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SCADAPack

334 Hardware Manual

Version: 2.27.1

Date: February 2017



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1 Legal Information

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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
Direct Worldwide	+1-613-591-1943
Email	supportTRSS@schneider-electric.com

Technical Support: Australia

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

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

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

Acceptable Use

SCADAPack 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 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

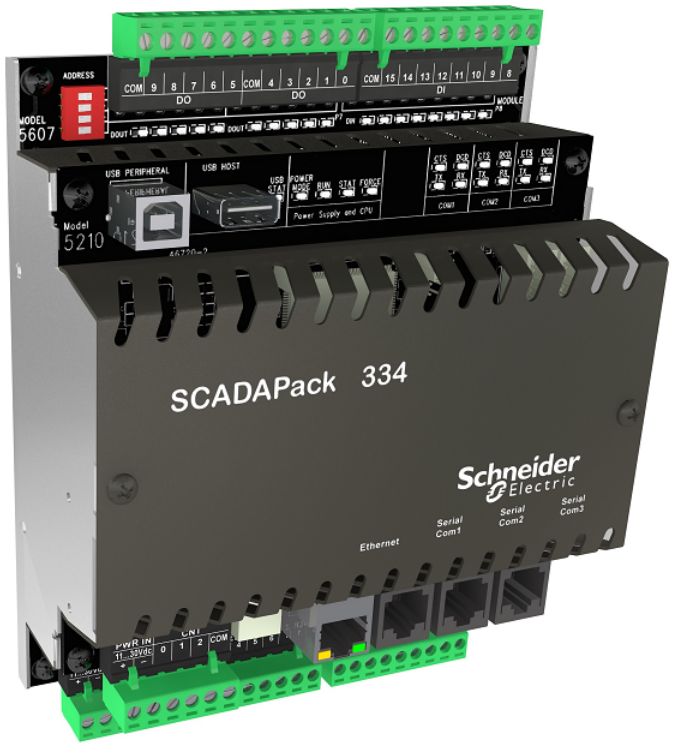
When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

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 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 334 RTU

If your SCADAPack 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 manual from **Start > All Programs > Schneider Electric > Hardware Manuals > Legacy**.



SCADAPack 334 RTU (Previous Version)

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 on your SCADAPack installation CD. The table below lists the main manuals for the tasks described. However, it is not a complete list of the manuals available to you.

For Information About	See
Updating firmware on your RTU	SCADAPack Configurator User Manual

Configuring your RTU to communicate with other RTUs and with input and output (I/O) devices	SCADAPack Configurator User Manual Telepace Studio User and Reference Manual TeleBUS Protocol Reference Manual DNP3 Protocol Reference Manual TeleBUS DF1 Protocol Reference Manual
Installing SCADAPack Workbench, using it to build custom applications for the RTU and downloading the applications to the RTU	SCADAPack Workbench Quick Start Guide SCADAPack Workbench Technical Manuals
Adding I/O expansion modules	I/O Expansion Module Hardware Manuals

6 About the SCADAPack 334

The SCADAPack 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).

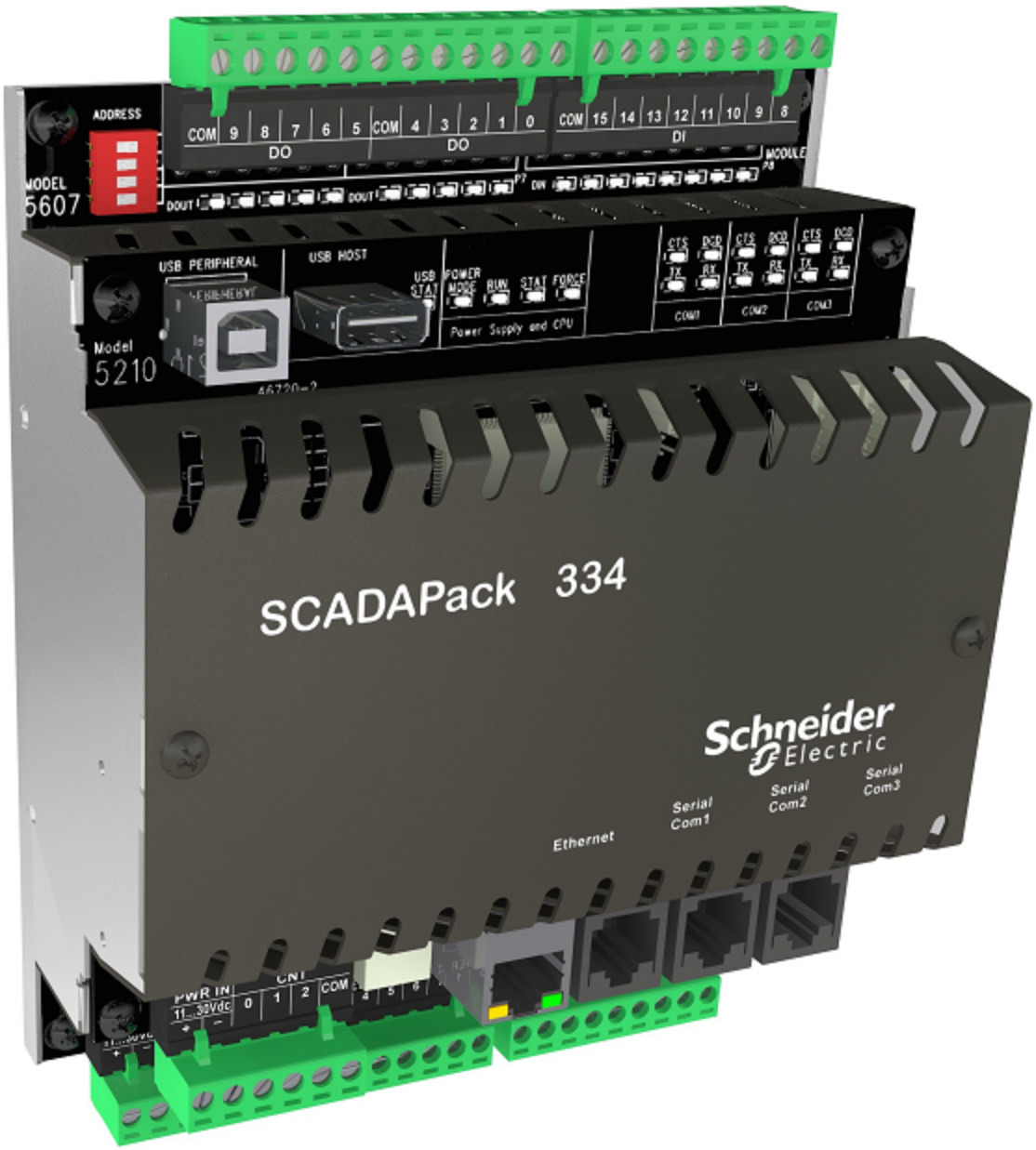
Many operational facilities can be configured, depending on the required telemetry and control application. This manual describes the hardware aspects of the RTU.

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).

Several power saving features are included in the RTU. These power saving features include sleep mode, communication port power control, USB disable and a reduced power mode that lowers the CPU clock.

A real time clock/calendar provides for time of day operations. A hardware watchdog timer monitors application program operation.

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 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 Ethernet port and two USB 2.0 compliant device ports for local configuration and to connect to other devices.

The SCADAPack RTU supports DNP3 to Subset Level 2 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

Configuration

You can configure the RTU using one of these methods:

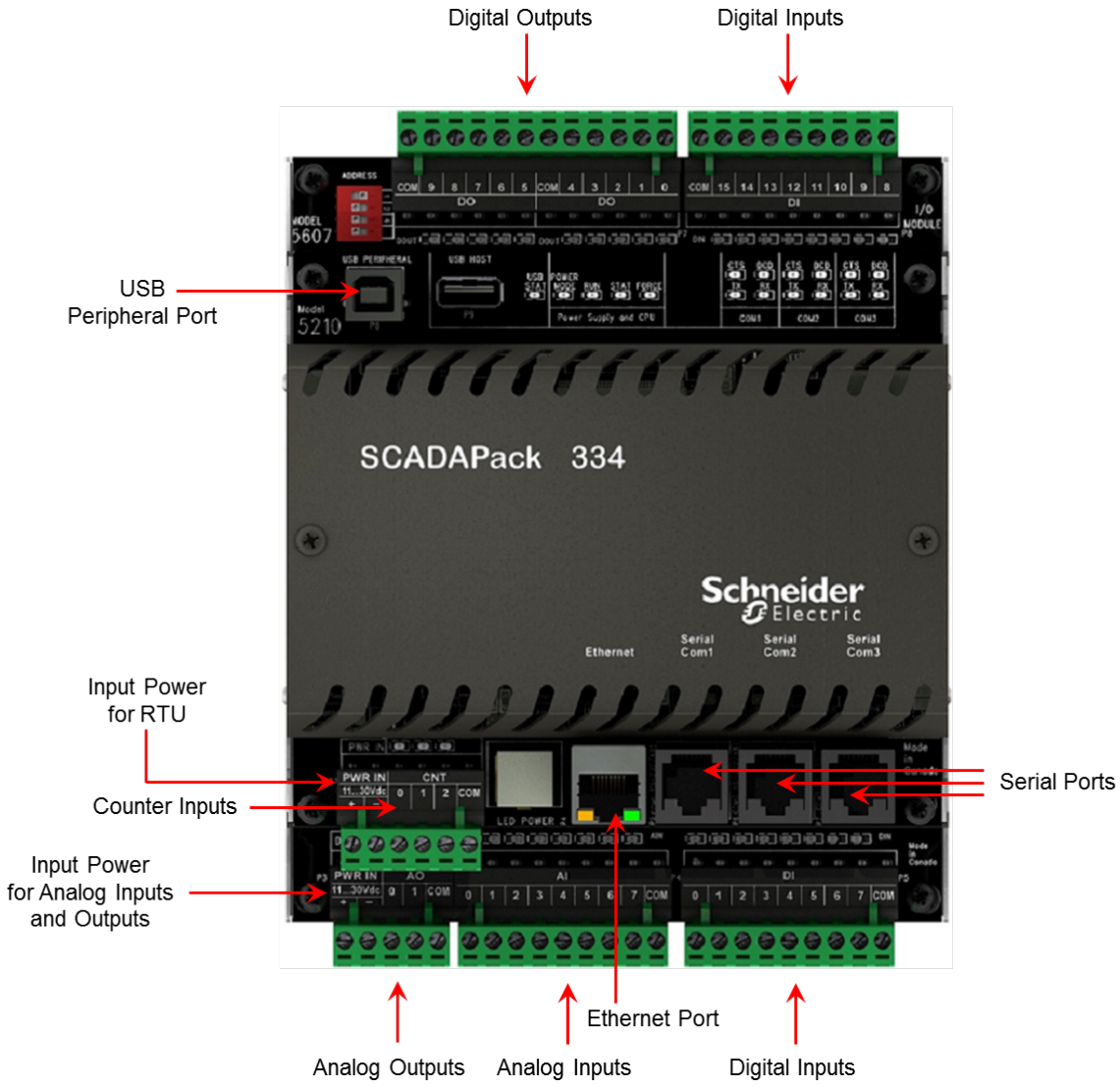
- SCADAPack Workbench for IEC 61131-3 programming
- Telepace Studio for integrated ladder logic programming
- C or C++ programming

You can develop C or C++ applications in your preferred development environment, then load them into your RTU using either SCADAPack Configurator (available with SCADAPack Workbench) or Telepace Studio. SCADAPack RTUs can execute logic applications simultaneously with C or C++ applications.

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

7 Hardware Overview

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



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

CPU, RAM and Storage 20

Power Supply and Back-up Battery 21

Serial Ports 21

Ethernet Port 34

USB Ports 36

Inputs and Outputs 40

7.1 CPU, RAM and Storage

CPU

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

- Communications protocols such as DNP3, DF1, Modbus RTU and Modbus ASCII
- Time-stamped event processing
- Configuration management
- User-created sequence and control applications such as those created in Telepace Studio or IEC 61131-3 programming.

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 Telepace Studio or IEC 61131-3 programming.
- Time-stamped event data

Storage

The RTU provides internal flash storage and support for USB storage media. The internal flash storage is described here. For more information about support for plug-in storage media, see USB Ports 36.

Operating System Flash

The operating system flash memory stores the RTU firmware. The firmware implements the communications protocols — DNP3, Modbus and others — the database of point configurations and the Telepace Studio or IEC 61131-3 programming 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

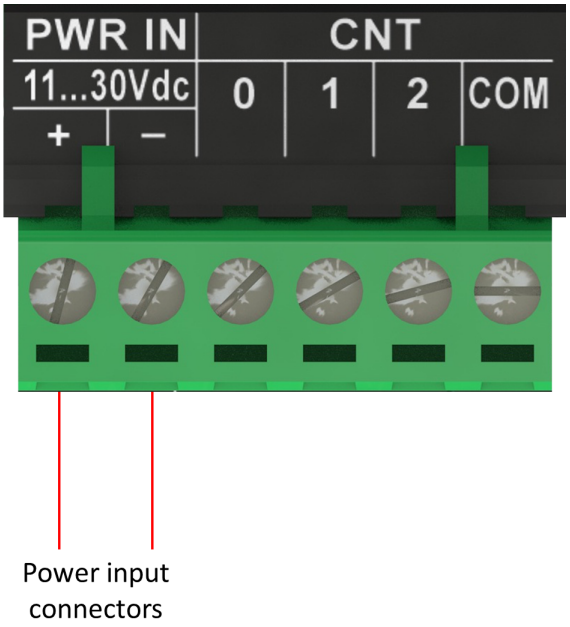
The boot monitor firmware resides in a separate flash memory chip on the controller board. The boot monitor firmware is the first code executed by the CPU when power is applied to the RTU. It configures the RTU hardware then verifies, loads and executes the operating system firmware.

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

7.2 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 103

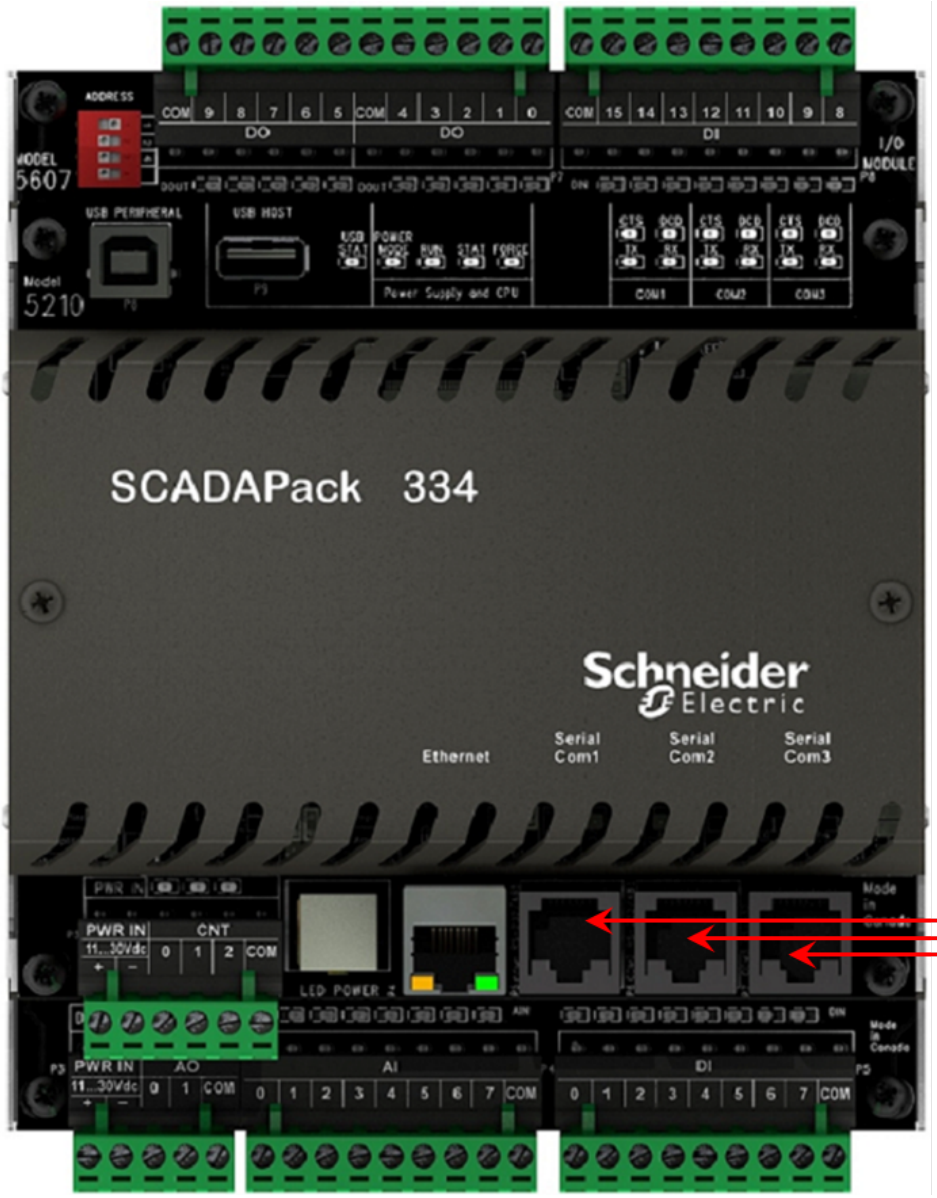
Analog Output Wiring Example 109

For details about power supply requirements and wiring, see Power Supply Requirements 59.

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.

7.3 Serial Ports

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



Communications

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

- 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

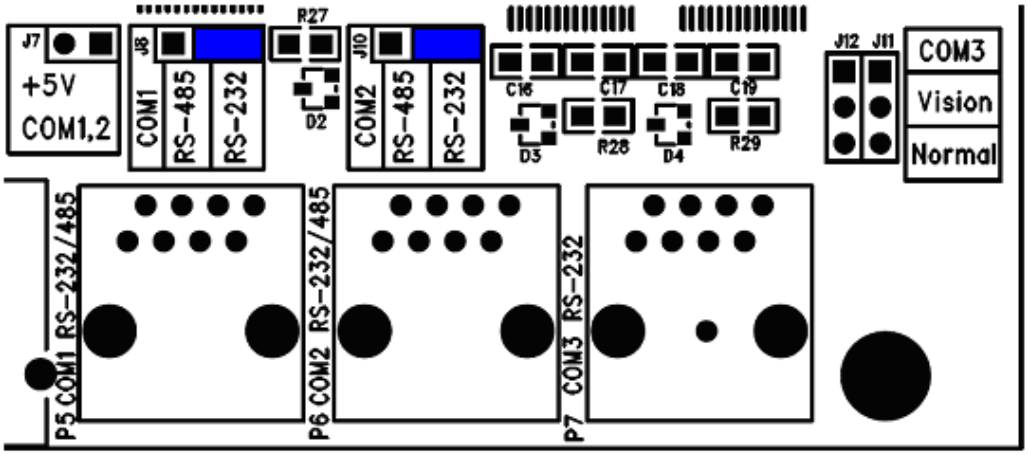
RS485 Serial Communications Ports 30

7.3.1 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.

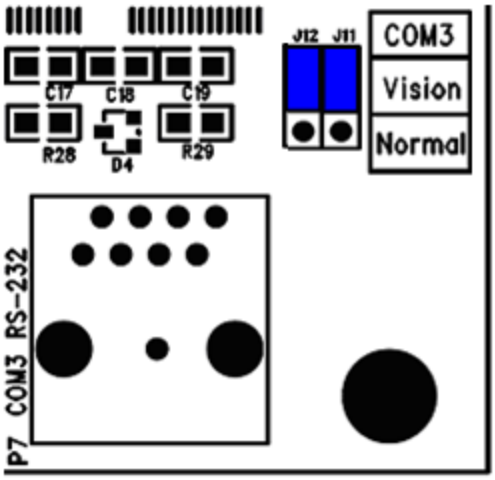
Serial ports COM1 and COM2 can be configured as either a six-line RS232 port or as a two-wire RS485 port. This section covers RS232 operation.

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.

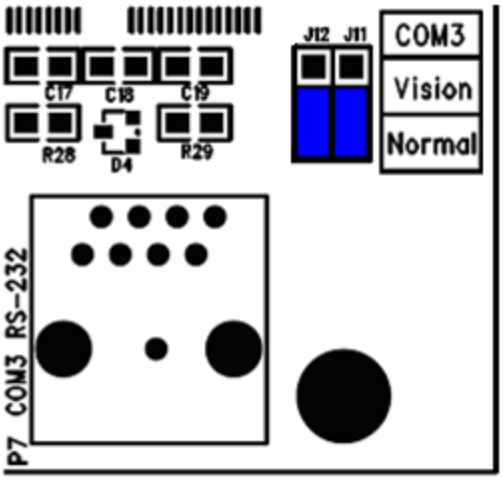


COM3 is designed to operate with the SCADAPack Vision operator interface and has several features not found on COM1 and COM2. Two of the signals (DTR and DCD) are shared with the test signals used to detect the ON switch closure on the Vision interface. To use the signals as DTR and DCD, install jumpers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



COM3 in Vision mode



COM3 in Normal mode

For more information, see the following sections:

COM1 and COM2 RS232 Serial Ports 25

COM3 RS232 Serial Port 28

7.3.1.1 COM1 and COM2 RS232 Serial Ports

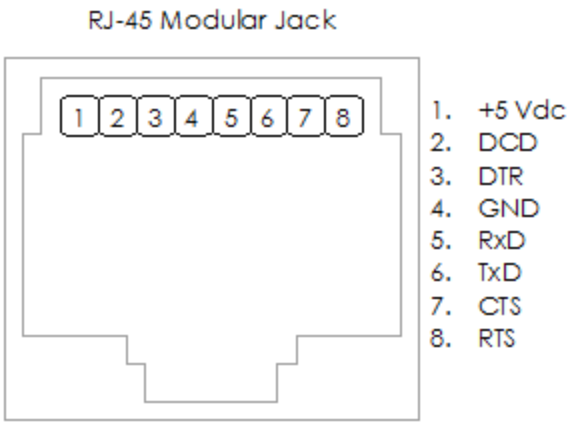
The following table provides a description of the connections and functions of each pin of the RJ-45 modular jack connector. In this table a MARK level is a voltage of 3 Vdc or greater and a SPACE level is a voltage of –3 Vdc or lower.

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

Modular Jack Pin	COM1 (J8=RS232)	COM2 (J10=RS232)	Description
			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 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.

Protocol	Addressing	Port Type	Baud	Data Mode
NONE Modbus RTU (default) Modbus ASCII DF1 Full Duplex BCC DF1 Full Duplex CRC DF1 Half Duplex BCC DF1 Half Duplex CRC DNP3	Standard (default) Extended	RS232 (default) RS232 Dial-up Modem	300 bps 600 bps 1200 bps 2400 bps 4800 bps 9600 bps (default) 19200 bps 38400 bps 57600 bps 115200 bps	8-bit No Parity 1 Stop Bit (default) 8-bit Even Parity 1 Stop Bit 8-bit Odd Parity 1 Stop Bit

7.3.1.2 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.

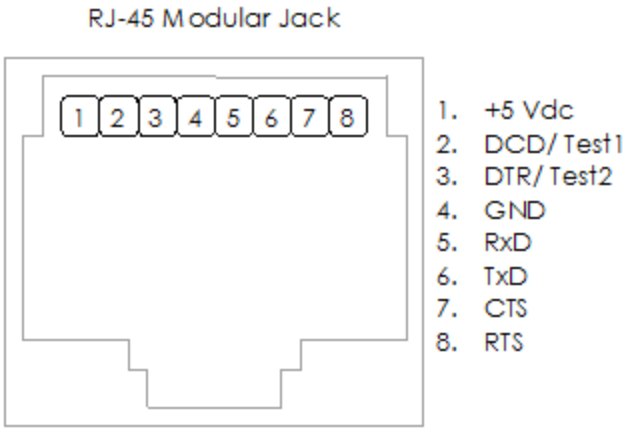
- 5 Vdc is available on Pin 1 when turned on by the user under program control or in Vision mode,

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 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.

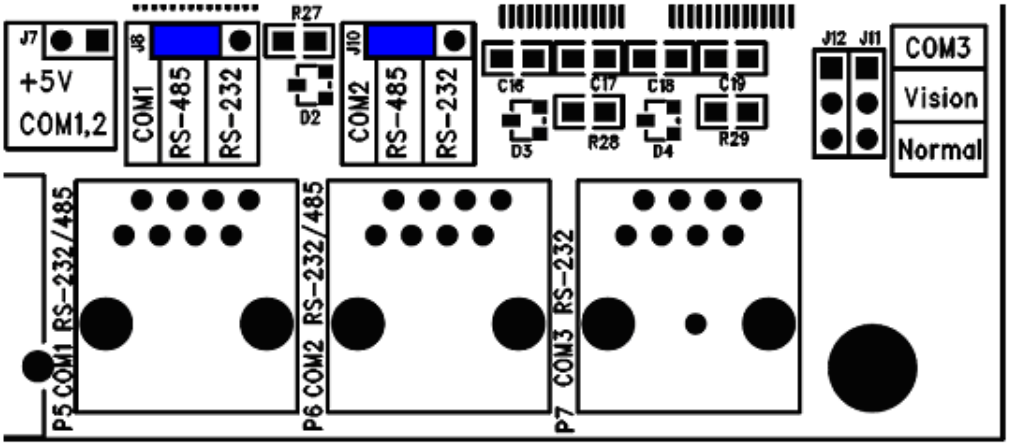
Protocol	Addressing	Baud	Data Mode
NONE	Standard (default)	300 bps	8-bit No Parity 1 Stop Bit (default)
Modbus RTU (default)	Extended	600 bps	8-bit Even Parity 1 Stop Bit
Modbus ASCII		1200 bps	8-bit Odd Parity 1 Stop Bit
DF1 Full Duplex BCC		2400 bps	
DF1 Full Duplex CRC		4800 bps	
DF1 Half Duplex BCC		9600 bps (default)	
DF1 Half Duplex CRC		19200 bps	
DNP		38400 bps	
		57600 bps	
		115200 bps	

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

See the figure below for the locations of jumpers J8 and J10 required to configure COM1 and COM2. COM1 and COM2 are both shown configured as RS485.



