

SCADAPack E

334E 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.

4 Documentation Check

Before you begin installation, verify that you are viewing the correct documentation. If your SCADAPack E Smart RTU looks like this (with green connectors, black controller and I/O boards and the Ethernet port oriented such that you can plug in the cable from the front), continue with this manual.



SCADAPack 334E Smart RTU

If your SCADAPack E Smart RTU looks like this (with white connectors, green controller and I/O boards and the Ethernet port oriented such that you have to plug in the cable from below), you will need to get the SCADAPack 330E Hardware Manual (Legacy) and the SCADAPack 5607 Hardware Manual (Legacy).

To access the legacy hardware manuals, select the **Start or Windows** icon, then navigate to the **Schneider Electric** folder and select **SCADAPack E > User and Reference Manuals > Legacy Hardware Manuals**.



SCADAPack 334E Smart RTU

5 About this Manual

Audience

This manual is written for people who need to install, troubleshoot or maintain the remote terminal unit (RTU) hardware. These individuals are typically:

- Systems Engineers
- Commissioning Engineers
- Maintenance Technicians

Scope

This manual describes:

- The physical design of the RTU, 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 RTU.
- Diagnostics capabilities on the RTU.
- Maintenance recommendations for the RTU.

Product Related Information

WARNING

UNINTENDED EQUIPMENT OPERATION

The application of this product requires expertise in the design and programming of control systems. Only persons with such expertise should be allowed to program, install, alter and apply this product.

Follow all local and national safety codes and standards.

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

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
Updating firmware on your RTU	SCADAPack E Firmware Update Technical Reference Manual
Configuring your RTU to communicate with other 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 RTU	Security Quick Start Guide Security Administrator User Manual Security Technical Reference Manual
Operating and troubleshooting your RTU	SCADAPack E Operational Reference Manual
Installing SCADAPack E Target 5 Workbench, using it to build custom applications for the RTU and downloading the applications to the RTU	SCADAPack Workbench Quick Start Guide SCADAPack E Target 5 Technical Manuals
Installing ISaGRAF 3 Workbench, using it to build custom applications for the RTU and downloading the applications to the RTU	ISaGRAF 3 Workbench Quick Start Guide SCADAPack E Target 3 Technical Manuals
Adding I/O expansion modules	SCADAPack E I/O Expansion Technical Reference Manual SCADAPack E System Configuration Guide I/O Expansion Module Hardware Manuals

6 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>

7 About the SCADAPack 334E

The SCADAPack E Smart RTU (Remote Terminal Unit) is an intelligent microprocessor-based telemetry and control device. It features extensive communications capabilities including Ethernet and USB interfaces and a powerful embedded micro-controller to provide the user with sophisticated telemetry and control in an Open System Environment (OSE).

Many operational facilities can be configured, depending on the required telemetry and control application. This manual describes the hardware aspects of the RTU.

The RTU has an extensive on-board I/O capability. The on-board switch mode power supply allows a wide range of voltage operation from a single external voltage supply (11...30 Vdc).

The use of flash memory chips allows new firmware to be downloaded both locally and remotely via the interfaces of the RTU, without removing it from its enclosure or removing the cover.



Communications

The SCADAPack E Smart RTU includes three serial ports that are available for communications with the SCADA master system, with other RTUs, with devices such as Programmable Logic Controllers (PLCs), and with the local configuration software. It also includes one USB 2.0 compliant device port for local

configuration and to connect to other devices.

The SCADAPack E RTU supports DNP3 to Subset Level 4 slave implementation with a range of additional features from the DNP3 standard.

In summary, the RTU provides the following facilities for use of DNP3:

- SCADA data configuration
- Simultaneous DNP3 operation on multiple ports
- Networking DNP3 frames
- Peer-to-peer communication
- DNP3 over TCP/IP LAN and WAN networks.

Configuration

You can configure the RTU using three different methods:

- Locally or remotely using SCADAPack E Configurator, a software application that runs on a desktop or laptop computer that is connected to the RTU through the USB device port or through any of the available serial ports or the Ethernet port (if available).
- 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 RTU. 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 RTU, 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 RTU. For information about using the ClearSCADA software, see the ClearSCADA documentation.

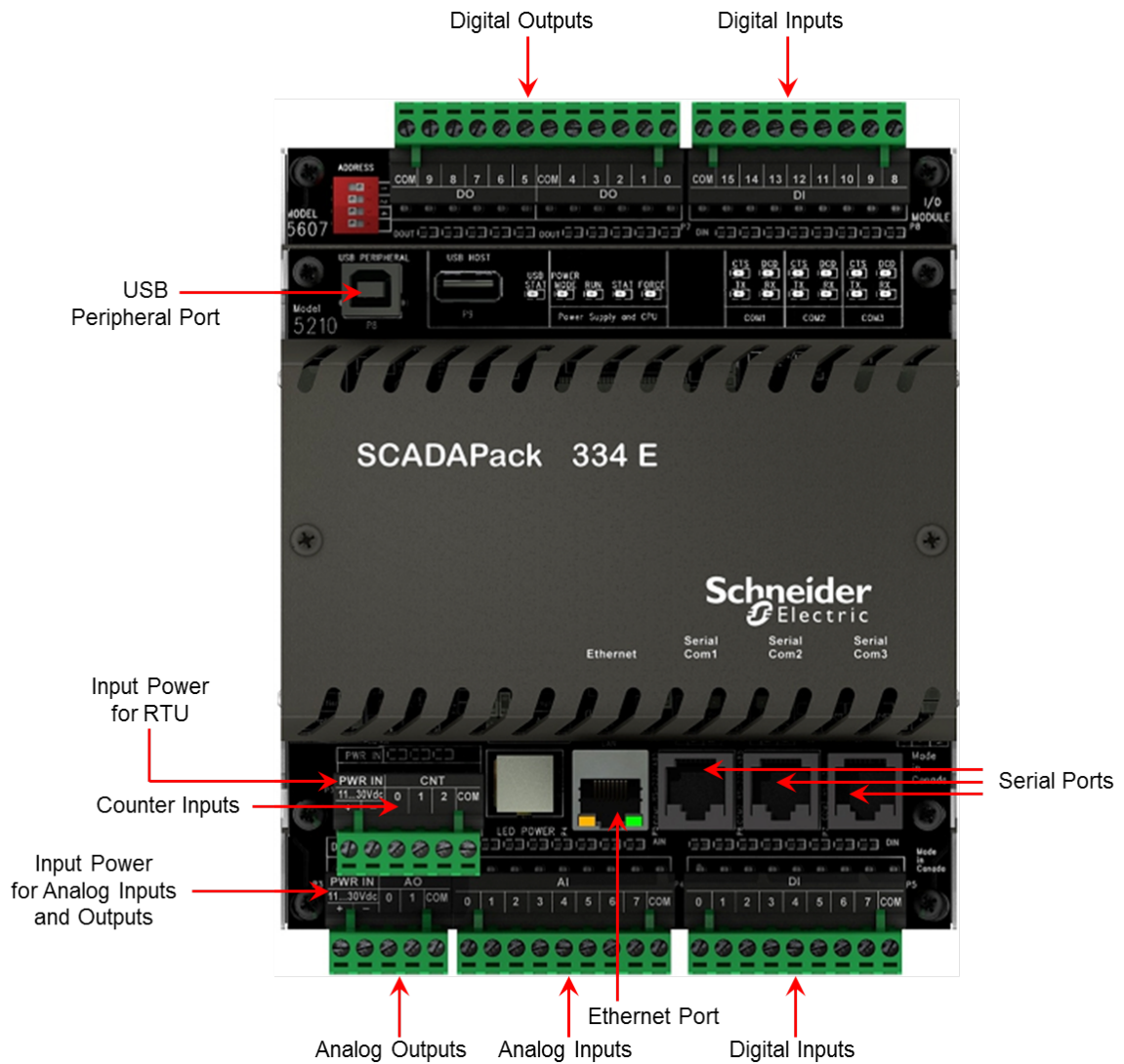
RTU configurations are maintained in the on-board battery backed RAM and may be modified locally or remotely.

Security

The RTU 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.

8 Hardware Overview

The following figure shows the inputs, outputs and ports on the RTU.



The hardware of the SCADAPack E Smart RTU is described in the following sections:

[CPU, RAM and Storage](#) ^[20]

[Power Supply and Back-up Battery](#) ^[21]

[Serial Ports](#) ^[22]

[Ethernet Port](#) ^[36]

[USB Port](#) ^[37]

[Inputs and Outputs](#) ^[40]

8.1 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 RTU provides internal flash storage and support for USB devices through the USB peripheral port. The internal flash storage is described here. For more information about support for the USB peripheral port, see [USB Port](#) ³⁷.

Operating System Flash

The operating system flash memory stores the RTU 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 RTU front cover.

Boot Monitor Flash

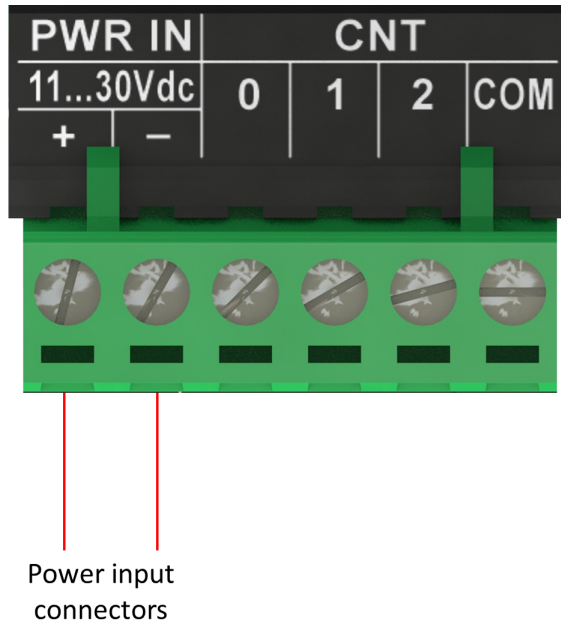
The boot monitor firmware resides in a separate flash memory chip on the controller board. The boot monitor firmware is the first code executed by the CPU when power is applied to the RTU. It configures the RTU hardware then verifies, loads and executes the operating system firmware.

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

8.2 Power Supply and Back-up Battery

The RTU is powered by an 11...30 Vdc power supply that is connected to the power input connectors on the RTU.

The illustration below shows the location of the power input connectors.



The analog inputs and outputs require their own power supply connection. See the following sections for details:

[Analog Input Wiring Example](#)^[100]

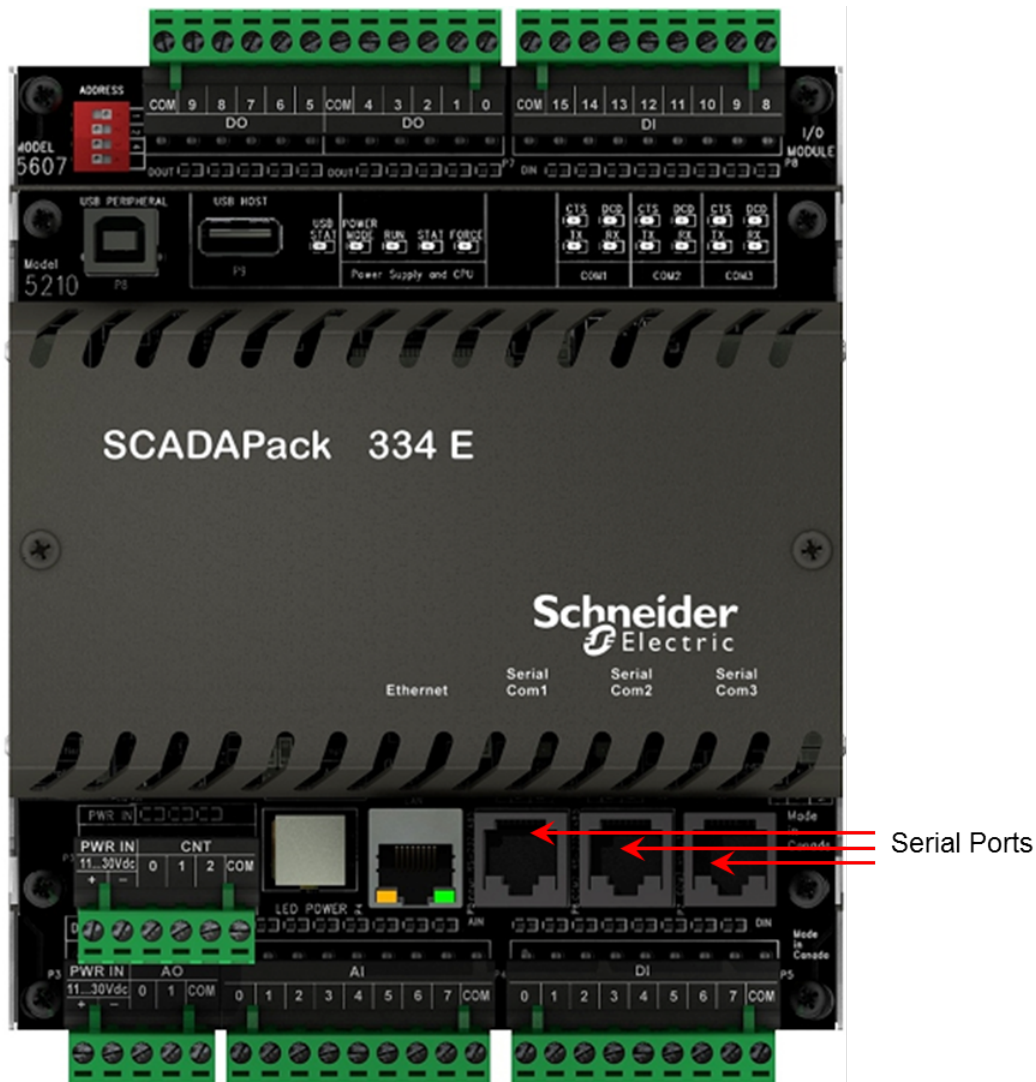
[Analog Output Wiring Example](#)^[105]

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

For details about power supply requirements and wiring, see [Power Supply Requirements](#)^[58].

8.3 Serial Ports

The figure below shows the three serial communication ports, labeled COM1, COM2, and COM3.



Communications

The SCADAPack E Smart RTU includes three serial ports that are available for communications with the SCADA master system, with other RTUs, with devices such as Programmable Logic Controllers (PLCs), and with the local configuration software. It also includes one USB 2.0 compliant device port for local configuration and to connect to other devices.

The SCADAPack E RTU supports DNP3 to Subset Level 4 slave implementation with a range of additional features from the DNP3 standard.

These ports correspond to Port 1, Port 2 and Port 3 when using SCADAPack E Configurator and in SCADAPack E diagnostics.

- COM1 can be configured for RS232 or 2-wire RS485.

- COM2 can be configured for RS232 or 2-wire RS485.
- COM3 is a dedicated RS232 port.

In summary, the RTU provides the following facilities for use of DNP3:

- SCADA data configuration
- Simultaneous DNP3 operation on multiple ports
- Networking DNP3 frames
- Peer-to-peer communication
- DNP3 over TCP/IP LAN and WAN networks

For more information, refer to the following topics:

[RS232 Serial Communications Ports](#)  ²⁴

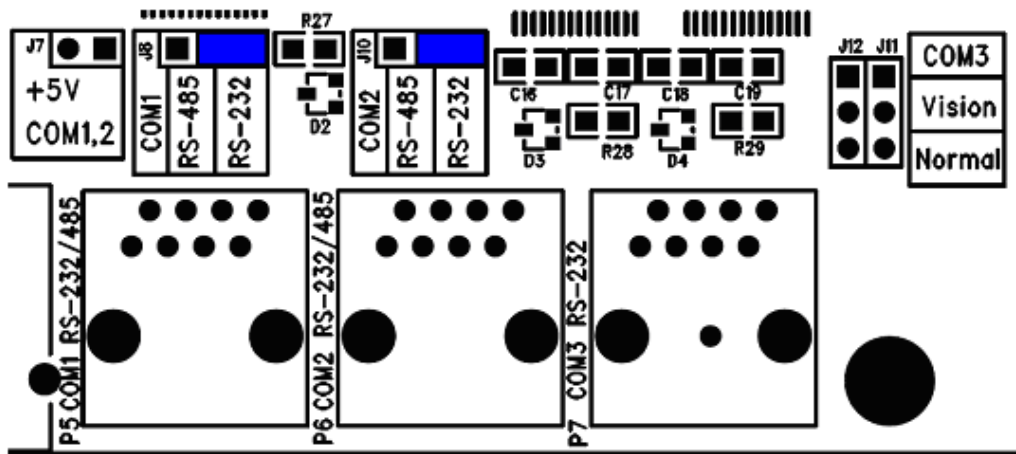
[RS485 Serial Communications Ports](#)  ³²

8.3.1 RS232 Serial Communications Ports

COM1, COM2 and COM3 support RS232 communication. Use shielded cable for RS232 wiring and connect the shield to chassis ground at one point. Improperly shielded cable may result in the installation not complying with Federal Communications Commission (FCC) or Department of Communications (DOC) radio interference regulations.

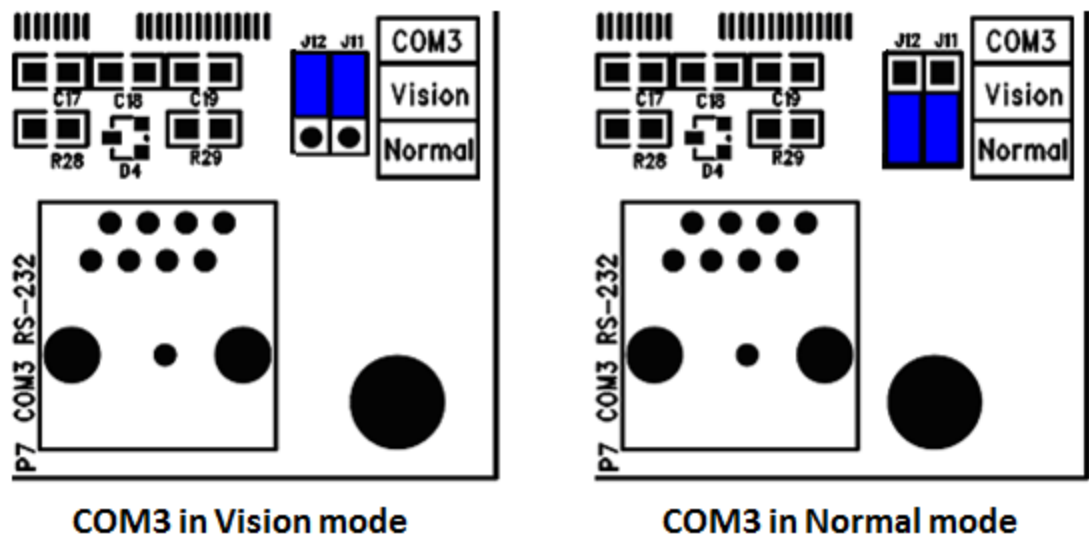
Serial ports COM1 and COM2 can be configured as either a six-line RS232 port or as a two-wire RS485 port. This section covers RS232 operation.

See the figure below for locations of the jumpers required to configure COM1 and COM2 for RS232 operation. COM1 (J8) and COM2 (J10) are both shown configured as RS232.



COM3 is designed to operate with the SCADAPack Vision operator interface and has several features not found on COM1 and COM2. Two of the signals (DTR and DCD) are shared with the test signals used to detect the ON switch closure on the Vision interface. To use the signals as DTR and DCD, install jumpers J11 and J12 in position **Normal**. To use the COM3 port with a Vision interface, install jumpers J11 and J12 in position **Vision**.

For proper operation, install jumpers J11 and J12 in the same position, either **Vision** or **Normal** as shown in the figure below.



For more information, see the following sections:

[COM1 and COM2 RS232 Serial Ports](#)^[26]

[COM3 RS232 Serial Port](#)^[29]

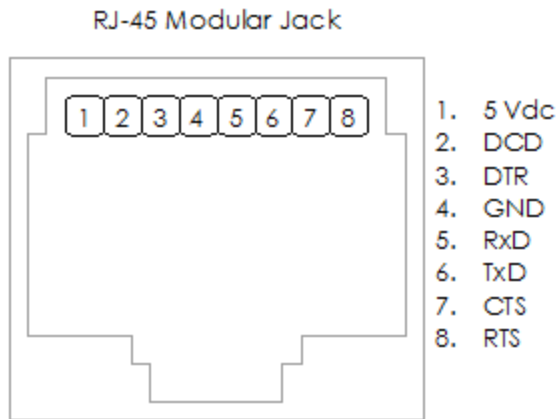
8.3.1.1 COM1 and COM2 RS232 Serial Ports

The following table provides a description of the connections and functions of each pin of the RJ-45 modular jack connector. In this table a MARK level is a voltage of 3 Vdc or greater and a SPACE level is a voltage of -3 Vdc or lower.

Modular Jack Pin	COM1 (J8=RS232)	COM2 (J10=RS232)	Description
1	5 Vdc (Output)	5 Vdc (Output)	This pin can be connected to the 5 Vdc power supply by installing a jumper at J14 on the RTU. This 5 Vdc output is used to power Vision terminals and other Schneider Electric accessories. Check that cables connecting this pin have no voltage applied.
2	DCD (Input)	DCD (Input)	The DCD led is on for a MARK level.
3	DTR (Output)	DTR (Output)	This pin is normally at a MARK level. This pin is at a SPACE level when DTR is de-asserted.
4	GND	GND	This pin is connected to the system ground.
5	RxD (Input)	RxD (Input)	The level is SPACE on standby and MARK for received data. The LED is lit for a MARK level.
6	TxD (Output)	TxD (Output)	The level is SPACE on standby and MARK for transmitted data. The LED is lit for a MARK level.
7	CTS (Input)	CTS (Input)	This level needs to be a MARK for the communication port to transmit data. When the attached device does not provide this signal, the controller keeps the line at a MARK. When the attached device does provide this signal, it needs to set CTS to MARK to allow the controller to transmit data.
8	RTS (Output)	RTS (Output)	This pin is a MARK if full-duplex operation is selected for the port. This pin is set to a MARK just before and during transmission of data if half-duplex operation is selected. This pin is set to a SPACE when no data is being transmitted. The LED is ON for a MARK level.

COM1 and COM2, when configured for RS232 operation, have six signal lines implemented, plus signal ground and a configurable 5 Vdc output. Refer to the table below for the pinout of the connectors.

The following diagram shows the pin connections for the RS232 (RJ-45) port connector for COM1 or COM2 operating in RS232 mode.



The following table shows the serial and protocol communication parameters supported by COM1 and COM2. These parameters are set from SCADAPack E Configurator or from an application program running on the RTU. Default values are set when a factory defaults initialization (Cold Boot) is performed on the RTU.

Function	Port Mode	Baud	Data Mode
NONE (default for COM1)	RS232 (RTS On) (default for COM2)	300 bps	8-bit No Parity 1 Stop Bit (default)
ISaGRAF	RS232 (RTS Keyed)	600 bps	8-bit Even Parity 1 Stop Bit
DNP3 (default for COM2)	RS485 2w (default for COM1)	1200 bps	8-bit Odd Parity 1 Stop Bit
Command Line	Hayes Modem	2400 bps	7-bit Even Parity 1 Stop Bit
PLC Device	Hayes Pool (COM1 only)	4800 bps	7-bit Odd Parity 1 Stop Bit
ISaGRAF-User	GPRS	9600 bps (default)	8-bit No Parity 2 Stop Bits
PPP/TCPIP	1xRTT	19200 bps	
TCP Service	RS232 (RTS Off)	38400 bps	
Modbus Master (Modbus RTU)		57600 bps	
Modbus Slave		115200 bps	
DNP VT Service			
IEC60870-5-103 Master			
IEC60870-5-101 Slave			

NTP GPS Receiver			
SLIP			
CSLIP			

When referenced in SCADAPack E Configuration and Diagnostic facilities, COM1 is known as Port 1 and COM2 is known as Port 2.

8.3.1.2 COM3 RS232 Serial Port

The following table provides a description of the connections and functions of each pin of the RJ-45 modular jack connector. In this table a MARK level is a voltage of 3 Vdc or greater and a SPACE level is a voltage of -3 Vdc or lower.

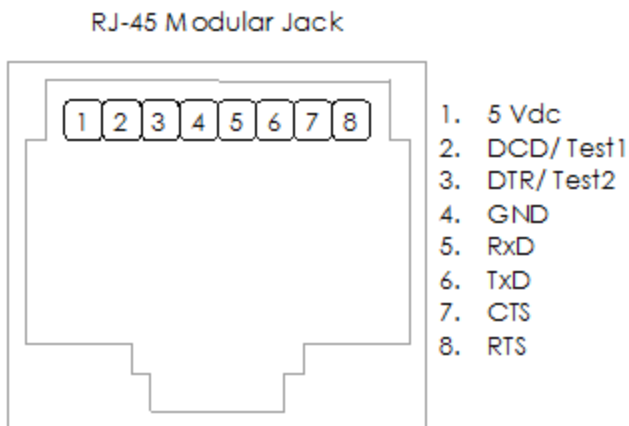
Modular Jack Pin	COM3	Description
1	5 Vdc Vision Power	This pin can be connected to the 5 Vdc power supply by installing a jumper at J14 on the RTU. This 5 Vdc output is used to power Vision terminals and other Schneider Electric accessories. Check that cables connecting this pin have no voltage applied.
2	DCD/Test1 (Input)	The DCD led is on for a MARK level.
3	DTR/Test2 (Output)	This pin is normally at a MARK level. This pin is at a SPACE level when DTR is de-asserted.
4	GND	This pin is connected to the system ground.
5	RxD (Input)	The level is SPACE on standby and MARK for received data. The LED is lit for a MARK level.
6	TxD (Output)	The level is SPACE on standby and MARK for transmitted data. The LED is lit for a MARK level.
7	CTS (Input)	This level needs to be a MARK for the communication port to transmit data. When the attached device does not provide this signal, the controller keeps the line at a MARK. When the attached device does provide this signal, it needs to set CTS to MARK to allow the controller to transmit data.
8	RTS (Output)	This pin is a MARK if full-duplex operation is selected for the port. This pin is set to a MARK just before and during transmission of data if half-duplex operation is selected. This pin is set to a SPACE when no data is being transmitted. The LED is ON for a MARK level.

- 5 Vdc is available on Pin 1 when turned on by the user under program control or in Vision mode, when the RTU detects the contact closure of the ON switch of the SCADAPack Vision or when the LEDs are turned on.
- This 5 Vdc output is used to power Vision terminals and other Schneider Electric accessories. Check that cables connecting this pin have no voltage applied.

- The SCADAPack Vision ON switch is wired to Pins 2 and 3. When a SCADAPack Vision is not used, set jumpers J11 and J12 to the **Normal** position, to avoid generating a CPU interrupt due to a change in the state of the DCD signal.
- COM3 only supports RS232.

