass storage devices up to 32 GB Supports communications at 1.5 Mb/s and 12 Mb/s
USB Device Port	USB 2.0-compliant B-type receptacle Supports communications at 1.5 Mb/s and 12 Mb/s
I/O Bus	I/O expansion module bus. The rPAC supports the following I/O expansion modules: • 5304 Analog Output Module • 5405 Digital Input Module • 5414 Digital Input Module • 5415 Relay Output Module • 5506 Analog Input Module • 6601 Input/Output Module with optional analog output module
Maximum Modbus/TCP Server Connections	Fixed: 20

15.6 Digital and Counter Inputs

Controller Board

Digital Inputs

Typical Operating Voltage	12 Vdc 24 Vdc
Turn-on Voltage	Minimum: 8 Vdc
Turn-off Voltage	Maximum: 4 Vdc
Over-Voltage Tolerance	36 Vdc sustained over-voltage without foreseeable damage
Input Current	0.35...0.45 mA at 12 Vdc 0.75...0.85 mA at 24 Vdc
Time Stamping	10 ms Sequence of Event (SOE)
Isolation	Ground return connected to chassis ground
Cable Length	Maximum: 3 m (9.84 ft)

I/O Board

Digital Inputs

Typical Operating Voltage	12 Vdc 24 Vdc
Turn-on Voltage	Minimum: 9 Vdc
Turn-off Voltage	Maximum: 4 Vdc
Over-Voltage Tolerance	36 Vdc sustained over-voltage without foreseeable damage
Input Current	0.9...1.2 mA at 12 Vdc 2.1...2.4 mA at 24 Vdc
Time Stamping	1 ms Sequence of Event (SOE)
Isolation	Isolation is in 2 groups of 8 Isolation from device logic and chassis 1000 Vac or 1500 Vdc

Counter Inputs

Electrical Characteristics	Shared with digital input channels
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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

15.7 Digital Outputs

Controller Board

Description	Sinking MOSFET output
Power Rating	30 Vdc, 0.5 A
Isolation	Ground return connected to chassis ground
Cable Length	Maximum: 3 m (9.84 ft)

I/O Board

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 device 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	Mounted horizontally on a vertical surface: - 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) Mounted in any other position: - 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

15.8 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 μ V on the 5 Vdc 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 Vdc range 2.4 μ A resolution on the 20 mA range
Accuracy	$\pm 0.1\%$ of full scale at 25 $^{\circ}$ C (77 $^{\circ}$ F) $\pm 0.2\%$ over-temperature range
Isolation	250 Vac from device logic and chassis 60 Vdc between inputs Transformer
Input Resistance	250 ohms in current configuration 800 kohms in voltage configuration
Range	Input Type: 4...20 mA, 0...20 mA, 1...5 Vdc, or 0...5 Vdc Under-range: 4...20 mA measures to 0 mA, 1...5 Vdc measures to 0 Vdc Individual inputs can be configured for current or voltage operation using DIP switches. Calibration in voltage mode 1...5 Vdc 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)

15.9 Analog Outputs

Type	Uni-polar
Resolution	12-bit over 0...20 mA range
Accuracy	±0.15% at 25 °C (77 °F) ±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 device logic and chassis
Range	0...20 mA 4...20 mA Voltage output may be accomplished with external precision resistor
Status & Reporting	Power missing 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

16 Standards and Certifications

Introduction

SCADAPack E rPACs are 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

CE Marking Compliance

For the latest information regarding product compliance with European Directives for CE marking, refer to the EU Declaration of Conformity issued for your product at www.schneider-electric.com

For the latest information regarding product compliance with RoHS, WEEE directives and REACH regulation, visit the Schneider Electric **Check a Product** portal at www.reach.schneider-electric.com

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
- ATEX (European directive 2014/34/EU) in defined atmosphere Zone 2 according to EN 60079-0 and EN 60079-15
- IECEx in defined atmosphere Zone 2 according to IEC 60079-0 and IEC 60079-15

Specific Countries

For Australia and New Zealand: ACMA requirements for RCM marking

For United States: FCC Part 15 Subpart B Class A

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