For more information, see the following sections:

COM1 and COM2 RS485 Serial Ports 30

RS485 Bias and Termination Resistors 33

7.3.2.1 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.

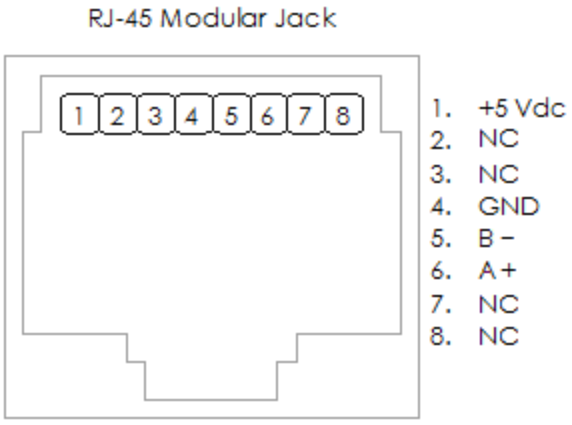
Modular Jack Pin	COM1 (J8=RS485)	COM2 (J10=RS485)	Description
1	5 Vdc when J7 installed (Output)	5 Vdc when J7 installed (Output)	This pin can be connected to the 5 Vdc power supply by installing a jumper at J7 on the SCADAPack RTU.
2	No connection	No connection	Not used in RS485 mode. Leave open.
3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

Modular Jack Pin	COM1 (J8=RS485)	COM2 (J10=RS485)	Description
4	GND	GND	This pin is connected to the system ground.
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 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.

Protocol	Addressing	Baud	Data Mode
NONE	Standard (default)	300 bps	8-bit No Parity 1 Stop Bit (default)
Modbus RTU (default)	Extended	600 bps	8-bit Even Parity 1 Stop Bit
Modbus ASCII		1200 bps	8-bit Odd Parity 1 Stop Bit
DF1 Full Duplex BCC		2400 bps	
DF1 Full Duplex CRC		4800 bps	
DF1 Half Duplex BCC		9600 bps (default)	
DF1 Half Duplex CRC		19200 bps	
DNP3		38400 bps	
		57600 bps	
		115200 bps	

7.3.2.2 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.

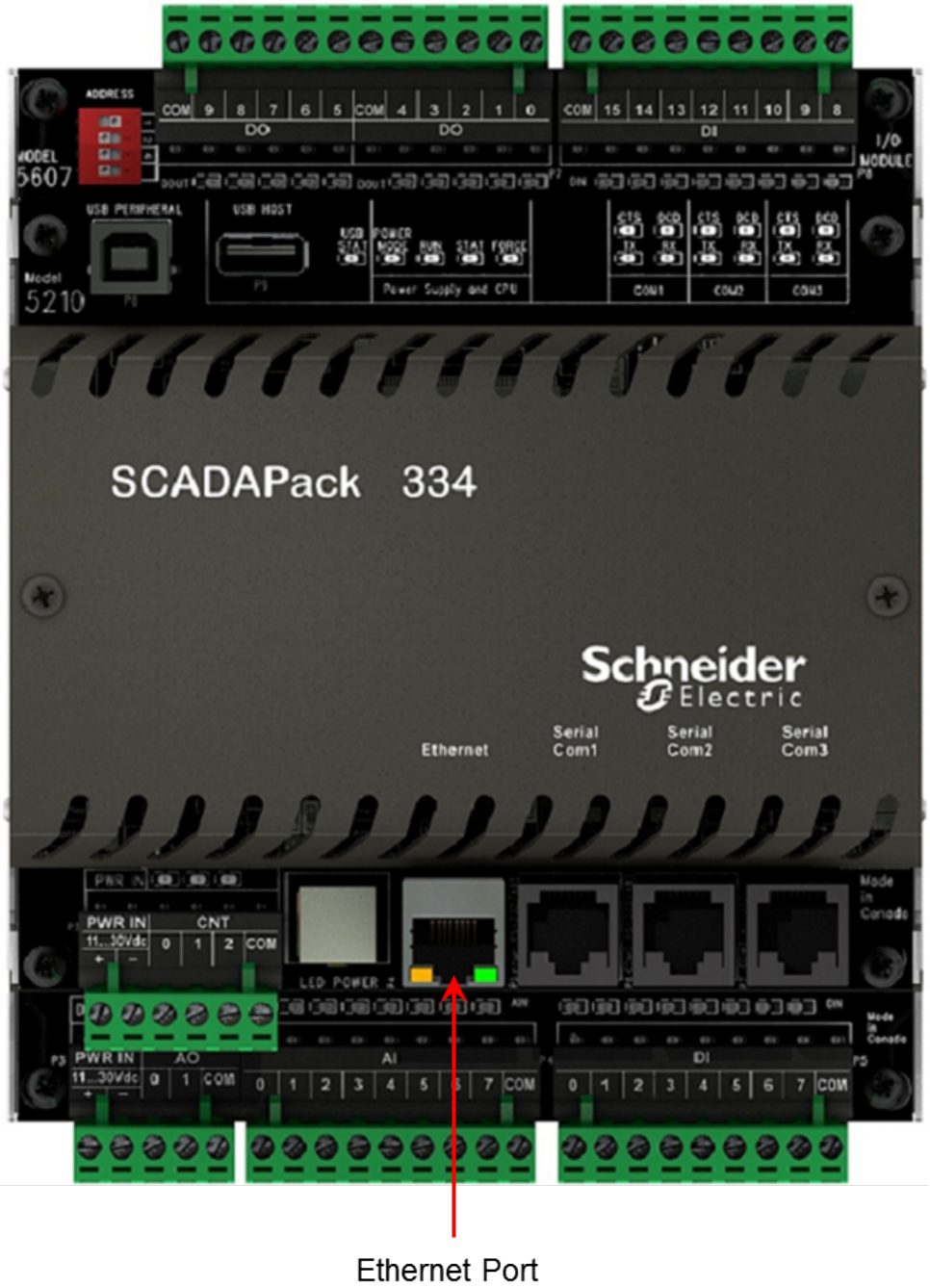
If required, RS485 networks are terminated with 120-ohm resistors on each end. The required 120-ohm resistor needs to be supplied and installed by the user. When using termination resistors it may be necessary to increase the line biasing by adding lower value bias resistors in order to generate at least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

7.4 Ethernet Port

The figure below shows the location of the 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 configuration and diagnostic facilities, the Ethernet port is referred to as

the LAN port.

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 84.

7.5 USB Ports

The SCADAPack RTU has two USB 2.0 compliant ports, supporting 1.5 Mb/s and 12 Mb/s connections. One of the ports allows the controller to act as a host, while the second port allows connection to a USB host, such as a notebook computer. The two USB ports can be used simultaneously.

The USB interface circuitry can be disabled to save power. Refer to USB Disable Control 132 for details.

⚠WARNING

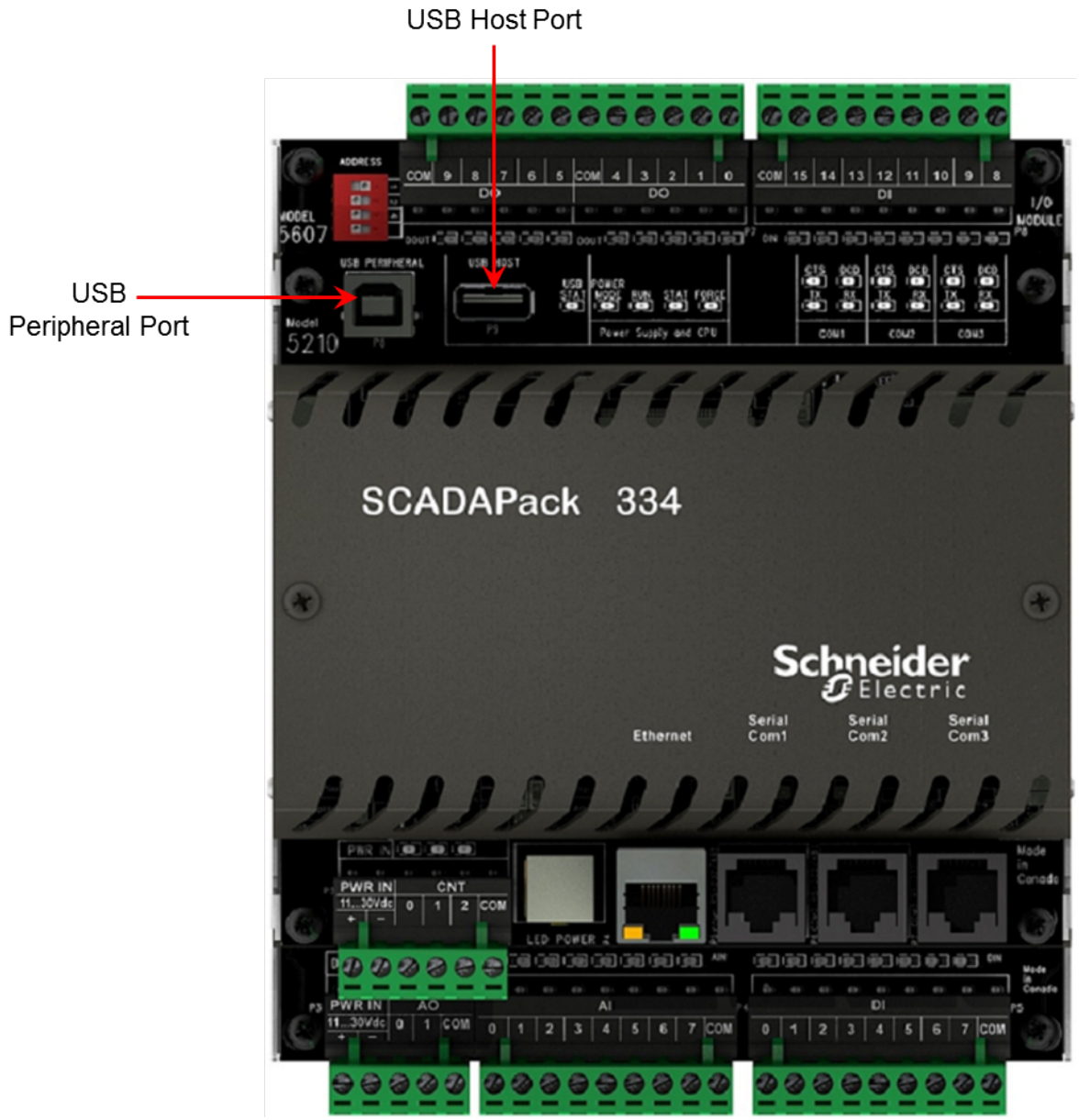
EXPLOSION RISK

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 USB ports on the SCADAPack RTU.



USB Connections

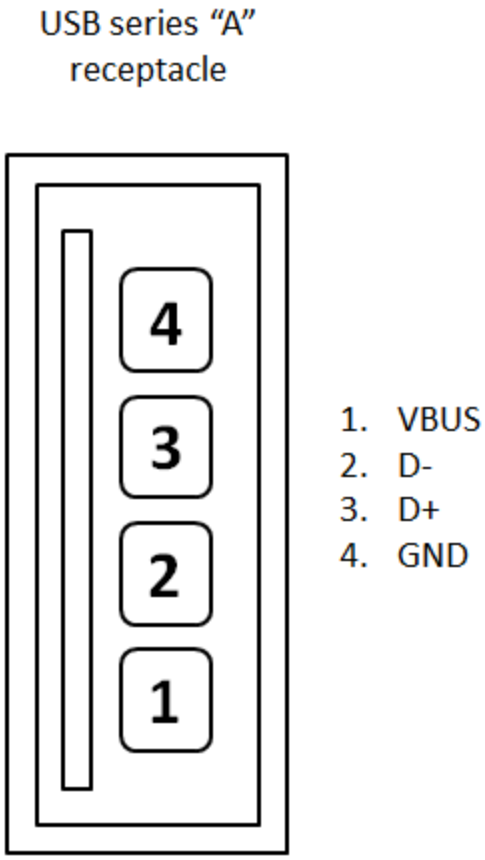
The connectors used for the USB ports are compliant with the USB specification.

USB Host Port 37

USB Peripheral Port 39

7.5.1 USB Host Port

The host port features a USB series “A” receptacle. For bus-powered USB memory sticks, the host port can provide up to 100 mA at 5 Vdc. The following diagram shows the connections for the host USB port.



The host port supports memory stick type devices only; external USB drives are not supported. The following USB memory sticks have been tested with the SCADAPack RTU. They were tested at room temperature only and should be okay for typical insert-copy-and-remove applications.

- GXT Mobile Disk 512 MB flash drive
- Kingston DataTraveler (512 MB)
- Lexar JumpDrive 1 GB flash drive (JDSP1GB-04-500B)
- PNY Attache 512 MB flash drive
- SanDisk Cruzer Micro (256 MB)
- SanDisk Cruzer Micro (2 GB)
- SanDisk Cruzer Mini (1 GB)

The following USB devices are not supported:

- USB hubs are not supported. USB hubs are devices that allow multiple USB devices to connect to a single USB port.
- Any USB memory device that incorporates an actual rotating hard-drive. These units are typically the size of a cell phone or larger and may mention in their documentation any of the following terms: IDE, 2.5”, 3.5”, or, some number of RPM.
- Any USB memory stick larger than 32 GB.

For optimum performance, use your PC to format any new USB memory stick to FAT32 file format.

To format a new USB memory stick to FAT32 file format

1. Right click the USB drive and select Format
2. If you have a choice of FAT and FAT32, select FAT32.

   This will get rid of any applications that may have been shipped pre-installed on your device and will provide the best performance.

7.5.2 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.

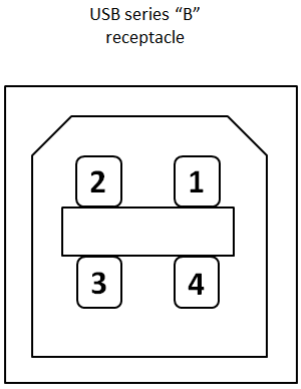
The peripheral port uses a USB series “B” receptacle.

A SCADAPack 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.

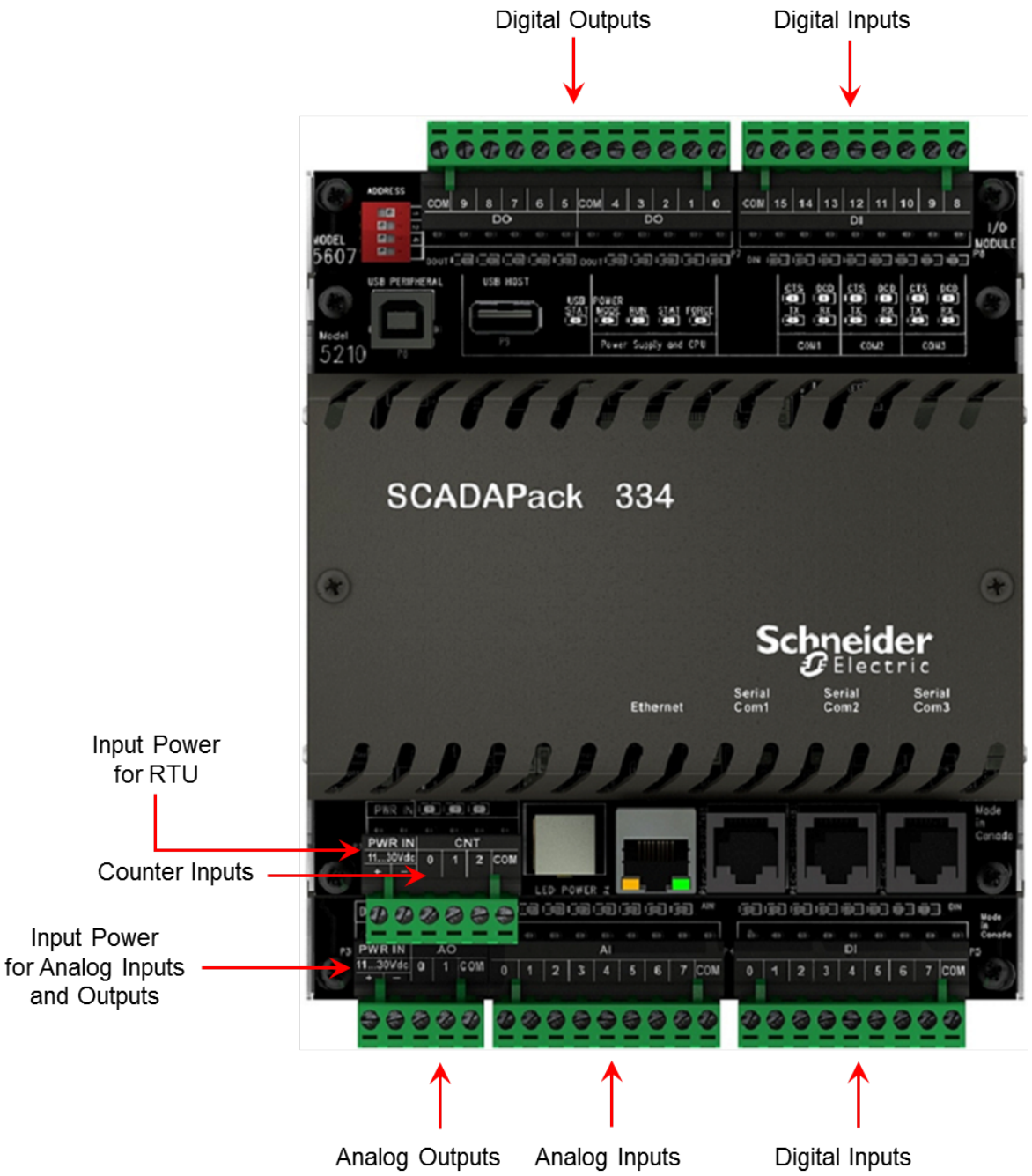
Parameter	Supported Values
USB	USB 2.0 compliant, peripheral port
Data Rate	Auto detect 1.5 Mb/s and 12 Mb/s
Protocol	DNP3

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



7.6 Inputs and Outputs

The figure below shows the inputs and outputs on the SCADAPack RTU.



The following table describes input and output characteristics. The inputs and outputs use 5 mm (0.197 in) pitch connectors. See the Specifications 153 section for the recommended wire sizes.

Input/Output Type	Description
Counter inputs 42	3 counter inputs 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 or solid state relay (SSR) outputs Wired to connectors P6 and P7
Analog inputs 46	8 analog inputs Wired to connector P4
Analog outputs 49	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

7.6.1 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 161 section for maximum voltages. **Failure to follow these instructions can result in equipment damage.**

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

For more information, see the following sections:

Counter Input 0 42

Turbine Meter Counter Inputs 1 and 2 42

7.6.1.1 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.

7.6.1.2 Turbine Meter Counter Inputs 1 and 2

You can connect two turbine meter sensors to your SCADAPack 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.

7.6.2 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 Configurator (available with SCADAPack Workbench) or Telepace Studio software, you can configure each input or output to define its characteristics, including:

- DNP3 Point Number
- Modbus Address
- Event Class
- Deadband

For more information about configuring digital inputs and outputs, see the Configurator User Manual or the Telepace Studio User and Reference Manual.

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.

Specifications

For digital input and output specifications, see Specifications 153.

Digital Inputs 44

Digital Outputs 45

7.6.2.1 Digital Inputs

The I/O board expands the function of the RTU with 16 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 (LEDs) on the digital inputs show the status of each 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.

7.6.2.2 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.

In the dry contact version, 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 output. The digital output LEDs can be disabled to conserve power.

Digital outputs are organized in groups of five. Each group of five shares one common.

7.6.3 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 47 for information on how to choose input modes.

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

By default, analog inputs are configured for voltage mode with a measurement range of 0...5 Vdc.

Configuration

Using the SCADAPack Configurator (available with SCADAPack Workbench) or Telepace Studio software, you can configure each analog input to define its characteristics, including:

- DNP3 Point Number
- Modbus Address
- Event Class
- Deadband

For more information about configuring analog inputs, see the Configurator User Manual or the Telepace Studio User and Reference Manual.

Wiring

Analog inputs support solid or stranded wires from 3.3...0.08 mm² (12...28 AWG). For more information, see Wiring Screw-Termination Connectors 72.

Specifications

For analog input specifications, see Specifications 153.

Current or Voltage Mode 47

Range and Resolution 47

7.6.3.1 Current or Voltage Mode

The analog inputs can be configured for either voltage or current mode via software. When assigning the registers in Telepace Studio or setting up an I/O connection or I/O device in IEC 61131-3 programming, the user is given an opportunity to select the mode of operation.

In current mode, a 250-ohm resistor appears across the analog input channel. Measurement range in current mode is 0...20 mA or 4...20mA. The 250-ohm resistor produces a voltage drop (input reading) of 5 Vdc for a 20 mA of current flow.

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.**

In voltage mode, these analog inputs are single-ended with a measurement range of 0...5 Vdc or 0...10 Vdc. In voltage mode, input channels are high impedance.

Refer to the respective Telepace and IEC 61131-3 software manuals for information on using the above functions.

7.6.3.2 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.

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 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)	Reading	Over or under range status
N/A	N/A	<3.968	N/A	0	ON

0...5 Vdc Range (Vdc)	0...10 Vdc Range (Vdc)	4...20 mA Range (mA)	0...20 mA Range (mA)	Reading	Over or under range status
0	0	4	0	0	OFF
1.25	2.5	8	5	8192	OFF
2.5	5.0	12	10	16384	OFF
3.75	7.5	16	15	24576	OFF
5	10	20	20	32767	OFF
5.0024	10.0048	20.032	20.01	32767	ON

7.6.4 Analog Outputs

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

If the optional analog output module was requested at time of purchase, there are two 20 mA analog outputs available for use.

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 Configurator (available with SCADAPack Workbench) or Telepace Studio software, you can configure each analog output to define its characteristics, including:

- DNP3 Point Number
- Modbus Address
- Event Class
- Deadband

For more information about configuring analog outputs, see the Configurator User Manual or the Telepace Studio User and Reference Manual.

Wiring

Analog outputs support solid or stranded wires from 3.3...0.08 mm² (12...28 AWG). For more information, see Wiring Screw-Termination Connectors 72.

Specifications

For analog output specifications, see Specifications 153.

Current and Voltage Outputs 50

Range and Resolution 51

7.6.4.1 Current and Voltage Outputs

Current Outputs

The I/O module can be equipped with an optional 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 109 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 109 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 ohm	0...20 mA 4...20 mA	0...5 Vdc
500 ohm	0...20 mA	0...10 Vdc

7.6.4.2 Range and Resolution

The optional analog output module installed on the I/O Module has a 12-bit, unipolar, digital to analog (D/A) converter. Both analog output channels use the same range:

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

There are 4096 D/A counts in the output signal range and one D/A count represents a value of 8 raw counts. Raw counts are displayed or issued from the application program.

The 0...20 mA output range resolution is 4.88 µA per D/A count, such that 8 raw counts represent 4.88 µA.

For a 0% offset, use the following relationship to determine the output current based on your raw counts:

Output Current [mA] = (20 * Raw Count) / 32760

For a 20% offset, use the following relationship:

Output Current [mA] = ((16 * Raw Count) / 32760) + 4

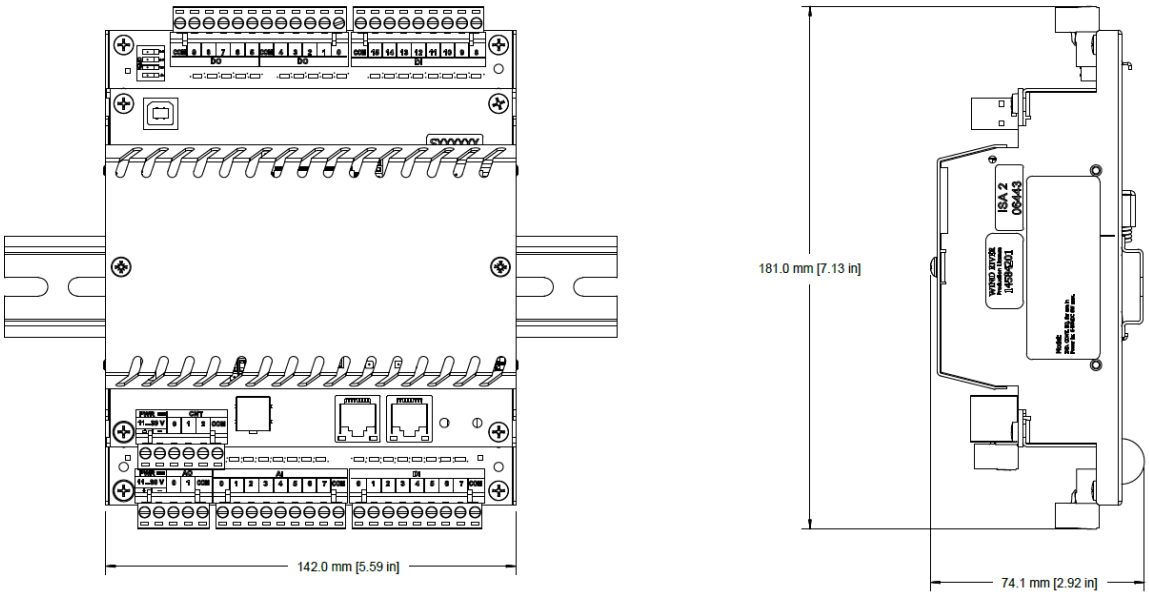
The table below shows the output current for several raw counts, when the analog output is configured for a 0% and 20% offset.