COM3 has six signal lines implemented, plus signal ground and a configurable 5 Vdc output.

The following diagram shows the pin connections for the RS232 (RJ-45) port connector for COM3.



The following table shows the serial and protocol communication parameters supported by COM3. These parameters are set from SCADAPack E Configurator or from an application program running in the RTU. Default values are set when a factory defaults initialization (Cold Boot) is performed on the RTU.

Function	Port Mode	Baud	Data Mode
NONE	RS232 (RTS On) (default)	300 bps	8-bit No Parity 1 Stop Bit (default)
ISaGRAF (default)	RS232 (RTS Keyed)	600 bps	8-bit Even Parity 1 Stop Bit
DNP3	Hayes Modem	1200 bps	8-bit Odd Parity 1 Stop Bit
Command Line	GPRS	2400 bps	7-bit Even Parity 1 Stop Bit
PLC Device	1xRTT	4800 bps	7-bit Odd Parity 1 Stop Bit
ISaGRAF-User	RS232 (RTS Off)	9600 bps (default)	8-bit No Parity 2 Stop Bits
PPP/TCPIP		19200 bps	
TCP Service		38400 bps	
Modbus Master (Modbus RTU)		57600 bps	
Modbus Slave		115200 bps	
DNP VT Service			
IEC60870-5-103 Master			
IEC60870-5-101 Slave			

NTP GPS Receiver			
SLIP			
CSLIP			

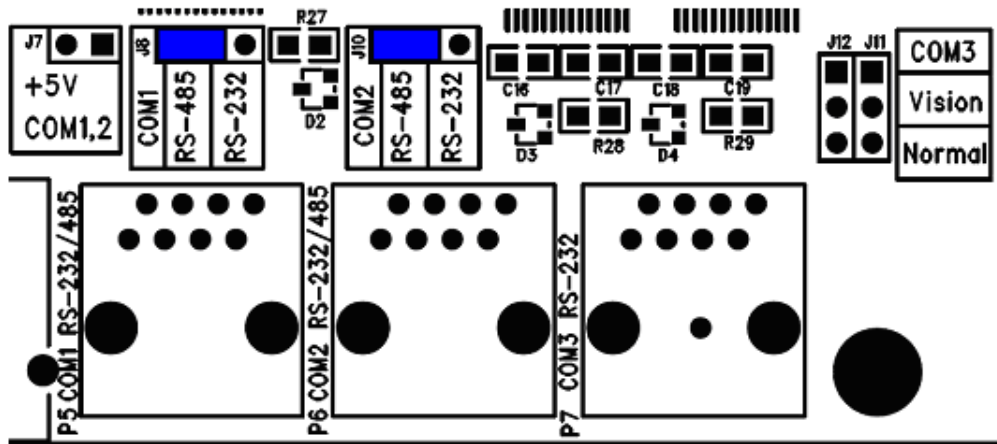
When referenced in SCADAPack E Configuration and Diagnostic facilities, COM3 is known as Port 3.

8.3.2 RS485 Serial Communications Ports

COM1 and COM 2 support RS485 communication. Use shielded cable for RS485 wiring and connect the shield to chassis ground at one point. Improperly shielded cable may result in the installation not complying with Federal Communications Commission (FCC) or Department of Communications (DOC) radio interference regulations.

Serial ports COM1 and COM2 can be configured as either six-line RS232 ports or two-wire RS485 ports. This section covers RS485 operation. For RS232 operation refer to [COM1 and COM2 RS232 Serial Ports](#) [26].

In the diagram below, jumpers J8 and J10 are shown configured for RS485 operation. COM3 is RS232.



For more information, see the following sections:

[COM1 and COM2 RS485 Serial Port](#) [32]

[RS485 Bias & Termination Resistors](#) [35]

8.3.2.1 COM1 and COM2 RS485 Serial Ports

The following table provides a description of the connections and functions of each pin of the RJ-45 modular jack connector.

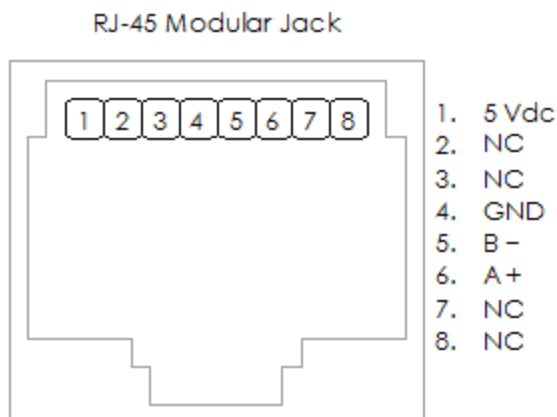
Modular Jack Pin	COM1 (J8=RS485)	COM2 (J10=RS485)	Description
1	5 Vdc when J7 installed (Output)	5 Vdc when J7 installed (Output)	This pin can be connected to the 5 Vdc power supply by installing a jumper at J7 on the SCADAPack E Smart RTU.
2	No connection	No connection	Not used in RS485 mode. Leave open.
3	No connection	No connection	Not used in RS485 mode. Leave open.
4	GND	GND	This pin is connected to the system ground.

Modular Jack Pin	COM1 (J8=RS485)	COM2 (J10=RS485)	Description
5	B  (Input/Output)	B  (Input/Output)	For RS485 operation, install J8 or J10 in position RS485. This pin is the B signal of the RS485 bus.
6	A  (Input/Output)	A  (Input/Output)	For RS485 operation, install J8 or J10 in position RS485. This pin is the A signal of the RS485 bus.
7	No connection	No connection	Not used in RS485 mode. Leave open.
8	No connection	No connection	Not used in RS485 mode. Leave open.

COM1 and COM2 receive and transmit differential voltages to other RS485 devices on a network. The RS485 specification allows a maximum of 32 devices connected on a single RS485 network. Limit cables to a maximum of 1200 m (4000 ft).

The signal grounds of the RS485 devices in the network are not connected together but instead are referenced to their respective incoming electrical grounds. The grounds of the RS485 devices on the network need to be within several volts of each other. RTU ground is connected to the chassis.

Connections to COM 1 and COM2 are made through an RJ-45 modular connector. COM1 and COM2 support two signals plus ground and 5 Vdc power. The pin connections for the RS485 (RJ-45) port connector for COM1 and COM2 operating in RS485 mode are shown below.



The following table shows the serial and protocol communication parameters supported by COM1 and COM2. These parameters are set from SCADAPack E Configurator or from an application program running in the RTU.

Default values are set when a factory defaults initialization (Cold Boot) is performed on the RTU.

Function	Port Mode	Baud	Data Mode
NONE (default for	RS232 (RTS On) (default for	300 bps	8-bit No Parity 1 Stop Bit

COM1)	COM2)	600 bps	(default)
ISaGRAF	RS232 (RTS Keyed)	1200 bps	8-bit Even Parity 1 Stop Bit
DNP3 (default for COM2)	RS485 2w (default for COM1)	2400 bps	8-bit Odd Parity 1 Stop Bit
Command Line	Hayes Modem	4800 bps	7-bit Even Parity 1 Stop Bit
PLC Device	Hayes Pool (COM1 only)	9600 bps (default)	7-bit Odd Parity 1 Stop Bit
ISaGRAF-User	GPRS	19200 bps	8-bit No Parity 2 Stop Bits
PPP/TCPIP	1xRTT	38400 bps	
TCP Service	RS232 (RTS Off)	57600 bps	
Modbus Master (Modbus RTU)		115200 bps	
Modbus Slave			
DNP VT Service			
IEC60870-5-103 Master			
IEC60870-5-101 Slave			
NTP GPS Receiver			
SLIP			
CSLIP			

When referenced in SCADAPack E Configuration and Diagnostic facilities, COM1 is known as PORT1 and COM2 is known as PORT2.

8.3.2.2 RS485 Bias and Termination Resistors

RS485 Bias Resistors

The RS485 receiver inputs on the RTU are biased so that the received data is driven to a valid state (space) when there are no active drivers on the network. The value of these bias resistors is 5100 ohms from Ground to the B inputs and 5100 ohms from 5 Vdc to the A inputs.

RS485 Termination Resistors

Termination resistors are required when operating over longer distances or at the highest baud rates. Networks operating over distances as long as 1200 m (4000 ft) at 9600 baud will function without termination resistors. Consider termination resistors if the baud rate is higher than 9600.

When termination resistors are required, install them on the first and last stations on the RS485 wire pair only.

If required, RS485 networks are terminated with 120-ohm resistors on each end. The required 120-ohm resistor needs to be supplied and installed by the user. When using termination resistors it may be necessary to increase the line biasing by adding lower value bias resistors in order to generate at least 0.2 Vdc across the RS485 line. The suggested value of the bias resistors is 470 ohms.

- One bias resistor is installed from the B signal to COM.
- The second bias resistor is installed from the A signal to 5 Vdc.

5 Vdc is available on pin 1 when J7 is installed.

8.4 Ethernet Port

The figure below shows the location of the Ethernet port.



Ethernet Port

The RTU has one 10/100Base-T Ethernet port. This is a single communications channel running at 10/100 Mbs over unshielded, twisted-pair cabling, using differential signaling. It supports both half-duplex and full-duplex operation. The interface supports auto-negotiation for both the speed and half/full-duplex mode selection.

When referred to in SCADAPack E configuration and diagnostic facilities, the Ethernet port is referred to as communications channel number 10.

Connections to the Ethernet port are made through an RJ-45 modular connector. The wiring and pin connections for this connector are described in section [RJ-45 Modular Connector for Ethernet](#) ⁸³.

8.5 USB Peripheral Port

The RTU provides a USB 2.0-compliant peripheral port that supports 1.5 Mb/s and 12 Mb/s connections to a USB host such as a laptop computer. The USB peripheral port provides DNP3 communications for local connection to SCADAPack E Configurator.

The USB host port is not currently supported by the SCADAPack E operating system.

WARNING

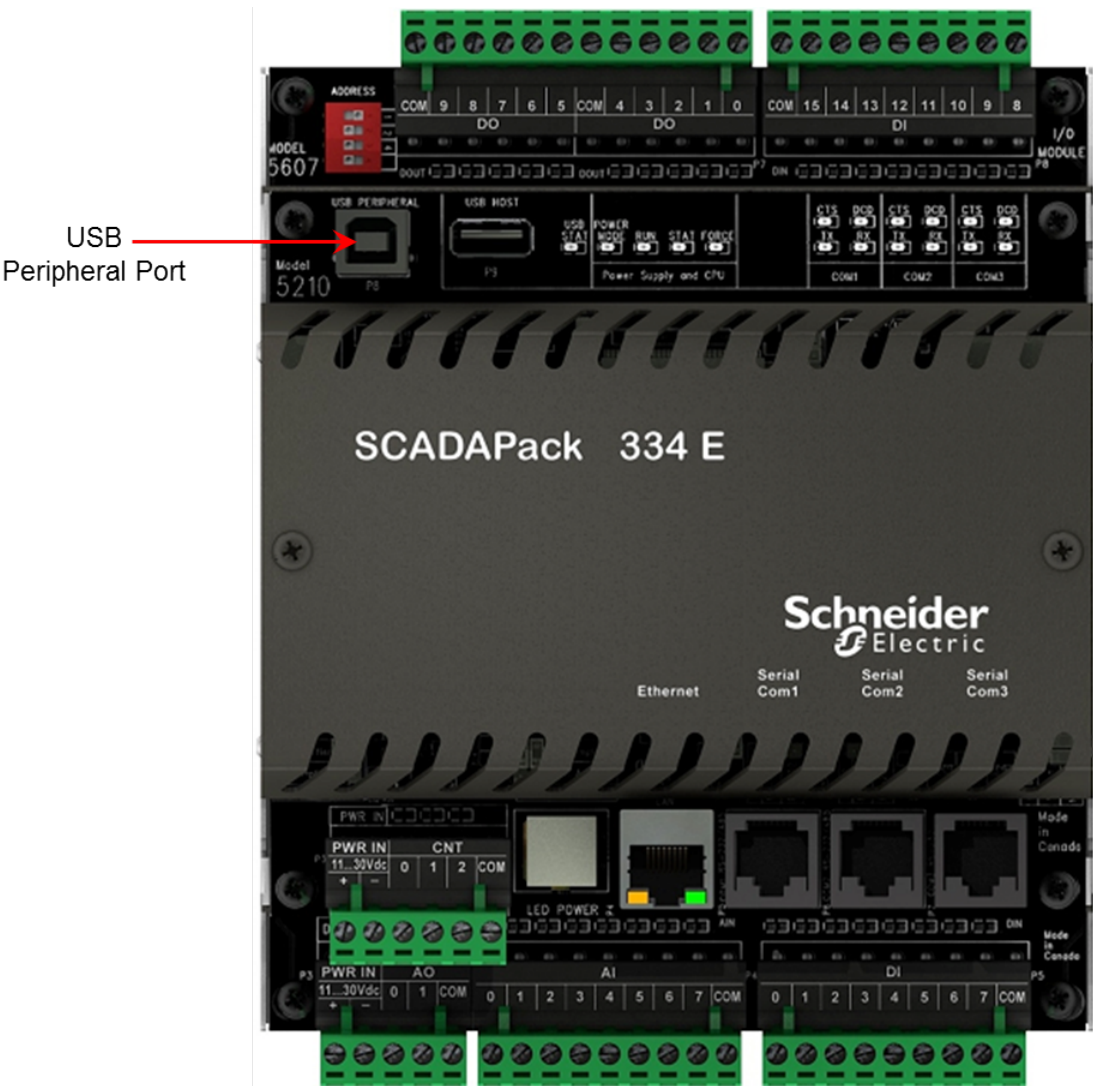
EXPLOSION RISK

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.

The figure below shows the location of the USB peripheral port on the RTU.



The peripheral port uses a USB series “B” receptacle.

An RTU will not draw any significant power from the host over the USB peripheral port.

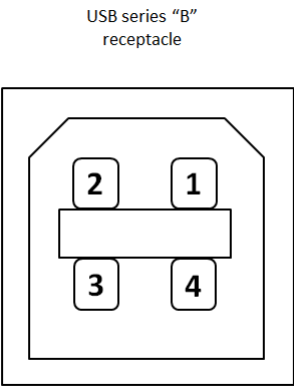
The following table shows the USB peripheral port communication parameters.

Parameter	Supported Values
USB	USB 2.0-compliant, peripheral port
Data Rate	Auto detect 1.5 Mb/s and 12 Mb/s
Protocol	DNP3
Configuration and Diagnostics	When referenced in SCADAPack E Configuration and Diagnostic facilities, this port is known as Port 0.

USB Connections

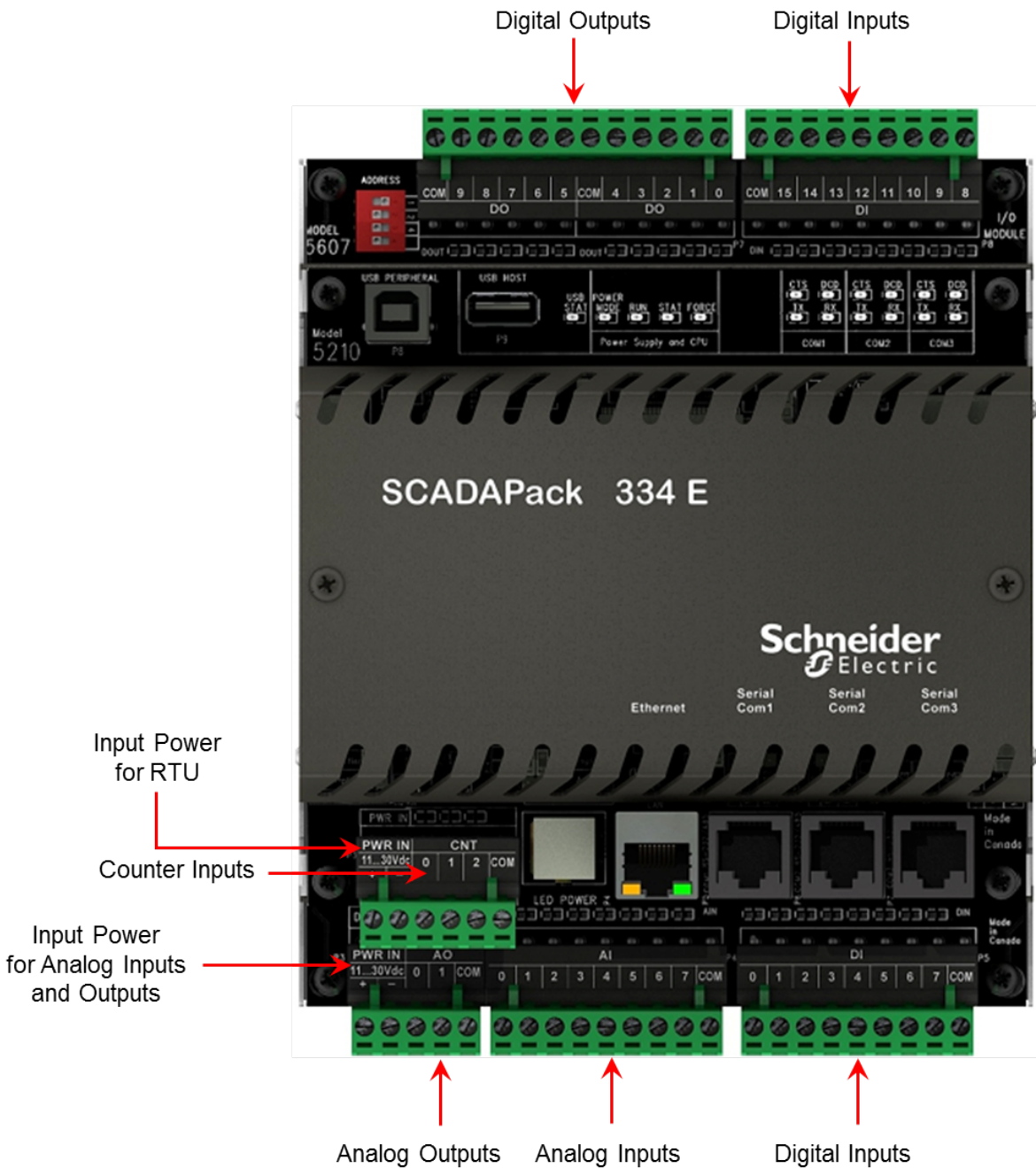
The connector used for the USB port is compliant with the USB 2.0 specification.

The following diagram shows the connections of the USB peripheral port.



8.6 Inputs and Outputs

The figure below shows the location of the inputs and outputs on the SCADAPack E Smart RTU.



The following table describes input and output characteristics. The inputs and outputs use 5 mm (0.197 in.) pitch connectors. See the [Specifications](#) ^[147] section for the recommended wire sizes.

Input/Output Type	Description
Counter Inputs ^[42]	3 counter inputs

Input/Output Type	Description
	Wired to connector P3 on the controller board
Digital inputs  44	16 digital inputs Optically isolated from logic power Wired to connectors P5 and P8
Digital outputs  45	10 dry contact (mechanical) relay and solid state relay (SSR) outputs Wired to connectors P6 and P7
Analog inputs  45	8 analog inputs Wired to connector P4
Analog outputs  47	2 analog outputs (optional) Wired to connector P3 12-bit, unipolar, digital to analog (D/A) converter
Input power  21	11...30 Vdc input power Wired to connector P3

8.6.1 Counter Inputs

The RTU has three counter inputs, identified as Counter 0, 1 and 2.

Counter 0 is a high-level digital input for use with open collector/drain output amplifiers.

Counters 1 and 2 are designed for millivolt level turbine meters.

NOTICE

UNINTENDED EQUIPMENT OPERATION

Do not exceed the maximum voltage specified for each counter input. See the Specifications topic for the maximum voltages.

Failure to follow these instructions can result in equipment damage.

Refer to the appropriate software manual for information on using the counter inputs in application programs.

Configuration

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

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

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](#)^[72].

Specifications

For counter input specifications, see [Specifications](#)^[147].

[Counter Input 0](#)^[43]

[Turbine Meter Counter Inputs 1 and 2](#)^[43]

8.6.1.1 Counter Input 0

Counter Input 0 is used to count contact closures. The input circuitry includes a resistor from the counter input to the 5 Vdc power supply.

8.6.1.2 Turbine Meter Counter Inputs 1 and 2

You can connect two turbine meter sensors to your SCADAPack E Smart RTU. These sensors produce millivolt outputs and do not require an additional pre-amplifier. Use the turbine meter inputs in low noise environments with shielded cabling.

There are four jumper links positions: J3, J4, J5 and J6 associated with configuring the turbine meter counter inputs for either millivolt signals (direct to sensor) or high level signals from turbine meters with external amplifiers, dry contacts or open collector outputs.

Jumper positions J3 and J5 enable the RTU's pre-amplifier on turbine counter input 1. Jumpers J4 and J6 enable the RTU's pre-amplifier on turbine counter input 2.

8.6.2 Digital Inputs and Outputs

The I/O board expands the function of the RTU with 16 digital inputs and 10 dry contact (mechanical) relay or solid state relay (SSR) outputs.

Digital inputs and outputs can be used to monitor or control 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.

The relay outputs are 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.

Configuration

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

- DNP3 attributes
- Point state
- Remote control interlock attributes
- Event attributes
- Alarm and trend attributes
- Properties
- Debounce time (inputs)
- Output pulse time (outputs)

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

Specifications

For digital input and output specifications, see [Specifications](#) ¹⁴⁷.

[Digital Inputs](#) ⁴⁴

[Digital Outputs](#) ⁴⁵

Wiring

Digital inputs and outputs support solid or stranded wires from 3.3...0.08 mm² (12...28 AWG).

For more information, see [Wiring Screw-Termination Connectors](#) ⁷².

8.6.2.1 Digital Inputs

The digital inputs are optically isolated from the logic power and are available in 12 or 24 Vdc voltage ranges. A current limiting resistor, on each input, determines the voltage range. Light Emitting Diodes (LED) on the digital inputs show the status of each of the input. The digital input LEDs can be disabled to conserve power.

To simplify field wiring, the 16 inputs are organized into two groups of eight inputs. Each group shares a common return. These groups of eight inputs are isolated from each other. Inputs 0 to 7 are in one group. Inputs 8 to 15 are in another group.

8.6.2.2 Digital Outputs

The I/O board expands the function of the RTU with 10 digital outputs.

NOTICE

UNINTENDED EQUIPMENT OPERATION

Incandescent lamps and other loads may have inrush currents that will exceed the rated maximum current of the relay contacts. This inrush current may damage the relay contacts. Interposing relays need to be used in these situations.

Failure to follow these instructions can result in equipment damage.

The 10 digital outputs are either dry contact (mechanical) relay or solid state relay (SSR) outputs.

Outputs are Form A (normally open NO). Loads can be connected to either output terminal and to either the high or the low side of the power source. Light Emitting Diodes (LEDs) on the digital outputs show the status of each of the outputs. The digital output LEDs can be disabled to conserve power.

8.6.3 Analog Inputs

The I/O board enhances the capacity of a SCADAPack RTU by providing an additional 8 single-ended analog inputs on connector P4 that can be configured for current or voltage mode.

The 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. Analog inputs can be individually configured for input mode — current or voltage — and range. Refer to [Current or Voltage Mode](#) ⁴⁶¹ for information on how to choose input modes.

The analog inputs use a 16-bit successive approximation digital to analog (D/A) converter.

Configuration

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

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

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

Specifications

For analog input specifications, see [Specifications](#) ^[147].

[Current or Voltage Mode](#) ^[46]

[Range and Resolution](#) ^[46]

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](#) ^[72].

8.6.3.1 Current or Voltage Mode

The analog inputs can be configured for either voltage or current mode via SCADAPack E Configurator.

- In current mode, a 250-ohm current sense resistor appears across each analog input channel. Measurement range in current mode is 0...20 mA or 4...20 mA, selectable via software. The 250-ohm resistor produces a voltage drop (input reading) of 5 Vdc for 20 mA of current flow.
- In voltage mode, analog inputs are single-ended with a measurement range of 0...5 Vdc or 0...10 Vdc.

NOTICE

UNINTENDED EQUIPMENT OPERATION

This 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 require external current sense resistors, with the module input range set to voltage.

Failure to follow these instructions can result in equipment damage.

8.6.3.2 Range and Resolution

The analog inputs have a 16-bit, unipolar, analog to digital (A/D) converter that measures input voltages from 0...5 Vdc or 0...10 Vdc. The analog inputs are factory-calibrated to scale the data and represent it with a 16-bit signed number.

When assigning RTU database points to the module channels using SCADAPack E Configurator, the user configures the input type signal range for each analog input channel.

The following input type ranges can be configured for each analog input channel:

- 0...5 Vdc
- 0...10 Vdc

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

The input type range selected is scaled to the **Raw Min.** to **Raw Max.** range configured for the individual analog input point when point integer values are used. The **Eng. Min.** to **Eng. Max.** range for the point is used to scale the analog input Engineering Floating Point database value.

For example, if an analog input point's attributes are **RAW_MIN = 0**, **RAW_MAX = 10000** and the input channel is selected for 4...20 mA, a 20 mA input is 100% of the selected input signal range and corresponds to 10000 counts. A 4 mA input is 0% of the selected input signal range and corresponds to 0 counts.

The following table shows the analog input values and status for several input signals. Over and under range status detection occurs when the measured input is outside of the measurement range by greater than 0.2%.

0...5 Vdc Range (Vdc)	0...10 Vdc Range (Vdc)	4...20 mA Range (mA)	0...20 mA Range (mA)	Point database value	Over or under range status*
N/A	N/A	<3.968	N/A	under-range	ON
0	0	4	0	RAW_MIN ENG_MIN	OFF
1.25	2.5	8	5	25% of scale	OFF
2.5	5.0	12	10	50% of scale	OFF
3.75	7.5	16	15	75% of scale	OFF
5	10	20	20	RAW_MAX ENG_MAX	OFF
5.0024	10.0048	20.032	20.01	over-range	ON

* Under-range and over-range point status may also be asserted by SCADAPack E Analog Input Point configuration parameters. For more information see the SCADAPack E I/O Expansion Technical Reference Manual and the SCADAPack E Data Processing Technical Reference Manual.

8.6.4 Analog Outputs

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

The optional analog outputs are ordered at the time of purchase.

The analog output channels are powered with an external 12 Vdc or 24 Vdc power supply. They can be configured for 0...20 mA or 4...20 mA current.

Configuration

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

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

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

Specifications

For analog output specifications, see [Specifications](#) ^[147].

[Current and Voltage Outputs](#) ^[48]

[Range and Resolution](#) ^[49]

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](#) ^[72].

8.6.4.1 Current and Voltage Outputs

Current Outputs

The I/O expansion module can be equipped with an optional 5305 analog output module that provides two 20 mA analog outputs. Analog output resolution is 12 bits. The outputs provide a level of transient and over-voltage protection. The outputs share a common return with each other and with the analog inputs. See [Analog Output Wiring](#) ^[106] for an illustration on how to connect current outputs.