Raw Count	**Current 0...20 mA (0% offset)**	**Current 4...20 mA (20% offset)**
0	Accuracy not specified.	4.000 mA
8	Accuracy not specified.	4.004 mA
1500	0.915 mA	4.733 mA
3200	1.954 mA	5.563 mA
6552	4.000 mA	7.200 mA
8190	5.000 mA	8.000 mA
10000	6.105 mA	8.884 mA
16380	10.000 mA	12.000 mA
24570	15.000 mA	16.000 mA
32760	20.000 mA	20.000 mA

8 Installation

The installation of SCADAPack 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 53

Mounting the SCADAPack RTU 56

Power Supply Requirements 59

Adding Inputs and Outputs 66

8.1 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

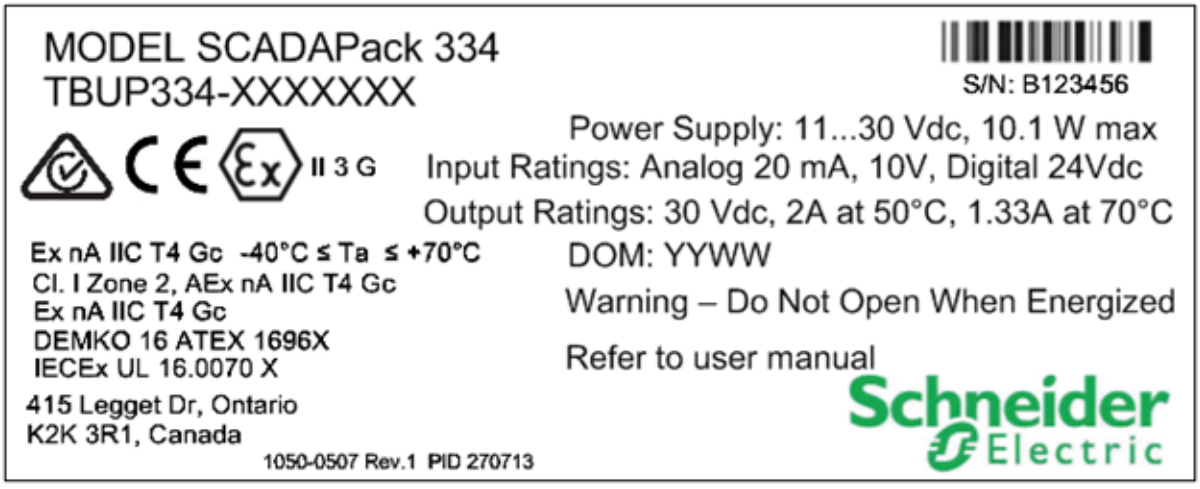
- Only install this equipment under the following conditions:

Conditions of Safe Use

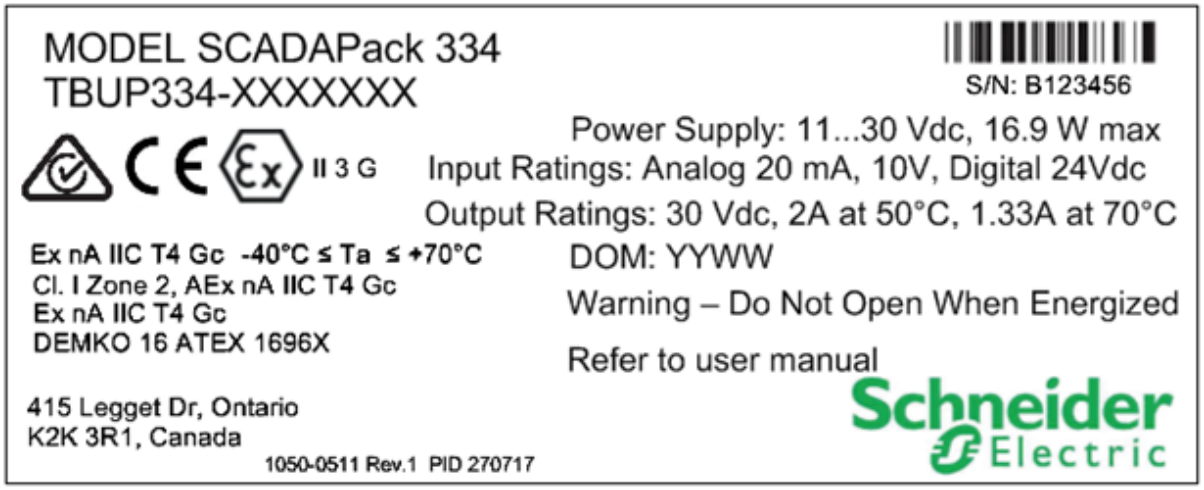
- Use this equipment in an area not exceeding pollution degree 2, as defined in EN 60664-1.
- Install this equipment in an enclosure that is only tool accessible and that provides a degree of protection not less than IP54 in accordance with EN 60079-15.
- Provide transient protection at a level not exceeding 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 ºF) 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 334 with no radio:



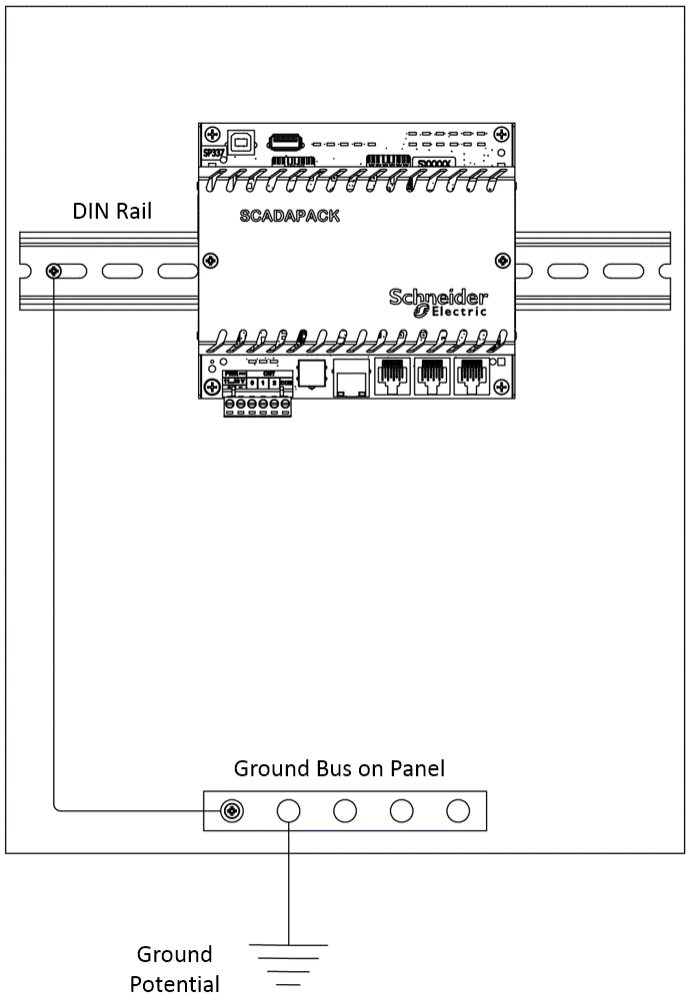
The following product label appears on a SCADAPack 334 with a radio:



8.2 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.


DIN Rail
SCADAPACK
Schneider Electric
Ground Bus on Panel
Ground
Potential

8.3 Mounting the SCADAPack 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.

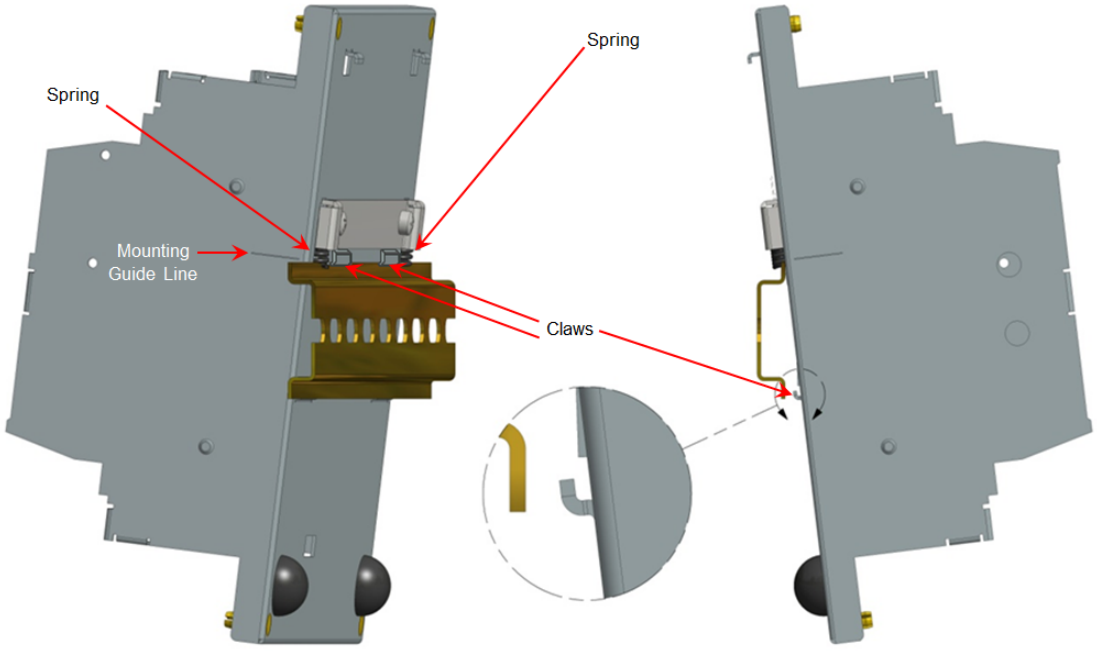
Failure to follow these instructions can result in equipment damage.

To Mount the SCADAPack 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.

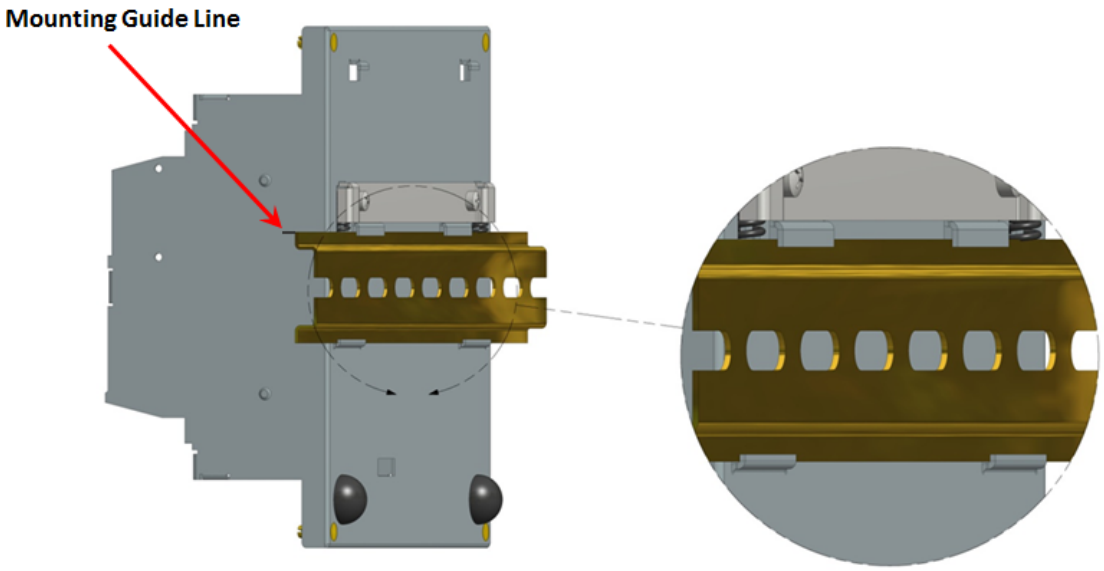
   Rest the springs on the back of the device on the DIN rail and insert the edge of the DIN rail under the upper support claws that are adjacent to the springs, as shown below.



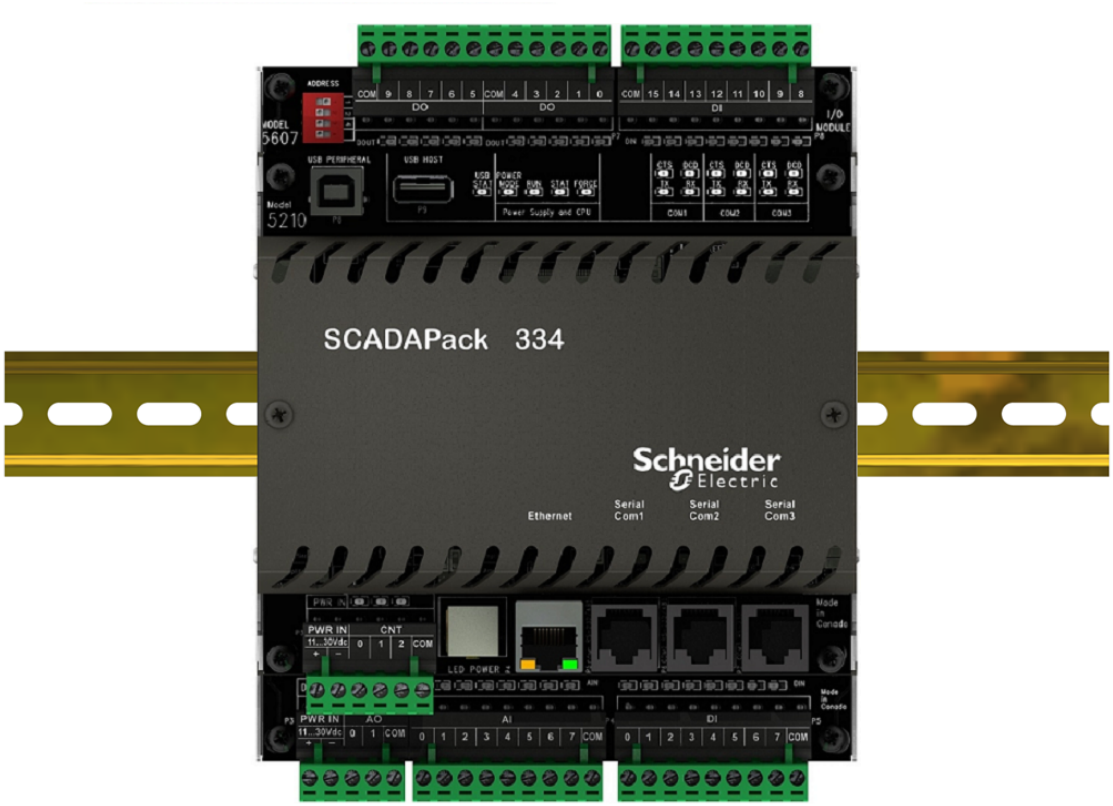
2. Push firmly on the device while tilting it toward the DIN rail until the DIN rail is positioned under both the upper and lower claws on the back of the device.
3. Release the pressure on the springs so that the DIN rail is held firmly in place between the upper and lower claws.

   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.



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



8.4 Power Supply Requirements

This topic describes the power requirements for the SCADAPack RTU.

The RTU is powered by an 11...30 Vdc input power source. Input power is applied to the positive (+) and negative (-) terminals on connector P3.

NOTICE
UNINTENDED EQUIPMENT OPERATION The RTU operates only on a DC power source. Connections to power sources such as 16 Vac transformers will blow the input power fuse. Do not exceed the maximum input voltage or apply a reverse voltage. **Failure to follow these instructions can result in equipment damage.**

When the input voltage is below the minimum recommended voltage the RTU turns off.

The power-input voltage is used to generate 5 Vdc at 1.2 A (6 W), some of which is used for the onboard circuitry. The output capacity of the 6 W is sufficient to power the controller board, a Schneider Electric Vision operator interface and a limited number of I/O modules, such as the integrated I/O board (where available.)

The power available for any 5000 series expansion I/O module is limited to 5.5 W (5 Vdc at 1200 mA) and depends on the features enabled.

For more information, see the following topics:

Power Calculations 59

Power Supply Wiring 61

8.4.1 Power Calculations

This topic describes the power requirements for a SCADAPack 334 with no I/O expansion modules.

Power requirements are determined by a combination of factors, including the number of relays energized, whether or not there is an Ethernet or USB Host connection, the number of LEDs activated, the number of analog outputs being used and whether the RTU is running in Normal Clock Mode, Reduced Clock Mode or Sleep Mode.

The power requirements specified are for operation at 25 °C (77 °F). Add 0.3 W to cover operation at the extremes of the -40...70 °C (-40...158 ºF) temperature range.

Analog outputs are not included in this calculation. Add 20 mA for each analog output used.

The calculations assume that the digital inputs are active.

The table below summarizes the base power requirements of the RTU in Normal Clock Mode and Reduced Clock Mode and the amount of 5 Vdc current available for I/O expansion.

	Normal Clock Mode	Reduced Clock Mode	

DO Relays	Ethernet and USB Host	LEDs	12 Vdc	24 Vdc	12 Vdc	24 Vdc	5 Vdc Current Available for I/O Expansion
Off	Off	Off	0.9 W	1.2 W	0.7 W	1.0 W	800 mA
Off	On	Off	2.0 W	2.3 W	1.8 W	2.1 W	800 mA
Off	Off	On	1.3 W	1.7 W	1.1 W	1.5 W	800 mA
On	Off	On	2.9 W	3.4 W	2.7 W	3.2 W	800 mA
Off	On	On	2.4 W	2.8 W	2.3 W	2.6 W	800 mA
On	On	On	4.0 W	4.5 W	3.8 W	4.3 W	500 mA

The table below summarizes the base power requirements of the RTU in Sleep Mode.

Sleep Mode	
12 Vdc	**24 Vdc**
90 mW	240 mW

For the power supply requirements of I/O expansion modules, see the individual I/O module hardware manual.

8.4.2 Power Supply Wiring

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

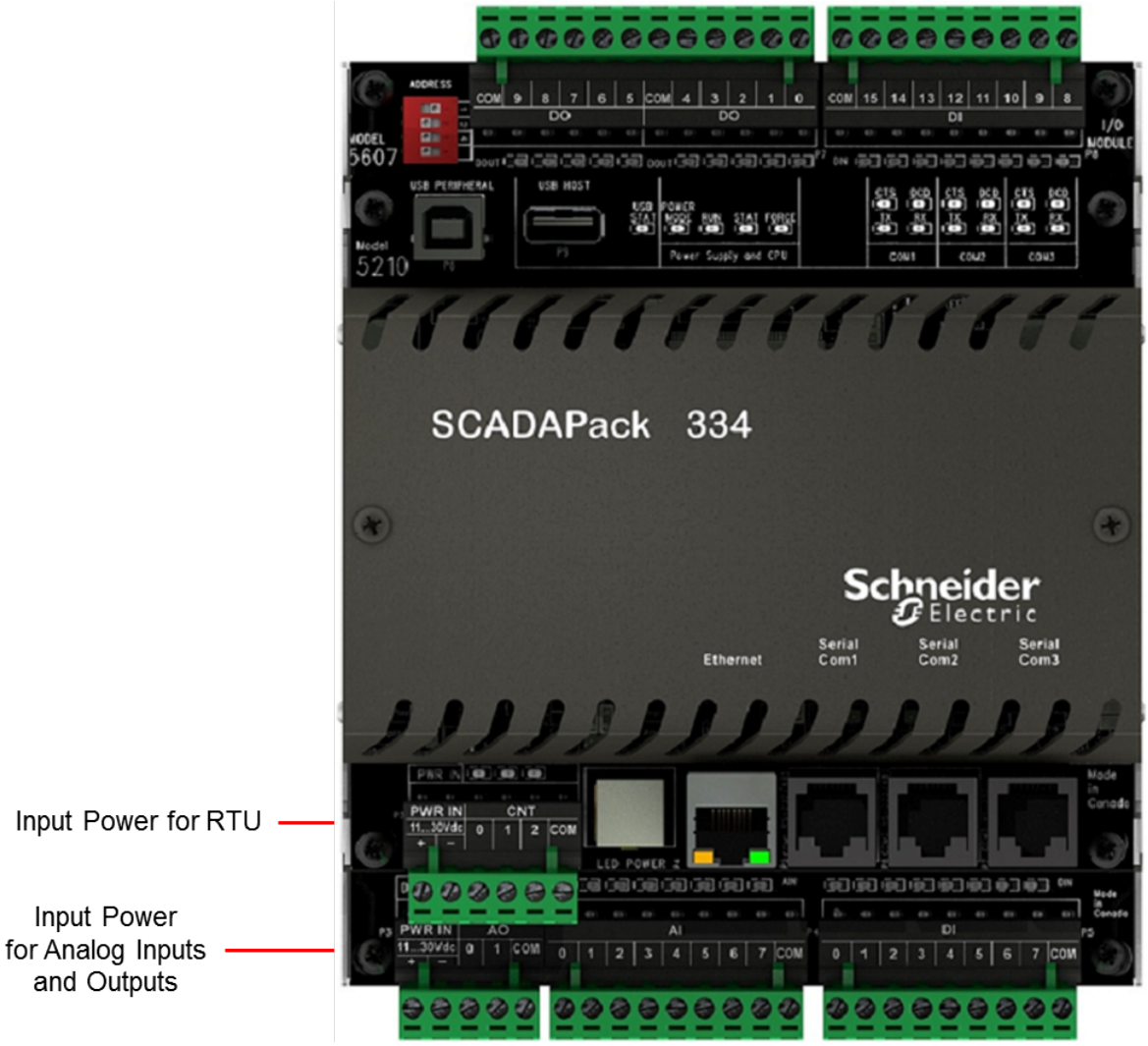
For basic power supply wiring for the RTU, see Basic Wiring 62.

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 RTU and on the I/O board or I/O expansion module, in a parallel configuration. See Recommended 24 Vdc Power Supply Configuration 64 for an example of this wiring configuration.
- With a 12 Vdc source connected to the PWR IN terminals on the RTU 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 a 5103 Uninterruptible Power Supply (UPS) providing 5 Vdc to the RTU through the intermodule 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 54.

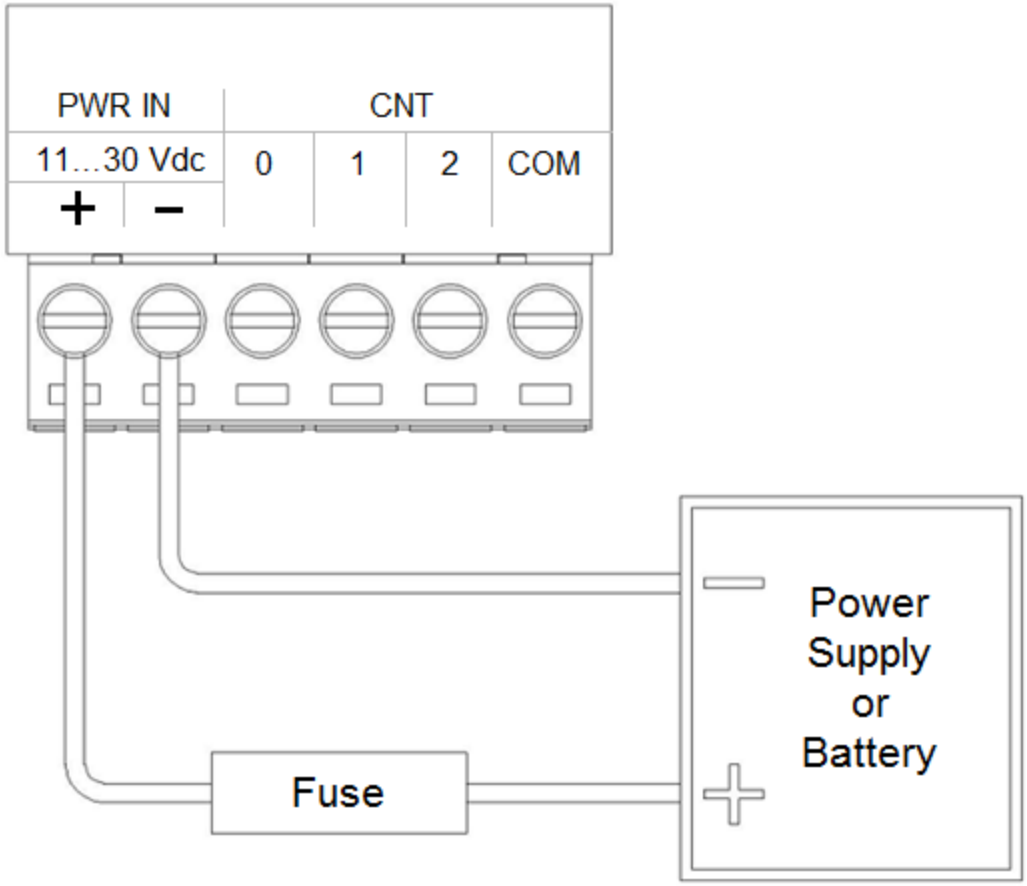
The figure below shows the location of the input power supply on the SCADAPack RTU.



8.4.2.1 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.**

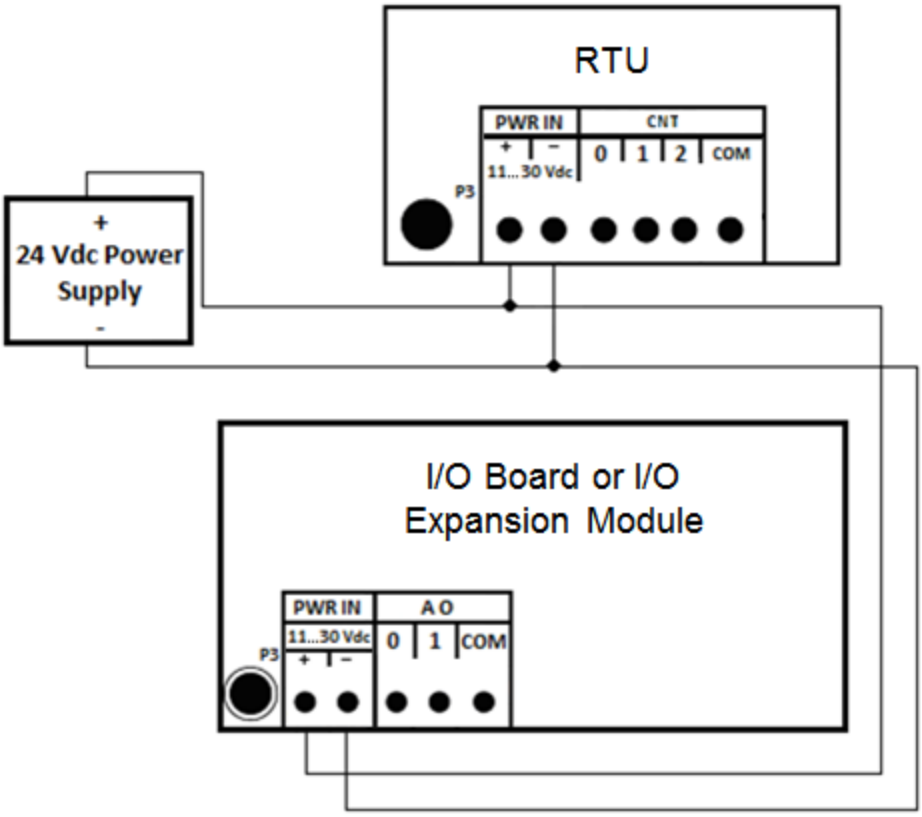
The following figure illustrates power supply wiring. For details on wiring the power supply connectors, see Wiring Screw-Termination Connectors 72.