Voltage Outputs

To obtain voltage outputs, connect a load resistor as shown in [Analog Output Wiring](#) ^[106] and connect the voltage device across the load resistor.

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 ohms	0...20 mA	0...5 Vdc

Resistance	Output Range	Voltage Range
	4...20 mA	
500 ohms	0...20 mA	0...10 Vdc

8.6.4.2 Range and Resolution

The optional analog output module installed on the I/O expansion module has a 12-bit, unipolar, digital to analog (D/A) converter. One of the following output type ranges can be configured on **SCADAPack E Configurator I/O > SCADAPack I/O** page for the I/O expansion module. 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.

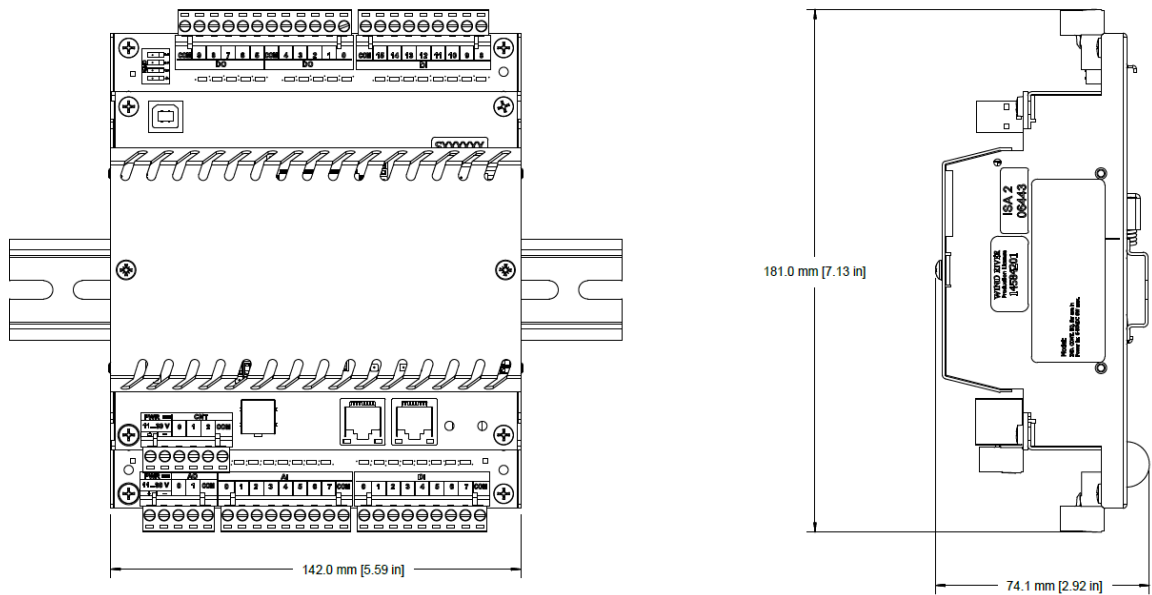
Configuration for points attached to the optional analog output channels uses the SCADAPack E **Raw Min.** to **Raw Max.** and **Eng. Min.** to **Eng. Max.** parameters for integer and engineering scaling, respectively.

These scaling ranges automatically apply to the analog output signal range selected by SCADAPack E Configurator for the analog output type (0...20 mA or 4...20 mA).

9 Installation

The installation of SCADAPack E Smart RTUs requires mounting the RTU on the 7.5 x 35 mm (0.3 x 1.4 in) DIN rail and optionally connecting the RTU to a system I/O Bus.

The following diagram shows the dimensions of the RTU.



For more information, see the following sections:

[For ATEX and IECEx Applications Only](#) ⁵¹

[Mounting the SCADAPack RTU](#) ⁵⁴

[Connecting I/O Modules](#) ⁶⁶

9.1 For ATEX and IECEx Applications Only

Provide overvoltage protection external to the equipment.

The rated supply cable temperature is 105 °C.

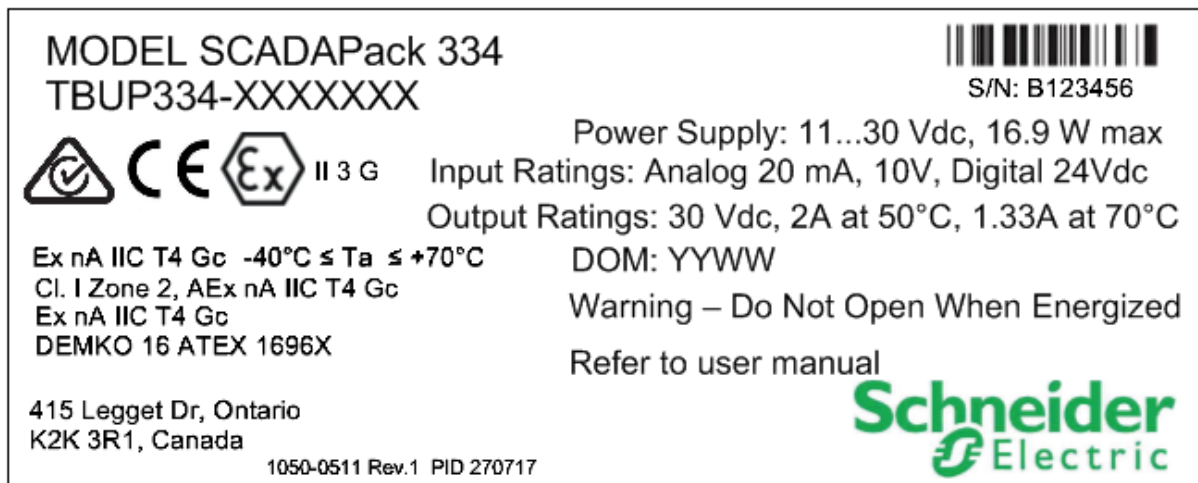
Consider the instructions in the warning message below when installing the I/O expansion module.

 WARNING
EXPLOSION HAZARD - Only install this equipment under the following conditions: Conditions of Safe Use - Only use this equipment in an area not exceeding pollution degree 2, as defined in EN/IEC 60664-1. - Install this equipment in an enclosure certified for use, that is tool accessible only and provides a degree of protection of IP54 or better, in accordance with EN 60079-15. - Provide transient protection at a level that does not exceed 140% of the peak rated voltage value at the supply terminals to the equipment. - The free internal volume of the enclosure must be dimensioned in order to keep the temperature rating. - For products using solid state relays (5606 and 5607 I/O modules and RTUs using these modules), a T4 rating is acceptable for maximum loads of 1.33 A. When 2 A loads are connected to the solid state relays, the maximum ambient rating is lowered to 50 °C (122 °F) in order to maintain the T4 rating. Failure to follow these instructions can result in death or serious injury.

The following product label appears on a SCADAPack 334E with no radio:

MODEL SCADAPack 334 TBUP334-XXXXXXX		 S/N: B123456
   II 3 G	Power Supply: 11...30 Vdc, 10.1 W max Input Ratings: Analog 20 mA, 10V, Digital 24Vdc Output Ratings: 30 Vdc, 2A at 50°C, 1.33A at 70°C	
Ex nA IIC T4 Gc -40°C ≤ Ta ≤ +70°C Cl. I Zone 2, AEx nA IIC T4 Gc Ex nA IIC T4 Gc DEMKO 16 ATEX 1696X IECEx UL 16.0070 X 415 Legget Dr, Ontario K2K 3R1, Canada	DOM: YYWW Warning – Do Not Open When Energized Refer to user manual	
1050-0507 Rev.1 PID 270713		

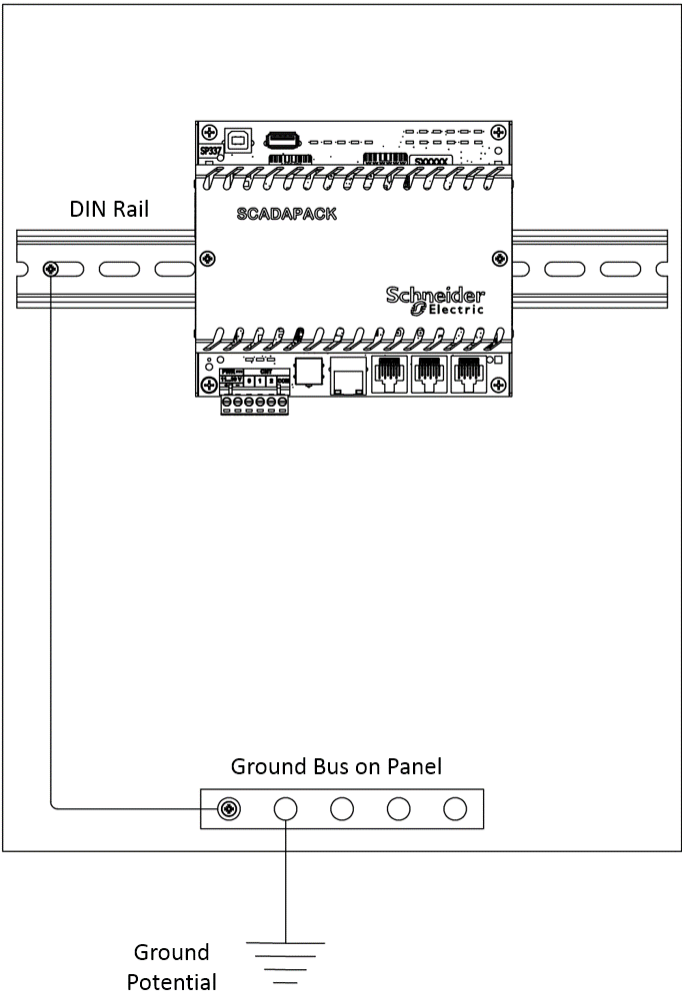
The following product label appears on a SCADAPack 334E with a radio:



9.2 System Grounding

Ground the system by connecting the system power supply common to the chassis or panel ground. The negative (-) side of the DC power input terminal as well as I/O point terminals labeled COM are connected to chassis ground.

RTUs and I/O expansion modules are mounted on a DIN rail which is connected to the panel as shown in the illustration below. Connect the panel to ground according to the local electrical code.



9.3 Mounting the SCADAPack E Smart RTU

The RTU mounts on a 7.5 x 35 mm (0.3 x 1.4 in) DIN rail.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

⚠ WARNING

ELECTRICAL HAZARD

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

Do not remove the RTU cover when mounting the RTU. The RTU 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

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

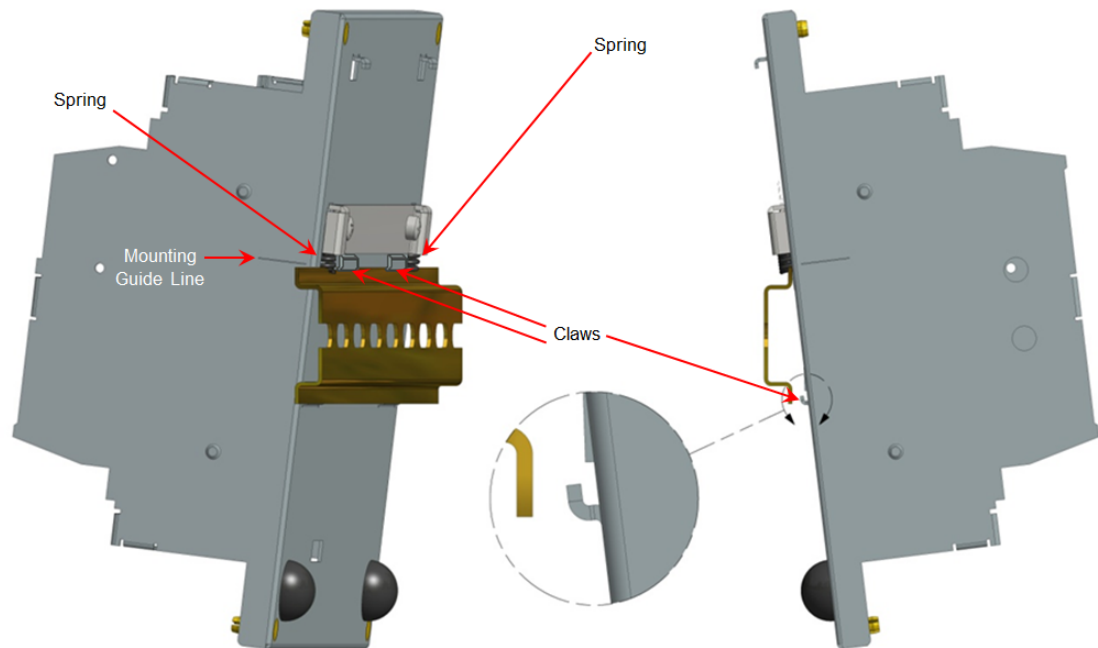
Failure to follow these instructions can result in equipment damage.

To Mount the SCADAPack E Smart RTU on a DIN Rail

The illustrations below show the correct way to mount the device on a horizontally-oriented DIN rail. The steps to mount the device on a vertically oriented DIN rail are the same. Your device may look different from the device shown in the illustrations.

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

Rest the springs on the back of the device on the DIN rail and insert the edge of the DIN rail under the upper support claws that are adjacent to the springs, as shown below.

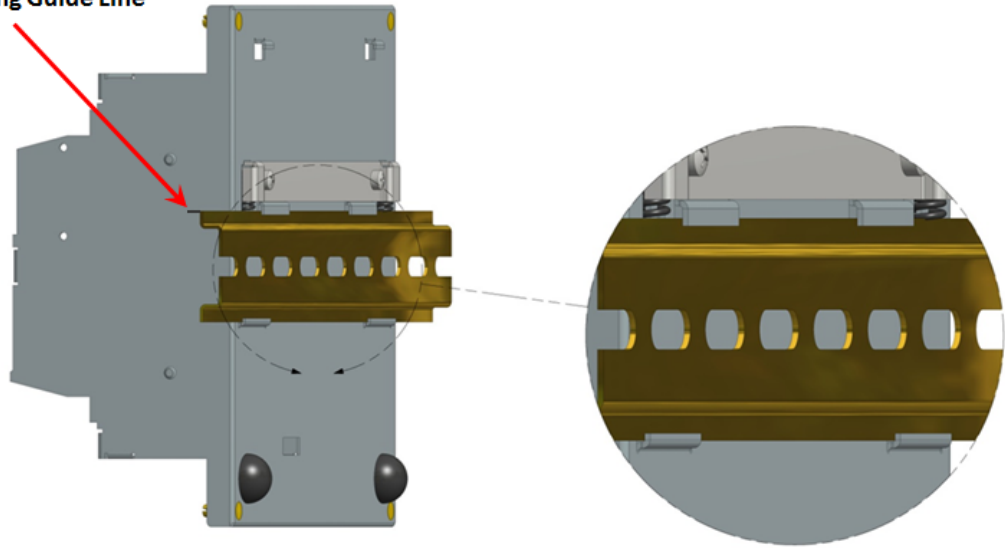


2. Push firmly on the device while tilting it toward the DIN rail until the DIN rail is positioned under both the upper and lower claws on the back of the device.
3. Release the pressure on the springs so that the DIN rail is held firmly in place between the upper and lower claws.

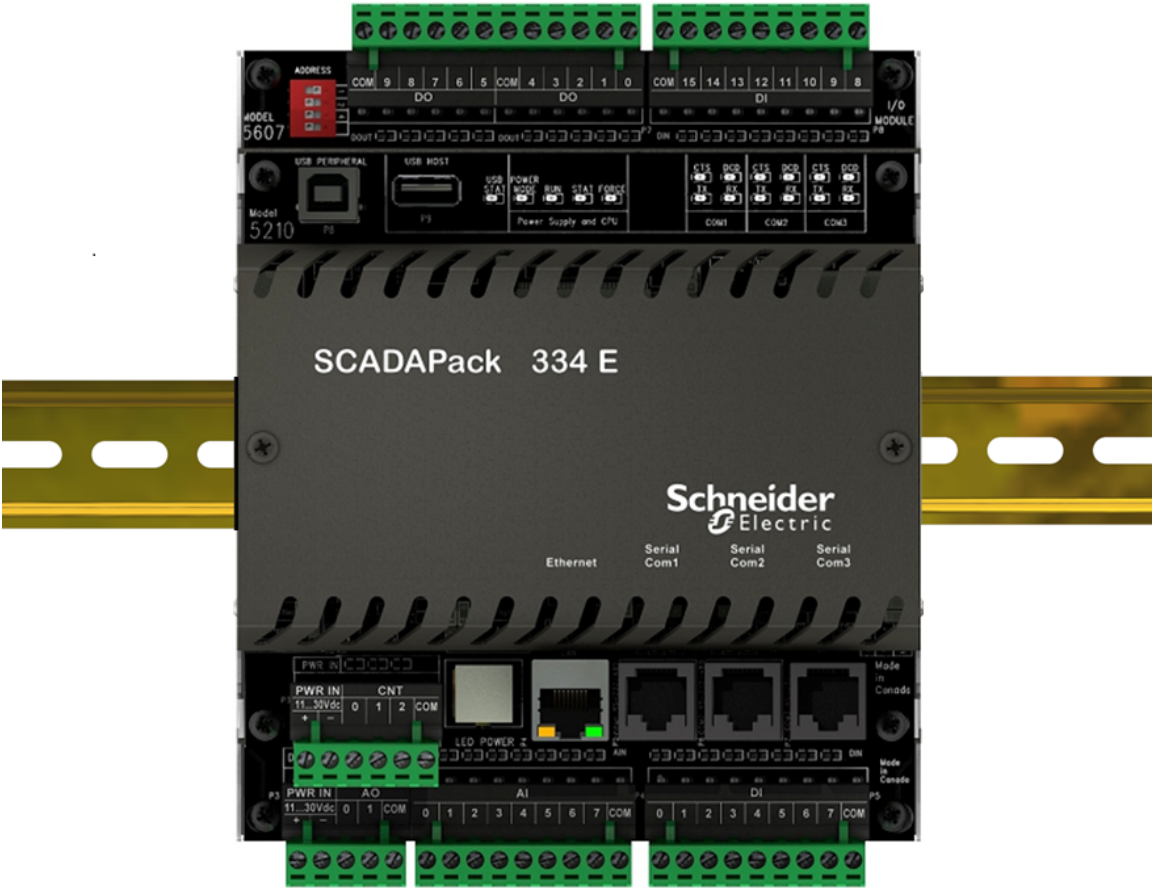
The mounting guide line will be aligned with the edge of the DIN rail.

The figure below shows a device with the DIN rail correctly positioned between the upper and lower claws on the back of the device.

Mounting Guide Line



The figure below shows the front view of the RTU mounted on a horizontally-oriented DIN rail.



9.4 Power Supply Requirements

The RTU is powered from an 11...30 Vdc input power source.

- Input power is applied to the positive (+) and negative (-) terminals on connector P3.
Refer to the [Specifications](#)¹⁴⁷ for the minimum and maximum operating voltages and input power requirements.
- When the input voltage is below the minimum recommended voltage the RTU will turn off.
- Exceeding the maximum input voltage or applying a reverse voltage will blow the input power fuse.

WARNING

UNEXPECTED EQUIPMENT OPERATION

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

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

WARNING

UNEXPECTED EQUIPMENT OPERATION

The input power supply must be a filtered DC supply.

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

NOTICE

UNEXPECTED EQUIPMENT OPERATION

Do not connect to power sources such as 16 Vac transformers, as this will blow the fuse.

Failure to follow these instructions can result in equipment damage.

The DC power-input voltage is used to generate 5 Vdc at 1.2 A (6 W) some of which is used for the controller onboard circuitry. The output capacity of the 6 W is sufficient to power the RTU and a limited number of 5000 Series I/O modules.

The power available for any 5000 Series expansion I/O modules is limited. Refer to the [Specifications](#)¹⁴⁷.

9.4.1 Power Calculations

This topic describes power calculations for the SCADAPack RTU. Power requirements depend on the number of I/O expansion modules used and how they are used.

The power requirements specified are for operation at 25 °C (77 °F). For operation at the extremes of the

temperature range, -40...70 °C (-40...158 °F), add 0.3 W. For information on power for compatible external I/O expansion modules and power output for expansion power supplies, see the appropriate I/O hardware manual specifications.

For information on power calculations, see:

[Determining if an Expansion Power Supply is Required](#) ⁵⁹

[Calculating the Total Power Supply Requirements](#) ⁵⁹

9.4.1.1 Determining if an Expansion Power Supply is Required

To determine if an expansion power supply is required, you need to calculate the total load on the system. When you have determined the total load, you can calculate the total power requirements of your system.

To determine the total load on your system, use the following calculation

$$L1 + L2 + L3 + L4 = C$$

Value	Description	Maximum Value
L1	Current supplied to COM3 external to the RTU	0.25 A
L2	Current supplied to USB external to the RTU	0.10 A
L3	Current supplied to COM2 external to the RTU	1.1 A
L4	Total current supplied to every I/O module attached to the RTU. See the I/O module manual to determine the power requirements for your I/O module(s)	1.1 A
C	The sum of all the loads on your system. If this number exceeds the total power capacity available for the RTU, then an additional power supply is required to power the I/O modules.	See table below

Use the following table to determine the load for each RTU.

RTU	312E	313E, 314, 314E	330, 330E	333E, 334, 334E	337E	350E	357E
Load Capacity	0.8 A	0.7 A	0.9 A	0.5 A	0.3 A	0.9 A	0.3 A

9.4.1.2 Calculating the Total Power Supply Requirements

To calculate the total power supply requirements and determine the size of the system power supply, there are several calculations needed.

To calculate the total power supply requirements

1. Determine the system voltage (**D**).

System voltage is typically either 12 or 24 Vdc. See the RTU specifications and your application.

2. Calculate the total current of the power supply using:

$$1.2 - A + C = E$$

Value	Description	Units
A	Capacity of the controller 5 Vdc power supply available for expansion. Do not include the lower I/O module because the lower I/O module requirements have already been factored in. See the RTU specifications.	A
C	Total Load for this RTU. See Determining if an Expansion Power Supply is Required .	A
E	Total current of the power supply	A

3. Determine the power required by the controller using:

$$E \times 5.9 = F$$

Value	Description	Units
E	The total current of the power supply	A
F	Power required by the controller	W

4. Calculate the current required by the controller at Vdc In using:

$$F/D = G1$$

Value	Description	Units
F	Power required by the controller	W
D	System voltage	V
G1	Current required by the controller	A

5. Determine the current at Vdc In required by the lower I/O module, (**G2**) in Amps.
6. Determine the current at Vdc In required by the expansion I/O modules, (**G3**) in Amps.
7. Calculate the current requirement using:

$$G1 + G2 + G3 = H$$

Value	Description	Units
G1	Current required by the controller	A
G2	Current at Vdc In required by the lower I/O module	A
G3	Current at Vdc In required by expansion I/O modules	A
H	Total current requirement	A

8. Calculate the total power requirement using:

$$D \times H = J$$

Value	Description	Units
D	System voltage	V
H	Total current requirement	A
J	Total power supply requirement	W

9.4.2 Power Supply Wiring

The topics in this section describe the power supply wiring of the SCADAPack E Smart RTU.

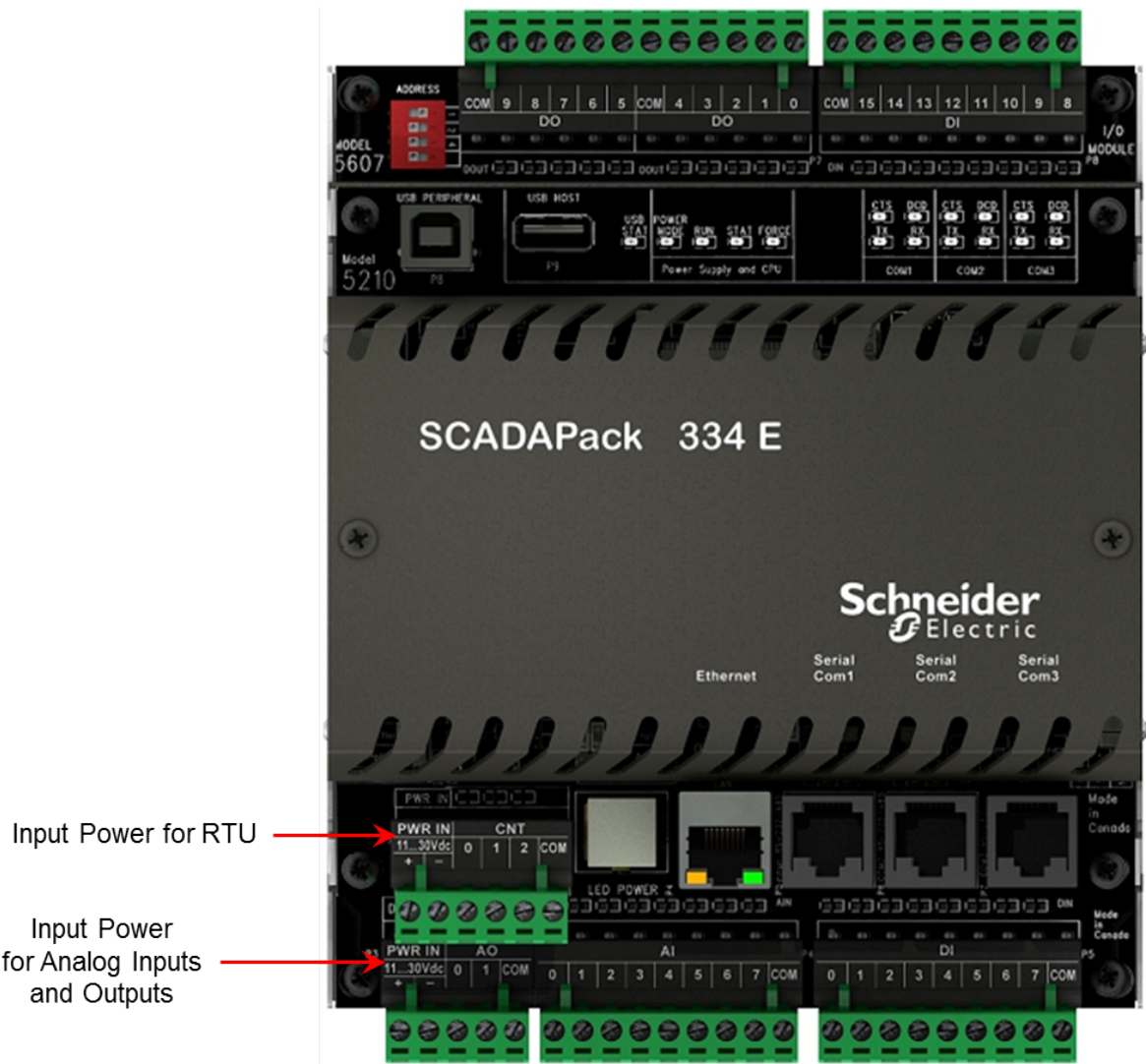
For basic power supply wiring for the RTU, see [Basic Wiring](#)^[63].

Power for the I/O board or I/O expansion module can be provided in several ways:

- With a 24 Vdc source connected to the PWR IN terminals on the controller board and on the I/O board or I/O expansion module, in a parallel configuration. See [Recommended 24 Vdc Power Supply Configuration](#)^[63] for an example of this wiring configuration.
- With a 12 Vdc source connected to the PWR IN terminals on the controller board and on the I/O board or I/O expansion module, in a parallel configuration. See [Recommended Battery Configuration](#)^[65] for an example of this wiring configuration.
- With an Uninterruptible Power Supply (UPS) providing 5 Vdc to the controller board through the IMC cable and 24 Vdc to the I/O board or I/O expansion module, through the 24 Vdc output. See [Recommended 5103 Power Supply Configuration](#)^[66] for an example of this wiring configuration.

For information about grounding the system, see [System Grounding](#)^[52].

The figure below shows the location of the input power supply connections on the SCADAPack E Smart RTU and the I/O board.



9.4.2.1 Basic Wiring

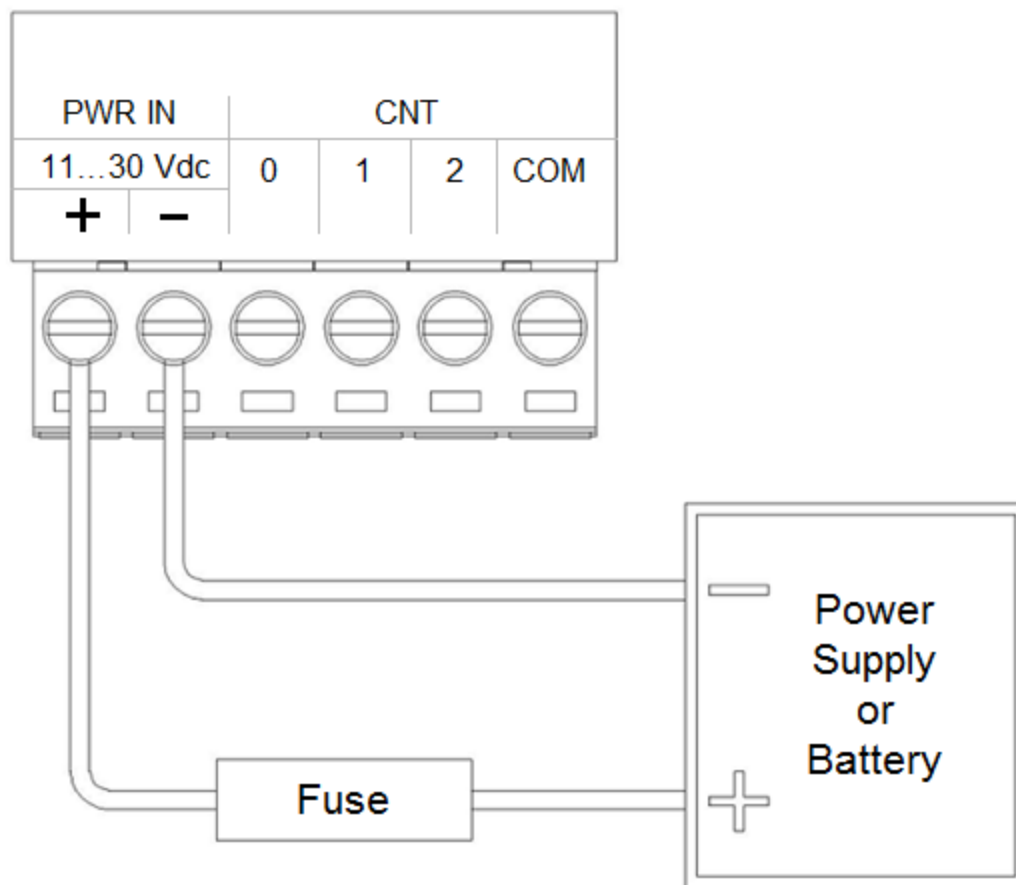
NOTICE

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.

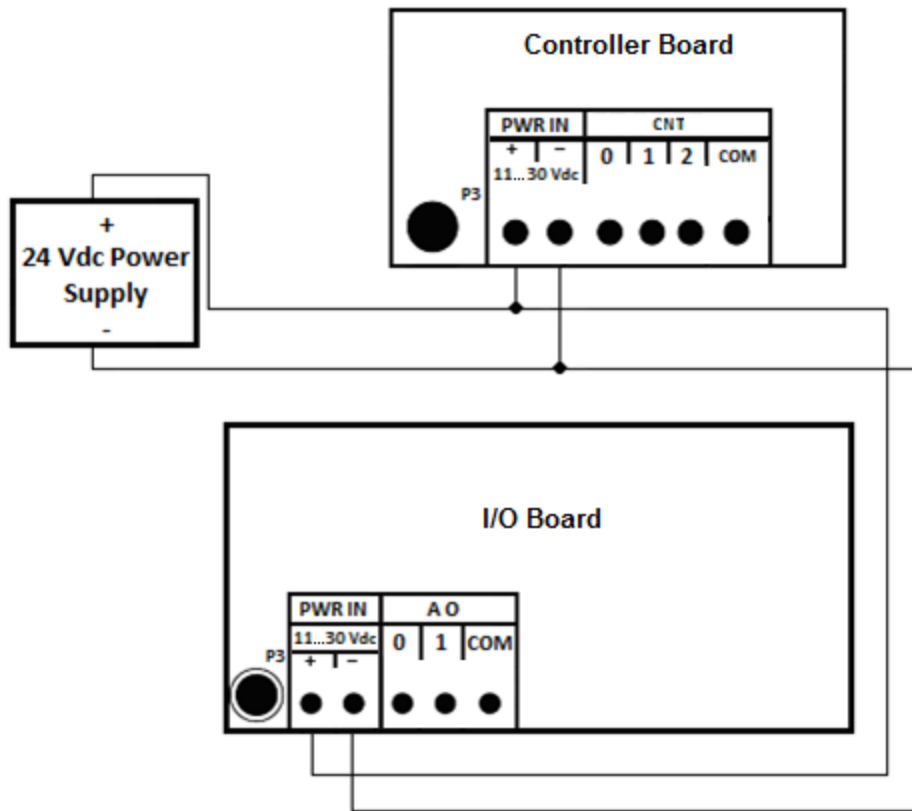
The following figure illustrates power supply wiring. For details on wiring the power supply connectors, see [Wiring Screw-Termination Connectors](#) ⁷².



9.4.2.2 Recommended 24 Vdc Power Supply Configuration

This configuration uses a 24 Vdc power supply to power the controller board and the I/O board or I/O expansion module. This 24 Vdc is also used to power the analog circuitry on the I/O board or I/O expansion module.

- This configuration is recommended when a large amount of current is required at 24 Vdc. Refer to the [Specifications](#) ¹⁴⁷ section.
- Connect the controller board **PWR IN** terminal to the same power supply as the I/O board or I/O expansion module **PWR IN** terminal.

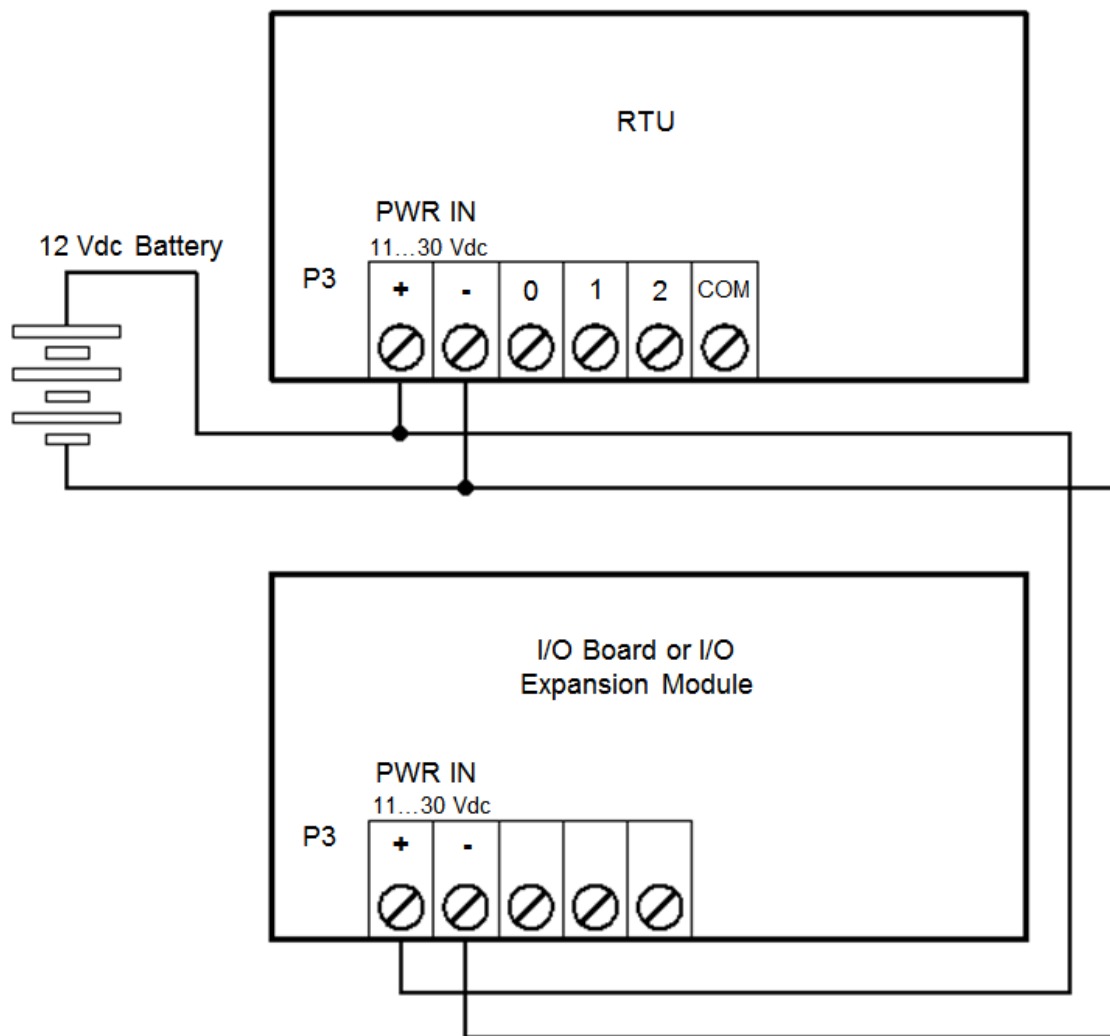


24 Vdc Power Supply Connection

9.4.2.3 Recommended Battery Configuration

This configuration uses a 12 V battery to power the controller board and I/O board or I/O expansion module. This 12 V battery is also used to power the analog circuitry for the analog inputs and optional analog outputs (when available on the I/O board).

- This configuration is recommended when a large amount of current is required at 12 Vdc. Refer to the [Specifications](#)¹⁴⁷ section for power requirements from a 12 V battery.
- Connect the controller board **PWR IN** terminal to the same power supply as the I/O board **PWR IN** terminal.



12 V Battery Power Supply Connection

9.4.2.4 Recommended 5103 Power Supply Configuration

When additional power is required by the system, 5103 power supplies can be used in combination with the RTU. The 5103 power supplies can be connected anywhere downstream (to the right) of the controller. They will supply power to the modules that are downstream from them.

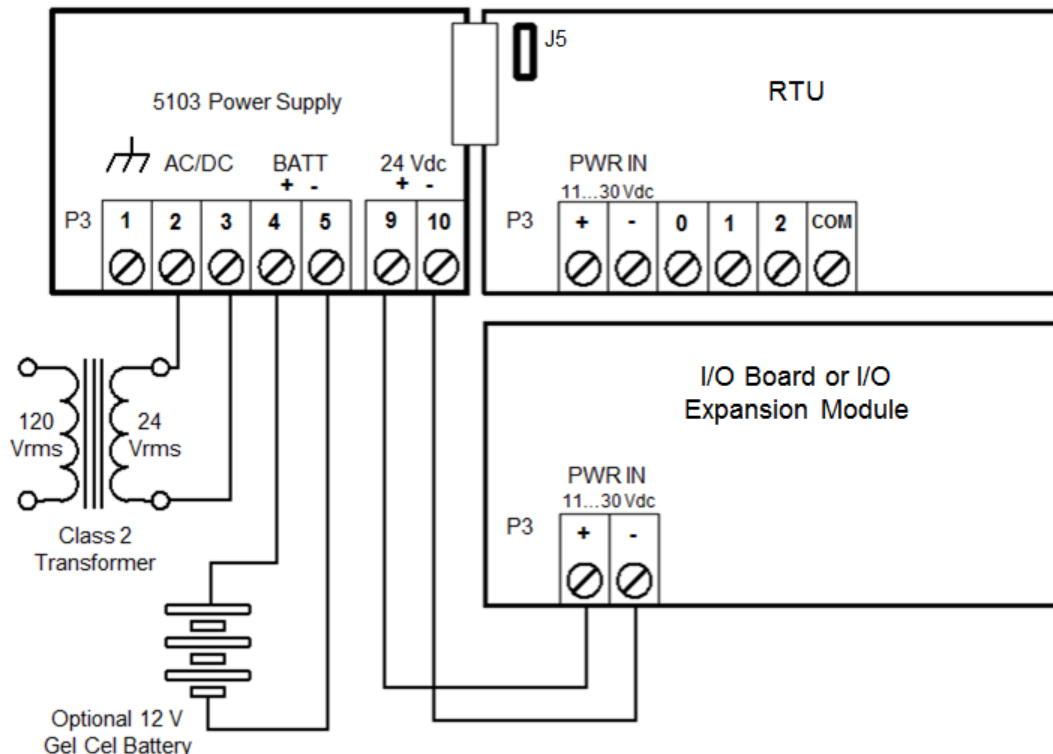
The 5103 power supply may also be connected upstream (to the left) of the RTU, but only if the following conditions are observed:

- No power is applied to the power inputs of the controller board, and
- A jumper is installed at position J5.

This configuration uses a 5103 Uninterruptible Power Supply (UPS) to power an RTU. The 24 Vdc output from the 5103 powers the I/O board. The 5103 power supply provides a 5 Vdc output to power the I/O board, the controller board and any additional I/O expansion modules through the intermodule cables.

No connection is made to the **PWR IN** terminals on the controller board.

The diagram below is representational, meant to illustrate the power connections of the devices.



9.5 Adding Inputs and Outputs

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

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

A maximum of 16 I/O modules (excluding the integrated I/O module) can be added. Additional power supply modules may be required.

The following 5000 series I/O modules are supported by the RTU:

5000 Series Module	Type	I/O	
5304	Analog Out	4	Analog Outputs
5405	Digital In	32	Digital Inputs
5411	Digital Out	32	Digital Outputs
5414	Digital In	16	Digital Inputs
5415	Relay Output	12	Relay Outputs
5505	RTD	4	RTD (Temperature) Inputs
5506	Analog In	8	Analog Inputs
5606	Composite I/O	32 16 8 2	Digital Inputs Relay Digital Outputs Analog Inputs Analog Outputs (optional with 5305)
5607	Composite I/O	16 10 8 2	Digital Inputs Relay Digital Outputs Analog Inputs Analog Outputs (optional with 5305)
5608	Composite I/O	12 6	Digital Inputs Relay Digital Outputs
5610	Composite I/O	16 10	Digital Inputs Relay Digital Outputs
Time for a 5000 series input change to be updated in the database: • For one module, typically: 150 ms • Add 20 ms for each additional 5000 series I/O module			
Time for a database change to be updated in the 5000 series output signal: • For one module, typically: 18 ms • For up to 10 modules, typically: 18...27 ms			

Power Requirements

Each I/O expansion module requires 5 Vdc power, which is provided by the RTU.

If you are using an analog input or analog output module, you require 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 the I/O expansion module hardware manual.

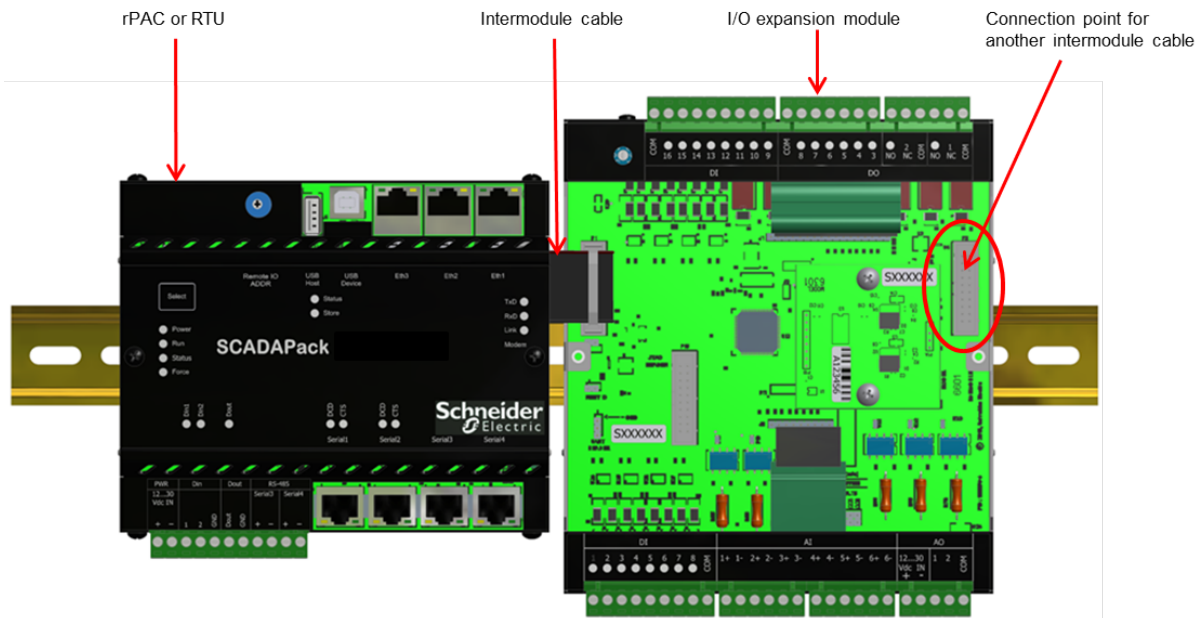
Mounting

I/O expansion modules are mounted on a 7.5 x 35 mm (0.3 x 1.4 in) DIN rail and then connected to the RTU.

Connecting

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

The figure below shows an RTU connected to an I/O expansion module. The figure is representational only. The number of ports and I/O will vary depending on the device type.



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

Precautions

Connection Rules

Attaching Intermodule Cables

Addressing

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

Addressing Rules

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

10 Field Wiring

SCADAPack E Smart RTUs use screw termination style connectors for termination of field wiring. These connectors accommodate solid or stranded wires from 3.3...0.08 mm² (12...28 AWG). The connectors are removable allowing replacement of the SCADAPack E Smart RTU without disturbing the field wiring. Leave enough slack in the field wiring for the connector to be removed.

NOTICE

UNINTENDED EQUIPMENT OPERATION

Do not exceed the maximum voltage specified for each analog and digital input. See the Specifications topic for the maximum voltages.

Failure to follow these instructions can result in equipment damage.

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.

There are several types of connectors for field wiring, as follows:

- RS232 communication ports, COM1, COM2, and COM3 connect through RJ-45 modular jacks. Refer to [RS232 Serial Communications Ports](#) ^[24] for pinout details and wiring diagrams for these modular jacks.
- RS485 communication ports, COM1 and COM2 connect through RJ-45 modular jacks. Refer to [RS485 Serial Communications Ports](#) ^[32] for pinout details and wiring diagrams for these modular jacks.
- Input and output wiring (where available) terminates in removable terminal connectors. Wiring examples are described in the corresponding wiring sections of this manual.
- The Ethernet port connects through an RJ-45 modular jack. Refer to [RJ-45 Modular Connector for Ethernet](#) ^[83] for details.
- The USB port uses a conventional USB-B interface connector. Refer to [USB Port](#) ^[37] for details.

[Wiring Screw-Termination Connectors](#) ^[72]

[Jumper Functions](#) ^[74]

[Serial Port Wiring](#) ^[76]

[Ethernet Port Wiring](#) ^[82]

[Counter Input Wiring](#) ^[84]

[Digital Input Wiring](#)  93

[Digital Output Wiring](#)  95

[Analog Input Wiring](#)  98

[Analog Output Wiring](#)  105

10.1 Wiring Screw-Termination Connectors

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

- Power supplies
- Inputs
- Outputs (where available)

These 5 mm (0.197 in) pitch connectors support solid or stranded wires from 3.3...0.08 mm² (12...28 AWG).

WARNING

UNINTENDED EQUIPMENT OPERATION

Evaluate the operational state of the equipment being monitored or controlled by the RTU or the I/O module before wiring screw-termination connectors.

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

NOTICE

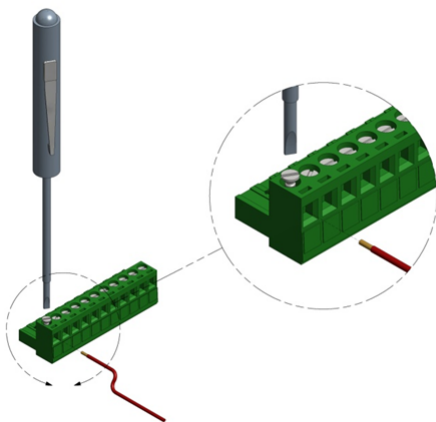
UNINTENDED EQUIPMENT OPERATION

Remove power from the device before servicing.

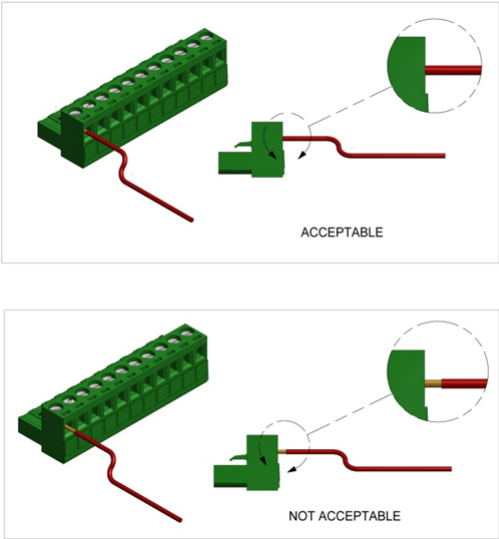
Failure to follow these instructions can result in equipment damage.

To wire a connector

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



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



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

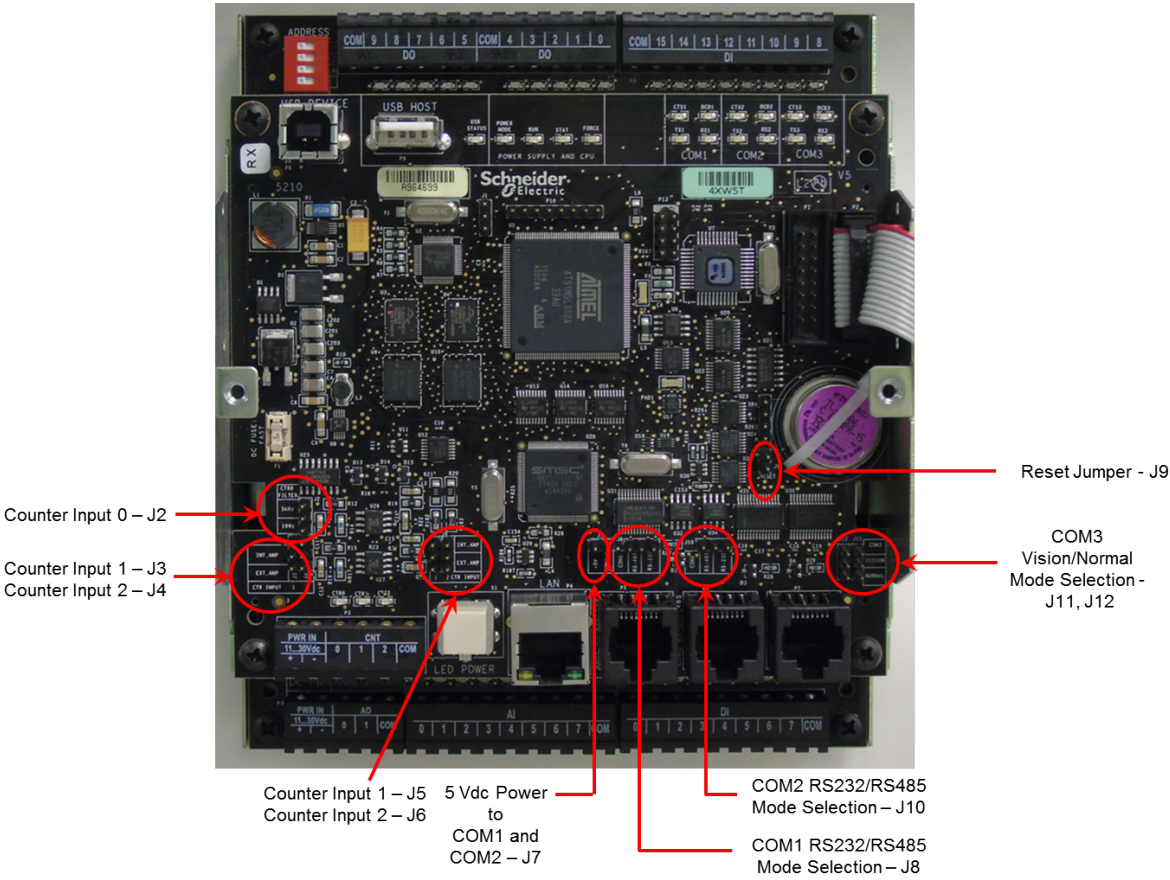
10.2 Jumper Functions

Some of the functions of the RTU are user configurable via jumpers and are described in the appropriate sections of this manual. Some jumpers are reserved for manufacturing and test functions.

The following table lists the jumpers and the relevant section of this manual.