PWR IN
CNT
11…30 Vdc
0
1
2
COM
+
–
Power
Supply
or
Battery
Fuse

8.4.2.2 Recommended 24 Vdc Power Supply Configuration

This configuration uses a 24 Vdc power supply to power the RTU 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 the I/O expansion module.

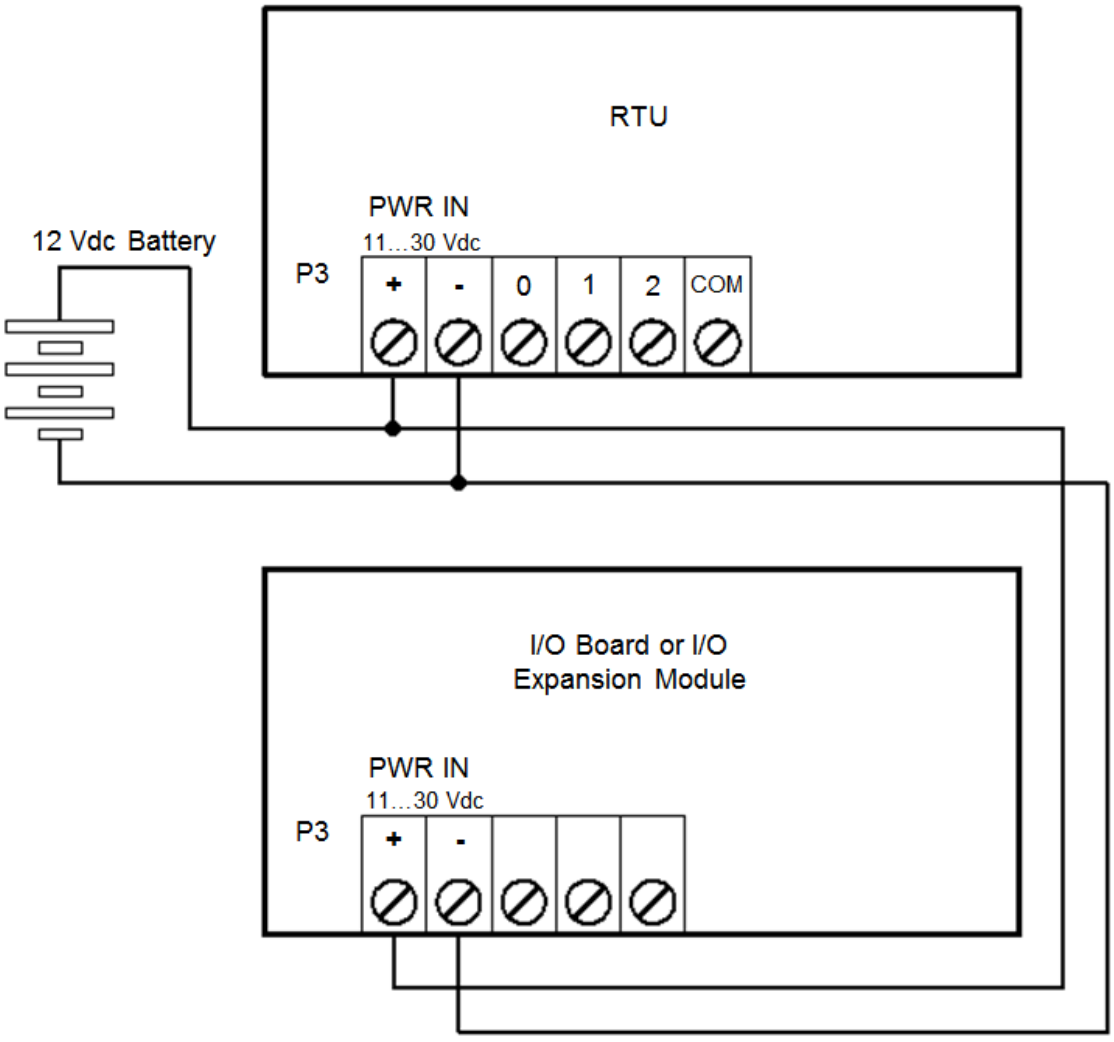
- This configuration is recommended when a large amount of current is required at 24 Vdc. Refer to the Specifications 153 section.
- Connect the RTU **PWR IN** terminal to the same power supply as the I/O board or I/O expansion module **PWR IN** terminal.



8.4.2.3 Recommended Battery Configuration

This configuration uses a 12 Vdc battery to power the RTU and the I/O board or I/O expansion module. The 12 Vdc battery is also used to power the analog circuitry for the analog inputs and for the analog outputs when they are available on the I/O board or I/O expansion module).

- This configuration is recommended when a large amount of current is required at 12 Vdc. Refer to the Specifications 153 section for power requirements from a 12 Vdc battery.
- Connect the RTU **PWR IN** terminal to the same power supply as the I/O board or I/O expansion module **PWR IN** terminal.



8.4.2.4 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 RTU. They will supply power to the modules that are downstream from them.

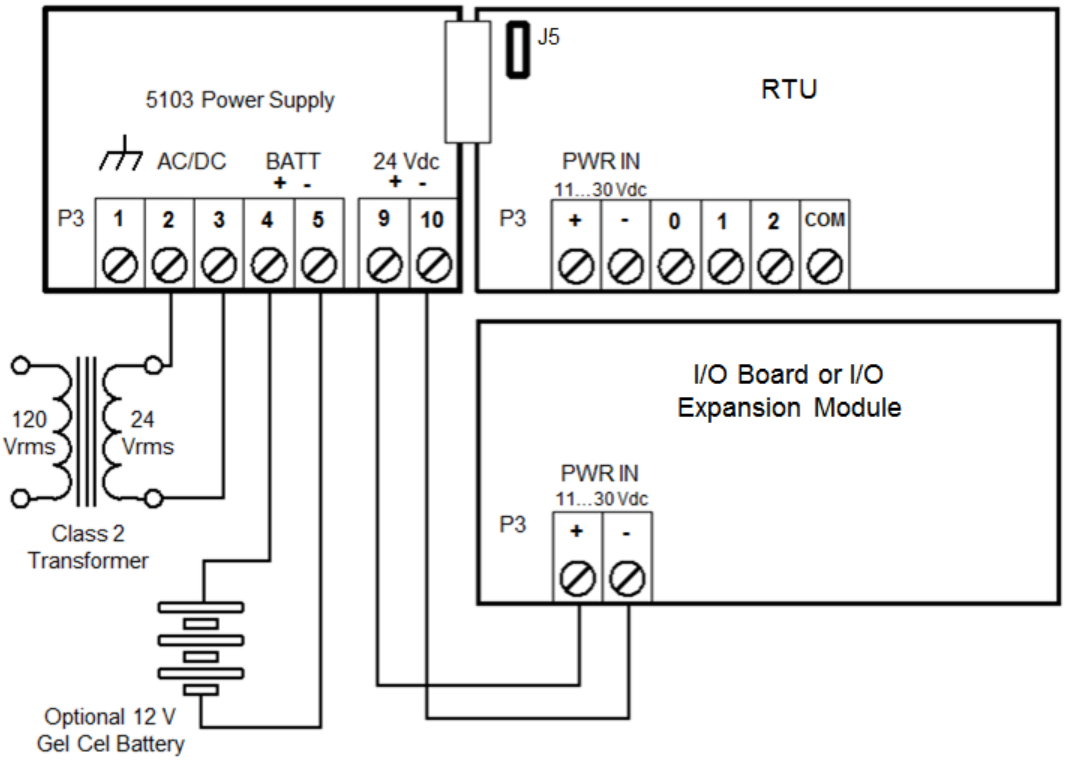
The 5103 power supply may also be connected upstream (to the left) of the RTU, but only if the following conditions are observed:

- No power is applied to the power inputs of the RTU, 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 RTU, the I/O 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.



8.5 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.

5000 Series I/O	A maximum of 16 I/O modules (excluding the integrated I/O module) can be added.

<table>
<tr><td>Expansion Capacity</td><td>Additional power supply modules may be required.
The following 5000 series I/O modules are supported by the SCADAPack 334 RTU:
<table>
<tr><th>5000 Series Module</th><th>Type</th><th>I/O</th><th></th></tr>
<tr><td>5304</td><td>Analog Out</td><td>4</td><td>Analog Outputs</td></tr>
<tr><td>5405</td><td>Digital In</td><td>32</td><td>Digital Inputs</td></tr>
<tr><td>5411</td><td>Digital Out</td><td>32</td><td>Digital Outputs</td></tr>
<tr><td>5414</td><td>Digital In</td><td>16</td><td>Digital Inputs</td></tr>
<tr><td>5415</td><td>Relay Output</td><td>12</td><td>Relay Outputs</td></tr>
<tr><td>5505</td><td>RTD</td><td>4</td><td>RTD (Temperature) Inputs</td></tr>
<tr><td>5506</td><td>Analog In</td><td>8</td><td>Analog Inputs</td></tr>
<tr><td>5606</td><td>Composite I/O</td><td>32</td><td>Digital Inputs</td></tr>
<tr><td></td><td></td><td>16</td><td>Relay Digital Outputs</td></tr>
<tr><td></td><td></td><td>8</td><td>Analog Inputs</td></tr>
<tr><td></td><td></td><td>2</td><td>Analog Outputs (optional with 53</td></tr>
<tr><td>5607</td><td>Composite I/O</td><td>16</td><td>Digital Inputs</td></tr>
<tr><td></td><td></td><td>10</td><td>Relay Digital Outputs</td></tr>
<tr><td></td><td></td><td>8</td><td>Analog Inputs</td></tr>
<tr><td></td><td></td><td>2</td><td>Analog Outputs (optional with 53</td></tr>
<tr><td>5608</td><td>Composite I/O</td><td>12</td><td>Digital Inputs</td></tr>
<tr><td></td><td></td><td>6</td><td>Relay Digital Outputs</td></tr>
<tr><td>5610</td><td>Composite I/O</td><td>16</td><td>Digital Inputs</td></tr>
<tr><td></td><td></td><td>10</td><td>Relay Digital Outputs</td></tr>
</table></td></tr>
<tr><td>Time for a 5000 series input change to be updated in the database</td><td>For one module, typically: 150 ms
Add 20 ms for each additional 5000 series I/O module</td></tr>
<tr><td>Time for a database change to be updated in the 5000 series</td><td>For one module, typically: 18 ms
For up to 10 modules, typically: 18...27 ms</td></tr>
</table>

output signal	

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.

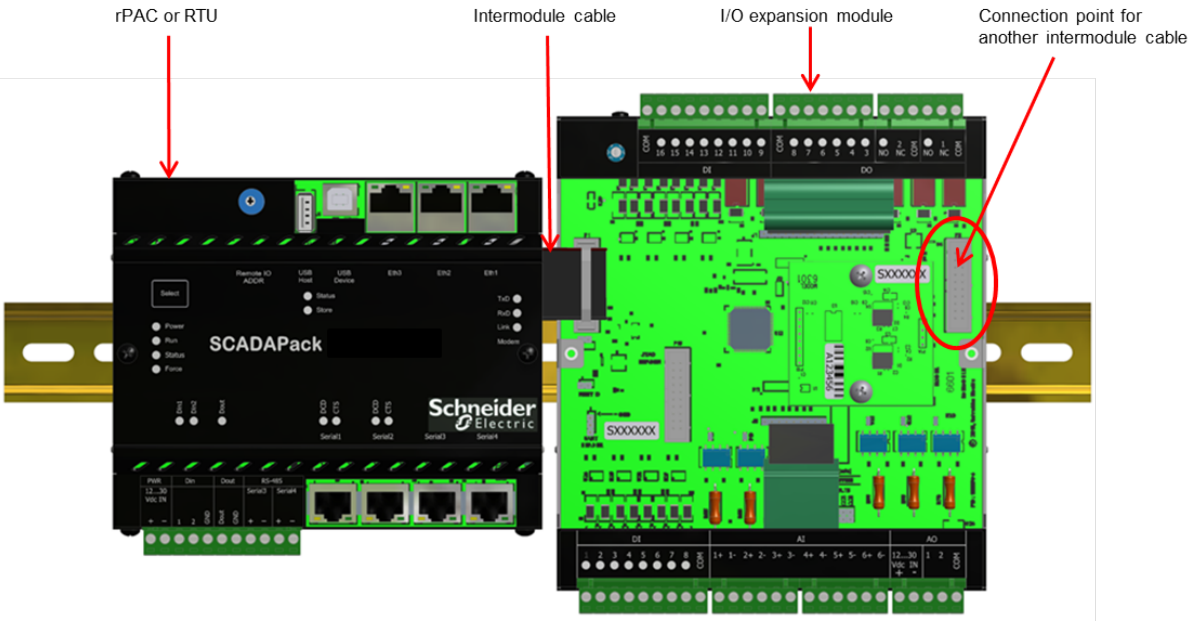
Mounting

I/O expansion modules are mounted on a 7.5 mm x 35 mm (0.3 in 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.



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 **System Configuration Guide**.

Configuring

Use Telepace Studio or SCADAPack Workbench to configure the inputs and outputs on the I/O expansion module.

For more information, see:

- Telepace Studio User and Reference Manual
- SCADAPack Workbench Quick Start Guide
- SCADAPack Workbench Technical Reference Manuals

9 Field Wiring

SCADAPack RTUs use screw termination style connectors for termination of field wiring. These connectors accommodate solid or stranded wires from 3.3...0.08 mm^2 (12...28 AWG). The connectors are removable allowing replacement of the SCADAPack 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 153 section for 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 30 for pinout details and wiring diagrams for these modular jacks.
- Input and output wiring 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 84 for details.
- The USB ports use conventional USB-A and USB-B interface connectors. Refer to USB Ports 36 for details.

See the following topics for more wiring information:

Wiring Screw-Termination Connectors 72

Jumper Functions 74

Serial Port Wiring 76

Ethernet Port Wiring 83

Counter Input Wiring 85

Digital Input Wiring 95

Digital Output Wiring 98

Analog Input Wiring 101

Analog Output Wiring 108

9.1 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 removing power.

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

NOTICE

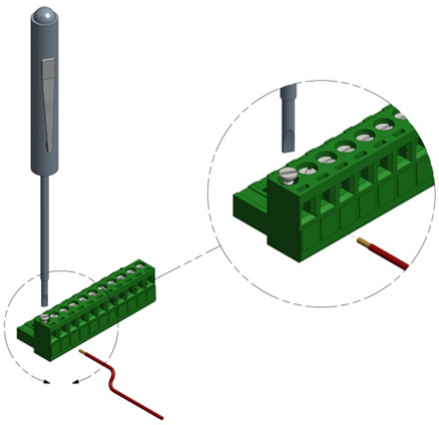
UNINTENDED EQUIPMENT OPERATION

Remove power from the device before servicing.

Failure to follow these instructions can result in equipment damage.

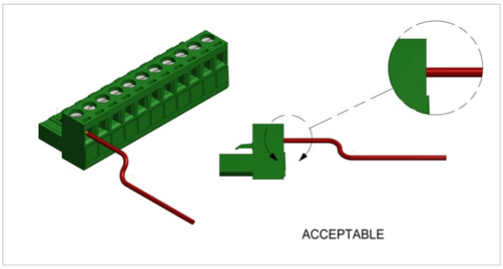
To wire a connector

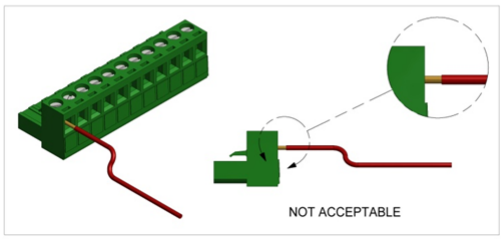
1. Use a slotted screwdriver to loosen the termination screw.



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

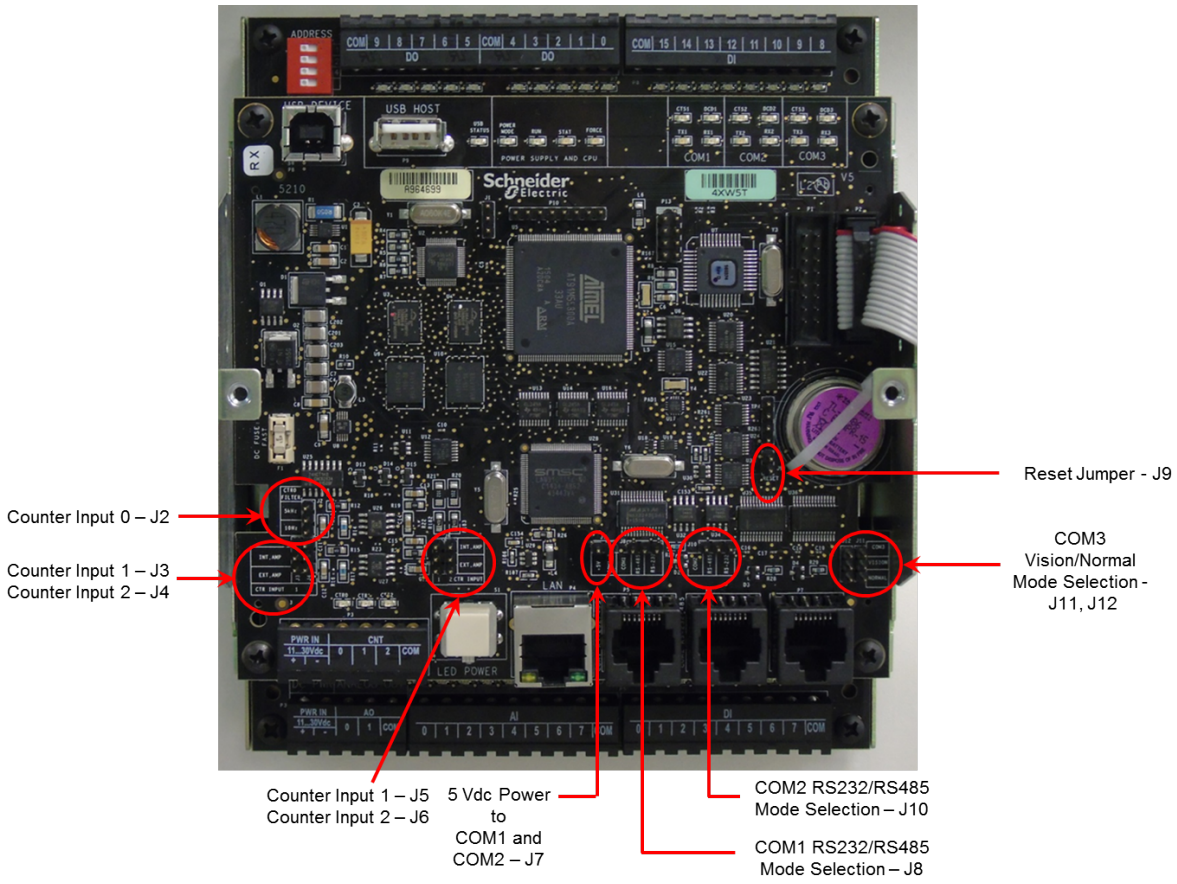
9.2 Jumper Functions

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.

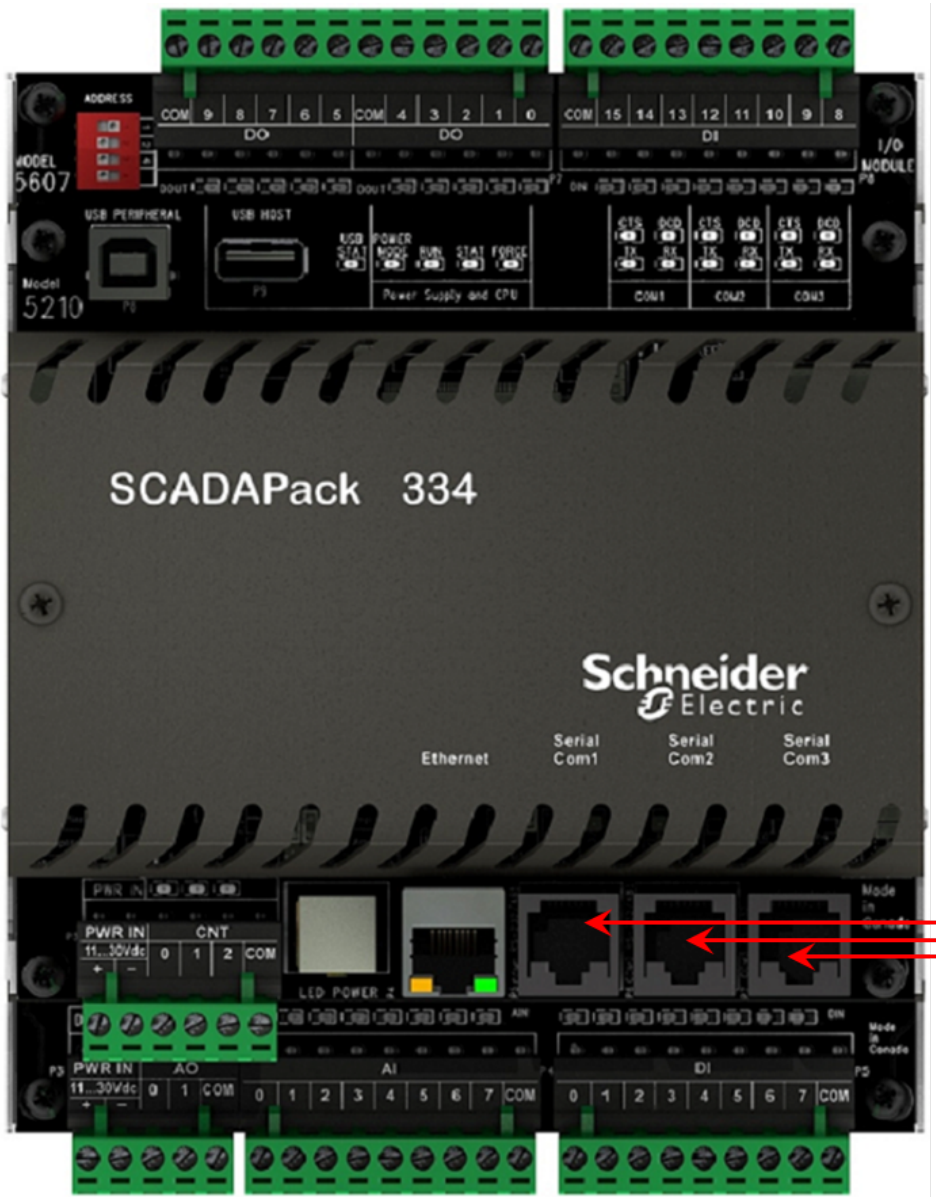
Jumper	Function	Further Information
J2	Counter Input 0 filtering	See Counter Input Wiring 85
J3, J5	Counter Input 1 Type	See Counter Inputs 42
J4, J6	Counter Input 2 Type	See Counter Inputs 42
J7	5 Vdc Power to COM1 and COM2	See COM1 and COM2 RS232 Serial Ports 25
J8	COM1 RS232 / RS485 mode selection	See COM1 and COM 2 RS485 Serial Port 30
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 30
J11, J12	COM3 Vision / Normal mode selection Install both these jumpers in the same position, either Vision or Normal	See COM3 RS232 Serial Port 28

See the following image for the location of jumpers.


Reset Jumper - J9
COM3 Vision/Normal Mode Selection - J11, J12
Counter Input 0 – J2
Counter Input 1 – J3
Counter Input 2 – J4
Counter Input 1 – J5
Counter Input 2 – J6
5 Vdc Power to COM1 and COM2 – J7
COM2 RS232/RS485 Mode Selection – J10
COM1 RS232/RS485 Mode Selection – J8

9.3 Serial Port Wiring

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



RS232 Cable Description 77

RS232 Wiring Examples 79

RS485 Wiring Example 82

9.3.1 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

9.3.2 RS232 Wiring Examples

⚠WARNING

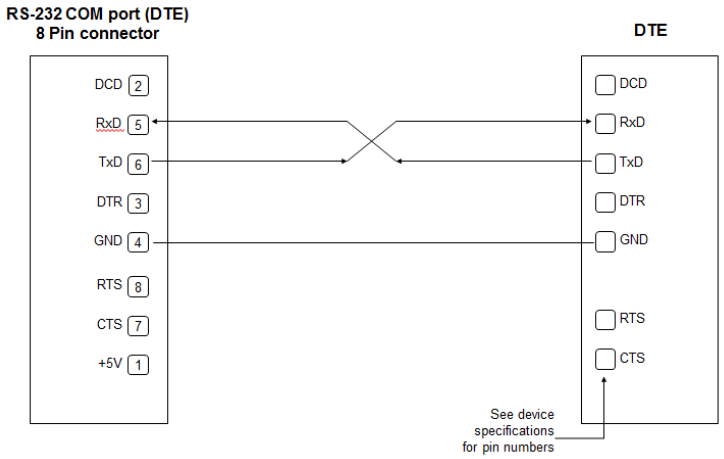
HAZARD OF ELECTRIC SHOCK

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.