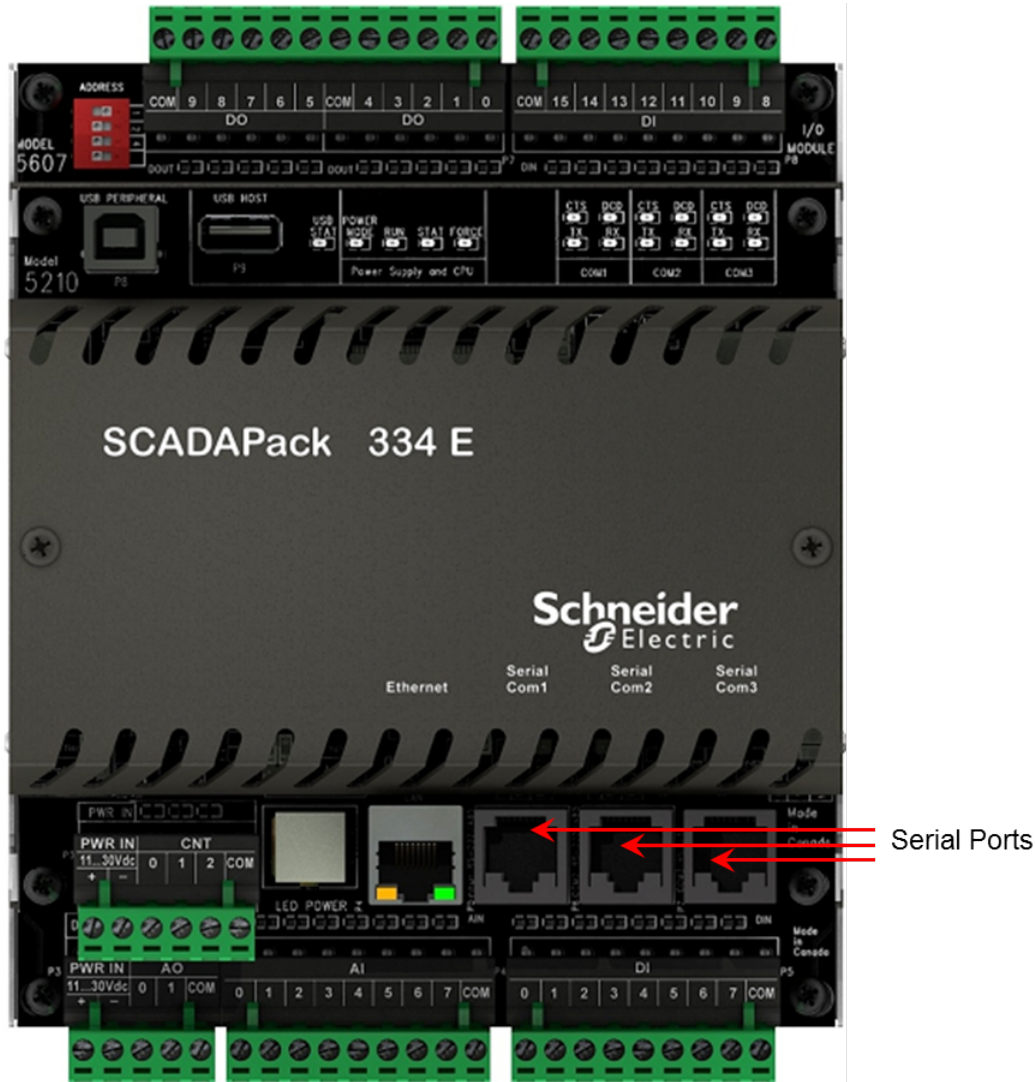
Jumper	Function	Further Information
J2	Counter Input 0 filtering	See Counter Input Wiring ^[84]
J3, J5	Counter Input 1 Type	See Counter Inputs ^[43]
J4, J6	Counter Input 2 Type	See Counter Inputs ^[43]
J7	5 Vdc Power to COM1 and COM2	See COM1 and COM2 RS232 Serial Ports ^[26]
J8	COM1 RS232 / RS485 mode selection	See COM1 and COM 2 RS485 Serial Port ^[32]
J9	Reset Jumper (performs a controller board reset similar to power cycle)	
J10	COM2 RS232 / RS485 mode selection	See COM1 and COM 2 RS485 Serial Port ^[32]
J11, J12	COM3 Vision / Normal mode selection Install both these jumpers in the same position, either Vision or Normal	See COM3 RS232 Serial Port ^[29]

See the following image for the location of jumpers.



10.3 Serial Port Wiring

The topics in this section describe the wiring for the RS232 and RS485 serial ports on the SCADAPack E Smart RTU.



[RS232 Cable Description](#) ⁷⁷

[RS232 Wiring Examples](#) ⁷⁹

[RS485 Wiring Example](#) ⁸¹

10.3.1 RS232 Cable Description

RJ-45 to DE-9S DTE (Data Terminal Equipment)

This cable is used to connect from an RJ-45-based RS232 port on the RTU to a DE-9S connector on DTE such as a PC. A 3 m (10 ft) long cable is available from Schneider Electric (part number TBUM297217).

RJ-45 8 Pins	RTU 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.

RJ-45 to Vision Display

This cable is used to connect from the COM1 or COM2 (RJ-45 based RS232) port on the RTU to a DE-9S connector on a Vision Display. A 1.5 m (5 ft) long cable is available from Schneider Electric (part number TBUM297237).

RJ-45 8 Pins	RTU Function	Vision Display Function	DE-9S
			Shield connects to shell
6	TxD	RxD	2
5	RxD	TxD	3
4	GND	GND	5
3	DTR / Test 2	ON switch	1
2	DCD / Test 1	ON switch	4
1	5 Vdc Out	5 Vdc In	9
7 and 8 are not connected at this end.			Wires not connected at this end.

RJ-45 to DE-9P DCE (Data Communication Equipment)

This cable is used to connect from an RJ-45-based RS232 port on the RTU to a DE-9P connector on DCE such as a modem. A 0.38 m (15 in) long cable is available from Schneider Electric (part number TBUM297218).

RJ-45	RTU 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	5 Vdc	5 Vdc	9

10.3.2 RS232 Wiring Examples

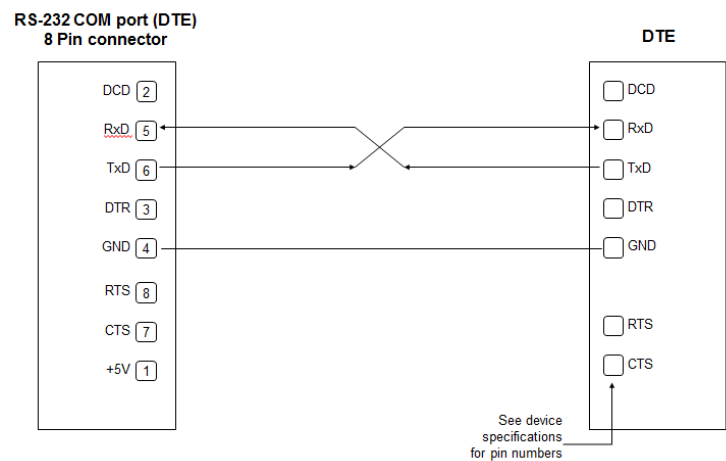


WARNING

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

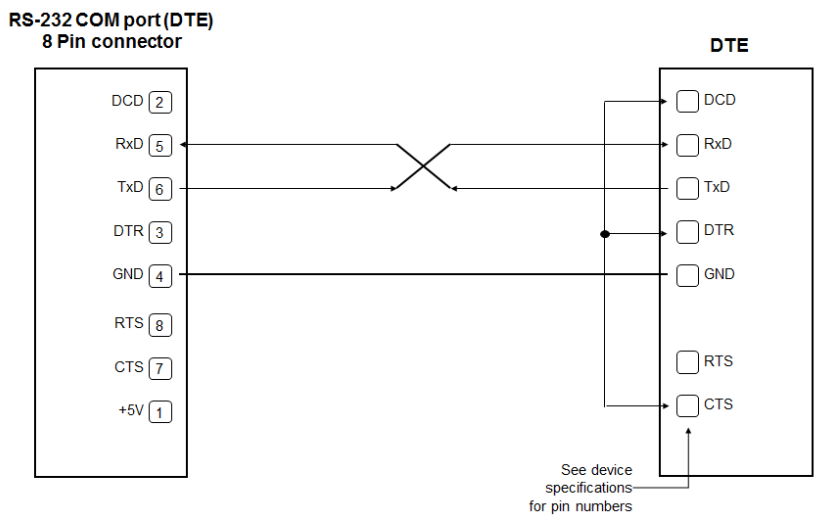
DTE to DTE Without Handshaking

There are several methods for wiring the RS232 COM port to DTE and DCE devices. The simplest connection requires only 3 wires: Rx/D, Tx/D and signal ground. The following diagram shows a common RS232 COM port to DTE device.



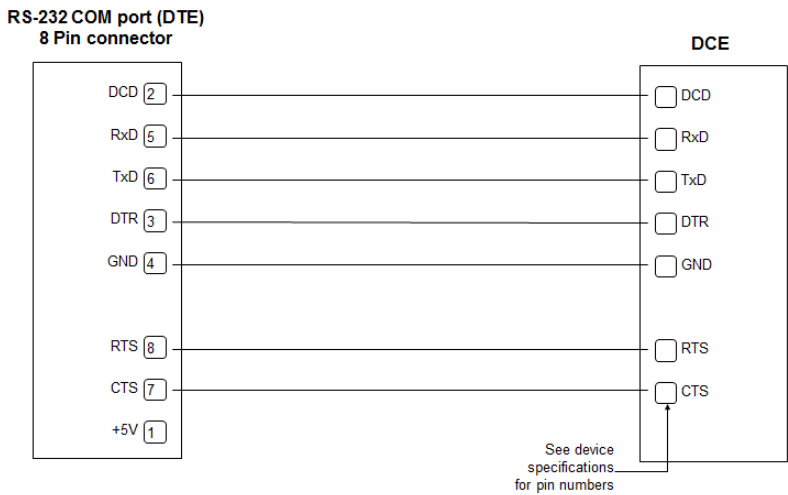
DTE to DTE with Handshaking

Some DTE devices may require hardware handshaking lines. Common lines are the CTS and RTS lines. Less common are the DTR and DCD lines. The RTU does not require these lines. Refer to the specifications of the external device for exact requirements. The following diagram shows a common connection of an RS232 COM port with a DTE device requiring handshaking lines.



DTE to DCE with Handshaking

DCE devices require different wiring. The handshaking lines need to be connected in many cases. Many DCE devices are half-duplex. Select half-duplex operation with these devices. The diagram below shows common connection of an RS232 COM port with a DCE device requiring handshaking lines.



10.3.3 RS485 Wiring Example

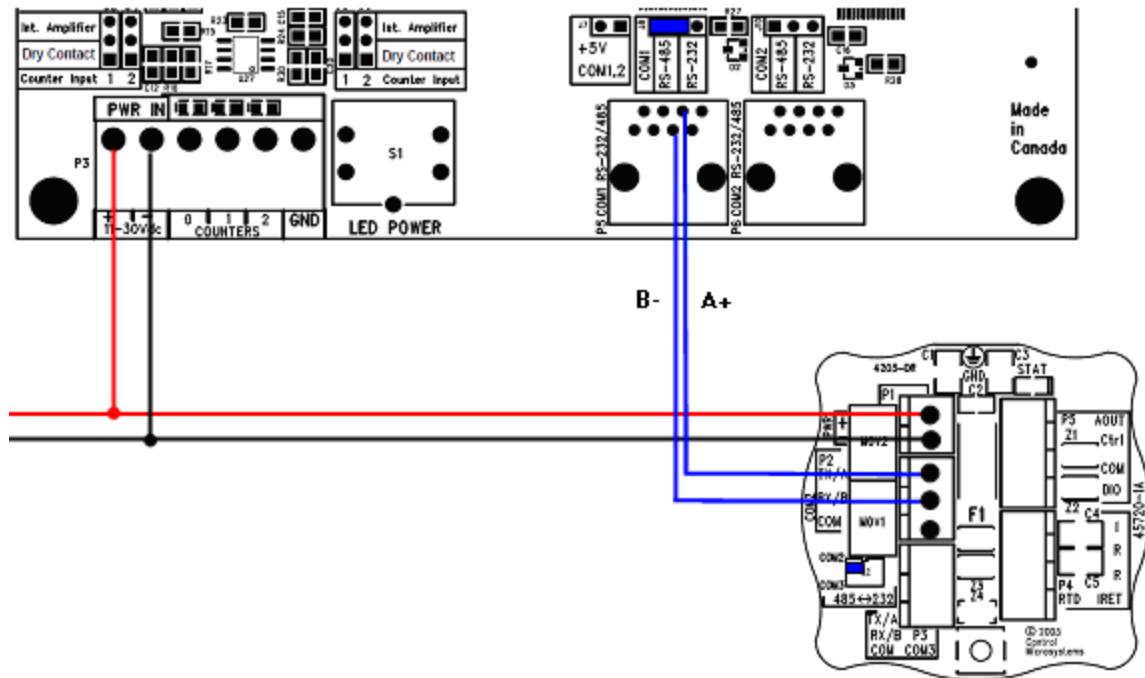
⚠ WARNING

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.

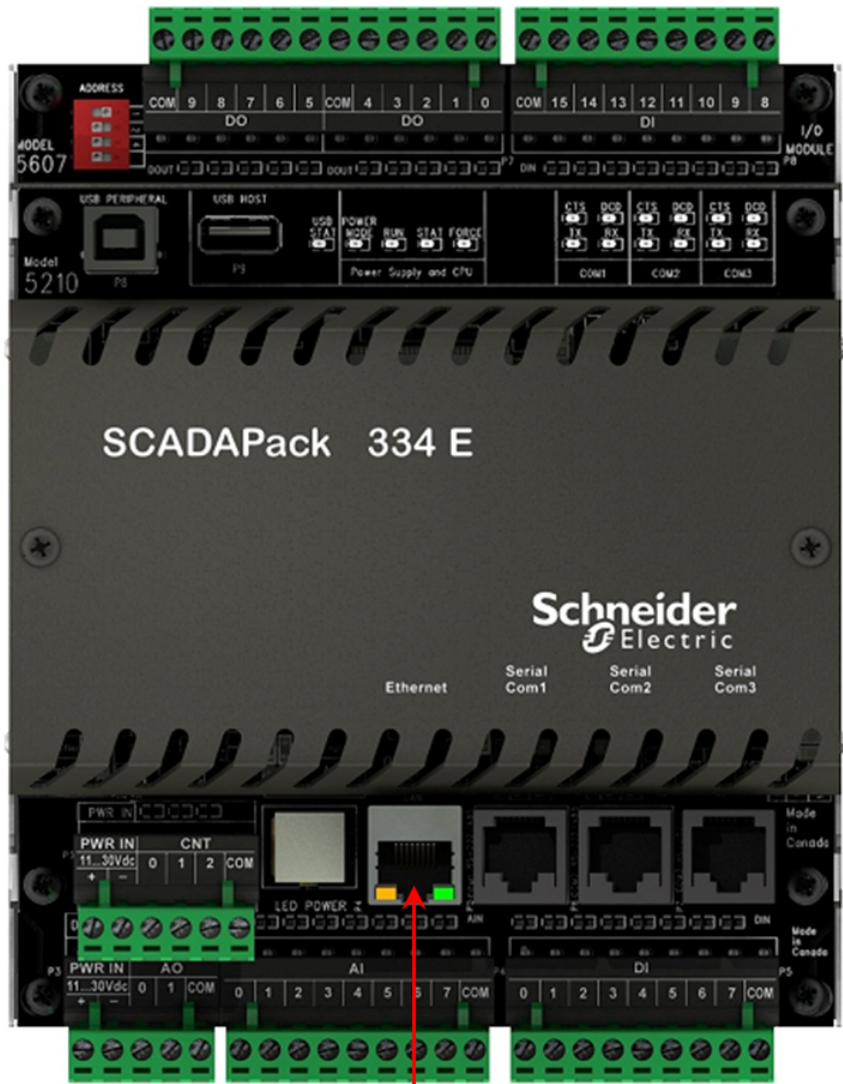
Failure to follow these instructions can result in death or serious injury.

A typical RS485 wiring example is shown below. COM1 is shown connected to a transmitter such as a Schneider Electric SCADAPack 4203 (COM2). The power for the transmitter comes from the same power source used to supply power to the RTU.



10.4 Ethernet Port Wiring

The topic in this section describes the wiring for the Ethernet port on the SCADAPack E Smart RTU.

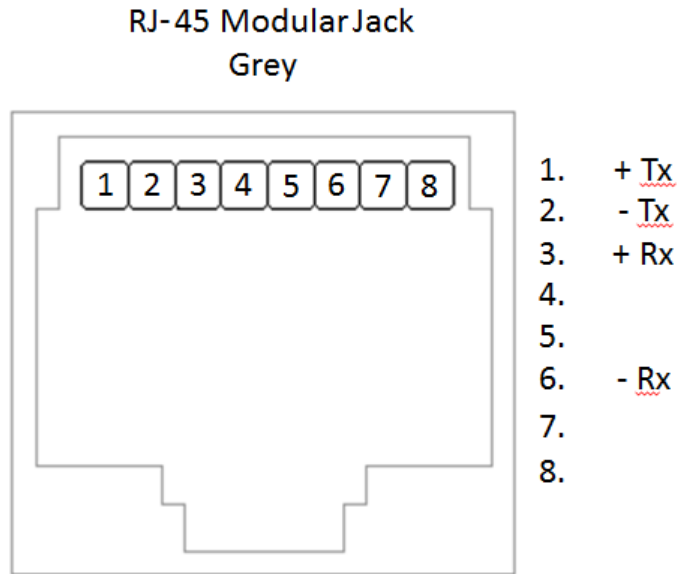


Ethernet Port

[RJ-45 Modular Connector for Ethernet](#) ⁸³

10.4.1 RJ-45 Modular Connector for Ethernet

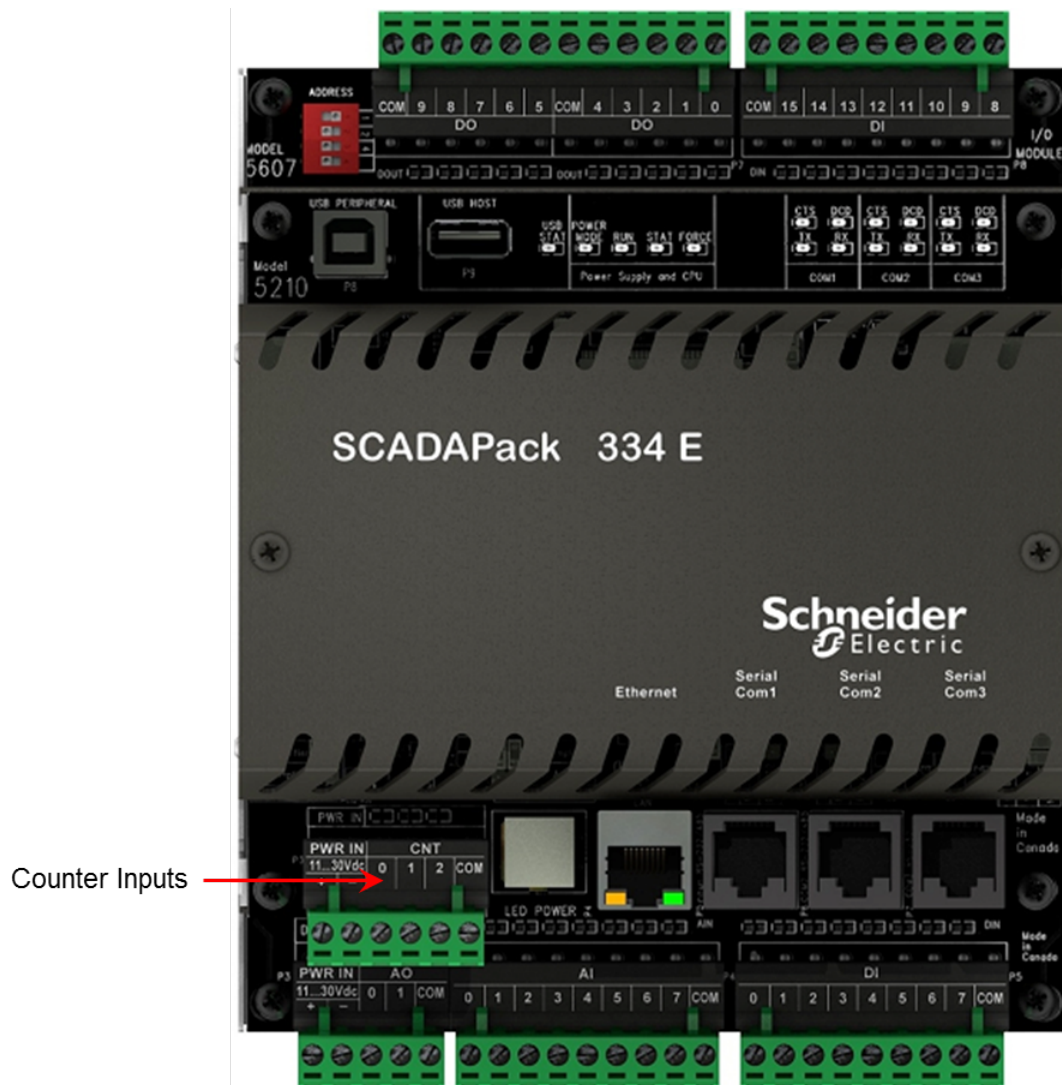
The RTU can be connected directly to a wall jack or hub using standard RJ-45 Category 5 patch cables. The following diagram shows the pin connections for the RJ-45 modular connector.



10/100Base-T has a maximum run of 100 m (328 ft), but the actual limit is based on signal loss and the noise in the environment. Running the Ethernet cables in parallel with power cables or any cables that generate noise will reduce the practical distance to less than 100 m (328 ft).

10.5 Counter Input Wiring

This section describes the wiring of counter inputs.



NOTICE

UNINTENDED EQUIPMENT OPERATION

When wiring counter inputs:

- Confirm that the connection to the counter input does not exceed the ratings for the input. See the Specifications section for details.
- Confirm that the polarity of the connection is correct with the two positive terminals wired together and the two negative terminals wired together.

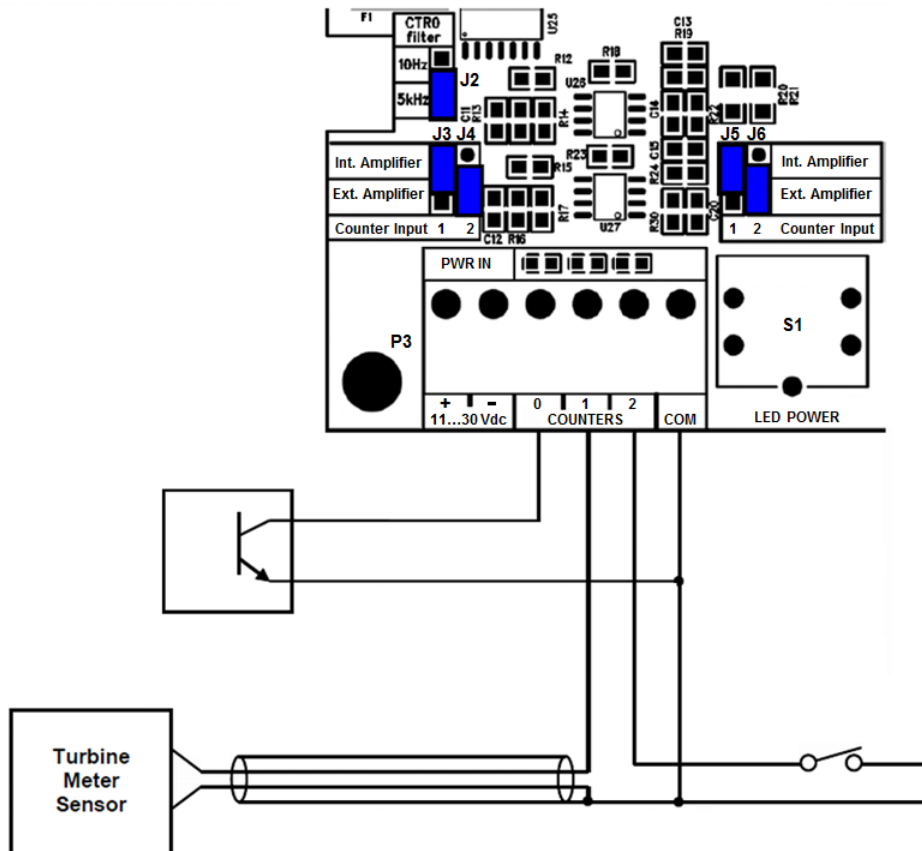
Failure to follow these instructions can result in equipment damage.

NOTICE

SIGNAL INTERFERENCE DUE TO NOISE

Counter input signals must be shielded using Belden 9322 or equivalent, when the unit is operating in an electrically noisy environment or to meet the requirements of EN61000-6-2.

Failure to follow these instructions can result in equipment damage.



Counter 1 is shown as a millivolt input with a direct connection to a turbine meter sensor. Use shielded wiring and connect the shield at one end only. Counter 2 is shown connected to an external amplifier. Refer to the following sections for details on connecting to the turbine meter counter inputs.

Counter 0 has a jumper selectable filter to set the maximum frequency of operation. The figure above shows the jumper (J2) installed in the lower (10 Hz) position. In this position, counter 0 is filtered. Use the 10 Hz position when the counter 0 input has contact bounce or other higher frequencies that need to be filtered. When the jumper is installed in the upper (5 kHz) position, there is no filtering and counter 0 is able to operate at the maximum frequency.

For further wiring information, see:

[Directly Connecting to Low Voltage Turbine Meters](#)⁸⁷

[Connecting to Open Collector Outputs with Internal Pullup](#)⁸⁹

[Connecting to Open Collector Outputs with External Pullup](#)⁹¹

10.5.1 Directly Connecting to Low Voltage Turbine Meters

NOTICE

UNINTENDED EQUIPMENT OPERATION

Do not exceed the maximum voltage specified for each counter input. See the Specifications topic for the maximum voltages.

Failure to follow these instructions can result in equipment damage.

NOTICE

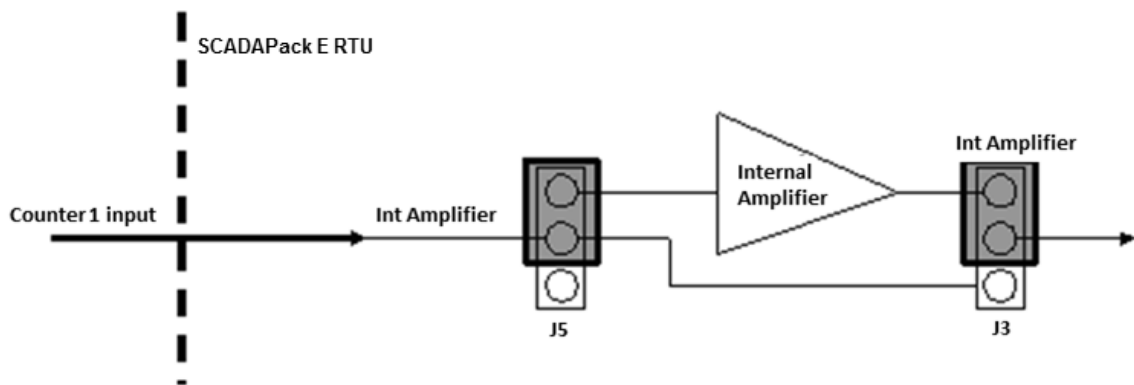
SIGNAL INTERFERENCE DUE TO NOISE

Counter input signals must be shielded using Belden 9322 or equivalent, when the unit is operating in an electrically noisy environment or to meet the requirements of EN61000-6-2.

Failure to follow these instructions can result in equipment damage.

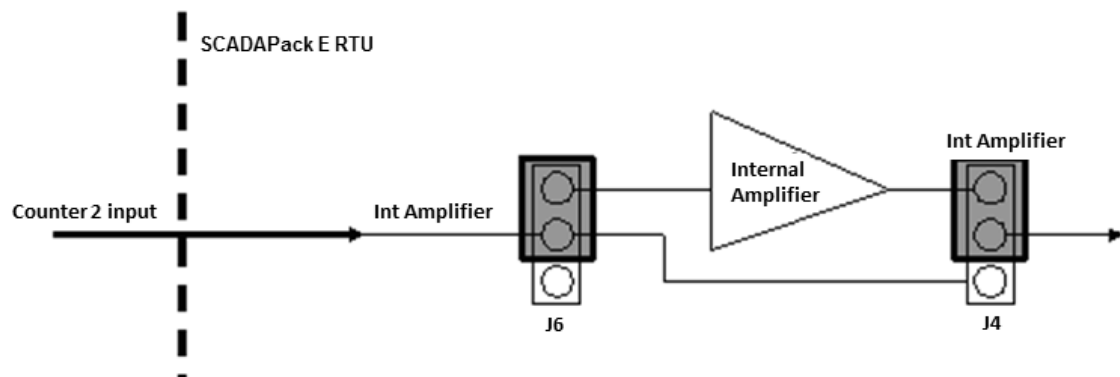
When connecting a low voltage (millivolt) turbine meter directly to counter input 1, enable the internal pre-amplifier on this input as follows:

1. Install jumper J5 on the **Int Amplifier** position, as shown below.
2. Install jumper J3 on the **Int Amplifier** position, as shown below.



Similarly, when connecting a low voltage (millivolt) turbine meter directly to the counter 2 input,

1. Install jumper J6 on the **Int Amplifier** position, as shown below.
2. Install jumper J4 on the **Int Amplifier** position, as shown below.



10.5.2 Connecting to Open Collector Outputs with Internal Pull-Up

NOTICE

UNINTENDED EQUIPMENT OPERATION

Do not exceed the maximum voltage specified for each counter input. See the Specifications topic for the maximum voltages.

Failure to follow these instructions can result in equipment damage.

NOTICE

SIGNAL INTERFERENCE DUE TO NOISE

Counter input signals must be shielded using Belden 9322 or equivalent, when the unit is operating in an electrically noisy environment or to meet the requirements of EN61000-6-2.

Failure to follow these instructions can result in equipment damage.

Counter Inputs 1 and 2 can also be used with open collector outputs. In this configuration, bypass the internal amplifiers.

For Counter 1

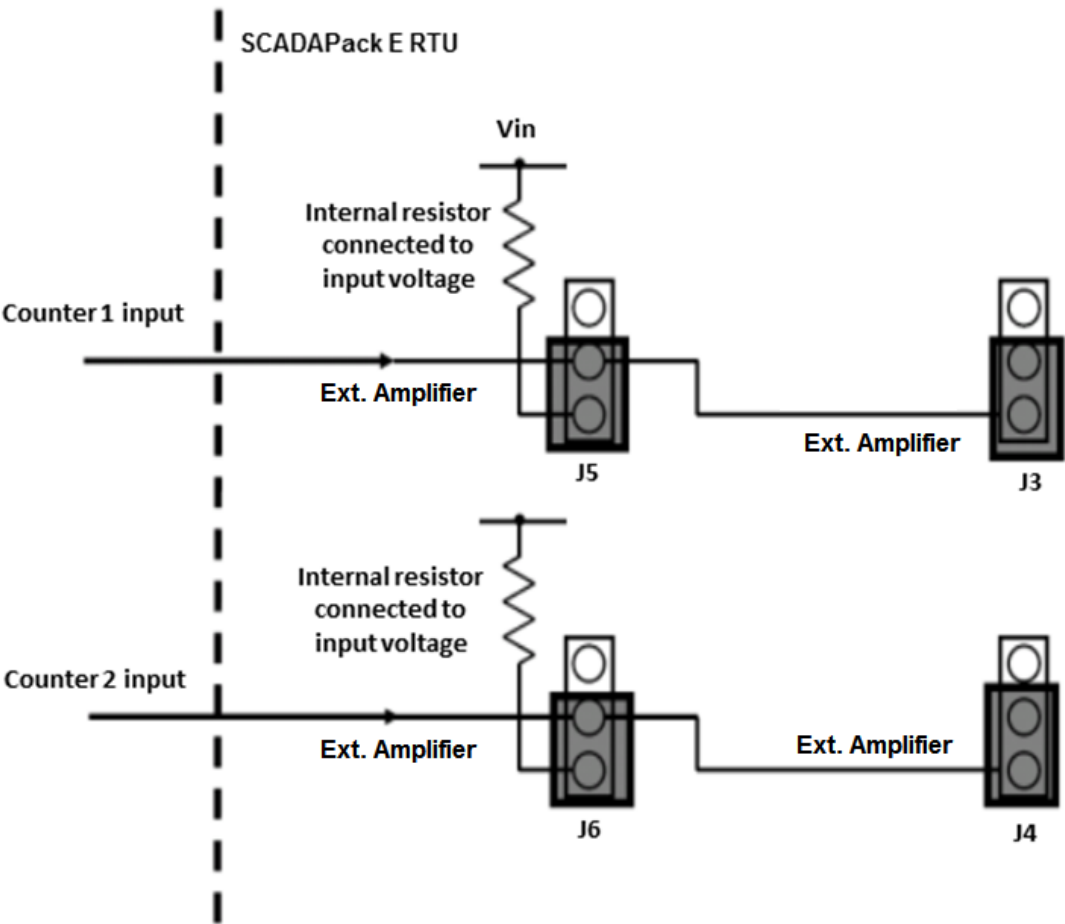
- Install jumper J5 in the **Ext. Amplifier** position.
- Install jumper J3 in the **Ext. Amplifier** position.

For Counter 2

- Install jumper J6 in the **Ext. Amplifier** position.
- Install jumper J4 in the **Ext. Amplifier** position.

Your application may have a specific current requirement as specified by the manufacturer. There is a 1000-ohm resistor from each counter input to the input power source which is connected when jumpers J3 and J5 are installed in the **Ext. Amplifier** position, as described above.

See the illustration below for connecting to open collector outputs with internal pullup:



10.5.3 Connecting to Open Collector Outputs with External Pull-Up

NOTICE

UNINTENDED EQUIPMENT OPERATION

Do not exceed the maximum voltage specified for each counter input. See the Specifications topic for the maximum voltages.

Failure to follow these instructions can result in equipment damage.

NOTICE

SIGNAL INTERFERENCE DUE TO NOISE

Counter input signals must be shielded using Belden 9322 or equivalent, when the unit is operating in an electrically noisy environment or to meet the requirements of EN61000-6-2.

Failure to follow these instructions can result in equipment damage.

In applications that require a pull-up resistor other than 1000 ohms, jumpers J5 and J6 are not used, while J3 and J4 are installed as shown in the figure below. The appropriate external pull-up resistor is then connected between the counter input and the positive terminal of your power supply, as shown in the following diagram.

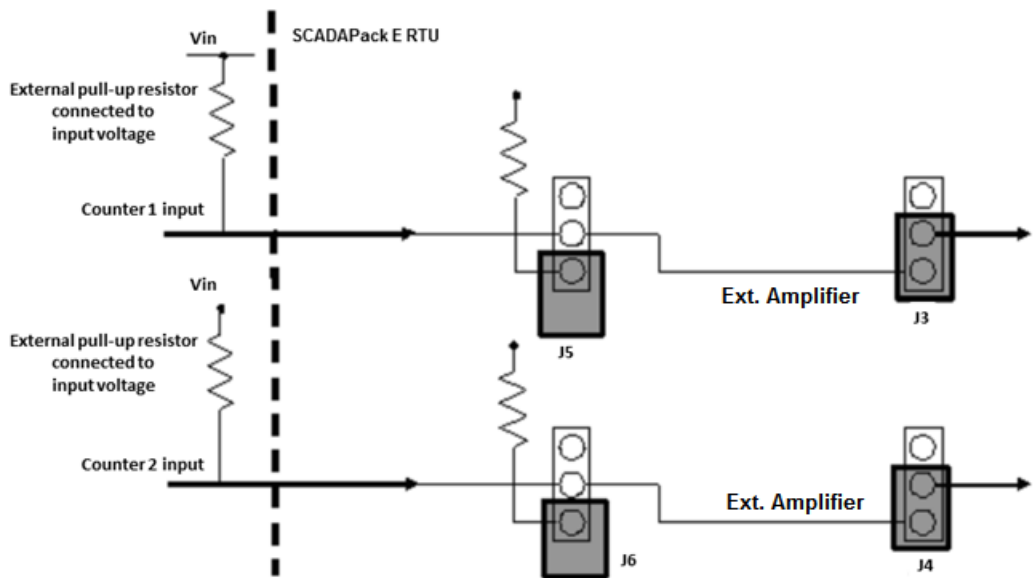
For Counter 1

- Install jumper J3 in the **Ext. Amplifier** position.
- Remove jumper J5 from the **Ext. Amplifier** position. This jumper is not used and can be stored, if required, on the single header pin.

For Counter 2

- Install jumper J4 in the **Ext. Amplifier** position.
- Remove jumper J6 from the **Ext. Amplifier** position. This jumper is not used and can be stored, if required, on the single header pin.

See the illustration below for connecting to open collector outputs with external pull-up. Jumpers J5 and J6 are not being used and are shown stored on the single header pin.



10.6 Digital Input Wiring

This section describes the wiring for the digital inputs.



[Digital Input Wiring Example](#)⁹⁴

10.6.1 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:

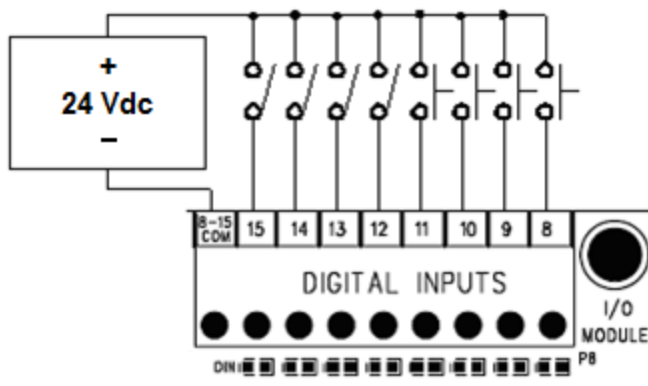
- Confirm that the connection to the digital input does not exceed the ratings for the digital input. See the Specifications topic for details.
- Confirm that the polarity of the connection is correct with the two positive terminals wired together and the two negative terminals wired together.

Failure to follow these instructions can result in equipment damage.

The I/O board accommodates DC inputs.

The voltage range is configured at the factory.

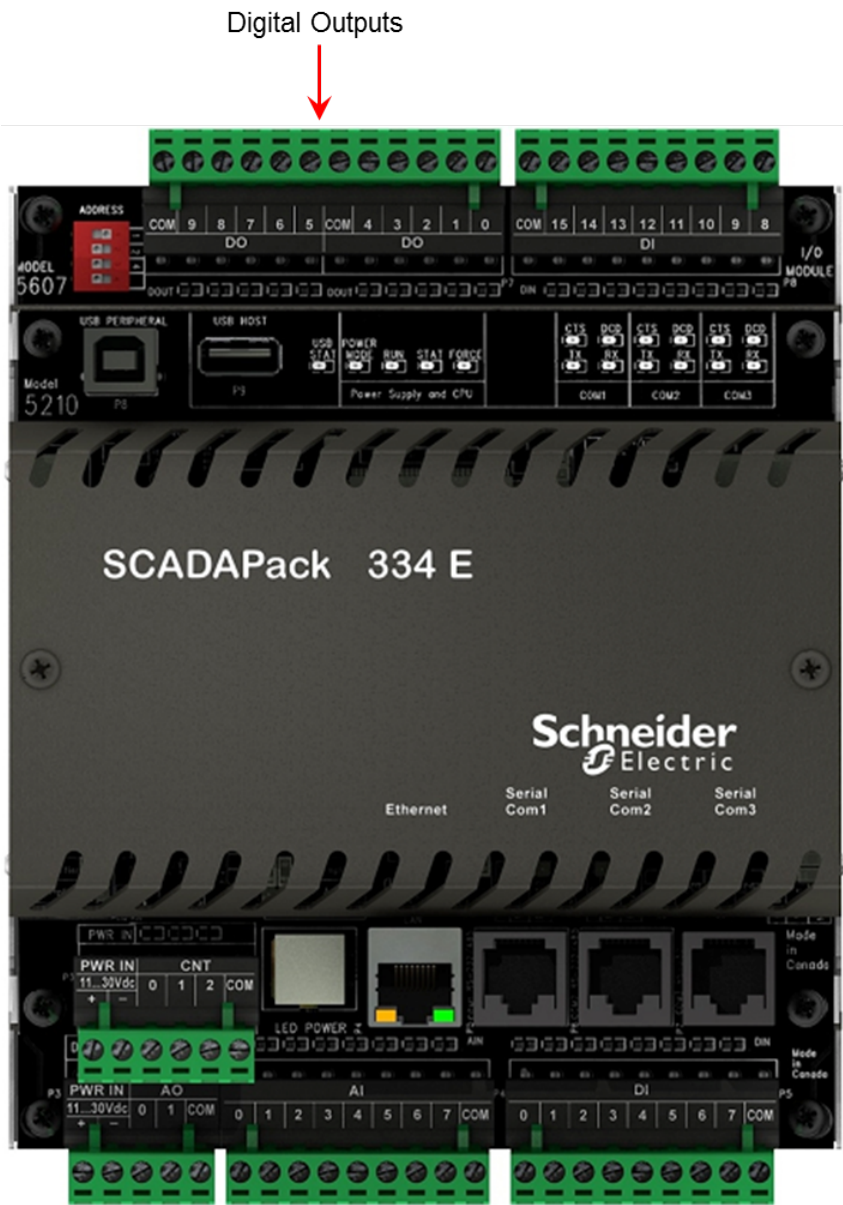
The following diagram shows typical wiring of DC signals to the digital input ports.



P8 – Digital Inputs
Module factory-configured for 12...24 Vdc.

10.7 Digital Output Wiring

This section describes the wiring for the digital outputs.



[Digital Output Wiring Example](#) ⁹⁶

10.7.1 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 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 inductive loads generates electrical noise when the relay contacts are opened.

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

Failure to follow these instructions can result in equipment damage.

NOTICE

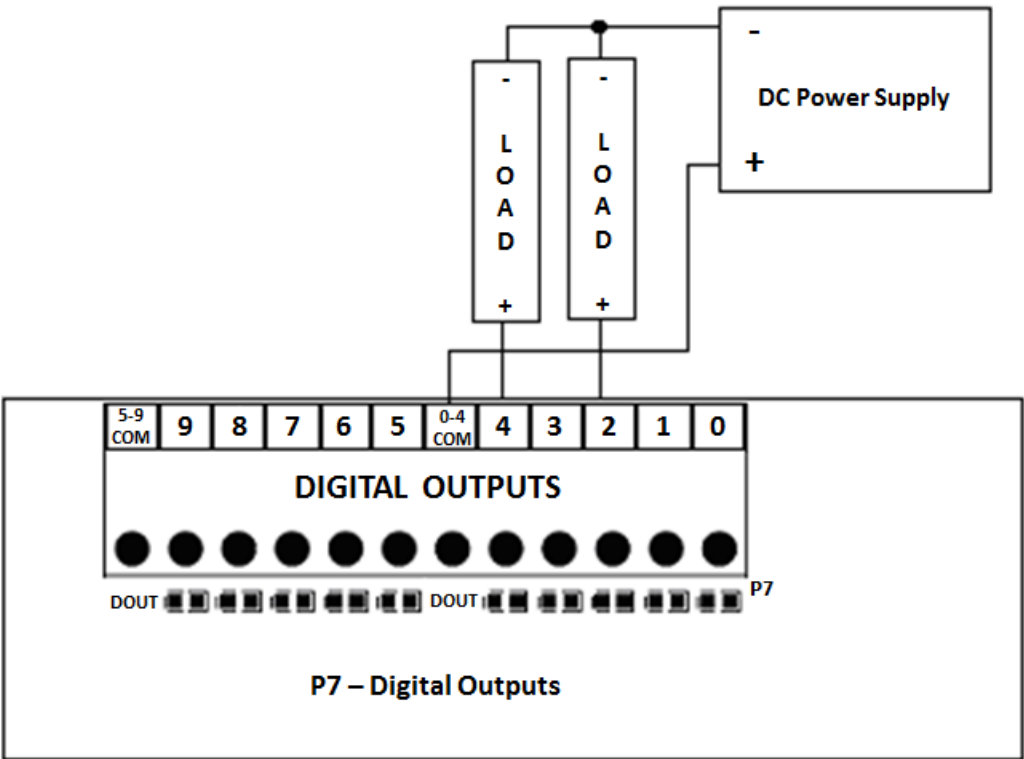
UNINTENDED EQUIPMENT OPERATION

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

Failure to follow these instructions can result in equipment damage.

Wiring Example

In the example below, relays 2 and 4 are used to switch the DC power to two loads. In this example the positive side of the loads are switched through the common of relays 0 - 4 to the positive side of the DC power supply.



10.8 Analog Input Wiring

This section describes the wiring for the analog inputs.

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

Loop-powered transmitters are two terminal devices that are connected between a power supply and the analog input. The loop current flows from the power supply through the transmitter and to ground through a 250-ohm resistor built into the 20 mA input circuit. Loop current will only flow in analog inputs that have been configured for 20 mA and when power is applied to P3.

Self-powered transmitters can have a current or voltage output. Self-powered transmitters have three terminals: Power In, Signal Out and Common. Power In connects to a power supply; Signal Out connects to the analog input channel and Common connects to COM.



[Analog Input Wiring Example](#) 

[Configuring Analog Inputs as Current Inputs](#) 

[Helping to Prevent Interruption of the Current Loop](#) 

10.8.1 Analog 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

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 RTU or I/O expansion module that provides the analog inputs is installed, there is an increased possibility of extremely severe power surges caused by lightning. In these cases, additional surge protection must be supplied by the user.

Failure to follow these instructions can result in equipment damage.

NOTICE

SIGNAL INTERFERENCE DUE TO NOISE

Analog input signals must be shielded using Belden 9322 or equivalent, when the unit is operating in an electrically noisy environment or to meet the requirements of EN61000-6-2.

Failure to follow these instructions can result in equipment damage.

NOTICE

UNINTENDED EQUIPMENT OPERATION

Do not exceed the maximum voltage specified for each analog input. See the Specifications topic for the maximum voltages.

Failure to follow these instructions can result in equipment damage.

NOTICE

UNINTENDED EQUIPMENT OPERATION

This 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 require external current sense resistors, with the module input range set to voltage.

Failure to follow these instructions can result in equipment damage.

Wiring Example

The diagram below shows several examples for wiring of loop-powered and self-powered transmitters with the corresponding analog inputs set to voltage mode with a 0...5 Vdc measurement range.

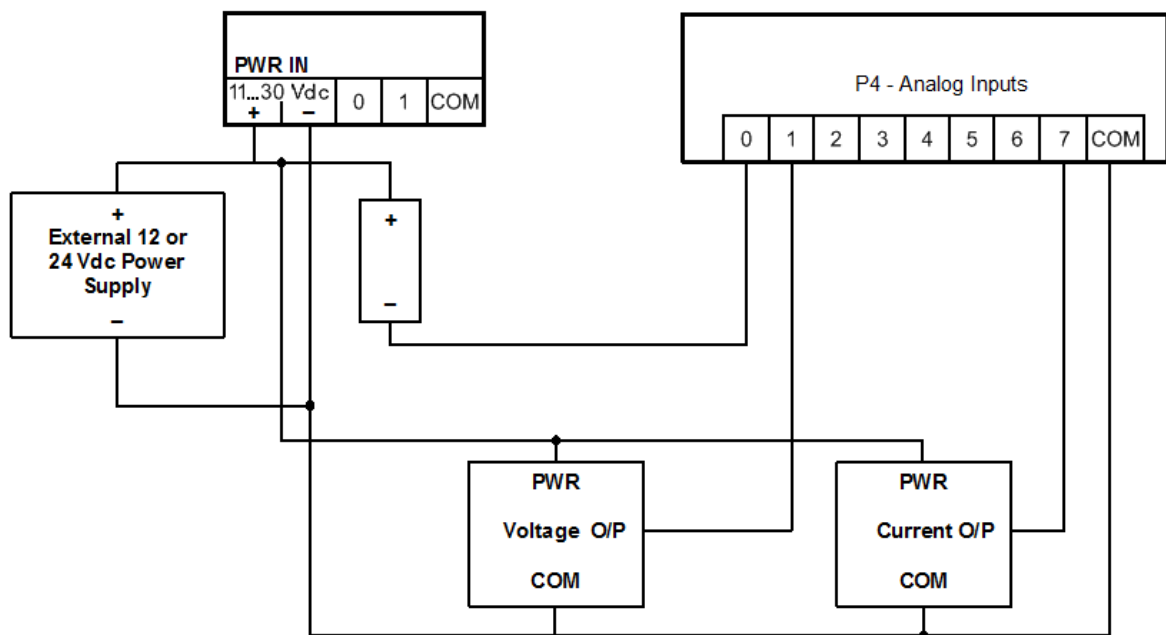
The analog inputs require their own power connection, as shown in the diagram.

Example 1: Channel 0 has a loop powered current transmitter connected to the external power supply.

Example 2: Channel 1 has a self-powered voltage transmitter connected to the external power supply.

Channels 2 through 6 are unused.

Example 3: Channel 7 has a self-powered current transmitter connected to the external power supply.



10.8.2 Configuring Analog Inputs as Current Inputs

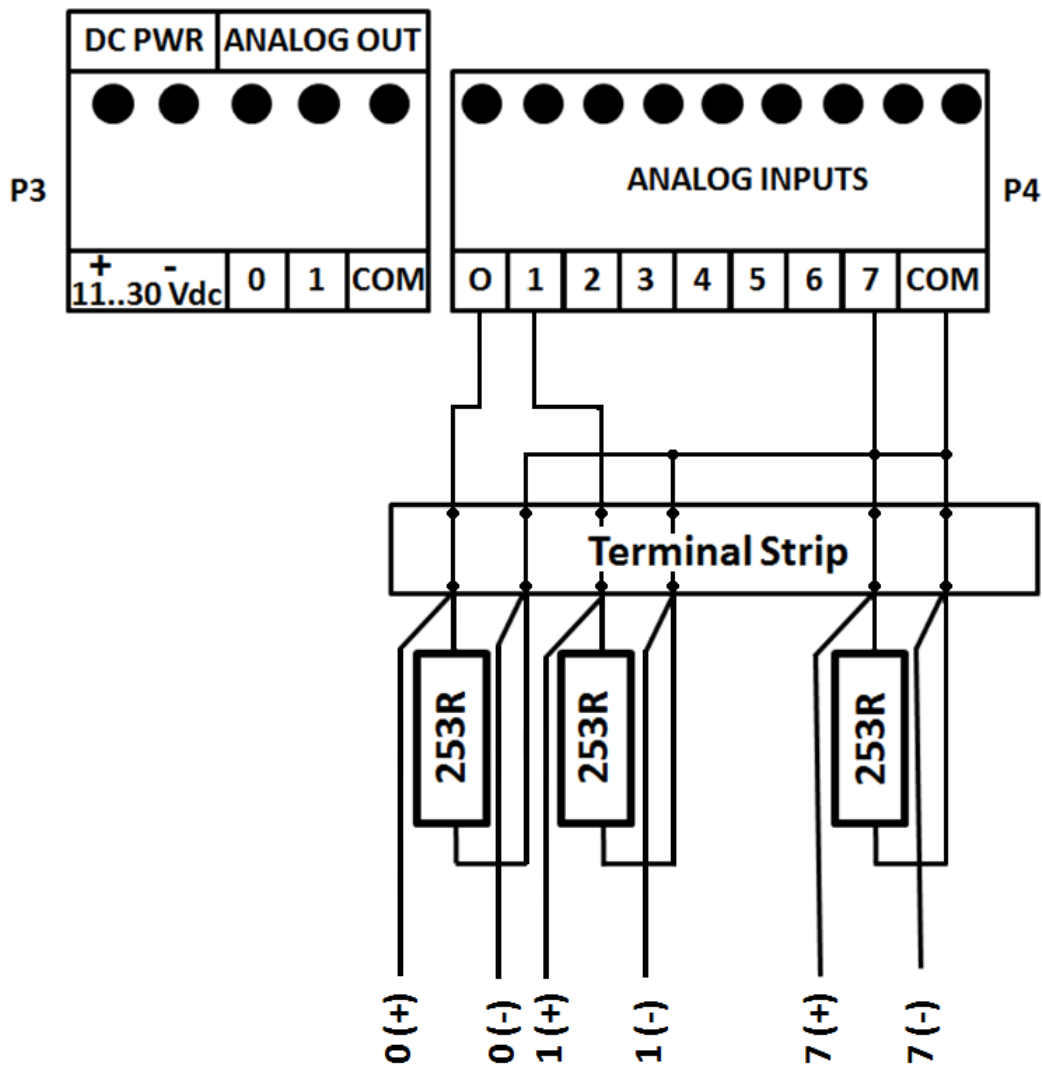
The analog inputs are configured in current input mode and have these possible operating conditions:

- The module is not the only transducer in a particular current loop
- The module is powered down, or reset

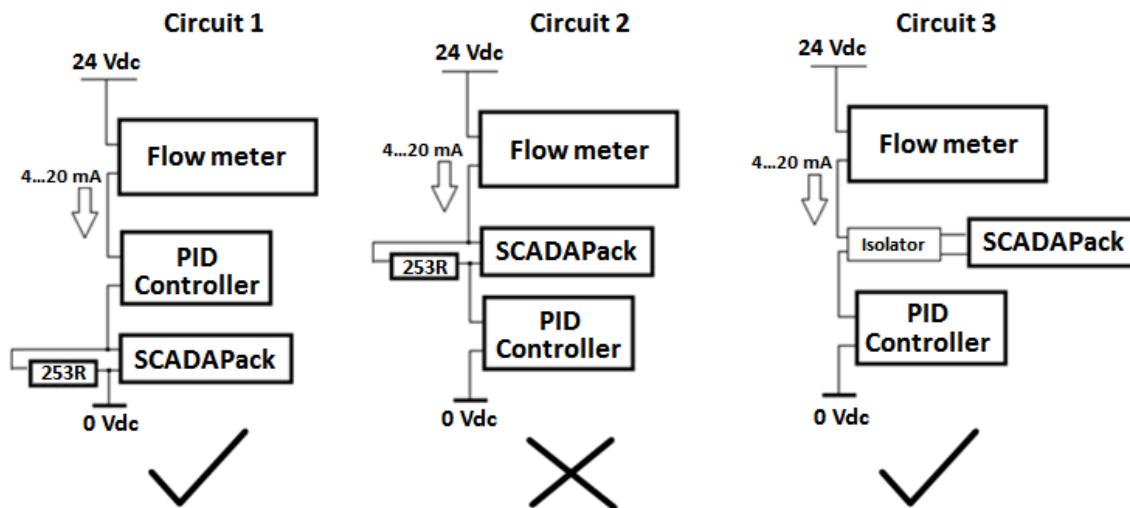
If you power down or reset the module in a multiple device loop, the analog inputs emulate voltage inputs that present a high impedance to the current loop, and effectively break the current loop of the system.