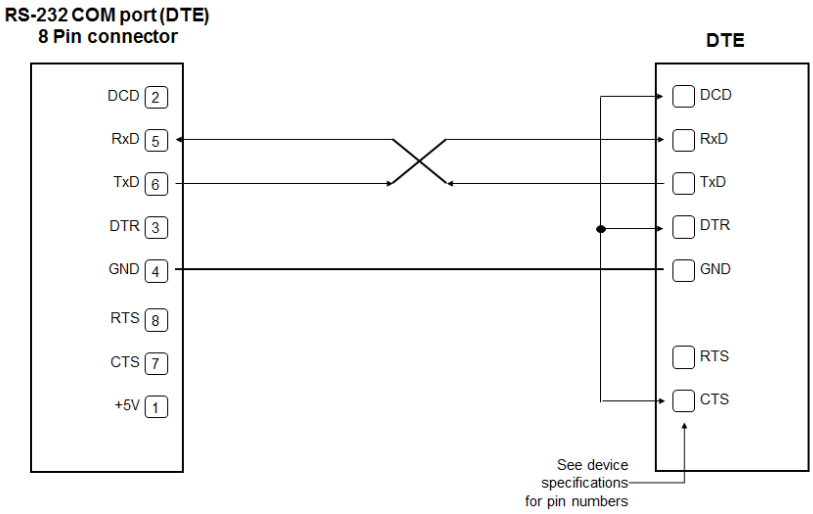
DTE to DTE Without Handshaking

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



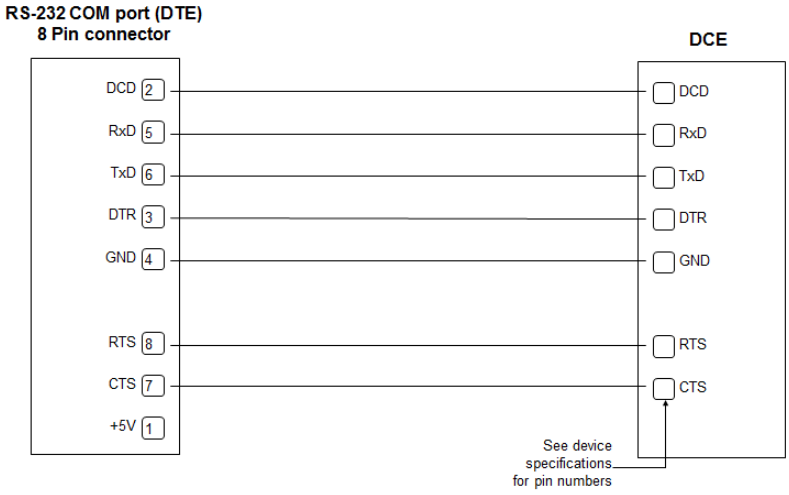
DTE to DTE with Handshaking

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.


RS-232 COM port (DTE)
8 Pin connector
DCD 2
RxD 5
TxD 6
DTR 3
GND 4
RTS 8
CTS 7
+5V 1
DTE
DCD
RxD
TxD
DTR
GND
RTS
CTS
See device specifications for pin numbers

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.



9.3.3 RS485 Wiring Example

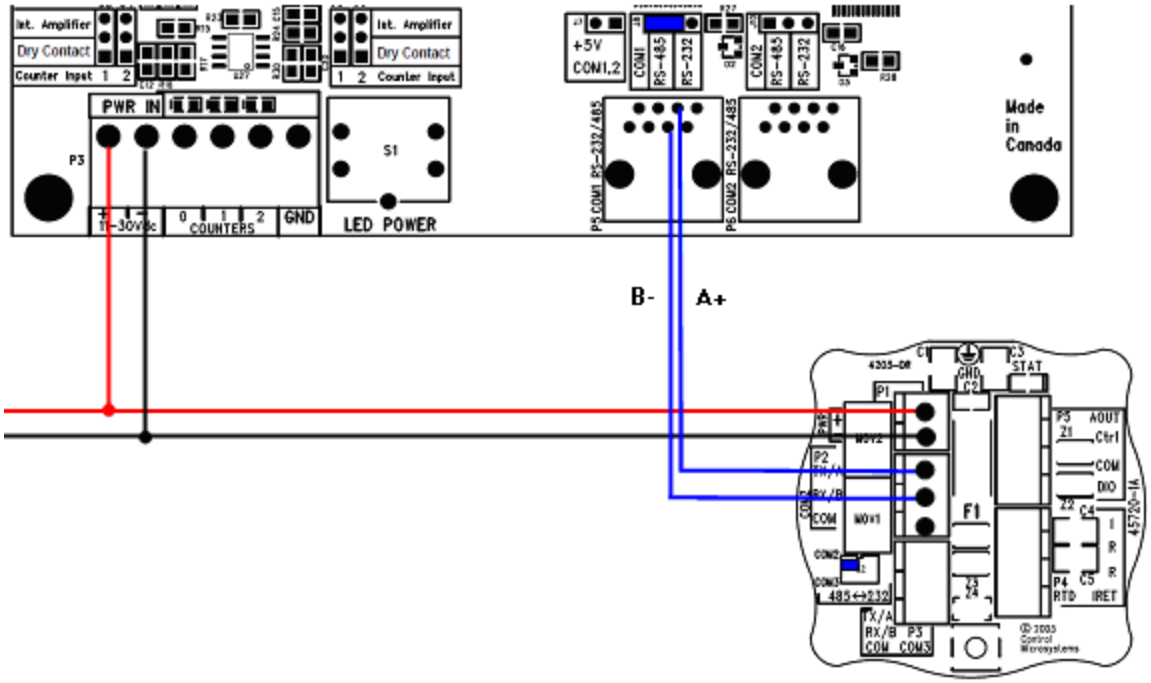
⚠WARNING

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.

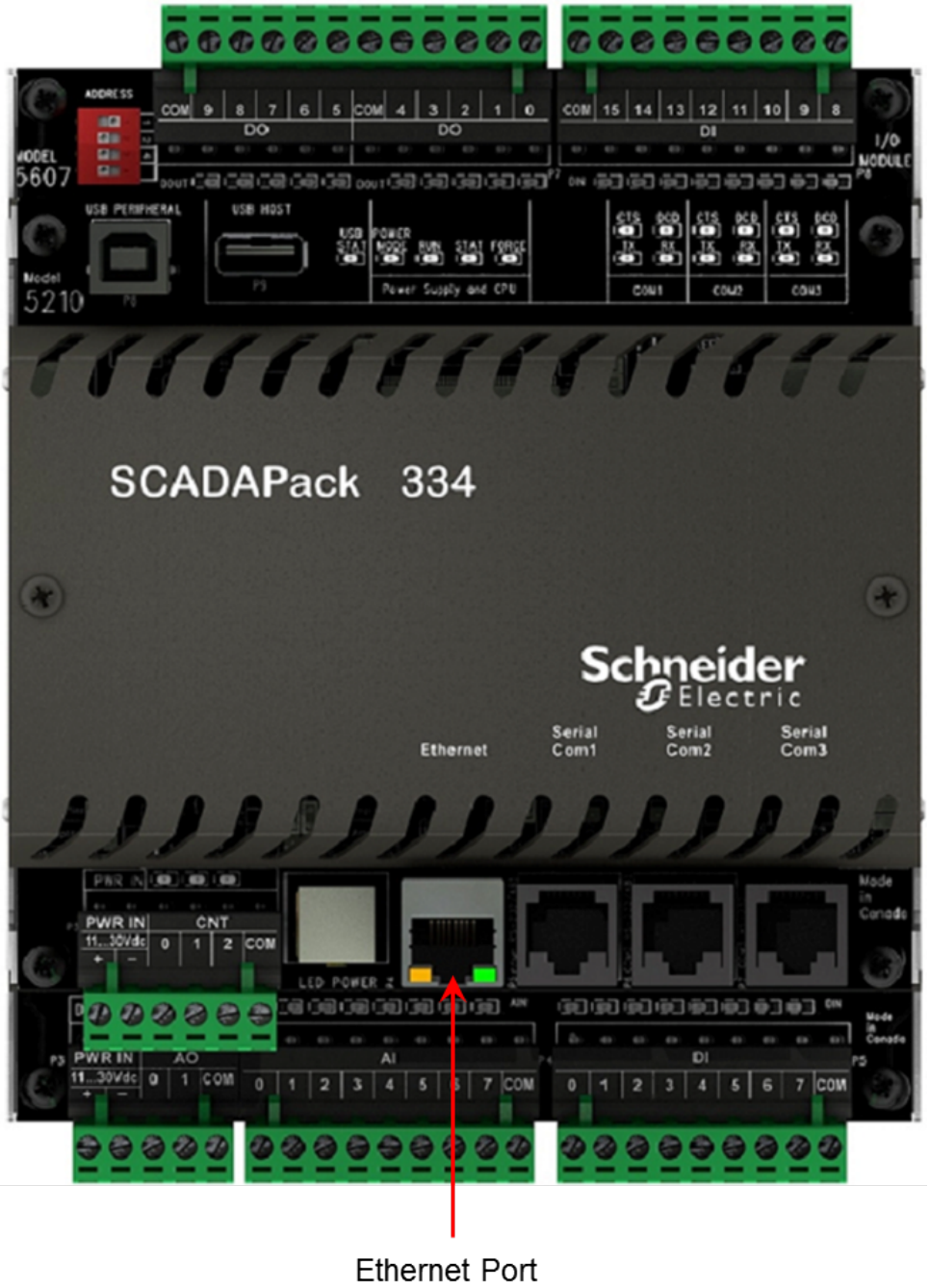
Failure to follow these instructions can result in death or serious injury.

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.



9.4 Ethernet Port Wiring

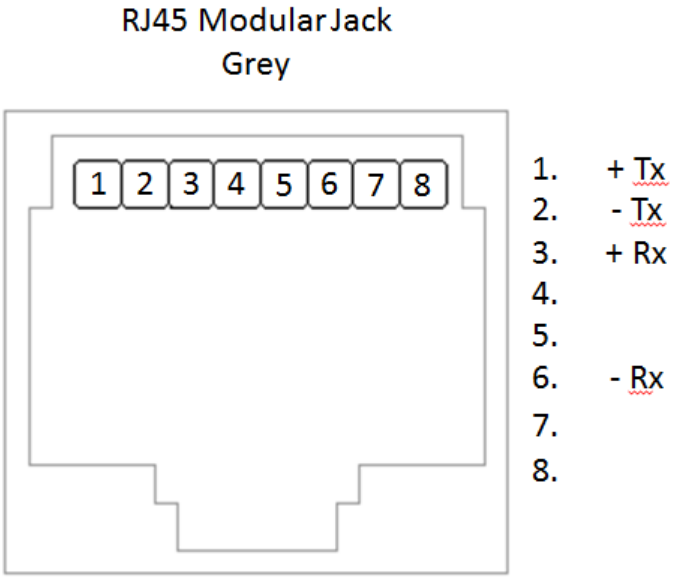
The topic in this section describes the wiring for the Ethernet port on the SCADAPack RTU.



RJ-45 Modular Connector for Ethernet 84

9.4.1 RJ-45 Modular Connector for Ethernet

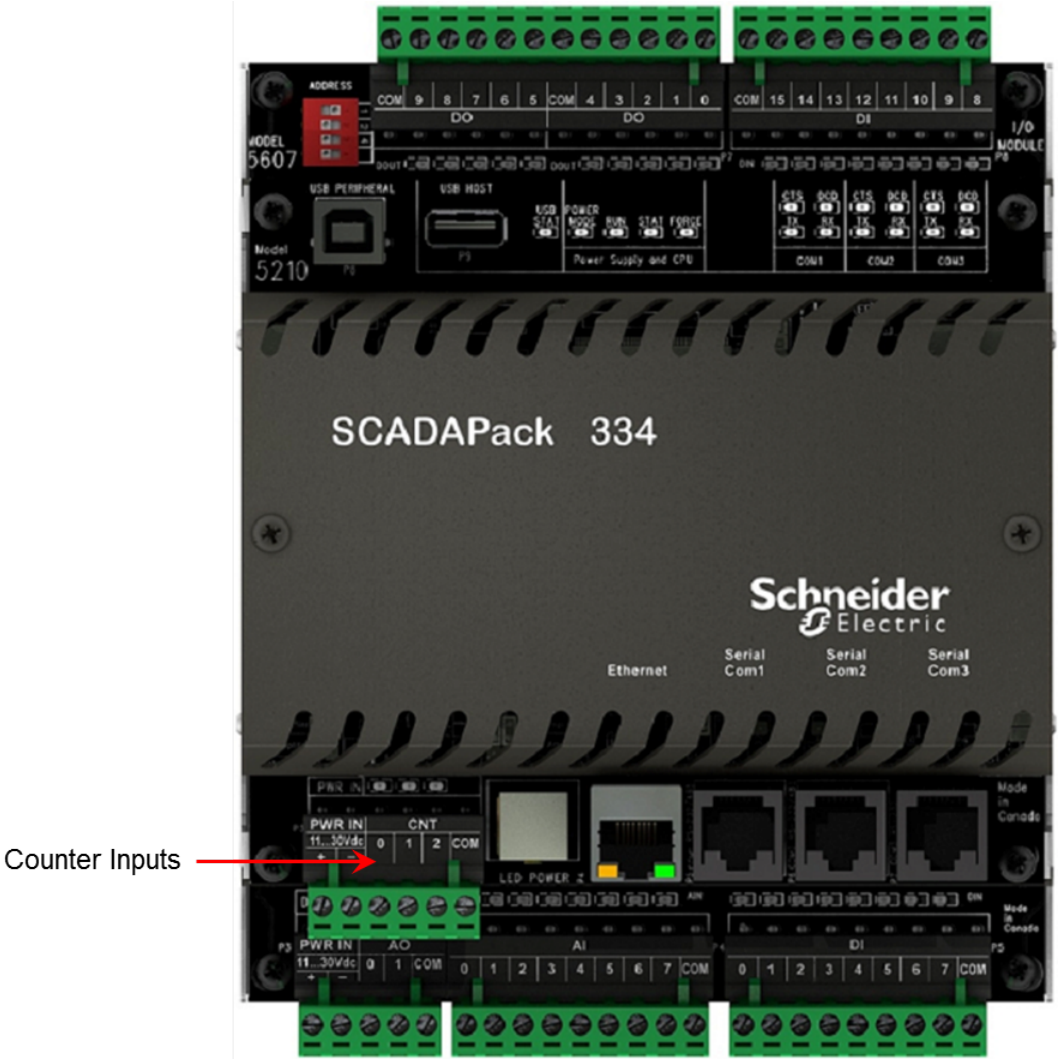
The RTU can be connected directly to a wall jack or hub using standard RJ-45 Category 5 patch cables. The following diagram shows the pin connections for the RJ-45 modular connector.



10/100Base-T has a maximum run of 100 m (350 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 (350 ft).

9.5 Counter Input Wiring

This section describes the wiring of counter inputs.



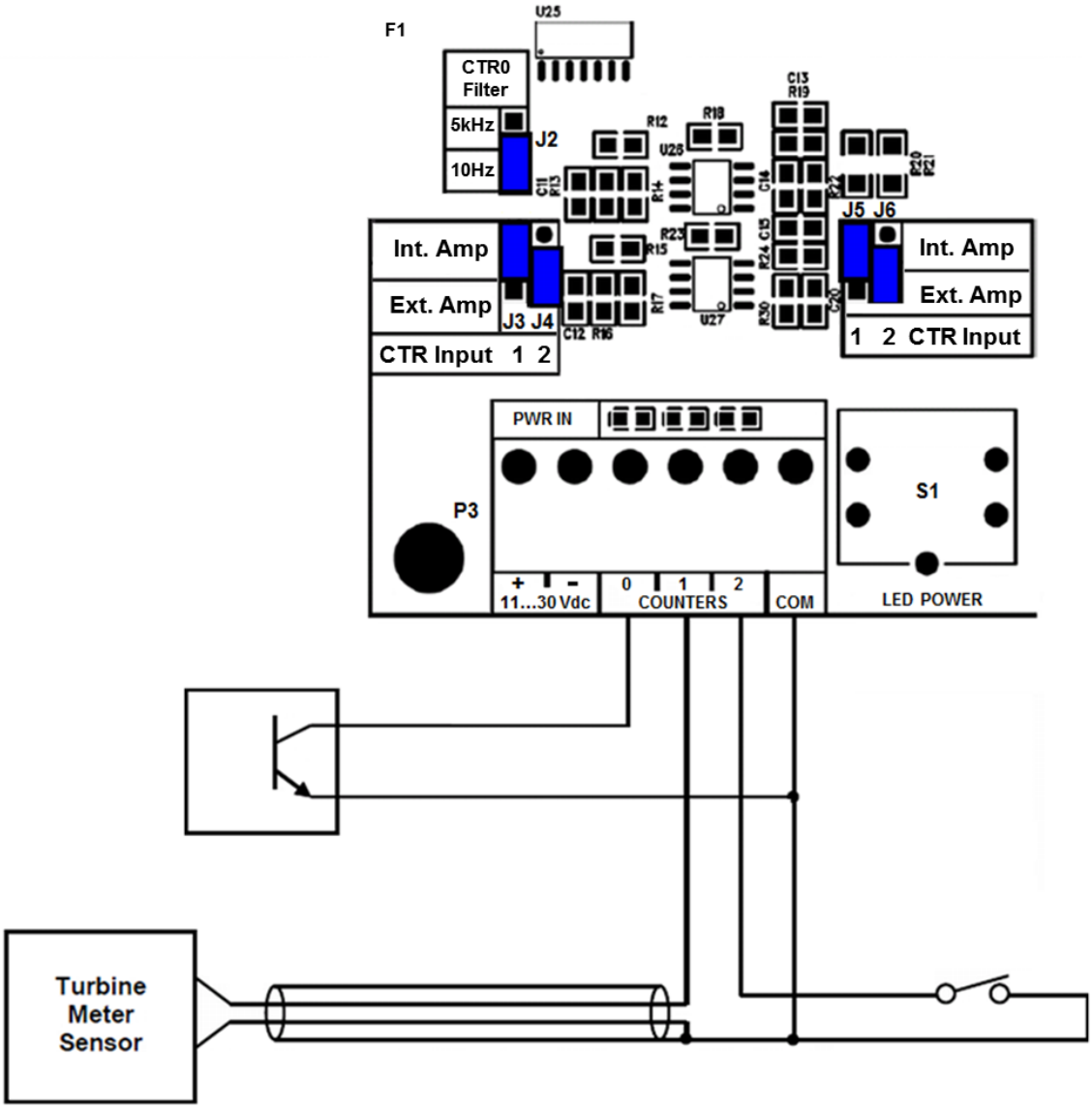
NOTICE
UNINTENDED EQUIPMENT OPERATION When wiring counter inputs: • Confirm that the connection to the counter input does not exceed the ratings for the input. See the Specifications 161 section for maximum voltages. • Confirm that the polarity of the connection is correct with the two positive terminals wired together and the two negative terminals wired together. **Failure to follow these instructions can result in equipment damage.**

NOTICE

SIGNAL INTERFERENCE DUE TO NOISE

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

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 89

Connecting to Open Collector Outputs with Internal Pullup 93

Connecting to Open Collector Outputs with External Pullup 93

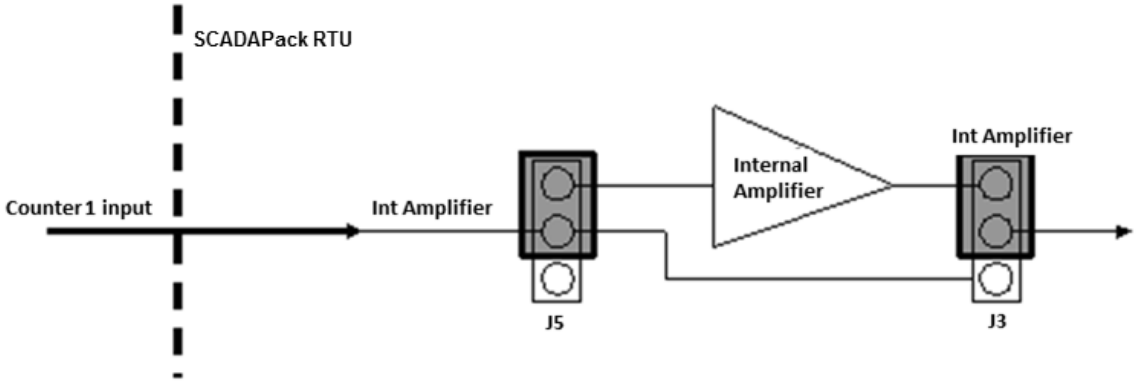
9.5.1 Directly Connecting to Low Voltage Turbine Meters

NOTICE
UNINTENDED EQUIPMENT OPERATION Do not exceed the maximum voltage specified for each counter input. See the Specifications 161 section for maximum voltages. **Failure to follow these instructions can result in equipment damage.**

NOTICE
SIGNAL INTERFERENCE DUE TO NOISE When the unit is operating in an electrically noisy environment or to meet the requirements of EN61000-6-2, counter input signals must be shielded using Belden 9322 or equivalent. **Failure to follow these instructions can result in equipment damage.**

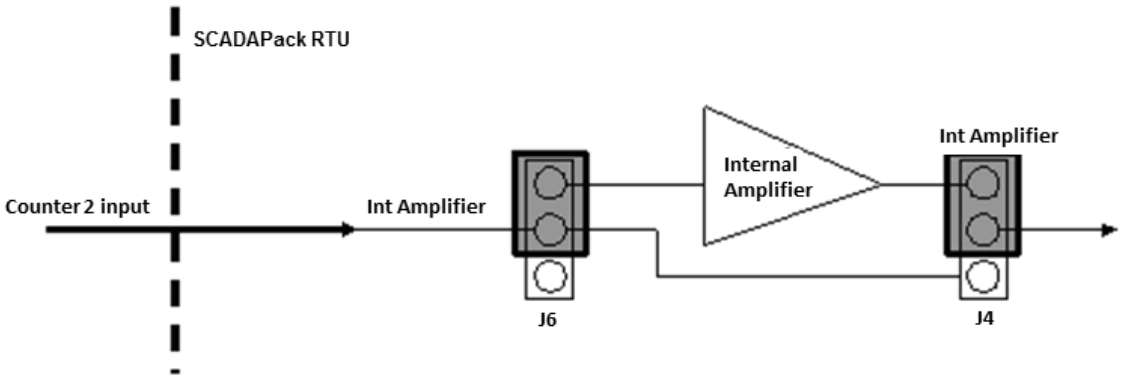
When connecting a low voltage (millivolt) turbine meter directly to counter input 1, enable the internal pre-amplifier on this input as follows:

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.



9.5.2 Connecting to Open Collector Outputs with Internal Pullup

NOTICE
UNINTENDED EQUIPMENT OPERATION Do not exceed the maximum voltage specified for each counter input. See the Specifications 161 section for maximum voltages. **Failure to follow these instructions can result in equipment damage.**

NOTICE
SIGNAL INTERFERENCE DUE TO NOISE When the unit is operating in an electrically noisy environment or to meet the requirements of EN61000-6-2, counter input signals must be shielded using Belden 9322 or equivalent. **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:

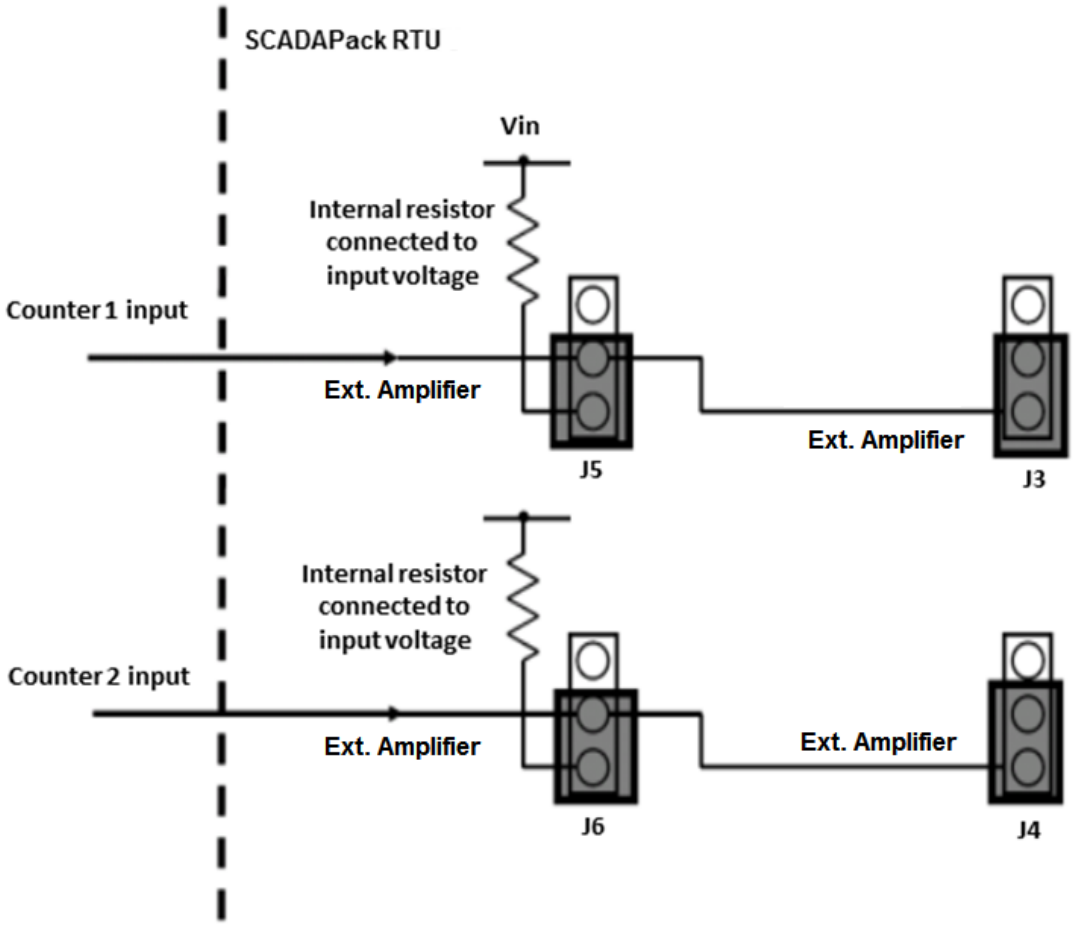
- Install jumper J5 in the **Ext. Amplifier** position.
- Install jumper J3 in the **Ext. Amplifier** position.

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:



9.5.3 Connecting to Open Collector Outputs with External Pullup

NOTICE

UNINTENDED EQUIPMENT OPERATION

Do not exceed the maximum voltage specified for each counter input. See the Specifications 161 section for maximum voltages.

Failure to follow these instructions can result in equipment damage.