10.8.3 Helping to Prevent Interruption of the Current Loop

This wiring method is preferred if you need to swap the device, as it allows you to remove the device without interrupting the current loop. Configure the analog inputs 0, 1 and 7 as voltage inputs, and add an external 253-ohm resistor to the current loop at the terminal strip as shown in the figure below.



The circuit configurations for the external 253-ohm resistor, or a signal isolator, are shown in the figure below:



- Use a 253-ohm external resistor in consideration of the 20 kilohm internal resistance of the voltage input circuit, as shown in Circuit 1.
- Either make the device the last device in the current loop, or use a signal isolator in the circuit without the 253-ohm resistor, as shown in Circuit 3.
- You can create other parallel resistor combinations to achieve a 253-ohm impedance.
- Circuit 2 indicates an incorrect configuration.

10.9 Analog Output Wiring

This section describes the wiring for the analog outputs.



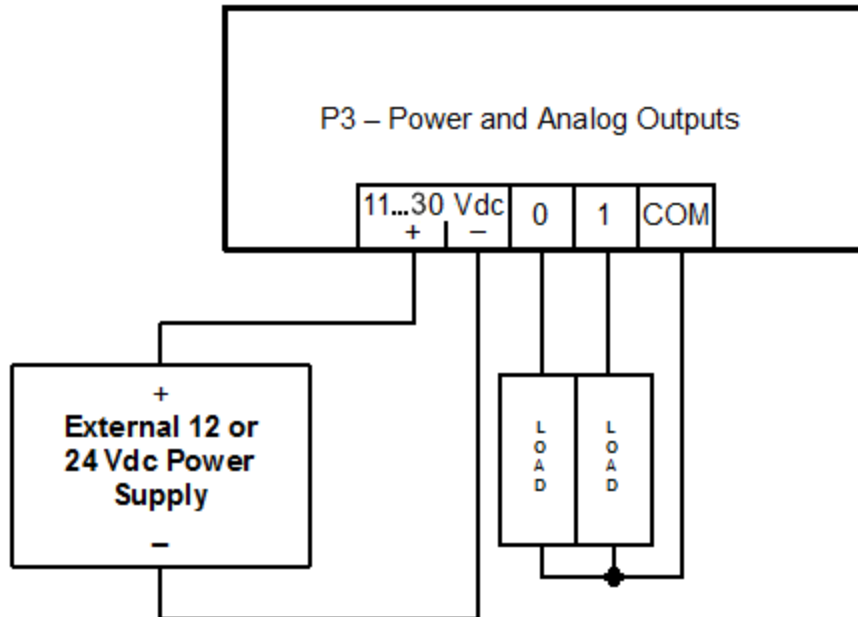
Analog Outputs

[Analog Output Wiring Example](#) ¹⁰⁵

10.9.1 Analog Output Wiring Example

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

The analog outputs require their own power connection, as shown in the diagram.



10.9.2 Analog Output Power Supply Configuration Options

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

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

NOTICE

UNINTENDED EQUIPMENT OPERATION

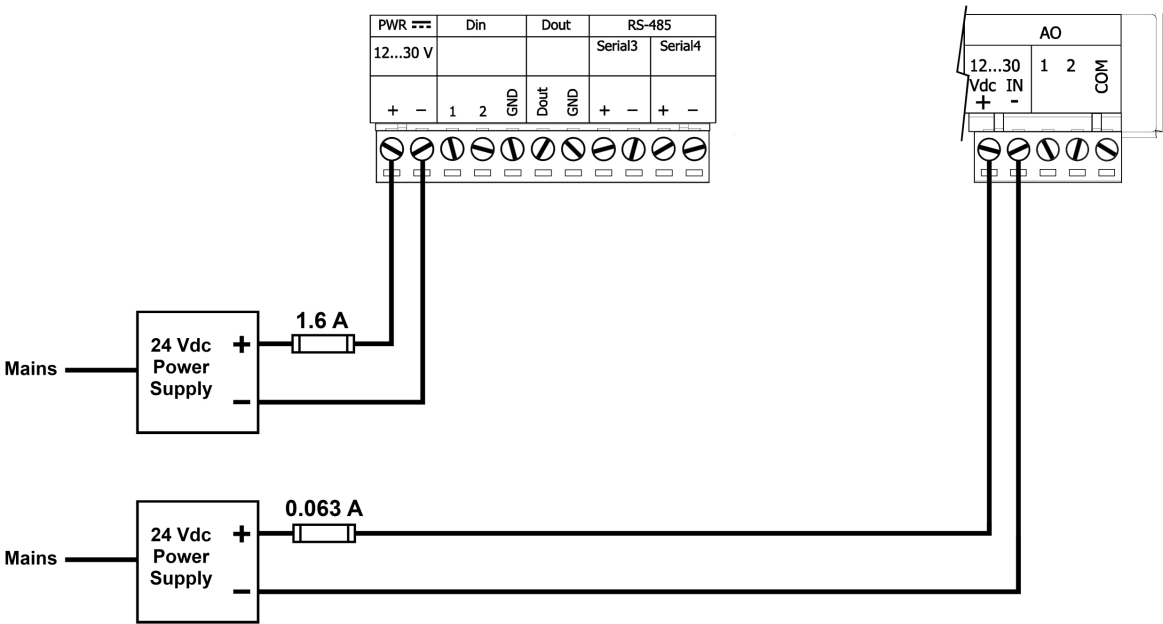
Install an external 1.6 A fast-acting fuse on the input voltage side of the RTU power supply connection.

Install an external 0.063 A fast-acting fuse on the input voltage side of the analog output power supply connection.

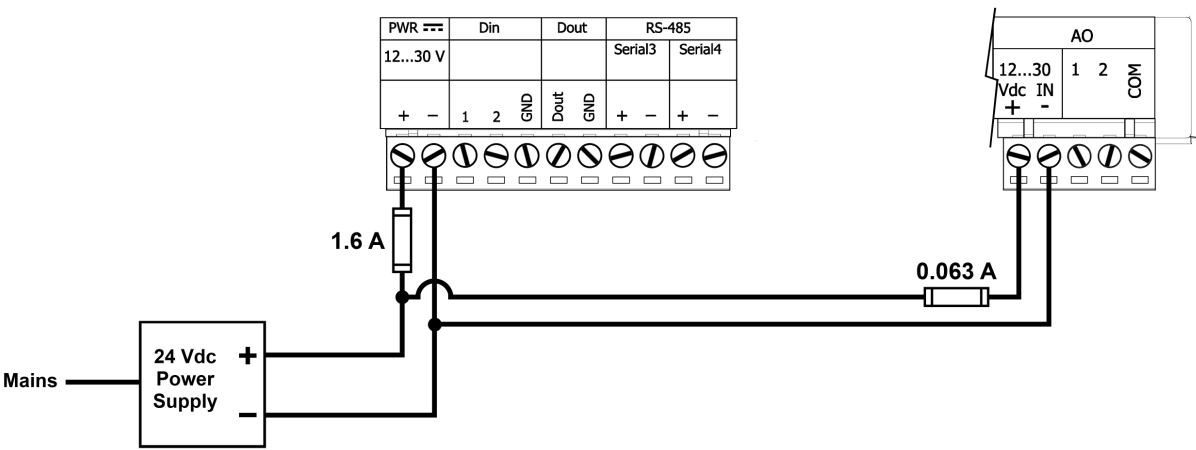
Failure to follow these instructions can result in equipment damage.

Wiring Examples

The following figure illustrates the power supply configurations for isolated and non-isolated analog outputs.



Isolated AO



Non-Isolated AO

11 Startup Modes

SCADAPack 300E RTUs can be started in four different operating modes:

- [Run mode](#)¹¹¹
- [Service Boot mode](#)¹¹²
- [Cold Boot mode](#)¹¹⁴
- [Factory Boot mode](#)¹¹⁶

By default, the RTU 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 RTU before restarting the RTU in a new mode of operation.

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

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

Because the startup mode is not determined until the LED POWER button is released, you can cancel the startup mode selection by removing power to the RTU while the LED POWER 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 LED POWER button down longer than your preferred startup mode requires.

Startup Mode Actions

NOTICE

CONFIGURATION AND APPLICATION LOSS

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

Before starting the RTU in Cold Boot mode or Factory Boot mode, save a copy of the RTU 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 defaults		X		
Serial 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 Run Mode

Run mode is the normal operating mode for SCADAPack 300E RTUs. The RTU 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 300E RTU starts in Run mode, it loads:

- The defined serial and Ethernet communication parameters for COM ports.
- RTU 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.

11.2 Service Boot Mode

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

When a SCADAPack 300E RTU starts in Service Boot mode:

- DNP3 node address zero (0) is set, enabling communication via SCADAPack E Configurator at a known DNP address. Connect SCADAPack E Configurator to USB, or serial Port 2 or Port 3.
- Any IEC 61131-3 applications that are running are stopped.
- Modbus Scanner operations are stopped.
- Applications 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 RTU for configuration, programming, and maintenance tasks without knowing the port settings used for daily operations.

Service Boot Serial and USB Port Settings for SCADAPack 300E RTUs

Parameter	USB	COM1 (Port 1)	COM2 (Port 2)	COM3 ² ¹¹² (Port 3)
Function	DNP3	None	DNP3	ISaGRAF
Mode	USB	RS485 2w ¹ ¹¹²	RS232 ¹ ¹¹²	RS232
Baud	-	9600 bps	9600 bps	9600 bps
Data Mode	-	8-bit No Parity	8-bit No Parity	8-bit No Parity
Stop Bits	-	1	1	1
Duplex	-	Half	Full	Full

¹ This table lists the software configuration settings. Verify that the hardware jumpers match these settings.

² COM3 is available on SCADAPack 330E, SCADAPack 333E, SCADAPack 334E, SCADAPack 337E, SCADAPack 350E, and SCADAPack 357E RTUs only.

Service Boot Ethernet Port Settings for SCADAPack 330E, SCADAPack 333E, SCADAPack 334E, SCADAPack 350E, and SCADAPack 357E

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

Service Boot IP Routing Settings for SCADAPack 330E, SCADAPack 333E, SCADAPack 334E, SCADAPack 350E, and SCADAPack 357E

Parameter	Address
Gateway IP	0.0.0.0

To Start a SCADAPack 300E RTU in Service Boot Mode** WARNING****UNINTENDED EQUIPMENT OPERATION**

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

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

1. Remove power from the RTU.
2. Hold down the LED POWER button.
3. Apply power to the RTU.
4. Continue holding down the LED POWER button until the **STAT LED** turns on.
5. Release the LED POWER button.

If the LED POWER button is released before the STAT LED turns on, the RTU will start in RUN mode.

11.3 Cold Boot Mode

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

Cold Boot mode does not format the flash file system. Start in [Factory Boot](#)¹¹⁶ mode to do this.

When a SCADAPack 300E RTU starts in Cold Boot mode:

- IEC 61131-3 applications are erased.
- The RTU points database is cleared.
- RTU configurations are returned to default.
- 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 300E RTUs

Parameter	USB	COM1 (Port 1)	COM2 (Port 2)	COM3 ^{2 112} (Port 3)
Function	DNP3	None	DNP3	ISaGRAF
Mode	USB	RS485 2w ^{1 112}	RS232 ^{1 112}	RS232
Baud	-	9600 bps	9600 bps	9600 bps
Data Mode	-	8-bit No Parity	8-bit No Parity	8-bit No Parity
Stop Bits	-	1	1	1
Duplex	-	Half	Full	Full

¹ This table lists the software configuration settings. Verify that the hardware jumpers match these settings.

² COM3 is available on SCADAPack 330E, SCADAPack 333E, SCADAPack 334E, SCADAPack 337E, SCADAPack 350E, and SCADAPack 357E RTUs only.

Cold Boot Ethernet Port Settings for SCADAPack 330E, SCADAPack 333E, SCADAPack 334E, SCADAPack 350E, and SCADAPack 357E RTUs

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

Cold Boot IP Routing Settings for SCADAPack 330E, SCADAPack 333E, SCADAPack 334E, SCADAPack 350E, and SCADAPack 357E RTUs

Parameter	Address
Gateway IP	0.0.0.0

To Start a SCADAPack 300E RTU in Cold Boot Mode

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

NOTICE

CONFIGURATION AND APPLICATION LOSS

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

Before starting the RTU in Cold Boot mode, save a copy of the RTU 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 RTU.
2. Hold down the LED POWER button.
3. Apply power to the RTU.
4. Continue holding the LED POWER button for 20 seconds until the STAT LED begins to flash on and off repeatedly.

If you release the LED POWER button before the STAT LED begins to flash, the RTU starts in Service Boot mode.

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

5. Release the LED POWER button.
6. Reload the RTU configuration and user-created applications from backup.

11.4 Factory Boot Mode

Factory Boot mode is used to reformat the flash file system and initialize the SCADAPack 300E RTU to factory default settings.

When a SCADAPack 300E RTU starts in Factory Boot mode:

- IEC 61131-3 applications are erased.
- The RTU point database is cleared.
- RTU configurations are returned to default.
- 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 Settings for SCADAPack 300E RTUs

Parameter	USB	COM1 (Port 1)	COM2 (Port 2)	COM3 ² (Port 3)
Function	DNP3	None	DNP3	ISaGRAF
Mode	USB	RS485 2w ¹	RS232 ¹	RS232
Baud	-	9600 bps	9600 bps	9600 bps
Data Mode	-	8-bit No Parity	8-bit No Parity	8-bit No Parity
Stop Bits	-	1	1	1
Duplex	-	Half	Full	Full

¹This table lists the software configuration settings. Verify that the hardware jumpers match these settings.

² COM3 is available on SCADAPack 330E, SCADAPack 333E, SCADAPack 334E, SCADAPack 337E, SCADAPack 350E, and SCADAPack 357E RTUs only.

Factory Boot Ethernet Port Settings for SCADAPack 330E, SCADAPack 333E, SCADAPack 334E, SCADAPack 350E, and SCADAPack 357E RTUs

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

Factory Boot IP Routing Settings for SCADAPack 330E, SCADAPack 333E, SCADAPack 334E, SCADAPack 350E, and SCADAPack 357E RTUs

Parameter	Address
Gateway IP	0.0.0.0

To Start a SCADAPack 300E RTU in Factory Boot Mode**⚠ WARNING****UNINTENDED EQUIPMENT OPERATION**

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

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

NOTICE**CONFIGURATION AND APPLICATION LOSS**

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

Before starting the RTU in Factory Boot mode, save a copy of the RTU 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 RTU.
2. Hold down the LED POWER button.
3. Apply power to the RTU.
4. Continue holding down the LED POWER button for longer than 30 seconds until the STAT LED stops blinking on and off and remains lit.

If you release the LED POWER button while the STAT LED is still blinking, the RTU starts in Cold Boot mode.

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

5. Release the LED POWER button.

The Factory Boot will take approximately 60 seconds to complete. During this time the RTU may appear unresponsive while the file system is being formatted to fix any corruption. The STAT LED will remain on until the Factory Boot has completed and the RTU restarts.

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

12 Configuration

The inputs and outputs on the RTU can be configured:

- Locally or remotely using SCADAPack E Configurator, 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.

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

[SCADAPack E Configurator](#)  120

[Reading and Writing Data with Logic Programs](#)  122

The RTU can be configured to reduce power consumption. For details see [Power Management Features](#)  124.

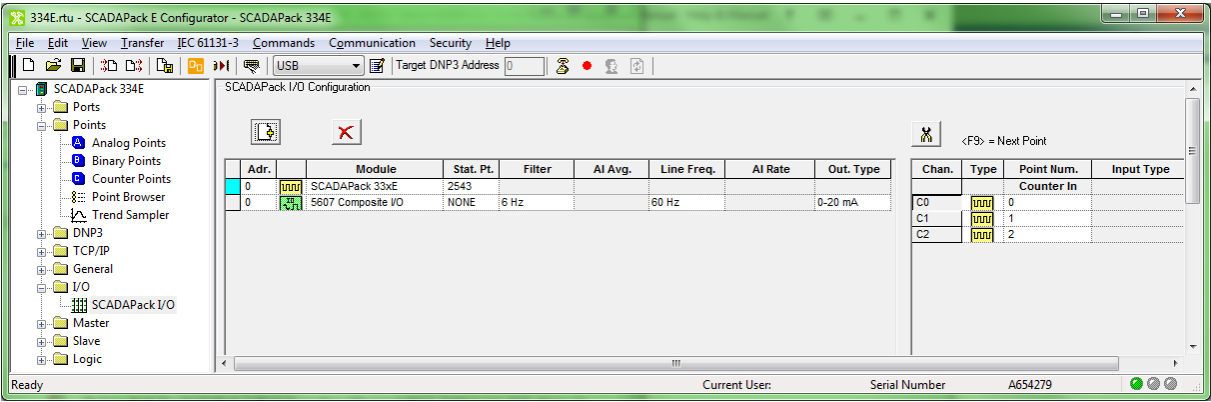
12.1 SCADAPack E Configurator

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

The following table summarizes where in the SCADAPack E Configurator software you will find the configurable attributes for the I/O board inputs and outputs. The configuration dialog is displayed when you double-click on the input or output in the table in the property page.

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

The figure below shows an example SCADAPack I/O property page in SCADAPack E Configurator and the location of the property pages listed in the table above. The I/O components listed on the SCADAPack I/O page depend on the RTU type. 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 RTU points database to access physical I/O points and derived data. Use SCADAPack E Configurator to assign RTU database points to the I/O card channels.

The following table provides a guide to reading and writing data in either SCADAPack Workbench or ISaGRAF 3 Workbench.

Data Type	SCADAPack Workbench	ISaGRAF 3 Workbench
Counter Input Data	Use RTU_COUNTER_READ I/O device to read counter inputs.	Use an rtuXXctr input board or complex equipment type to read counter inputs.
Digital I/O Data	- Use RTU_BIN_READ I/O devices to read data. - Use RTU_BIN_READ_OUTPUT I/O devices to read digital output point states. - Use RTU_BIN_WRITE I/O devices to write digital input or output points.	Use rtuxxdi, rtuxxdo or rtuxxdos I/O boards to read or write to digital inputs or outputs.
Analog Input Data	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. - Use RTU_RAW_READ or RTU_ENG_READ I/O devices to read analog input points - Use RTU_RAW_WRITE or RTU_ENG_WRITE I/O devices to write data to analog input points.	Use rtuxxai I/O boards to read analog input points.
Analog Output Data	- Use RTU_RAW_READ_OUTPUT and RTU_ENG_READ_OUTPUT I/O devices to read analog output points. - Use RTU_RAW_WRITE or RTU_ENG_WRITE I/O devices to write data to analog output points.	- Use rtuxxaos I/O boards to read analog output points. - Use rtuxxao I/O boards to write data to analog output points.

More Information

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

12.3 Power Management Features

Your SCADAPack E RTU provides a number of special features to reduce power consumption.

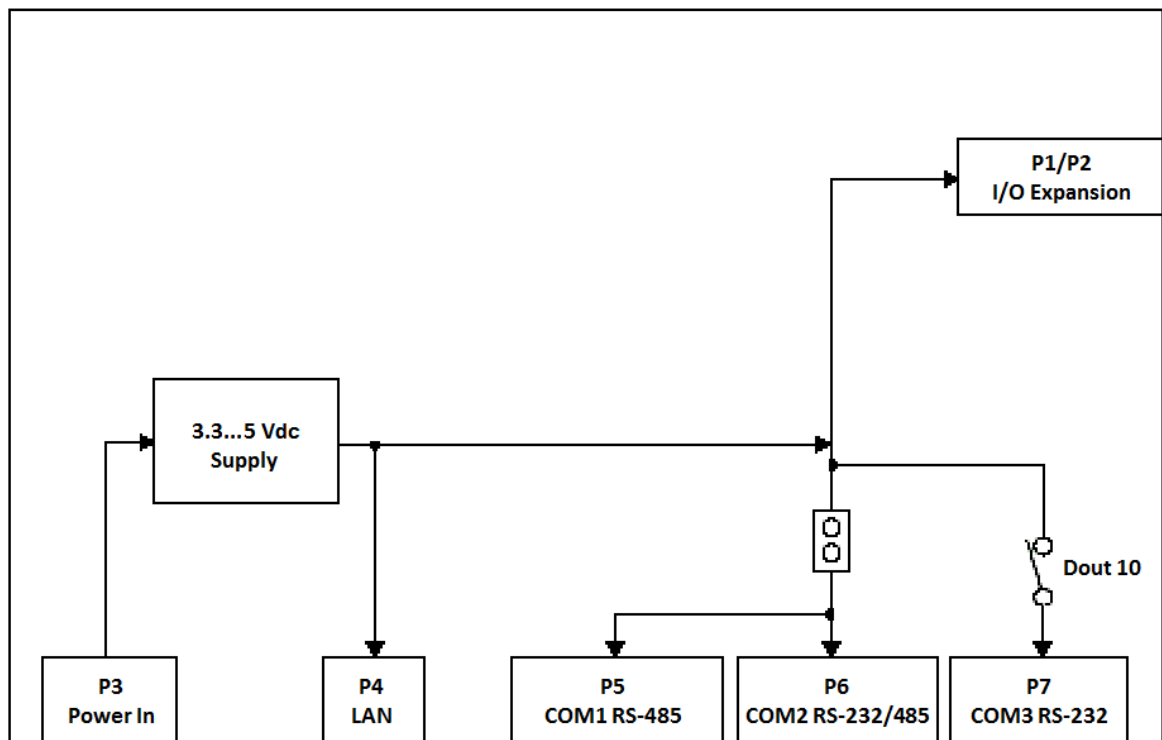
These power management features are described in the following topics:

[COM1 and COM2 Serial Port Power Control](#) ¹²⁶

[COM3 Serial Port Power Control](#) ¹²⁶

[LED Power Control](#) ¹²⁷

Refer to the figure below for an overview of the power management features.

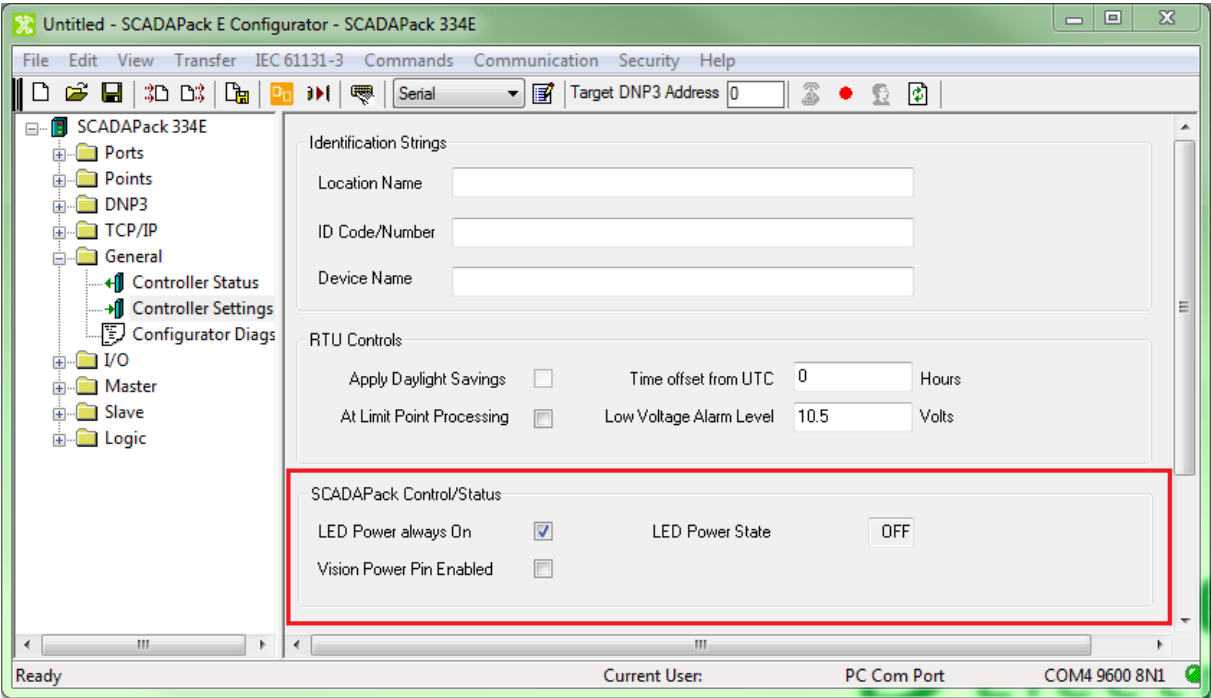


System points and the power management functions they control are described in the [Diagnostics](#) ¹²⁸ section, in the following topics:

[Input Supply Voltage and Internal Temperature](#) ¹³⁰

[Power Supply and Battery Status](#) ¹³²

SCADAPack E Configurator controls for the power management modes are found on the **General > Controller Settings** property page.



12.3.1 COM1 and COM2 Serial Port Power Control

Serial ports on the RTU can have pin 1 on the RJ-45 connector connected to 5 Vdc. For COM1 and COM2 connectors, this pin can be connected to the 5 Vdc power supply by installing a jumper at J7 (5 Vdc COM1, COM2).

NOTICE

UNINTENDED EQUIPMENT OPERATION

The 5 Vdc output on serial ports is used to power Vision terminals and other Schneider Electric accessories.

Verify that no voltage is applied to cables connected to pin 1 on serial ports.

Failure to follow these instructions can result in equipment damage.

12.3.2 COM3 Serial Port Power Control

The COM3 serial port is for use with the SCADAPack Vision or other Human Machine Interface (HMI).

Pin 1 of the RJ-45 connector provides a switched 5 Vdc power for the SCADAPack Vision or other HMI.

Refer to Section [COM3 RS232 Serial Port](#)^[29] for information on COM3 and Section [RS232 Cable Description \(RJ-45 to SCADAPack Vision\)](#)^[77] for wiring examples.

Binary System Point 50750

HMI power is controlled in the following ways.

- When the LED power is enabled, the HMI power is turned on.
- When the LED power is disabled and Binary System Point 50750 is ON (SCADAPack E Configurator Vision Power Pin Enabled ON) HMI power is turned on.
- When the LED power is disabled and Binary System Point 50750 is OFF (SCADAPack E Configurator Vision Power Pin Enabled OFF) HMI power is turned off.