NOTICE

SIGNAL INTERFERENCE DUE TO NOISE

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

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.

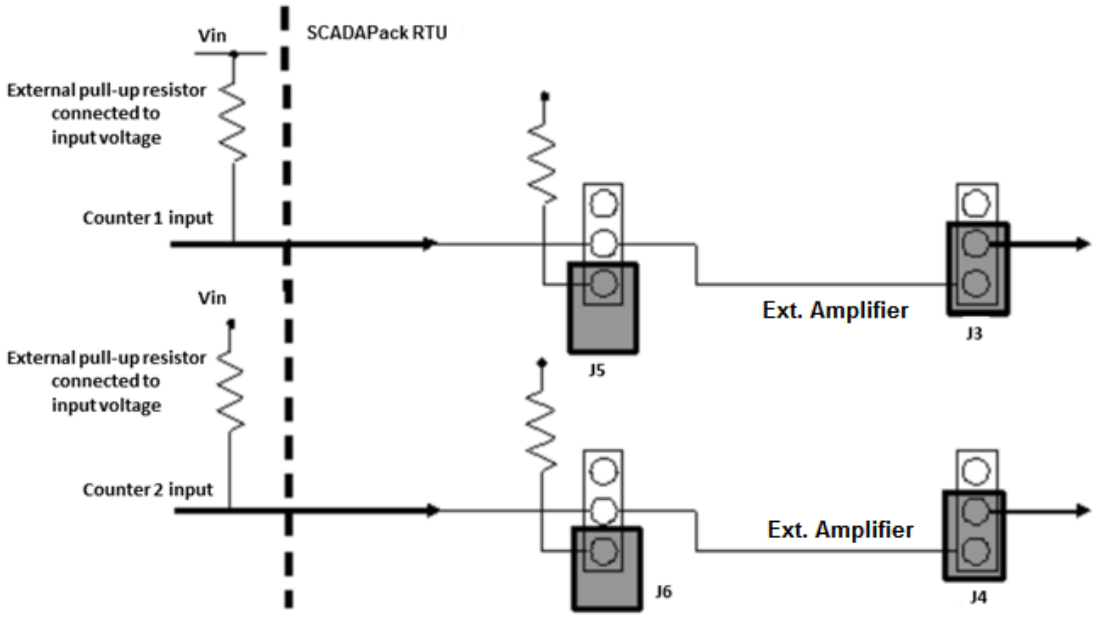
For Counter 1:

- 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:

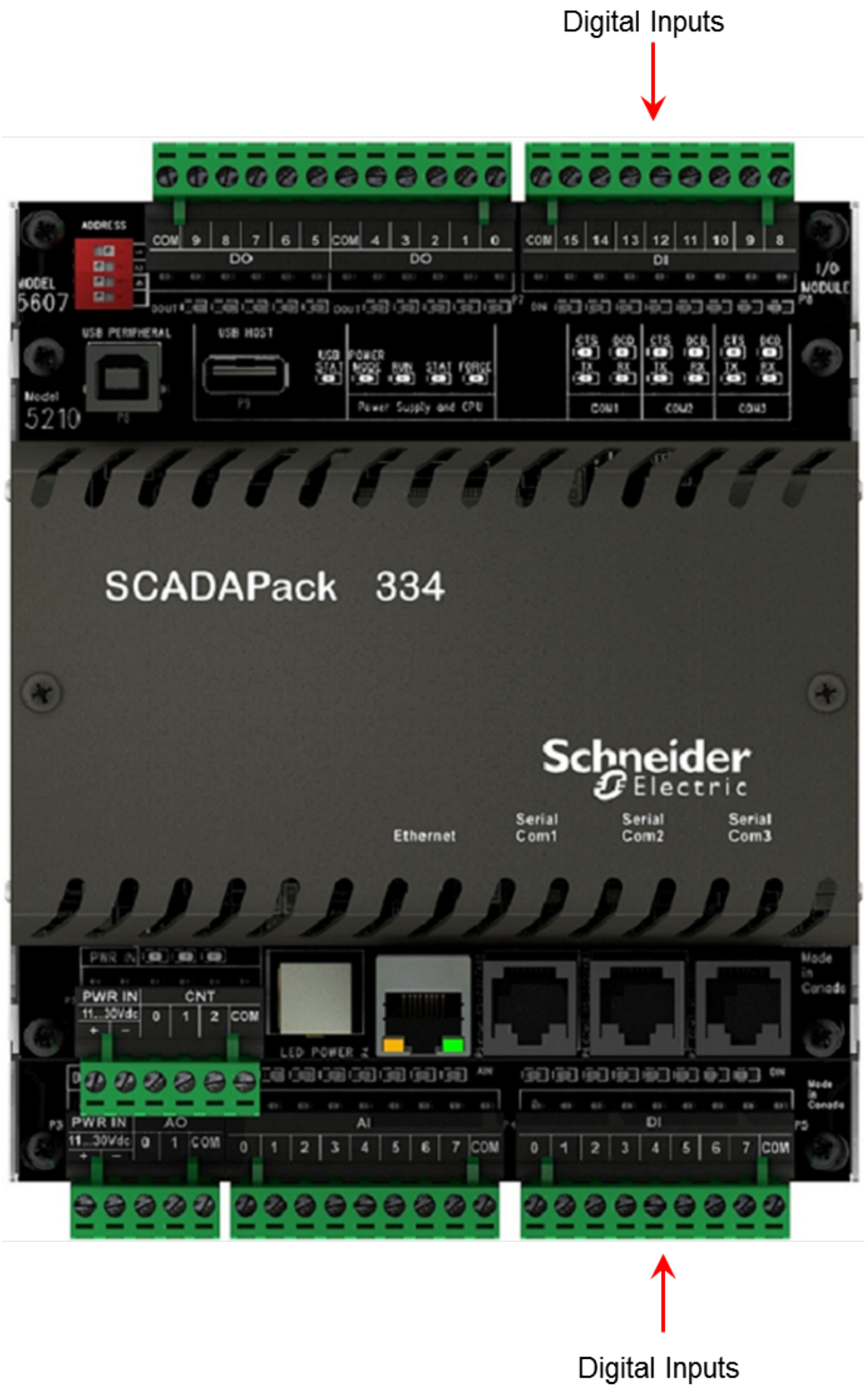
- Install jumper J4 in the **Ext. Amplifier** position.
- Remove jumper J6 from the **Ext. Amplifier** position. This jumper is not used and can be stored, if required, on the single header pin.

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



9.6 Digital Input Wiring

This section describes the wiring for the digital inputs.



Digital Input Wiring Example 97

9.6.1 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:

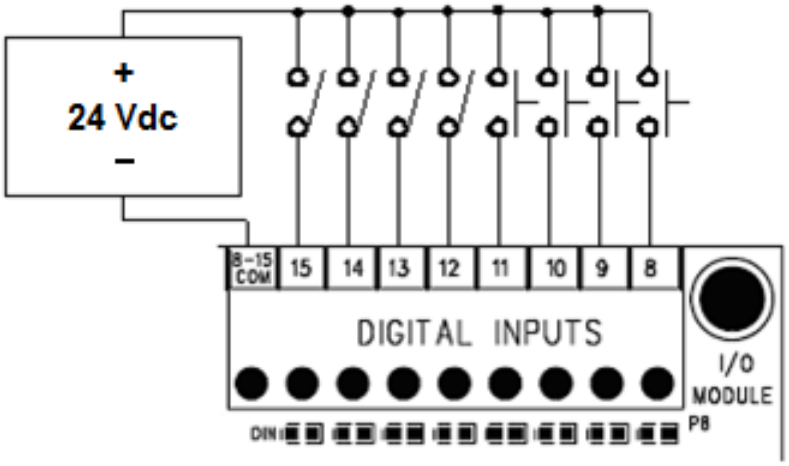
- Confirm that the connection to the digital input does not exceed the ratings for the digital input. See the Specifications 153 section for maximum voltages.
- Confirm that the polarity of the connection is correct. Connect the positive signal to the input. Connect the negative signal to the common.

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.

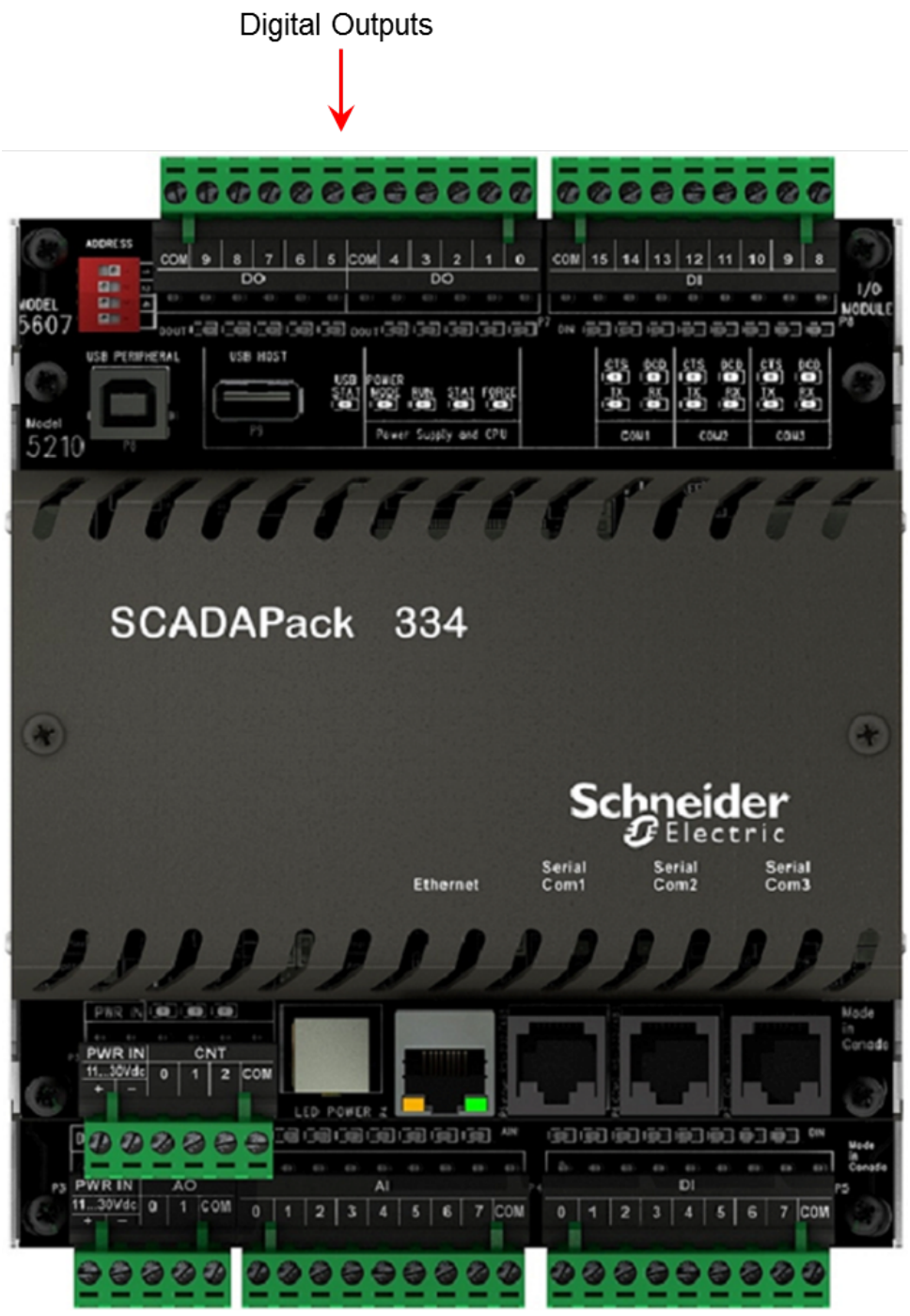
The following diagram shows typical wiring of DC signals to the digital input ports.



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

9.7 Digital Output Wiring

This section describes the wiring for the digital outputs.



Digital Output Wiring Example 99

9.7.1 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

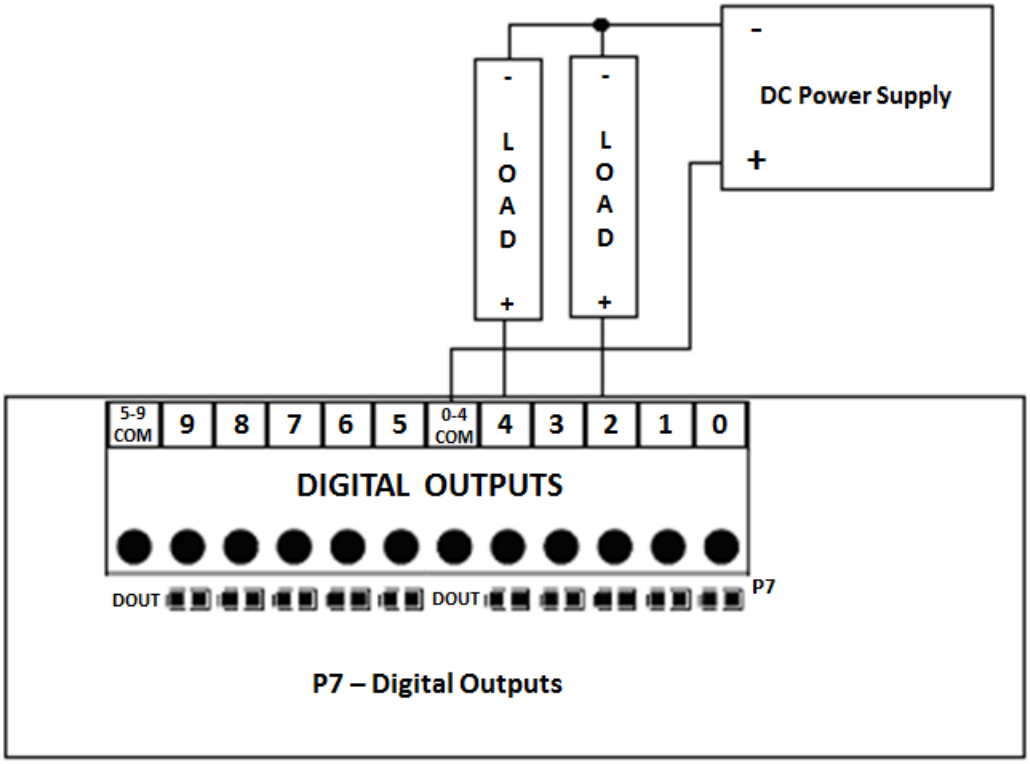
UNINTENDED EQUIPMENT OPERATION

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 sides of the loads are switched through the common of relays 0 - 4 to the positive side of the DC power supply.



Solid State Relay Version

The I/O module is optionally available with solid state relays (SSR). Refer to the **Specifications** section for limitations associated with using solid state relays.

Consider the polarity of the load voltages when using the SSR version of the I/O module. The loads are connected to the positive side of the power supply and the positive side of the power is switched through the COM terminal as shown in example above.

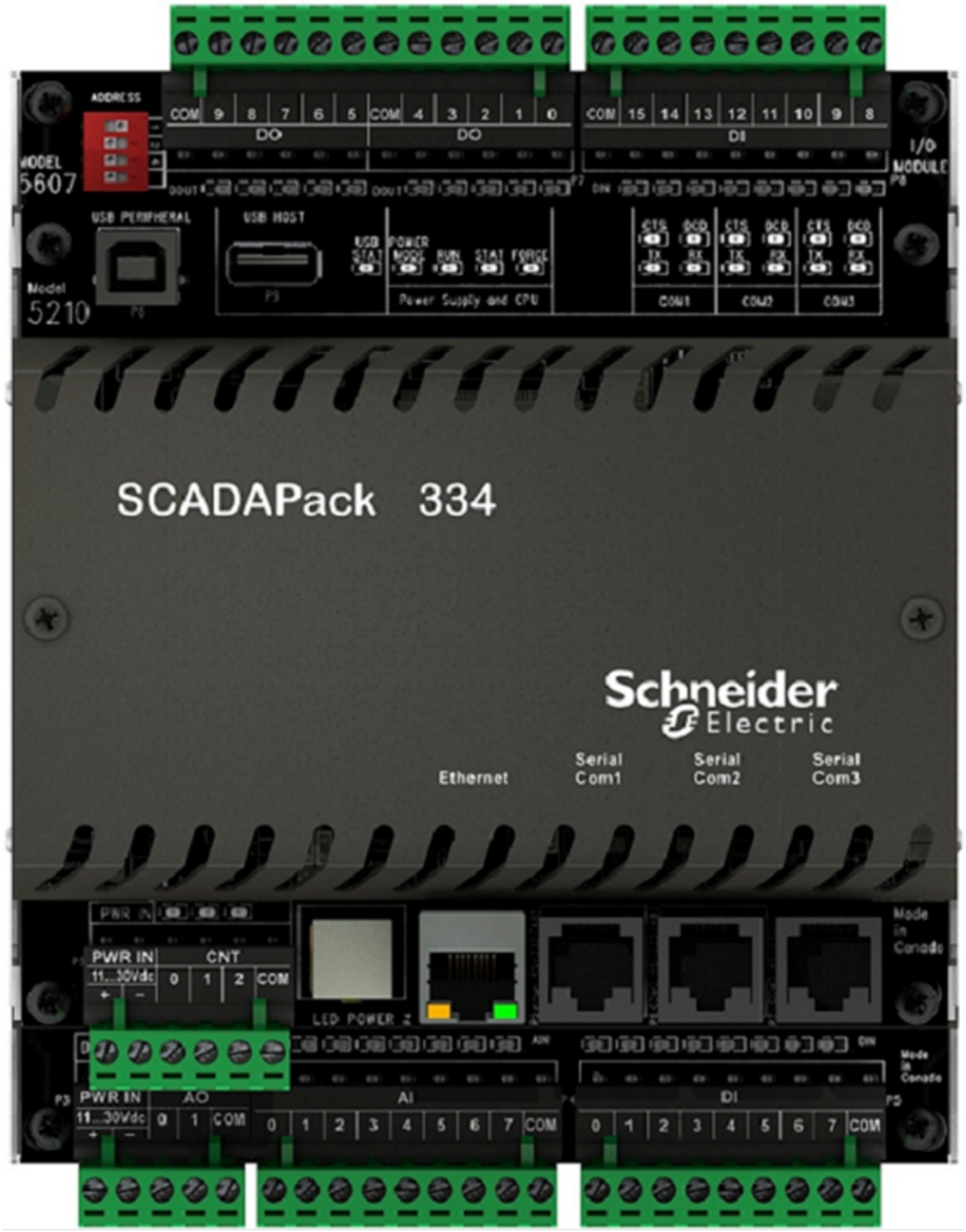
9.8 Analog Input Wiring

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 103

Configuring Analog Inputs as Current Inputs 105

Helping to Prevent Interruption of the Current Loop 106

9.8.1 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

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

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 153 section for 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

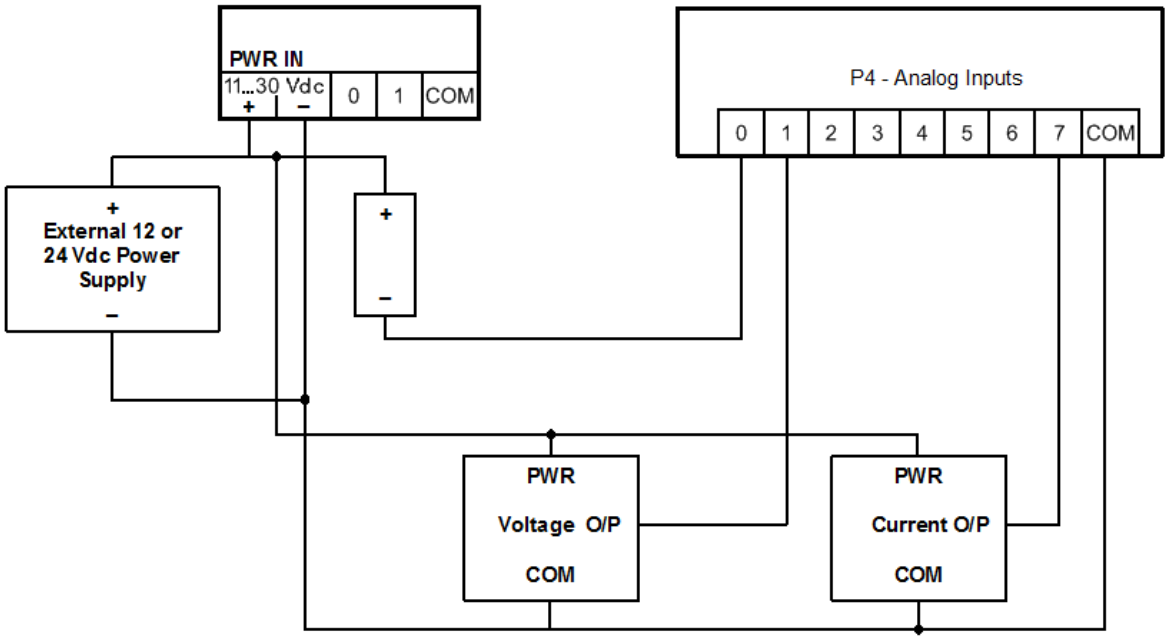
The graphic below shows several examples for wiring of loop-powered and self-powered transmitters with the corresponding analog inputs set to voltage mode with a 0...5 Vdc measurement range.

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.



9.8.2 Configuring Analog Inputs as Current Inputs

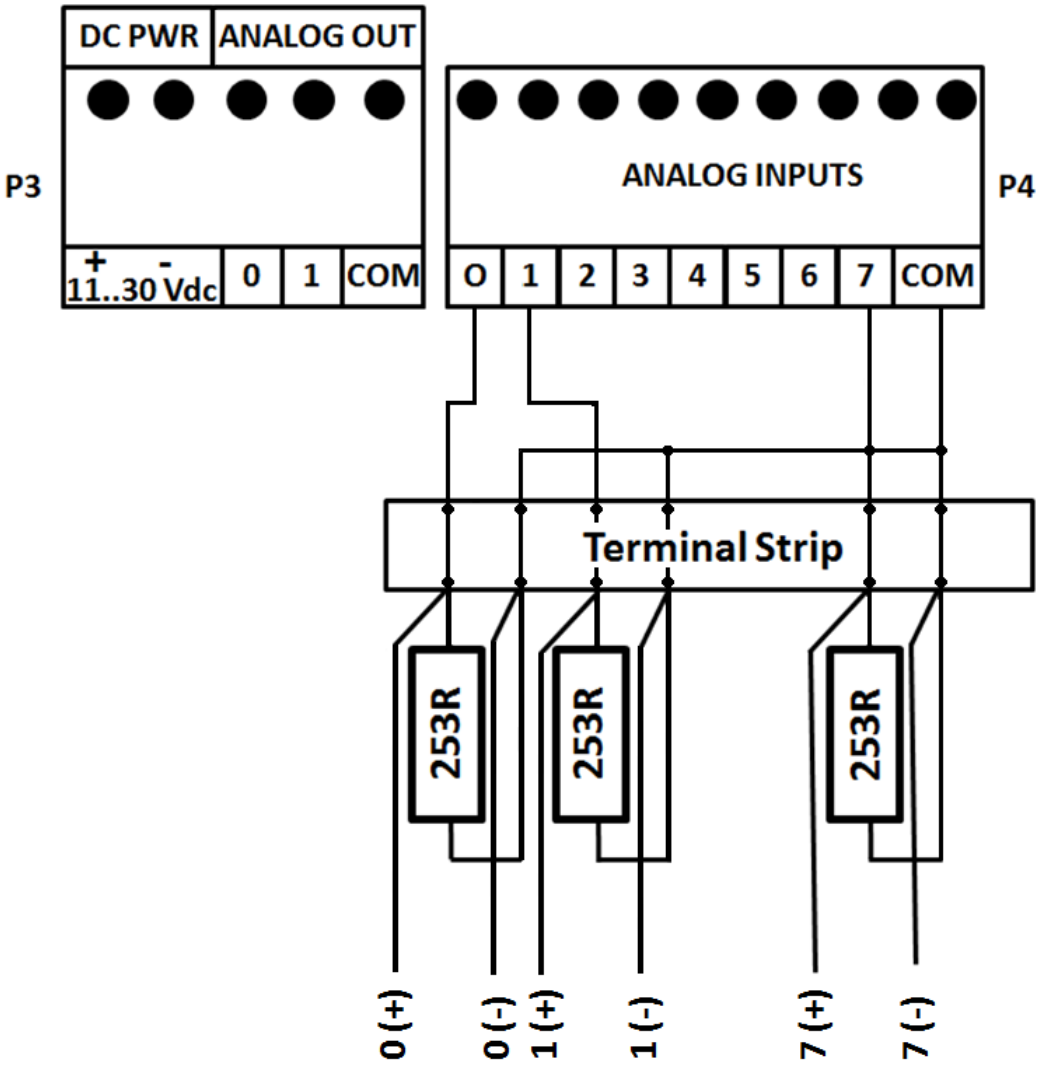
The analog inputs are configured in Current Input mode and have these possible operating conditions:

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

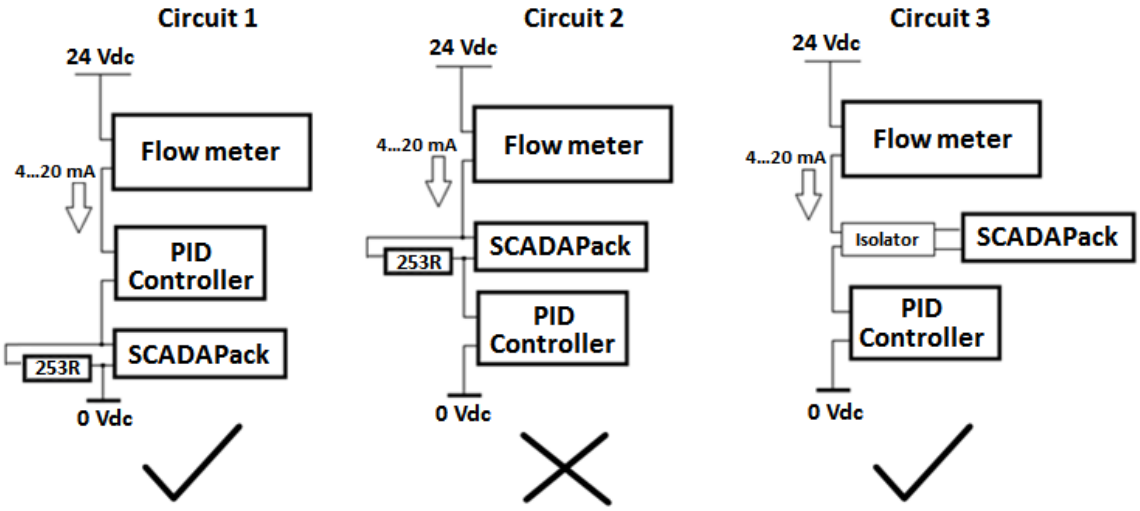
If you power down or reset the module in a multiple device loop, the analog inputs emulate voltage inputs that present a high impedance to the current loop, and effectively break the current loop of the system.

9.8.3 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.



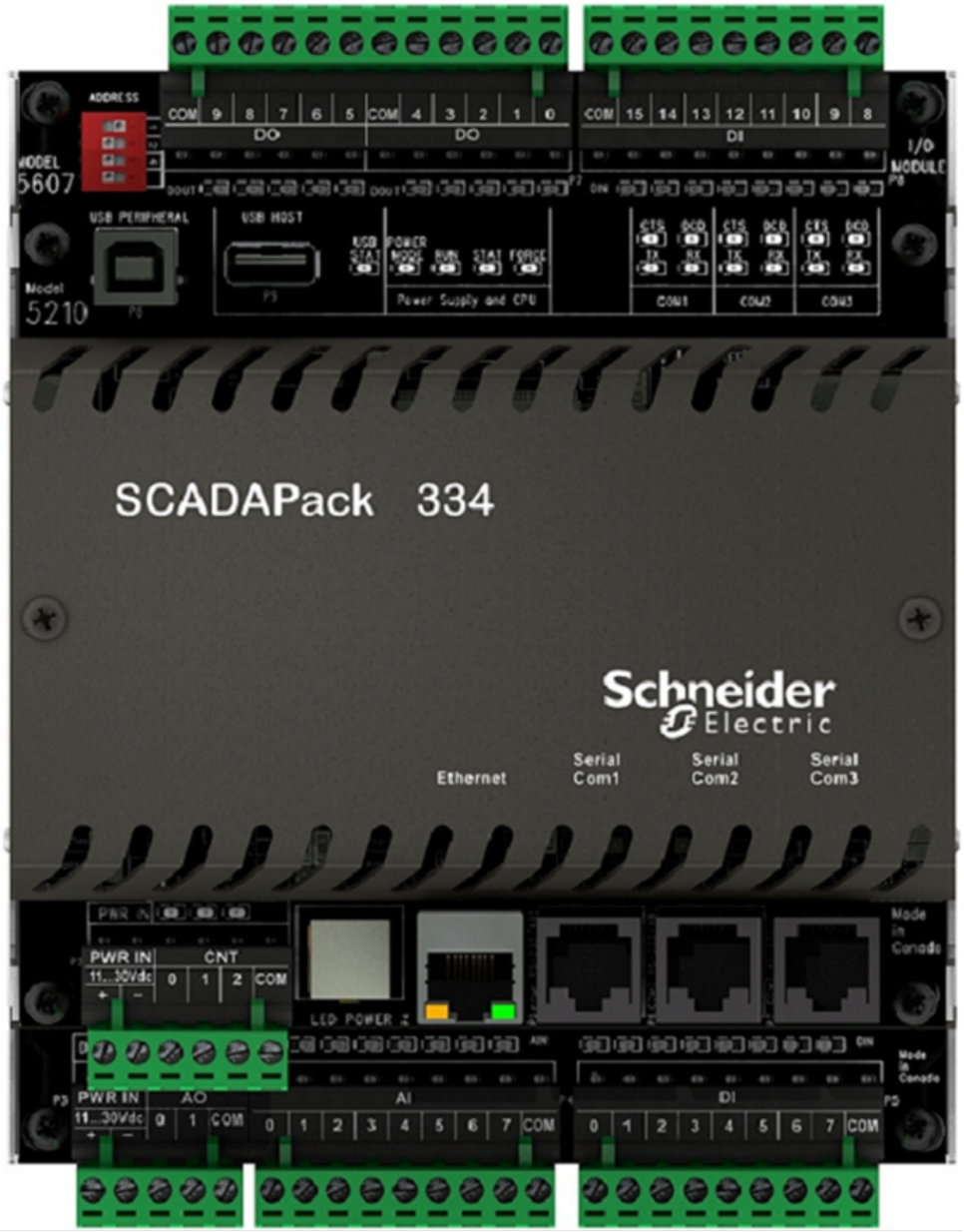
The circuit configurations for the external 253-ohm resistor, or a signal isolator, are shown in the figure below:



- 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.

9.9 Analog Output Wiring

This section describes the wiring for the analog outputs.

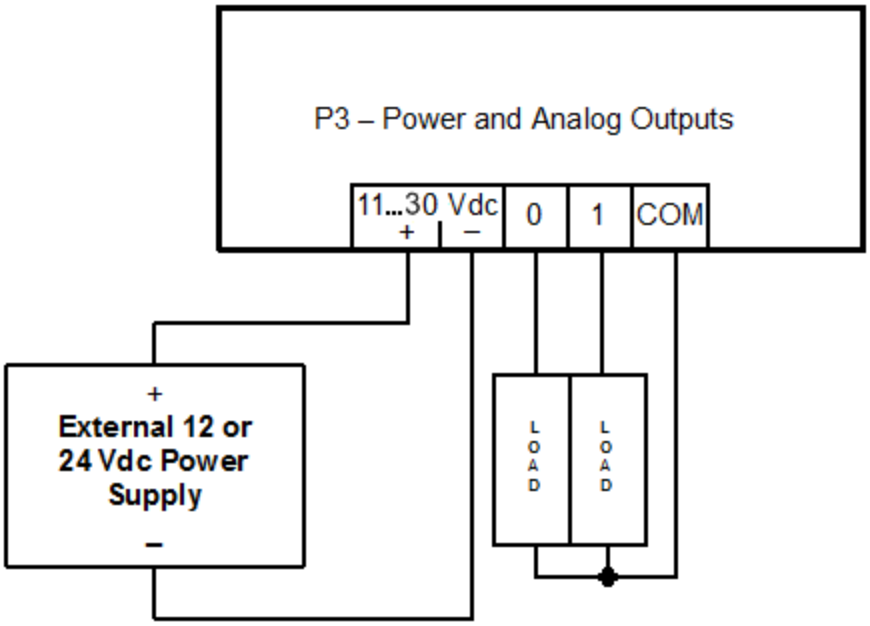


Analog Output Wiring Example 109

Analog Output Power Supply Configuration Options 110

9.9.1 Analog Output Wiring Example

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



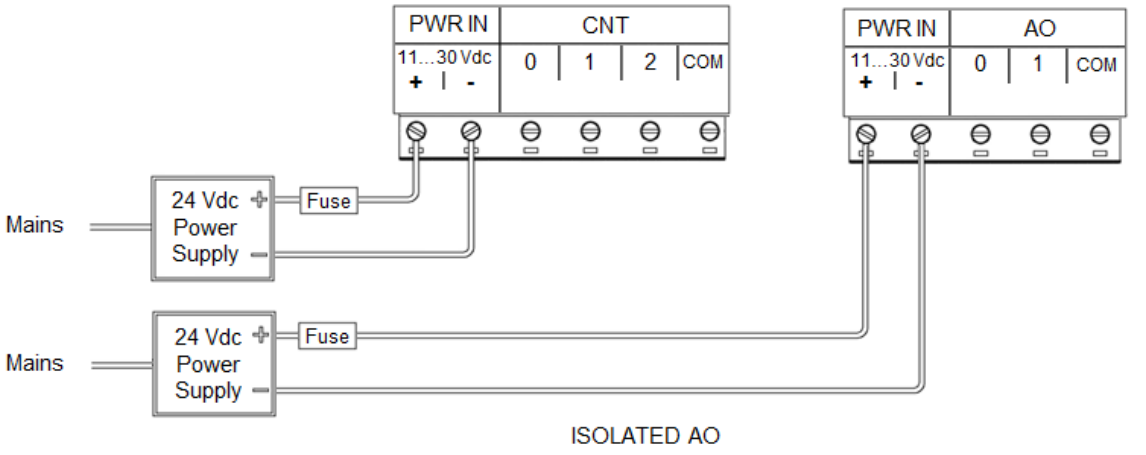
9.9.2 Analog Output Power Supply Configuration Options

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

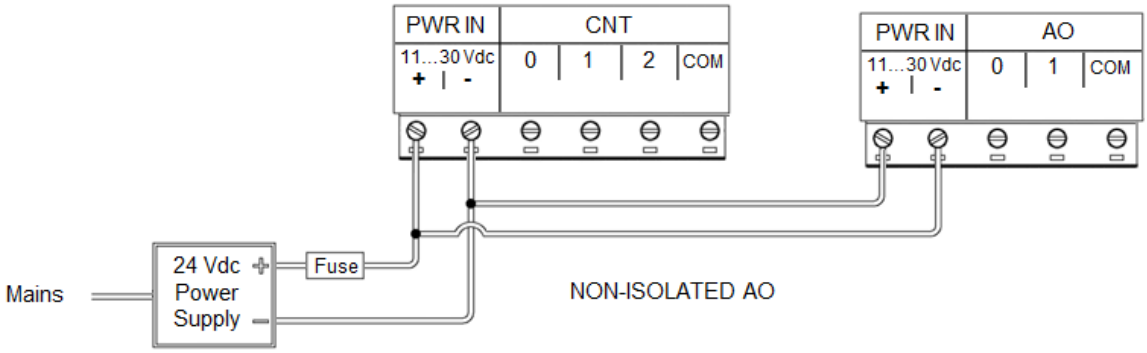
- The analog output module and the RTU can each have their own 24 Vdc power supply. In this configuration, the analog outputs are isolated from the system logic.
- The analog output module can share an external 24 Vdc power supply with the RTU. In this configuration, the analog outputs are not isolated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

The following figure illustrates the power supply configurations for isolated and non-isolated analog outputs. For details on wiring the power supply connectors, see Wiring Screw-Termination Connectors 72.



ISOLATED AO



NON-ISOLATED AO

10 Startup Modes

SCADAPack RTUs can be started in four different operating modes:

- Run mode 115
- Service mode 116
- Cold Boot mode 117
- Factory Boot mode 119

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

If the lithium RAM battery is at a very low level, a modified Run Boot or Service Boot mode is initiated. See Low RAM Battery Voltage Effect 121 for further details.

⚠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 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 useful 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 Telepace Studio or IEC 61131-3. 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 data loss.

The table below summarizes the effects of the various boot modes.

Run Mode	Service Mode	Cold Boot	Factory Boot	Re-entry Boot	Action
	X	X	X		Serial settings set to default
		X	X		Lock settings set to default
	X	X	X		Store and forward settings set to default
		X	X		LED power set to default
		X	X	IEC 61131-3 programs - Yes Telepace Studio, if upgrading from firmware older than 1.40	Database initialized
		X	X	IEC 61131-3 programs - Yes Telepace Studio, if upgrading from firmware older than 1.40	Logic application(s) erased
		X	X		C/C++ applications erased
		X	X		Application files are erased
			X		Flash File System reformatted

Run Mode	Service Mode	Cold Boot	Factory Boot	Re-entry Boot	Action
X					C/C++ applications started
X					Logic applications started
				X	Communication settings on active interface retained
		X	X	X	Settings retained in non-volatile memory
		X	X		Ladder logic in Flash is erased
	X	X	X		Protocols are set to defaults

10.1 Run Mode

Run mode is the normal operating mode of the SCADAPack RTU. No action is required to select Run mode.

When the RTU starts:

- The RTU loads the defined serial and Ethernet (where available) communication parameters, for COM ports.
- If a Telepace Ladder Logic or IEC 61131-3 application program is loaded in RAM, it is executed.
- If a C/C++ application program is loaded in RAM and the program checksum is correct, it is executed.
- If there is no Telepace Studio or IEC 61131-3 application program in RAM and there is an application program in flash ROM, then the flash ROM program will be executed.
- The RTU lock settings and password are applied.

10.2 Service Boot Mode

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

When the RTU starts in Service Boot mode:

- The default serial communication parameters are used.
- The Telepace Ladder Logic or IEC 61131-3 program is stopped.
- The C/C++ program is stopped.
- Application programs are retained in non-volatile memory.
- The RTU lock settings and password are applied.

⚠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.

To start the RTU in Service Boot mode:

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 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.

10.3 Cold Boot Mode

Cold Boot mode is used after installing new SCADAPack firmware.

When the RTU starts in Cold Boot mode:

- The default serial and Ethernet (where applicable) communication parameters are used.
- The Telepace Ladder Logic or IEC 61131-3 and any C/C++ programs are erased.
- The registers in the I/O database or I/O connection are initialized to their default values.
- The register assignment is erased.
- The RTU is unlocked.

⚠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

DATA LOSS

Starting the RTU in Cold Boot mode returns RTU configuration parameters to their default settings and erases applications created in Telepace Studio or IEC 61131-3. 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 loss of files related to configuration and data collection.

To start the RTU in Cold Boot mode:

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 will start in Service mode.

   To cancel the startup mode selection at this point, remove power from the RTU before you proceed

to step 5. This can be a useful tactic to avoid starting up in modes where more actions are applied if you have held the **LED POWER** button down longer than this mode requires.

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

10.4 Factory Boot Mode

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

When the RTU starts in Factory boot mode:

- The default serial and Ethernet (where applicable) communication parameters are used.
- The Telepace Ladder Logic or IEC 61131-3 and any C/C++ programs are erased.
- The registers in the I/O database or I/O connection are initialized to their default values.
- The register assignment is erased.
- The RTU is unlocked.
- The Flash File system is reformatted.

⚠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

DATA LOSS

Starting the RTU in Factory Boot mode returns RTU configuration parameters to their default settings and erases applications created in Telepace Studio or IEC 61131-3. 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 loss of files related to configuration and data collection.

To start the RTU in FACTORY BOOT mode:

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 longer than 30 seconds until the STAT LED turns solid.

   If you release the **LED POWER** button while the STAT LED is still blinking, the RTU will start in

Cold Boot mode.

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

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 back-up.

10.5 Low RAM Battery Voltage Effect

If the lithium RAM battery is at a very low level and to provide a modified Run Boot or Service Boot, if that is the case. The **Low RAM Battery Voltage** effect occurs when a Run Boot or Service Boot is performed and the RAM battery voltage is detected at 1.0 Vdc or less or if the battery is removed.

The special initialization with low voltage battery includes the following steps:

- The registers in the I/O database or I/O Connection are initialized to their default values.
- Ladder logic applications saved in RAM are erased.
- Ladder Logic programs, including DNP3 configurations and register assignments, saved to Flash memory will be restarted on a Run boot.
- IEC 61131-3 applications are erased.
- The DNP3 configuration is erased.
- The communication parameters for serial ports and Ethernet port (where available) are set to default values when a Service Boot is performed and are returned to user-defined values when a Run Boot is performed.
- C/C++ applications are stopped during a Service Boot and restarted fresh with the execution state set to first run during a Run Boot condition. This enables C/C++ applications to re-initialize any “dynamic NVRAM” allocation that needs to occur when the application starts.
- Data Log and Data Log to File functions will return either Invalid ID or has not been created or Invalid logging mode.

11 Configuration

The following applications let you configure inputs and outputs (where available) on an integrated or expansion I/O module. The application(s) you use depends on the language you want to use to define I/O operation:

- SCADAPack Configurator with SCADAPack Workbench for IEC 61131-3 programming
- Telepace Studio for integrated ladder logic programming
- C or C++ programming

You can also develop C or C++ applications in your preferred development environment, then load them into your RTU using either SCADAPack Configurator or Telepace Studio. SCADAPack RTUs can execute logic applications or IEC 61131-3 applications simultaneously with C or C++ applications.

See the following topics for further information:

SCADAPack Configurator and SCADAPack Workbench 123

Telepace Studio 127

C/C++ Programs 128

The RTU can be configured to reduce power consumption. For details see Power Management Features 130.

11.1 SCADAPack Configurator and SCADAPack Workbench

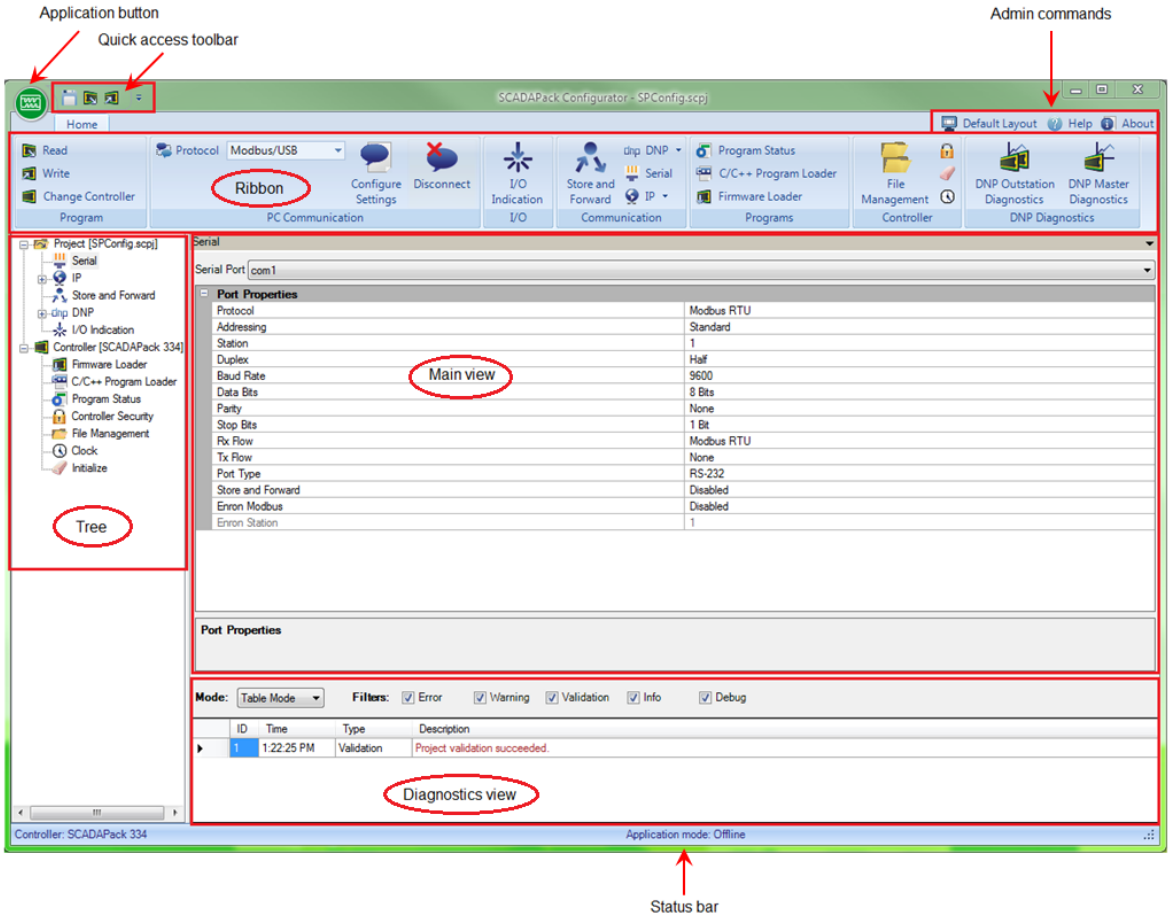
SCADAPack Configurator

SCADAPack Configurator provides a graphical user interface to configure and manage SCADAPack RTUs that are running IEC 61131-3 firmware. You can use SCADAPack Configurator to:

- Configure serial, IP and DNP settings
- Manage IEC 61131-3 and C/C++ programs
- Load new firmware
- Configure security
- Set the controller clock
- Initialize the RTU
- Configure store and forward messaging
- Manage files
- View diagnostics and debug information, including DNP master and DNP outstation diagnostics information.

You can also use SCADAPack Configurator to configure the communication settings on the PC running the SCADAPack Configurator software.

The figure below outlines the key areas in the SCADAPack Configurator user interface.



The application button provides access to menu items to create, open and save projects.

The quick access toolbar provides access to frequently used commands.

The admin commands provide access to layout settings and help.

The ribbon provides access to the SCADAPack Configurator functionality.

The tree also provides access to SCADAPack Configurator functionality.

The main view displays the results of selections made through the Ribbon or the Tree.

The diagnostics view displays diagnostics information in various formats.

The status bar displays the controller type and communication status.

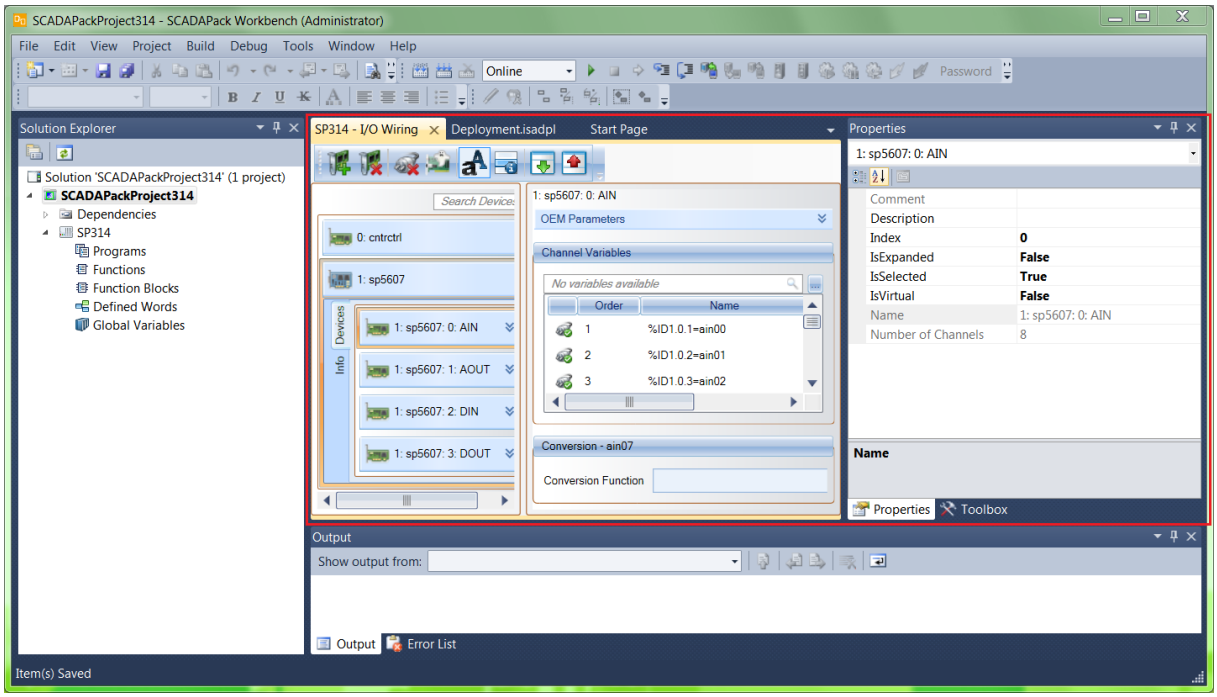
For more information, see the **SCADAPack Configurator User Manual**.

SCADAPack Workbench

SCADAPack Workbench provides a graphical user interface for writing IEC 61131-3 programs that you can download to the RTU. The following IEC 61131-3 languages are supported for SCADAPack RTUs:

- Function Block Diagram (FBD)
- Structured Text (ST)
- Ladder Diagram (LD)

The figure below shows the I/O Wiring editor, which is used to define I/O operation.



The following table summarizes the I/O Devices and function blocks that are used to configure inputs, outputs (where available) and power management features.

Inputs/Outputs	**I/O Device**
Analog and digital inputs and outputs	I/O Wiring > spxxxx
Internal Analog Inputs:	
Controller input voltage	I/O Wiring > ainvolt
Controller board temperature	I/O Wiring > aintemp
Controller RAM battery voltage	I/O Wiring > ainbatt
Counter inputs	I/O Wiring > sp33x: 0: CNTR
Power Management Features	**Function Block**

LED power control	getled and setled
Ethernet Disable control (where available)	getpmode and setpmode
USB Disable control	getpmode and setpmode
Reduced power mode	getpmode and setpmode
Sleep mode	sleep

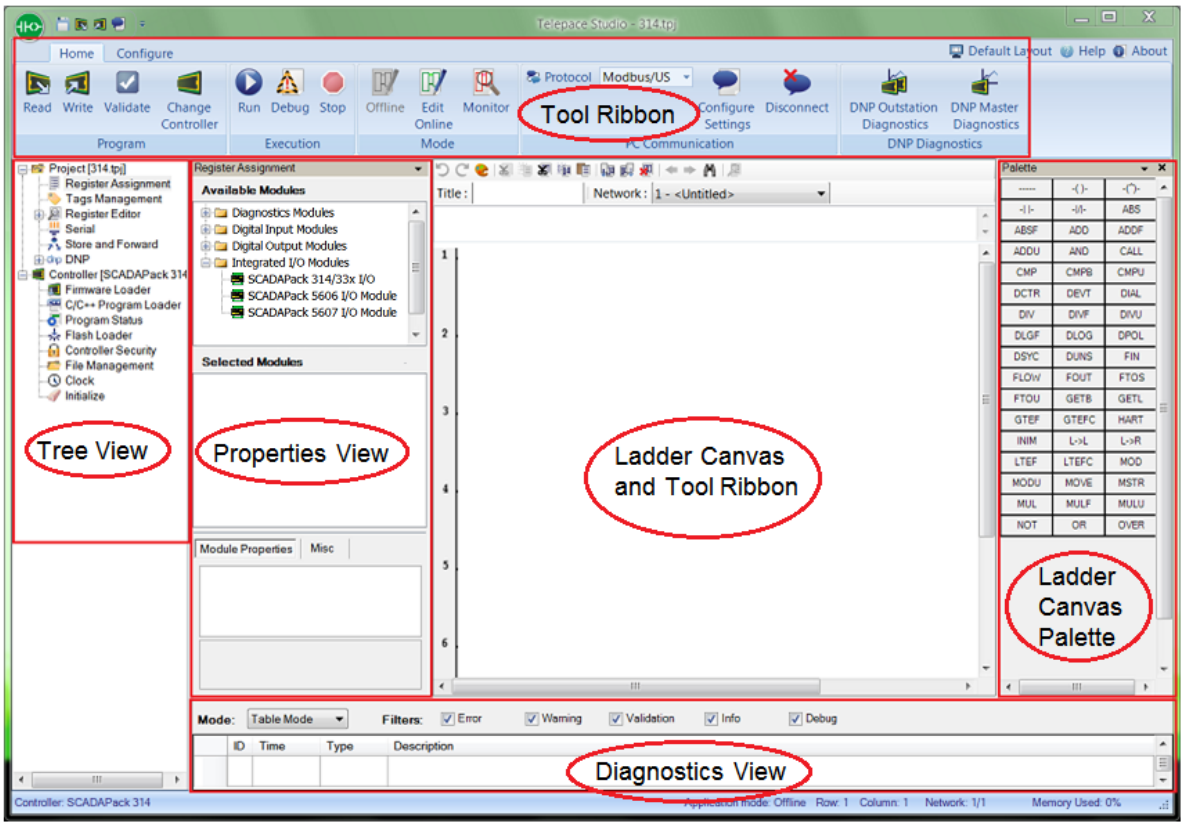
For more information, see the SCADAPack Workbench documentation.