Binary System Point 50750 indicates the status of COM3 serial port power. It is set when COM3 serial port power is on and is cleared when COM3 serial port power is off.

HMI power is turned on whenever the LED power is enabled. This is provided for service and diagnostics. Refer to [LED Power Control](#)^[127] for further information.

The **Vision Power Pin Enabled** control, found in the **SCADAPack E Configurator General > Controller Settings** page, can also be used to control the Vision (or other HMI) power.

12.3.3 LED Power Control

You can disable the LEDs on the RTU to conserve power. This is particularly useful in solar-powered or unattended installations.

The **Power Mode** LED indicates the LED power state. It is on when LED power is enabled.

Using the LED POWER push-button to enable LED power

- Press the **LED POWER** push-button (located beside the counter inputs) to toggle LED power from off to on or from on to off.

Using SCADAPack E Configurator to enable LED power

- In the **General > Controller Settings** property page,
 - Select the **LED Power always On** check box to deactivate the **LED POWER** button and keep the LEDs on.
 - Clear the **LED Power always On** check box to turn the LEDs off, except at the following times:

At RTU startup, the LEDs are enabled. 60 seconds after the controller has started the LEDs will be disabled.

While the RTU is running, when you press the **LED POWER** button, the LEDs are enabled for a period of 60 seconds. After 60 seconds, the LEDs are again disabled.

The LED state is independent of the Vision display controls on the RTU. You can programmatically relate these items together through ISaGRAF logic if required, for example, to activate the DC/DC converter and Vision display when the LEDs are activated.

13 Diagnostics

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

- LEDs that indicate the status of RTU ports and communications
- System points that measure internal RTU temperature and provide power supply and battery status
- System points that provide communications status information.

The following topics provide an overview of the diagnostic capabilities on the RTU:

[Status LED](#)  128

[LED Indicators](#)  129

[Battery Voltage, Supply Voltage, and Internal Temperature](#)  130

[Power Supply and Battery Status](#)  132

[Counter Inputs](#)  133

[Digital Inputs](#)  133

[Digital Outputs](#)  133

[Analog Inputs](#)  134

[Analog Outputs](#)  134

13.1 Status LED

The STAT LED indicates the current RTU status condition as follows:

- The STAT LED blinks when a status code is present.
- The STAT LED turns off when the status code is returned to 0.

To determine the cause of the STAT LED condition

- View the RTU system point **50020**.
- In the **SCADAPack E Configurator General > Controller Status** property page, view the **System Error Code** field.

To clear the status code and the STAT LED indicator

- In the **SCADAPack E Configurator General > Controller Status** property page, click **Clear Errors**.

13.2 LED Indicators

The table below describes the LEDs on the RTU. LEDs can be disabled to conserve power using SCADAPack E Configurator.

LED	Function
Power Mode	On when operating and the LEDs are enabled Off when the LEDs are disabled Off when powered off
RUN	Blinking every 1.5 seconds when the RTU is operating normally For detailed information about indication of RTU startup phases see the SCADAPack E Operational Reference manual
STAT	Blinking when there is a status code The status code and description can be viewed on the SCADAPack E Configurator General > Controller Status property page The status code is also available in SCADAPack E Analog System Point 50020
FORCE	On when I/O points are forced (locked by ISaGRAF 3 Workbench and SCADAPack Workbench)
RX	On when receiving data on the corresponding serial port
TX	On when transmitting data on the corresponding serial port
CTS	On when the CTS input is asserted on the corresponding serial port
DCD	On when the DCD input is asserted on the corresponding serial port
Counter 0	On when the counter input is present and low
Counters 1 and 2	When the input is configured to use an external amplifier, the LED is on when the counter input is present and low When the input is configured to use the internal amplifier, the LED is on when input pulses are present
Digital outputs	On when the corresponding output is on
Digital inputs	On when the corresponding input is on
Analog inputs	On when analog input is configured for current Off when analog input is configured for voltage Long flashes when the applied current is out of range Short flashes when the applied voltage is out of range

13.3 Battery Voltage, Supply Voltage, and Internal Temperature

Internal analog points measure the RTU input battery voltage, supply voltage, and internal temperature. These can be accessed from a user application program or via remote RTU 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 RTU circuit board in degrees Celsius. It is useful for measuring the operating environment of the RTU and returns an integer value in the range -40...75.

The temperature reading represents temperatures in the range -40...75 °C. Temperatures outside this range cannot be measured.

- Use the system point directly by assigning an analog point of this point number (50062) 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 °F

Analog System Point 50063

This analog system point measures the ambient temperature at the RTU circuit board in degrees

Fahrenheit. It is useful for measuring the operating environment of the RTU and returns an integer value in the range -40...167.

The temperature reading represents temperatures in the range -40...167 °F. Temperatures outside this range cannot be measured.

- Use the system point directly by assigning an analog point at this point number (50063) 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.

13.4 Power Supply and Battery Status

Two internal binary system points are provided which indicate the status of the RTU input supply voltage and the on-board lithium battery. These can be accessed from a user application program or via remote RTU communications.

Local Input Power Supply Low

Binary System Point 50206

This binary system point indicates the condition of the input power supply. It compares the [Supply Voltage Analog System Point 50060](#)¹³⁰ with the Low Voltage Alarm Level set on the SCADAPack E Configurator **General > Controller Settings** property page. If the input power supply is lower than the Low Voltage Alarm Level then this system point is activated.

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

Local On-Board Battery Low

Binary System Point 50207

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

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

13.5 Counter Inputs

Condition	Action
Input LED does not come on when input signal is applied.	Check the input signal at the termination block. It should be at least 50% of the counter input range. Check the LEDs are turned on.

13.6 Digital Inputs

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

13.7 Digital Outputs

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

13.8 Analog Inputs

Condition	Action
20 mA inputs read 0.	Check transmitter power.
Reading is at or near 0 for every input signals.	Check whether the input transient suppressors are damaged.
20 mA readings are not accurate.	Check for a damaged 250-ohm current sense resistor.
Reading is constant.	Check that the analog input is not forced.
Reading seems out of calibration for small inputs but improves as input increases.	Check the input range setting.
In Current Loop Mode, there can be an open circuit in the Current Loop.	Refer to the section Configuring Analog Inputs as Current Inputs ^[102] .
Other devices are not functional after installation of the module.	In Current Loop mode, make the module the last device in the loop, or use a signal isolator as discussed in the section Configuring Analog Inputs as Current Inputs ^[102] .

13.9 Analog Outputs

Condition	Action
Outputs are 0 mA	Check if there is an analog output module installed. Check the 24 Vdc power.
The full-scale output is less than 20 mA.	Check the 24 Vdc power. Check that the load resistance is within specification.
Output is constant instead of changing.	Check that the analog outputs are not forced.

14 Maintenance

The RTU requires little maintenance. The **Power Mode** LED indicates the status of the 5 Vdc supply.

If the LED is off, the on-board fuse F1 may require replacing. The fuse is a Littelfuse Nano-SMF, part number **045301.5** or **R45101.5**. This fuse is available in a package of 10 from Schneider Electric as part number **TBUM297327**.

If the program is lost during power outages, the lithium battery may require replacement. See [Replacing the Battery](#)^[141] for details.

The analog input and output circuitry (where available) is calibrated at the factory and does not require periodic calibration. Calibration may be necessary if the module has been repaired as a result of damage.

If the RTU is not functioning correctly, contact Schneider Electric Technical Support for information regarding returning the SCADAPack E Smart RTU for repair.

WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

WARNING

HAZARD OF ELECTRIC SHOCK

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

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

For more information, see the following sections:

[Calibration](#)^[136]

[Preventive Maintenance](#)^[136]

[Routine Maintenance](#)^[136]

[Replacing the Battery](#)^[141]

[Updating Firmware](#)^[144]

[Fuses](#)^[145]

14.1 Calibration

The RTU 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 RTU or the I/O expansion module before removing power.

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

WARNING

HAZARD OF ELECTRIC SHOCK

Remove power from the RTU before removing the RTU cover.

Remove power from the RTU 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

UNINTENDED EQUIPMENT OPERATION

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

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

WARNING

HAZARD OF ELECTRIC SHOCK

Remove power from the RTU before removing the RTU cover.

Remove power from the RTU before servicing.

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

NOTICE

UNINTENDED EQUIPMENT OPERATION

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

Failure to follow these instructions can result in equipment damage.

Primary Power Supply

The primary power for the RTU 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 RTU 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 RTU configuration during a power-supply interruption.

NOTICE

DATA LOSS

RTU 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 RTU is disconnected.

When memory contents are lost, RTU configuration information and user-created applications must be reloaded for correct RTU operation.

Failure to follow these instructions can result in equipment damage.

NOTICE

UNINTENDED EQUIPMENT OPERATION

Before replacing the onboard RAM back-up battery, save a copy of the RTU 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 RTU 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 RTU provides notifications for the following:

- Onboard lithium battery low
- Input power supply low

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 Technical Support](#) ⁸ for advice.

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

A flat-package lithium battery located on the controller board provides back-up power to the RTU'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 RTU 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 following procedure requires the RTU to be powered off briefly. It also requires restarting the RTU in **Cold Boot** mode. Consider the following precautions before proceeding.

Back Up Data Before Replacing the Battery

RTU 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 RTU disconnected, as required in the procedure below.
- The RTU 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 need to reload user-created applications and RTU configuration information for correct RTU operation.

NOTICE

DATA LOSS

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

WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

2. Remove power from the RTU.

NOTICE

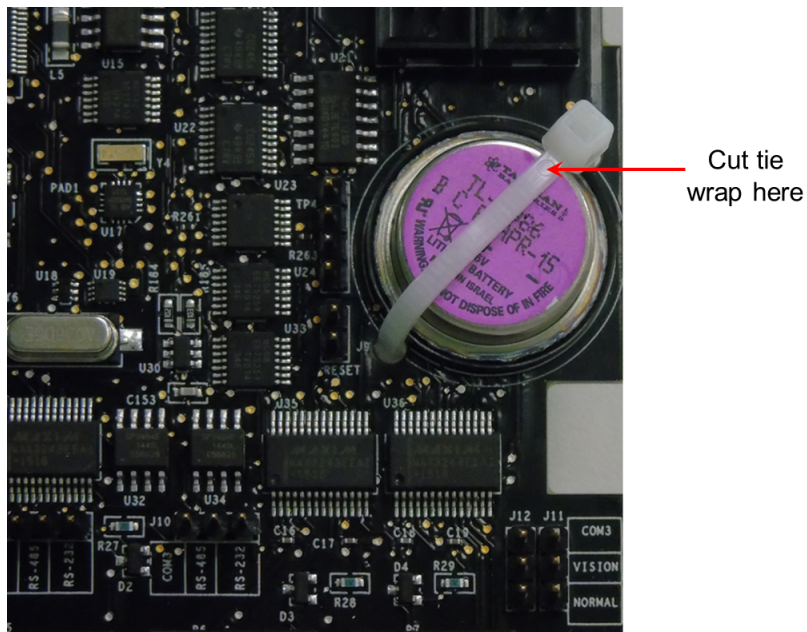
STATIC ELECTRICITY DAMAGE

The electronics inside the RTU can be damaged by static electricity. If you need to remove the RTU cover, wear an anti-static wrist strap that is connected to ground. Failing to follow this step can cause intermittent or total loss of RTU 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 RTU 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 RTU cover.
9. Apply power to the RTU and start it in Cold Boot mode by holding the **LED POWER** 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 RTU.
11. Reload the RTU configuration and user-created applications from back-up.

14.5 Updating Firmware

On the SCADAPack E Smart RTU, 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

UNINTENDED EQUIPMENT OPERATION

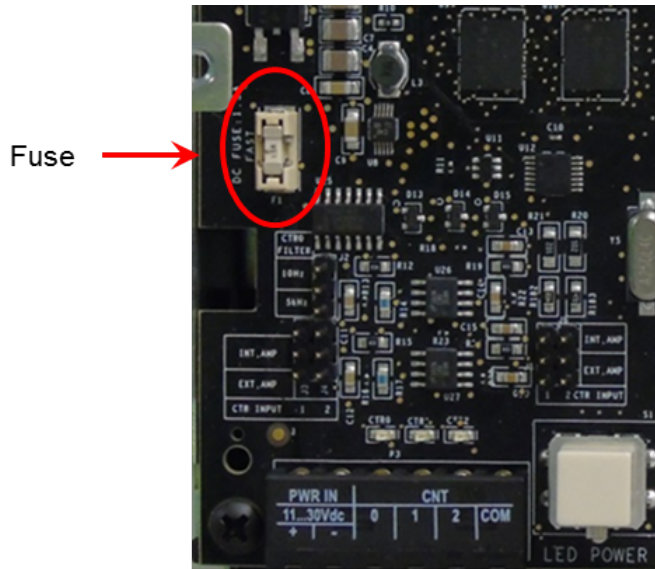
Before you install any firmware updates, check the Release Notes for the firmware update to determine the most suitable firmware versions for the functionality you are using and to confirm version compatibility.

Failure to follow these instructions can result in equipment damage.

For the procedures to update firmware, see the **SCADAPack E Firmware Update Technical Reference Manual**.

14.6 Fuses

A single 1.5 Amp fast-blow fuse provides protection for the power supply. The fuse is mounted under the cover. See the following image for the location.



WARNING

RISK OF EXPLOSION

Before replacing the fuse:

- Verify that the area is non-hazardous.
- Assess the impact that disconnecting power may have on other devices.
- Disconnect power.

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

WARNING

UNINTENDED EQUIPMENT OPERATION

Evaluate the operational state of the equipment monitored and controlled by the SCADAPack E RTU.

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

 WARNING**UNINTENDED EQUIPMENT OPERATION**

Replace the fuse with a fuse of the same rating. Under no circumstances would a fuse be bypassed or replaced with a fuse of a higher rating.

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

The fuse is a Littelfuse Nano-SMF, part number **045301.5** or **R45101.5**. This fuse is available in a package of 10 from Schneider Electric as part number **TBUM297327**.

In every case, investigate and correct the cause of the blown fuse before replacement. Common causes of a blown fuse are short circuits and excessive input voltages.

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](#) .

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15.1 General

Feature/Function	Detail
Terminations	• 5, 6 and 9-pin, removable terminal blocks • 3.3...0.08 mm² (12...28 AWG) • 15 A contacts • Screw termination - 0.5 N•m (4.5 lb-in) torque
Dimensions	• 142 mm (5.59 in) wide • 181 mm (7.13 in) high • 74.1 mm (2.92 in) deep
Packaging	Corrosion-resistant zinc-plated steel with black enamel paint
Environment	• 5% RH to 95% RH, non-condensing • -40...70 °C (-40...158 °F) operation • -40...85 °C (-40...185 °F) storage

15.2 Power Supply

Feature/Function	Detail
Power required at 12 Vdc (Relays, Ethernet, digital inputs and LEDs active)	4.0 W
Power required at 24 Vdc (Relays, Ethernet, digital inputs and LEDs active)	4.5 W
5 Vdc current available for I/O expansion	500 mA
Maximum power consumption with maximum I/O expansion	7.7 W

15.3 Controller Board

Feature/Function	Detail
Processors	• 32-bit ARM7-TDMI microcontroller (32 MHz clock) • Integrated watchdog timer • Microcontroller I/O co-processors (20 MHz clock)
Memory	• 16 MB FLASH ROM • 4 MB CMOS RAM • 4 kB EEPROM
Non-volatile RAM	CMOS RAM with lithium battery retains contents for 2 years with no power
Clock calendar	±1 minute/month at 25 °C (77 °F) +1/-3 minutes/month 0...50 °C (32...122 °F)
Internal temperature	• Measurement range -40...75 °C Accuracy ± 5 °C • Measurement range -40...167 °F Accuracy ± 9 °F
Lithium Battery Monitor	• Accuracy ± 0.2 Vdc • Status indicated by Internal Binary Points¹³²
Power Input Voltage Monitor	Accuracy ±0.4 Vdc

15.4 Data Capacity

Feature/Function	Detail
Maximum Database Points or Registers	Up to 1,000 DNP3 points or 1,000 to 2,000 Modbus registers, depending on the register type.
Maximum DNP3 Events	20,000
Maximum Data Concentrator Points	Up to 500 in DNP3
Maximum Data Concentrator Devices	Up to 10 in DNP3 Up to 100 in Modbus or DF1
File System Typical Storage	5 MB in 31x and 33x RTUs 6 MB in 35x RTUs
Trend sample files	80 (when no user programming used)
Integers	20,000
Floats	10,000
Trend aggregation	Up to 5 MB (with Restart History programming in SCADAPack Workbench. See SCADAPack E Trend Sampler Technical manual)
Integers	1,200,000
Floats	600,000

15.5 Serial Ports

Feature/Function	Detail
Serial Port COM1	RS232 mode: • RS232 compatible serial port • Jumper configurable • Data Terminal Equipment (DTE) • 8-pin modular jack • Full or half duplex with RTS/CTS control • Implemented: TxD, RxD, CTS, RTS, DCD, DTR, 5 Vdc power with jumper link (shared with COM2)
	RS485 mode: • RS485 compatible serial port • Jumper configurable • Data Terminal Equipment (DTE) • 8-pin modular jack • Two-wire half duplex • Implemented: TxD, RxD, CTS, RTS, DCD, DTR, 5 Vdc power with jumper link (shared with COM2) • Bias resistors installed
Serial Port COM2	RS232 mode: • RS232 compatible serial port • Jumper configurable • Data Terminal Equipment (DTE) • 8-pin modular jack • Full or half duplex with RTS/CTS control • Implemented: TxD, RxD, CTS, RTS, DCD, DTR, 5 Vdc power with jumper link (shared with COM1)
	RS485 mode: • RS485 compatible serial port • Jumper configurable • Data Terminal Equipment (DTE) • 8-pin modular jack

Feature/Function	Detail
	• Two-wire half duplex • Implemented: TxD, RxD, CTS, RTS, DCD, DTR, 5 Vdc power with jumper link (shared with COM1) • Bias resistors installed
Serial Port COM3	• Dedicated RS232 compatible serial port • Jumper configurable for Normal or Vision mode • Data Terminal Equipment (DTE) • 8-pin modular jack • Full or half duplex with RTS/ CTS control • Implemented TxD, RxD, CTS, RTS, DCD, DTR and 5 Vdc power under program control • For use with SCADAPack Vision operator interface
Baud Rates	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Data Modes	• 8-bit, no parity, 1 stop bit • 8-bit, even parity, 1 stop bit • 8-bit, odd parity, 1 stop bit • 7-bit, even parity, 1 stop bit • 7-bit, odd parity, 1 stop bit • 8-bit, no parity, 2 stop bits
Isolation	Common ground return connected to chassis ground
Cable Length	• RS232: maximum 3 m (10 ft) • RS485: maximum 1200 m (4000 ft)
Protocol	DNP3 Slave, DNP3 Master, IEC60870-5-101 Slave, IEC60870-5-103 Master, Modbus RTU Master, Modbus RTU Slave, DF1
Protocol Modes	Slave, master, master/slave, store and forward

15.6 Ethernet Port

Feature/Function	Detail
Terminations	• RJ-45 modular connector • 10Base-T/100Base-T (twisted pair) • 10/100 Mbits per second
Protocols Supported	• DNP3 in TCP Master/Slave (default) • DNP3 in UDP Master/Slave (default) • ISaGRAF/TCP • Modbus/TCP Client • Modbus/TCP Server • Modbus RTU in TCP Client • IEC60870-5-104 Slave (subject to license) • NTP Server • Telnet Server • FTP Server • BOOTP Server

15.7 USB Port

Feature/Function	Detail
Compliance	USB 2.0
USB Port	• One USB Peripheral Port "B" connector (for local configuration) • USB Host Port "A" connector - Not currently supported
Speed	• 1.5 Mb/s • 12 Mb/s
Protocols Supported	DNP3

15.8 Visual Indicators

Feature/Function	Detail
COM1	Received data: (RX) LED Transmitted data: (TX) LED Clear to send: (CTS) LED Data carrier detect: (DCD) LED
COM2	Received data: (RX) LED Transmitted data: (TX) LED Clear to send: (CTS) LED Data carrier detect: (DCD) LED
COM3	Received data: (RX) LED Transmitted data: (TX) LED Clear to send: (CTS) LED Data carrier detect: (DCD) LED
Status	• POWER MODE LED • RUN LED • STAT LED (blinking when operational non-zero status code present) • FORCE LED (some I/O has been locked by ISaGRAF)
Counters	3 LEDs
Ethernet	Link indicator: (LINK) LED Activity indicator: (ACT.) LED
USB	USB status indicator: (USB STAT) LED (under user program control)
LED POWER button	LED power toggle and operating mode selector

15.9 Counter Inputs

Feature/Function	Detail
Counter Inputs	- Counter 0 digital input counter - Counter 1 turbine meter inputs - Counter 2 turbine meter inputs
Digital Input Counter 0	- Jumper selectable maximum frequency 10 Hz or 5 kHz - Dry contact input - Wetting current typically 5 mA - Contact closure to ground is ON - Open input is OFF
Counter 1 and 2	- Designed for use with low voltage, turbine meter outputs - Jumper link selectable for use with turbine meter amplifiers or dry contact closure
Counter 1 and 2 Turbine Meter Sensitivity	- Minimum input 30 mVp-p at 5...50 Hz - Minimum input 150 mVp-p at 150 Hz - Minimum input 650 mVp-p at 5 kHz - Minimum input 750 mVp-p at 10 kHz - Maximum input 4 Vp-p using internal amplifier
Counter 1 and 2 Dry Contact	- Maximum input 10 Vp-p without internal amplifier - Maximum frequency 10 KHz
Dry Contact Thresholds	0.9 Vdc typical turn on voltage - Less than 0.4 Vdc turn on input voltage 1.5 Vdc typical turn off input voltage - Greater than 2.2 Vdc turn off input voltage
Isolation	Common ground return connected to chassis ground

15.10 Digital Inputs

Quantity	16	
Connectors	2 removable, 8-pin	
Indicators	Logic-powered LEDs that can be disabled to conserve power	
Voltage	Typical: 12 Vdc or 24 Vdc	
Over-voltage Tolerance	36 Vdc	
Input Current	0.67 mA typical at 24 Vdc	
Input Voltage	Turn on voltage 9 Vdc (minimum turn on voltage) Turn off voltage 3 Vdc (maximum turn off voltage)	
Response Time	Off – To – On	On – To – Off
@ 50 Hz	15...19 ms	25...29 ms
@ 60 Hz	13.5...18 ms	23...28 ms
Isolation	Isolation is in 2 groups of 8 Isolation from logic supply and chassis: 250 Vac/1000 Vdc	

15.11 Digital Outputs

Quantity	10
Connector	Removable, 12-pin
Type	Form A Contacts (normally open) 5 contacts share one common
Indicators	Logic-powered LEDs that can be disabled to conserve power
Inductive Loads	Place a diode across the coil to suppress the noise in DC circuits and extend the life of the relay contacts See Digital Output Wiring Example ⁹⁶ for further information
Isolation	Isolation is in 2 groups of 5 Chassis to contact: 1500 Vac (1 min) Logic to contact: 1500 Vac (1 min) Output group to output group: 1500 Vac (1 min)
Operate Time	25 ms maximum, 20 ms typical
Release Time	30 ms maximum, 25 ms typical
Dry Contact Relay Version	
Contact rating	3 A, 30 Vdc 12 A maximum per common
Switching Capacity	5 A, 30 Vdc (150 W Resistive)
Service Life	2 x 10 ⁷ mechanical 1 x 10 ⁵ at contact rating
Bounce Time	1 ms typical
Solid State Relay Version	
Load Voltage	30 Vdc maximum
Load Current	2 A continuous maximum at 50 °C (122 °F) ambient 1.33 A continuous maximum at 70 °C (158 °F) ambient
On Resistance	0.09 ohms
Off State Leakage Current	10 µA

Service Life	Unlimited
Bounce Time	None

15.12 Analog Inputs

Quantity	8
Connector	Removable, 9-pin
Indicators	Logic-powered LEDs that can be disabled to conserve power Indicate voltage or current mode and out-of-range input signal
Ranges	Software-configurable 0...20 mA 4...20 mA 0...10 Vdc 0...5 Vdc
Resolution	15 bits over the 0...10 Vdc measurement range 14 bits over the 0...5 Vdc and 0...20 mA measurement range
Accuracy	±0.1% of full scale at 25 °C (77 °F) ±0.2% over temperature range
Input Resistance	250 ohms or 20 kilohms in 20 mA or 10 Vdc configurations
Isolation	Isolation from logic supply and chassis: 500 Vac

15.13 Analog Outputs

Quantity	2 with optional 5305 module
Connector	Removable, 5-pin
Range	0...20 mA sourcing 4...20 mA sourcing
Resolution	12 bits
Maximum Load Resistance	925 W with 24 Vdc input voltage or when internal 24 Vdc power supply is on 375 W with 12 Vdc input voltage 250 W with input voltage at power supply turnoff
Accuracy	Accuracy specified from 0.5...20 mA $\pm 0.15\%$ of full scale at 25 °C (77 °F) $\pm 0.25\%$ of full scale over temperature range
Noise and Ripple	0.04% maximum
Logic End-Of-Scan to Signal Update Latency	With up to 10, 5000 series I/O expansion modules Typical: 18...27 ms
Response time (D/A to signal)	Less than 10 μ s for 10% to 90% signal change
Isolation	Isolation from logic supply and chassis

16 Standards and Certifications

Hazardous Locations - North America	 Non-Incendive Electrical Equipment for Use in Class I, Division 2 Groups A, B, C and D Hazardous Locations. • CSA Std. C22.2 No. 213-M1987 - Hazardous Locations. • ANSI/ISA 12.12.01 - Hazardous (Classified) Locations.
Hazardous Locations - Europe	• ATEX II 3G, Ex nA IIC T4 Gc • per EN 60079-15, protection type n (Zone 2)
Hazardous Locations - IECEX	This certification does not apply to SCADAPack devices with a radio. • IECEX, Ex nA IIC T4 Gc • CoC IECEX UL 16.0070 X • per IEC 60079-15, protection type n (Zone 2)
Safety	• CSA (cCSAus) certified to the requirements of: CSA C22.2 No. 142-M1987 and UL508. (Process Control Equipment, Industrial Control Equipment) • UL (cULus) certified to the requirements of UL508 and CSA C22.2 No. 142-M1987 (Industrial Control Equipment, Process Control Equipment)
Digital Emissions	• FCC Part 15, Subpart B, Class A Verification • EN 61000-6-4 Electromagnetic Compatibility (EMC) - Generic Emission Standard for Industrial Environments • RCM Compliance
Immunity	• EN 61000-6-2 Electromagnetic Compatibility (EMC) - Generic Standards - Immunity for Industrial Environments
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

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