11.2 Telepace Studio

Telepace Studio provides a graphical user interface for developing, debugging, monitoring and documenting ladder logic programs that will control the operation of the I/O module.

The Register Assignments for the inputs and outputs are found in **Properties View > Integrated I/O Modules > SCADAPack xxxx I/O Module**, where **xxxx** represents the number of the I/O module.

The figure below outlines the key areas in the Telepace Studio user interface.



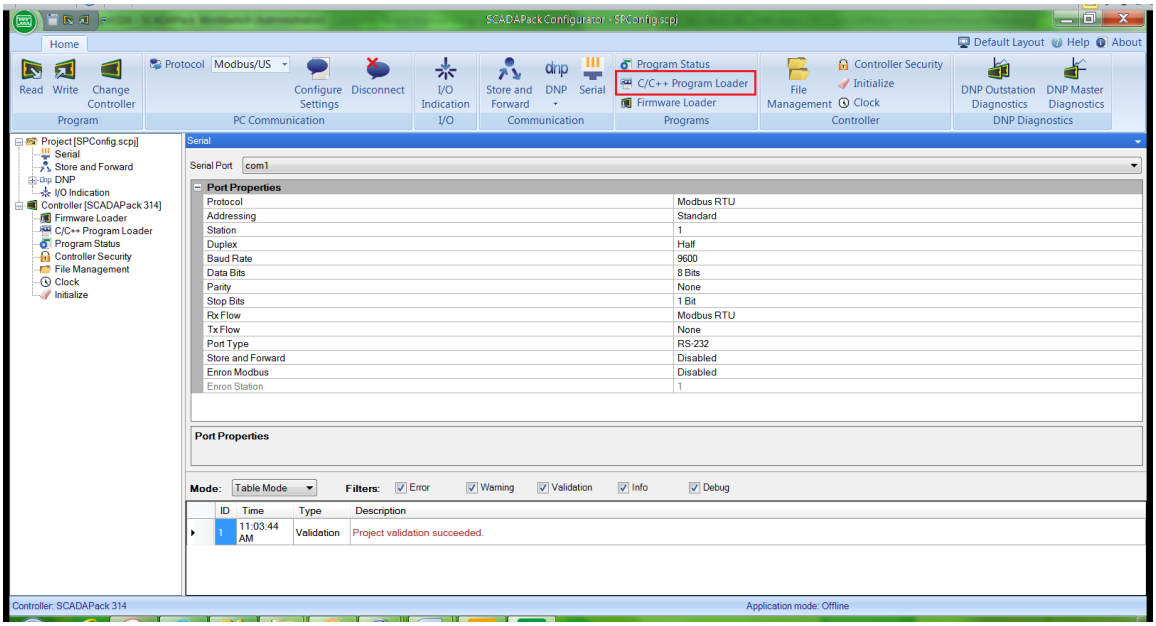
- The tool ribbon contains two tabs, each containing a number of program groups. These groups contain commands for configuring parameters used in a ladder logic program.
- The tree view provides a listing of the configuration parameters used in ladder logic applications. These parameters are the same as those selectable from the tool ribbon.
- The properties view is used to edit the parameters for inputs and outputs via the tool ribbon, tree view commands or ladder logic function blocks.
- The ladder canvas and tool ribbon contains commands used to create and edit a ladder logic program.
- The ladder canvas palette contains the function blocks available for a ladder logic program.

11.3 C and C++ Programs

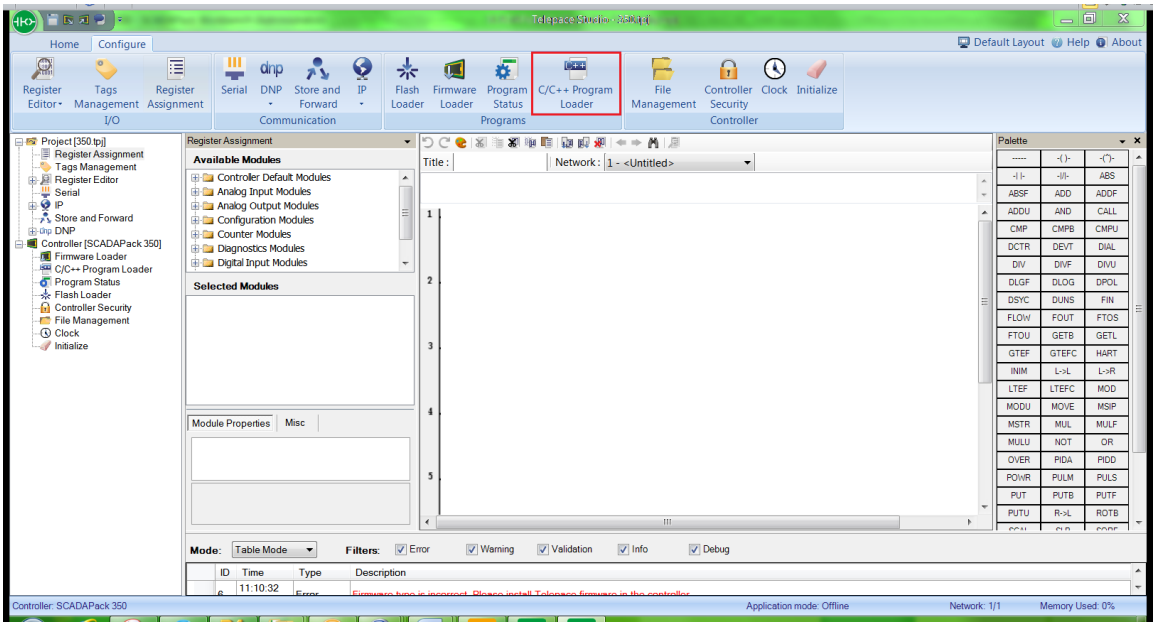
If you have created a program in C or C++, you can load the program into your RTU using either SCADAPack Configurator or Telepace Studio.

To access the C/C++ Program Loader:

- In SCADAPack Configurator, select **C/C++ Program Loader** from the **Home** ribbon, as shown below.



- In Telepace Studio, select **C/C++ Program Loader** from the **Configure** ribbon, as shown below.



Use the C/C++ functions to configure the inputs, outputs (where available) and power management features as shown in the table below.

Inputs/Outputs	Function
Analog or digital inputs	ioRead5607Inputs
Analog or digital outputs	ioRead5607Outputs
Internal Analog Inputs:	
Controller input voltage	readInputVoltage
Controller board temperature	readThermistor
Controller RAM battery voltage	readBattery
Counter inputs	ioReadCounterSP2
Power Management Features	
LED power control	ledPower
Ethernet Disable control (where available)	getPowerMode and setPowerMode
USB Disable control	getPowerMode and setPowerMode
Reduced power mode	getPowerMode and setPowerMode
Sleep mode	sleepMode

11.4 Power Management Features

Your SCADAPack 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 131

COM3 Serial Port Power Control 131

LED Power Control 132

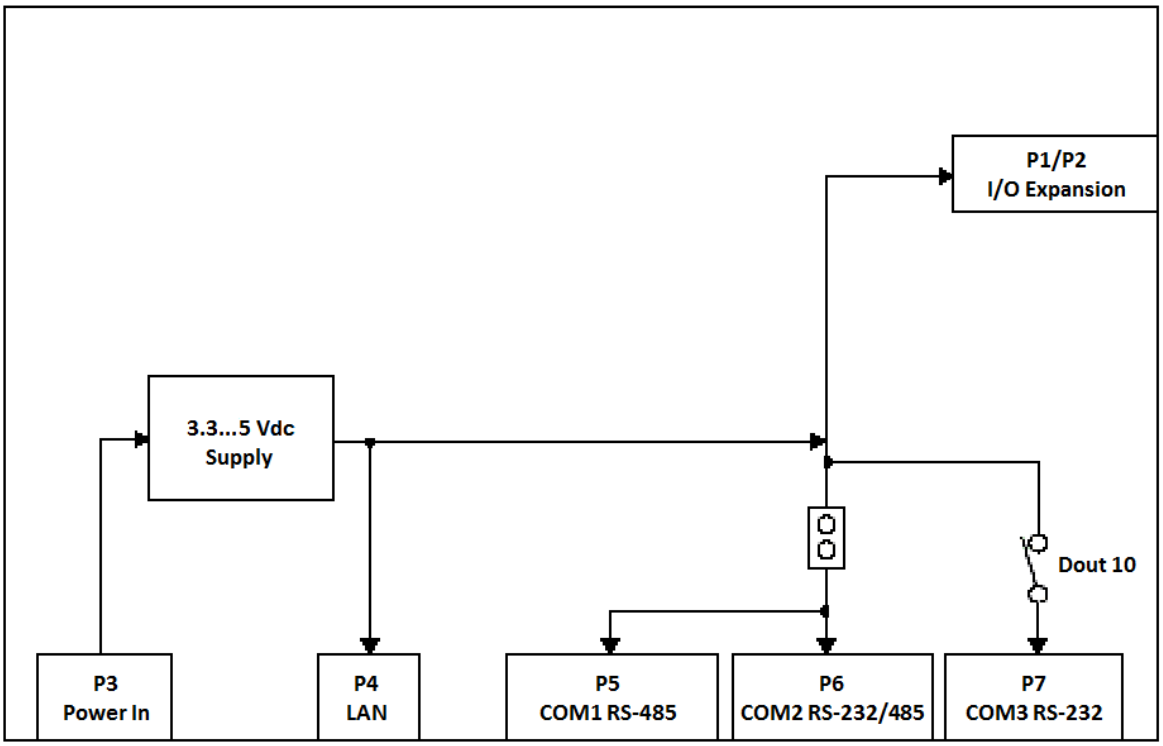
Ethernet Disable Control 132

USB Disable Control 132

Reduced Power Mode 133

Sleep Mode 133

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 134 section, in the following topics:

Input Voltage 137

Ambient Temperature 137

RAM Battery Voltage 137

11.4.1 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.**

11.4.2 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.

To use the signals as DTR, DCD jumpers J11, J12 have their jumper links installed in position **Normal**.

To use the COM3 port with a Vision interface, jumpers J11, J12 jumper links are installed in position **Vision**.

Refer to Section COM3 RS-232 Serial Port 28 for information on COM3 and Section RS-232 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. This is provided for service and diagnostics. Refer to LED Power Control 132 for further information.
- When the LED power is disabled and internal **Digital Output 1** is **ON**, HMI power is turned on.
- When the LED power is disabled and internal **Digital Output 1** is **OFF**, HMI power is turned off.
- When the LED power is disabled, HMI power is turned on for five minutes when a momentary contact is made between pin 2 (DCD) and pin 3 (DTR) on the RJ-45 connector of COM3. This permits the SCADAPack Vision or an HMI pushbutton to control HMI power. At each momentary contact, the five-minute power timer is reloaded. If the five-minute power timer is maintaining the HMI power on, a momentary contact between DCD and DTR will turn off HMI power.

Internal **Digital Input 0** indicates the status of COM3 serial port power. **Digital Input 0** is set when COM3 serial port power is on and is cleared when COM3 serial port power is off.

11.4.3 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 on the controller indicates the LED power state. It is on when LED power is enabled.

The **LED POWER** push-button toggles the LED power signal. Press the **LED POWER** push-button to toggle LED power from off to on, or from on to off.

The application program sets the default state of the LED power. The LED power returns to the default state 5 minutes after the **LED POWER** push-button is last pressed. The application program may change the default time and state.

11.4.4 Ethernet Disable Control

The SCADAPack RTU can disable the Ethernet port to conserve power. By default the Ethernet port is enabled.

The Ethernet port is enabled or disabled by the application program.

11.4.5 USB Disable Control

The SCADAPack RTU can disable the USB ports to conserve power. By default the USB ports are enabled.

The USB ports are enabled or disabled by the application program.

USB power consumption will increase when a device is connected to the USB peripheral port. The power consumed by the USB downstream ports is a function of the devices connected.

11.4.6 Reduced Power Mode

A SCADAPack RTU is capable of lower power operation when in **Reduced Power Mode**. In **Reduced Power Mode** the following happens:

- The CPU runs at 12 MHz.
- The **Power Mode** LED blinks once a second to indicate this mode.

Entering Reduced Power mode

The RTU enters **Reduced Power** mode under control of the application program.

11.4.7 Sleep Mode

The SCADAPack RTU is capable of extremely low power operation when in **Sleep** mode. During **Sleep** mode the following happens:

- Application programs stop executing.
- The 5 Vdc power to the circuit of the controller is switched off.
- The 5 Vdc power to the I/O expansion bus is switched off.
- The three counter inputs on the controller board continue to function.
- The real-time clock continues to function.

In **Sleep** mode, the processor uses a very slow speed clock.

Entering Sleep mode

The RTU enters **Sleep** mode under control of the application program.

Exiting Sleep mode

The RTU wakes up from sleep mode under the following conditions:

- There is a hardware **RESET** caused by power removed and applied to the RTU.
- The **LED POWER** push-button is pressed.
- A real time clock wake event, defined by the application program, occurs.
- Any of the RTU counters rolls over. This occurs every 65536 pulses on each input.
- A device is connected to the USB peripheral port.

12 Diagnostics

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

- LEDs that indicate the status of RTU ports and communications
- Internal analog inputs that measure the controller input voltage, RTU ambient temperature and NV-RAM battery voltage

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

Status LED 135

LED Indicators 136

Input Voltage 137

Internal Temperature 137

RAM Battery Voltage 137

Counter Inputs 138

Digital Inputs 138

Digital Outputs 138

Analog Inputs 139

Analog Outputs 139

12.1 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.

The STAT LED blinks a binary sequence indicating codes. The sequences consist of long and short flashes, followed by an off delay of 1 second. The sequence then repeats. The sequence may be read as the Controller Status Code. A short flash indicates a binary zero. A long flash indicates a binary one. The least significant bit is output first. As few bits as possible are displayed; leading zeros are ignored. The application program defines the values of the codes.

The table below shows the meaning of the sequences.

Sequence	Controller Status Code
Off	0 = Normal
1 Long	1 = I/O Module Indication
1 Short, 1 Long	2 = Register Assignment Checksum Indication

I/O Module Indication

When the STAT LED flashes controller status code 1 (i.e. a long flash, once every second), one or more I/O modules is not communicating with the controller.

To correct do one of the following:

- Check that every module contained in the Register Assignment Table is connected to the controller. Check that the module address selected for each module agrees with the selection made in the Register Assignment Table.
- If a module is still suspect confirm the condition by removing the module from the Register Assignment Table. Write the changes to the controller. Check if the STAT LED has stopped flashing.
- If a module is currently not connected to the controller, delete it from the Register Assignment Table. Write the changes to the controller. Check if the STAT LED has stopped flashing.
- If unused modules are intentionally left in the Register Assignment Table, the I/O indication may be disabled from a selection box on the Register Assignment dialog.

Register Assignment Checksum Indication

When the STAT LED flashes controller status code 2 (i.e. a short flash then a long flash followed by a 1 second delay), this indicates the register assignment is not valid.

To correct this, initialize the register assignment from the Telepace Studio software, or alternatively, perform a Cold Boot as described in the Cold Boot Mode 117 section of this manual. Check if the STAT LED has stopped flashing.

12.2 LED Indicators

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

LED	Function
Power Mode	On when in **Normal** mode Off and blinks once per second when in **Reduced Power** mode Off when in **Sleep** mode
RUN	On when the ladder logic program is executing
STAT	Blinking when there is a status code present
FORCE	On when I/O points are forced
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

12.3 Input Voltage

The controller input voltage provides useful information about the power input to the controller, such as if a battery back-up system is functioning correctly. The reading returned from this input is typically in the range from 11000 to 30000 representing the input supply in millivolts. The input supply voltage resolution is 100 millivolts.

12.4 Internal Temperature

Internal analog points measure the RTU ambient temperature. These can be accessed from a user application program or via remote RTU communications.

Internal Temperature °C

This system analog 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.

Internal Temperature °F

This system analog 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.

12.5 RAM Battery Voltage

The lithium battery internal analog input measures the voltage of the battery that maintains the non-volatile RAM in the controller. The reading returned from this input is in the range from 0...5000 representing the battery voltage in mV. It is useful in determining if the battery needs replacement. The 3.6 Vdc lithium battery will return a typical value of 3500...3700. A reading of less than 3000 (3.0 Vdc) indicates that the lithium battery requires replacement.

12.6 Counter 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 counter input range. Check the LEDs are turned on.

12.7 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
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

12.8 Digital Outputs

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

12.9 Analog Inputs

Condition	Action
20 mA inputs read 0	Check transmitter power
Reading is at or near 0 for every input signals	Check if the input transient suppressers 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 105
Other devices are not functional after installation of the module	In Current Loop mode, the device must be the last device in the loop, or use a signal isolator as discussed in the section, Configuring Analog Inputs as Current Inputs 105

12.10 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 and should be changing	Check that the analog outputs are not forced

13 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 147 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 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 141

Preventive Maintenance 142

Routine Maintenance 144

Replacing the Battery 147

Updating Firmware 150

Fuses 151

13.1 Calibration

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

There are no user calibration procedures.

13.2 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
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 simple 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.**

13.3 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

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 simple 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.

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.

NOTICE
DATA LOSS 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.

Routine Maintenance Schedule

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

13.4 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 144 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 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 is disconnected, as required in the procedure below.
- The RTU is started in Factory Boot mode or in Cold Boot mode. Staring 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.

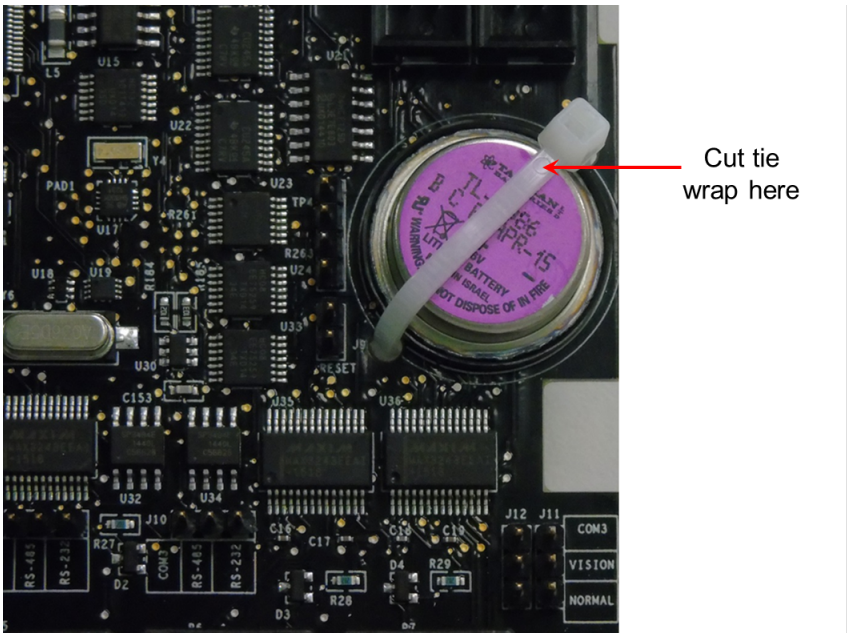
> **⚠WARNING**
>
> **UNINTENDED EQUIPMENT OPERATION**
>
> Evaluate the operational state of the equipment being monitored or controlled by the RTU before removing power.
>
> **Failure to follow these instructions can result in death or serious injury.**

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 simple 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 STAT LED begins blinking on and off.
10. Reload the RTU configuration and user-created applications from back-up.

13.5 Updating Firmware

You can update the firmware on your SCADAPack RTU using SCADAPack Configurator or Telepace Studio.

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.**

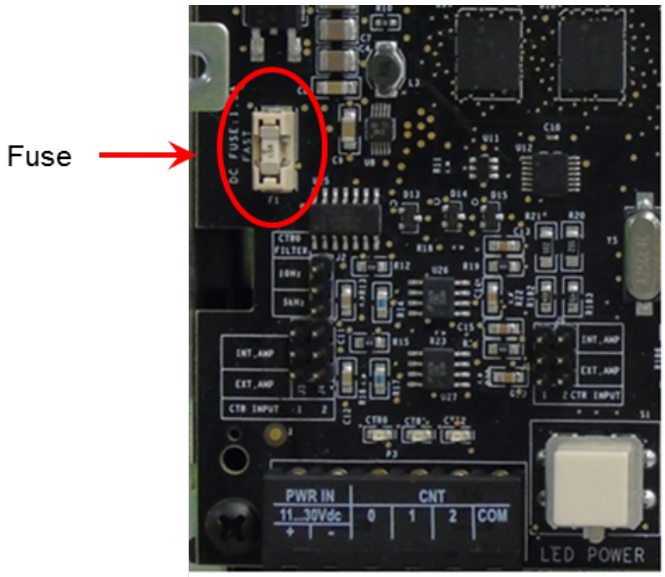
To update firmware

1. First verify that your PC is connected to a valid port on the RTU.
2. Then, in SCADAPack Configurator or in Telepace Studio, click on **Firmware Loader**.
3. In the **Firmware Loader** page, click **Update Firmware**.

For more information about updating firmware, see the Configurator User Manual or the Telepace Studio User and Reference Manual.

13.6 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 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.

14 Specifications

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

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14.1 General

Terminations	5, 6 and 9-pin, removable terminal blocks 3.3...0.08 mm² (12...28 AWG) 15 A contacts Screw termination - 0.51 Nm (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 ºC (–40...158 ºF) operation –40...85 ºC (–40...185 ºF) storage

14.2 Power Supply

Power required at 12 Vdc (Relays, Ethernet, LEDs and USB Host active, Normal Clock Mode)	4.0 W
Power required at 24 Vdc (Relays, Ethernet, LEDs and USB Host active, Normal Clock Mode)	4.5 W
5 Vdc current available for I/O expansion	500 mA
Maximum power consumption with maximum I/O expansion	7.7 W

14.3 Controller Board

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 Analog Points 137
Input Voltage Monitor	Measurement range 11000...30000 mV

14.4 Serial Ports

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 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
Transient Protection	COM1, COM2 and COM3: 2.5 kV surge withstand capability as per ANSI/IEEE C37.90.1-1989
Isolation	Common ground return connected to Chassis Ground.
Cable Length	RS232 – maximum 3 m (10 ft) RS485 – maximum 1200 m (4000 ft)
Protocol	TeleBUS (compatible with Modbus RTU and Modbus ASCII) DF1 or DNP
Protocol Modes	Slave, master, master/slave, store and forward

14.5 Ethernet Port

Terminations	RJ45 modular connector 10Base-T/100Base-T (twisted pair) 10/100 Mbits per second
Maximum Server Connections	20
Protocols Supported	Modbus/TCP Modbus RTU in UDP Modbus ASCII in UDP DNP in TCP DNP in UDP FTP

14.6 USB Ports

Port	USB Host: One Port "A" connector with 5 V/100 mA capacity USB Peripheral: One Port "B" connector
Speed	USB 2.0 compliant 1.5 Mb/s 12 Mb/s

14.7 Visual Indicators

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
LED POWER button	LED power toggle and operating mode selector	

14.8 Counter Inputs

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 Wetting current typically 5 mA 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 2.5 Vdc turn off input voltage below 1 KHz Greater than 3.5 Vdc turn off input voltage above 1 KHz
Isolation	Common ground return connected to chassis ground

14.9 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 Logic-HI Level	OFF to ON transition threshold is typically 6.5 Vdc	
Input Voltage	Off – To – On 6.5 Vdc +/- 0.5 Vdc	On – To – Off 6.5 Vdc +/- 0.5 Vdc
Response Time @ 50 Hz @ 60 Hz	Off – To – On 15...19 ms 13.5...18 ms	On – To – Off 25...29 ms 23...28 ms
Isolation	Isolation is in 2 groups of 8 Isolation from logic supply and chassis: 250 Vac/1000 Vdc	

14.10 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 the Digital Output Wiring Example 99 topic 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) Chassis to contact: 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 (resistive) 12 A maximum per common
Switching Capacity	5 A, 30 Vdc (150 W resistive)
Service Life	2×10^7 mechanical 1×10^5 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

14.11 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 ºF) ±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

14.12 Analog Outputs

Quantity	2 with optional analog output 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 ±0.15% of full scale at 25 ºC (77 ºF) ±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 I/O expansion modules Typical: 18...27 ms
Response time (D/A to signal)	Less than 10 µs for 10% to 90% signal change
Isolation	Isolation from logic supply and chassis

15 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. UL listed and CSA certified to the following standards: • 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 Mark Declaration	This product conforms to the above Emissions and Immunity Standards and therefore conforms with the requirements of Council Directive 2014/30/EU (as amended) relating to electromagnetic compatibility and is eligible to bear the CE mark. The Low Voltage Directive 2014/35/EU is not applicable to this product when installed according to our specifications.

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